



บรรณานุกรม

ภาษาไทย

ก่อเกียรติ เก่งสกุล และ บุญเจริญ ศิริเนาวกุล. ทฤษฎีและการประยุกต์ใช้งานปัญญาประดิษฐ์ และระบบผู้เชี่ยวชาญ. กรุงเทพมหานคร: สำนักพิมพ์ซีไอเอสเคชั่น, 2534.

ธวัชชัย จันทร์คง. การพัฒนาเปลือกกระบบผู้เชี่ยวชาญให้คำปรึกษาแบบแบล็คบอร์ดเพื่อการวินิจฉัยระบบเครื่องกล. วิทยานิพนธ์ปริญญามหาบัณฑิต จุฬาลงกรณ์มหาวิทยาลัย, 2534.

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הנאמנות

ภาคผนวก ก

โปรแกรมของระบบผู้เชี่ยวชาญที่ทำการวิจัย

```
/* Expert system shell with automobile troubleshooting */
```

```
code = 4000
```

```
DOMAINS
```

```
INSP = INNO*
```

```
COND = BNO*
```

```
RECO = RENO*
```

```
HIST = RNO*
```

```
RNO, BNO, FNO, RENO, INNO = INTEGER
```

```
CATE = STRING
```

```
data_file = string
```

```
file = save_file
```

```
slist = string*
```

```
flist = string*
```

```
flist1 = string*
```

```
plist = string*
```

```
nlist = integer*
```

```
DATABASE -rulebase
```

```
symptom(RNO,CATE,CATE,CATE,RECO,COND,INSP,data_file)
```

```
inspec(INNO,STRING)
```

```
cause(BNO,STRING)
```

```
rec(RENO,STRING)
```

```
data_file(data_file)
```

DATABASE '-dynabase

accum (STRING)
accum1 (INTEGER)
accum3 (INTEGER)
accum5 (STRING)
accum6 (STRING)
accum8 (INTEGER)
accum11 (INTEGER)
accum16 (INTEGER)
accum17 (INTEGER)
accum29 (STRING)
accum30 (STRING)
accum34 (STRING)

DATABASE -dynabase1

accum7 (STRING)
accum12 (INTEGER)
accum31 (INTEGER)
accum32 (INTEGER)

DATABASE -dynabase2

accum9 (STRING)
accum10 (STRING)

DATABASE -dynabase3

accum13 (STRING)
accum14 (STRING)
accum15 (STRING)
accum33 (STRING)

```
include "tdoms.pro"  
include "tpreds.pro"  
include "longmenu.pro"  
include "smenu2.pro"  
include "linemenu.pro"
```

PREDICATES

```
/*Commands*/
```

```
title_go  
update  
update1  
update2  
edit_kb  
list  
print  
screen  
changedir  
llist(HIST,string)  
load_know  
save_know  
pick_dba(data_file)  
use_file(data_file)  
erase  
erase1  
erase2  
erase3  
proces(integer)  
proces1(integer)
```

choice(integer)
choice1(string)
choice2(integer)
endd(integer)
run
start
xinspect
answer
canswer
unable
otherp
otherc
otherc1
noques
endcon
wna
wna1
ans
anc
ckey
lkey(char)
lkey1(char)
reverse(COND, COND)
reverse1(COND, COND, COND)
reverse2(INSP, INSP)
reverse3(INSP, INSP, INSP)
reverse4(RECO, RECO)
reverse5(RECO, RECO, RECO)
unique(StringList, StringList)


```
un(StringList, StringList, StringList)
```

```
dele(string, StringList, StringList)
```

```
/*Inferences mechanisms*/
```

```
title_go1
```

```
title_go2
```

```
process(integer, integer)
```

```
process1(char)
```

```
process2(char)
```

```
process3(char)
```

```
process4(char)
```

```
process5(char)
```

```
process6(char)
```

```
process7(char)
```

```
process8(char)
```

```
process9(char)
```

```
process10(char)
```

```
process11(char)
```

```
response(char)
```

```
last(flist, symbol)
```

```
last1(nlist, integer)
```

```
show_sym(nlist)
```

```
show_con(COND)
```

```
show_con1(COND)
```

```
show_rec(RECO)
```

```
show_rec1(RECO)
```

```
show_why(INSP)
```

```
show_why1(COND)
```

```
show_file(data_file)
```

show_file1(data_file)
show_inspec(nlist)
show_insp1(INSP)
show_print(STRINGLIST)
show_print1(STRINGLIST)
show_ans(integer)
check_sym(CATE,plist)
check_insp(INSP)
check_insp1(INSP)
check(STRING,STRINGLIST)
com(integer,integer,integer)
comp(STRING,STRING)
comp3(CATE,STRING)
unique1(nlist,nlist)
unique2(plist,plist)
un1(nlist,nlist,nlist)
un2(plist,plist,plist)
rev(nlist,nlist)
rev1(STRINGLIST,STRINGLIST)
check_pos4(string,STRINGLIST,integer)
new_list(nlist,nlist,nlist)
new_list1(plist,plist,plist)
dele1(integer,nlist,nlist)
dele2(string,plist,plist)
number(nlist,integer,integer)
number1(plist,integer,integer)
number2(INSP,integer,integer)
number3(COND,integer,integer)
buildlist(string,STRINGLIST)

/*Explanations*/

sub_cat(CATE, CATE, CATE)
show_inst(INSP, string)
show_cont(COND, string)
show_recd(RECO, string)
show_rule(RNO, string)
show_inspt(INNO, string)
show_cond(BNO, string)
show_reco(RENO, string)
quest(CATE, integer, integer, CATE)

/*Update the knowledge : topict(string) */

getrnr(RNO, RNO)
getbnr(BNO, BNO)
getcnr(RENO, RENO)
getdnr(INNO, INNO)
readcon(COND)
readrec(RECO)
readinsp(INSP)
help
getcond(BNO, STRING)
getrec(RENO, STRING)
getinspec(INNO, STRING)
save_y(char, string, data_file)
append(STRINGLIST, STRINGLIST, STRINGLIST)
spec
change(STRING, STRING)
countstrs(STRING, STRING, STRING, STRING)
limitlen(STRING, STRING)


```

run :- retractall(_,dynabase3),disk(DISK1),
assert(accum33(DISK1),dynabase3),repeat,
shiftwindow(7),clearwindow,shiftwindow(4),clearwindow,
write("    Select option with Arrow Key or press letter 'u'
      to 'j' for that Menu"),
menu(4,21,15,95,["A. Select Knowledge Base",
                 "B. Start Consultation",
                 "C. Inspect Knowledge Base",
                 "D. Create Or Update Knowledge Base ",
                 "E. Erase Knowledge Base in memory",
                 "F. Edit Knowledge Base",
                 "G. Help Information",
                 "H. Change Knowledge Base Directory",
                 "I. Exit To DOS Shell",
                 "J. Exit Expert System"],
     "Select A Main Menu Item",1,CHOICE),
proces(CHOICE),endd(CHOICE),!.

```

```

/*Process Choice*/

```

```

proces(0):-exit.
proces(1):-load_know.
proces(2):-title_go.
proces(3):-list.
proces(4):-update.
proces(5):-erase.
proces(6):-edit_kb.
proces(7):-help.
proces(8):-changedir.
proces(9):-system("").
proces(10).

```

```

endd(0).
endd(10):-
    shiftwindow(7),clearwindow,shiftwindow(4),clearwindow,
    write("\t\t\t Please press 'y' or 'n'"),
    makewindow(11,116,27,"EXIT EXPERT SYSTEM",8,20,5,40),
    clearwindow,write("\n\tAre you sure (y/n)?"),ckey,erase2,
    removewindow(11,1),removewindow(13,1),removewindow(1,1),
    removewindow(4,1),clearwindow,exit.

/***** Inference mechanism *****/
title_go:-
    assert(accum14("\n\t ##### The details of consultation #####
\n"),dynabase3),title_go1.

title_go1:- retractall(accum31(_),dynabase1), /* ## 1 ## */
    retractall(accum17(_),dynabase),
    findall(Y1,accum7(Y1),MY),last(MY,Z),
    findall(YX,symptom(_,-,-,YX,-,-,-),XZ),
    number1(XZ,RZ,0),dele2(Z,XZ,YZ),number1(YZ,ZR,0),
    RZ <> ZR,check_sym(Z,XZ),title_go2.

title_go1:- removewindow(14,1),removewindow(1,1),removewindow(6,1),
    shiftwindow(7),clearwindow,shiftwindow(4),clearwindow,
    write("\t\t Use ARROW KEY to find Option and Press ENTER to
select"),
    findall(X,symptom(_,-,-,X,-,-,-),Sym),
    unique(Sym,Syp),rev1(Syp,Symp),
    longmenu(2,3,20,15,95,Symp,"Select A Problem : ",1,C),
    choice(C).

```

choice(Y):-

```

findall(X,symptom(---,X,---,---),Sym),
unique(Sym,Smp),rev1(Smp,Syt),check_pos4(Mgoal,Syt,Y),
choice1(Mgoal).

```

choice1(Mgoal) :- /* For link any problem file */

```

clearwindow,symptom(---,MM,Mgoal,---,---,FILE),MM = " ",
retractall(---,rulebase),use_file(FILE),consult(FILE,rulebase),
title_go1.

```

choice1(Mgoal) :-

```

findall(YX,symptom(---,YX,---,---),XZ),
check_sym(Mgoal,XZ),removewindow(20,1),removewindow(6,1),
removewindow(14,1),
makewindow(14,14,26,"DISPLAY THE PROCEDURE OF CONSULTATION",
           0,0,4,80,1,-1,"\201\187\204\185\205\186"),
write(" Your problem is \n ",Mgoal,"").",
concat("=> Your problem is \n   ",Mgoal,DT),
concat(DT,".\n-----",DX),
concat(DX,"\n=> You answered these question is/are",MN),
assert(accum14(DX),dynabase3),assert(accum10(MN),dynabase2),
makewindow(6,14,26,"",3,0,19,80,1,-1,
           "\204\185\200\188\205\186"),
write(" Answer Questions by using CURSOR KEY and press ENTER
      to select. "),
write("\n----- "),
title_go2.

```

title_go2:-

```
findall(XA,accum31(XA),XCL),unique1(XCL,XCR),rev(XCR,XC),
show_sym(XC),clearwindow,endcon.
```

/* ##### Symptoms management ##### */

show_sym([]):- /* answer yes one and other no in a symptom */

```
findall(AB,accum11(AB),AC),AC = [],
findall(DD,accum3(DD),AD),AD = [],retractall(_,dynabase),
findall(AA,accum12(AA),BB),last1(BB,BA),
symptom(BA,_,_,_,_,_,FI),show_file(FI),wna1,
response(Ans3),process3(Ans3).
```

show_sym([]):- /* answer all yes */

```
findall(AB,accum11(AB),AC),AC = [],
findall(XX,accum(XX),YY),number1(YY,HHI,0),HHI <> 0,
findall(AA,accum12(AA),BB),last1(BB,BA),
symptom(BA,_,_,_,_,_,FI),show_file1(FI).
```

show_sym([]):- /* answer yes and no or all no */

```
findall(WW,accum11(WW),WJ),number(WJ,WN,0),WN <>0,
findall(VAN,accum12(VAN),VN),last1(VN,WA),
symptom(WA,_,_,_,_,CON,_,FI),number3(CON,CC,0),CC <> 0,
show_file(FI),removewindow(18,1),write("\n\n\n\n\n"),unable.
```

show_sym([]):- /* answer yes and no or all no to find system of
problem */

```
findall(WW,accum11(WW),WJ),number(WJ,WN,0),WN <>0,
findall(VAN,accum12(VAN),VN),last1(VN,WA),
symptom(WA,_,_,_,_,CON,_,_),CON = [],write("\n\n\n\n\n"),
unable.
```




```
show_sym([FXC!LXC]):-
    retractall(accum1(_),dynabase),removewindow(35,1),
    number(LXC,LX,0),assert(accum32(LX),dynabase1),
    symptom(FXC,--,Mgl,--,INS,_),asserta(accum7(Mgl),dynabase1),
    assert(accum8(FXC),dynabase),assert(accum12(FXC),dynabase1),
    assert(accum14("\n\n=> You answered these question is/are"),
        dynabase3),
    check_insp(INS),check_insp1(INS),findall(XB,accum17(XB),INP),
    retractall(accum3(_),dynabase),show_inspec(INP),
    retractall(accum17(_),dynabase),show_sym(LXC).

/* ##### Inspections management ##### */
show_inspec([]) :- /* For linked from name of problems file (file have
                    no REC,CON,and INSPEC) */
    findall(VEE,accum12(VEE),NA),last1(NA,YU),
    symptom(YU,--,REC,CON,INP,FI),REC = [],CON = [],INP = [],
    retractall(_,rulebase),use_file(FI),
    consult(FI,rulebase),title_go1.

show_inspec([]):- /* For find system of problem */
    findall(CU,accum11(CU),CP),CP = [],
    findall(CX,accum(CX),CD),number1(CD,DX,0),DX <> 0,
    findall(XX,accum12(XX),YY),last1(YY,ZZ),
    symptom(ZZ,--,REC,CON,INP,FI),number2(INP,NN,0),NN <> 0,
    REC = [],CON = [],FI <> "",retractall(_,rulebase),
    retractall(_,dynabase),use_file(FI),consult(FI,rulebase),
    title_go1.
```

```

show_inspec([]):- /* For pass symptom have not CON,REC,FILINK */
    findall(CU,accum11(CU),CP),CP = [],
    findall(CX,accum(CX),CD),number1(CD,DX,0),DX <> 0,
    findall(XX,accum12(XX),YY),last1(YY,ZZ),
    symptom(ZZ,_,_,_,REC,CON,INP,FI),number2(INP,NN,0),NN <> 0,
    REC = [], CON = [],FI = "".

show_inspec([]):-/* Ask problem with answer questions all yes again */
    findall(WN,accum17(WN),UN),UN =[],
    findall(CX,accum11(CX),CC),CC = [],
    findall(VU,accum12(VU),NU),last1(NU,AW),
    symptom(AW,_,_,_,_,_,IP,_),number2(IP,FR,0),FR <> 0,
    xinspec,canswer,sanswer.

show_inspec([]):-/* symptom has all yes answered */
    findall(CU,accum11(CU),CP),CP = [],removewindow(20,1),xinspec,
    write("\n-----"),
    write("\n\n\t===> The probable cause(s) of this problem can be
        obtained. <==="),sanswer.

show_inspec([]):- /* symptom has no INSPEC (No question) */
    findall(CU,accum(CU),CP),CP = [],
    findall(CX,accum11(CX),CD),CD = [],
    findall(XX,accum12(XX),YY),last1(YY,ZZ),
    symptom(ZZ,_,_,_,_,INP,_),INP = [],
    write("\n\n\t===> The probable cause(s) of this problem can
        be obtained. <==="),sanswer.

show_inspec([]):- /* For answers are yes and no . */
    findall(WN,accum11(WN),NW),number(NW,NP,0),NP <> 0.

show_inspec([]):- /* For LINSPEC = [] for inspec answer "no" */
    findall(XX,accum11(XX),YY),YY = [],
    findall(AA,accum(AA),BB),BB = [].

```

```
show_inspec([]):-/* For last symptom has file link and answer
                all yes */
```

```
    findall(CU,accum11(CU),CP),CP = [],removewindow(20,1),
    findall(CX,accum15(CX),CD),number1(CD,DX,0),DX <> 0,
    findall(VU,accum12(VU),NU),last1(NU,AW),
    symptom(AW,--,--,--,--,IP,ZR),ZR <> "",
    retractall(accum29(_),dynabase),
    show_why(IP),
    findall(XD,accum29(XD),AS),
    new_list1(CD,AS,DR),
    unique2(DR,RE),number1(RE,EX,0),
    DX <> EX,
    show_file(ZR).
```

```
show_inspec([FINP:LINP]):- /* For pass symptom when it has inspection
                            answered "no" */
```

```
    inspec(FINP,_),
    findall(PB,accum13(PB),PC),number1(PC,DX,0), DX <> 0,
    findall(VU,accum12(VU),NU),last1(NU,AW),
    symptom(AW,--,--,--,--,IP,_),retractall(accum29(_),dynabase),
    show_why(IP),findall(PD,accum29(PD),PS),new_list1(PC,PS,PR),
    number1(PR,PW,0),unique2(PR,PE),number1(PE,PX,0),PW <> PX,
    show_inspec(LINP).
```

```
show_inspec([FINP:LINP]):-
```

```
    retractall(accum11(_),dynabase),inspec(FINP,INSP),
    write("\n=> Is it true that \n\t ",INSP," ?:-"),
    linemenu(22,15,10,["A.Yes  ", "B.No  ", "C.Why  ", "D.Review"],
    Reply),
    process(FINP,Reply),!,show_inspec(LINP).
```

```
/* ===== */
```

```
xinspect:-
```

```
findall(CX,accum15(CX),CD),number1(CD,DX,0),DX <> 0,
findall(VU,accum12(VU),NU),last1(NU,AW),
symptom(AW,--,--,--,CN,IP,-),number3(CN,HB,0),HB <> 0,
retractall(accum29(_),dynabase),show_why(IP),
findall(XD,accum29(XD),AS),new_list1(CD,AS,DR),
unique2(DR,RE),number1(RE,EX,0),DX = EX.
```

```
sanswer:-
```

```
makewindow(34,15,26,"",22,0,3,80),
write("\t< Press Any KEY to show the probable causes of
      this problem >"),readchar(_),
removewindow,findall(VU,accum12(VU),NU),last1(NU,AW),
symptom(AW,--,MM,--,RE,CN,--,_),clearwindow,
makewindow(39,15,0,"",4,1,17,78),
write(" Your problem come from ",MM),
write("\n The probable cause(s) of this problem :"),
write("\n-----"),
assert(accum14("\n==> The probable cause(s) of this
              problem :"),dynabase3),
show_con(CN),write("\n\n Recomendation(s) :"),
write("\n-----"),
assert(accum14("\n==>Recomendation(s) :"),dynabase3),
show_rec(RE).
```

answer:-'

```

findall(VU,accum12(VU),NU),last1(NU,AW),
symptom(AW,-----,IP,-),number2(IP,BN,0),BN <> 0,
retractall(_,dynabase),clearwindow,
write(" ==> You answered these questions already : <=="),
write("\n -----"),
show_insp1(IP),
write("\n\n\t==> The probable cause(s) of this problem can be
      obtained. <== " ).

```

/* ***** Conditions Management ***** */

show_con([]):- !.

show_con([FCND;LCND]):-

```

cause(FCND,CON),write("\n ", "* ",CON),
assert(accum6(CON),dynabase),concat("\n * ",CON,CO),
assert(accum14(CO),dynabase3),show_con(LCND).

```

show_insp1([]):-

```

write("\n-----").

```

show_insp1([FINS;LINS]):-

```

inspec(FINS,INN),concat(TTM," :is YES ",PDT),write(PDT),
assert(accum14(PDT),dynabase3),show_insp1(LINS).

```

show_con1([]).

show_con1([FCND;LCND]):-

```

cause(FCND,CON),write("\n * ",CON),show_con1(LCND).

```

```
/* ##### Recommendations Management ##### */
```

```
show_rec([]):-
```

```
    findall(DD,accum32(DD),DX),last1(DX,XD),show_ans(XD).
```

```
show_rec([FREC:LREC]):-
```

```
    rec(FREC,REC),concat("\n * ",REC,RC),
```

```
    assert(accum14(RC),dynabase3),write("\n * ",REC),
```

```
    show_rec(LREC).
```

```
show_rec1([]).
```

```
show_rec1([FREC:LREC]):-
```

```
    rec(FREC,REC),concat("\n* ",REC,RED),
```

```
    assert(accum34(RED),dynabase),show_rec1(LREC).
```

```
show_ans(0).
```

```
show_ans(XD):-
```

```
    XD <> 0,wna.
```

```
wna:- wna1,response(Ans3),removewindow(61,1),process5(Ans3).
```

```
wna1:- removewindow(35,1),
```

```
    makewindow(35,15,26,"",22,0,3,80), /* For answer obtained */
```

```
    write("\t\t\t < Press 'y' or 'n' >"),removewindow(61,1),
```

```
    makewindow(61,15,0,"",20,1,1,78),
```

```
    write("\t\t Do you want to know how the answer is obtained ?").
```

```
/* ##### Whys Management ##### */
```

```
show_why([]):-
```

```
    assert(accum34("\nConclusion for the cause of this problem
                  is/are"),dynabase).
```

```
show_why([FINS:LINS]):-
```

```
    inspec(FINS,IN),concat("\n* ",IN,INT),
    assert(accum29(IN),dynabase),assert(accum30(INT),dynabase),
    assert(accum34(INT),dynabase),show_why(LINS).
```

```
show_why1([]):-
```

```
    assert(accum30("\n\n If it has symptom :"),dynabase).
```

```
show_why1([FCON:LCON]):-
```

```
    cause(FCON,SCN),concat("\n* ",SCN,SCR),
    assert(accum30(SCR),dynabase),assert(accum34(SCR),dynabase),
    show_why1(LCON).
```

```
/* ##### Files Management ##### */
```

```
show_file("").
```

```
show_file(FI):-
```

```
    retractall(_,rulebase),use_file(FI),
    consult(FI,rulebase),title_go1.
```

```
show_file1(FI):-
```

```
    FI <> "",wna1,response(Ans3),process9(Ans3).
```

```
show_file1("").:-
```

```
    wna1,response(Ans3),process3(Ans3).
```

```

/* ##### Prevent redundant questioning ##### */
/* ### Check for repeated symptoms ### */
check_sym(_, []).
check_sym(My1, [FXZ; LXZ]) :-
    comp3(My1, FXZ), check_sym(My1, LXZ).

comp3(My1, FXZ) :-
    My1 = FXZ, symptom(A, _, _, FXZ, _, _, _, _),
    assert(accum31(A), dynabase1), fail.
comp3(_, _).

/* ### Check repeated inspections ### */
check_insp([]). /* Find element is repeated in list */
check_insp([FINS; LINS]) :-
    inspec(FINS, IN), findall(WD, accum15(WD), ND), check(IN, ND),
    check_insp(LINS).

check(_, []).
check(IN, [FND; LND]) :-
    comp(IN, FND), check(IN, LND).

comp(IN, FND) :-
    IN = FND, inspec(FIN, IN),
    assert(accum16(FIN), dynabase), fail.
comp(_, _).

```



```

check_insp1([]). /* Find element is not repeated in list */
check_insp1([FINS;LINS]):-
    findall(W,accum16(W),NL),
    number(NL,TX,0),dele1(FINS,NL,R),
    number(R,N,0),com(FINS,TX,N),
    check_insp1(LINS).

com(FINS,TX,N):- /* find number is not repeat in list for show
                question */
    TX = N,assert(accum17(FINS),dynabase),fail.
com(_,-,-).

check_pos4(P,[P;_],1).
check_pos4(P,[_;R],X):- !,
    N = X - 1,check_pos4(P,R,N).

/* ##### */
dele1(_,[],[]). /* cut out repeated element in integerlist */
dele1(H,[H;T],R):-!,
    dele1(H,T,R).
dele1(TO,[H;T],[H;R]):-!,
    dele1(TO,T,R).

dele2(_,[],[]). /* cut out repeated element in stringlist */
dele2(H,[H;T],R):-!,
    dele2(H,T,R).
dele2(TO,[H;T],[H;R]):-!,
    dele2(TO,T,R).

```

```

/* count element of list from dynamic database (from accum) */
number([],RS,RS).
number([_:TNL],RS,Cnt):-
    NCnt = Cnt + 1, number(TNL,RS,NCnt).

/* count element of list from stringlist */
number1([],RS,RS).
number1([_:TNL],RS,Cnt):-
    NCnt = Cnt + 1,number1(TNL,RS,NCnt).

/* count element of INSPECTIONS from rulebase */
number2([],RS,RS).
number2([_:TNL],RS,Cnt):-
    NCnt = Cnt + 1,number2(TNL,RS,NCnt).

/* count element of CONDITIONS from rulebase */
number3([],RS,RS).
number3([_:TNL],RS,Cnt):-
    NCnt = Cnt + 1,number3(TNL,RS,NCnt).

/* Remove duplicate elements and rearrange order from more to less
   in a list */
unique1([],[]). /* For integerlist */
unique1(RX,RY):-
    un1(RX,RY,[]).
un1([],RZ,RZ).
un1([RA:RB],RY,RZ):-
    dele1(RA,RB,RC),
    un1(RC,RY,[RA:RZ]),!.

```

```

unique2([],[]). /* For stringlist */
unique2(RX,RY):-
    un2(RX,RY,[]).

un2([],RZ,RZ).
un2([RA:RB],RY,RZ):-
    dele2(RA,RB,RC),un2(RC,RY,[RA:RZ]),!.

/* Rearrange order of element in a list from less to more */
rev1([],[]). /* For stringlist */
rev1([F:L],W):- !,
    rev1(L,TE),append(TE,[F],W).

rev([],[]). /* For integerlist */
rev([F:L],W):- !,
    rev(L,TE),new_list(TE,[F],W).

new_list([],NW,NW). /* List addition (append) for integerlist */
new_list([X:NW1],NW2,[X:NW3]):-
    new_list(NW1,NW2,NW3).

new_list1([],NW,NW). /* List addition (append) for stringlist */
new_list1([X:NW1],NW2,[X:NW3]):-
    new_list1(NW1,NW2,NW3).

/* ### Converts a list into a string ### */
buildlist("",[]):- !.
buildlist(Str,[First:Tail]):-
    free(Str),bound(First),buildlist(Rest,Tail),
    concat(First,Rest,Str).

```

```
/* ##### Answer Questions ##### */
```

```
process(FINP,1):-
```

```
    write(" yes "),inspec(FINP,INSP),
    assert(accum3(FINP),dynabase),concat("\n * ",INSP,AA),
    concat(AA," :is YES ",AB),assert(accum10(AB),dynabase2),
    assert(accum14(AB),dynabase3),!,
    assert(accum(INSP),dynabase),!,
    assert(accum15(INSP),dynabase3),!.
```

```
process(FINP,2):-
```

```
    write(" no "),inspec(FINP,INSP),
    retractall(accum1(_),dynabase),concat("\n * ",INSP,BA),
    concat(BA," :is NO ",BB),assert(accum10(BB),dynabase2),
    assert(accum14(BB),dynabase3),!,
    assert(accum1(FINP),dynabase),!,
    assert(accum13(INSP),dynabase3),!,
    assert(accum11(FINP),dynabase),!.
```

```
process(FINP,3):-
```

```
    retractall(accum30(_),dynabase),
    makewindow(37,14,26,"",21,0,4,80,1,-1,
               "\204\185\200\188\205\186"),
    write("\t * Use Cursor Key to find out why in next page "),
    write("\n\t   and press Esc to answer questions continue * "),
    makewindow(23,14,28,"Answer question when you ask Why ?.",
               4,2,17,76),
    findall(AB,accum12(AB),WAN),last1(WAN,PA),
    symptom(PA,_,MM,_,_,CON,INS,_),clearwindow,
    concat("\n * Your problem come from ",MM,MX),
    concat(MX," \n\n which its cause : ",MZ),
    assert(accum30(MZ),dynabase),show_why1(CON),show_why(INS),
```

```

findall(ASD,accum30(ASD),TP),unique(TP,TPA),rev1(TPA,TPI),
buildlist(Str,TPI),
concat("\n Because I try to show that :\n ",Str,Strn),
display(Strn),removewindow,removewindow(37,1),
linemenu(22,15,10,[" A.Yes  ","B.No  ","C.Why  ",
"D.Review" ],Reply),
process(FINP,Reply),!.

process(FINP,4):-
makewindow(37,14,26,"",21,0,4,80,1,-1,
"\204\185\200\188\205\186"),
write("\t * Use Cursor Key to return your answered in
next page"),
write("\n\t and press Esc to answer questions continue *"),
makewindow(26,14,28,"Review your answered",1,2,20,76),
findall(ASD,accum10(ASD),TP),unique(TP,TPA),rev1(TPA,TPI),
show_print1(TPI),findall(XX,accum5(XX),XY),buildlist(Strn,XY),
display(Strn),removewindow,removewindow(37,1),
linemenu(22,15,10,[" A.Yes  ","B.No  ","C.Why  ",
"D.Review" ],Reply),
process(FINP,Reply),!.

/* ===== */
process1('y'):-
erase1,removewindow(41,1),
print.

process1('n'):-
erase2,removewindow(41,1),
run. /* use run for go to main menu */

```

process2('y'):-

```
removewindow(40,1),retractall(_,dynabase),
findall(XX,accum12(XX),XY),last1(XY,Z1),
symptom(Z1,_,_,_,_,_,_,ZX),show_file(ZX).
```

process2('n'):-

```
removewindow(40,1),erase1,endcon.
```

process3('y'):-

```
screen,removewindow(6,1),removewindow(35,1),
removewindow(39,1),
makewindow(6,14,26,"",3,0,19,80,1,-1,
"\204\185\200\188\205\186"),
noques.
```

process3('n'):-

```
removewindow(39,1),retractall(_,dynabase),clearwindow,
noques.
```

process4('y'):-

```
retractall(_,dynabase),
findall(AX,accum12(AX),NW),last1(NW,WN),
symptom(WN,_,_,_,_,_,_,FILE),show_file(FILE).
```

process4('n'):- ans,makewindow(40,15,12,"",8,10,7,60),

```
write("\n\n\t Do you want to consult other problems ?"),
response(Ans),process2(Ans).
```

process5('y'):- screen,

```
removewindow(6,1),removewindow(35,1),removewindow(39,1),
makewindow(6,14,26,"",3,0,19,80,1,-1,
"\204\185\200\188\205\186"),otherc1.
```

process5('n'):-

```
removewindow(39,1),retractall(_,dynabase),
removewindow(22,1),clearwindow,otherc1.
```

process6('y'):-

```
write("'yes'"),
findall(AB,accum12(AB),WAN),last1(WAN,PA),
symptom(PA,FF,-----),
write("\n\n\t\t Your file name is '",FF,"'"),
removewindow(50,1),makewindow(50,15,26,"",22,0,3,80),
write("\t\t < Press any key to update knowledge base >"),
readchar(_),removewindow(6,1),removewindow(61,1),erase2,
removewindow(14,1),removewindow(40,1),removewindow(50,1),
update2.
```

process6('n'):-

```
erase3,removewindow(40,1),otherp.
```

process8('y'):-

```
removewindow(36,1),removewindow(6,1),
makewindow(6,14,26,"",3,0,19,80,1,-1,
"\204\185\200\188\205\186"),
write(" Answer Questions by using CURSOR KEY and
press ENTER to select."),
write("\n-----").
```

process8('n'):-

```
removewindow(36,1),
erase3,otherp.
```

process9('y'):-

```
screen,removewindow(6,1),removewindow(35,1),removewindow(39,1),
makewindow(6,14,26,"",3,0,19,80,1,-1,
          "\204\185\200\188\205\186"),
otherc.
```

process9('n'):-

```
removewindow(39,1),clearwindow,otherc.
```

process10('y'):-

```
removewindow(40,1),
erase3,retractall(accum13(_),dynabase3),
findall(XX,accum9(XX),XY),
last(XY,ZX),show_file(ZX).
```

process10('n'):-

```
removewindow(40,1),
erase1,endcon.
```

process11('y'):-

```
removewindow(36,1),removewindow(6,1),
makewindow(6,14,26,"",3,0,19,80,1,-1,
          "\204\185\200\188\205\186"),
write(" Answer Questions by using CURSOR KEY and
      press ENTER to select. "),
write("\n----- "),
retractall(_,dynabase),
findall(XX,accum12(XX),XY),last1(XY,Z1),
symptom(Z1,-,-,-,-,-,ZX),show_file(ZX).
```

process11('n'):-

```
removewindow(36,1),erase3,otherp.
```



```
/* %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% */
```

```
unable:-
```

```
    removewindow(35,1),
    makewindow(35,15,26,"",22,0,3,80),ans,
    makewindow(40,15,0,"",17,1,4,78),
    write("        Sorry,there is no recomendation /no more
          database for consultation."),
    write("\n\t\t Do you want to update my knowledge base ?:- "),
    response(Ans),process6(Ans).
```

```
otherp:- removewindow(6,1),
```

```
    makewindow(6,14,26,"",3,0,19,80,1,-1,
              "\204\185\200\188\205\186"),ans,
    makewindow(40,15,12,"",8,10,7,60),
    write("\n\n\t Do you want to consult other problems ?"),
    response(Ans),process10(Ans).
```

```
otherc:- ans,anc,
```

```
    response(Ans2),process11(Ans2).
```

```
otherc1:- ans,anc,
```

```
    response(Ans2),process8(Ans2).
```

```
noques:- ans,
```

```
    makewindow(40,15,12,"",7,7,11,65),
    write("\n\n\t        No question for this problem"),
    write("\n\n\t Do you want to update my knowledge base ?:- "),
    response(Ans),process6(Ans).
```



```
/* %%%%%%%%% Print Result Management %%%%%%%%% */
```

```
print:-
```

```
makewindow(27,15,12,"PRINT RESULT",1,3,20,74),clearwindow,
findall(XX,accum14(XX),YZR),show_print(YZR),
write("\n\n\n\t *** Detail of Consultation is Printed
      already ***"),
write("\n\t\t Do you want to print again ?"),!,
response(Ans),process1(Ans).
```

```
show_print([]). /* For print result to printer */
```

```
show_print([FYZ!LYZ]):-
```

```
writedevic(printer),write(FYZ),
writedevic(screen),write(FYZ),show_print(LYZ).
```

```
show_print1([]). /* For review answer */
```

```
show_print1([FYZ!LYZ]):-
```

```
assert(accum5(FYZ),dynabase),show_print1(LYZ).
```

```
/* %%%%%%%%% Show the answer is obtained to screen %%%%%%%%% */
```

```
screen:- retractall(_,dynabase),removewindow(22,1),
```

```
removewindow(35,1),removewindow(39,1),
```

```
makewindow(22,15,26,"",22,0,3,80),clearwindow,
```

```
write("\t\t\tPress Esc to continue"),
```

```
makewindow(28,14,15,"",1,2,20,76),clearwindow,
```

```
findall(AB,accum12(AB),WAN),last1(WAN,PA),
```

```
syptom(PA,_,MM,XX,REC,CON,INS,_),clearwindow,
```

```
concat(" When you ask problem : ",XX,MT),
```

```
concat(MT,"\nThen you accepted the symptom is/are ",NX),
```

```
assert(accum34(NX),dynabase),show_why(INS),show_why1(CON),
```

```

concat("\nwhich it is in ",MM,MN),
concat(MN,"\nRecomendation(s):",MX),
assert(accum34(MX),dynabase),show_rec1(REC),
findall(ASD,accum34(ASD),TP),unique(TP,TPA),rev1(TPA,TPI),
buildlist(Str,TPI),display(Str),removewindow,
removewindow(6,1).

```

```

/* %%%%%%%%%%%%%%% List Rules / Explanation Mechanism %%%%%%%%%%%%%%% */

```

```

list :- erase2,
pick_dba(Data),consult(Data,rulebase),
shiftwindow(4),clearwindow,
write("      Use ARROW KEY move cursor to next page: And Press
      Esc to Main Menu"),
makewindow(9,14,28,"INSPECT KNOWLEDGE BASE",0,0,23,80,1,-1,
          "\201\187\204\185\205\186"),
findall(RNO,symptom(RNO,-,-,-,-,-,-,-),LST),
llist(Lst,Str),!,display(Str),!.

```

```

llist([], "") :-!.

```

```

llist([RNO:List],Str):-

```

```

    llist(List,Oldstr),show_rule(RNO,RNO_Str),
    concat(RNO_Str,Oldstr,Str).

```

```

show_rule(RNO,Strg):-

```

```

    symptom(RNO,FI,MM,My1,RECM,CON,INSP,FILE),
str_int(RNO_str,RNO),concat("\t Symptom No. ",RNO_str,Am),
concat(Am,"\n\t -----",Ax),
concat(Ax,"\nFile name : ",Ar),concat(Ar,FI,An),
concat(An,"\nProblem from : ",An1),concat(An1,MM,Ans),

```

```

concat(Ans,"\\nProblem Name : ",Ans1),
concat(Ans1,Myl,Ans2),
concat(Ans2,"\\n\\nQuestion is/are\\n - ",Ans3),
reverse2(INSP,INS),show_inst(INS,ANT),
concat(Ans3,ANT,Ans4),
concat(Ans4,"\\n\\nCauso is/are\\n - ",Ans5),
reverse(CON,COND),show_cont(COND,CD),concat(Ans5,CD,Ans6),
concat(Ans6,"\\n\\nRecomendation is/are\\n - ",Ans7),
reverse4(RECM,REC),show_recd(REC,RE),concat(Ans7,RE,Ans8),
concat(Ans8,"\\n\\nFile conection : ",Ans9),
concat(Ans9,FILE,SS),concat(SS,"\\n\\n",Strg).

```

```

reverse(X,Y):-trace(off), /* For CONDITIONS List */
reverse1([],X,Y).

```

```

reverse1(Y,[],Y).
reverse1(X1,[U:X2],Y):-reverse1([U:X1],X2,Y),trace(on).

```

```

reverse2(X,Y):-trace(off), /* For INSPECTIONS List */
reverse3([],X,Y).

```

```

reverse3(Y,[],Y).
reverse3(X1,[U:X2],Y):-reverse3([U:X1],X2,Y),trace(on).

```

```

reverse4(X,Y):-trace(off), /* For RECOMENDS List */
reverse5([],X,Y).

```

```

reverse5(Y,[],Y).
reverse5(X1,[U:X2],Y):-reverse5([U:X1],X2,Y),trace(on).

```

```
show_inst([], " ").
```

```
show_inst([INS], ANS):-
```

```
    show_inspt(INS, ANS), !.
```

```
show_inst([INS|REST], ANS):-
```

```
    show_inspt(INS, Text), concat("\n - ", Text, Nstr),
```

```
    show_inst(REST, Next_ans), concat(Next_ans, Nstr, ANS).
```

```
show_inspt(INS, TEXT):-inspec(INS, TEXT).
```

```
show_cont([], "").
```

```
show_cont([COND], CD):-
```

```
    show_cond(COND, CD), !.
```

```
show_cont([COND|REST], CD):-
```

```
    show_cond(COND, Text), concat("\n - ", Text, Nstr),
```

```
    show_cont(REST, Next_ans), concat(Next_ans, Nstr, CD).
```

```
show_cond(COND, TEXT):-cause(COND, TEXT).
```

```
show_recd([], " ").
```

```
show_recd([REC], RE):- show_reco(REC, RE), !.
```

```
show_recd([REC|REST], RE):-
```

```
    show_reco(REC, Text), concat("\n - ", Text, Nstr),
```

```
    show_recd(REST, Next_ans), concat(Next_ans, Nstr, RE).
```

```
show_reco(REC, TEXT):-rec(REC, TEXT).
```

```
sub_cat(Mgl1, Mgl2, Lstr):-
```

```
    concat(Mgl1, " ", Str),
```

```
    concat(Str, Mgl2, Lstr).
```

```
/* %%%%%%%%%% EDIT KNOWLEDGE %%%%%%%%%% */
```

```
edit_kb :-
```

```
    erase2,pick_dba(Finame),file_str(Finame,Data),
    shiftwindow(4),clearwindow,
    write("\tress F10 to end editing or Esc to abort editing "),
    makewindow(10,15,28,"EDIT KNOWLEDGE BASE",0,0,23,80,1,-1,
              "\201\187\204\185\205\186"),
    edit(Data,NewData),clearwindow,
    makewindow(56,15,0,"",23,1,1,78),clearwindow,
    write("\n\t\t\t\t < Press 'y' or 'n'>"),
    makewindow(55,15,0,"",7,3,5,74),
    write("\n\t Do you want to save the Knowledge Base (y/n)? "),
    beep,beep,retractall(_),ckey,upper_lower('y',Ans1),
    save_y(Ans1,NewData,Finame),removewindow,removewindow(10,1),
    removewindow(56,1),erase2.
```

```
save_y('y',D,Finame):-
```

```
    openwrite(save_file,Finame),writedevise(save_file),
    write(D),closefile(save_file).
```

```
save_y('n',-,-).
```

```
/* %%%%%%%%%% HELP %%%%%%%%%% */
```

```
help :-
```

```
    file_str("expert.hlp",Hhelp),shiftwindow(4),clearwindow,
    write("        Use ARROW KEY move cursor to next page :
          And press Esc to Main Menu"),
    makewindow(12,15,28,"HELP INFORMATION",0,0,23,80,1,-1,
              "\201\187\204\185\205\186"),
    display(Hhelp).
```

```
/*User commands*/
```

```
load_know:-
```

```
    erase2,removewindow(1,1),use_file("Sysfile"),
    consult("Sysfile",rulebase),!,shiftwindow(4),clearwindow,
    write("    Select system with Arrow Key or press letter
          'a' to 'q' for that Menu"),
    findall(Y,symptom(_,-,-,_,Y,-,-,-,-),ZY),
    menu(2,20,15,95,ZY,"Automobile's system for you consult",
        1,CHD),
    choice2(CHD).
```

```
choice2(CHD):-
```

```
    symptom(CHD,-,-,-,-,-,FI),retractall(_,rulebase),
    use_file(FI),consult(FI,rulebase),
    asserta(accum9(FI),dynabase2).
```

```
save_know :- data_file(Data), bound(Data),!,
```

```
    save(Data,rulebase),clearwindow,shiftwindow(7),clearwindow,
    makewindow(18,116,79,"SAVE KNOWLEDGE BASE",8,5,6,70),
    clearwindow,
    writef("\n\t\tYour % Knowledge Base has been saved",Data),
    write("\n    < Please press any key to return to Create or
          Update Menu >"),
    readchar(_),removewindow.
```

```
save_know :- shiftwindow(7),clearwindow,DISK(XM),
```

```
    makewindow(64,11,28,"",22,0,3,80,1,-1,
        "\204\185\200\188\205\186"),
    write("\n\t\t\tEnter File Name and Press ENTER"),
```



```

makewindow(17,116,79,"SAVE KNOWLEDGE BASE",5,8,15,64),
clearwindow,
makewindow(15,12,22,"Give A File Name",9,18,6,44),
write("\n    Enter File Name With Drive ",XM," \n    "),
readln(Data),assert(data_file(Data)),removewindow,
save(Data,rulebase),clearwindow,removewindow(64,1),
writef("\n\n\n\n\n\t    Your % Knowledge Base has been saved",
      Data),
write("\n < Please press any key to return to Create or
      Update Menu >"),
readchar(_),removewindow(17,1).

```

pick_dba(Data) :-

```

makewindow(3,80,28,"SELECT KNOWLEDGE BASE",0,0,23,80,1,-1,
          "\201\187\204\185\205\186"),
shiftwindow(4),clearwindow,
write("    Use ARROW KEY to select KNOWLEDGE BASE and press
      ENTER to selection"),
makewindow(16,15,79,"PICK A KNOWLEDGE BASE",5,8,14,64),
disk(DI),dir(DI,"*",Data),removewindow.

```

/* %%%%%%%%%%% Erase Knowledge in Memory %%%%%%%%%%% */

erase:-

```

erase2,shiftwindow(4),clearwindow,
write("\t\t Press any key to return to main menu. "),
makewindow(30,48,126,"",8,10,7,60),clearwindow,
write("\n\n\t    Knowledge in Memory has been erased. "),
readchar(_).

```

```
erase1:- erase3,retractall(_,dynabase2).
```

```
erase2:- erase1,retractall(_,dynabase3).
```

```
erase3:- retractall(_,rulebase),retractall(_,dynabase),
         retractall(_,dynabase1).
```

```
/* %%%%%%%%% Create or Update Knowledge Base %%%%%%%%% */
```

```
update:- /*erase2, TEST Erase */
```

```
        repeat,clearwindow,removewindow(5,1),
```

```
        makewindow(5,15,28,"CREATE OR UPDATE KNOWLEDGE BASE",
                   0,0,23,80,1,-1,"\201\187\204\185\205\186"),
```

```
        shiftwindow(4),clearwindow,
```

```
        write("\t Select option with Arrow Key or press letter
              'a' to 'e'"),
```

```
        menu(6,27,15,95,["A.Update Knowledge Base",
```

```
                        "B.Create Knowledge Base",
```

```
                        "C.Edit Knowledge base","D.Save knowledge Base",
```

```
                        "E.Go to Main Menu"],"Select option ",1,CHOICE),
```

```
        proces1(CHOICE).
```

```
proces1(1):- update1.
```

```
proces1(2):- erase2,update2.
```

```
proces1(3):- edit_kb,erase2,update.
```

```
proces1(4):- save_know,erase2,update.
```

```
proces1(5):- erase2,run.
```

```
update1:-
```

```
        erase2,
```

```
        pick_dba(Data),consult(Data,rulebase),update2.
```

```

update2:- spec,
    shiftwindow(4),clearwindow,removewindow(5,1),
    write(" Keep pressing Enter to return to Main Menu or '?'
          for help and press Enter"),
    makewindow(5,15,28,"CREATE OR UPDATE KNOWLEDGE BASE",
               0,0,23,80,1,-1,"\201\187\204\185\205\186"),
    write("\nCreate or Update Knowledge
          \n-----"),nl,
    write("File name : "),nl,nl,
    write("Problem from : "),nl,nl,
    write("Problem Name : "),nl,nl,
    cursor(3,12),readln(FIL1),FIL1<"",limitlen(FIL1,FIL2),
    quest(FIL2,1,18,FIL),cursor(5,15),readln(KAT1),KAT1<"",
    limitlen(KAT1,KAT2),quest(KAT2,1,18,KAT),cursor(7,15),
    readln(SUB1),SUB1<"",imitlen(SUB1,SUB2),
    quest(SUB2,3,18,SUB),
    readinsp(INSPI),readcon(CON),readrec(REC),
    write("\nFile Link (USE UPPERCASE) : "),readln(Filink),
    upper_lower(File,Filink),getrnr(1,RNO),clearwindow,
    assert(symptom(RNO,FIL,KAT,SUB,REC,CON,INSPI,File)),
    removewindow,update2.

update2:- clearwindow,shiftwindow(4),clearwindow,
    write("\t\t\t\t < Press 'y' or 'n' >"),
    makewindow(54,15,0,"",7,3,5,74),
    write("\n\n\t\t\t\tDo you want to SAVE this Knowledge Base ?"),
    beep,beep,response(Ans),removewindow,process7(Ans).

```

```

quest(Q,X,Y,Q2):- Q = "7",shiftwindow(4),clearwindow,
    write("\t\t\t\t Press any key to continue "),
    makewindow(29,15,28,"CREATE OR UPDATE KNOWLEDGE BASE",
        0,0,23,80,1,-1,"\201\187\204\185\205\186"),
    write("\n\nThis is an example of how to create knowledge b
        ase with the problems"),
    write("\n\t'Engine problem' "),nl,nl,
    write(" File name : fuel "),nl,
    write(" Problem from : fuel system "),nl,
    write(" Problem name : engine backfiles"),nl,
    write(" question : explode from carburetor "),nl,
    write(" question : overheating "),nl,
    write(" cause : lean mixture "),nl,
    write(" recomendation : adjust carburetor to correct
        mixture "),nl,
    write(" file link : ignition "),readchar(_),removewindow,
    update2,cursor(X,Y),readln(Q2).

quest(Q,_,_,Q).

```

spec:-

```

getrnr(1,RNO),RNO > 30,!,shiftwindow(4),clearwindow,
    write("\t\t\t\t < Press 'y' or 'n' >"),
    makewindow(53,15,0,"",6,3,10,74),
    write("\n\n\t\t\t\t This file is very big."),
    write("\n\n Please create new file which relations to this
        file,if it is possible. "),
    write("\n\n\t\t\t\tDo you want to SAVE this Knowledge Base ?"),
    beep,beep,response(Ans),removewindow,process7(Ans).

```

spec.

```
process7('y'):-  
    removewindow(53,1),save_know,update.
```

```
process7('n'):- removewindow(53,1),update.
```

```
append([],L,L).
```

```
append([I:L1],L2,[I:L3]):-
```

```
    append(L1,L2,L3).
```

```
unique([],[]).
```

```
unique(X,Y):- un(X,Y,[]).
```

```
un([],Z,Z).
```

```
un([A:B],Y,Z):-
```

```
    dele(A,B,C),un(C,Y,[A:Z]),!.
```

```
dele(_,[],[]).
```

```
dele(X,[X:L],M):-
```

```
    dele(X,L,M).
```

```
dele(X,[Y:L],[Y:M]):-
```

```
    dele(X,L,M).
```

```
limitlen(X,X1):-
```

```
    str_len(X,L),
```

```
    L<71,! ,X1=X.
```

```
limitlen(X,X1):-
```

```
    frontstr(70,X,X1,_),!.
```

```
/* %%%%%%%%%%%%%% Update the knowledge base %%%%%%%%%%%%%%%*/
```

```
getrnr(N,N):-not(symptom(N,_,_,_,_,_,_,_)),!.
```

```
getrnr(N,N1):-H=N+1,getrnr(H,N1).
```

```
getbnr(N,N):-not(cause(N,_)),!.
```

```
getbnr(N,N1):-H=N+1,getbnr(H,N1).
```

```
getcnr(N,N):-not(rec(N,_)),!.
```

```
getcnr(N,N1):-H=N+1,getcnr(H,N1).
```

```
getdnr(N,N):-not(inspec(N,_)),!.
```

```
getdnr(N,N1):-H=N+1,getdnr(H,N1).
```

```
readcon( [BNO:R] ):-
```

```
    shiftwindow(4),clearwindow,
```

```
    write("\t\tKeep pressing Enter to return to Main Menu"),
```

```
    shiftwindow(5),write("cause: "),readln(COND),COND><"",!,
```

```
    change(COND,COND1),getcond(BNO,COND1),readcon( R ).
```

```
readcon( [] ).
```

```
readrec([RENO:R]):-
```

```
    shiftwindow(4),clearwindow,
```

```
    write("\t\tKeep pressing Enter to return to Main Menu"),
```

```
    shiftwindow(5),write("recomendation : "),readln(REC),
```

```
    REC><"",!,change(REC,REC1),getrec(RENO,REC1),readrec( R ).
```

```
readrec( [] ).
```

```

readinsp([INNO:R]):- shiftwindow(4),clearwindow,
    write("\t\tKeep pressing Enter to return to Main Menu"),
    shiftwindow(5),write("question : "),readln(INPC),INPC><"",!,
    change(INPC,INPC1),getinspec(INNO,INPC1),readinsp( R ).
readinsp( [ ] ).

```

```

getcond(BNO,COND):-cause(BNO,COND),!.
getcond(BNO,COND):-getbnr(1,BNO), assert( cause(BNO,COND) ).

```

```

getrec(RENO,REC):-rec(RENO,REC),!.
getrec(RENO,REC):-getcnr(1,RENO), assert( rec(RENO,REC) ).

```

```

getinspec(INNO,INSP):-inspec(INNO,INSP),!.
getinspec(INNO,INSP):-getdnr(1,INNO), assert( inspec(INNO,INSP) ).

```

```

change(X,X1):-
    fronttoken(X,"not",_),str_len(X,L),L<70,!,X1=X.

```

```

change(X,X1):-
    fronttoken(X,"not",_),!,frontstr(62,X,X2,X3),
    countstrs(X,X2,X3,X1).

```

```

change(X,X1):-
    str_len(X,L),L<=58,!,X1=X.

```

```

change(X,X1):-!,
    frontstr(58,X,X2,X3),countstrs(X,X2,X3,X1).

```

```

countstrs(X1,X2,X3,X4):-
    fronttoken(X3,X10,X11),concat(X2,X10,X12),
    concat(X12,X11,X13),str_len(X1,L1),str_len(X13,L13),
    L1>L13,!,concat(X2," \n",X5),concat(X5,X3,X4).

```

```
countstrs(.,X2,X3,X4):-
    fronttoken(X3,X5,X6),concat(X2,X5,X7),concat(X7," \n",X8),
    str_len(X6,L6),L6 > 58,frontstr(58,X6,X9,X10),
    fronttoken(X10,X11,X12),concat(X8,X9,X13),concat(X13,X11,X14),
    concat(X14,"\n",X15),concat(X15,X12,X4).
```

```
countstrs(.,X2,X3,X4):-!,
    fronttoken(X3,X5,X6),concat(X2,X5,X7),concat(X7," \n",X8),
    concat(X8,X6,X4).
```

```
/* ##### Change Knowledge bases Directory ##### */
```

```
changedir :-
```

```
    disk(DISK1),shiftwindow(4),clearwindow,
    write("\t Use Format : ",DISK1," or press Esc to return
           to main menu."),
    makewindow(19,23,22,"Change Knowledge Bases Directory",
              8,10,7,60),
    write("\n\t Current Directory : ",DISK1),
    write("\n\t Change to New Directory : "),readln(DISK),
    upper_lower(DISK2,DISK),disk(DISK2),removewindow.
```

```
/* %%%%%%%%%%%Check File in Disk %%%%%%%%%%% */
```

```
use_file(X):-
```

```
    existfile(X),!.
```

```
use_file(X):-
```

```
    disk(Y),clearwindow,makewindow(33,116,79,"",8,8,6,64),
    clearwindow,write("\n Please insert diskette with file ",X,
                      " in drive ",Y),
    write("\n\t\t and press ENTER to continue "),
    readln(_),removewindow.
```



```
/* %%%%%%%%% Prevent to Press KEY is not specificated %%%%%%%%% */
```

```
ckey:-
```

```
    readchar(A),lkey(A).
```

```
lkey(A):- A = 'y',!.
```

```
lkey(A):- A = 'Y',!.
```

```
lkey(A):- A = 'n',!,fail.
```

```
lkey(A):- A = 'N',!,fail.
```

```
lkey(_):- beep,beep,ckey.
```

```
/* %%%%%%%%% End Of Program %%%%%%%%% */
```

ภาคผนวก ข

ตัวอย่างการใช้งาน

ระบบผู้เชี่ยวชาญการวินิจฉัยหาสาเหตุข้อขัดข้องของรถยนต์นั่ง

เงื่อนไขการใช้งาน

ในการนำระบบผู้เชี่ยวชาญที่สร้างขึ้นมานี้มาใช้ให้ได้ผลและให้มีประสิทธิภาพมากที่สุดนั้น ผู้ใช้จะต้องเป็นผู้ที่ทำงานทางด้าน การซ่อมบำรุงรถยนต์นั่งหรือผู้ที่มีความรู้พื้นฐานและสนใจเกี่ยวกับรถยนต์นั่งบ้างพอสมควร และผู้ที่นำระบบผู้เชี่ยวชาญนี้ไปใช้เป็นระบบผู้เชี่ยวชาญทางด้านอื่น ๆ นั้น ผู้ใช้นั้นจะต้องมีความรู้พื้นฐานทางด้านระบบผู้เชี่ยวชาญบ้างพอสมควร เข้าใจถึงองค์ประกอบพื้นฐาน การแสดงความรู้ และกลยุทธ์การแก้ปัญหาของระบบผู้เชี่ยวชาญ และจะต้องมีความรู้ในด้านที่จะนำไปใช้นั้น ๆ เป็นอย่างดี จึงจะสามารถสร้างระบบผู้เชี่ยวชาญทางด้านที่ต้องการได้ หรือไม่เช่นนั้น ก็ต้องใช้วิธีการถ่ายทอดความรู้มาจากผู้เชี่ยวชาญอีกทีหนึ่ง

ขอบเขตการใช้งาน

ระบบผู้เชี่ยวชาญที่สร้างขึ้นนี้มีจุดประสงค์เพื่อการวินิจฉัยหาสาเหตุข้อขัดข้องที่เกิดขึ้นในระบบต่าง ๆ ของรถยนต์นั่ง เพราะฉะนั้นขอบเขตการใช้งานที่ระบบผู้เชี่ยวชาญนี้จะใช้ได้ก็คือใช้งานวินิจฉัยหาข้อขัดข้องของระบบต่าง ๆ ในรถยนต์นั่ง เช่น ระบบจุดระเบิด ระบบน้ำมันเชื้อเพลิง ระบบระบายความร้อน เป็นต้น และในบางครั้งก็สามารถที่จะนำไปประยุกต์ใช้กับงานวินิจฉัยหาสาเหตุข้อขัดข้องในงานด้านอื่น ๆ ที่มีลักษณะของการแก้ปัญหาที่เหมือน ๆ กันได้ โดยมีข้อจำกัด คือ ต้องสามารถแสดงความรู้ในฐานความรู้ของงานด้านนั้นให้อยู่ในรูปของกฎปรกติชัดเจน และมีโครงสร้างฐานความรู้เป็นแบบต้นไม้ดังแสดงในรูปที่ 4.2 ได้

หนึ่งในการนำระบบผู้เชี่ยวชาญไปประยุกต์ใช้จะต้องคำนึงถึงความเข้ากันได้ และการสื่อความหมายกันได้ดีระหว่างระบบผู้เชี่ยวชาญกับฐานความรู้ที่จะนำไปใช้ การปฏิบัติกับผู้ใช้ต้องสื่อความหมายได้ดี เข้ากับเรื่องที่จะนำไปประยุกต์ใช้นั้นด้วย

การใช้งานระบบผู้เชี่ยวชาญ

ระบบผู้เชี่ยวชาญที่สร้างขึ้นมานั้นมีความสามารถในการทำหน้าที่หลัก 2 ประการ คือ สร้างเพิ่มเติม แก้ไขฐานความรู้เอาไว้ใช้ให้คำปรึกษา และให้คำปรึกษาวินิจฉัยโดยใช้ฐานความรู้ที่ได้สร้างไว้แล้ว ซึ่งจะได้กล่าวถึงรายละเอียดตัวอย่างการใช้งาน ดังต่อไปนี้

1. การสร้างเพิ่มเติม แก้ไขฐานความรู้

ในส่วนนี้จะรวมถึงทั้งการสร้างฐานความรู้ใหม่ การเพิ่มเติมฐานความรู้เดิมที่มีอยู่ แล้วให้ความรู้กว้างขวางมากยิ่งขึ้น และการแก้ไขฐานความรู้เดิมให้ถูกต้องทันสมัยตามเหตุการณ์ที่เปลี่ยนไป

1.1 การสร้างฐานความรู้ใหม่ จะต้องจัดข้อมูลความรู้ขึ้น ๆ ให้อยู่ในรูปกฎเกณฑ์ก่อน ดังแสดงตัวอย่างต่อไปนี้

ตัวอย่างความรู้เกี่ยวกับข้อขัดข้องของเครื่องยนต์

กฎที่ 1. Engine Problem is a "engine has rough idle"

กฎที่ 2. Fuel system Problem is a "engine has rough idle"
if the engine operating normally under all other conditions,
then the cause is improper idle speed and fuel mixture a
djustments.
Recommendation "Adjust idle speed and fuel mixture to
specification."

กฎที่ 3. Fuel system Problem is a "engine has rough idle"
if the engine operating normally under all other conditions
and altering idle speed and fuel mixture adjustments does not
seem to help, then the idle circuit is clogged.
Recommendation "Clean idle circuit".

จากตัวอย่างความรู้นี้ จะต้องจัดให้อยู่ในรูปแบบ File name, Problem from, Problem name, Questions, Causes, Recommendations, File link ได้ดังนี้

ชื่อไฟล์ ENGINE

symptom 1 File name : engine
 Problem from : engine problem
 Problem Name : engine has rough idle
 question : -
 cause : -
 recommendation: -
 file link : FUEL

ชื่อไฟล์ FUEL

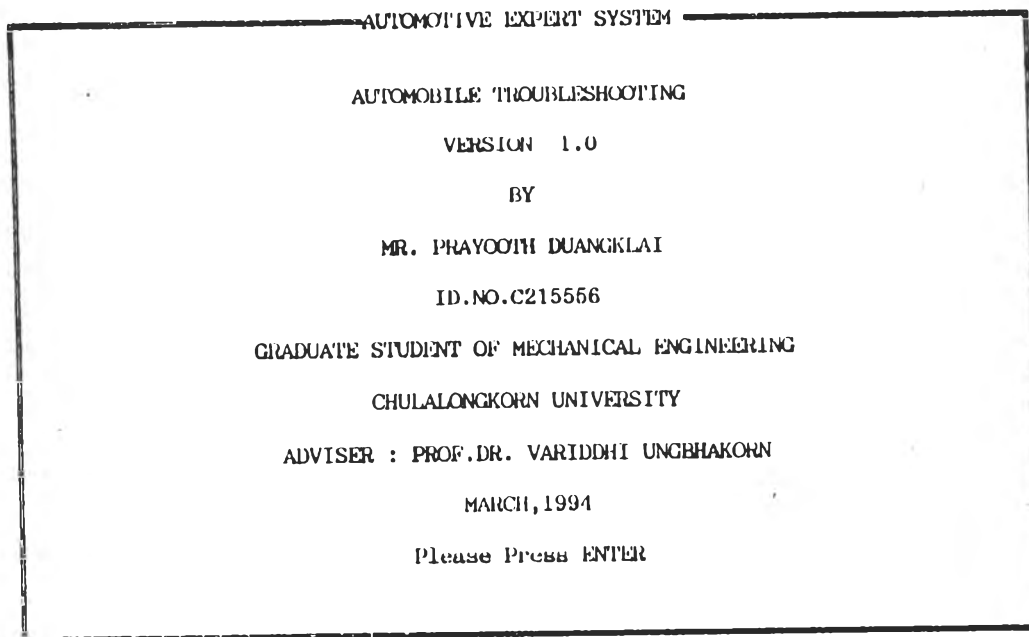
symptom 1 File name : fuel
 Problem from : fuel system
 Problem Name : engine has rough idle
 question : the engine operating normally under all other conditions
 cause : improper idle speed and fuel mixture adjustments.
 recommendation: Adjust idle speed and fuel mixture to specification.
 file link : -

symptom 2 'File name : fuel
 Problem from : fuel system
 Problem Name : engine has rough idle
 question 1 : the engine operating normally under
 all other conditions
 question 2 : altering idle speed and fuel mixture
 adjustments does not seem to help
 cause : the idle circuit is clogged.
 recommendation: Clean idle circuit.
 file link : -

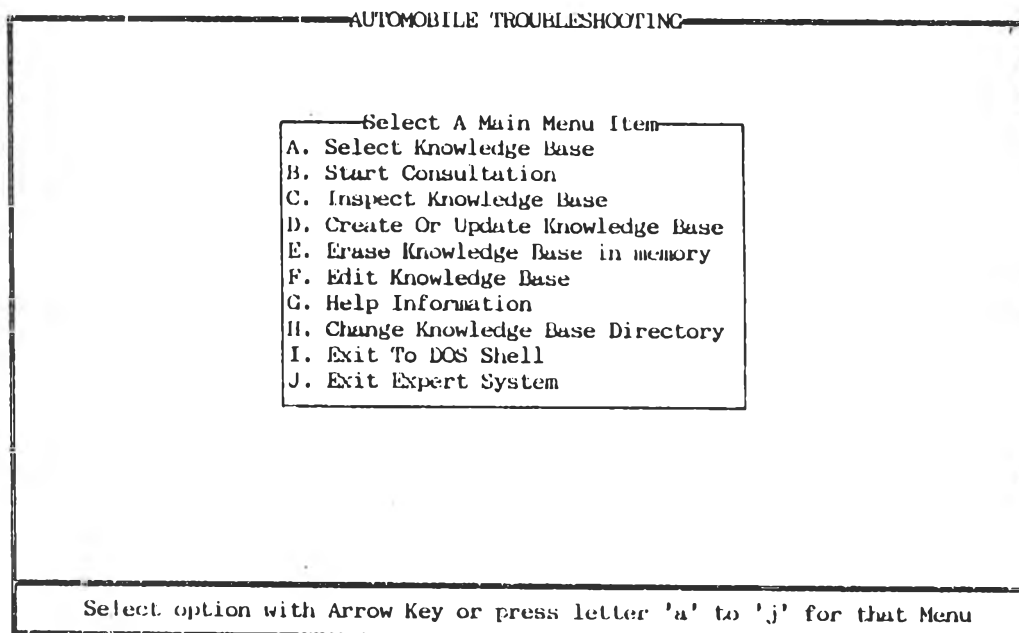
จากภาพที่ปัญหาของเครื่องยนต์มีมาก มีสาเหตุมาจากหลาย ๆ ระบบ การสร้างฐาน
 ความรู้จึงต้องแยกออกเป็นไฟล์ย่อย ๆ หลาย ๆ ไฟล์ เพื่อให้การตรวจดูและแก้ไขเพิ่มเติมข้อ
 มูลความรู้ได้ง่ายในโอกาสต่อไป ในที่นี้จึงแยกออกเป็นไฟล์ชื่อ ENGINE ซึ่งบรรจุกฎที่ 1 ไว้
 และไฟล์ FUEL บรรจุกฎที่ 2 และ 3 ไว้

ขั้นตอนไปใช้ระบบผู้เชี่ยวชาญสร้างฐานความรู้ ดังนี้

- 1.1.1 เข้าสู่ระบบผู้เชี่ยวชาญ จะปรากฏจอภาพดังรูปที่ 7.1
- 1.1.2 กด Enter เพื่อเข้าสู่เมนูหลัก ดังรูปที่ 7.2
- 1.1.3 กด D (D. Create Or Update Knowledge Base) หรือ
 ใช้คีย์ลูกศรเลื่อนแถบสว่างไปที่ D แล้วกด Enter จะปรากฏเมนูของ Create Or Update
 Knowledge Base ดังรูปที่ 7.3
- 1.1.4 กด B (B. Create Knowledge Base) หรือใช้คีย์ลูกศร
 เลื่อนแถบสว่างไปที่ D แล้วกด Enter สร้างฐานข้อมูลใหม่ จะปรากฏจอภาพ ดังรูปที่ 7.4
- 1.1.5 ทำการพิมพ์ engine แล้วกด Enter พิมพ์ engine problem
 แล้วกด Enter พิมพ์ engine has rough idle แล้วกด Enter กด Enter ผ่าน question
 กด Enter ผ่าน cause กด Enter ผ่าน recommendation พิมพ์ fuel ตัวใหญ่หรือตัวเล็กก็ได้
 แล้วกด Enter จะปรากฏจอภาพ ดังรูปที่ 7.4 อีกครั้งหนึ่ง



รูปที่ 7.1 จอภาพแสดงการเริ่มต้นเข้าสู่ระบบผู้เชี่ยวชาญ



รูปที่ 7.2 จอภาพแสดงรายการของเมนูหลัก

CREATE OR UPDATE KNOWLEDGE BASE

Select option

A.Update Knowledge Base
 B.Create Knowledge Base
 C.Edit Knowledge base
 D.Save knowledge Base
 E.Go to Main Menu

Select option with Arrow Key or press letter 'a' to 'e'

รูปที่ 7.3 จอภาพแสดงเมนูของการสร้าง เพิ่มเติม แก้ไข ฐานความรู้

CREATE OR UPDATE KNOWLEDGE BASE

Create or Update Knowledge

 File name :
 Problem from :
 Problem Name :

Keep pressing Enter to return to Main Menu or '?' for help and press Enter

รูปที่ 7.4 จอภาพแสดงการพร้อมรับข้อมูลการสร้างฐานความรู้

AUTOMOBILE TROUBLESHOOTING

SAVE KNOWLEDGE BASE

Give A File Name

Enter File Name With Drive A:\

Enter File Name and Press ENTER

รูปที่ 7.5 จอภาพแสดงการพร้อมรับชื่อไฟล์ฐานความรู้

SELECT KNOWLEDGE BASE

PICK A KNOWLEDGE BASE

BATT	BRAKE	CLUTCH	COOL
DRIVE	EMIS	ENGINE	FUEL
FUEL1	FUEL2	FUELX	GEAR
IGNIT	IGNIT1	IGNIT2	IGNIT3
LIGHT	LIGHT1	LIGHT2	LUB
MECH	START	START1	START2
STEER	STEER1	SUS	SUS1
SUS2	SYSFILE	TEST	WHEEL
WHEEL1			

Use ARROW KEY to select KNOWLEDGE BASE and press ENTER to selection

รูปที่ 7.6 จอภาพแสดงชื่อไฟล์ฐานความรู้ที่มีอยู่ในแผ่นเก็บข้อมูล

INSPECT KNOWLEDGE BASE	
Symptom No. 1 -----	
File name : fuel	
Problem from : fuel system	
Problem Name : engine has rough idle	
Question is/are	
- the engine operating normally under all other conditions	
Cause is/are	
- Improper idle speed and fuel mixture adjustments.	
Recommendation is/are	
- Adjust idle speed and idle speed fuel mixture to specification	
File conection :	
Symptom No. 2 -----	
File name : fuel	
Problem from : fuel system	
Use ARROW KEY move cursor to next page: And Press Esc to Main Menu	

รูปที่ 7.7 จอภาพแสดงข้อมูลในฐานความรู้ให้ตราจสอบ

EDIT KNOWLEDGE BASE			
Line 1	Col 1	Indent	Insert
symptom(1,"fuel","fuel system","engine has rough idle",	[1],[1],[1],	"")
symptom(2,"fuel","fuel system","engine has rough idle",	[2],[2],[1,2],	"")
symptom(3,"fuel","fuel system","engine has rough idle",	[3],[3],[3],	"")
inspec(1,"the engine operating normally under all other conditions")			
inspec(2,"altering idle speed and mixture adjustments does not seem to \n help			
inspec(3,"rough idle combined with other engine operating troubles,such \n as			
cause(1,"improper idle speed and fuel mixture adjustments.")			
cause(2,"The idle circuit is clogged.")			
cause(3,"Intake vacuum leak.")			
rec(1,"Adjust idle speed and idle speed fuel mixture to specification")			
rec(2,"Clean idle circuit.")			
rec(3,"Check manifold,carburetor mounting,any connections to manifold \n and v			
data_file("fuel")			
Press F10 to end editing or Esc to abort editing			

รูปที่ 7.8 จอภาพแสดงการพร้อมรับการแก้ไขฐานความรู้

1.1.6 กด Enter เพื่อเลิกการเพิ่มข้อมูล จะปรากฏข้อความ "Do you want to save knowledge base ? " กดแป้นอักษร "y" จอภาพจะปรากฏ ดังรูปที่ 7.5

1.1.7 ใส่ชื่อไฟล์ฐานข้อมูล โดยกำหนดชื่อช่องเก็บข้อมูลไว้ ข้างหน้าชื่อไฟล์ เช่น ต้องการเก็บข้อมูลของไฟล์ลงในช่องเก็บข้อมูล B ชื่อ engine โดยการพิมพ์ B:\engine แล้วกด Enter ก็จะได้ไฟล์ฐานข้อมูลชื่อ ENGINE บรรจุในแผ่นข้อมูล และจอภาพจะปรากฏ ดังรูปที่ 7.3 (ถ้าไม่ได้เก็บข้อมูล ด้วยข้อ 1.1.6 ก็สามารเก็บข้อมูล ด้วยการกดแป้นอักษร "D" (D. Save knowledge base) หรือใช้คีย์ลูกศรเลื่อนแถบสว่างไปที่ D ในรูปที่ 7.3 แล้วกด Enter และทำตามข้อ 1.1.7 ก็จะเก็บข้อมูลลงในแผ่นข้อมูลตามต้องการ)

สำหรับการสร้างไฟล์ฐานความรู้ FUEL ก็ทำในทำนองเดียวกันโดยขั้นตอนแรกเริ่มจากข้อ 1.1.4 แล้วใส่ข้อมูลตามที่ต้องการตามลำดับจนถึงข้อ 1.1.7 ก็จะได้ไฟล์ฐานข้อมูลไฟล์ที่ 2 ชื่อ FUEL

หากต้องการจะตรวจดูฐานความรู้ในไฟล์ฐานความรู้ใดฐานความรู้หนึ่งก็สามารถกระทำได้ โดยกลับไปเมนูหลัก ในรูปที่ 7.2 แล้วเลือกเมนู C. Inspect Knowledge Base จะปรากฏชื่อไฟล์ที่จอภาพให้เลือก ดังรูปที่ 7.6 ถ้าต้องการเลือกไฟล์ FUEL ใช้คีย์ลูกศรเลื่อนแถบสว่างไปที่ FUEL แล้วกด Enter ก็ จะปรากฏข้อมูลความรู้ของไฟล์ FUEL บนจอภาพดังรูปที่ 7.7 แต่ไม่สามารถแก้ไขได้ จะใช้ในการตรวจดูเพียงอย่างเดียวเท่านั้น

จากขั้นตอนที่กล่าวมาทั้งหมดก็จะได้ฐานความรู้ใหม่ในการวินิจฉัยข้อขัดข้องของเครื่องยนต์ 2 ไฟล์ฐานความรู้ต่อเนื่องกัน ในการสร้างฐานความรู้สำหรับระบบผู้เชี่ยวชาญจริง ๆ แล้วจะมีจำนวนกฎหรือจำนวนไฟล์มากกว่านี้มาก แต่ที่กล่าวมาเป็นเพียงตัวอย่างเพื่อแสดงขั้นตอนการสร้างไฟล์ฐานความรู้เท่านั้น

1.2 การเพิ่มเติมฐานความรู้ ในกรณีที่มิไฟล์ฐานความรู้อยู่แล้วต้องการเพิ่มเติมฐานความรู้ให้มกกฎความรู้มากขึ้น ตัวอย่างเช่น ต้องการเพิ่มความรู้นลงในไฟล์ฐานความรู้ FUEL

File name : fuel
 Problem from : fuel system
 Problem name : engine has rough idle
 question : rough idle combined with other engine operating troubles such as lack of power, missing, overheating and so on
 cause : Intake vacuum leak.
 recommendation : Check manifold, carburetor mounting, any connections to manifold and vacuum advance. Repair defective parts.
 File link : -

ข้อมูลความรู้เหล่านี้ ก็มีวิธีการเพิ่มเติมเช่นเดียวกับวิธีการสร้างฐานความรู้ใหม่ แต่การเพิ่มเติมฐานความรู้จะต้องอ่านฐานความรู้เก่าคือไฟล์ FUEL เข้ามาเก็บไว้ในหน่วยความจำก่อน โดยการใช้เมนู D. Create Or Update Knowledge Base ของเมนูหลัก ในรูปที่ 7.2 ก็จะได้เมนูดังรูปที่ 7.3 แล้วเลือก A. Update knowledge base ก็จะปรากฏจอภาพเป็น ชื่อไฟล์ต่าง ๆ ที่มีอยู่ในขณะนั้นให้เลือก ดังรูปที่ 7.6 เลือกไฟล์ FUEL แล้วทำการเพิ่มเติมความรู้ใหม่เข้าไป ความรู้ที่เพิ่มเติมเข้าไปใหม่จะไปต่อกับความรู้เก่าที่มีอยู่แล้วในส่วนท้ายของฐานข้อมูลนั้น ๆ ถึงขณะนี้ไฟล์ FUEL ก็จะประกอบด้วยกฎ 3 กฎ ในการบันทึกข้อมูลลงบนแผ่นข้อมูลระบบจะไม่ถามชื่อไฟล์อีกแล้ว เพราะชื่อไฟล์มีอยู่แล้วคือ FUEL

1.3 การแก้ไขฐานความรู้ ใช้ในกรณีที่มีความผิดพลาด เช่น พิมพ์ผิดตัวอย่าง เช่น หากต้องการแก้ไขข้อมูลในไฟล์ FUEL ก็จะมีขั้นตอน ดังนี้

1.3.1 เลือกเมนู F. Edit Knowledge Base จากเมนูหลักดังรูปที่ 7.2 จะปรากฏจอภาพเป็นชื่อไฟล์ต่าง ๆ ที่มีอยู่ในขณะนั้นให้เลือก

1.3.2 เลือกไฟล์ FUEL โดยใช้คีย์ลูกศรแล้วกด Enter จะปรากฏจอภาพ ดังรูปที่ 7.8

1.3.3 ทำการแก้ไขข้อความต่าง ๆ ตามต้องการ โดยใช้คีย์ต่าง ๆ คล้าย ๆ กับการทำงานในโปรแกรมประมวลคำ (Word processor) ที่ว่า ๆ ไป

1.3.4 กด F10 เมื่อเสร็จการแก้ไขระบบจะถามว่า "ต้องการจัดเก็บข้อมูลที่แก้ไขหรือไม่" ให้ตอบ "y" ไฟล์ฐานความรู้ที่ถูกแก้ไขใหม่แล้วนั้นจะถูกจัดเก็บแทนไฟล์ฐานความรู้เก่า

ในการแก้ไขฐานความรู้ ผู้ใช้จะต้องสังเกตการจตุรูปในการจัดเก็บข้อมูลความรู้ กฎต่าง ๆ ให้ดีก่อน กฎต่าง ๆ ถูกจัดอยู่ในรูปแบบเรียงกัน ดังนี้ (รูปที่ 7.8 ประกอบ)

```
symptom(No.,"file name","problem from","problem name",
[No.of recommendations],[No.of causes],
[No.of questions],"file link")
```

Recommendations Causes และ questions จะจัดเก็บไว้โดยใช้ตัวเลขอ้างอิง และแยกเก็บข้อความออกมาเป็น

```
inspec(No.of question,"question")
cause(No.of cause,"cause")
rec(No.of recommendation,"recommendation")
```

จากขั้นตอนการปฏิบัติที่กล่าวมาจนถึงขณะนี้ ก็ได้ฐานความรู้ใหม่สำหรับระบบผู้เชี่ยวชาญ 2 ไฟล์ คือ ไฟล์ ENGINE ประกอบด้วยกฎความรู้ 1 กฎ และไฟล์ FUEL ประกอบด้วยกฎความรู้ 3 กฎ พร้อมทั้งจะนำไปใช้ในการให้คำปรึกษาต่อไป

2. การให้คำปรึกษา

ในการให้คำปรึกษา ระบบผู้เชี่ยวชาญจะต้องเรียกใช้ฐานความรู้ในเรื่องที่จะให้คำปรึกษานั้น ซึ่งอาจจะได้จากการสร้างฐานความรู้ขึ้นมาในขณะนั้น หรือการเรียกใช้ไฟล์ฐานความรู้ที่ได้สร้างไว้แล้วตามขั้นตอนที่ได้กล่าวผ่านมา ในที่นี้จะยกตัวอย่างโดยใช้ฐานความรู้ที่ได้สร้างไว้ในขั้นตอนตัวอย่างการสร้างฐานความรู้ที่ผ่านมา คือ เรื่องข้อขัดข้องของเครื่องยนต์ ซึ่งมีลำดับขั้นตอนการให้คำปรึกษาและการปฏิบัติกับผู้ใช้ขณะให้คำปรึกษาเป็นดังนี้

2.1 เลือกเมนู A. Select Knowledge Base จากเมนูหลักดังรูปที่ 7.2 เพื่อเลือกฐานความรู้ที่เกี่ยวข้องกับเรื่องที่จะปรึกษา จอภาพจะปรากฏชื่อฐานความรู้ที่มีอยู่ในขณะนั้นให้เลือก ดังรูปที่ 7.9 เลือกฐานความรู้ที่ต้องการปรึกษา โดยใช้คีย์ลูกศรเลื่อนแถบสว่างมายังฐานความรู้ที่ต้องการ แล้วกด Enter หรือกดแป้นตัวอักษรที่ตรงกับตัวอักษรที่อยู่ข้างหน้าชื่อฐานความรู้

2.2 เลือกเมนู B. Start Consultation เพื่อเริ่มการปรึกษาระบบ ผู้เชี่ยวชาญจะแสดงข้อปัญหาข้อขัดข้องที่มีอยู่ในไฟล์ฐานความรู้ที่เลือกไว้ในข้อ 2.1 ทางจอภาพ ดังแสดงในรูปที่ 7.10 ใช้คีย์ลูกศรเลื่อนแถบสว่างไปยังปัญหาที่ต้องการปรึกษา แล้วกด Enter

2.3 ระบบผู้เชี่ยวชาญก็จะแสดงคำถามเพื่อหาสาเหตุข้อขัดข้องให้ผู้ผู้ใช้ตอบ ซึ่งจะปรากฏจอภาพ ดังรูปที่ 7.11 บรรทัดแรก

2.4 หากข้อมูลในคำถามนั้นเป็นจริง ให้ผู้ใช้ตอบ "yes" ระบบก็จะไปค้นหาคำตอบ แม้ยังไม่ได้คำตอบ แต่ระบบก็จะรู้ขอบเขตของปัญหาที่แคบลงคือ fuel system problem ระบบจึงเรียกไฟล์ FUEL แล้วถามคำถามเพิ่มเติม ปรากฏจอภาพดังรูปที่ 7.11

2.5 หากข้อมูลในคำถามนั้นไม่เป็นจริง ให้ผู้ใช้ตอบ "no" ระบบก็จะแสดงคำถามเพื่อหาสาเหตุอื่น ให้ผู้ใช้ตอบต่อไป

2.6 หากผู้ใช้ต้องการทราบเหตุผลที่ถามคำถาม ก็จะถาม "why" ระบบก็จะแสดงเหตุผลทางจอภาพ ดังรูปที่ 7.12 ต่อไปให้กดแป้น "Esc" เพื่อกลับสู่คำถามเดิม

2.7 หากผู้ใช้ต้องการทราบว่าเคยตอบคำถามว่าอย่างไรมาบ้าง ก็จะถาม "Review" ระบบก็จะแสดงการตอบคำถามที่เคยตอบมาแล้วว่าตอบอย่างไรไปบ้างดังรูปที่ 7.13 ต่อไปให้กดแป้น "Esc" เพื่อกลับสู่คำถามเดิม

2.8 หากข้อมูลในคำถามนั้นเป็นจริง ให้ผู้ใช้ตอบ "yes" แต่เงื่อนไขที่ต้องพิสูจน์ยังไม่ครบ ระบบจึงถามคำถามเพิ่มเติมอีก หากผู้ใช้ตอบ "yes" ก็จะได้คำตอบดังแสดงในรูปที่ 7.14 และรูปที่ 7.15

2.9 ระบบจะถามผู้ใช้ว่า "ต้องการทราบว่าได้คำตอบนั้นมาได้อย่างไรหรือไม่" หากผู้ใช้กดแป้นอักษร "y" ระบบก็จะแสดงที่มาของคำตอบ ดังแสดงในรูปที่ 7.16 แล้วกดแป้น "Esc" หากไม่ต้องการก็กดแป้นอักษร "n"

2.10 ในกรณีที่หมดข้อมูลที่เป็นสาเหตุของปัญหานี้ ระบบจะแสดงว่า ไม่มีคำถามสำหรับปัญหานี้แล้ว และถามว่า "ต้องการเพิ่มเติมฐานความรู้หรือไม่" หากต้องการเพิ่มเติม กดแป้นอักษร "y" ระบบก็จะบอกชื่อไฟล์ที่กำลังคิดต่ออยู่ว่าชื่อไฟล์อะไร จากนั้นผู้ใช้ก็เพิ่มเติมฐาน

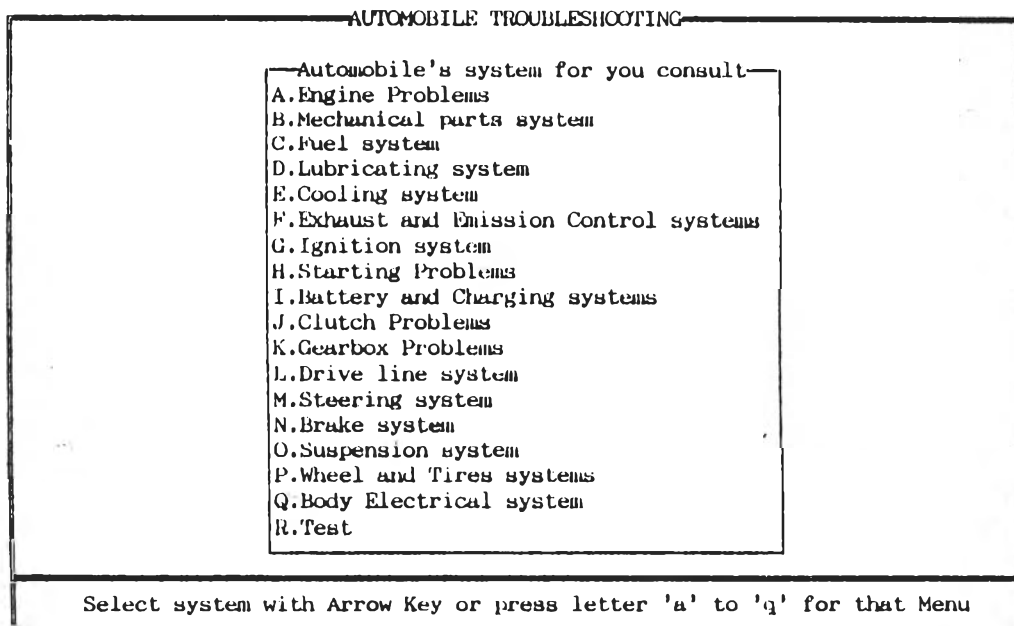
ความรู้ตามวิธีที่กล่าวมาแล้วในหัวข้อการเพิ่มเติมฐานความรู้ หากไม่ต้องการเพิ่มเติมกดแป้นอักษร "n"

2.11 ในกรณีที่ทำการพิสูจน์เป้าหมายต่าง ๆ แล้วไม่บรรลุผลสำเร็จ กล่าวคือ เงื่อนไขไม่เป็นจริง จะปรากฏจอภาพดังรูปที่ 7.17 และถามว่า "ต้องการเพิ่มเติมฐานความรู้หรือไม่" หากต้องการเพิ่มเติมกดแป้นอักษร "y" ระบบก็จะบอกชื่อไฟล์ที่กำลังติดต่ออยู่ว่าชื่อไฟล์อะไรจากนั้นผู้ใช้ก็เพิ่มเติมฐานความรู้ตามวิธีที่กล่าวมาแล้วในหัวข้อการเพิ่มเติมฐานความรู้ หากไม่ต้องการเพิ่มเติมกดแป้นอักษร "n"

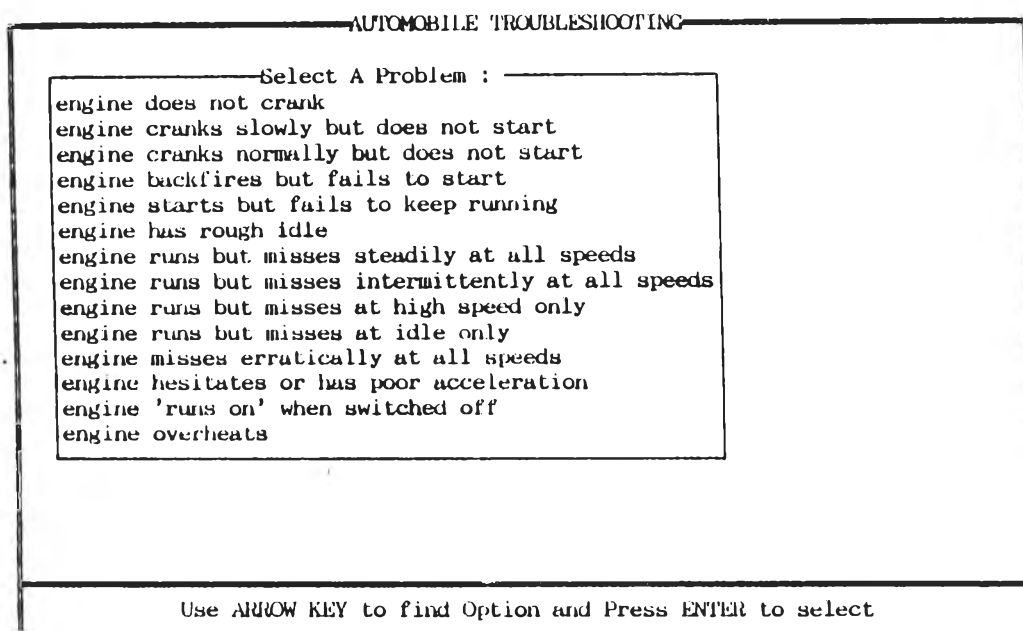
2.12 ระบบจะถามว่า "ต้องการหาคำตอบอื่น ๆ ของปัญหานี้หรือไม่" หากต้องการกดแป้นอักษร "y" ระบบก็จะถามคำถามเพื่อพิสูจน์เงื่อนไขหาสาเหตุอื่น ๆ อีก หากเงื่อนไขเป็นจริงระบบก็จะแสดงคำตอบหรือข้อสรุปนั้น ๆ ตามรูปแบบที่กล่าวมาแล้ว หากไม่ต้องการคำตอบอื่นอีก ก็กดแป้นอักษร "n"

2.13 ระบบก็จะแสดงว่าสิ้นสุดการให้คำปรึกษา และถามว่า "ต้องการพิมพ์ผลการปรึกษาหรือไม่" หากต้องการกดแป้นอักษร "y" ก็จะพิมพ์ผลการปรึกษาออกทางเครื่องพิมพ์เสร็จแล้วก็จะถามว่า "ต้องการพิมพ์อีกหรือไม่" หากต้องการก็กดแป้นอักษร "y" ก็จะพิมพ์ผลอีก หากไม่ต้องการก็กดแป้นอักษร "n" กลับเข้าสู่เมนูหลัก พร้อมทั้งจะทำงานต่อไป

การให้คำปรึกษาที่ยกตัวอย่างนี้เป็นเพียงไฟล์เล็ก ๆ เพื่อให้เห็นถึงขั้นตอนการใช้และการปฏิภาคกับผู้ใช้ของระบบเท่านั้น ส่วนการให้คำปรึกษาที่สมบูรณ์ที่ได้สร้างไว้ คือการวินิจฉัยหาสาเหตุหรือข้อขัดข้องในระบบต่าง ๆ ของรถยนต์หนึ่ง ซึ่งประกอบด้วยกฎความรู้กว่า 350 กฎ ครอบคลุมปัญหาต่าง ๆ ของทุกระบบหลัก ๆ ของรถยนต์หนึ่ง



รูปที่ 7.9 จอภาพแสดงข้อมูลฐานความรู้ที่ผู้ใช้เพื่อการศึกษา



รูปที่ 7.10 จอภาพแสดงข้อปัญหาที่มีอยู่ในฐานความรู้ที่เลือกปรึกษา

DISPLAY THE PROCEDURE OF CONSULTATION

Your problem is
'engine has rough idle'.

Answer Questions by using CURSOR KEY and press ENTER to select.

=> Is it true that
the engine operating normally under all other conditions ?:- no

=> Is it true that
rough idle combined with other engine operating troubles, such
as lack of power, missing, overheating and so on ?:- no

=> Is it true that
the throttle valve shaft is loose ?:-

A.Yes B.No C.Why D.Review

รูปที่ 7.11 จอภาพแสดงคำถามเพื่อหาสาเหตุข้อขัดข้องของปัญหา

DISPLAY THE PROCEDURE OF CONSULTATION

Your problem is
'engine has rough idle'.

Answer question when you ask Why ?.

= Because I try to show that :

= * Your problem come from fuel system,
which its cause :

= * Air leak through the throttle valve shaft to engine causing
the mixture too lean.

If it has symptom :

* the throttle valve shaft is loose

* Use Cursor Key to find out why in next page
and press Esc to answer questions continue *

รูปที่ 7.12 จอภาพแสดงผลสำหรับคำถาม "Why"

DISPLAY THE PROCEDURE OF CONSULTATION	
Review your answered	
==>	Your problem is 'engine has rough idle.'

==>	You answered these question is/are
=	* the engine operating normally under all other conditions :is NO
=	* rough idle combined with other engine operating troubles, such as lack of power, missing, overheating and so on :is NO
=	
* Use Cursor Key to return your answered in next page and press Esc to answer questions continue *	

รูปที่ 7.13 จอภาพแสดงคำตอบเมื่อถาม "Review"

DISPLAY THE PROCEDURE OF CONSULTATION	
Your problem is 'engine has rough idle'.	
Answer Questions by using CURSOR KEY and press ENTER to select.	

=>	Is it true that the engine operating normally under all other conditions ?:- no
=>	Is it true that rough idle combined with other engine operating troubles, such as lack of power, missing, overheating and so on ?:- no
=>	Is it true that the throttle valve shaft is loose ?:- yes

===> The probable cause(s) of this problem can be obtained. <===	
< Press Any KEY to show the probable causes of this problem >	

รูปที่ 7.14 จอภาพที่แสดงเมื่กดข้อมูลในคำถามเป็นจริง

DISPLAY THE PROCEDURE OF CONSULTATION

Your problem is
'engine has rough idle'.

Your problem come from fuel system
The probable cause(s) of this problem :

* Air leak through the throttle valve shaft to engine causing
the mixture too lean.

Recommendation(s) :

* Replace or repair the throttle valve shaft.

Do you want to know how the answer is obtained ?

< Press 'y' or 'n' >

รูปที่ 7.15 รูปภาพแสดงคำตอบที่ได้จากการวินิจฉัย

DISPLAY THE PROCEDURE OF CONSULTATION

When you ask problem : engine has rough idle
Then you accepted the symptom is/are
* the throttle valve shaft is loose
Conclusion for the cause of this problem is/are
* Air leak through the throttle valve shaft to engine causing
the mixture too lean.
which it is in fuel system
Recommendation(s):
* Replace or repair the throttle valve shaft.

Press Esc to continue

รูปที่ 7.16 จอภาพแสดงที่มาของคำตอบสำหรับคำถาม "how"

DISPLAY THE PROCEDURE OF CONSULTATION
Your problem is 'engine has rough idle'.
=> Is it true that the engine operating normally under all other conditions ?:- no
=> Is it true that rough idle combined with other engine operating troubles, such as lack of power, missing, overheating and so on ?:- no
=> Is it true that the throttle valve shaft is loose ?:- no
=> Is it true that engine has a PCV valve ?:- no
Sorry, there is no recommendation /no more database for consultation. Do you want to update my knowledge base ?:-
< Press 'y' or 'n' >

รูปที่ 7.17 จอภาพแสดงการหมดข้อมูลในฐานความรู้

ภาคผนวก ค

ฐานความรู้สำหรับการวินิจฉัยหาสาเหตุข้อบกพร่องของระบบต่าง ๆ ในรถยนต์นั่ง

ฐานความรู้ของระบบผู้เชี่ยวชาญการวินิจฉัยหาสาเหตุข้อบกพร่องของรถยนต์นั่งที่ทำการวิจัยนี้ ประกอบด้วยกฎโปรดักชันประมาณ 350 กฎ แบ่งอยู่ตามไฟล์ฐานความรู้ต่าง ๆ ดังต่อไปนี้

ชื่อไฟล์	เป็นไฟล์ฐานความรู้ของระบบ
BATT	Battery and Charging Systems
BRAKE	Brake System
CLUTCH	Clutch System
COOL	Cooling System
DRIVE	Drive line Systems
EMIS	Exhaust & Emission Control Systems
ENGINE	Engine Problems
FUEL, FUEL1, FUEL2	Fuel System
GEAR	Gearbox System
IGNIT, IGNIT1, IGNIT2, IGNIT3	Ignition System
LIGHT, LIGHT1, LIGHT2	Body Electrical Systems
LUB	Lubricating System
MECH	Mechanical parts Systems
START, START1, START2	Starting System
STEER, STEER1	Steering System
SUS, SUS1, SUS2	Suspension System
WHEEL, WHEEL1	Wheel and Tires Systems

รูปที่ 8.1 ชื่อไฟล์ของฐานความรู้ที่ใช้ในระบบผู้เชี่ยวชาญที่ทำการวิจัย

1wa BATT

Symptom 1 File batt

battery and charging systems problem

is a 'charge warning lamp does not come on when ignition switch turned to ON'

If check fuse or contact in the charge warning lamp circuit, it is blown or bad contact, then No current from battery to charge warning lamp.

Recommendation(s) :

Repair or replace fuse or contact.

Symptom 2 File batt

battery and charging systems problem

is a 'charge warning lamp does not come on when ignition switch turned to ON'

If check regulator connectors, it is loose or faulty, then Excessive voltage drop at regulator connectors.

Recommendation(s) :

Repair regulator connectors.

Symptom 3 File batt

battery and charging systems problem

is a 'charge warning lamp does not come on when ignition switch turned to ON'

If measure voltage at terminal N of the alternator, it had voltage,

then A short-circuit in the positive diodes of the alternator.

Recommendation(s) :

Replace the positive diodes of the alternator.

Symptom 4 File batt

battery and charging systems problem

is a 'charge warning lamp does not come on when ignition switch turned to ON'

If ground terminal L of the regulator, the charge lamp comes on,

then Defective regulator.

Recommendation(s) :

Replace regulator.

Symptom 5 File batt

battery and charging systems problem

is a 'charge warning lamp does not come on when ignition switch turned to ON'

If the regulator is normal operated,

then Burnt out bulb or faulty wire harness of charge warning lamp.

Recommendation(s) :

Replace the bulb or repair the wiring harness.

Symptom 6 File batt

battery and charging systems problem

is a 'charge warning lamp does not go out after engine starts'

If check alternator drive belt, it squeals or loose,

then The alternator is not generating electricity due drive belt is slipped.

Recommendation(s) :

Adjust or replace the alternator drive belt.

Symptom 7 ' File batt

battery and charging systems problem

is a 'charge warning lamp does not go out after engine starts'

If check voltage at IG terminal of regulator, it is no or low voltage,

then Blown IG fuse or bad fuse contact.

Recommendation(s) :

Replace IG fuse or repair fuse contact.

Symptom 8 File batt

battery and charging systems problem

is a 'charge warning lamp does not go out after engine starts'

If check voltage at terminal B of alternator, the voltage is over 15 V

and check voltage at terminal N of alternator, the voltage is normal,

then Defective regulator.

Recommendation(s) :

Repair or replace regulator.

Symptom 9 'File batt

battery and charging systems problem

is a 'charge warning lamp does not go out after engine starts'

If check voltage at terminal B of alternator, the voltage is over 15 V

and check voltage at terminal N of the regulator connector, it is no voltage,

then Open in the neutral circuit of the alternator.

Recommendation(s) :

Repair or replace alternator.

File Link :

Symptom 10 File batt

battery and charging systems problem

is a 'charge warning lamp does not go out after engine starts'

If check voltage at terminal B of alternator, the voltage is lower than 13 V

and check the field voltage at terminal F of the regulator connector, the voltage is corrected,

then Broken coil in the rotor or faulty brush contact in the alternator.

Recommendation(s) :

Repair or replace the alternator.

Symptom 11 File batt

battery and charging systems problem

is a 'charge warning lamp does not go out after engine starts'

If check battery voltage at the IG terminal of regulator connector, the voltage is normal, then The regulator does not supply voltage to the alternator.

Recommendation(s) :

Repair or replace regulator.

Symptom 12 File batt

battery and charging systems problem

is a 'charge warning lamp does not go out after engine starts'

If check the voltage at the end of the wire harness between the ignition switch and the IG terminal of regulator connector, no voltage indicates, then A damage to the wire harness between the ignition switch and regulator connector.

Recommendation(s) :

Repair wire harness.

Symptom 13 File batt

battery and charging systems problem

is a 'charge warning lamp lights faintly when engine is running'

If check fuse or contact in the charge warning lamp circuit, it is blown or bad contact, then There is reverse current from terminal L of the regulator via the charge warning lamp due to blown fuse or fuse contact.

Recommendation(s) :

Repair or replace fuse or fuse contact.

Symptom 14 File batt

battery and charging systems problem

is a 'charge warning lamp lights faintly when engine is running'

If check internal resistance of the ignition switch, there is much contact resistance in the ignition switch, then There is reverse current from terminal L of the regulator via the charge warning lamp due to excessive resistance in the ignition switch.

Recommendation(s) :

Repair or replace the ignition switch.

Symptom 15 File batt

battery and charging systems problem

is a 'charge warning lamp lights faintly when engine is running'

If check contact at each connector of the wire harness, there is much resistance in the wiring harness, then There is reverse current from terminal L of the regulator via the charge warning lamp due to excessive resistance at the contact connector of the wire harness.

Recommendation(s) :

Repair the contact connector of the wire harness.

Symptom 16 File batt

battery and charging systems problem

is a 'charge warning lamp sometimes comes on while engine is running'

If lightly tap the alternator and regulator connector, the charge warning lamp blinks,

then The connector terminals are not making proper contact due to vibration, the current to the terminals will be interrupted, so the alternator will not be able to generate power.

Recommendation(s) :

Repair the alternator and regulator connector terminals to proper contact.

Symptom 17 File batt

battery and charging systems problem

is a 'charge warning lamp sometimes comes on while engine is running'

If check the contact condition of each point of the regulator and resistance between each terminal, there is excessive resistance, then Defective regulator.

Recommendation(s) :

Repair or replace the regulator.

Symptom 18 File batt

battery and charging systems problem

is a 'charge warning lamp sometimes comes on while engine is running'

If check the contact condition of the brushes and the slip rings, the brushes are worn over limit, then Field current to the rotor will be interrupt, and the alternator will not be able to generate power due to poor brushes contact.

Recommendation(s) :

Replace the brushes.

1wa BRAKE

Symptom 1 File brake

brake system problem

is a 'too much pedal travel before brakes operate'

If excessive brake pedal free play,

then Master-cylinder push-rod has excessive clearance.

Recomendation(s) :

Adjust push rod clearance.

Symptom 2 File brake

brake system problem

is a 'too much pedal travel before brakes operate'

If after check and/or adjusted brake pedal free play the

problem stills happen,

then The brake shoes are excessively worn.

Recomendation(s) :

Replace the brake shoes and adjust the brakes.

CLUTCH

Symptom 1 File clutch

clutch system problem

is a 'clutch slips while engaged'

If the clutch-pedal is insufficient free travel,
then Improper clutch-linkage adjustment.

Recommendation(s) :

Adjust free travel to manufacturer's specification.

Symptom 2 File clutch

clutch system problem

is a 'clutch slips while engaged'

If the pedal free travel is correct and the clutch still
slips while engaged,

then Broken or weak pressure springs.

Worn friction-disk facings.

Binding of clutch release mechanism.

Grease or oil on disk facings.

Recommendation(s) :

The clutch must be removed from the car so that it can be
disassembled and examined.

Symptom 3 File clutch

clutch system problem

is a 'clutch grabs or chatters while engaging'

If the clutch linkage is free and operating in normal fashion,

then Oil or gum on the pressure plate, friction-disk, or flywheel facings.

Binding of release mechanism or friction-disk hub on clutch shaft.

Broken disk facing, springs, or pressure plate.

Loose drive-line mechanisms (shaft bushings, universal joint, or coupling).

Recommendation(s) :

Removing the clutch from the car so that it can be disassembled and examined.

Symptom 4 File clutch

clutch system problem

is a 'clutch spins or drags while disengaged'

If the clutch-pedal is excessive free travel,

then Full pedal movement will not fully release the clutch.

Recommendation(s) :

Adjust free travel to manufacturer's specification and try clutch again.

Symptom 5 'File clutch

clutch system problem

is a 'clutch spins or drags while disengaged'

If pedal free travel is correct and the clutch still drags or spins while disengaged,

then Warped or distorted friction disk or pressure plate.

Loose friction-disk facings.

Friction-disk hub binding on clutch shaft.

Improper release-lever adjustment (on clutch with this type of adjustment).

No grease in transmission.

Recommendation(s) :

The clutch must be removed from the car, disassembled, and examined so that the trouble can be found.

Symptom 6 'File clutch

clutch system problem

is a 'clutch-pedal pulsation'

then Improper alignment of transmission with engine.

Pressure plate out of alignment.

Release levers (on adjustable type) not evenly adjusted.

Flywheel not seated on crankshaft flange or flange bent.

Recommendation(s) :

Correct alignment and adjust, repair or replace defective parts.

Symptom 7 File clutch

clutch system problem

is a 'rapid friction-disk-facing wear'

If the driver usually keeps his foot on the clutch pedal, partly depressing it (called 'riding' the clutch), then The clutch slips due to riding the clutch.

Recommendation(s) :

Change driving habits.

Symptom 8 File clutch

clutch system problem

is a 'rapid friction-disk-facing wear'

If the driver is not riding the clutch but it still rapid wears,

then Improper pedal-linkage adjustment.

Weak or broken pressure springs.

Warped pressure plate or friction disk.

Rough flywheel or friction disk.

Recommendation(s) :

Adjust the pedal-linkage.

The clutch must be removed from the car, disassembled, and examined so that the trouble can be found.

Symptom 9 File clutch

clutch system problem

is a 'clutch noises'

If the noise is heard with the clutch engaged,

Friction-disk hub loose on clutch shaft.

Friction-disk springs broken or weak.

Misalignment to transmission and engine.

Recommendation(s) :

Removal and disassembly of the clutch units involved so that the parts can be adjusted or replaced.

Symptom 10 File clutch

clutch system problem

is a 'clutch noises'

If the noise is heard with the clutch disengaged,

then Throw-out bearing that is worn, binding, or

inadequately lubricated.

Adjustable-type release levers out of adjustment so that they rub against hub.

Clutch-shaft pilot bearing in crankshaft that is worn or inadequately lubricated.

Retracting spring (on diaphragm-spring clutch) that is worn so that it rattles.

Recommendation(s) :

Removal and disassembly of the clutch units involved so that the parts can be adjusted or replaced.

Wā cool

Symptom 1 File cool

cooling system problem

is a 'engine warms up slowly'

If by squeezing the upper hose immediately after starting a cold, you should be felt the coolant flow through the upper hose,

then The thermostat is missing or stuck-open.

Recommendation(s) :

Install the proper thermostat for your particular engine.

Symptom 2 File cool

cooling system problem

is a 'engine warms up slowly'

If cover the front of the radiator core until the engine temperature is at least normal, the gauge still reads 'Cold' or light is still brightness,

then Defective temperature gauge or temperature sending switch.

Recommendation(s) :

Check electrical circuits. Repair as required.

Symptom 3 File cool

cooling system problem

is a 'engine overheats'

If the coolant level in the reservoir is always found to be lower than LOW line,

then Leakage in the cooling system.

Recommendation(s) :

Check for leak and repair as necessary.

Symptom 4 File cool

cooling system problem

is a 'engine overheats'

If the fan turns improperly

and the fan belt is noisy,

then Fan belt looses or missing.

Recommendation(s) :

Adjust or replace the fan belt.

Symptom 5 File cool

cooling system problem

is a 'engine overheats'

If there are leaves, insects or dirt on radiator or air

conditioner condenser,

then Air does not cool water (Radiator or air conditioner

condenser obstructed).

Recommendation(s) :

Clean radiator or air conditioner condenser.

Symptom 6 File cool

cooling system problem

is a 'engine overheats'

If the engine overheats without the radiator becoming normally warm

and the fan belt is properly tightened,

then The thermostat does not open normally, blocking circulation of coolant.

The thermostat is installed backwards usually cannot open.

Recommendation(s) :

Test. Replace it if necessary.

Install the thermostat in correct position.

Symptom 7 File cool

cooling system problem

is a 'engine overheats'

If the water is always overflow through the overflow tube(s) or vent,

then Defective or wrong radiator pressure cap.

Recommendation(s) :

Check that the radiator cap's rubber seal and pressure-test the radiator cap and replace it necessary.

Symptom 8 File cool

cooling system problem

is a 'engine overheats'

If the fan belt is properly tightened
and the fan turns improperly when engine is hot,
then Fan-drive clutch defective.

Recommendation(s) :

Test. Replace it if necessary.

Symptom 9 File cool

cooling system problem

is a 'engine overheats'

If water pressure from water pump is too low
(from pressure testing),
then Water pump faulty.

Recommendation(s) :

Repair or replace water pump.

Symptom 10 File cool

cooling system problem

is a 'engine overheats'

If the vehicle has been driven too long in a low gear,
then Water does not cool properly.

Recommendation(s) :

Check driving habits or driving conditions.

File Link : IGNIT

Symptom 11 File cool

cooling system problem

is a 'repeated loss of coolant'

If coolant loss through the overflow tube or vent while engine is normal temperature,

then The radiator pressure cap or gasket defective.

Recommendation(s) :

Inspect, wash and pressure test. Replace if cap will not hold pressure.

Symptom 12 File cool

cooling system problem

is a 'repeated loss of coolant'

If check cooling system, you should be observed coolant leakage (rust stains usually show where),

then Coolant leak due to loose or damage cooling system parts as observed.

Recommendation(s) :

Inspect hoses, connections, gaskets, core plugs, drain plugs, water pump, expansion tank and hose, radiator. Repair or replace as required.

Symptom 13 File cool

cooling system problem

is a 'repeated loss of coolant'

If the engine emitting clouds of white exhaust smoke,
then The coolant leaks into some other part of the engine.

Recommendation(s) :

Check head-bolt torque.

Dissemble engine as necessary, check for blown head gasket,
cracked \n head or block.

Two DRIVE

Symptom 1 File drive

drive line systems problem

is a 'knock in drive line, clunking noise'

If clunking noise when car is operated under floating condition at 16 km/h in high gear or neutral,

then Worn or damaged universal joints.

Side-gear hub counterbore in differential worn oversize.

Recomendation(s) :

Replace the universal joints.

Replace differential case and/or side gears as required.

Symptom 2 File drive

drive line systems problem

is a 'ping, snap, or click in drive line'

If usually occurs on initial load application after transmission has been put in gear either forward or reverse,

then Loose bushing bolts in upper or lower control arm.

Loose companion flange.

Recomendation(s) :

Tighten bolts to specified torque.

Remove companion flange, turn 180 degree from its original position, lubricate splines, and tighten pinion nut to specified torque.

171 EMIS

Symptom 1 File emis

exhaust and emission control systems problem

is a 'engine has rough idle'

If engine has a PCV valve

and engine is frequent stalling or loping (speeding up and slowing down),

then The PCV valve is stuck open or a clogged PCV air filter.

Recommendation(s) :

Replace the PCV valve or the PCV air filter.

Symptom 2 File emis

exhaust and emission control systems problem

is a 'engine has rough idle'

If engine has a PCV valve

and after install new PCV valve the loping or rough idle persists,

then Restrictions in the PCV valve lines.

Recommendation(s) :

Replace the PCV valve lines.

File Link : MECH

Symptom 3 File emis

exhaust and emission control systems problem

is a 'engine hesitates or has poor acceleration'

If the engine has EGR valve,

then The EGR valve is stuck open or opens too soon, it

will admit too much exhaust gas to the engine

cylinders and cause weak combustion.

Recommendation(s) :

Check, clean the EGR valve.



1wa ENGINE

Symptom 1 File engine

engine problem

is a 'engine does not crank'

File Link : START

Symptom 2 File engine

engine problem

is a 'engine cranks slowly but does not start'

File Link : START

Symptom 3 File engine

engine problem

is a 'engine cranks normally but does not start'

if no or weak spark at all spark plug wires when spark test.

File Link : IGNIT

Symptom 4 File engine

engine problem

is a 'engine cranks normally but does not start'

if the fuel can not be seen squirting into carburetor throat
while pumping throttle linkage.

File Link : FUEL

- Symptom 5** File engine
engine problem
is a 'engine cranks normally but does not start
if check the ignition system and fuel systems,they are
properly operated.
File Link : MECH
- Symptom 6** File engine
engine problem
is a 'engine backfires but fails to start'
File Link : IGNIT")
- Symptom 7** File engine
engine problem
is a 'engine starts but fails to keep running'
File Link : IGNIT
- Symptom 8** File engine
engine problem
is a 'engine has rough idle'
File Link : FUEL
- Symptom 9** File engine
engine problem
is a 'engine runs but misses steadily at all speeds'
File Link : IGNIT

- Symptom 10 File engine
engine problem
is a 'engine runs but misses intermittently at all speeds'
File Link : IGNIT
- Symptom 11 File engine
engine problem
is a 'engine runs but misses at high speed only'
File Link : IGNIT
- Symptom 12 File engine
engine problem
is a 'engine runs but misses at idle only'
File Link : IGNIT"
- Symptom 13 File engine
engine problem
is a 'engine misses erratically at all speeds'
File Link : FUEL
- Symptom 14 File engine
engine problem
is a 'engine hesitates or has poor acceleration'
File Link : FUEL
- Symptom 15 File engine
engine problem
is a 'engine 'runs on' when switched off'
File Link : FUEL

Symptom 16 File engine
engine problem
is a 'engine overheats'
File Link : COOL

Two FUEL

Symptom 1 File fuel

fuel system problem

is a 'engine cranks normally but does not start'

if engine does not start at all conditions.

File Link : FUEL1

Symptom 2 File fuel

fuel system problem

is a 'engine cranks normally but does not start'

if engine does not start when it is hot.

File Link : FUEL2

Symptom 3 File fuel

fuel system problem

is a 'engine cranks normally but does not start'

if engine does not start when it is cold.

Symptom 4 File fuel

fuel system problem

is a 'engine cranks normally but does not start'

if engine does not start when it is cold and

the choke valve does not close far enough for the ambient temperature,

then the air-fuel mixture will not be rich enough to start the engine.

Recommendation(s) :

Adjust or repair choke system.

Symptom 5 Fuel fuel

fuel system problem

is a 'engine cranks normally but does not start'

if engine does not start when it is cold

and the choke valve close too far

and the engine to stall immediately after starting,

then the mixture too rich to start the engine (this is called overchoking).

Recommendation(s) :

Adjust or repair choke system.

Symptom 6 Fuel fuel

fuel system problem

is a 'engine cranks normally but does not start'")

if engine does not start when it is cold

and the idle speed too low with engine warmed up,

then the fast idle will not be able to be correctly adjusted.

Recommendation(s) :

Adjust fast idle speed.

Symptom 7 File fuel

fuel system problem

is a 'engine cranks normally but does not start'

if engine does not start when it is cold

and before starting engine depress the accelerator pedal

slightly and release it, the choke does not close,

then the automatic choke does not operate.

Recommendation(s) :

Repair or replace the automatic choke.

File Link : MECH

Symptom 8 File fuel

fuel system problem

is a 'engine starts but fails to keep running'

if there is insufficient fuel supply to the carburetor,

then no fuel, fuel line clogged or fuel pump faulty.

Recommendation(s) :

Check fuel in tank, fuel line and fuel pump.

File Link : MECH

Symptom 9 File fuel

fuel system problem

is a 'engine hesitates or has poor acceleration'

if the carburetor fuel float level is at normal level

(see from sight glass)

and gasoline does not spurt out from the acceleration

nozzle (check by opening the throttle valve),

then accelerator pump faulty or accelerator linkage out of adjustment.

Recommendation(s) :

Repair or replace accelerator pump, or check full throttle in the car is also full throttle at the carburetor. Adjust as necessary.

File Link : FUEL2

Symptom 10 File fuel

fuel system problem

is a 'engine has rough idle'

if the engine operating normally under all other conditions,

then improper idle speed and fuel mixture adjustments.

Recommendation(s) :

Adjust idle speed and idle speed fuel mixture to specification.

Symptom 11 Fuel fuel

fuel system problem

is a 'engine has rough idle'

if the engine operating normally under all other conditions and altering idle speed and mixture adjustments does not seem to help,

then the idle circuit is clogged.

Recommendation(s) :

Clean idle circuit.

Symptom 12 Fuel fuel

fuel system problem

is a 'engine has rough idle'

if rough idle combined with other engine operating troubles, such as lack of power, missing, overheating and so on,

then Intake vacuum leak.

Recommendation(s) :

Check manifold, carburetor mounting, any connections to manifold and vacuum advance.

Symptom 13 File fuel

fuel system problem

is a 'engine runs but misses at idle only'

if the problem exist after carburetor's idle mixture is adjusted,

then carburetor's idle mixture is improperly adjusted.

Recommendation(s) :

Readjust the carburetor's idle mixture according to the manufacturer's specifications.

File Link : FUEL1

Symptom 14 File fuel

fuel system problem

is a 'engine runs but misses at high speed only'

if check the fuel pump pressure, its pressure is not within manufacturer's specifications,

then the fuel pump pressure is erratic.

Recommendation(s) :

Replace the fuel pump.

File Link : FUEL2

Symptom 15 File fuel

fuel system problem

is a 'engine misses erratically at all speeds'

if engine coughs and splutters irregularly often backfiring, then there may be dirt or water in the fuel system.

Recommendation(s) :

Clean out the fuel system.

File Link : FUEL2

**Symptom 16** File fuel

fuel system problem

is a 'engine has rough idle'

if the throttle valve shaft is loose,

then air leak through the throttle valve shaft to engine
causing the mixture too lean.

Recommendation(s) :

Replace or repair the throttle valve shaft.

File Link : IGNIT

Symptom 17 File fuel

fuel system problem

is a 'engine 'runs on' when switched off'

if the carburetor has a fuel cut solenoid valve

and the engine has smooth idle

and the fuel cut solenoid valve does not a click when
connecting and disconnecting the valve terminal to battery
terminal,

then the fuel cut solenoid valve is stuck opened.

Recommendation(s) :

Replace or repair the fuel cut solenoid valve.

176 FUEL1

Symptom 1 Fuel fuel

fuel system problem

is a 'engine cranks normally but does not start'

If it has fuel in fuel tank but the fuel can not be seen squirting into carburetor throat while pumping throttle

linkage

and engine does not start at all conditions

and the gasoline will not be visible through the sight

glass when operate the acceleration pump is not the

presence of gasoline in the float chamber

and disconnect the carburetor's inlet hose and crank

the engine then see that gasoline is coming out of the hose,

then no gasoline in float chamber due to the needle valve

is sticking to the seat or the needle valve strainer is

clogged up.

Recommendation(s) :

Clean or replace needle valve set or strainer.

Symptom 2 File fuel1

fuel system problem

is a 'engine cranks normally but does not start'

If it has fuel in fuel tank but the fuel can not be seen squirting into carburetor throat while pumping throttle linkage

and engine does not start at all conditions

and when crank engine the gasoline is not coming out of the carburetor's inlet hose

and the fuel level in the fuel filter is not rise

and when operate the acceleration pump is not the presence of gasoline in the float chamber,

then fuel pump malfunction.

Recommendation(s) :

Repair or replace fuel pump.

Symptom 3 File fuel1

fuel system problem

is a 'engine cranks normally but does not start'

If it has fuel in fuel tank but the fuel can not be seen squirting into carburetor throat while pumping throttle linkage

and engine does not start at all conditions

and fuel pump operating normally

and the fuel level in the fuel filter is rise

and when operate the acceleration pump is not the presence of gasoline in the float chamber,

then fuel filter is clogged.

Recommendation(s) :

Replace the fuel filter.

Symptom 4 File fuel1

fuel system problem

is a 'engine cranks normally but does not start'

If engine does not start at all conditions

and float level gasoline in float chamber is corrected

and the primary or secondary throttle valve are open when
the engine is started,

then the air-fuel mixture will be too lean due throttle
valve does not close.

Recommendation(s) :

Repair or replace.

Symptom 5 File fuel1

fuel system problem

is a 'engine cranks normally but does not start'

If engine does not start at all conditions

and float level gasoline in float chamber is corrected

and the throttle valve shaft is loose,

then air leak through the throttle valve shaft to engine
causing the mixture too lean.

Recommendation(s) :

Replace or repair throttle valve shaft.

Symptom 6 File fuel1

fuel system problem

is a 'engine cranks normally but does not start'

If engine does not start at all conditions

and float level gasoline in float chamber is corrected

and the carburetor has fuel cut solenoid valve

and you do not feel a click from the solenoid valve when

connecting and disconnecting the valve terminal to battery terminal,

then Fuel cut solenoid valve is not open.

Recommendation(s) :

Replace fuel cut solenoid valve.

Symptom 7 File fuel1

fuel system problem

is a 'engine cranks normally but does not start'

If engine does not start at all conditions

and float level gasoline in float chamber is corrected

and the throttle valve and fuel cut solenoid valve are

normal,

then primary low speed circuit is clogged.

Recommendation(s) :

Repair (clean).

Symptom 8 File fuel1

fuel system problem

is a 'engine runs but misses at idle only'

If altering the idle mixture adjustment does not seem to help,

then There are restrictions in the idle fuel system of the carburetor.

Recommendation(s) :

Remove,disassemble and clean out the carburetor.

Symptom 9 File fuel1

fuel system problem

is a 'engine cranks normally but does not start'

If engine does not start at all conditions

and the gasoline will not be visible through the sight glass

and when operate the acceleration pump is presence of gasoline in the float chamber,

then A foreign particle has gotten between the needle valve and seat,jamming the valve open causing overflowing.

Recommendation(s) :

Lightly tap the air horn over the needle valve with grip of screwdriver to loosens the particle.

Clean the needle valve and the valve seat.

File Link : MECH

170 FUEL2

Symptom 1 File fuel2

fuel system problem

is a 'engine cranks normally but does not start'

If engine does not start when it is hot

and choke closed when engine is hot,

then The carburetor flooding is due to overchoking.

Recommendation(s) :

Check choke system.

Symptom 2 File fuel2

fuel system problem

is a 'engine cranks normally but does not start'

If engine does not start when it is hot

and choke is proper operated and a strong odor of fuel is present after engine is stopped,

then The carburetor flooding is due to fuel percolation.

Recommendation(s) :

Open the throttle wide and crank the engine to exhaust the rich gases.

Insulated the carburetor from the heat of the engine.

File Link : MECH

Symptom 3 File fuel2

fuel system problem

is a 'engine runs but misses at high speed only'

If the fuel pump pressure and float level are normal,
then Carburetor's power valve or passages are clogged or
damaged.

Recommendation(s) :

Disassemble carburetor and clean or replace the necessary
components.

Symptom 4 File fuel2

fuel system problem

is a 'engine misses erratically at all speeds'

If check fuel filter, it is clogged,
then Insufficient fuel to carburetor.

Recommendation(s) :

Replace the fuel filter.

Symptom 5 File fuel2

fuel system problem

is a 'engine misses erratically at all speeds'

If check carburetor float level, it is higher than normal
level,

then The fuel is erratic flow to engine cylinders.

Recommendation(s) :

Readjust the carburetor float level according to the
manufacturer's specifications.

Symptom 6 File fuel2

fuel system problem

is a 'engine hesitates or has poor acceleration'

**If the carburetor float level setting is low,
then Insufficient fuel for accelerating.**

Recommendation(s) :

**Readjust the carburetor float level setting according to
the manufacturer's specifications.**

File Link : IGNIT

Worn GEAR

Symptom 1 File gear

gearbox system problem

is a 'gear noises'

If excessive noise in any one gear position,
then Defective gears or bearings that are loaded in that
gear position.

Recommendation(s) :

Removal and disassembly of the gearbox involved so that
the parts can be repaired.

Symptom 2 File gear

gearbox system problem

is a 'gear noises'

If humming or growling during the time that the gears
under load,

then Worn, chipped, rough, or cracked gears.

Recommendation(s) :

Removal and disassembly the gearbox then replace the gears.

Symptom 3 File gear

gearbox system problem

is a 'gear noises'

If gear-grinding noise during engagement(car not moving),
then Engine idling too fast.

Recommendation(s) :

Adjust as required.

Symptom 4 File gear

gearbox system problem

is a 'gear noises'

If grinding noise during gear changes,

then Clutch not operating correctly.

Synchromesh worn.

Worn gearbox bearings.

Recommendation(s) :

Inspect and correct the clutch.

Removal and disassembly of the gearbox involved so that

the parts can be repaired.

Symptom 5 File gear

gearbox system problem

is a 'gear noises'

If gear noisy in forward gears,

then Lubricant level is low.

Gearbox misaligned.

Gearbox internal component(s) worn, broken or damaged.

Recommendation(s) :

Add the lubricant in corrects level.

Align and tighten bolts.

Repair or replace defective parts.

Symptom 6 File gear

gearbox system problem

is a 'gear noises'

If gearbox noisy in reverse,

then Reverse idler-gear or shaft worn or damaged.

Recommendation(s) :

Replace defective part(s).

Symptom 7 File gear

gearbox system problem

is a 'gear noises'

If gear lever rattles or makes buzzing noise,

then Gear-stick loose.

Gear-stick damper loose or missing.

Gear-stick ball and socket over-lubricated.

Remote-control linkage worn.

Recommendation(s) :

Check and tighten gear-stick.

Check, tighten or replace gear-stick damper.

Remove, dry ball and socket, lubricate sparingly and replace.

Fit new parts as necessary.

Symptom 8 File gear

gearbox system problem

is a 'hard gear shifting'

If the shift lever moves hard in all gears,
then Insufficient lubrication of linkages, excessive
tension on shifter rail or shift springs.

Sliding gears tight on shaft splines, bent shifter fork,
scored synchronizing cone or drums, or improper linkage
adjustments.

Failure of clutch to release fully.

Recommendation(s) :

Lubricate linkages, check and adjust or replace springs.

Removal and disassembly of the gearbox involved so that
the parts can be adjusted or repaired or reeplaced.

Check and repair the clutch.

Symptom 9 File gear

gearbox system problem

is a 'hard gear shifting'

If gear clashing when shifting into second or high,
then Failure of the synchronizing mechanism because of
a broken spring, end play, or defective cone surfaces.

The clutch may not be releasing fully.

Recommendation(s) :

Check and replace defective parts.

Check and repair the clutch.

Symptom 10 File gear

gearbox system problem

is a 'hard gear shifting'

If gear clashing when shifting into first and/or reverse position,

then The clutch may not be releasing fully.

Recommendation(s) :

Check and repair the clutch.

Symptom 11 File gear

gearbox system problem

is a 'failure of gears to stay in mesh'

If the gears slip out of high,

then Misalignment between the engine and the gearbox.

Excessive mainshaft end play, worn bearings.

Insufficient spring tension on the gearshift-lever detent ball notch or worn notch.

Damaged or poor fit of sliding sleeve or synchronizing unit in gearbox main gear, or improperly adjusted linkage.

Recommendation(s) :

Correct the gearbox alignment.

Removal and disassembly of the gearbox involved so that the parts can be adjusted, repaired or replaced.

Symptom 12 File gear

gearbox system problem

is a 'failure of gears to stay in mesh'

If the gears slip out of second,

then Abnormal gear clearance or end play of main shaft,
worn gear teeth.

Defective fit of sliding sleeve or synchronizing unit in
second-gear or on main shaft.

Improperly adjusted linkages.

Recommendation(s) :

Removal and disassembly of the gearbox involved so that
the parts can be adjusted, repaired or replaced.

Symptom 13 File gear

gearbox system problem

is a 'failure of gears to stay in mesh'

If the gears slip out of low or reverse,

then Loose fit of sliding sleeve and low-speed gear on main
shaft, excessive countershaft end play.

Improperly adjusted linkages.

Recommendation(s) :

Removal and disassembly of the gearbox involved so that
the parts can be adjusted, repaired or replaced.

IGNIT

Symptom 1 File ignit

ignition system problem

is a 'engine cranks normally but does not start'

if no or weak spark is observed from coil out wire (when spark test),

then the ignition primary circuit is defective.

Recommendation(s) :

Check ignition switch, low tension wires, ballast resistor, contact breaker point for shorted or defective, clean, repair or replace.

Check condenser with condenser test, replace if it is faulty.

Check ignition coil for open or shorted, replace.

Check contact breaker for shorts or missing insulation

between moving arm and baseplate, replace if it is shorts.

Check ignition module for open, grounded loose, or corroded, or defective, repair or replace.

Check reluctor or pickup coil for defective, replace.

Symptom 2 File ignit

ignition system problem

is a 'engine cranks normally but does not start'

if no or weak spark is observed from all or any spark plug wires (when spark test),

then the ignition secondary circuit is defective.

Recommendation(s) :

Check distributor cap towers and/or terminals, carbon brush, if they are corroded or eroded, replace.

Check distributor rotor, if it is cracked, replace.

Check spark plug wires, if it is crack or deterioration, replace.

Symptom 3 File ignit

ignition system problem

is a 'engine cranks normally but does not start'

if the engine is wet due to it has been raining or the car has just been washed,

then the high tension wires being shorted through condensation or damp.

Recommendation(s) :

Remove the distributor cap and dry it out.

Wipe all spark plug cables dry and off the coil primary cable.

Wipe all moisture from the distributor terminal housing, cap, coil, spark plugs and spark plug wires.

Symptom 4 File ignit

ignition system problem

is a 'engine cranks normally but does not start'

if engine is misfired,

then Defective or dirty spark plugs or incorrect ignition timing or secondary cables not connected in firing order.

Recommendation(s) :

Check spark plug gap and adjust to recommended specifications \nor clean spark plugs.

Adjust ignition timing or reconnect firing order.

File Link : FUEL

Symptom 5 File ignit

ignition system problem

is a 'engine backfires but fails to start'

if the car has just been washed or it has been raining,

then the high tension wires being shorted.

Recommendation(s) :

Wipe all dust and moisture from the exterior of the distributor, coil, spark plugs, and spark plug wires and again attempt to start the engine.

Symptom 6 File ignit

ignition system problem

is a 'engine backfires but fails to start'

if the car has just been washed or it has been raining and

check interior of distributor cap, it is wet,

then high-voltage leakage between terminals.

Recommendation(s) :

Dry the interior of distributor cap and rotor.

Symptom 7 File ignit

ignition system problem

is a 'engine backfires but fails to start'

if the problem is existed after the spark plug wires are removed and installed,

then the spark plug wires go to incorrect spark plugs.

Recommendation(s) :

Reconnect the spark plug wires correctly.

Symptom 8 File ignit

ignition system problem

is a 'engine backfires but fails to start'

if check distributor cap and rotor, they are cracked or shorted,

then the high-voltage surge jumps from its normal path to nearby terminal or spark plug wire causing the wrong spark plug to fire.

Recommendation(s) :

Replace defective parts.

Symptom 9 File ignit

ignition system problem

is a 'engine starts but fails to keep running'

if unsatisfactory spark is being delivered to the spark plugs,

then defective in ignition system.

Recommendation(s) :

Check to find defective parts and repair or replace.

File Link : FUEL

Symptom 10 File ignit

ignition system problem

is a 'engine has rough idle'

if the engine operating normally under all other conditions

and idle speed and mixture are proper adjustments, then fouled or improperly gapped spark plugs.

Recommendation(s) :

Clean and adjust spark plug gaps or replace spark plugs.

Symptom 11 File ignit

ignition system problem

is a 'engine has rough idle'

if rough idle combined with other engine operating troubles, such as lack of power, missing, overheating and so on

and no leak in intake system,

then contact-breaker points incorrectly set or worn.

Loose connections in the ignition primary circuit.

Recommendation(s) :

Clean and adjust (or replace) breaker points.

Tighten all connections in the ignition primary circuit, including the condenser ground connection.

Symptom 12 File ignit

ignition system problem

is a 'engine has rough idle'

if rough idle combined with other engine operating troubles, such as lack of power, missing, overheating and so on

and altering contact-breaker points and tighten all connections does not seem help,

then Incorrect ignition timing.

Recommendation(s) :

Adjust ignition timing to specification.

File Link : EMIS

Symptom 13 File ignit

ignition system problem

is a 'engine runs but misses steadily at all speeds'

File Link : IGNIT1")

Symptom 14 File ignit

ignition system problem

is a 'engine runs but misses intermittently at all speeds'

File Link : IGNIT2

Symptom 15 File ignit

ignition system problem

is a 'engine runs but misses at high speed only'

File Link : IGNIT3

Symptom 16 File ignit

ignition system problem

is a 'engine runs but misses at idle only'

File Link : IGNIT1

Symptom 17 File ignit

ignition system problem

is a 'engine hesitates or has poor acceleration'

if the engine backfires while its accelerated,

then the ignition timing is set too late, i.e., "retard".

Incorrect distributor automatic advance.

Recommendation(s) :

Readjust ignition timing to manufacturer's specifications.

Replace worn or damaged parts. Adjust engine timing to specifications. Remove restriction or carry out repair, or tighten connections in vacuum line.

File Link : IGNIT3

Symptom 18 File ignit

ignition system problem

is a 'engine overheats'

If the cooling system is properly operated

and the engine has poor acceleration,

then Retard ignition timing.

Recommendation(s) :

Adjust ignition timing to meet the manufacturer's specifications.

IGNIT1

Symptom 1 File ignit1

ignition system problem

is a 'engine runs but misses steadily at all speeds'

If check the rpm drop as each spark plug wire is disconnected, no rpm drop when a particular spark plug wire is disconnected,

then The particular spark plug is defective.

Recommendation(s) :

Replace the defective spark plug.

Symptom 2 File ignit1

ignition system problem

is a 'engine runs but misses steadily at all speeds'

If check the resistance of each spark plug wire, it is abnormal resistance,

then Spark plug wires are broken, cracked or otherwise defective.

Recommendation(s) :

Replace those wires which do not meet the manufacturer's specifications.

Symptom 3 File ignit1

ignition system problem

is a 'engine runs but misses steadily at all speeds'

If inspect distributor cap, it is cracked, burned or eroded terminals, corrosion in the sockets or evidence of carbon tracking,

then The distributor cap is chipped, cracked or otherwise defective.

Recommendation(s) :

Replace or repair distributor cap as necessary.

Symptom 4 File ignit1

ignition system problem

is a 'engine runs but misses at idle only'

If check contact points gap, it is smaller than specification,

then The ignition contact points are incorrectly set.

Recommendation(s) :

Readjust the gap and check it with a dwell meter, as specification.

Symptom 5 File ignit1

ignition system problem

is a 'engine runs but misses at idle only'

If check condition of distributor's shaft, distributor cam and rubbing block, they are loose or worn,

then Incorrect ignition timing due to worn distributor's shaft bushing or the distributor cam and rubbing block.

Recommendation(s) :

Replace the bushing or the cam and breaker points unit.

Symptom 6 File ignit1

ignition system problem

is a 'engine runs but misses at idle only'

If the contact points, distributor's shaft, distributor
cam and rubbing block are proper condition,

then Ignition system has a faulty coil or condenser.

Recommendation(s) :

Check the coil and condenser with an electrical tester and
replace the necessary defective parts.

File Link : FUEL

1wa IGNIT2

Symptom 1 File ignit2

ignition system problem

is a 'engine runs but misses intermittently at all speeds'

If inspect the breaker contacts points, they are dirty or corroded,

then Excessive the contact points resistance.

Recommendation(s) :

Clean or replace the contact points as necessary.

Symptom 2 File ignit2

ignition system problem

is a 'engine runs but misses intermittently at all speeds'

If the breaker contact points are corroded rapidly,

then The distributor's condenser has excessive condenser resistance, output capacity, or leakage.

Recommendation(s) :

Check it with a condenser tester. Make sure that all the connections are tight. Replace the condenser if it is defective.

Symptom 3 File ignit2

ignition system problem

is a 'engine runs but misses intermittently at all speeds'

If check voltage drop across the primary resistance wire or ballast resistor with voltmeter, it is abnormal voltage drop,

then The ignition coil's primary winding shows evidence of worn insulation or broken strands, and the coil's terminals are loose or corroded.

Recommendation(s) :

Replace defective units if not within manufacturer's specifications.

Symptom 4 File ignit2

ignition system problem

is a 'engine runs but misses intermittently at all speeds'

If proper ignition primary circuit,

then Ignition coil is defective.

Recommendation(s) :

Check the coil with a coil tester and replace it if it is defective.

Ywa IGNIT3

Symptom 1 File ignit3

ignition system problem

is a 'engine runs but misses at high speed only'

If check condition of spark plugs, they are abnormal,
then Spark plugs are fouled or incorrectly gapped.

Recommendation(s) :

Clean and regap the spark plugs as necessary.

File Link : FUEL

Symptom 2 File ignit3

ignition system problem

is a 'engine hesitates or has poor acceleration'

If the engine misfires while its accelerated,
then Spark plugs are fouled or incorrectly gapped.

Recommendation(s) :

Clean and regap the spark plugs to manufacturer's
specification.

Symptom 3 File ignit3

ignition system problem

is a 'engine hesitates or has poor acceleration'

If altering the spark plugs do not seem to help,
then The distributor's contact points are dirty or pitted.

Recommendation(s) :

Clean the contact points as necessary and regap to
manufacturer's specifications.

File Link : EMIS

ไฟล์ LIGHT

Symptom 1 File light

body electrical system problem

is a 'head lamps do not light for both high and low beams'

If after check and corrected fusible link, this problem can be eliminated,

then Head lamps are open circuit due defective fusible link.

Recommendation(s) :

Replace fusible link.

File Link : LIGHT2

Symptom 2 File light

body electrical system problem

is a 'high beam cannot be switched to low beam or vice versa'

If conduct continuity test across the combination switch, the head lamps will light,

then Defective combination switch.

Recommendation(s) :

Replace combination switch.

Symptom 3 File light

body electrical system problem

is a 'high beam cannot be switched to low beam or vice versa'

If conduct continuity test across the light relay, the head lamps will light,

then Defective light relay.

Recommendation(s) :

Check light relay for proper operation and replace if necessary.

Symptom 4 File light

body electrical system problem

is a 'head lamps dim'

If the head lamps will bright while increased engine speed, then Partly discharged or defective battery.

Recommendation(s) :

Measure specific gravity of electrolyte and recharge or replace battery if necessary.

File Link : LIGHT2

Symptom 5 File light

body electrical system problem

is a 'head lamp lights on only one side'

If after check and corrected the head lamp connection, the head lamp light,

then Loose head lamp connection.

Recommendation(s) :

Repair and/or tighten head lamp connection.

Symptom 6 File light

body electrical system problem

is a 'turn signal lamps do not operate'

If after check and corrected fuse, turn signal lamps will normal operate,

then Burnt fuse.

Recommendation(s) :

Replace fuse.

File Link : LIGHT2

Symptom 7 File light

body electrical system problem

is a 'flashing cycle is too slow or too fast (Pilot lamp does not go out)'

If the problem exists after replace new bulbs,

then Bulbs of wattage other than that specified is being used.

Recommendation(s) :

Replace with one specified.

File Link : LIGHT2

Symptom 8 File light

body electrical system problem

is a 'flashing cycle is irregular'

If flashing cycle is normal after replace new bulbs,

then Burnt bulbs.

Recommendation(s) :

Check and replace defective bulb with one specified.

File Link : LIGHT2

Symptom 9 File light

body electrical system problem

is a 'the stoplights remain on'

If after check and corrected stoplight switch, the stoplights will normal operate,

then The stoplight switch is improperly adjusted or defective.

Recommendation(s) :

Adjust or replace the stoplight switch as required.

File Link : LIGHT2

Symptom 10 File light

body electrical system problem

is a 'the stoplights do not go on'

If after check and corrected fuse, the stoplights will normal operate,

then A fuse may be blown out.

Recommendation(s) :

Replace the fuse using one of correct ampere rating.

File Link : LIGHT2

Symptom 11 File light

body electrical system problem

is a 'horn does not operate'

If head lamps dim,

then Discharged battery.

Recommendation(s) :

Recharge or replace battery.

File Link : LIGHT2

Symptom 12 File light

body electrical system problem

is a 'horn sounds continuously'

If when the lead wire is disconnected from horn relay 'S' terminal, horn stops to sound,

then Short-circuited horn button and/or horn button lead wire.

Recommendation(s) :

Repair horn button or its its wiring.

Symptom 13 File light

body electrical system problem

is a 'horn sounds continuously'

If when the lead wire is disconnected from horn relay 'H' terminal, horn stops to sound,

then Defective horn relay.

Recommendation(s) :

Replace horn relay.

Symptom 14 File light

body electrical system problem

is a 'horn reduced volume and/or tone quality'

If after check and corrected connector contact

(fuse, relay, horn and/or horn button), horn sound is normal,

then Loose or poor connector contact.

Recommendation(s) :

Repair connector contact.

Symptom 15 File light

body electrical system problem

is a 'horn reduced volume and/or tone quality'

If horn sounds abnormal when 'B' and 'H' horn relay

terminals are connected with a test lead,

then Defective horn.

Recommendation(s) :

Repair or replace horn.

Symptom 16 File light

body electrical system problem

is a 'windshield wipers do not operate'

If windshield wipers will operate when connected test lead

across the wiper fuse,

then The wiper fuse is blown.

Recommendation(s) :

Replace the fuse with one of correct ampere rating.

File Link : LIGHT2

Symptom 17 File light

body electrical system problem

is a 'windshield wiper operating speed is too slow'

If the head lamps dim,

then Low source voltage.

Recommendation(s) :

Recharged or replace battery if necessary.

Symptom 18 File light

body electrical system problem

is a 'windshield wiper operating speed is too slow'

If the wiper operating speed is normal when conduct continuity test the wiper switch,

then Improper wiper switch contact.

Recommendation(s) :

Repair or replace the wiper switch.

File Link : LIGHT2

Symptom 19 File light

body electrical system problem

is a 'windshield washer does not operate'

If windshield washer will operate when connected pump motor terminal to battery with test lead,

then The windshield washer switch or the wiring or connectors are faulty.

Recommendation(s) :

Replace the windshield washer switch.

Check all the connectors to make sure that they are clean and tight.

Check the wiring for open or short circuiting.

Symptom 20 File light

body electrical system problem

is a 'windshield washer does not operate'

If the windshield washer pump does not operate,
then The windshield washer pump is defective.

Recommendation(s) :

Replace the windshield washer pump.

File Link : LIGHT1

Washer LIGHT1

Symptom 1 File light1

body electrical system problem

is a 'windshield washer does not operate'

If windshield washer will operate after check and

corrected the fluid level in the reservoir,

then The fluid level in the reservoir is low.

Recommendation(s) :

Add fluid into reservoir as required to bring up the level.

Symptom 2 File light1

body electrical system problem

is a 'windshield washer does not operate'

If windshield washer will operate when check and corrected

the hose leading to the nozzles and the nozzles,

then The hose leading to the nozzles are disconnected or

damaged.

The nozzles are clogged.

Recommendation(s) :

Reconnect or replace the hoses as required.

Clean out the nozzles or replace them.

Wiring LIGHT2

Symptom 1 File light2

body electrical system problem

is a 'head lamps do not light for both high and low beams'

If after check and corrected head lamps connection, this problem can be eliminated,

then Loose connection or open circuit.

Recommendation(s) :

Check wiring and/or repair connection.

Symptom 2 File light2

body electrical system problem

is a 'head lamps do not light for both high and low beams'

If conduct continuity test across the combination switch, the head lamps will light,

then Defective combination switch.

Recommendation(s) :

Replace combination switch.

Symptom 3 File light2

body electrical system problem

is a 'head lamps do not light for both high and low beams'

If after added ground, the head lamps will light,

then Defective light relay.

Recommendation(s) :

Check light relay for proper operation and replace if necessary.

Symptom 4 File light2

body electrical system problem

is a 'head lamps do not light for both high and low beams'

If after added ground, the head lamps will light,
then No ground.

Recommendation(s) :

Clean and tighten ground terminal.

Symptom 5 File light2

body electrical system problem

is a 'head lamps dim'

If after check and corrected ground and connection, the
head lamps will bright,

then Poor ground or loose connection.

Recommendation(s) :

Clean and/or tighten.

Symptom 6 File light2

body electrical system problem

is a 'head lamps dim'

If the voltage at head lamp terminals is less than 12.8
Volts while increased engine speed,

then Defective charging system.

Recommendation(s) :

Check and correct charging system for proper operation.

Symptom 7 File light2

body electrical system problem

is a 'turn signal lamps do not operate'

If after check and corrected wiring connection, the turn signals normal operate,

then Loose connection or open circuit.

Recommendation(s) :

Check wiring and/or repair connection.

Symptom 8 File light2

body electrical system problem

is a 'turn signal lamps do not operate'

If after check and corrected flasher unit, the turn signals will normal operate,

then Defective flasher unit.

Recommendation(s) :

Replace flasher unit.

Symptom 9 File light2

body electrical system problem

is a 'turn signal lamps do not operate'

If after conduct continuity test turn signal lamps across turn signal switch, the turn signal lamps will normal operate,

then Defective turn signal switch.

Recommendation(s) :

Repair or replace turn signal switch.

Symptom 10 File light2

body electrical system problem

is a 'flashing cycle is too slow or too fast (Pilot lamp does not go out)'

If flashing cycle is normal after replace new bulbs,
then Burnt bulbs.

Recommendation(s) :

Check and replace defective bulb with one specified.

Symptom 11 File light2

body electrical system problem

is a 'flashing cycle is too slow or too fast (Pilot lamp does not go out)'

If after check and corrected the wiring connection,
flashing cycle is normal,
then Loose connection.

Recommendation(s) :

Check wiring and/or repair connection.

Symptom 12 File light2

body electrical system problem

is a 'flashing cycle is too slow or too fast (Pilot lamp does not go out)'

If after check and corrected flasher unit, the flashing
cycle will normal operate,
then Defective flasher unit.

Recommendation(s) :

Replace flasher unit.

Symptom 13 File light2

body electrical system problem

is a 'flashing cycle is irregular'

If after check and corrected the wiring connection,

flashing cycle is normal,

then Loose connection.

Recommendation(s) :

Check wiring and/or repair connection,

Symptom 14 File light2

body electrical system problem

is a 'flashing cycle is irregular'

If the problem exists after replace new bulbs,

then Bulbs of wattage other than that specified is being used.

Recommendation(s) :

Replace with one specified.

Symptom 15 File light2

body electrical system problem

is a 'the stoplights remain on'

If after check and corrected wiring for grounds, the

stoplight will normal operate,

then The wiring is faulty.

Recommendation(s) :

Check the wiring in the affected circuit for grounds, and correct as necessary.

Symptom 16 File light2

body electrical system problem

is a 'the stoplights do not go on'

If after check and replace the bulbs,the stoplights go on,
then The bulbs are burned out.

Recommendation(s) :

Replace the bulbs using correct type replacement bulbs.

Symptom 17 File light2

body electrical system problem

is a 'the stoplights do not go on'

If after conduct continuity test across the stoplight
switch,the stoplights go on,

then The stoplight switch is improperly adjusted or
defective.

Recommendation(s) :

Adjust or replace the switch as required.

Symptom 18 File light2

body electrical system problem

is a 'the stoplights do not go on'

If after check and corrected wiring connection,the
stoplights go on,

then Loose connection or open circuit.

Recommendation(s) :

Check the connectors to make sure that they are clean and
tight.

Check wiring in affected circuit for opens or grounds.

Symptom 19 File light2

body electrical system problem

is a 'horn does not operate'

If after check and corrected fuse, horn sounds,
then Burnt fuse.

Recommendation(s) :

Replace the fuse using one of correct ampere rating.

Symptom 20 File light2

body electrical system problem

is a 'horn does not operate'

If horn sounds when horn relay 'S' terminal is grounded,
then Faulty horn button contact.

Recommendation(s) :

Repair horn button.

Symptom 21 File light2

body electrical system problem

is a 'horn does not operate'

If horn sounds when 'B' and 'H' horn relay terminals are
connected with a test lead,
then Defective from horn relay.

Recommendation(s) :

Replace horn relay.

Symptom 22 File light2

body electrical system problem

is a 'horn does not operate'

If horn sounds after check and corrected horn and wiring connection,

then Defective horn or loose horn terminal connection.

Recommendation(s) :

Correct horn terminal connection or replace horn.

Symptom 23 File light2

body electrical system problem

is a 'windshield wipers do not operate'

If after check and corrected wiring and connectors, the windshield wipers will normal operate,

then Faulty wiring or connectors.

Recommendation(s) :

Check all the connectors to make sure that they are clean and tight:

Check the wiring for open or short circuiting.

Symptom 24 File light2

body electrical system problem

is a 'windshield wipers do not operate'

If windshield wipers will operate when check and corrected the wiper switch,

then The wiper switch is faulty.

Recommendation(s) :

Replace the wiper switch.

Symptom 25 File light2

body electrical system problem

is a 'windshield wipers do not operate'

If the wipers will not operate when connected the wiper motor terminal to battery with lead test, then The wiper motor is faulty.

Recommendation(s) :

Repair or replace the wiper motor.

Symptom 26 File light2

body electrical system problem

is a 'windshield wipers do not operate'

If the wiper motor will turn when the wiper link is disconnected,

then Foreign materials interrupt the movement of link mechanism.

Seized or rusted arm shaft.

Recommendation(s) :

Remove the foreign materials.

Lubricate or replace arm shaft.

Symptom 27 File light2

body electrical system problem

is a 'windshield wiper operating speed is too slow'

If humming occurs on motor in arm operating cycle, then Seized arm shaft and/or link mechanism.

Recommendation(s) :

Lubricate or replace

Symptom 28 File light2

body electrical system problem

is a 'windshield wiper operating speed is too slow'

If with arm raised, excessive current still flow to wiper motor,

then Short-circuit of motor armature.

Seized wiper motor shaft.

Recommendation(s) :

Replace wiper motor.

Rplace wiper motor or lubricate bearing with engine oil.

Symptom 29 File light2

body electrical system problem

is a 'windshIELD wiper operating speed is too slow'

If windshield wiper stops by lightly holding with hand, then Worn wiper motor brush.

Recommendation(s) :

Replace wiper motor.

Symptom 30 File light2

body electrical system problem

is a 'windshield wiper operating speed is too slow'

If wiper operating speed is normal when raise arm and windshield wiper with out applying load,

then Windshield wiper blade sticks on windshield glass.

Recommendation(s) :

Clean windshield glass and/or replace wiper blade.

1wa LUB

Symptom 1 File lub

lubricating system problem

is a 'engine uses too much oil (excessive oil consumption)'

If blue-gray smoke from exhaust when accelerate the engine after operating idle speed for short time,

then The oil is getting into the combustion chamber past the valve \n guides and the piston rings and it burns.

Recommendation(s) :

The engine will require a teardown and overhaul to replace and repair the valve guides and piston rings.

Symptom 2 File lub

lubricating system problem

is a 'engine uses too much oil (excessive oil consumption)'

If have oil spots under the engine of a parked car,

then The oil leak from a loose fitting or filter, or from a gasket or seal that fails.

Recommendation(s) :

Clean engine thoroughly. Run engine (hot) and look for leaks.

Replace or tighten gaskets as necessary.

Symptom 3 File lub

lubricating system problem

is a 'engine uses too much oil (excessive oil consumption)'

If have oil spots under the engine of a parked car and
check PCV valve, it is stuck closed,

then Oil leak through gaskets and seals due to excessive
crankcase pressure.

Recommendation(s) :

Replace PCV valve.

Symptom 4 File lub

lubricating system problem

is a 'oil-pressure light or gauge shows low pressure'

If check the level of the oil in the oil pan to use the
dipstick, the oil level under low line,

then Low oil level.

Recommendation(s) :

Add oil to correct level.

Symptom 5 File lub

lubricating system problem

is a 'oil-pressure light or gauge shows low pressure'

If check condition of oil, it is contaminated or contains
gasoline,

then Oil excessively thin because of dilution, poor quality,
or improper grade.

Recommendation(s) :

Drain and refill crankcase with recommended oil.

Symptom 6 File lub

lubricating system problem

is a 'oil-pressure light or gauge shows low pressure'

If substitute a good oil-pressure sending unit or gauge,

the light or gauge reads normally,

then Defective oil-pressure sending unit or inaccurate

gauge.

Recommendation(s) :

Inspect and replace the oil-pressure sending unit or gauge.

Symptom 7 File lub

lubricating system problem

is a 'oil-pressure light or gauge shows low pressure'

If check oil pressure with oil-pressure gauge while running

engine, the oil pressure is lower than normal,

then A weak or broken relief-valve spring. and

A worn oil pump. and

A broken or cracked or an obstruction in the oil line.

Recommendation(s) :

Check, repair or replace the defective parts.

Symptom 8 File lub

lubricating system problem

is a 'oil-pressure light or gauge shows low pressure'

If noise from the main, rod, or camshaft bearings,

then Excessive main, rod, or camshaft bearing clearance.

Recommendation(s) :

Measure bearing clearances, repair as necessary.

1WA MECH

Symptom 1 File mech

mechanical parts system problem

is a 'engine cranks normally but does not start'

If check compression all cylinders with compression test gauge, the compression is extremely low,

then Compression is leaked through damage engine parts such as piston rings, valves, head gasket.

Recommendation(s) :

Determine cause of low compression by performing a compression test with compression tester and correct as necessary.

Symptom 2 File mech

mechanical parts system problem

is a 'engine starts but fails to keep running'

If ignition and fuel systems are properly operated, then Leaking valves and valves sticking or with incorrect clearances and then broken or weak valve springs and then worn guides and leaking cylinder gasket and leak past piston rings, scored cylinder bores.

Recommendation(s) :

Repair or replace the defective parts.

Symptom 3 File mech

mechanical parts system problem

is a 'engine has rough idle'

If rough idle combined with other engine operating troubles, such as lack of power, missing, overheating and so on and check engine compression, it is lower than normal, then Poor valve to valve seat contact.

Failure of cylinder head gasket.

Recommendation(s) :

Regrinding or replace valve and valve seat.

Replace cylinder head gasket.

Symptom 4 File mech

mechanical parts system problem

is a 'engine has rough idle'

If rough idle combined with other engine operating troubles, such as lack of power, missing, overheating and so on and check valve clearance, it is too tight.

then Leak through valves.

Recommendation(s) :

Adjust valve clearance to specification.

1wa START

Symptom 1 File start

starting system problem

is a 'engine does not crank'

If the starting motor does not spin.

File Link : START1

Symptom 2 File start

starting system problem

is a 'engine does not crank'

If the starting motor spins and drive pinion engages with
flywheel ring gear,

then The starting motor overrunning clutch is slipping.

Recommendation(s) :

Repair or replace the overrunning clutch.

Symptom 3 File start

starting system problem

is a 'engine does not crank'

If the starting motor spins and the pinion gear is rotates,
making unusual rapsing noise,

then Damage or worn the pinion or ring gear.

Recommendation(s) :

Replace the gear.

Symptom 4 File start

starting system problem

is a 'engine cranks slowly but does not start'

File Link : START2

Symptom 5 File start

starting system problem

is a 'unusual noises'

If high-pitched whine during cranking (before engine fires),

then Too much clearance between the overrunning-clutch pinion and ring gear.

Recommendation(s) :

Adjusting the clearance between pinion and ring gear according to the manufacturer's specifications.

Symptom 6 File start

starting system problem

is a 'unusual noises'

If high-pitched whine during after engine fires as key is released,

then Too little clearance between the overrunning-clutch pinion and ring gear.

Recommendation(s) :

Adjusting the clearance between pinion and ring gear according to the manufacturer's specifications.

Symptom 7 File start

starting system problem

is a 'unusual noises'

If loud whoop, buzzing, or siren sound after engine fires but while starter is engaged-sounds like a siren if engine is rewed,

then Defective overrunning clutch.

Recommendation(s) :

Replace overrunning clutch.

Symptom 8 File start

starting system problem

is a 'unusual noises'

If Rumble, growl, or knock as starter is coasting to a stop after engine starts,

then Bent or unbalanced armature.

Recommendation(s) :

Replace armature.

1wa START1

Symptom 1 File start1

starting system problem

is a 'engine does not crank'

If the starting motor does not spin

and the solenoid plunger to repeatedly pull in and release (making a clattering noise),

then Insufficient voltage is being applied to the starting motor or defective starter solenoid.

Recommendation(s) :

Check battery terminal voltage. While starting, if the voltage below 9.8 Volt, recharge or replace the battery.

Check for stains or corroded battery terminal, cables or loose connections as well.

Check starter solenoid for damaged hold-in coil, improper hold-in coil grounding.

Symptom 2 File start1

starting system problem

is a 'engine does not crank'

If the starting motor does not spin

and the solenoid plunger does not pull in(not loud click),

then Starting circuit is opened.

Recommendation(s) :

Check ignition switch, the wiring between battery and solenoid switch terminal and repair or replace any defective components.

Check the starter solenoid and repair or replace, if its defective.

Symptom 3 File start1

starting system problem

is a 'engine does not crank'

If the starting motor does not spin

and the solenoid plunger pulls in (a loud click) but
nothing else happens,

then Short or open circuit in the starting motor.

The pinion gear jammed in flywheel ring gear.

Seized engine or water in cylinder.

Recommendation(s) :

Repair or replace starting motor.

Free the pinion gear.

Check engine to find trouble.

Ywa START2

Symptom 1 File start2

starting system problem

is a 'engine cranks slowly but does not start'

If check battery voltage before starting, the voltage is lower than normal,

then Battery low in charge.

Recommendation(s) :

Charge battery and check charging system.

Symptom 2 File start2

starting system problem

is a 'engine cranks slowly but does not start'

If battery cables or connections are abnormal hot while starting engine,

then Corroded battery cables or loose connections, or bad engine-to-chassis earth strap, or undersize battery cables.

Recommendation(s) :

Clean battery connections or replace battery cables and earth strap. Tighten battery and starter-motor connections.

Symptom 3 File start2

starting system problem

is a 'engine cranks slowly but does not start'

If this problem exists after change engine oil, then Incorrect viscosity of engine oil.

Recommendation(s) :

Drain crankcase and refill with proper-viscosity engine oil and change oil filter if necessary.

Symptom 4 File start2

starting system problem

is a 'engine cranks slowly but does not start'

If the engine can not be turned easily with a socket and wrench at the engine crankshaft pulley,

then Problem in mechanical parts such as a broken or seized piston ring or bearing.

Recommendation(s) :

Disassembly engine to find causes of rotational resistance and repair.

Symptom 5 File start2

starting system problem

is a 'engine cranks slowly but does not start'

If check starting motor when it removed from engine, it spins at normal speed,

then Defective in starting motor.

Recommendation(s) :

Check solenoid contact, repair or replace if necessary.

Check the brushes and the commutator, repair or replace if necessary.

Check for slipping if the starter overrunning-clutch, replace if necessary.

check for shorting into starting motor, repair or replace if necessary.

WHEEL STEER

Symptom 1 File steer

steering system problem

is a 'car hard to steer'

If car is used manual steering

and check steering linkage, it is excessive friction,

then steering linkage is dry.

Recommendation(s) :

Lubricate linkage.

Symptom 2 File steer

steering system problem

is a 'car hard to steer'

If car is used power steering

and check power steering belt, it is too loose,

then Power steering belt slips.

Recommendation(s) :

Tighten or replace belt.

Symptom 3 File steer

steering system problem

is a 'poor steering wheel return'

If check steering gear, it is excessive friction,

then Steering gear misadjusted or low oil level.

Recommendation(s) :

Have steering gear adjusted or lubricated.

Symptom 4 File steer

steering system problem

is a 'poor steering wheel return'

If check steering linkage, it is excessive friction,
then steering linkage is dry.

Recommendation(s) :

Lubricate linkage.

Symptom 5 File steer

steering system problem

is a 'car hard to steer'

If car is used power steering
and check steering gear, it is excessive friction,
then Steering gear misadjusted or low oil level.

Recommendation(s) :

Have steering gear adjusted or lubricated.

Symptom 6 File steer

steering system problem

is a 'loud squeal in steering'

If car is used power steering
and check power steering belt, it is too loose,
then Power steering belt slips.

Recommendation(s) :

Tighten or replace belt.

Symptom 7 File steer

steering system problem

is a 'grinding noise in steering'

If car is used power steering

and check power steering fluid level, it is too low,

then Lack power steering fluid for properly operation.

Recommendation(s) :

Check and corrected for fluid leakage, add power steering fluid for proper level.

Symptom 8 File steer

steering system problem

is a 'car hard to steer'

If car is used power steering

and check power steering fluid level, it is too low,

then Lack power steering fluid for properly operation.

Recommendation(s) :

Check and corrected for fluid leakage, add power steering fluid for proper level.

Symptom 9 File steer

steering system problem

is a 'car hard to steer'

If car is used power steering

and check power steering pump pressure, it is low pressure

while power steering belt and fluid level are normal,

then Power steering pump faulty.

Recommendation(s) :

Have pump tested and repair.

Symptom 10 File steer

steering system problem

is a 'steering wheel surges or jerks'

If car is used power steering

and check power steering pump pressure, it is low pressure

while power steering belt and fluid level are normal,

then Power steering pump faulty.

Recommendation(s) :

Have pump tested and repair.

Symptom 11 File steer

steering system problem

is a 'steering wheel surges or jerks'

If car is used power steering

and check steering linkage, it is loose,

then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

Symptom 12 File steer

steering system problem

is a 'car pulls to one side when in motion'

If check steering linkage, it is loose,

then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

Symptom 13 File steer

steering system problem

is a 'car pulls to one side when in motion'

If check steering gear, it is excessive friction,
then Steering gear misadjusted or low oil level.

Recommendation(s) :

Have steering gear adjusted or lubricated.

Symptom 14 File steer

steering system problem

is a 'car wanders from side to side'

If check steering linkage, it is loose,
then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

Symptom 15 File steer

steering system problem

is a 'car wanders from side to side'

If check steering gear, it is excessive friction,
then Steering gear misadjusted or low oil level.

Recommendation(s) :

Have steering gear adjusted or lubricated.

Symptom 16 File steer

steering system problem

is a 'front wheels shimmy'

If check tie rod ends, they are loosen,
then Tie rod ends are worn.

Recommendation(s) :

Have tie rod ends replace.

Symptom 17 File steer

steering system problem

is a 'front wheels shimmy'

If check steering linkage, it is loose,
then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

Symptom 18 File steer

steering system problem

is a 'front wheels shimmy'

If check steering gear, it is excessive friction,
then Steering gear misadjusted or low oil level.

Recommendation(s) :

Have steering gear adjusted or lubricated.

Symptom 19 File steer

steering system problem

is a 'uneven tire wear'

If check steering linkage, it is loose,
then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

File Link : STEER1

Symptom 20 File steer

steering system problem

is a 'steering wheel shimmies'

If check steering linkage, it is loose,
then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

File Link : STEER1

Symptom 21 File steer

steering system problem

is a 'play or looseness in steering'

If check steering linkage, it is loose,
then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

File Link : STEER1

Symptom 22 File steer

steering system problem

is a 'steering wheel kicks back'

If check steering linkage, it is loose,
then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

Symptom 23 File steer

steering system problem

is a 'noise in front end'

If check steering linkage, it is loose,
then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

Symptom 24 File steer

steering system problem

is a 'non-parallel wheel tracking (crabbing)'

If check steering gear, it is excessive friction,
then Steering gear misadjusted or low oil level.

Recommendation(s) :

Have steering gear adjusted or lubricated.

Symptom 25 File steer

steering system problem

is a 'steering erratic when brakes are applied'

If check steering linkage, it is loose,
then Steering linkage is loose or worn.

Recommendation(s) :

Tighten or replace steering linkage.

1wa STEER1

Symptom 1 File steer1

steering system problem

is a 'uneven tire wear'

If check tie rod ends, they are loosen,
then Tie rod ends are worn.

Recommendation(s) :

Have tie rod ends replace.

Symptom 2 File steer1

steering system problem

is a 'steering wheel shimmies'

If check tie rod ends, they are loosen,
then Tie rod ends are worn.

Recommendation(s) :

Have tie rod ends replace.

Symptom 3 File steer1

steering system problem

is a 'play or looseness in steering'

If check steering gear, it is excessive friction,
then Steering gear misadjusted or low oil level.

Recommendation(s) :

Have steering gear adjusted or lubricated.

Symptom 4 File steer1

steering system problem

is a 'play or looseness in steering'

If check tie rod ends, they are loosen,

then Tie rod ends are worn.

Recommendation(s) :

Have tie rod ends replace.

File SUS

Symptom 1 File sus

suspension system problem

is a 'car pulls to one side when in motion'

If check condition of suspension arms, they are damaged,
then Car is misaligned due to suspension arms are damaged.

Recommendation(s) :

Repair suspension arms.

Symptom 2 File sus

suspension system problem

is a 'car pulls to one side when in motion'

If check condition of springs or leafs, they are sagging or
broken,

then Car is misaligned due to springs or leafs are sagging
or broken.

Recommendation(s) :

Have new or helper springs or leafs installed.

File Link : SUS2

Symptom 3 File sus

suspension system problem

is a 'car wanders from side to side'

If check condition of shock absorbers, they are abnormal
operation,

then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

Symptom 4 File sus

suspension system problem

is a 'car wanders from side to side'

If check condition of suspension arms, they are damaged,
then Car is misaligned due to suspension arms are damaged.

Recommendation(s) :

Repair suspension arms.

File Link : SUS2

Symptom 5 File sus

suspension system problem

is a 'uneven tire wear'

If check condition of rear-axle housing, it is bent,
then Car is misaligned due to the rear-axle housing is bent.

Recommendation(s) :

Have rear-axle housing checked and repaired.

Symptom 6 File sus

suspension system problem

is a 'uneven tire wear'

If check condition of tire, it is abnormalled,
then Bump or blister on tire.

Recommendation(s) :

Replace faulty tire.

File Link : SUS2

Symptom 7 File sus

suspension problem

is a 'rapid or excessive tire wear'

If check condition of suspension arms, they are damaged,
then Car is misaligned due to suspension arms are damaged.

Recommendation(s) :

Repair suspension arms.

Symptom 8 File sus

suspension problem

is a 'rapid or excessive tire wear'

If check condition of shock absorbers, they are abnormal
operation,

then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

File Link : SUS2

Symptom 9 File sus

suspension system problem

is a 'wear on one sides of tires (scuffing) '

If check condition of suspension arms, they are damaged,
then Car is misaligned due to suspension arms are damaged.

Recommendation(s) :

Repair suspension arms.

Symptom 10 File sus

suspension system problem

is a 'car hard to steer'

If check condition of suspension arms, they are damaged,
then Car is misaligned due to suspension arms are damaged.

Recommendation(s) :

Repair suspension arms.

Symptom 11 File sus

suspension system problem

is a 'car hard to steer'

If check condition of frame or underbody, it is bent,
then Car is misaligned due to frame or underbody is
misaligned.

Recommendation(s) :

Have frame and underbody checked and realigned.

File Link : SUS1

Symptom 12 File sus

suspension system problem

is a 'poor steering wheel return'

File Link : SUS1

Symptom 13 File sus

suspension system problem

is a 'heavy thumps on rough roads'

If check condition of suspension arms, they are damaged,
then Car is misaligned due to suspension arms are damaged.

Recommendation(s) :

Repair suspension arms.

Symptom 14 File sus

suspension system problem

is a 'heavy thumps on rough roads'

If check condition of springs or leafs, they are sagging or broken,

then Car is misaligned due to springs or leafs are sagging or broken.

Recommendation(s) :

Have new or helper springs or leafs installed.

File Link : SUS2

Symptom 15 File sus

suspension system problem

is a 'body leans or sways when car corners'

If extra weight on the car,

then Car is overloaded.

Recommendation(s) :

Remove extra weight from the car or install heavier shocks.

Symptom 16 File sus

suspension system problem

is a 'body leans or sways when car corners'

If check condition of suspension arms, they are damaged,

then Car is misaligned due to suspension arms are damaged.

Recommendation(s) :

Repair suspension arms.

File Link : SUS2

Symptom 17 File sus

suspension system problem

is a 'front wheel shimmy'

If check condition of springs or leafs, they are sagging or broken,

then Car is misaligned due to springs or leafs are sagging or broken.

Recommendation(s) :

Have new or helper springs or leafs installed.

Symptom 18 File sus

suspension system problem

is a 'front wheel shimmy'

If check condition of sway bar and bushings, they are loose,

then Car is misaligned due to loose sway bar, worn bushings.

Recommendation(s) :

Tighten or replace loose or worn parts.

File Link : SUS2

Symptom 19 File sus

suspension system problem

is a 'non-parallel wheel tracking (crabbing)'

If check condition of springs or leafs, they are sagging or broken,

then Car is misaligned due to springs or leafs are sagging or broken.

Recommendation(s) :

Have new or helper springs or leafs installed.

Symptom 20 File sus
suspension system problem
is a 'steering erratic when brakes are applied'
If check condition of springs or leafs, they are sagging
or broken,
then Car is misaligned due to springs or leafs are sagging
or broken.
Recommendation(s) :
Have new or helper springs or leafs installed.

Symptom 21 File sus
suspension system problem
is a 'noise in front end'
If check condition of springs or leafs, they are sagging
or broken,
then Car is misaligned due to springs or leafs are sagging
or broken.
Recommendation(s) :
Have new or helper springs or leafs installed.

Symptom 22 File sus
suspension system problem
is a 'suspension bottoms out on bumps'
File Link : SUS1

Symptom 23 File sus
suspension system problem
is a 'car vibrates at high speeds'
File Link : SUS1

Symptom 24 File sus

suspension system problem

is a 'wheel thumps'

File Link : SUS1

Symptom 25 File sus

suspension system problem

is a 'steering wheel shimmies'

File Link : SUS1

Symptom 26 File sus

suspension system problem

is a 'play or looseness in steering'

File Link : SUS1

Symptom 27 File sus

suspension system problem

is a 'ride too hard or too soft'

File Link : SUS1

ไฟล์ SUS1**Symptom 1** File sus1

suspension system problem

is a 'car hard to steer'

If check condition of ball joints, they are binding,
then Defective ball joints.

Recommendation(s) :

Grease or replace ball joints.

Symptom 2 File sus1

suspension system problem

is a 'car hard to steer'

If the front end used MacPherson strut,
then MacPherson strut bearing is worn.

Recommendation(s) :

Replace worn parts.

Symptom 3 File sus1

suspension system problem

is a 'poor steering wheel return'

If check condition of ball joints, they are binding,
then Defective ball joints.

Recommendation(s) :

Grease or replace ball joints.

Symptom 4 File sus1

suspension system problem

is a 'noise in front end'

If the front end used MacPherson strut,
then MacPherson strut bearing is worn.

Recommendation(s) :

Replace worn parts.

Symptom 5 File sus1

suspension system problem

is a 'suspension bottoms out on bumps'

If check condition of springs, they are sagging or broken,
then The springs are sagging or broken.

Recommendation(s) :

Have new or helper springs installed.

Symptom 6 File sus1

suspension system problem

is a 'suspension bottoms out on bumps'

If extra weight on the car,
then Car is overloaded.

Recommendation(s) :

Remove extra weight from the car or install heavier shocks.

Symptom 7 File sus1

suspension system problem

is a 'suspension bottoms out on bumps'

If check condition of shock absorbers, they are abnormal,
then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

Symptom 8 File sus1

suspension system problem

is a 'car vibrates at high speeds'

If check condition of tire, it is abnormal condition,
then Bump or blister on tire.

Recommendation(s) :

Replace faulty tire.

Symptom 9 File sus1

suspension system problem

is a 'wheel thumps'

If check condition of tire, it is abnormal condition,
then Bump or blister on tire.

Recommendation(s) :

Replace faulty tire.

Symptom 10 File sus1

suspension system problem

is a 'car vibrates at high speeds'

If check condition of shock absorbers, they are abnormal,
then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

Symptom 11 File sus1

suspension system problem

is a 'wheel thumps'

If check condition of shock absorbers, they are abnormal,
then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

Symptom 12 File sus1

suspension system problem

is a 'steering wheel shimmies'

If check condition of ball joints, they are loosed,
then Ball joints are worn.

Recommendation(s) :

Have ball joints replaced.

Symptom 13 File sus1

suspension system problem

is a 'play or looseness in steering'

If check condition of ball joints, they are loosed,
then Ball joints are worn.

Recommendation(s) :

Have ball joints replaced.

Symptom 14 File sus1

suspension system problem

is a 'ride too hard or too soft'

If check condition of shock absorbers, they are abnormal,
then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

Unit SUS2**Symptom 1** File sus2

suspension system problem

is a 'car pulls to one side when in motion'

If check condition of sway bar and bushings, they are loose,
then Car is misaligned due to loose sway bar, worn bushings.

Recommendation(s) :

Tighten or replace loose or worn parts.

Symptom 2 File sus2

suspension system problem

is a 'car pulls to one side when in motion'

If check condition of frame or underbody, it is bent,
then Car is misaligned due to frame or underbody is
misaligned.

Recommendation(s) :

Have frame and underbody checked and realigned.

Symptom 3 File sus2

suspension system problem

is a 'car pulls to one side when in motion'

If check condition of ball joints, they are loose,
then Car is misaligned due to ball joints are worn.

Recommendation(s) :

Have ball joints replaced.

Symptom 4 File sus2

suspension system problem

is a 'car wanders from side to side'

If check condition of springs or leafs, they are sagging or broken,

then Car is misaligned due to springs or leafs are sagging or broken.

Recommendation(s) :

Have new or helper springs or leafs installed.

Symptom 5 File sus2

suspension system problem

is a 'car wanders from side to side'

If check condition of sway bar and bushings, they are loose, then Car is misaligned due to loose sway bar, worn bushings.

Recommendation(s) :

Tighten or replace loose or worn parts.

Symptom 6 File sus2

suspension system problem

is a 'car wanders from side to side'

If check condition of ball joints, they are loose, then Car is misaligned due to ball joints are worn.

Recommendation(s) :

Have ball joints replaced.

Symptom 7 File sus2

suspension system problem

is a 'uneven tire wear'

If check condition of suspension arms, they are damaged,
then Car is misaligned due to suspension arms are damaged.

Recommendation(s) :

Repair suspension arms.

Symptom 8 File sus2

suspension system problem

is a 'uneven tire wear'

If check condition of frame or underbody, it is bent,
then Car is misaligned due to frame or underbody is
misaligned.

Recommendation(s) :

Have frame and underbody checked and realigned.

Symptom 9 File sus2

suspension system problem

is a 'uneven tire wear'

If check condition of ball joints, they are loose,
then Car is misaligned due to ball joints are worn.

Recommendation(s) :

Have ball joints replaced.

Symptom 10 File sus2

suspension system problem

is a 'uneven tire wear'

If check condition of shock absorbers, they are abnormal operation,

then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

Symptom 11 File sus2

suspension system problem

is a 'car hard to steer'

If check condition of springs or leafs, they are sagging or broken,

then Car is misaligned due to springs or leafs are sagging or broken.

Recommendation(s) :

Have new or helper springs or leafs installed.

Symptom 12 File sus2

suspension system problem

is a 'heavy thumps on rough roads'

If check condition of ball joints, they are loose,

then Car is misaligned due to ball joints are worn.

Recommendation(s) :

Have ball joints replaced.

Symptom 13 File sus2

suspension system problem

is a 'heavy thumps on rough roads'

If check condition of shock absorbers, they are abnormal operation,

then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

Symptom 14 File sus2

suspension system problem

is a 'body leans or sways when car corners'

If check condition of sway bar and bushings, they are loose,

then Car is misaligned due to loose sway bar, worn bushings.

Recommendation(s) :

Tighten or replace loose or worn parts.

Symptom 15 File sus2

suspension system problem

is a 'body leans or sways when car corners'

If check condition of springs or leafs, they are sagging or broken,

then Car is misaligned due to springs or leafs are sagging or broken.

Recommendation(s) :

Have new or helper springs or leafs installed.

Symptom 16 File sus2

suspension system problem

is a 'body leans or sways when car corners'

If check condition of shock absorbers, they are abnormal operation,

then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

Symptom 17 File sus2

suspension system problem

is a 'front wheel shimmy'

If check condition of ball joints, they are looses,

then Car is misaligned due to ball joints are worn.

Recommendation(s) :

Have ball joints replaced.

Symptom 18 File sus2

suspension system problem

is a 'front wheel shimmy'

If check condition of shock absorbers, they are abnormal operation,

then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

Symptom 19 File sus2

suspension system problem

is a 'non-parallel wheel tracking (crabbing)'

If check condition of rear-axle housing, it is bent,
then Car is misaligned due to the rear-axle housing is
bent.

Recommendation(s) :

Have rear-axle housing checked and repaired.

Symptom 20 File sus2

suspension system problem

is a 'non-parallel wheel tracking (crabbing)'

If check condition of frame or underbody, it is bent,
then Car is misaligned due to frame or underbody is
misaligned.

Recommendation(s) :

Have frame and underbody checked and realigned.

Symptom 21 File sus2

suspension system problem

is a 'steering erratic when brakes are applied'

If check condition of frame or underbody, it is bent,
then Car is misaligned due to frame or underbody is
misaligned.

Recommendation(s) :

Have frame and underbody checked and realigned.

Symptom 22 File sus2

suspension system problem

is a 'noise in front end'

If check condition of shock absorbers, they are abnormal
operation,

then Shock absorbers are worn.

Recommendation(s) :

Replace shock absorbers.

File Link : SUS1

WHEEL

Symptom 1 File wheel

wheel and tire system problem

is a 'abnormal tire wear'

If tire rapid wear at shoulders,

then Under-inflation or lack of rotation.

Recommendation(s) :

Adjust pressure to specifications when tires are cool.

Symptom 2 File wheel

wheel and tire system problem

is a 'abnormal tire wear'

If tire rapid wear at center,

then Over-inflation or lack of rotation.

Recommendation(s) :

Adjust pressure to specifications when tires are cool.

Symptom 3 File wheel

wheel and tire system problem

is a 'abnormal tire wear'

If tire cracked treads,

then Under-inflation or excessive speed.

Recommendation(s) :

Adjust pressure to specifications when tires are cool.

Symptom 4 File wheel

wheel and tire system problem

is a 'abnormal tire wear'

If tire wear on one side,

then Excessive camber,

Recommendation(s) :

Adjust camber to specification.

Symptom 5 File wheel

wheel and tire system problem

is a 'abnormal tire wear'

If tire feathered edge,

then Incorrect toe.

Recommendation(s) :

Adjust toe-in to specification.

Symptom 6 File wheel

wheel and tire system problem

is a 'abnormal tire wear'

If tire bald spots,

then Unbalanced wheel or tire defect.

Recommendation(s) :

dynamic or static balance wheels.

Symptom 7 File wheel

wheel and tire system problem

is a 'abnormal tire wear'

If tire scalloped wear,

then Lack of rotation of tires or worn or out of alignment suspension.

Recommendation(s) :

Rotate tires and inspect suspension.

Symptom 8 File wheel

wheel and tire system problem

is a 'car pulls to one side when in motion'

If check tire pressure, the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

File Link : WHEEL1

Symptom 9 File wheel

wheel and tire system problem

is a 'car wanders from side to side'

If check tire pressure, the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

File Link : WHEEL1

Symptom 10 File wheel

wheel and tire system problem

is a 'car vibrates at high speeds'

If check tire pressure,the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

File Link : WHEEL1

Symptom 11 File wheel

wheel and tire system problem

is a 'front wheels shimmy'

If check tire pressure,the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

File Link : WHEEL1

Symptom 12 File wheel

wheel and tire system problem

is a 'uneven tire wear'

If check tire pressure,the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

File Link : WHEEL1

Symptom 13 File wheel

wheel and tire system problem

is a 'rapid or excessive tire wear'

If check tire pressure, the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

File Link : WHEEL1

Symptom 14 File wheel

wheel and tire system problem

is a 'car hard to steer'

If check tire pressure, the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

File Link : WHEEL1

Symptom 15 File wheel

wheel and tire system problem

is a 'heavy thumps on rough roads'

If check tire pressure, the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

Symptom 16 File wheel

wheel and tire system problem

is a 'body leans or sways when car corners'

If check tire pressure, the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

Symptom 17 File wheel

wheel and tire system problem

is a 'ride too hard or too soft'

If check tire pressure, the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

Symptom 18 File wheel

wheel and tire system problem

is a 'wear on sides of tires (scuffing)'

If check tire pressure, the tire pressure is improper to specification,

then The tire pressure is low or uneven.

Recommendation(s) :

Inflate all tires properly.

File Link : WHEEL1

Symptom 19 File wheel

wheel and tire system problem

is a 'steering wheel shimmies'

If check front wheel bearings,they are loosed,
then Loose or worn front wheel bearings.

Recommendation(s) :

Adjust,if possible,or replace all front wheel bearings.

Symptom 20 File wheel

wheel and tire system problem

is a 'play or looseness in steering'

If check front wheel bearings,they are loosed,
then Loose or worn front wheel bearings.

Recommendation(s) :

Adjust,if possible,or replace all front wheel bearings.

Symptom 21 File wheel

wheel and tire system problem

is a 'steering erratic when brakes are applies'

If check front wheel bearings,they are loosed,
then Loose or worn front wheel bearings.

Recommendation(s) :

Adjust,if possible,or replace all front wheel bearings.

File Link : WHEEL1

Symptom 22 File wheel

wheel and tire system problem

is a 'noise in front end'

If check front wheel bearings, they are loosed,
then Loose or worn front wheel bearings.

Recommendation(s) :

Adjust, if possible, or replace all front wheel bearings.

Symptom 23 File wheel

wheel and tire system problem

is a 'poor steering wheel return'

If check front end, it is misaligned,
then The front end alignment is incorrect.

Recommendation(s) :

Align the front end.

Symptom 24 File wheel

wheel and tire system problem

is a 'wheel thumps'

If check condition of tires, they are abnormal,
then Bump or blister on tires.

Recommendation(s) :

Replace faulty tires.

WHEEL1

Symptom 1 File wheel1

wheel and tire system problem

is a 'car wanders from side to side'

If check front wheel bearings, they are loosed,
then Loose or worn front wheel bearings.

Recommendation(s) :

Adjust, if possible, or replace all front wheel bearings.

Symptom 2 File wheel1

wheel and tire system problem

is a 'car vibrates at high speeds'

If check wheels and tires for balance, they are out of
balance,

then The wheels or tires are out of balance.

Recommendation(s) :

Balance all wheels and tires statically and dynamically.

Symptom 3 File wheel1

wheel and tire system problem

is a 'front wheels shimmy'

If check front wheel bearings, they are loosed,
then Loose or worn front wheel bearings.

Recommendation(s) :

Adjust, if possible, or replace all front wheel bearings.

Symptom 4 File wheel1

wheel and tire system problem

is a 'uneven tire wear'

If check front wheel bearings, they are loosed,
then Loose or worn front wheel bearings.

Recommendation(s) :

Adjust, if possible, or replace all front wheel bearings.

Symptom 5 File wheel1

wheel and tire system problem

is a 'rapid or excessive tire wear'

If check front end, it is misaligned,
then The front end alignment is incorrect.

Recommendation(s) :

Align the front end.

Symptom 6 File wheel1

wheel and tire system problem

is a 'car hard to steer'

If check front end, it is misaligned,
then The front end alignment is incorrect.

Recommendation(s) :

Align the front end.

Symptom 7 File wheel1

wheel and tire system problem

is a 'wear on sides of tires (scuffing)'

If check front end, it is misaligned,

then The front end alignment is incorrect.

Recommendation(s) :

Align the front end.

Symptom 8 File wheel1

wheel and tire system problem

is a 'steering erratic when brakes are applies'

If check front wheel bearings, they are loosed,

then Loose or worn front wheel bearings.

Recommendation(s) :

Adjust, if possible, or replace all front wheel bearings.

Symptom 9 File wheel1

wheel and tire system problem

is a 'car pulls to one side when in motion'

If check front wheel bearings, they are loosed,

then Loose or worn front wheel bearings.

Recommendation(s) :

Adjust, if possible, or replace all front wheel bearings.

Symptom 10 File wheel1

wheel and tire system problem

is a 'car pulls to one side when in motion'

If check front end, it is misaligned,

then The front end alignment is incorrect.

Recommendation(s) :

Align the front end.

Symptom 11 File wheel1

wheel and tire system problem

is a 'car pulls to one side when in motion'

If the problem is existed after change new tire,

then Dissimilar tires.

Recommendation(s) :

Install same-type tires on all wheels.

Symptom 12 File wheel1

wheel and tire system problem

is a 'car wanders from side to side'

If check front end, it is misaligned,

then The front end alignment is incorrect.

Recommendation(s) :

Align the front end.

Symptom 13 File wheel1

wheel and tire system problem

is a 'front wheels shimmy'

If check front end, it is misaligned,

then The front end alignment is incorrect.

Recommendation(s) :

Align the front end.

Symptom 14 File wheel1

wheel and tire system problem

is a 'uneven tire wear'

If check front end, it is misaligned,

then The front end alignment is incorrect.

Recommendation(s) :

Align the front end.

Symptom 15 File wheel1

wheel and tire system problem

is a 'steering erratic when brakes are applied'

If check front end, it is misaligned,

then The front end alignment is incorrect.

Recommendation(s) :

Align the front end.

Symptom 16 File wheel1

wheel and tire system problem

is a 'front wheels shimmy '

If uneven tire wear,

then The tires are out of round.

Recommendation(s) :

Replace all worn tires.

Symptom 17 File wheel1

wheel and tire system problem

is a 'front wheel shimmy'

If the problem is existed after change new tire,

then Dissimilar tires.

Recommendation(s) :

Install same-type tires on all wheels.

Symptom 18 File wheel1

wheel and tire system problem

is a 'front wheel shimmy'

If check wheels and tires for balance,they are out of
balance,

then The wheels or tires are out of balance.

Recommendation(s) :

Balance all wheels and tires statically and dynamically.

Symptom 19 File wheel1

wheel and tire system problem

is a 'uneven tire wear'

If check wheels and tires for balance,they are out of balance,

then The wheels or tires are out of balance.

Recommendation(s) :

Balance all wheels and tires statically and dynamically.

Symptom 20 File wheel1

wheel and tire system problem

is a 'rapid or excessive tire wear'

If check wheels and tires for balance,they are out of balance,

then The wheels or tires are out of balance.

Recommendation(s) :

Balance all wheels and tires statically and dynamically.

Symptom 21 File wheel1

wheel and tire system problem

is a 'car pulls to one side when in motion'

If brake drums or discs are very hot,

then Brakes are dragging or grabbing.

Recommendation(s) :

Adjust or repair brakes.

Symptom 22 File wheel1

wheel and tire system problem

is a 'steering erratic when brakes are applied'

If brake drums or discs are very hot,
then Brakes are dragging or grabbing.

Recommendation(s) :

Adjust or repair brakes.

Symptom 23 File wheel1

wheel and tire system problem

is a 'rapid or excessive tire wear'

If sudden start and improper speed due to rapid
acceleration or improper brake application,
then Hard driving.

Recommendation(s) :

Install tires suited to driving habits and road
conditions.

Symptom 24 File wheel1

wheel and tire system problem

is a 'wear on sides of tires (scuffing)'

If driving high speed on curve,
then Excessive speed on turns.

Recommendation(s) :

Modify driving or install heavy-duty suspension parts.

ไฟล์แสดงชื่อฐานความรู้ที่มีให้ปรึกษาในระบบผู้เชี่ยวชาญ

ไฟล์ SYSFILE

Symptom 1 File sysfile

engine problem

is a 'A.Engine Problems'

File Link : ENGINE

Symptom 2 File sysfile

engine problem

is a 'B.Mechanical parts system'

File Link : MECH

Symptom 3 File sysfile

engine problem

is a 'C.Fuel system'

File Link : FUEL

Symptom 4 File sysfile

engine problem

is a 'D.Lubricating system'

File Link : LUB

Symptom 5 File sysfile

engine problem

is a 'E.Cooling system'

File Link : COOL

Symptom 6 File sysfile
engine problem
is a 'F.Exhaust and Emission Control systems'
File Link : EMIS

Symptom 7 File sysfile
engine electrical systems problem
is a 'G.Ignition system'
File Link : IGNIT

Symptom 8 File sysfile
engine electrical systems problem
is a 'H.Starting Problems'
File Link : START

Symptom 9 File sysfile
engine electrical systems problem
is a 'I.Battery and Charging systems'
File Link : BATT

Symptom 10 File sysfile
power transmission systems problem
is a 'J.Clutch Problems'
File Link : CLUTCH

Symptom 11 File sysfile
power transmission systems problem
is a 'K.Gearbox Problems'
File Link : GEAR

- Symptom 12 File sysfile
power transmission systems problem
is a 'L.Drive line system'
File Link : DRIVE
- Symptom 13 File sysfile
suspension and vehicle control systems problem
is a 'M.Steering system'
File Link : STEER
- Symptom 14 File sysfile
suspension and vehicle control systems problem
is a 'N.Brake system'
File Link : BRAKE
- Symptom 15 File sysfile
suspension and vehicle control systems problem
is a 'O.Suspension system'
File Link : SUS
- Symptom 16 File sysfile
suspension and vehicle control systems problem
is a 'P.Wheel and Tires systems'
File Link : WHEEL
- Symptom 17 File sysfile
body electrical system problem
is a 'Q.Body Electrical system'
File Link : LIGHT

Symptom 18 File sysfile
test problem
is a 'R.Test'
File Link : TEST

ตัวอย่างฐานความรู้ที่ใช้ทดสอบการทำงานของระบบผู้เชี่ยวชาญในการให้คำปรึกษาเรื่องอื่น ๆ

ไฟล์ TEST

Symptom 1 File test

test problem
is a 'animal'
If mammal
and carnivore
and tawny color
and black spots,
then Cheetah.

Symptom 2 File test

test problem
is a 'animal'
If mammal
and carnivore
and tawny color
and black_stripes,
then Tiger.

Symptom 3 File test

test problem
is a 'animal'
If mammal
and ungulate
and long neck
and long legs
and dark spots,
then Giraffe.

Symptom 4 File test
test problem
is a 'animal'
If mammal
and ungulate
and black
and white stripes,
then Zebra.

Symptom 5 File test
test problem
is a 'animal'
If bird
and not fly
and long neck
and long legs
and black
and while color,
then Ostrich.

Symptom 6 File test
test problem
is a 'animal'
If bird
and not fly
and does swim
and black
and white color,
then Penguin.

Symptom 7 File test
test problem
is a 'animal'
If bird
and fly well
and black color,
then Crow.

Symptom 8 File test
test problem
is a 'fruit'
If grows on tree
and round shape
and does not grow in the Deep South
and color is red or yellow,
then Apple.

Symptom 9 File test
test problem
is a 'fruit'
If grows on vine
and small in size
and color varies
and vine does not have thorns
and can be used to make wine,
then Grape.

Symptom 10 File test

test problem
is a 'fruit'
If grows on tree
and round shape
and cannot grow in the North
and color is orange,
then Orange.

Symptom 11 File test

test problem
is a 'fruit'
If grows on cane
and the cane have thorns
and color is red,
then Raspberry.

Symptom 12 File test

test problem
is a 'disease'
If runny nose and harsh, hacking cough
and brownish-pink rash, first on scalp and neck and then
body
and high, fast-rising temperature
and bloodshot eyes
and conjunctivitis(inflamed eye membrane)
and rosy colored skin areas with white spots inside
of cheek
and intolerance to light,
then Measles.

Symptom 13 File test

test problem

is a 'disease'

If runny nose

and slight temperature

and light rosy colored rash, first on face and neck, then
body

and stiff joints

and swollen lymph nodes behind ear

and sore throat,

then German Measles.

Symptom 14 File test

test problem

is a 'disease'

If temperature and chills

and strong body aches

and harsh, hacking cough

and weakness

and severe headache

and vomiting

and diarrhea

and conjunctivitis

and runny nose

and sore throat

and sneezing,

then Flu.

Symptom 15 File test
test problem
is a 'disease'
If sore throat
and runny nose
and sneezing
and moderate headache
and moderate cough,
then Common Cold.

Symptom 16 File test
test problem
is a 'disease'
If runny nose
and coughs, the whooping air intake
and loss of appetite
and light, hacking cough at first
and sneezing,
then Whooping Cough.

Symptom 17 File test
test problem
is a 'disease'
If high, fast rising temperature
and severe headache
and vomiting
and rash-small purplish or reddish spots on body
and intolerance to light
then Meningitis.



ประวัติผู้เขียน

นายประยทธ ดวงคล้าย เกิดวันที่ 7 มิถุนายน พ.ศ. 2502 ที่อำเภอเมือง จังหวัดราชบุรี สำเร็จการศึกษาปริญญาตรีวิศวกรรมศาสตรบัณฑิต สาขาวิศวกรรมเครื่องกล ภาควิชาวิศวกรรมเครื่องกล คณะวิศวกรรมเทคโนโลยี วิทยาลัยเทคโนโลยีและอาชีวศึกษา ในปีการศึกษา 2526 และเข้าศึกษาต่อในหลักสูตรวิศวกรรมศาสตรมหาบัณฑิต ที่จุฬาลงกรณ์มหาวิทยาลัย เมื่อปี พ.ศ. 2532 ปัจจุบันรับราชการที่ภาควิชาวิศวกรรมเครื่องกล สถาบันเทคโนโลยีราชมงคล วิทยาเขตเทเวศร์ กรุงเทพฯ ฯ