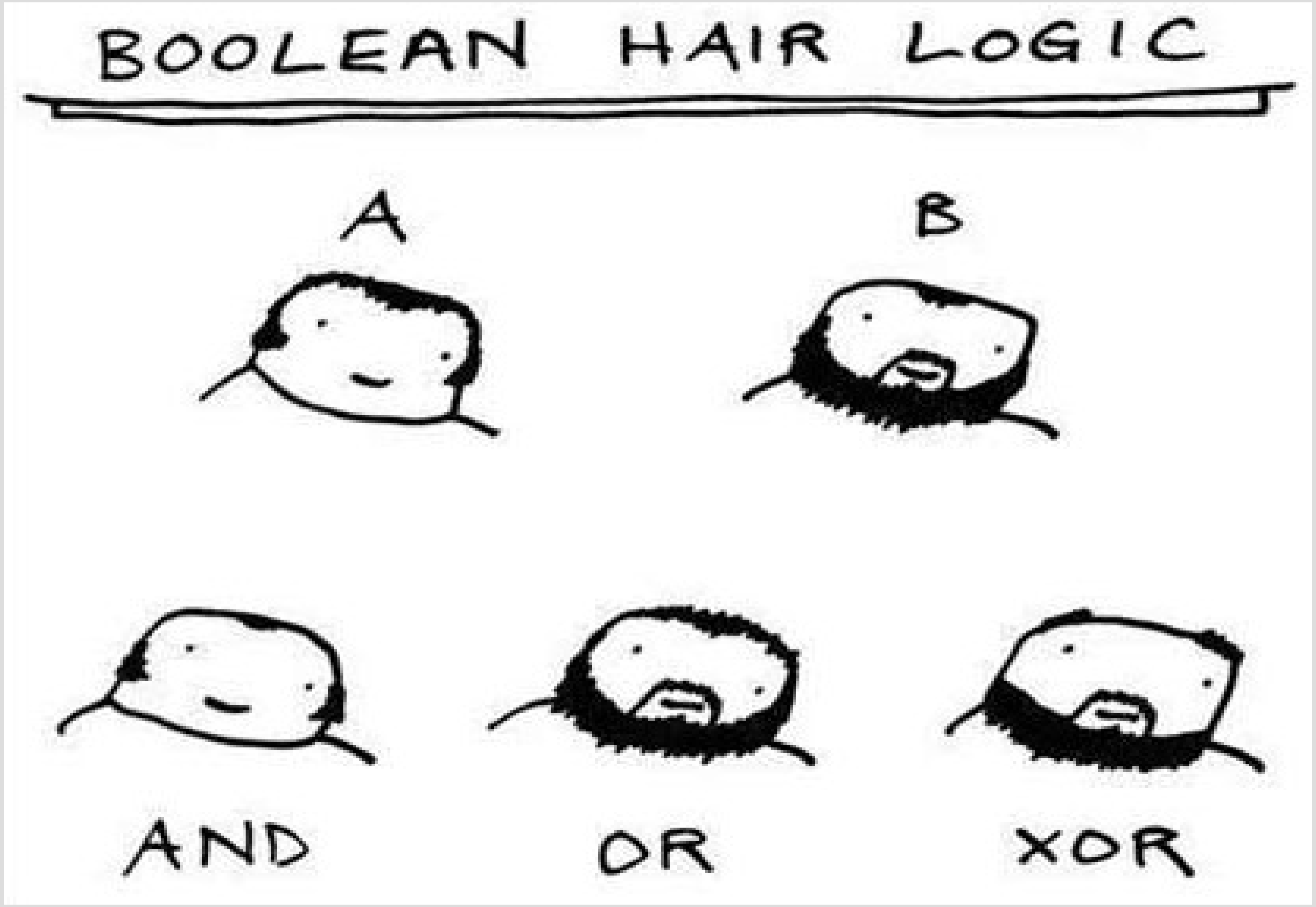

BOOLEAN HAIR LOGIC
A
B
AND
OR
XOR

; and if

Please always put {} after if-statements

The compiler will let you get away with not putting these (this leads to another issue)

If you do not put {} immediately after an if, it will only associate the first command after with the if-statement
(see: ifAndSemi.cpp)

Logical operators

These are all the operators that result in a bool:

> (greater than), e.g. 7 > 2.5 is true

== (equals), e.g. 5 == 4 is false

< (less than), e.g. 1 < 1 is false

>= (greater than or equal to), e.g. 1 <= 1 is true

!= (not equal to), e.g. 8 != 7 is true

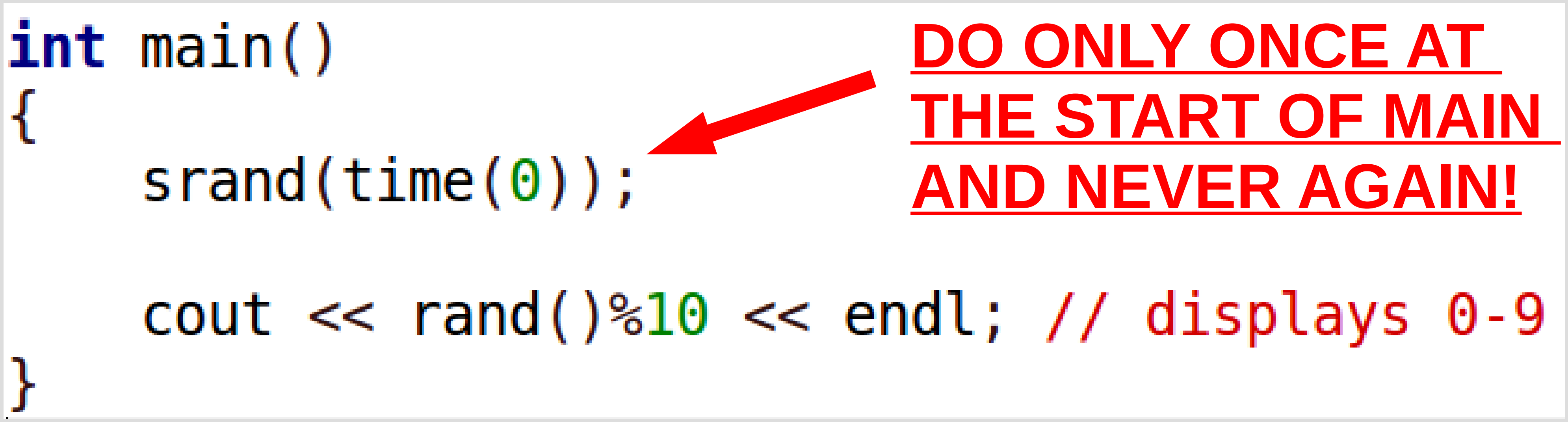
<= (less than or equal to), e.g. 6 <= 2 is false

! (not, negation), e.g. !true is false

Random numbers

To use random numbers, you need to do:

1. Run srand(time(0)) once
2. Use rand() to actually generate a number



```
int main()
{
    srand(time(0));

    cout << rand()%10 << endl; // displays 0-9
}
```

DO ONLY ONCE AT THE START OF MAIN AND NEVER AGAIN!

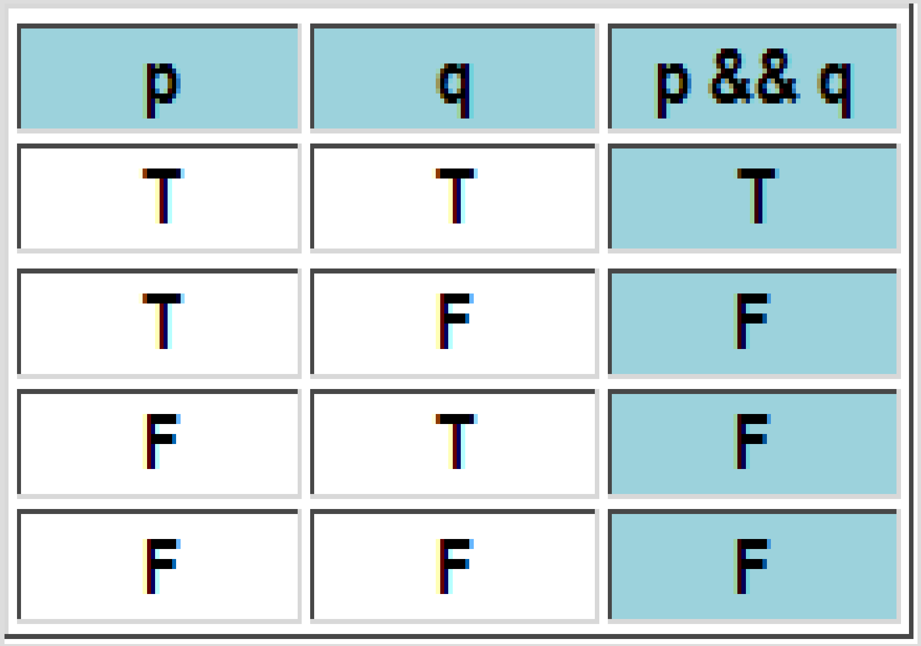
(See: rng.cpp)

Complex expressions

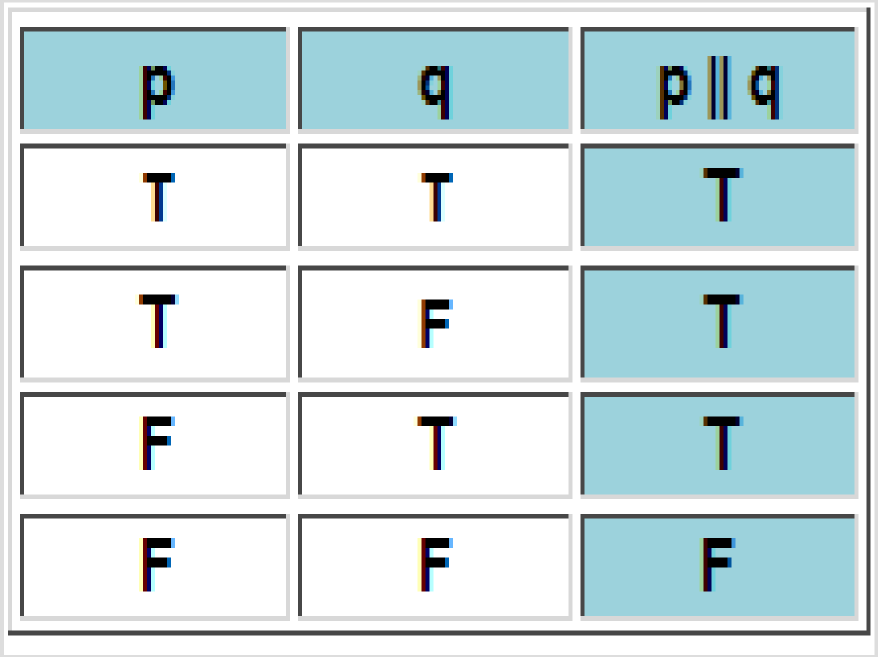
Two boolean operators:

&& is the AND operations

|| is the OR operations



p	q	p && q
T	T	T
T	F	F
F	T	F
F	F	F



p	q	p || q
T	T	T
T	F	T
F	T	T
F	F	F

Complex expressions

AND operation removes Ts from the result
The OR operation adds Ts to the result

Evaluate (!p OR q) AND (p)

p	q	!p	!p OR q	(!p OR q) AND (p)
T	T	F	T	T
T	F	F	F	F
F	T	T	T	F
F	F	T	T	F

Complex expressions

Write an if statement for checking if a variable (int) x is a positive odd number.

Hint: You may want to use the remainder (also called modulus) operator (the % sign).

For example, 5 % 3 = 2

Complex expressions

int x = 9, y = 7;

$$\underbrace{x < 12} \;\&\&\; \underbrace{y > 10}$$

$$\underbrace{9 < 12} \;\&\&\; \underbrace{7 > 10}$$

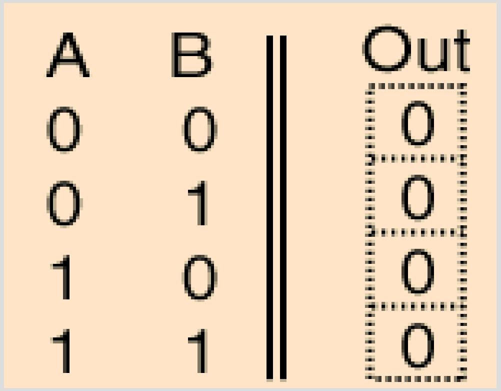
$$\underbrace{T \quad \&\& \quad F}$$

$$F$$

Complex expressions

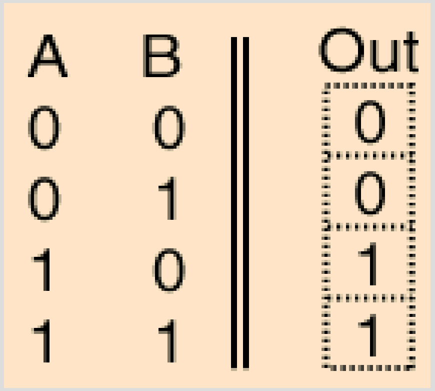
Write boolean expressions for each of the following truth tables:

1.



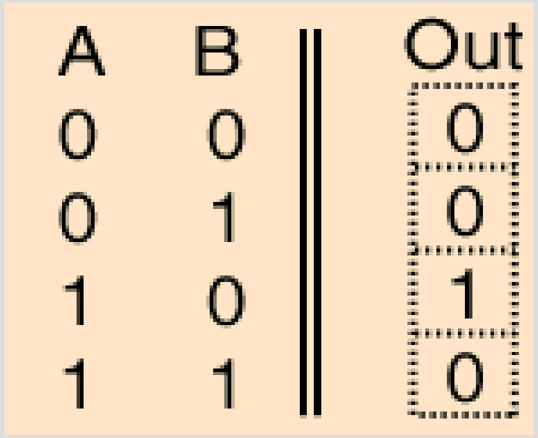
A	B	Out
0	0	0
0	1	0
1	0	0
1	1	0

2.



A	B	Out
0	0	0
0	1	0
1	0	1
1	1	1

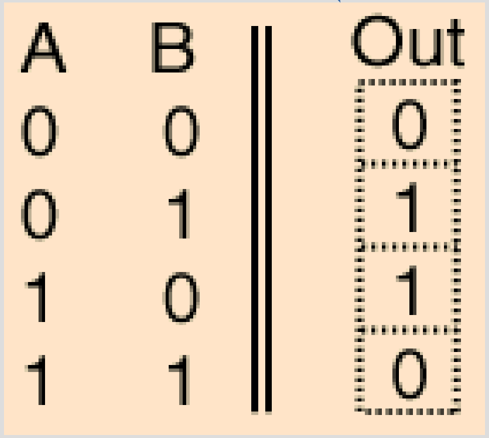
3.



A	B	Out
0	0	0
0	1	0
1	0	1
1	1	0

4.

XOR



A	B	Out
0	0	0
0	1	1
1	0	1
1	1	0

Complex expressions

Humans tend to use the english word OR to describe XOR (exclusive or)

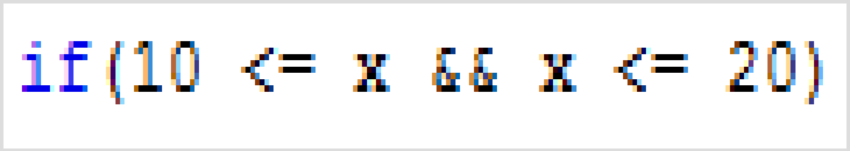
“You can get a side order of a salad, fries or a soup.”

Did you think the statement above meant you could get all three?

Complex expressions

If statements for when x...

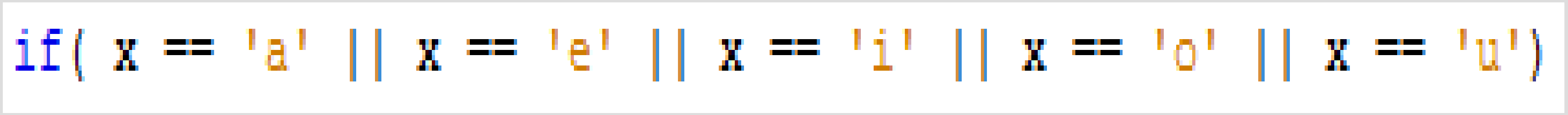
... is between 10 and 20 (inclusive)



```
if(10 <= x && x <= 20)
```

Cannot say: 10 <= x <= 20 (why?)

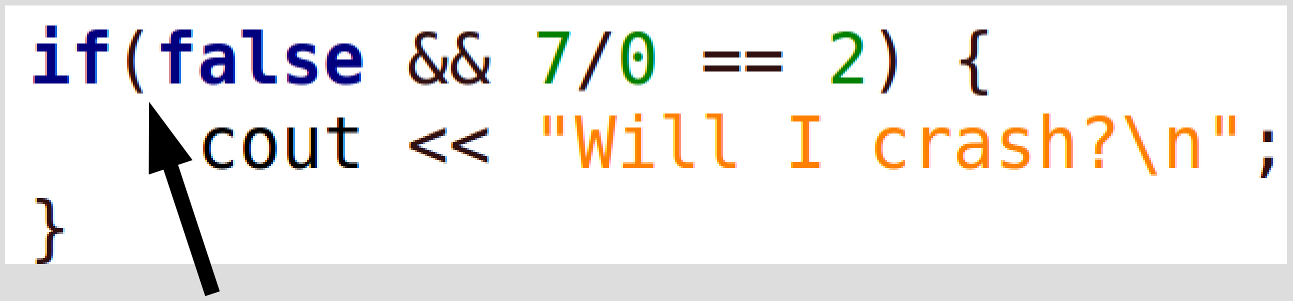
... is a vowel (x is type char)



```
if( x == 'a' || x == 'e' || x == 'i' || x == 'o' || x == 'u')
```

Short-circuit evaluation

<u>Short-circuit</u> evaluation is when you have a complex bool expression (&& or ||) but you don't need to compute all parts.



```
if(false && 7/0 == 2) {
    cout << "Will I crash?\n";
}
```

If this is false, then it will not check next

(See: shortCircuit.cpp)

Short-circuit evaluation

Simple cases of short-circuit:

When you have a bunch of ORs

```
if( expression || exp || exp || exp )
```

Once it finds any true expression,
if statement will be true

When you have a bunch of ANDs

```
if( expression && exp && exp && exp )
```

Once it finds any false expression,
if statement will be false

Complex expressions

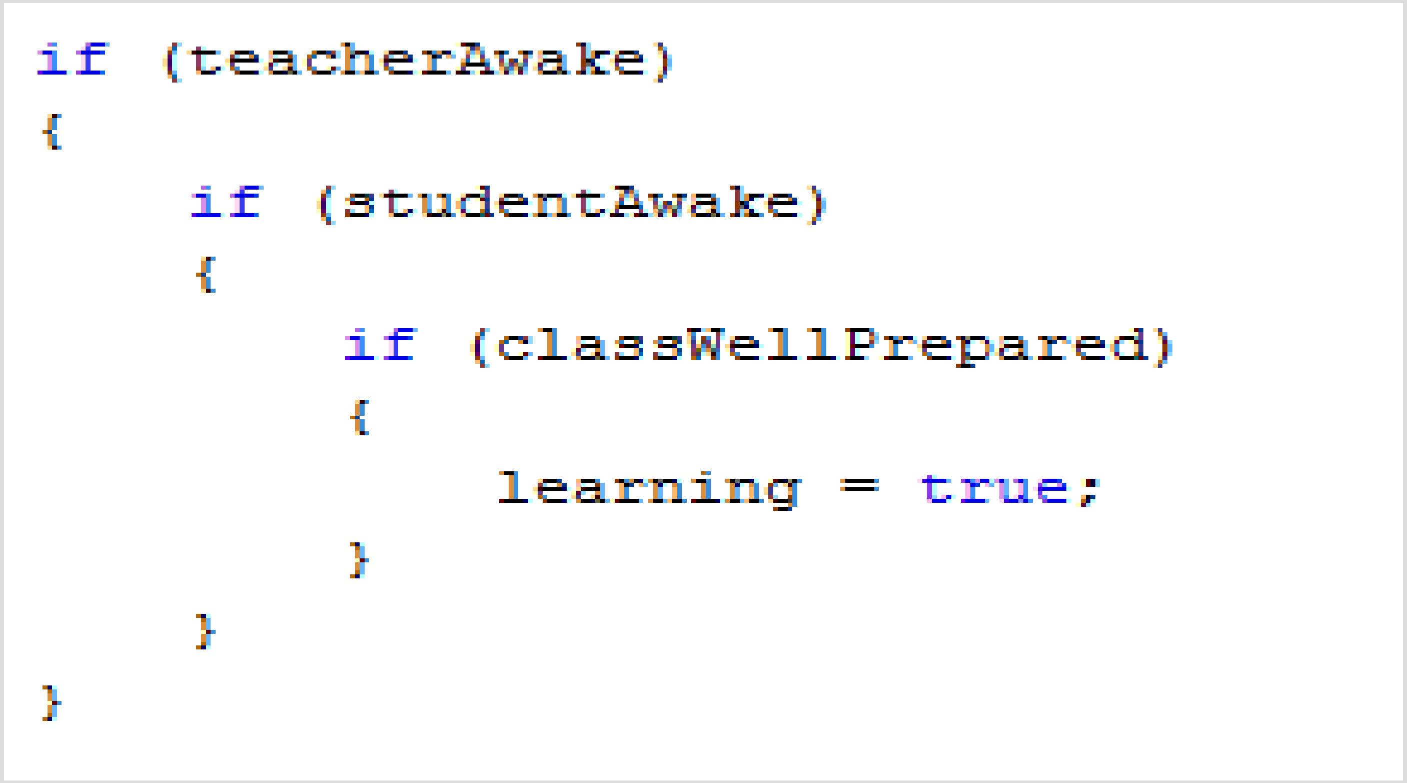
Be careful when negating, that you follow De Morgan's Law:

```
bool a, b;
!(a OR b) is equivalent to (!a) AND (!b)
!(a AND b) is equivalent to (!a) OR (!b)
```

“Neither rainy or sunny” means
“Both not rain and not sunny”

Nested if statements

You can have as many if statements inside each other as you want.



```
if (teacherAwake)
{
    if (studentAwake)
    {
        if (classWellPrepared)
        {
            learning = true;
        }
    }
}
```

Nested if statements

From a truth table perspective, nested loops are similar to AND

The previous if code is equivalent to:

```
if(teacherAwake && studentAwake && classWellPrepared)
{
    learning = true;
}
```

However, sometimes you want to do other code between these evaluations

Nested if statements

RUT-
ROH
WHAT IS AN INTERNET LAWYER?
MONTY PYTHON and the HOLY GRAIL
Keeper of the Bridge of Death

(See: bridgeOfDeath.cpp)

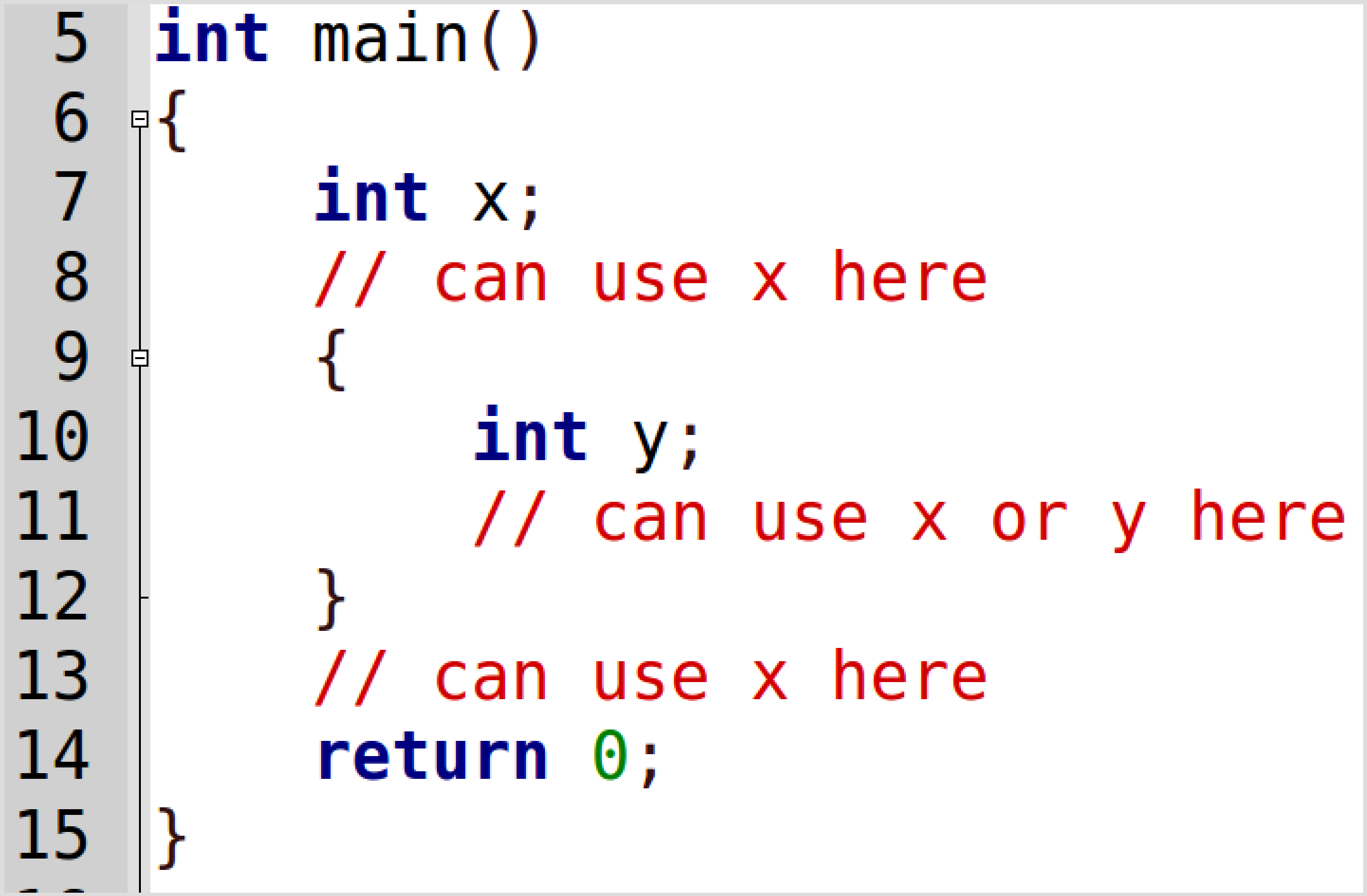
Scope

Where a variable is visible is called its <u>scope</u>

Typically variables only live inside the block (denoted with matching { and })

A variable lives until the block is closed, so inner blocks can see everything from the block it was created inside

Scope



```
int main()
{
    int x;
    // can use x here
    {
        int y;
        // can use x or y here
    }
    // can use x here
    return 0;
}
```

(See: scope.cpp)

If... if... else!

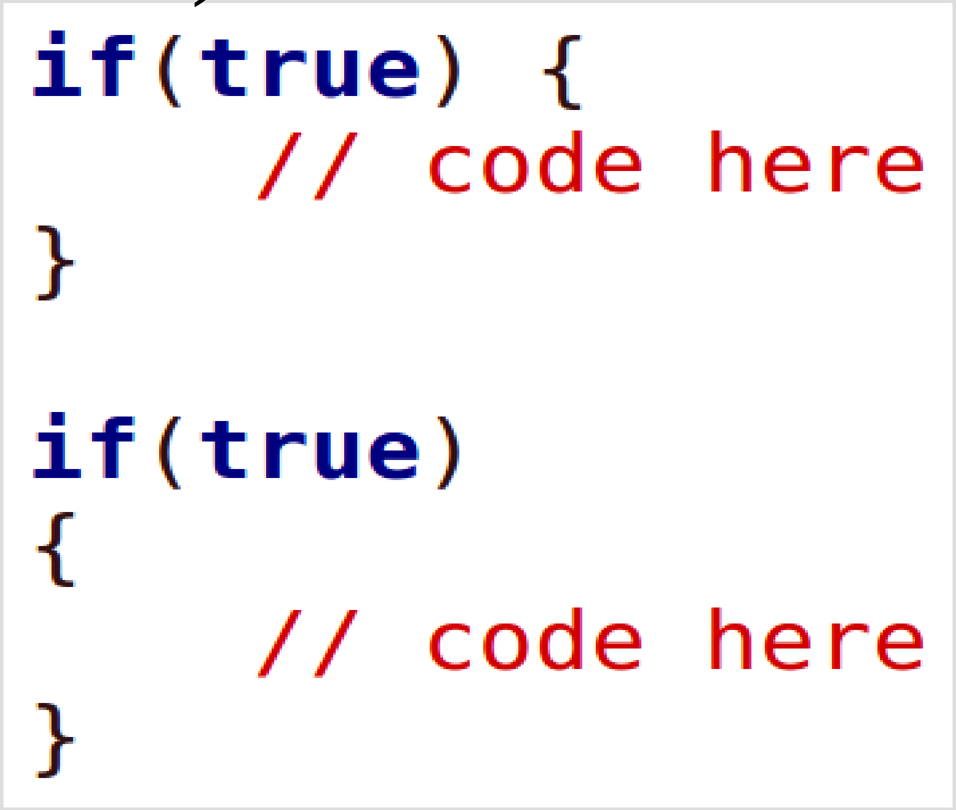
hey, psss
HEY
shut up!
if there were two ifs and one else
To which if does else belong to
@HANNAH HILLAM / BUZZFEED

If... if... else!

When in doubt, use parenthesis and blocks!
(Some people like to put the first brace after the if, others on a new line)

What happens if
you have an
if if else?

(See: ifIfElse.cpp)



```
if(true) {
    // code here
}

if(true)
{
    // code here
}
```

Multiway if/else

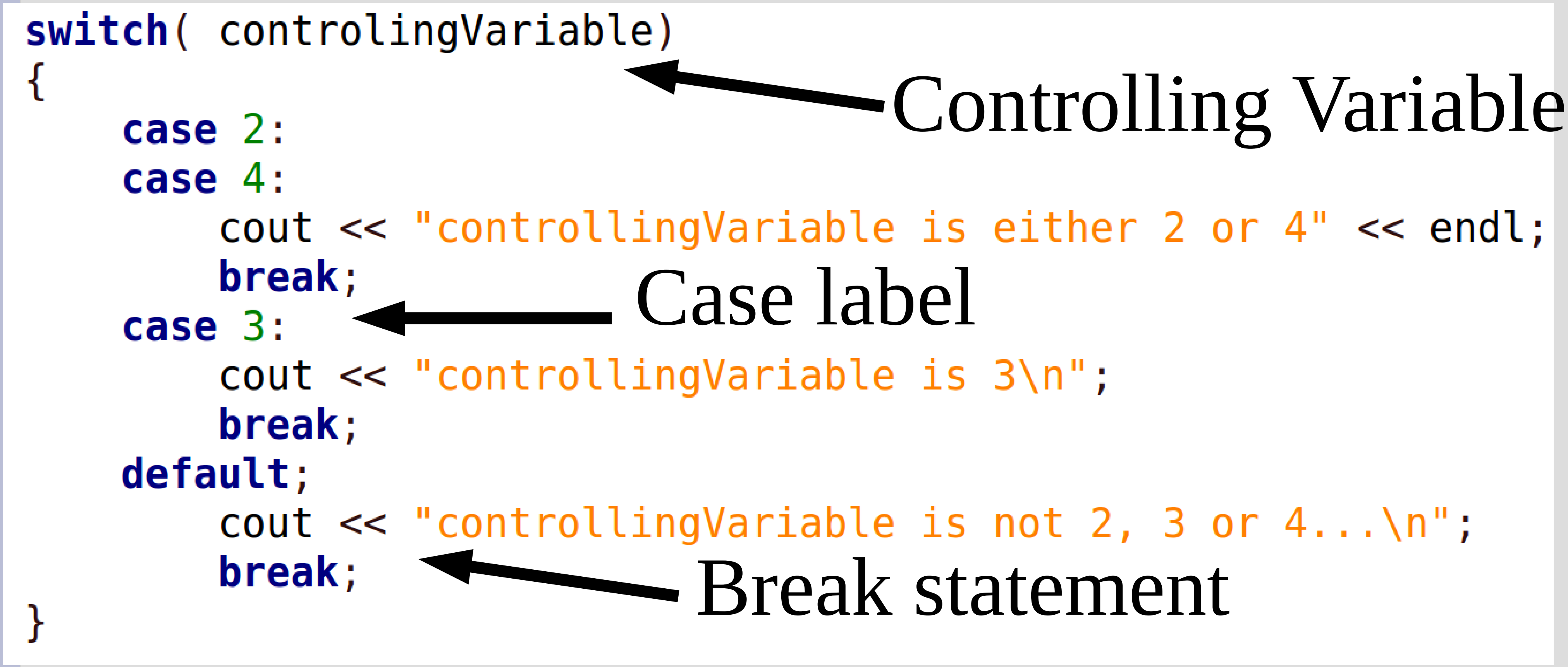
This is a special format if you put an if statement after an else.

This second “if statement” only is tested when the first “if statement” is not true

(See: grades.cpp)

Switch

A <u>switch statement</u> checks to see if a variable has a specific value.



```
switch( controlingVariable)
{
    case 2:
    case 4:
        cout << "controllingVariable is either 2 or 4" << endl;
        break;
    case 3:
        cout << "controllingVariable is 3\n";
        break;
    default;
        cout << "controllingVariable is not 2, 3 or 4...\n";
        break;
}
```

Switch

If the value of the controlling variable
is found in a case label, all code until
a break statement is ran (or the switch ends)

Switch statements only test equality
with case labels (not greater or less than)

(See: switch.cpp)

Switch

Switch statements can be written as multiway if/else statements.

Could use just “if statements” but “else if” shows only one of these will run

(See: switchToIf.cpp)

Conditional operator

We will not use in this class, but if you use other people's code you will encounter

Shorthand for an if-else statement

(boolean) ? [if true] : [if false]

Example:

```
max = (x>y) ? x : y;
```

(See: max.cpp)