Санкт-Петербургский Национальный Исследовательский  
Университет ИТМО

Факультет программной инженерии и компьютерной техники

**Домашняя работа №6**

По дискретной математике

Вариант 102

Выполнил:

Студент группы P3109

Саранча Павел Александрович

Преподаватель:

Поляков Владимир Иванович



Санкт-Петербург

2023

|  |  |  |
| --- | --- | --- |
| **102** | 0,915 | 0,636 |

A = 0,915  
B = 0,636

**1.1 Формат Ф1**

A = (0,915)10 = (0,EA3D71)16 = (0,EA3D71)16 · 160

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

B = (0,636)10 = (0,A2D0E5)16 = (0,A2D0E5)16 · 160

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

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

(XA-XB) = 0; XC = XA = XB = 0

**а) A>0, B>0:**

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

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

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

С\* = МС · 16Рс = (0,18D)16 · 161 = 1,55078.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 1,551 – 1,55078 = 0,00022

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,00022 |  | · 100% = 0,0141% |
| 1,551 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы результата при его нормализации;

**б) A>0, B<0:**

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

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

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

С\* = МС · 16Рс = (0,477)16 · 160 = 0,27905.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 0,279 – 0,27905 = -0,00005

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,00005 |  | · 100% = 0,0189% |
| 0,279 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;

**с) A<0, B>0:**

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

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

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

С\* = МС · 16Рс = (-0,477)16 · 160 = -0,27905.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -0,279 – (-0,27905) = 0,00005

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,00005 |  | · 100% = 0,0189% |
| -0,279 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;

**2.1 Формат Ф2**

A = (0,915)10 = (0,EA3D71)16 = (0,1110101000111101)2 · 20

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

B = (0,636)10 = (0,A2D0E5)16 = (0,1010001011010001)2 · 20

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

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

(XA-XB) = 0; XC = XA = XB = 0

**а) A>0, B>0:**

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

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

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

С\* = МС · 2Рс = (0,110001101)2 · 21 = 1,55078.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 1,551 – 1,55078 = 0,00022

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,00022 |  | · 100% = 0,0141% |
| 1,551 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы результата при его нормализации;

**б) A>0, B<0:**

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

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

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

С\* = МС · 2Рс = (0,10001110111)2 · 2-1 = 0,27905.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 0,279 – 0,27905 = -0,00005

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,00005 |  | · 100% = 0,0189% |
| 0,279 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы результата при его нормализации;

**с) A<0, B>0:**

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

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

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

С\* = МС · 2Рс = (-0,10001110111)2 · 2-1 = -0,27905.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -0,279 – (-0,27905) = 0,00005

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,00005 |  | · 100% = 0,0189% |
| -0,279 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* 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.