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

CS 241
Data Organization using C

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\begin{quote}
\textbf{DILBERT by SCOTT ADAMS}
\end{quote}

\begin{quote}
\texttt{TOUR OF ACCOUNTING}
\end{quote}

\begin{quote}
\texttt{OVER HERE WE HAVE OUR RANDOM NUMBER GENERATOR.}
\end{quote}

\begin{quote}
\texttt{NINE NINE NINE NINE NINE}
\end{quote}

\begin{quote}
\texttt{ARE YOU SURE THAT'S RANDOM?}
\end{quote}

\begin{quote}
\texttt{THAT'S THE PROBLEM WITH RANDOMNESS, YOU CAN NEVER BE SURE.}
\end{quote}
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[] = {0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0};
    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]++;
}

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

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![Triangular Distribution Chart](chart.png)
#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());
    }
}