### OOP第十四周作业文档

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### 项目信息

**1、功能说明**

输入一个双精度浮点数，输出它在内存中的二进制表示。

输出非数和无穷的二进制表示，并计算它们之间的四则运算。

### **软件构件介绍**

|  |  |
| --- | --- |
| **文件** | **功能介绍** |
| CP\_UnionDoubleUnsignedlonglong.h/cpp | double的共用体类 |
| CP\_UnionDoubleUnsignedlonglongMain.cpp | 主程序 |

### **3、测试环境**

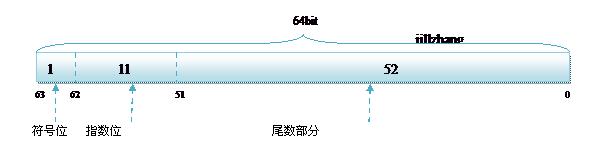
|  |  |
| --- | --- |
| CPU | Intel(R) Core(TM)i7-9750H CPU @ 2.6Ghz 6核12线程 |
| GPU | NVIDIA GeForce RTX2070 |
| RAM | DDR4 16G+16G |
| Operating System | Microsoft Windows 版本1909 |
| Compiler | MSVC++ 14.24 |

### 程序过程

1. 将输出的double在内存中的值转换成unsigned long long。
2. 通过bitset的构造函数，将unsigned long long转化成bitset。
3. 通过bitset的to\_string成员函数，将bitset转化为string。
4. 输出最后的string。

### 测试

##### 1、double的二进制表示



Source:<https://blog.csdn.net/yansmile1/article/details/70145416/>

一个浮点数可以唯一表示为：(+/-)(1+x)\*2^y （0<=x<1）

符号位0表示+，1表示-。

指数位表示 y+127 的值。

尾数位表示x。

例如：8.5 = +(1+0.0625)\*2^3 = +(1+(0b)0.0001)\*2^3

所以x的前缀为0001

符号位为 3+127=130=(0b)10000000010

所以8.5的double二进制表示为

0b **0100000000100001000000000000000000000000000000000000000000000000**

##### 2、测试

|  |  |  |  |
| --- | --- | --- | --- |
| 数的类型 | 选取案例 | 表示 | 输出 |
| 零 | 0 | / | 0b **000000000000**  **0000000000000000000000000000000000000000000000000000** |
| 负零 | -0 | / | 0b **100000000000**  **0000000000000000000000000000000000000000000000000000** |
| 正数 | 1024 | **+**(1+**0**)  \*2^**10** | 0b **010000001001**  **0000000000000000000000000000000000000000000000000000** |
| 4/3 | **+**(1+**1/3**)  \*2^**0** | 0b **001111111111**  **0101010101010101010101010101010101010101010101010101** |
| 负数 | -8.5 | **-**(1+**0.0625**)  \*2^**3** | 0b **110000000010**  **0001000000000000000000000000000000000000000000000000** |
| -1/6 | **-**(1+**1/3**)  \*2^**-3** | 0b 1**01111111100**  **0101010101010101010101010101010101010101010101010101** |

都与上述预测的二进制表示相同。

### 提高部分

##### 1、非数和无穷的表示

测试结果如下：

|  |  |
| --- | --- |
| **数据类型** | **二进制表示** |
| inf | 0b **0111111111110000000000000000000000000000000000000000000000000000** |
| -inf | 0b **1111111111110000000000000000000000000000000000000000000000000000** |
| -nan(ind) | 0b **1111111111111000000000000000000000000000000000000000000000000000** |
| nan | 0b **0111111111111000000000000000000000000000000000000000000000000000** |

符号位依然表示正负。

指数位全是1。

尾数位若全是0，表示inf。若不全为0，表示nan。

##### 2、非数和无穷的四则运算

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **+** | **inf** | **-inf** | **-nan(ind)** | **nan** | **1** |
| **inf** | inf | -nan(ind) | -nan(ind) | nan | inf |
| **-inf** | -nan(ind) | -inf | -nan(ind) | nan | -inf |
| **-nan(ind)** | -nan(ind) | -nan(ind) | -nan(ind) | -nan(ind) | -nan(ind) |
| **nan** | nan | nan | nan | nan | nan |
| **1** | inf | -inf | -nan(ind) | nan | 2 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **-** | **inf** | **-inf** | **-nan(ind)** | **nan** | **1** |
| **inf** | -nan(ind) | inf | -nan(ind) | nan | inf |
| **-inf** | -inf | -nan(ind) | -nan(ind) | nan | -inf |
| **-nan(ind)** | -nan(ind) | -nan(ind) | -nan(ind) | -nan(ind) | -nan(ind) |
| **nan** | nan | nan | nan | nan | nan |
| **1** | -inf | inf | -nan(ind) | nan | 0 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **\*** | **inf** | **-inf** | **-nan(ind)** | **nan** | **1** |
| **inf** | inf | -inf | -nan(ind) | nan | inf |
| **-inf** | -inf | inf | -nan(ind) | nan | -inf |
| **-nan(ind)** | -nan(ind) | -nan(ind) | -nan(ind) | -nan(ind) | -nan(ind) |
| **nan** | nan | nan | nan | nan | nan |
| **1** | inf | -inf | -nan(ind) | nan | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **/** | **inf** | **-inf** | **-nan(ind)** | **nan** | **1** |
| **inf** | -nan(ind) | -nan(ind) | -nan(ind) | nan | inf |
| **-inf** | -nan(ind) | -nan(ind) | -nan(ind) | nan | -inf |
| **-nan(ind)** | -nan(ind) | -nan(ind) | -nan(ind) | -nan(ind) | -nan(ind) |
| **nan** | nan | nan | nan | nan | nan |
| **1** | 0 | -0 | -nan(ind) | nan | 1 |

**总结：**

1. nan与inf或者通常数计算，结果都是nan。
2. nan与-nan(ind)运算，谁在左边结果是谁。
3. inf表示lim n->inf n，-inf表示inf表示lim n->inf -n，nan表示不存在。

则四则运算的结果就是这两个极限的运算结果。