

Randomization in C++ (p. 128)

- C++ provides a library function `rand()` that generates random numbers
- You need to include the `cstdlib` library
- Example:
 - `y = rand();`
- In reality it's a pseudorandom number!!!

Example

```
#include <iostream>
```

```
#include <cstdlib>
```

```
using namespace std;
```

```
int main()
```

```
{
```

```
    cout << rand() << endl;
```

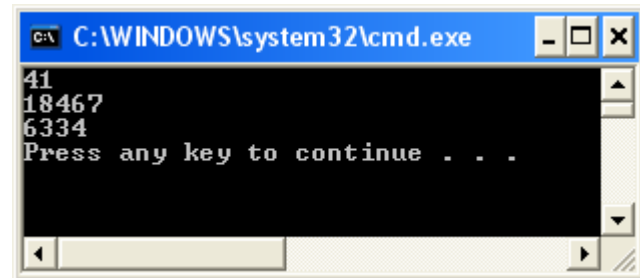
```
    cout << rand() << endl;
```

```
    cout << rand() << endl;
```

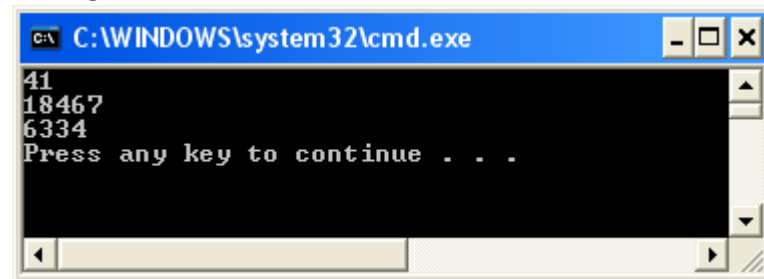
```
    return 0;
```

```
}
```

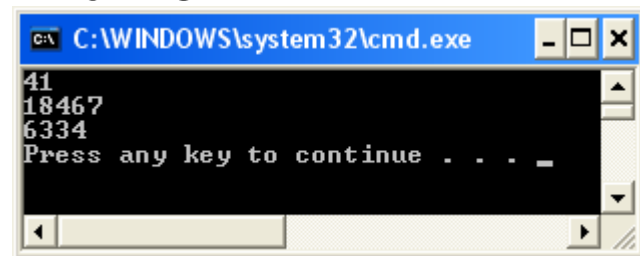
Run 1



Run 2



Run 3



Seeding the Generator

- We need to randomize the results of `rand()`
- To do that, we use `srand()` to seed the random number generator
- Different seed values will result in different random numbers

Example

```
#include <iostream>
#include <cstdlib>

using namespace std;

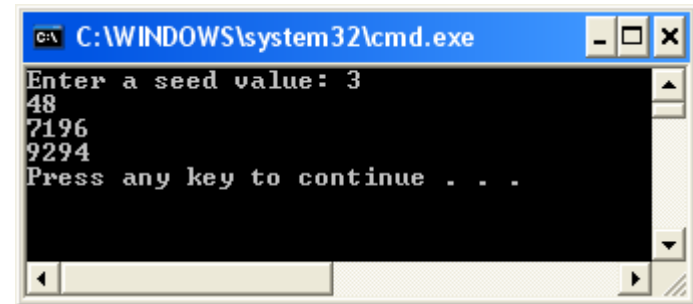
int main()
{
    unsigned seed;

    cout << "Enter a seed value: ";
    cin >> seed;

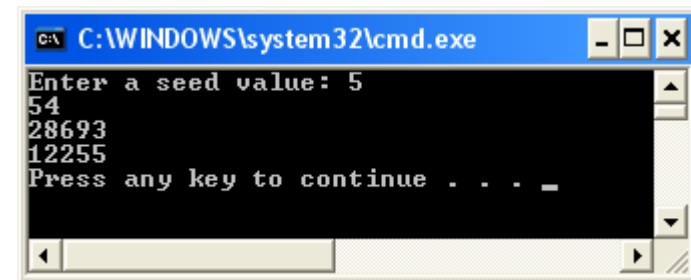
    srand(seed);

    cout << rand() << endl;
    cout << rand() << endl;
    cout << rand() << endl;

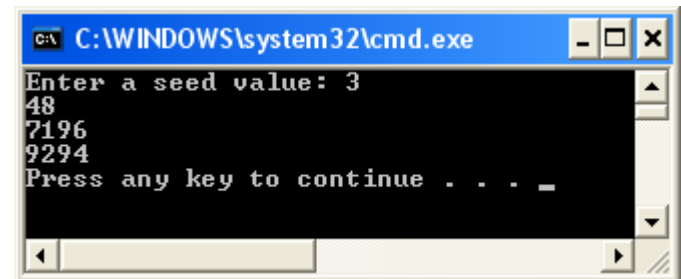
    return 0;
}
```



```
C:\WINDOWS\system32\cmd.exe
Enter a seed value: 3
48
7196
9294
Press any key to continue . . .
```



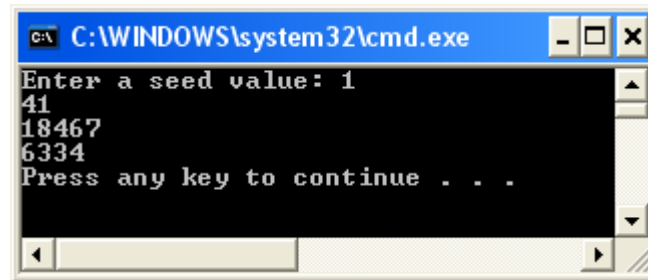
```
C:\WINDOWS\system32\cmd.exe
Enter a seed value: 5
54
28693
12255
Press any key to continue . . .
```



```
C:\WINDOWS\system32\cmd.exe
Enter a seed value: 3
48
7196
9294
Press any key to continue . . .
```

Example

- What happens if we use a seed value of 1?



```
C:\WINDOWS\system32\cmd.exe
Enter a seed value: 1
41
18467
6334
Press any key to continue . . .
```

- Note that the random numbers generated may be different on your computer

Better Seeding

- What would be a better way of seeding the random number generator?
 - Use the time!
- You must include `ctime`
- Set the seed to `time(0)`
 - `seed = time(0);`
- `time(0)` returns the number of seconds that have elapsed since January 1, 1970

Example

```
#include <iostream>
#include <cstdlib>
#include <ctime>

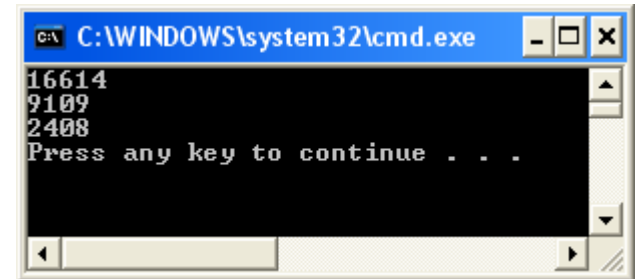
using namespace std;

int main()
{
    unsigned seed;

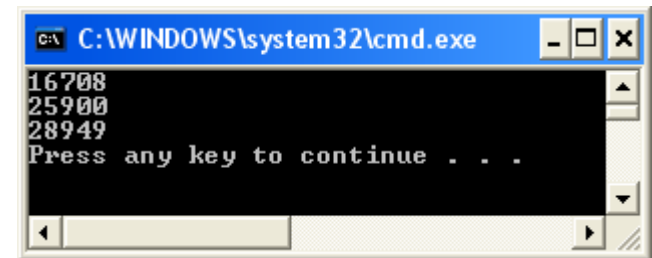
    seed = time(0);
    srand(seed);

    cout << rand() << endl;
    cout << rand() << endl;
    cout << rand() << endl;

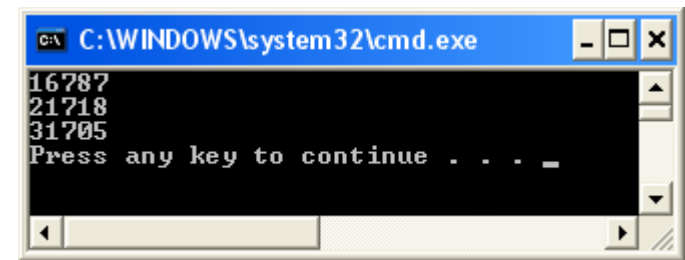
    return 0;
}
```



```
C:\WINDOWS\system32\cmd.exe
16614
9109
2408
Press any key to continue . . .
```



```
C:\WINDOWS\system32\cmd.exe
16708
25900
28949
Press any key to continue . . .
```



```
C:\WINDOWS\system32\cmd.exe
16787
21718
31705
Press any key to continue . . .
```

Specifying a Range

- A lot of the times we would like to specify a range for the random numbers being generated
 - Between 1 and 6 inclusive for faces of a dice for example
- To do that we add one to the random number and % it by the maximum
 - **diceFace = 1 + rand() % 6;**