CISC 1600/1610 Computer Science I

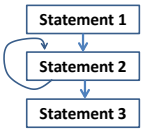
Flow of control - Loops

Professor Daniel Leeds
dleeds@fordham.edu
JMH 328A

Alternatives to "linear execution"

Repeated actions

```
> ./myProgram
Infinite bottles of beer. Take one down.
Infinite bottles of beer. Take one down.
Infinite bottles of beer. Take one down.
Infinite bottles of beer. Take one down.
>
```



The `while` loop

```
while ( condition )
   statement_to_repeat;
```

OR

```
while (condition)
{
   statement_to_repeat1;
   . . .
   statement_to_repeatN;
}
```

block of statements

`condition` – a Boolean expression

Just a reminder from our earlier `if-else` slides

- Boolean expressions are either true or false
- Conditions often consist of **comparisons**
  - age ≥ 21 // can buy drinks
  - age < 4 // can ride subway for free
  - year = 2 // you are a sophomore

How can we output "Hello world" 4 times?

```
int x=4;
while ( x>0 )
{
   cout << "Hello world.\n";
   x--;
}
```

Remember `x--;` same as `x=x-1;`

Repeats until x≤0

Execution of while loop

- If `condition` is true, enter `while` loop
  - Complete all statements in block
  - Return to top (re-evaluate `condition`)
- Otherwise, continue to statements beyond loop

Execution of while loop

- If `condition` is `true`, enter `while` loop
  - Complete all statements in block
  - Return to top (re-evaluate `condition`)
- Otherwise, continue to statements beyond loop

```
int x=2;
while ( x>0 )
{
   x--;
   cout << "Hello world.\n";
}
```

How many "Hello world"s are output?

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What does this code do?

```
int b=3;
while(b<6)
{
  cout << b;
  b+=2;
}
```

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What code will do this for us?

```
> ./myProgram.out
1 mississippi
2 mississippi
3 mississippi
4 mississippi
5 mississippi
>
```

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What does this code do?

```
int b=6;
while(b!=3)
{
  cout << b;
  b-=2;
}
```

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Beware infinite loops!

- Loops that never stop are called infinite loops
- Typically, write code so each loop will stop

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Beware the misplaced ;

Placing a semicolon after the parentheses of a `while` loop causes an empty statement as the body of the loop

```
int i=1;
while(i<10);
{
  cout << "Hello\n";
  i++;
}
```

Infinite loop

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Counters and accumulators

How can we write a program to compute 1+2+3+4+5 ?

Use two variables:

- **Counter:** Keep track of number of loop repeats
- **Accumulator:** Keep track of running sums

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`do-while` loop

- `while` evaluates `condition`, then performs statements if `condition` is **`true`**
- `do-while` performs statements, then evaluates `condition` to determine whether to perform statements again

```
do
{
   statement1;
   . . .
   statement N;
}
while ( condition );
```

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What does this code do?

```
int main () {
   int a;
   cout << "Input a number: ";
   cin >> a;
   do {
      cout << "one ";
      cout << "two\n";
      a-=2;
   } while ( a > 0);
   return 0;
}
```

Given:

- user inputs 4
- users inputs -2

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`for` loop

a `while` loop alternative

```
for ( init; condition; update )
{
   statement1;
   . . .
   statement N;
}
```

typical example:

```
int i, product=1;
for ( i=1; i<=5; i++)
{
   product = product*i;
}
```

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`init` – initializes variable

`condition` – statement about variable, must stay true for loop to keep running

`update` – updates the variable after each loop execution

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What does this code do?

```
int main () {
   int i, product=1;
   for ( i=1; i<=5; i++)
      product = product*i;
   cout << i << "! = " << product << endl;

   return 0;
}
```

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Picking a loop

- `do-while` if you need to perform the action at least once
- `for` if there is a standard repeated mathematical update to your loop variable (e.g., count++)
- `while` loop for less-standard loop variable updates

"loop variable" is the variable tested by the condition in your given loop

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