Федеральное государственное автономное образовательное учреждение высшего образования «Национальный исследовательский университет ИТМО»

Факультет программной инженерии и компьютерной техники

Домашняя работа №5

Номер Варианта: 37

Выполнил: Бурейко Роман Олегович 412902

Группа: p3115

ФИО преподавателя: Поляков Владимир Иванович

Санкт-Петербург

A = 117,6  
B = 163,1

**1.1 Формат Ф1**

A = (117,6)10 = (75,99999A)16 = (0,7599999A)16 · 162

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

B = (163,1)10 = (A3,19999A)16 = (0,A319999A)16 · 162

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

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

Результат сложения денормализован влево.  
  
MC = . 0 0 0 1 0 0 0 1 1 0 0 0  
  
Т.к. выполнен сдвиг мантиссы вправо, характеристику результата нужно увеличить на 1 (ХC = ХC + 1 = 3).

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

С\* = МС · 16Рс = (0,118)16 · 163 = 280.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 280,7 – 280 = 0,7

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,7 |  | · 100% = 0,24938% |
| 280,7 |

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

**б) A>0, B<0:**

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

Результат вычитания нормализован и представлен в дополнительном коде.  
  
MC = . 1 1 0 1 0 0 1 0 1 0 0 0

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

С\* = МС · 16Рс = (-0,2D8)16 · 162 = -45,5.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -45,5 – (-45,5) = 0

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0 |  | · 100% = 0% |
| -45,5 |

**с) A<0, B>0:**

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

Результат вычитания нормализован.  
  
MC = . 0 0 1 0 1 1 0 1 1 0 0 0

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

С\* = МС · 16Рс = (0,2D8)16 · 162 = 45,5.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 45,5 – 45,5 = 0

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0 |  | · 100% = 0% |
| 45,5 |

**2.1 Формат Ф2**

A = (117,6)10 = (75,99999A)16 = (0,1110101100110011001101)2 · 27

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

B = (163,1)10 = (A3,19999A)16 = (0,10100011000110011001101)2 · 28

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

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

(XA-XB) = -1; XC = XB = 8

**а) A>0, B>0:**

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

Результат сложения денормализован влево.  
  
MC = . 1 0 0 0 1 1 0 0 0 1 0 1  
  
Т.к. выполнен сдвиг мантиссы вправо, характеристику результата нужно увеличить на 1 (ХC = ХC + 1 = 9).

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

С\* = МС · 2Рс = (0,100011000101)2 · 29 = 280,625.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 280,7 – 280,625 = 0,075

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,075 |  | · 100% = 0,02672% |
| 280,7 |

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

**б) A>0, B<0:**

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

Результат вычитания денормализован вправо и представлен в дополнительном коде.  
  
MC = . 0 1 0 0 1 0 0 1 1 1 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 2 (ХC = ХC - 2 = 6).

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

С\* = МС · 2Рс = (-0,1011011001)2 · 26 = -45,5625.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -45,5 – (-45,5625) = 0,0625

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,0625 |  | · 100% = 0,13736% |
| -45,5 |

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

**с) A<0, B>0:**

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

Результат вычитания денормализован вправо.  
  
MC = . 1 0 1 1 0 1 1 0 0 1 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 2 (ХC = ХC - 2 = 6).

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

С\* = МС · 2Рс = (0,1011011001)2 · 26 = 45,5625.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 45,5 – 45,5625 = -0,0625

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,0625 |  | · 100% = 0,13736% |
| 45,5 |

Результат получился представленным с избытком. Этот факт можно объяснить потерей значащих разрядов мантиссы результата при его нормализации.  
  
  
В формате Ф2 результаты получились точнее из-за того, что операнды представлены точнее и при нормализации результата сдвиг производился на один двоичный разряд, а не на четыре.