Random Numbers:
\texttt{rand()} and \texttt{srand()} Library Functions

CS 241
Data Organization using C

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\begin{Dilbert}
\textsc{Tour of Accounting}
Over here we have our random number generator.

Nine nine nine nine nine nine.

\textsc{Are You Sure That's Random?}
That's the problem with randomness, you can never be sure.
\end{Dilbert}
**stdlib.h: The rand Function**

```c
#include <stdlib.h>

int rand(void)

Generate a uniformly distributed pseudo-random value between 0 and RAND_MAX.

On moons.cs.unm.edu: RAND_MAX = 2,147,483,647
On many older machines: RAND_MAX = 32,767

void srand (unsigned long seed)

Initializes pseudo-random number generator.

If no seed value is provided, the rand() function is automatically seeded with a value of 1.

Usually, called once and only once in a program.
```

**rand() to get an integer [0, n-1]**

```c
#include <stdio.h>
#include <stdlib.h>

void main(void)

{ 
    srand((unsigned long)time(NULL));
    int i;
    for (i=0; i<20; i++)
    {
        int r = rand(); // [0,RAND_MAX]
        int roll = r%6; // [0,5]
        printf("%d (%d)\n", roll, r);
    }
}
```
What are the Properties of the Output?

```c
#include <stdio.h>
#include <stdlib.h>

void main(void)
{
    int i;
    int bin[] = {0,0,0,0,0,0,0,0,0,0,0,0};
    srand((unsigned long)time(NULL));

    for (i=0; i<1000000; i++)
    {
        int r = (rand()%6) + (rand()%6);
        bin[r]++;
    }

    for (i=0; i<=10; i++)
    { printf("bin[%2d] = %7d\n", i, bin[i]);
    }
}
```

What is going on here?
Could this cause a segmentation fault?

Triangular Distribution

```c
for (i=0; i<1000000; i++)
{
    int r = (rand()%6) + (rand()%6);
    bin[r]++;
}
```

```plaintext
bin[ 0] = 27601
bin[ 1] = 55624
bin[ 2] = 83146
bin[ 3] = 111668
bin[ 4] = 138926
bin[ 5] = 166089
bin[ 6] = 139566
bin[ 7] = 110848
bin[ 8] = 83093
bin[ 9] = 55655
bin[10] = 27784
```
rand() to get a double [0.0, 1.0]

```c
#include <stdio.h>
#include <stdlib.h>

double randomDouble()
{
    return (double)rand() / (double)RAND_MAX;
}

void main(void)
{
    srand((unsigned long)time(NULL));
    int i;
    for (i=0; i<20; i++)
    {
        printf("%f\n", randomDouble());
    }
}
```