CSC 211: Computer Programming
Introducing loops (for)

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THINK BIG WE DO℠

Administrative Notes

‣ A00 Due ~ will start grading manually

‣ Exam 02/24

Basic building blocks

any program you might want to write

objects

functions and modules

graphics, sound, and image I/O

arrays

conditionals and loops

Math | text I/O

primitive data types | assignment statements

Previous lecture:
equivalent to a calculator

This lecture:
to infinity and beyond!

Flowchart of `if` statements

Test expression — False / True

Body of if

Statement just below if
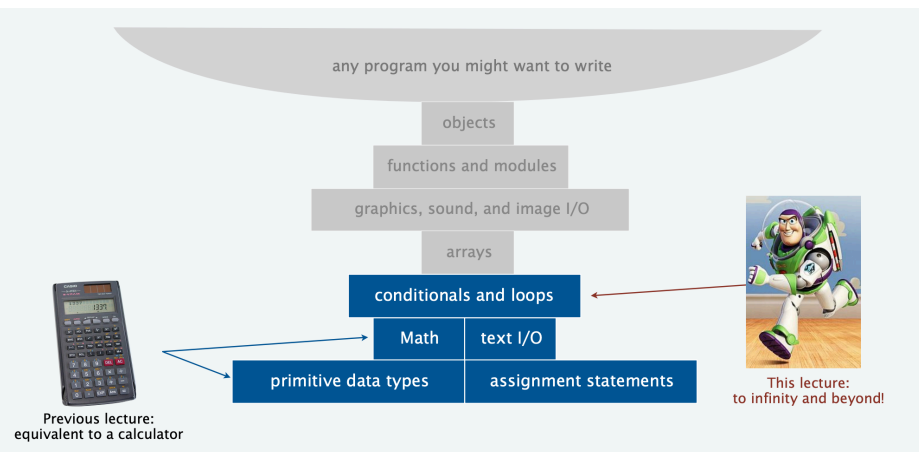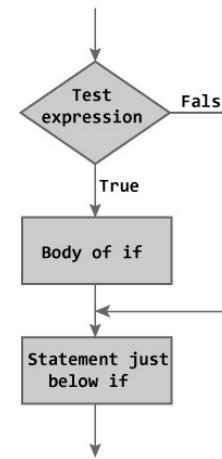
Figure: Flowchart of if Statement

```
// ...
// statements above
// ...

if (test_expression) {
    // body of if
}

// ...
// statements below
// ...
```

Flowchart of `if` statements

```
// ...
// statements above
// ...

if (test_expression) {
    // body of if
} else {
    // body of else
}

// ...
// statements below
// ...
```
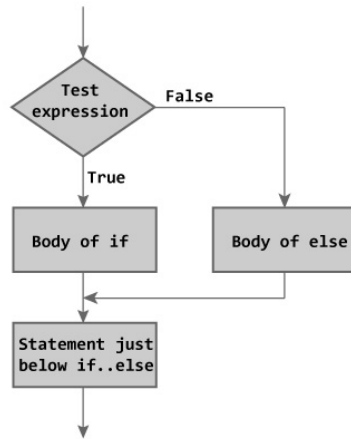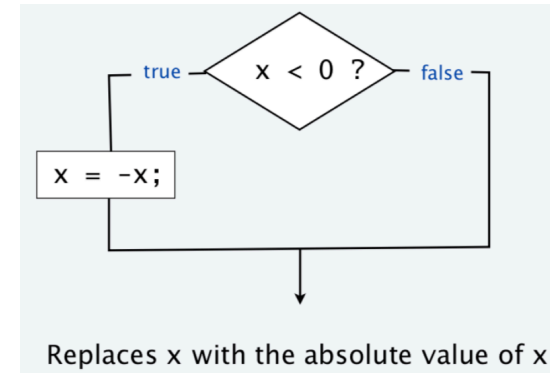
Test expression — False → Body of else; True → Body of if

Statement just below if..else

Figure: Flowchart of if...else Statement

`if` statement examples

Example: `if (x < 0) x = -x;`

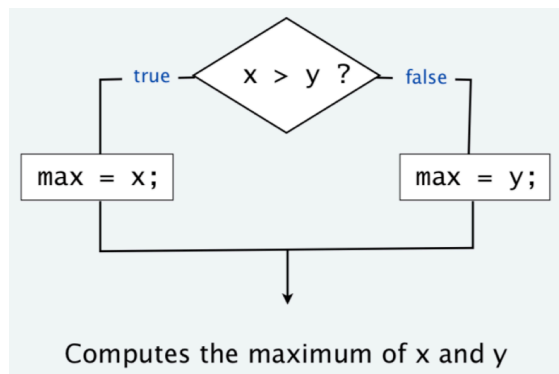true ← x < 0 ? → false

`x = -x;`

Replaces x with the absolute value of x

`if` statement examples

Example: `if (x > y) max = x;`
`        else           max = y;`

true ← x > y ? → false

`max = x;`   `max = y;`

Computes the maximum of x and y

The increment/decrement operators

- Increment (**++**) and decrement (**−−**) are **unary** operators that add or subtract one, to or from their operand, respectively
  - ✓ **pre-increment** and **pre-decrement** operators increment (or decrement) their operand by **1**, and the value of the expression is the resulting incremented (or decremented) value
  - ✓ **post-increment** and **post-decrement** operators increase (or decrease) the value of their operand by **1**, but the value of the expression is the operand's original value prior to the increment (or decrement) operation

The increment/decrement operators

‣ Example:

```
a = 5;
```

```
std::cout << 5 + ++a
```

v.s

```
a = 5;
```

```
std::cout << 5 + a++;
```
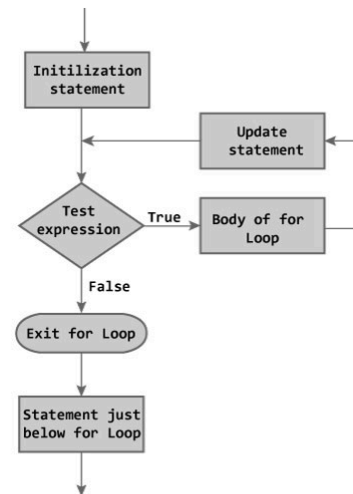
Trace the code

```cpp
int  x;
int  y;

x = 1;

y = ++x;

// Checkpoint a (status of x and y?)

y = x++;

// Checkpoint b (status of x and y?)

x = 5;

y = x--;

// Checkpoint c (status of x and y?)

y = --x;

// Checkpoint d (status of x and y?)
```

the `for` loop

Flowchart of `for` statement


```cpp
// ...
// statements above
// ...

for (init ; test ; update) {
    // body of for
}

// ...
// statements below
// ...
```

Figure: Flowchart of for Loop

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```
1. initialization          4. update

            2. boolean

for (int i = 0 ; i < 3 ; i++) {
    std::cout << i << ' ';
}
            3. statement
```

then go back to step 2

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A *for* Statement

```
//Illustrates a for loop.
#include <iostream>
using namespace std;
                        Initializing      Repeat the loop as
int main()              action            long as this is true.
{                                                           Done after each
    int sum = 0;                                            loop body iteration

    for (int n = 1; n <= 10; n++)  //Note that the variable n is a local
        sum = sum + n;             //variable of the body of the for loop!

    cout << "The sum of the numbers 1 to 10 is "
         << sum << endl;
    return 0;
}
```

Output

```
The sum of the numbers 1 to 10 is 55
```

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What is the output?

```
int value = 0;

for (int i = 0 ; i < 5 ; i++) {
    value += (i * 10);
}

std::cout << value << std::endl;
```

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***for* Loop with a Multistatement Body**

Syntax

```
for (Initialization_Action; Boolean_Expression; Update_Action)
{
    Statement_1
    Statement_2
        .
        .                        Body
        .
    Statement_Last
}
```

Example

```
for (int number = 100; number >= 0; number--)
{
    cout << number
         << " bottles of beer on the shelf.\n";
    if (number > 0)
        cout << "Take one down and pass it around.\n";
}
```

Examples

```cpp
int n = 1;

for ( ; n <= 10 ; n = n + 2)
    std::cout << n << std::endl;

for (n = 10 ; n > 0 ; n -= 2) std::cout << n << std::endl;

for (n = 0 ; n > -30 ; n = n - 7) {
    std::cout << n << std::endl;
}

for (double x = 16.0 ;  x >= 2.0 ;  x = sqrt(x)) {
    std::cout << x;
    std::cout << std::endl;
}
```

What is the output?

```cpp
for (int count = 1 ; count <= 10 ; count++);
    std::cout << "Hello\n";
```

Careful with the semi-colon

· Semi-colon is used to end statements

· Placing it after the parenthesis of a `for` loop creates an **empty statement**

Careful with the semi-colon

```cpp
for (int count = 1 ; count <= 10 ; count++)
    std::cout << count << std::endl;
```

V.S

```cpp
for (int count = 1 ; count <= 10 ; ++count)
    std::cout << count << std::endl;
```

Question

- Write a single for loop to print the first 50 even numbers

Question

- Write a single for loop to print the average of the first 25 multiples of 3