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

Факультет Программной Инженерии и Компьютерной Техники

Домашняя работа № 6

По дискретной математике

Вариант 83

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**ЗАДАНИЕ 6**

**СЛОЖЕНИЕ ЧИСЕЛ С ПЛАВАЮЩЕЙ ЗАПЯТОЙ**

|  |  |  |
| --- | --- | --- |
| **83** | 0,023 | 0,993 |

***А* = 0,023; *В* = 0,993.**

1. Формат *Ф1* (число разрядов мантиссы *m* =12).

A = (0,023)10 = (0,5E3)16 \* 16-1

М*А*

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

**1** округление к ближайшему

0 1 7 8 19  
*В* = (0,993)10 = (0,FE3)16 · 160

M*B*

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

**1** округление к ближайшему

0 1  7 8 19

*XA* = \_0 1 1 1 1 1 1

*XB* = 1 0 0 0 0 0 0

(*XA-XB*)доп.= 1 1 1 1 1 1 1

(*XA-XB*). = -1; *ХС = ХВ =* 0*.*

**а) Оба операнда положительные (*А*>0, *B*>0):**

М*А* = . 0 0 0 0 0 0 1 0 1 1 1 1

+

М*В* = . 1 1 1 1 1 1 1 0 0 1 0 0

М*С* = 1. 0 0 0 0 0 0 0 1 0 0 1 1

4

МС = . 0 0 0 1 0 0 0 0 0 0 0 1

Т.к. выполнен сдвиг мантиссы влево, то характеристику результата нужно увеличить на 1 (*ХС* = *ХС* +1 = 1).

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

*С*

0 1  7 8 19

*С*\* = М*С* · 16Р*с* = (0,101)16 · 161 = (1,01)16 = 1,00390625.

Δ*С* = *С*Т - *С*\* = 1,016–1,00390625 = -0,01209375

где Δ*С* –абсолютная погрешность;

*С*Т –точное значение;

*С*\* - приближенное значение.

δ*С* = · 100% = = 1,19%,

где δ*С* – относительная погрешность.

**б) *А*<0, *B*>0.**

Сложение мантисс будем проводить их прямым вычитанием. В качестве уменьшаемого используем мантиссу положительного операнда (*В*);

М*В* = . 1 1 1 1 1 1 1 0 0 1 0 0

4

М*А* = . 0 0 0 0 0 0 1 0 1 1 1 1

М*С* = . 1 1 1 1 1 0 1 1 0 1 0 1

Результат сложения нормализован.

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

*С*

0 1  7 8 19

*С*\* = М*С* · 16Р*с* = (-0,FD5)16 · 160 = (-0, FD5)16 = 0,98950195.

Δ*С* = *С*Т - *С*\* = - 0,97 + 0,98950195 = 0,01950195

δ*С* = · 100% = = 2,01%.

**в) *А*>0, *B*<0.**

М*В* = . 1 1 1 1 1 1 1 0 0 1 0 0

4

М*А* = . 0 0 0 0 0 0 1 0 1 1 1 1

М*С* = . 1 1 1 1 1 0 1 1 0 1 0 1

Результат сложения нормализован.

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

*С*

0 1  7 8 19

*С*\* = М*С* · 16Р*с* = (0,FD5)16 · 160 = (0, FD5)16 = 0,98950195.

Δ*С* = *С*Т - *С*\* = 0,97 - 0,98950195 = -0,01950195

δ*С* = · 100% = = 2,01%.

2. Формат *Ф2*.

*А* = (0,023)10 = (0.101111000110)2 · 2-6

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

19 18 11 10 0  
*В* = (0,993)10 = (0,111111100011)2 · 20

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

19 18 11 10 0

*XA* = 0 1 1 1 1 0 1 0

*XB* = 1 0 0 0 0 0 0 0

(*XA-XB*)доп.= 1 1 1 1 1 0 1 0

(*XA-XB*). = -6; *ХС = ХВ* = 0*.*

а) Оба операнда положительные (*А*>0, *B*>0):

6

М*А* = . 0 0 0 0 0 0 1 0 1 1 1 1

+

М*В* = . 1 1 1 1 1 1 1 0 0 0 1 1

М*С* = 1 . 0 0 0 0 0 0 0 1 0 0 1 0

6

МС = . 0 0 0 0 0 1 0 0 0 0 0 0

Т.к. выполнен сдвиг мантиссы влево, то характеристику результата нужно увеличить на 1 (*ХС* = *ХС* +1 = 1).

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

*С*

19 18 11 10 0  
*С*\* = М*С* · 2Р*с* = (0,100000001001)2 · 21 = (1,00000001001)2 = 1,00439453.

Δ*С* = *С*Т - *С*\* = 1,016 – 1,00439453= -0,01160547

δ*С* = · 100% = \* 100% = 1,0005%.

б) *А*<0, *B*>0.

М*В* = . 1 1 1 1 1 1 1 0 0 0 1 1

М*А* = . 0 0 0 0 0 0 1 0 1 1 1 1

М*С* = . 1 1 1 1 1 0 1 1 0 1 0 0

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

*С*

19 18 11 10 0  
 *С*\* = М*С* · 2Р*с* = (-0.111110110100)2 · 20 = (-0.111110110100)2 = -0.9814453125.

Δ*С* = *С*Т - *С*\* = - 0,97 + 0.9814453125 = 0,0114453125.

δ*С* = · 100% = \* 100% = 1,18%.

в) *А*>0, *B*<0.

М*В* = . 1 1 1 1 1 1 1 0 0 0 1 1

М*А* = . 0 0 0 0 0 0 1 0 1 1 1 1

М*С* = . 1 1 1 1 1 0 1 1 0 1 0 0

*С*

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

19 18 11 10 0  
 *С*\* = М*С* · 2Р*с* = (0.111110110100)2 · 20 = (0.111110110100)2 = 0.9814453125.

Δ*С* = *С*Т - *С*\* = 0,97 - 0.9814453125 = -0,0114453125.

δ*С* = · 100% = \* 100% = 1,18%.