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

Факультет Программной Инженерии и Компьютерной Техники

Домашняя работа № 6

По дискретной математике

Вариант 89

Выполнил:

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|  |  |  |
| --- | --- | --- |
| **89** | 326,8 | 250,2 |

A = 326,8 B = 250,2

**1.1 Формат Ф1**

A = (326,8)10 = (146,CCCCCD)16 = (0,146CCCCCD)16 · 163

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

B = (250,2)10 = (FA,333333)16 = (0,FA333333)16 · 162

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

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

(XA-XB) = 1; XC = XA = 3

**а) A>0, B>0:**

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

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

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

С\* = МС · 16Рс = (0,241)16 · 163 = 577.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 577 – 577 = 0

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0 |  | · 100% = 0% |
| 577 |

**б) A>0, B<0:**

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

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

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

С\* = МС · 16Рс = (0,4D0)16 · 162 = 77.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 76,6 – 77 = -0,4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,4 |  | · 100% = 0,52219% |
| 76,6 |

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 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| MA | = |  | . | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| MC | = |  |  | . | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |

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

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

С\* = МС · 16Рс = (-0,4D0)16 · 162 = -77.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -76,6 – (-77) = 0,4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,4 |  | · 100% = 0,52219% |
| -76,6 |

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

**2.1 Формат Ф2**

A = (326,8)10 = (146,CCCCCD)16 = (0,1010001101100110011001101)2 · 29

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

B = (250,2)10 = (FA,333333)16 = (0,111110100011001100110011)2 · 28

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

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

(XA-XB) = 1; XC = XA = 9

**а) A>0, B>0:**

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

Результат сложения денормализован влево.  
  
MC = . 1 0 0 1 0 0 0 0 0 0 1 1  
  
Т.к. выполнен сдвиг мантиссы вправо, характеристику результата нужно увеличить на 1 (ХC = ХC + 1 = 10).

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

С\* = МС · 2Рс = (0,100100000011)2 · 210 = 576,75.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 577 – 576,75 = 0,25

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,25 |  | · 100% = 0,04333% |
| 577 |

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

**б) A>0, B<0:**

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

Результат вычитания денормализован вправо.  
  
MC = . 1 0 0 1 1 0 0 1 0 1 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 2 (ХC = ХC - 2 = 7).

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

С\* = МС · 2Рс = (0,1001100101)2 · 27 = 76,625.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 76,6 – 76,625 = -0,025

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,025 |  | · 100% = 0,03264% |
| 76,6 |

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 | 0 | 1 | 0 | 0 | 0 | 1 |
| MA | = |  | . | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| MC | = |  |  | . | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |

Результат вычитания денормализован вправо и представлен в дополнительном коде.  
  
MC = . 0 1 1 0 0 1 1 0 1 1 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 2 (ХC = ХC - 2 = 7).

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

С\* = МС · 2Рс = (-0,1001100101)2 · 27 = -76,625.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -76,6 – (-76,625) = 0,025

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,025 |  | · 100% = 0,03264% |
| -76,6 |

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.