Why we need control structures

- So far, all we have seen is how to make a program do a *sequence* of things.
  - `goNorth()`
  - `goEast()`
  - `goNorth()`
- There is more to life than this!
- We want to be able to make a program:
  - Choose between doing different things
  - Do the same thing several times
- C++ gives us *control structures* which allow us to do these things.

roombaGame

LOGICAL OPERATIONS, CONTROL STRUCTURES

Today

- The `if` statement
- Relational operators
- Logical operators
- Truth tables
- The `if-else` statement.
- The `while` statement

Boolean expressions

- Boolean expressions are things that are true or false.
- Boolean variables: `true` (1) or `false` (0)
- Logical operators:

!	not
&&	and
||	or

- Example:

```
boolean a, b;
x = 1; // true
y = 0; // false

   if(x && y){
     cout << "This is false\n";
   }

   if(x || y){
     cout << "This is true\n";
   }
```

The `if` branching statement

- **roombaGame** used several new features of C++.
- Perhaps the simplest is the `if` statement.
- To tell when the roomba is at the dirt, we need to do:

```
if(x == dirtX) {
   cout << "The roomba found the dirt" << endl;
  }
```

- Let's look at it in a bit more detail.

The `if` branching statement

- The `if` is a *conditional*
  - Means the computer makes a choice
- It is also a *control structure*
- General structure:

```
if(<something that is true or false>)
{

    <some instructions>

}
```

The `if` branching statement (again)

```
// Is the robot still in the world?

if ((x < 10) && (y < 10))
{
  cout << "The roomba is on the grid\n";
}
```

- And the actual code from the **roombaGame**:

```
if((x == dirtX)&&(y == dirtY))
{
  cout << "You found the dirt\n";
}
```

Truth tables

a	!a
false	true
true	false

a	b	a && b
true	true	true
true	false	false
false	true	false
false	false	false

a	b	a || b
true	true	true
true	false	true
false	true	true
false	false	false

Relational operators

==	equality
!=	inequality
>	greater than
<	less than
>=	greater than or equal to
<=	Less than or equal to

example:

```
int x, y;
x = -5;
y = 7;
```

some truths:

(x < y)	true
(x == y)	false
(x >= y)	false

The `if-else` branching statement

- A neater way of doing some branching.
- This:

```
if((x == dirtX)&&(y == dirtY)){
  cout << "You found the dirt\n";
}

if((x != dirtX)||(y != dirtY))){
  cout << "You missed the dirt\n";
}
```

- Is a bit neater as:

```
if((x == dirtX)&&(y == dirtY))
{
  cout << "You found the dirt\n";
}
else
{
  cout << "You missed the dirt\n";
}
```

- General structure:

```
if(<something that is true or false>)
{

    <some instructions>

}
else
{
    <alternative instructions>
}
```

the `while` looping statement.

- `while` allows us to repeat things:

```
// Go north 4 times

   count = 0;

   while (count <= 4)
    {
      goNorth();
    }
```

- General structure:

```
while(<something that is true or false>)
{

    <some instructions>

}
```

- This structure looks a lot like `if`

Summary

- We covered some of the basic control structures:
  - `if`, `while`
- Along the way we looked at boolean expressions and relational operators as well.
- Now it is time to read Chapter 2 of the textbook.