

Jan 02, 11 20:09

order_of_summation1.cpp

Page 1/2

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//*****
// file: order_of_summation1.cpp
//
// Program to demonstrate that the order of summation of even positive
// numbers matters
//
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//
// Revision history:
// 01/02/11 new version from demol.cpp
//
// Notes:
// * An example to try to understand summing upward vs. summing
// downward. Add a small number eps (slightly below single-precision
// machine precision) many times to 1. It makes a big difference
// (in single precision) whether you do 1 + eps + eps + ... or
// eps + eps + ... + 1.
//
// * First pass: no subroutine
// * Use single precision AND double precision at the same time
// * Here is the output with eps=5e-8 added 10^7 time:
//
//          1+eps+eps+...  eps+eps+...+1
// single precision: 1.0000000000  1.5323836803
// double precision: 1.4999999992  1.4999999999
//
// To do:
//
//*****

// include files
#include <iostream>           // note that .h is omitted
#include <iomanip>             // note that .h is omitted
using namespace std;        // we need this when .h is omitted

//***** begin main *****

int
main ()
{
    int num_eps = 100000000; // number of times to add eps to 1
    float eps_sp = 5.e-7;    // single precision small increment
    double eps_dp = 5.e-7;   // double precision small increment

    float sum_first_sp = 1.; // adding 1 first (single precision)
    float sum_last_sp = 0.; // adding 1 at the end (single precision)
    double sum_first_dp = 1.; // adding 1 first (double precision)
    double sum_last_dp = 0.; // adding 1 at the end (double precision)

    cout << endl << "Adding small numbers many times to a big number:"
    << endl << endl;

    // add small numbers (in single or double precision) num_eps times
    for (int i = 0; i < num_eps; i++)
    {
        sum_first_sp += eps_sp;
        sum_last_sp += eps_sp;

        sum_first_dp += eps_dp;
        sum_last_dp += eps_dp;
    }

    sum_last_sp += 1.; // add 1 at the end
    sum_last_dp += 1.; // add 1 at the end

    cout << "          1+eps+eps+...  eps+eps+...+1 \n";
    cout << "single precision: " << fixed << setprecision (15) << setw (20)

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Jan 02, 11 20:09

order_of_summation1.cpp

Page 2/2

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    << sum_first_sp << " " << setw (20) << sum_last_sp << endl;
    cout << "double precision: " << fixed << setprecision (10) << setw (20)
    << sum_first_dp << " " << setw (15) << sum_last_dp << endl;

    return (0);
}

```