Мирзаитов Тимур P3112 Домашняя работа №5 Деление чисел с фиксированной запятой

Вариант №45

A = 0,782  
B = 128,2

A = (0,782)10 = (0,C83127)16 = (0,C83127)16 · 160

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

B = (128,2)10 = (80,333333)16 = (0,80333333)16 · 162

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

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

(XA-XB) = -2; XC = XB = 2

а) A>0, B>0:

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

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

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

С\* = МС · 16Рс = (0,80F)16 · 162 = 128,9375.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 128,982 – 128,9375 = 0,0445

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,0445 |  | · 100% = 0,0345% |
| 128,982 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;

б) A>0, B<0:

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

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

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

С\* = МС · 16Рс = (-0,7F7)16 · 162 = -127,4375.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -127,418 – (-127,4375) = 0,0195

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,0195 |  | · 100% = 0,0153% |
| -127,418 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;

с) A<0, B>0:

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

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

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

С\* = МС · 16Рс = (0,7F7)16 · 162 = 127,4375.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 127,418 – 127,4375 = -0,0195

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,0195 |  | · 100% = 0,0153% |
| 127,418 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;

2.1 Формат Ф2

A = (0,782)10 = (0,C83127)16 = (0,1100100000110001)2 · 20

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

B = (128,2)10 = (80,333333)16 = (0,100000000011001100110011)2 · 28

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

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

(XA-XB) = -8; XC = XB = 8

а) A>0, B>0:

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

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

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

С\* = МС · 2Рс = (0,100000001111)2 · 28 = 128,9375.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 128,982 – 128,9375 = 0,0445

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,0445 |  | · 100% = 0,0345% |
| 128,982 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;

б) A>0, B<0:

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

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

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

С\* = МС · 2Рс = (-0,11111110111)2 · 27 = -127,4375.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -127,418 – (-127,4375) = 0,0195

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,0195 |  | · 100% = 0,0153% |
| -127,418 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;
* потерей значащих разрядов мантиссы результата при его нормализации;

с) A<0, B>0:

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

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

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

С\* = МС · 2Рс = (0,11111110111)2 · 27 = 127,4375.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 127,418 – 127,4375 = -0,0195

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,0195 |  | · 100% = 0,0153% |
| 127,418 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;
* 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.