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ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย



ภาคผนวก ก

ตัวอย่างการทดสอบโปรแกรมการเข้ารหัสและถอดรหัสแบบแชนมิ่ง

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

input transmission text <1-8 chars> = asdfg* k

char a

parity code = 0010

codeword 1 = 011000000110

char s

parity code = 1110

codeword 2 = 011110011110

char d

parity code = 0111

codeword 3 = 011000101011

char f

parity code = 0010

codeword 4 = 011000110010

char g

parity code = 0001

codeword 5 = 011000110101

char *


parity code = 1000

codeword 6 = 001011010000

char

parity code = 1010

codeword 7 = 001010000010



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char k

parity code = 0000

codeword 8 = 011001010100

Using Interleaving

codeword 1 = 00010100

codeword 2 = 01001111

codeword 3 = 10010011

codeword 4 = 00000110

codeword 5 = 10111010

codeword 6 = 00011100

codeword 7 = 10100000

codeword 8 = 01100010

codeword 9 = 00000010

codeword 10 = 11111111

codeword 11 = 10011111

codeword 12 = 00000000

Tranmission

When the wrong position is <1-8> 3

on the block no.<1-12> 2 and no. of error bits = 5

receive codeword 1 = 00010100

receive codeword 2 = 00110011

receive codeword 3 = 10010011

receive codeword 4 = 00000110

receive codeword 5 = 10111010

receive codeword 6 = 00011100

receive codeword 7 = 10100000

receive codeword 8 = 01100010

receive codeword 9 = 00000010
 receive codeword 10 = 11111111
 receive codeword 11 = 10011111
 receive codeword 12 = 00000000

Using Deinterleaving

codeword 1 = 011000000110
 codeword 2 = 011110011110
 codeword 3 = 011000101001
 codeword 4 = 011000110000
 codeword 5 = 011000110111
 codeword 6 = 001011010010
 codeword 7 = 001010000000
 codeword 8 = 011001010100

After encoded

received char 1 = a

received char 2 = s

char 3 error position = 2

After Correction

received char 3 = d

char 4 error position = 2

After Correction

received char 4 = f

char 5 error position = 2

After Correction

received char 5 = g

char 6 error position = 2

After Correction

received char 6 = *

char 7 error position = 2

After Correction

received char 7 =

received char 8 = k

correct chr 1 = a

correct chr 2 = s

correct chr 3 = d

correct chr 4 = f

correct chr 5 = g

correct chr 6 = *

correct chr 7 =

correct chr 8 = k

received text = asdfg* k

All received characters is Correct !



ภาคผนวก ข

ตัวอย่างการทดสอบโปรแกรมการเข้ารหัสและถอดรหัสแบบไฮคล็อก

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

input transmission text <1-8 chars> = asdfg* k

char 1 = a

char 1 = 0000000001100001

remain 1 = 0000000000011010

transmit codeword 1 = 0011000010011010

char 2 = s

char 2 = 0000000001110011

remain 2 = 0000000001001110

transmit codeword 2 = 0011100111001110

char 3 = d

char 3 = 0000000001100100

remain 3 = 0000000001000100

transmit codeword 3 = 0011001001000100

char 4 = f

char 4 = 0000000001100110

remain 4 = 0000000001010010

transmit codeword 4 = 0011001101010010

char 5 = g

char 5 = 0000000001100111

remain 5 = 000000000100000

transmit codeword 5 = 0011001110100000

char 6 = *
 char 6 = 000000000101010
 remain 6 = 000000000111000
 transmit codeword 6 = 0001010100111000

char 7 =
 char 7 = 000000000100000
 remain 7 = 0000000001110110
 transmit codeword 7 = 0001000001110110

char 8 = k
 char 8 = 0000000001101011
 remain 8 = 0000000001010100
 transmit codeword 8 = 0011010111010100

Using Interleaving

codeword 1 = 00000000
 codeword 2 = 01001011
 codeword 3 = 11000110
 codeword 4 = 00100011
 codeword 5 = 11101001
 codeword 6 = 01110000
 codeword 7 = 11001110
 codeword 8 = 10010011
 codeword 9 = 10111010
 codeword 10 = 00011100
 codeword 11 = 10100000
 codeword 12 = 00000010
 codeword 13 = 11111111
 codeword 14 = 10011111

codeword 15 = 00000000

codeword 16 = 00000000

Transmission

When the wrong position is <1-8> 2

on the block no.<1-16> 4 and no. of error bits = 10

receive codeword 1 = 00000000

receive codeword 2 = 01001011

receive codeword 3 = 11000110

receive codeword 4 = 11011101

receive codeword 5 = 11101110

receive codeword 6 = 01110000

receive codeword 7 = 11001110

receive codeword 8 = 10010011

receive codeword 9 = 10111010

receive codeword 10 = 00011100

receive codeword 11 = 10100000

receive codeword 12 = 00000010

receive codeword 13 = 11111111

receive codeword 14 = 10011111

receive codeword 15 = 00000000

receive codeword 16 = 00000000

Using Deinterleaving

codeword 1 = 0011000010001010

codeword 2 = 0011100111010110

codeword 3 = 0011001001011100

codeword 4 = 0011001101011010

codeword 5 = 0011001110101000

codeword 6 = 0001010100110000

codeword 7 = 0001000001111110

codeword 8 = 0011010111011100

receives 1 = 0011000010001010

Receive error

after correction = 0011000010011010

codeword 1 = a

receive char 1 = 0000000001100001

receives 2 = 0011100111010110

Receive error

after correction = 0011100111001110

codeword 2 = s

receive char 2 = 0000000001110011

receives 3 = 0011001001011100

Receive error

after correction = 0011001001000100

codeword 3 = d

receive char 3 = 0000000001100100

receives 4 = 0011001101011010

Receive error

after correction = 0011001101010010

codeword 4 = f

receive char 4 = 0000000001100110

receives 5 = 0011001110101000

Receive error

after correction = 0011001110100000

codeword 5 = g

receive char 5 = 0000000001100111

receives 6 = 0001010100110000

Receive error

after correction = 0001010100111000

codeword 6 = *

receive char 6 = 0000000000101010

receives 7 = 0001000001111110

Receive error

after correction = 0001000001110110

codeword 7 =

receive char 7 = 0000000000100000

receives 8 = 0011010111011100

Receive error

after correction = 0011010111010100

codeword 8 = k

receive char 8 = 0000000001101011

received text = asdfg* k

All received characters is Correct !



ศูนย์วิทยพัชกร
จุฬาลงกรณ์มหาวิทยาลัย



ภาคผนวก ค

ตัวอย่างการทดสอบ โปรแกรมการเข้ารหัสและถอดรหัสคอนโวลูชันนัล

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

input transmission text <1-8 chars> = asdfg* k

encode char a

bitstream 1 = 0011010111000011

encode char s

bitstream 2 = 0011011001111101

encode char d

bitstream 3 = 0011010111111011

encode char f

bitstream 4 = 0011010111110101

encode char g

bitstream 5 = 0011010111110110

encode char *

bitstream 6 = 0000111000100010

encode char

bitstream 7 = 0000111011000000

encode char k

bitstream 8 = 0011010100100001



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จุฬาลงกรณ์มหาวิทยาลัย

Using Interleaving

bitstream 1 = 10001111
 bitstream 2 = 00110101
 bitstream 3 = 00011010
 bitstream 4 = 00000110
 bitstream 5 = 00011110
 bitstream 6 = 10111110
 bitstream 7 = 01011111
 bitstream 8 = 01011101
 bitstream 9 = 10011101
 bitstream 10 = 01100010
 bitstream 11 = 11111111
 bitstream 12 = 01100000
 bitstream 13 = 10011111
 bitstream 14 = 10011111
 bitstream 15 = 00000000
 bitstream 16 = 00000000

Transmission

When the wrong position is <1-8> 3

on the stream no. <1-16> 5 and no. of error bits = 6

receive bitstream 1 = 10001111
 receive bitstream 2 = 00110101
 receive bitstream 3 = 00011010
 receive bitstream 4 = 00000110
 receive bitstream 5 = 11100010
 receive bitstream 6 = 10111110
 receive bitstream 7 = 01011111
 receive bitstream 8 = 01011101

receive bitstream 9 = 10011101
 receive bitstream 10 = 01100010
 receive bitstream 11 = 11111111
 receive bitstream 12 = 01100000
 receive bitstream 13 = 10011111
 receive bitstream 14 = 10011111
 receive bitstream 15 = 00000000
 receive bitstream 16 = 00000000

Using Deinterleaving

bitstream 1 = 0011010111000011
 bitstream 2 = 0011011001111101
 bitstream 3 = 0011010111101011
 bitstream 4 = 0011010111100101
 bitstream 5 = 0011010111100110
 bitstream 6 = 0000111000110010
 bitstream 7 = 0000111011010000
 bitstream 8 = 0011010100110001

encode bitstream 0011010111000011

receive char 1 = 01100001

encode bitstream 0011011001111101

receive char 2 = 01110011

encode bitstream 0011010111101011

receive char 3 = 01100100

encode bitstream 0011010111100101

receive char 4 = 01100110

encode bitstream 0011010111100110

receive char 5 = 01100111

encode bitstream 0000111000110010

receive char 6 = 00101010

encode bitstream 0000111011010000

receive char 7 = 00100000

encode bitstream 0011010100110001

receive char 8 = 01101011

correct chr 1 = a

correct chr 2 = s

correct chr 3 = d

correct chr 4 = f

correct chr 5 = g

correct chr 6 = *

correct chr 7 =

correct chr 8 = k

received text = asdfg* k

All received characters is Correct !

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย



ภาคผนวก ง

ตัวอย่างการทดสอบ โปรแกรมการเพิ่มประสิทธิภาพของรหัส

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

input transmission text <1-8 chars> = การส่ง..

char 1 = ก = 0000000010100001

remain 1 = 0000000000111000

transmit codeword 1 = 0101000010111000

char 2 = ฃ = 0000000011010010

remain 2 = 0000000001110110

transmit codeword 2 = 0110100101110110

char 3 = ฅ = 0000000011000011

remain 3 = 0000000001000110

transmit codeword 3 = 0110000111000110

char 4 = ฆ = 0000000011001010

remain 4 = 0000000001101100

transmit codeword 4 = 0110010101101100

char 5 = แ = 0000000011101000

remain 5 = 0000000000001100

transmit codeword 5 = 0111010000001100

char 6 = โ = 0000000010100111

remain 6 = 0000000000000010

transmit codeword 6 = 0101001110000010

char 7 = . = 0000000000101110

remain 7 = 0000000000010100

transmit codeword 7 = 0001011100010100

char 8 = . = 000000000101110
 remain 8 = 000000000010100
 transmit codeword 8 = 0001011100010100

Using Interleaving

codeword 1 = 00000000
 codeword 2 = 00100110
 codeword 3 = 11011110
 codeword 4 = 00011001
 codeword 5 = 11000011
 codeword 6 = 00001011
 codeword 7 = 00001110
 codeword 8 = 00100101
 codeword 9 = 11101110
 codeword 10 = 11100000
 codeword 11 = 11011000
 codeword 12 = 00000010
 codeword 13 = 11110001
 codeword 14 = 00011110
 codeword 15 = 00111111
 codeword 16 = 00000000

Transmission

When the wrong position is $\langle 1-8 \rangle 3$
 on the block no. $\langle 1-16 \rangle 4$ and no. of error bits = 30

receive codeword 1 = 00000000
 receive codeword 2 = 00100110
 receive codeword 3 = 11011110
 receive codeword 4 = 11100101

receive codeword 5 = 00111100
 receive codeword 6 = 11110100
 receive codeword 7 = 11110001
 receive codeword 8 = 00100101
 receive codeword 9 = 11101110
 receive codeword 10 = 11100000
 receive codeword 11 = 11011000
 receive codeword 12 = 00000010
 receive codeword 13 = 11110001
 receive codeword 14 = 00011110
 receive codeword 15 = 00111111
 receive codeword 16 = 00000000

Using Deinterleaving

codeword 1 = 0101000011001000
 codeword 2 = 0110100100000110
 codeword 3 = 0110000110111110
 codeword 4 = 0110010100010100
 codeword 5 = 0111010001110100
 codeword 6 = 0101001111111010
 codeword 7 = 0001011101101100
 codeword 8 = 0001011101101100

receive codeword 1 = 0101000011001000

error code = 112

position error = 5 no = 3

using SD = 0101000010111000

This codeword can be corrected

codeword 1 = \emptyset

receive char 1 = 0000000010100001

receive codeword 2 = 0110100100000110

error code = 112

position error = 5 no = 3

using SD = 0110100101110110

This codeword can be corrected

codeword 2 = ๗

receive char 2 = 0000000011010010

receive codeword 3 = 0110000110111110

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0110000101001110

SD error code = 3

using Stat position 0110000111000110

This codeword can be corrected

codeword 3 = ๙

receive char 3 = 0000000011000011

receive codeword 4 = 0110010100010100

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0110010111100100

SD error code = 3

using Stat position 0110010101101100

This codeword can be corrected

codeword 4 = ๘

receive char 4 = 0000000011001010

receive codeword 5 = 0111010001110100

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0111010010000100

SD error code = 3

using Stat position 0111010000001100

This codeword can be corrected

codeword 5 =

receive char 5 = 0000000011101000

receive codeword 6 = 0101001111111010

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0101001100001010

SD error code = 3

using Stat position 0101001110000010

This codeword can be corrected

codeword 6 = √

receive char 6 = 0000000010100111

receive codeword 7 = 0001011101101100

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0001011110011100

SD error code = 3

using Stat position 0001011100010100

This codeword can be corrected

codeword 7 = .

receive char 7 = 0000000000101110

receive codeword 8 = 0001011101101100

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0001011110011100

SD error code = 3

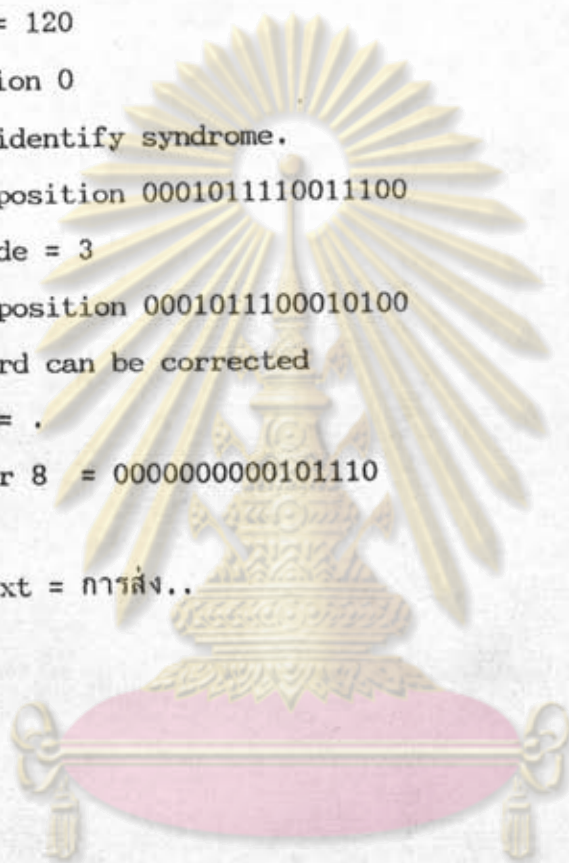
using Stat position 0001011100010100

This codeword can be corrected

codeword 8 = .

receive char 8 = 0000000000101110

received text = การส่ง..



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จุฬาลงกรณ์มหาวิทยาลัย

input transmission text <1-8 chars> = ในข้อมูล

char 1 = ใ = 0000000011100011

remain 1 = 0000000000110000

transmit codeword 1 = 0111000110110000

char 2 = น = 0000000010111001

remain 2 = 0000000000100010

transmit codeword 2 = 0101110010100010

char 3 = ฎ = 0000000010100010

remain 3 = 0000000001011100

transmit codeword 3 = 0101000101011100

char 4 = ฐ = 0000000011101001

remain 4 = 0000000000000111

transmit codeword 4 = 0111010010000111

char 5 = ฒ = 0000000011001101

remain 5 = 0000000000100100

transmit codeword 5 = 0110011010100100

char 6 = ฬ = 0000000011000001

remain 6 = 0000000001010000

transmit codeword 6 = 0110000011010000

char 7 = ฬ = 0000000011011001

remain 7 = 0000000001001010

transmit codeword 7 = 0110110011001010



ศูนย์วิทยพัชการ

จุฬาลงกรณ์มหาวิทยาลัย

char 8 = ๙ = 0000000011000101
 remain 8 = 0000000000000101
 transmit codeword 8 = 0110001010000101

Using Interleaving

codeword 1 = 10001000
 codeword 2 = 01001010
 codeword 3 = 10011100
 codeword 4 = 01000100
 codeword 5 = 00100101
 codeword 6 = 00010011
 codeword 7 = 01100100
 codeword 8 = 11111011
 codeword 9 = 00000101
 codeword 10 = 10010000
 codeword 11 = 01011010
 codeword 12 = 01000010
 codeword 13 = 00001111
 codeword 14 = 11111001
 codeword 15 = 11111111
 codeword 16 = 00000000

Transmission

When the wrong position is $\langle 1-8 \rangle 2$
 on the block no. $\langle 1-16 \rangle 4$ and no. of error bits = 31

receive codeword 1 = 10001000
 receive codeword 2 = 01001010
 receive codeword 3 = 10011100
 receive codeword 4 = 10111010

receive codeword 5 = 11011010
 receive codeword 6 = 11101100
 receive codeword 7 = 10011011
 receive codeword 8 = 11111011
 receive codeword 9 = 00000101
 receive codeword 10 = 10010000
 receive codeword 11 = 01011010
 receive codeword 12 = 01000010
 receive codeword 13 = 00001111
 receive codeword 14 = 11111001
 receive codeword 15 = 11111111
 receive codeword 16 = 00000000

Using Deinterleaving

codeword 1 = 0111000111000000
 codeword 2 = 0101110011011010
 codeword 3 = 0101000100100100
 codeword 4 = 0111010011111111
 codeword 5 = 0110011011011100
 codeword 6 = 0110000010101000
 codeword 7 = 0110110010110010
 codeword 8 = 0110001011111101

receive codeword 1 = 0111000111000000

error code = 112

position error = 5 no = 3

using SD = 0111000110110000

This codeword can be corrected

codeword 1 = 1

receive char 1 = 0000000011100011

receive codeword 2 = 0101110011011010

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0101110000101010

SD error code = 3

using Stat position 0101110010100010

This codeword can be corrected

codeword 2 = u

receive char 2 = 0000000010111001

receive codeword 3 = 0101000100100100

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0101000111010100

SD error code = 3

using Stat position 0101000101011100

This codeword can be corrected

codeword 3 = u

receive char 3 = 0000000010100010

receive codeword 4 = 0111010011111111

error code = 1

position error = 1 no = 1

using SD = 0111010011111110

This codeword can be corrected

codeword 4 = u

receive char 4 = 0000000011101001

receive codeword 5 = 0110011011011100

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0110011011011111

SD error code = 2unknown position 0

using Stat position 0110011011011101

This codeword can be corrected

codeword 5 = 0

receive char 5 = 0000000011001101

receive codeword 6 = 0110000010101000

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0110000010101011

SD error code = 2unknown position 0

using Stat position 0110000010101001

This codeword can be corrected

codeword 6 = ๙

receive char 6 = 0000000011000001

receive codeword 7 = 0110110010110010

error code = 120

error position 0

ERR! Can't identify syndrome.

using Stat position 0110110010110001

SD error code = 2unknown position 0

using Stat position 0110110010110011

This codeword can be corrected

codeword 7 = ν

receive char 7 = 0000000011011001

receive codeword 8 = 0110001011111101

error code = 1

position error = 1 no = 1

using SD = 0110001011111100

This codeword can be corrected

codeword 8 = ล

receive char 8 = 0000000011000101

received text = ในข้อมูล



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย



ประวัติผู้เขียน

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