2024 Fall CPSC 240 Assignment 4

Non-deterministic Random Numbers

Goals

Make an assembly program that provides real experience in the following:

How to obtain 64-bit random numbers without a “seed”.
How to input string data that may contain while space. [You already know this.]
How to scale random numbers to stay within a fixed range

Purpose

This program will generate up to 100 random number using the non-deterministic random number generator found inside of modern X86 microprocessors.   Initially random numbers are generated that extend throughout the entire space of all 64-bit IEEE754 numbers.

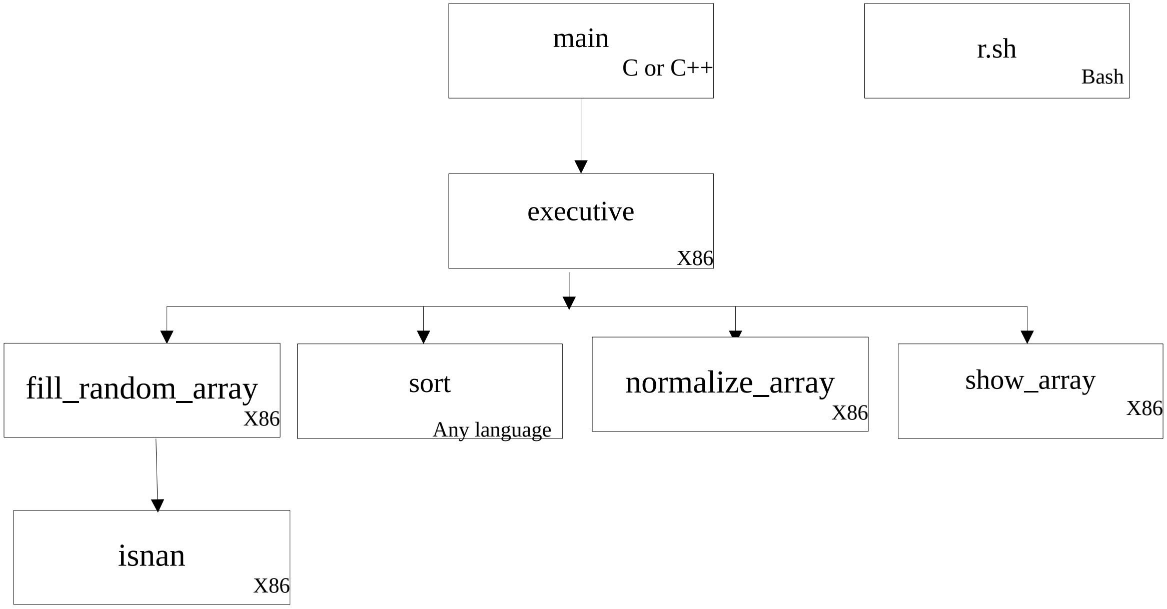
Later the random numbers are restricted to the interval 1.0 <= Number < 2.0 or even intervals such as 1.0 <= number < M, where M is a predetermined fixed upper limit..

Sample dialog

```
Welcome to Random Products, LLC.
This software is maintained by Alfred Finkelstein
Please enter your name: Sam Friedrickson
Please enter your title (Mr,Ms,Sargent,Chief,Project Leader,etc): Freshman
Nice to meet you Freshman Sam Freidrickson

This program will generate 64-bit IEEE float numbers.
How many numbers do you want.  Today's limit is 100 per customer.  6
Your numbers have been stored in an array.  Here is that array.

IEEE754                     Scientific Decimal
0x4095E4679BA82230      1.456234286364e+02
0x3FFF566589AA7BB0      3.525345676748e+01
0x3439CCCC878790FF      7.562123455666e-04
0xCCF256904232424B      -5.932435276577e+13
0X8049234245AAC7FF      5.6847467464011e+106
0xD45B98234E34D459      -8.234253426624e+09

The array will now be normalized to the range 1.0 to 2.0  Here is the normalized array

IEEE754                     Scientific Decimal
0X3FF9234245AAC7FF      1.584746746401e+0
0x3FF256904232424B      1.232435276577e+0
0x3FFB98234E34D459      1.562123455666e-0
0x3FFF566589AA7BB0      1.325345676748e+0
0x3FF5E4679BA82230      1.456234286364e+0
0x3FF9CCCC878790FF      1.074321245235e-0

The array will now be sorted

IEEE754                     Scientific Decimal
0x3FF9CCCC878790FF      1.074321245235e-0
0x3FF256904232424B      1.232435276577e+0
0x3FFF566589AA7BB0      1.325345676748e+0
0x3FF5E4679BA82230      1.456234286364e+0
0x3FFB98234E34D459      1.562123455666e-0
0X3FF9234245AAC7FF      1.584746746401e+0

Good bye Freshman.  You are welcome any time.

Oh, Sam Freidrickson.  We hope you enjoyed your arrays.  Do come again.
A zero will be returned to the operating system.
```

//End of dialog

Calling diagram



Some suggestions for building this program:

To display the number in hex use “0x%016lx”,0

To display the number in scientific decimal use “%18.13g”,0
The integer 18 is the total width of the field in columns.
The integer 13 is the precision number of digits.
You may have to adjust 18 slightly upward or downward to obtain an aligned column
Format g defaults to automatic right alignment within the field.
To obtain left alignment within the field insert a hyphen as in “%-18.13g”.

Declare your array for random numbers in bss with a fixed size of say 100. You pick the fixed size. If a user enters a value greater than the array size or a negative value, then reject that value. You decide what to do when the inputted value is rejected.

The generator called rdrand produces random bits from nature not from an algorithm. Sometimes it produces a nan, which is an un-welcomed set of bits. These nans occur occasionally, but not frequently. When rdrand provides a number, that number needs to be checked to determine if is a nan. If it is a nan then discard it and get the next random number.

Conclusion

Due date Nov 4, 2024 @ 2:00am

You know where to send it: cpscgrader@proton.me

Reminders of things you know from the first day of the semester.

Do not send me any pdf files.

Do not send me a link to your files posted in the cloud. If a link is sent, then it is discarded without opening.   You have to know the meaning of email “attachment”. Do not put assembly files in One-Drive or in Google-Docs.

If you send a read.me file it must be in one of the formats doc, docx, or .odt.

The source files must meet the professional standard. Describing “professional standard” requires a mini-lecture, but I think you know what that standard is by now. Non-professional programs will be simply receive a zero without being read.

Why? Professional software may get you a career job. Non-professional software will not be read by HR (Human Resources department)

As a general rule, send program files to cpscgrader@proton.me

Send documents (such as concept test) to holliday@fullerton.edu