

Федеральное государственное автономное образовательное

учреждение высшего образования

«Национальный исследовательский университет ИТМО»

Факультет программной инженерии и компьютерной техники

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Дисциплина «Дискретная математика»

**Отчёт по домашней работе №1**

Вариант №18

Выполнил

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# Задание:

## Задание 1 (представление чисел с фиксированной и плавающей запятой в различных форматах)

1. Заданное число A представить в виде двоично-кодированного числа:

а) в упакованном виде (BCD);

б) в неупакованном виде (ASCII).

1.а)

A = 1800

|  |  |
| --- | --- |
| 0001.1000 | 0000.0000 |

1 8 0 0

1.б)

|  |  |  |  |
| --- | --- | --- | --- |
| 0011.0001 | 0011.1000 | 0011.0000 | 0011.0000 |
| 1 | 8 | 0 | 0 |

Старшая тетрада байта имеет стандартное значение 0011.

**2. Заданное число A и –A представить в форме с фиксированной запятой.**

2.1. A = (1800)10 = (11100001000)2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

В шестнадцатеричной СС:

(1000)2 = (8)16

(0000)2 = (0)16

(0111)2 = (7)16

(1800)10 = (708)16

2.2. –A = (-1800)10

Прямой код:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Обратный код:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Дополнительный код:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

**3. Заданные числа A и B представить в форме с плавающей запятой в формате Ф1.**

A = 1800

B = 0,01

3.1. A = (1800)10 = (708)16 = (0,708)16 \* 163

XA = PA + 64 = 3 + 64 = (67)10 = (1000011)2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |

3.2. B = (0,01)10 = (0,028F5C28)16 = (0,028F5C3)16

B = (0,028F5C3)16 = (0,28F5C3)16 \* 16-1

XB = PB + 64 = -1 + 64 = 63 = (0111111)2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |

**4. Заданные числа A и B представить в форме с плавающей запятой в формате Ф2.**

A = 1800

B = 0,01

4.1. A = (1800)10 = (708)16 = (11100001000)2 = (0,11100001)2 \* 211

XA = PA + 128 = 11 + 128 = 139 = (10001011)2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

4.2. B = (0,01)10 = (0,028F5C28)16 = (0,028F5C3)16 = (0,0000 0010 1000 1111 0101 1100 0010 1000)2 = (0, 0000 0010 1000 1111 0101 1100 0011)2 = (0,10 1000 1111 0101 1100 0011) \* 2-6

XB = PB + 128 = -6 + 128 = 122 = (0111 1010)2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

**5. Заданные числа A и B представить в форме с плавающей запятой в формате Ф3.**

5.1. A = (1800)10 = (708)16 = (11100001000)2 = (1,1100001)2 \* 210

XA = PA + 127 = 10 + 127 = 137 = (1000 1001)2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

5.2. B = (0,01)10 = (0,028F5C3)16 = (0,0000 0010 1000 1111 0101 1100 0011)2 = (1,0 1000 1111 0101 1100 0011)2 \* 2-7

XB = PB + 127 = 120 = (01111000)2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

**6. Найти значение чисел Y и Z по их заданным шестнадцатеричным представлениям R и S в форме с плавающей точкой в формате Ф1.**

R **=** C380F800

S = 3C400000

6.1. Для определения значения числа Y производится наложение его шестнадцатеричного представления R на разрядную сетку формата Ф1:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |

C16 = (1100)2

316 = (0011)2

816 = (1000)2

016 = (0000)2

F16 = (1111)2

Из этого представления видно, что число Y – положительное (в знаковом разряде числа – ноль).

Определим порядок числа Y по его характеристике:

XY = (1000011)2 = 6710 = 64 + 3,

64 – смещение, 3 – порядок

PY = XY – 64 = 3

Представим число Y с помощью мантиссы и порядка:

Y = -(0,80F8)16 \* 163

Получили представление числа в нормальной (полулогарифмической) форме. Для приведения числа Y к естественной форме необходимо перенести запятую в мантиссе на количество шестнадцатеричных цифр, равное модулю порядка, вправо – при положительном или влево – при отрицательном порядке.

Y = -(80F,8)16

Переведем число Y из шестнадцатеричной системы счисления в десятичную:

Y = -(80F,8)16 = -(2063,5)10

6.2. Для определения значения числа Z производится наложение его шестнадцатеричного представления S (3C400000) на разрядную сетку формата Ф1:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |

Порядок числа Z:

PZ = XZ – 64 = 60 – 64 = -4

Значение числа Z:

Z = (0,4)16 \* 16-4 = (0,00004)16 = 4 \* 16-5 = 4 / 165 = 4 / 220 = 1 / 218 = 28 / 210 = 256 \* 10-3 = (0.256)10

**7. Найти значение чисел V и W по их заданным шестнадцатеричным представлениям R и S в форме с плавающей точкой в формате Ф2.**

R **=** C380F800

S = 3C400000

7.1. Представление числа V в формате Ф2 имеет вид:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Порядок числа V:

PV = XV – 128 = 135 – 128 = 7

Значение числа V в нормальной форме:

V = (0,1000 0000 1111 1)2 \* 27

При определении двоичного значения мантиссы производится восстановление её скрытого старшего разряда, равного 1.

Для приведения числа V к естественной форме запятая в его мантиссе переносится вправо на 7 двоичных разрядов:

V = (1000 0000,1111 1)2 = (12,96875)10

7.2. Представление числа W в формате:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Порядок числа W:

PW = XW – 128 = 120 – 128 = -8

Число W в нормальной форме:

W = (0,11)2 \* 2-8

Число W в естественной форме получается переносом запятой в мантиссе влево на 8 двоичных разрядов:

W = (0,0000 0000 11)2 = (11)2 \* 2-10 = 11 / 1024 = (0,0107421875)10

**8. Найти значение чисел T и Q по их заданным шестнадцатеричным представлениям R и S в форме с плавающей точкой в формате Ф3.**

R **=** C380F800

S = 3C400000

8.1. Представление числа T в формате Ф3 имеет тот же вид, что и для числа V в формате Ф2.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Порядок числа T:9

PT = XT – 127 = 135 – 127 = 7

Значение числа T в двоичной СС:

T = -(1,0000 0001 1111)2 \* 27 = -(1,007568359375 \* 128) = -128,96875

8.2. Представление числа Q в формате Ф3 имеет тот же вид, что и для числа V в формате Ф2.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Порядок числа Q:

PQ = XQ - 127 = 120 - 127 = -7

Значение числа Q:

Q = (1,1)2 \* 2-7 = (11)2 \* 2-8 = 3 \* 2-8 = 3 / 256 = 0.01171875