Федеральное государственное автономное образовательное учреждение

высшего образования “Национальный исследовательский университет ИТМО”

Факультет Программной Инженерии И Компьютерной Техники

Домашняя работа №6

Вариант 90

Выполнила:

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Группа P3108

Проверил:

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A black number on a white background

Description automatically generated

A = 78,21  
B = 63,29

#### 1. **Формат Ф1**

A = (78,21)10 = (4E,35C28F)16 = (0,4E35C28F)16 · 162

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |

B = (63,29)10 = (3F,4A3D71)16 = (0,3F4A3D71)16 · 162

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| XA | = | – | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| XB | = | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| (XA-XB)пр. | = |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

(XA-XB) = 0; XC = XA = XB = 2

#### а) A>0, B>0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MA | = | + |  | . | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| MB | = |  | . | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| MC | = |  |  | . | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |

Результат сложения нормализован.  
  
MC = . 1 0 0 0 1 1 0 1 1 0 0 0

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |

С\* = МС · 16Рс = (0,8D8)16 · 162 = 141,5.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 141,5 – 141,5 = 0

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0 |  | · 100% = 0% |
| 141,5 |

#### б) A>0, B<0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MA | = | – |  | . | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| MB | = |  | . | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| MC | = |  |  | . | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |

Результат вычитания денормализован вправо  
  
MC = . 1 1 1 0 1 1 1 0 0 0 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 1 (ХC = ХC - 1 = 1)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

С\* = МС · 16Рс = (0,EE0)16 · 161 = 14,875  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 14,92 – 14,875 = 0,045

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,045 |  | · 100% = 0,30161% |
| 14,92 |

Результат получился представленным с избытком. Этот факт можно объяснить потерей значащих разрядов мантиссы результата при его нормализации

#### с) A<0, B>0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MB | = | – |  | . | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| MA | = |  | . | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| MC | = |  |  | . | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

Результат вычитания денормализован вправо и представлен в дополнительном коде  
  
MC = . 0 0 0 1 0 0 1 0 0 0 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 1 (ХC = ХC - 1 = 1)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

С\* = МС · 16Рс = (-0,EE0)16 · 161 = -14,875  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -14,92 – (-14,875) = -0,045

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,045 |  | · 100% = 0,30161% |
| -14,92 |

Результат получился представленным с избытком. Этот факт можно объяснить потерей значащих разрядов мантиссы результата при его нормализации

#### 2. **Формат Ф2**

A = (78,21)10 = (4E,35C28F)16 = (0,10011100011010111000011)2 · 27

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |

B = (63,29)10 = (3F,4A3D71)16 = (0,1111110100101000111101)2 · 26

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| XA | = | – | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| XB | = | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| (XA-XB)пр. | = |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

(XA-XB) = 1; XC = XA = 7

#### а) A>0, B>0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MA | = | + |  | . | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| MB | = |  | . | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| MC | = |  | 1 | . | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |

Результат сложения денормализован влево  
  
MC = . 1 0 0 0 1 1 0 1 1 0 0 0  
  
Т.к. выполнен сдвиг мантиссы вправо, характеристику результата нужно увеличить на 1 (ХC = ХC + 1 = 8)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |

С\* = МС · 2Рс = (0,100011011)2 · 28 = 141,5  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 141,5 – 141,5 = 0

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0 |  | · 100% = 0% |
| 141,5 |

#### б) A>0, B<0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MA | = | – |  | . | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| MB | = |  | . | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| MC | = |  |  | . | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |

Результат вычитания денормализован вправо  
  
MC = . 1 1 1 0 1 1 1 1 0 0 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 3 (ХC = ХC - 3 = 4)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

С\* = МС · 2Рс = (0,11101111)2 · 24 = 14,9375  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 14,92 – 14,9375 = -0,0175

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,0175 |  | · 100% = 0,11729% |
| 14,92 |

Результат получился представленным с избытком. Этот факт можно объяснить потерей значащих разрядов мантиссы результата при его нормализации

#### с) A<0, B>0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MB | = | – |  | . | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| MA | = |  | . | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| MC | = |  |  | . | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |

Результат вычитания денормализован вправо и представлен в дополнительном коде  
  
MC = . 0 0 0 1 0 0 0 1 0 0 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 3 (ХC = ХC - 3 = 4)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

С\* = МС · 2Рс = (-0,11101111)2 · 24 = -14,9375  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -14,92 – (-14,9375) = 0,0175

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,0175 |  | · 100% = 0,11729% |
| -14,92 |

Результат получился представленным с избытком. Этот факт можно объяснить потерей значащих разрядов мантиссы результата при его нормализации

В формате Ф2 результаты получились точнее, так как операнды представлены точнее, и при нормализации результата сдвиг производился на 1 двоичный разряд, а не на 4