

FOR LOOPS, FILE HANDLING AND RANDOM
NUMBERS

Today

- The `for` statement
- How to read data in from a file.
- How to write data out to a file.
- Generate random numbers

On the course website you can find the sample program `roombaLog` which shows some aspects of filehandling.

The for loop statement

- Imagine we put the following code in `main` in one of the roomba examples:
- As usual `x` and `y` are the location of the robot.

```
int myCount;
```

```
for(myCount = 1 ; myCount <= 5 ; myCount++) {
```

```
    x = x + 1;
```

```
    y = y + 1;
```

```
}
```

- This would increase the value of `x` and `y` (the position of the robot) by 5.

The for loop statement

- General structure:

```
for(<start>; <true or false> ; <change>)  
{  
  
    <some instructions>  
  
}
```

- This works as follows

The for loop statement

- At the start of the loop, the instruction in `<start>` is carried out.
- We usually use this to set the value of a counter.
- Then `<true or false>` is tested to see if it is true or false.
- This is usually a test on the counter.
- If it is false, the program will skip to the `}` that marks the end of the control structure.
- If it is true the `<some instructions>` are executed.
- Once they are done, the instruction in `<change>` is executed.
- This is usually something that changes the value of the counter.
- Then `<true or false>` is tested again.
- Thus `<some instructions>` will be repeatedly executed until `<true or false>` becomes false.

Examples

- Let's go back to our initial example:

```
int myCount;
```

```
for(myCount = 1 ; myCount <= 5 ; myCount++){
```

```
    x = x + 1;
```

```
    y = y + 1;
```

```
}
```

- This increases the value of x and y by 5.

- While:

```
int myCount;
```

```
for(myCount = 10 ; myCount > 5 ; myCount--)  
{  
  
    x = x + 1;  
    y = y + 1;  
  
}
```

would do the same, but with different values of myCount.

- What about this one?

```
int myCount;
```

```
for(myCount = 3 ; myCount < 7 ; myCount++) {
```

```
    x = x + 1;
```

```
    y = y + 1;
```

```
}
```

- This increases the value of x and y by 4.

- What would

```
int myCount;
```

```
for(myCount = 2 ; myCount < 8 ; myCount+=2)  
{
```

```
    x = x - 1;
```

```
    y = y + 1;
```

```
}
```

do?

Using files

- In the same way as we use `cin` to read data from the keyboard, we can read data from files.
- In the same way as we use `cout` to write data to the screen, we can write data to files.
- This allows us to store information on the computer's hard drive, and to use it when we want it without having to type it in each time.

File preliminaries

- To use read and write data to a file, we will make use of some *library functions*.
- To use these functions we need to add:
`#include <fstream>`
at the start of the program.
- We put this in the same place as:
`#include <iostream>`

Simple input

- The function `cin` allows us to read input from the keyboard.
- A typical pattern of usage is:

```
cout << "Enter a number" << endl;  
cin  >> x;
```

which first *prompts* the user, then reads the next thing they type into the variable `x`.

- Other examples of using `cin` can be found in the various roomba programs on the course website.
- `cin` is the counterpart of `cout`.

Reading from a file

- To read from a file, we have to tell the program three things:
 - That we are going to read from a file.
 - How we will refer to the file inside the program.
 - What the name of the file on the hard drive is.
- We can do those three things using one command:

```
ifstream infile( "commands.txt" );
```

- The `ifstream` says we are going to read from a file.
- `infile` is the name we are going to use inside the program.
- `patient.dat` is the name of the file on the hard drive.

- Alternatively we can write this as two commands:

```
ifstream infile;  
infile.open( "commands.txt" );
```

- Now that we have defined `infile` as an *input stream*, we can read data from it.
- We use `infile` much like `cin`.
- Thus:

```
infile >> command;
```

reads the next character from the file into the variable `command`

- Once we have finished reading from the file, we close it:

```
infile.close();
```

Writing to a file

- To write to a file, we have to tell the program three things:
 - That we are going to write to a file.
 - How we will refer to the file inside the program.
 - What the name of the file on the hard drive is.
- Again we can do those three things using one command:

```
ofstream outfile("log.txt");
```

or using two commands:

```
ofstream outfile;  
outfile.open("log.txt");
```


- Once we have defined `outfile` as an *output stream*, we can send data to it.
- We use `outfile` much like `cout`.
- Thus:

```
outfile << whatIDid;
```

sends the value of the variable `whatIDid` to the file.

- Once we have finished reading from the file, we close it:

```
outfile.close();
```

- When writing to a file it is important to close it — if the file isn't closed, the data that we have set to the file might not be stored in it.

File open modes

- When we open a file for writing, the computer discards any information that is in the file.
- This is not always what we want to do.
- We can control what happens by specifying the *file open mode*.
- For example, instead of:

```
ofstream outfile;  
outfile.open("log.txt");
```

we can have:

```
ofstream outfile;  
outfile.open("log.txt", ios::app);
```

which will write new output to the end of the file.

- There are other options.

`outfile.open("log.txt", ios::trunc);`
will discard any information in the file.

`outfile.open("log.txt", ios::out);`
will open the file for output, and is just another way to do:

`outfile.open("log.txt");`

- We also have:

`outfile.open("log.txt", ios::nocreate);`
which will fail to open the file if it doesn't already exist.

- Finally, we have have:

```
outfile.open("log.txt", ios::noreplace);
```

which will fail to open the file if it does already exist.

- noreplace is thus the dual of nocreate.
- There are also modes for input files.
- We have:

```
ifstream myfile;
```

```
myfile.open("commands.txt", ios::in);
```

which will open the file for input.

Random numbers

- In the lab today we will use random numbers to perk up the roomba example a little.
- To generate random numbers we use the function `rand()`
- For example;

```
int x;  
x = rand( );
```

- This assigns a random value to `x`. The value is somewhere between 0 and (at least) 32767.
- To use `rand()`, we need to add `#include<cstdlib>` to our program.

- Each time we run our program `rand()` will produce some (apparently) random numbers.
- But it will produce the *same* numbers each time we run the program.
- To get different numbers each time we run the program, we need to *seed* the random number generator.
- The usual way to do that is to add:

```
srand( time( NULL ) );
```
- The `time(NULL)` uses the clock to generate a seed.
- We have to add `#include<ctime>` to do this.

Summary

- This lecture started with `for` loops.
- Then we looked at simple file handling.
- In particular, we looked at:
 - reading data in from; and
 - writing data out tosimple sequential files.
- Finally, we looked at how to generate random numbers.