**Практичне завдання №4**

**СТАТИСТИЧНІ МЕТОДИ ЕКОНОМНОГО КОДУВАННЯ**

**Варіант 19**

**4.1.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Варіант |  |  |  |  |  |  |  |  |  |
| 19 | 0,31 | 0,17 | 0,11 | 0,16 | 0,09 | 0,03 | 0,06 | 0,07 | 0 |

Код за алгоритмом Шеннона-Фано:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 0,31 | 11 | 2 | **0,62** |
|  | 0,17 | 10 | 2 | **0,34** |
|  | 0,16 | 010 | 3 | **0,48** |
|  | 0,11 | 0110 | 3 | **0,33** |
|  | 0,09 | 0111 | 3 | **0,27** |
|  | 0,07 | 0010 | 4 | **0,28** |
|  | 0,06 | 0001 | 5 | **0,3** |
|  | 0,03 | 0000 | 5 | **0,15** |
|  | | | | **2,77** |

**H(X) = 2,71**ξ = = **0,022**

Код за алгоритмом Хаффмена:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 0,31 | 10 | 2 | **0,62** |
|  | 0,17 | 00 | 2 | **0,34** |
|  | 0,16 | 111 | 3 | **0,48** |
|  | 0,11 | 011 | 3 | **0,33** |
|  | 0,09 | 010 | 3 | **0,27** |
|  | 0,07 | 1101 | 4 | **0,28** |
|  | 0,06 | 11001 | 5 | **0,3** |
|  | 0,03 | 11000 | 5 | **0,15** |
|  | | | | **2,77** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0,31 | | 0,31 | | 0,31 | | 0,31 | | 0,32 | | 0,37 | | 0,63+ | 1 | 10 | 2 | **0,62** |
|  | 0,17 | | 0,17 | | 0,17 | | 0,2 | | 0,31 | | 0,32+ | | 0,37+ |  | 00 | 2 | **0,34** |
|  | 0,16 | | 0,16 | | 0,16 | | 0,17 | | 0,2+ | | 0,31+ | |  |  | 111 | 3 | **0,48** |
|  | 0,11 | | 0,11 | | 0,16 | | 0,16+ | | 0,17+ | |  | |  |  | 011 | 4 | **0,33** |
|  | 0,09 | | 0,09 | | 0,11+ | | 0,16+ | |  | |  | |  |  | 010 | 4 | **0,27** |
|  | 0,07 | | 0,09+ | | 0,09+ | |  | |  | |  | |  |  | 1101 | 4 | **0,28** |
|  | 0,06+ | | 0,07+ | |  | |  | |  | |  | |  |  | 11001 | 4 | **0,3** |
|  | 0,03+ | |  | |  | |  | |  | |  | |  |  | 11000 | 4 | **0,15** |
|  |  |  | |  | |  | |  | |  | |  | | | | | **2,77** |

*Дерево**Хаффмена***:**

1

0

0

1

0

1

1

0

1

0

1

0

0

1

1

1

**H(X) = 2, 71**

ξ = = **0,022**

**4.2.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Варіант | p(A) | p(B) | p(C) | p(D) | Фрагмент повідомлення |
| 9 | 0,29 | 0,12 | 0,01 | 0,58 | CCACDACACCCDACACDDBCDCBDABADBD |

*Код за алгоритмом Шеннона-Фано:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| D | 0,58 | 1 | 1 | **0,58** |
| A | 0,29 | 01 | 2 | **0,58** |
| B | 0,12 | 001 | 3 | **0,36** |
| C | 0,01 | 000 | 3 | **0,03** |
|  | | | | **1,55** |

**H(X) = 1,407**

ξ = = **0,101**

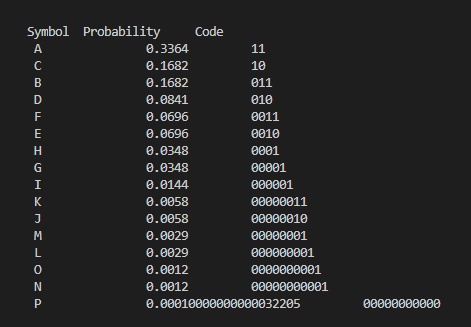
*Закодований фрагмент:*

**BDBCAACDDBCACDBCACABDCBBDDAADA=**

**001100100001010001100100001000100100001000010011000001001110101101**

**L = 66**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DD | 0,3364 | 11 | 2 | 0,6728 |
| AD | 0,1682 | 10 | 2 | 0,3364 |
| DA | 0,1682 | 011 | 3 | 0,5046 |
| AA | 0,0841 | 010 | 3 | 0,2523 |
| BD | 0,0696 | 0011 | 4 | 0,2784 |
| DB | 0,0696 | 0010 | 4 | 0,2784 |
| AB | 0,0348 | 0001 | 4 | 0,1392 |
| BA | 0,0348 | 00001 | 5 | 0,174 |
| BB | 0,0144 | 000001 | 6 | 0,0864 |
| DC | 0,0058 | 00000011 | 8 | 0,0464 |
| CD | 0,0058 | 00000010 | 8 | 0,0464 |
| AC | 0,0029 | 00000001 | 8 | 0,0232 |
| CA | 0,0029 | 000000001 | 9 | 0,0261 |
| BC | 0,0012 | 0000000001 | 10 | 0,012 |
| CB | 0,0012 | 00000000001 | 11 | 0,0132 |
| CC | 0,0001 | 00000000000 | 11 | 0,0011 |
|  | | | | **2,8909** |

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**=** 2,8909/2 **= 1,44545**

**H(X) = 1,407**

ξ = = **0,0273**

*Закодований фрагмент:*

**BDBCAACDDBCACDBCACABDCBBDDAADA = 001100000000010100000001000100000000010000001000000000010000000100010000001100000111010011**

**L = 92**

**4.3.**

|  |  |  |
| --- | --- | --- |
| Варіант |  | Фрагмент повідомлення |
| 9 |  | ABCBABBCCBABCCBBCACA |

Знаходження безумовних імовірностей виникнення символів:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| C | 0,64 | 1 | 1 | **0,64** |
| B | 0,23 | 01 | 2 | **0,46** |
| A | 0,13 | 00 | 2 | **0,26** |
|  | | | | **1,36** |

**H(X) = 1,2824**

ξ = = **0,06**

*Закодований фрагмент:*

**ABCBABBCCBABCCBBCACA = 000110100010111010001110101100100**

**L = 33**

|  |  |
| --- | --- |
| AA |  |
| AB |  |
| AC |  |
| BB |  |
| BA |  |
| BC |  |
| CC |  |
| CA |  |
| CB |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CC | 0,4032 | 11 | 2 | | **0,4032** |
| CB | 0,2112 | 10 | 2 | | **0,6336** |
| BC | 0,1725 | 011 | 3 | | **0,5175** |
| AC | 0,0611 | 010 | 3 | | **0,2444** |
| AA | 0,0572 | 0011 | 4 | | **0,2288** |
| BA | 0,0506 | 0010 | 4 | | **0,2024** |
| CA | 0,0256 | 00011 | 5 | | **0,128** |
| AB | 0,0117 | 000010 | 6 | | **0,0702** |
| BB | 0,0069 | 000000 | 6 | | **0,0414** |
|  | | | | **2,6004** | |

**=** 2,6004/2 **= 1,3002**

**H(X) = 1,2824**

ξ = = **0,139**

*Закодований фрагмент:*

**ABCBABBCCBABCCBBCACA = ABCBABBCCBABCCBBCACA**

**L =**

*Після символу А:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| C | 0,47 | 1 | 1 |  |
| A | 0,44 | 01 | 2 |  |
| B | 0,09 | 00 | 2 |  |
|  | | | |  |

*Після символу B:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 0,75 | 1 | 1 |  |
|  | 0,22 | 01 | 2 |  |
|  | 0,03 | 00 | 2 |  |
|  | | | |  |

*Після символу C:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 0,63 | 1 | 1 |  |
|  | 0,33 | 01 | 2 |  |
|  | 0,04 | 00 | 2 |  |
|  | | | |  |

**= P(A)+ P(B)+ P(C)=** 0.13\*=

*Закодований фрагмент:*

**ABCBABBCCBABCCBBCACA =**

**L =**

ξ = = **0,057**