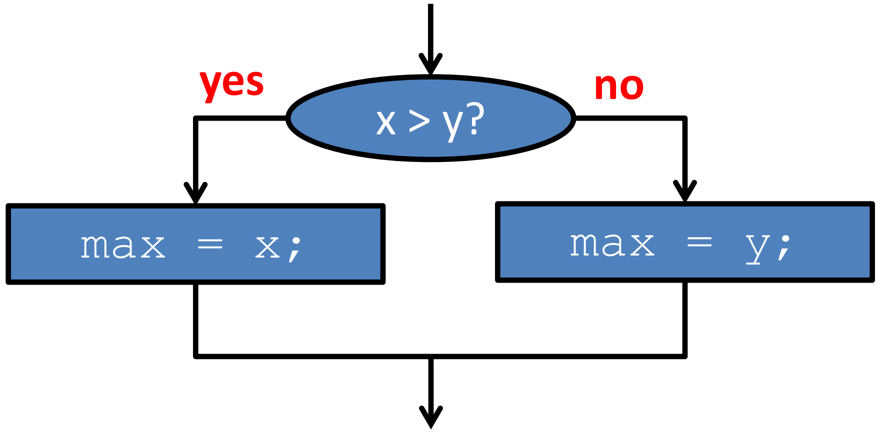
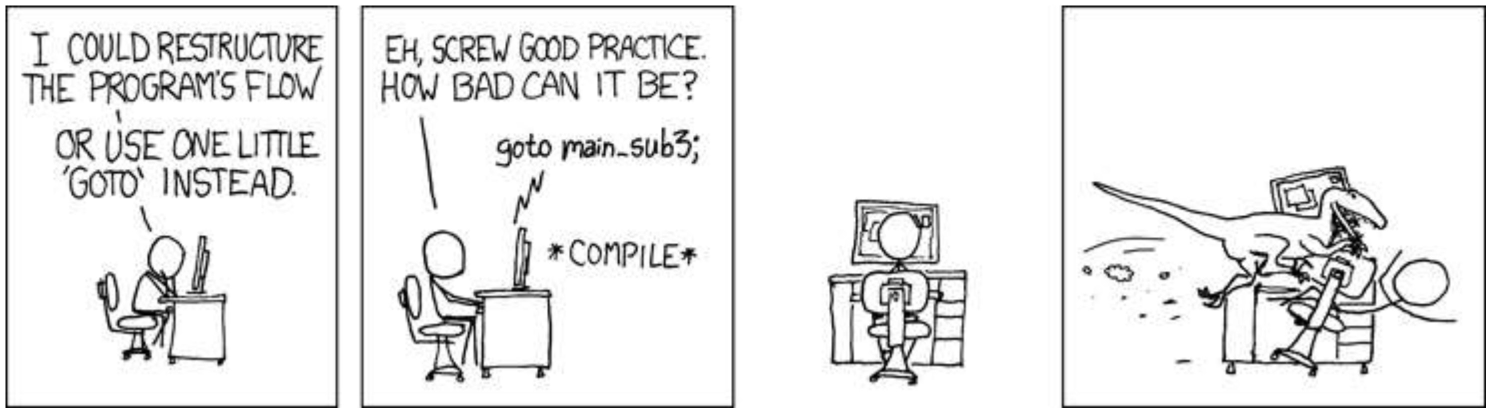
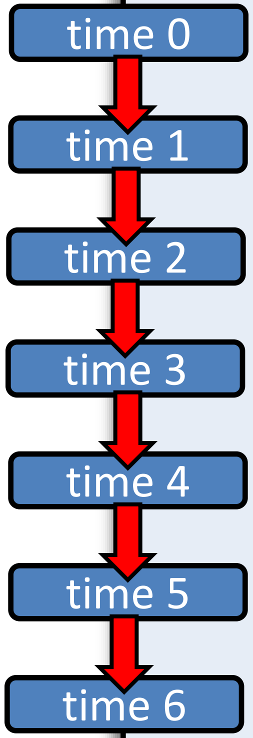
Control Flow: Conditionals and Loops




I COULD RESTRUCTURE THE PROGRAM'S FLOW
OR USE ONE LITTLE 'GOTO' INSTEAD.
EH, SCREW GOOD PRACTICE. HOW BAD CAN IT BE?
goto main_sub3;
COMPILE

http://xkcd.com/292/

Control flow thus far



```java
public class ArgsExample
{
   public static void main(String [] args)
   {
      String product = args[0];

      int    qty     = Integer.parseInt(args[1]);

      double cost    = Double.parseDouble(args[2]);

      double total = qty * cost;

      System.out.print("To buy " + qty);

      System.out.print(" " + product);

      System.out.println(" you will need $" + total);
   }
}
```

Control flow

- Interesting and powerful programs need:
  - To skip over some lines
  - To repeat lines
- Conditionals → sometimes skip parts
- Loops → allow repetition of lines

if statement

- Common branching statement
- Evaluate a `boolean` expression
  - If `true`, do some stuff
  - If `false`, do some other stuff (optional)

```
if (expression)
{
    statement1;
    statement2;
    …
}
```

Note lack of semicolon!

```
if (expression)
{
    statement1;
    statement2;
    …
}
else
{
    statement3;
    statement4;
    …
}
```

if statement

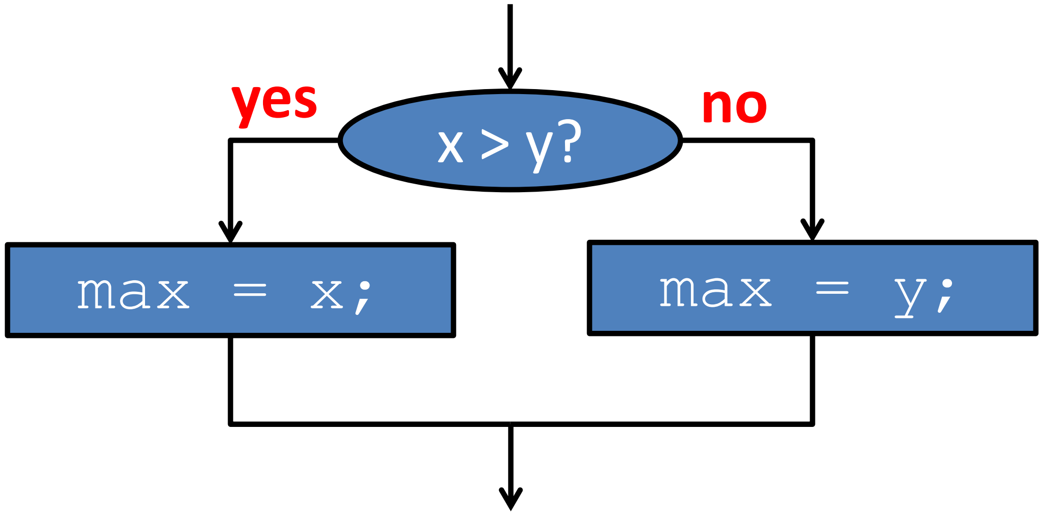
- {}'s optional if only one statement

```
if (expression)
    statement1;
```

```
if (expression)
    statement1;
else
    statement2;
```

- Example:

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



if examples

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

Take absolute value of x

```
if (Math.random() < 0.5)
   money = money * 2;
else
   money = 0.0;
```

Make a double or nothing bet with 50-50 odds.

```
if (x > y)
{
   int t = x;
   x = y;
   y = t;
}
```

Put x and y into sorted order

```
num = 0;
if (args.length > 0)
{
   num = Integer.parseInt(args[0]);
}
```

If a command line option is passed in, use it as the value for `num`.

Nested if

- Execute one of three options:

```
if (category == 0)
{
    title = "Books";
}
else
{
    if (category == 1)
    {
        title = "CDs";
    }
    else
    {
        title = "Misc";
    }
}
```

=

```
if (category == 0)
{
    title = "Books";
}
else if (category == 1)
{
    title = "CDs";
}
else
{
    title = "Misc";
}
```

while loop

- Common way to repeat code
  - Evaluate a `boolean` expression
  - If `true`, do a block a code, evaluate again
  - If `false`, skip over block

```
while (expression)
{
    statement1;
    statement2;
    …
}
```

while loop with multiple statements in a {} block

```
while (expression)
    statement1;
```

while loop with a single statement

while loop example 1

- Print out summations, 0 + 1 + 2 + … + N

```java
public class Summation
{
   public static void main(String [] args)
   {
      int  limit = Integer.parseInt(args[0]);
      int  i     = 1;
      int  sum   = 0;

      while (i <= limit)
      {
         sum += i;
         System.out.println("sum 0..." + i +
                            " = " + sum);
         i++;
      }
   }
}
```

```
% java Summation 4
sum 0...1 = 1
sum 0...2 = 3
sum 0...3 = 6
sum 0...4 = 10
```

while loop example 2

- Print out powers of 2 up to but not including a limit

```
public class Powers2
{
   public static void main(String [] args)
   {
      int  limit = Integer.parseInt(args[0]);
      long total = 1;
      while (total < limit)
      {
          System.out.println(total);
          total = total * 2;
      }
   }
}
```

```
% java Powers2 16
1
2
4
8
```

while loop

```
while (expression)
{
    statement1;
    statement2;
}
```

```
while (expression);
{
    statement1;
    statement2;
}
```

while loop

```
while (expression)
{
    statement1;
    statement2;
}
```

```
while (expression);
{
    statement1;
    statement2;
}
```

This semicolon is the entire body of the while loop! Almost never what you want.

for loop

- for-loop: very common type of loop
  - Execute an initialization statement
  - Evaluate a `boolean` expression
  - If `true`, do code block then increment
  - If `false`, done with loop

```
for (init; expression; increment)
{
    statement1;
    statement2;
    …
}
```

for loop versions

```
for (init; expression; increment)
{
    statement1;
    statement2;
    …
}
```

{} block version

```
for (init; expression; increment)
    statement1;
```

single line version

```
for (init; expression; increment);
{
    statement1;
    statement2;
    …
}
```

buggy version

for loop example

- Print out summations, 0 + 1 + 2 + … + N

```java
public class SummationFor
{
   public static void main(String [] args)
   {
      int  limit = Integer.parseInt(args[0]);
      int  sum   = 0;

      for (int i = 1; i <= limit; i++)
      {
         sum += i;
         System.out.println("sum 0..." + i +
                                   " = " + sum);
      }
   }
}
```

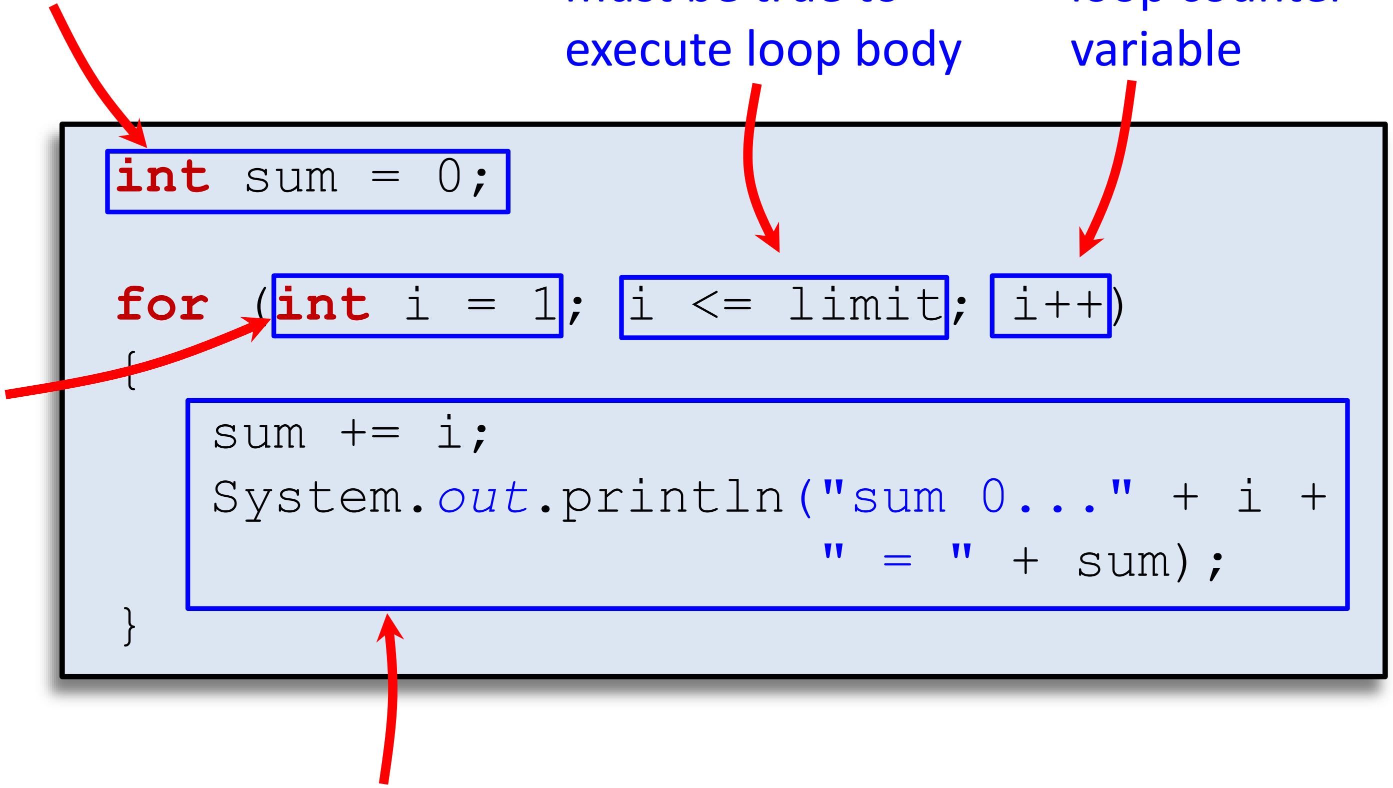
for loop anatomy

declare and initialize a variable for use inside and outside the loop body

condition which must be true to execute loop body

changes the loop counter variable

declare and initialize a loop control variable



```
int sum = 0;

for (int i = 1; i <= limit; i++)
{
    sum += i;
    System.out.println("sum 0..." + i +
                       " = " + sum);
}
```

loop body, executes 0 or more times

do while loop

- do while loop: always executes loop body at least once
  - Do a block a code
  - Evaluate a `boolean` expression
  - If expression true, do block again

```
do
{
    statement1;
    statement2;
    …
}
while (condition);
```

do-while needs this semicolon!

do while example

- Draw random points in [0, 1) until we hit interval [left, right]

```
public class DrawPoints
{
    public static void main(String[] args)
    {
        double left  = Double.parseDouble(args[0]);
        double right = Double.parseDouble(args[1]);
        double point = 0.0;
        int    count = 0;

        do
        {
            point = Math.random();
            count++;
        }
        while ((point < left) || (point > right));

        System.out.println(count + " random draws");
    }
}
```

do while example runs

```
% java DrawPoints 0.1 0.2
9 random draws

% java DrawPoints 0.1 0.2
2 random draws
```

```
% java DrawPoints 0.1 0.11
74 random draws

% java DrawPoints 0.1 0.2
198 random draws
```

```
% java DrawPoints -0.2 -0.1
(never terminates!)

% java DrawPoints 0.2 0.1
(never terminates!)
```

- Infinite loop: possible for all loop types (while/for)
  - Eclipse, hit the red stop button
  - Command line, hit ctrl-c

Nested loops

- Loop inside another loop

```
public class StarTriangle
{
    public static void main(String[] args)
    {
        int limit = Integer.parseInt(args[0]);
        for (int i = 0; i < limit; i++)
        {
            for (int j = 0; j <= i; j++)
               System.out.print("*");
            System.out.println();
        }
    }
}
```

```
% java StarTriangle 4
*
**
***
****
```

Loop choice

- Does your loop need a counter variable?
  - e.g. Going from 0 to N or N to 0 in fixed steps
  - Use a for loop
  - Counter variable is local to loop
  - Harder to forget the increment/decrement
- Do you need an unknown number of loops?
  - Use a while loop
- Do you need to loop at least once?
  - Use a do while loop

Style: comments

- Comments help reader/grader understand the program
  - Good comments explain why something is done
  - Write before coding tricky bits, helps make a plan
  - Don't comment the obvious
    - `i++;   // Increment i by one`

```
// Two slashes means a comment only on this line

/* Slash start means a comment
   that can go over multiple lines
   end with a start slash */

int dist = x + y;    // Short comments can go here too
```

Style: naming things

- Variable names
  - Begin with lowercase, uppercase each new word
  - `int totalWidgets;`
- Class names
  - Begin uppercase, then lowercase except for new words
  - `public class InventoryTracker`
  - Name exactly as in assignment description
- Constants
  - All upper case, use _ between words
  - `double SPEED_LIGHT = 3.0e8;`

Style: whitespace

```
public class StarTriangle
{
public static void main(String[] args)
   {int limit = Integer.parseInt(args[0]);
for (int i=0;i<limit;i++){
            for (int j = 0; j <= i; j++)
            System.out.print("*");System.out.println();
}}}
```

- Indent each level of conditionals/loops
  - Indent a fixed number of spaces (3-4)
  - Eclipse can fix automatically, ctrl-a then ctrl-i
- Use blank lines to separate logical sections
- Only one statement per line

Style: whitespace

```
for (int i=0;i<limit;i++)
```

vs.

```
for (int i=0; i < limit; i++)
```

```
a=b*c/d-(8.12*e);
```

vs.

```
a = b * c / d - (8.12 * e);
```

```
//this is a comment
//describing my code
```

vs.

```
// this is a comment
// describing my code
```

- Use spaces between
  - statements in for loop
  - operators in math expressions
  - after the // starting a comment

Style: whitespace

```
Math . random ();
```

vs.

```
Math.random();
```

```
args [0];
```

vs.

```
args[0];
```

```
i = i + 1 ;
```

vs.

```
i = i + 1;
```

- Do NOT use spaces between
  - method class, dot, name, or ()'s
  - array name and []'s
  - statement and ending semicolon

Style: whitespace

- Use spaces to align parallel code if it makes it more readable
  - Often helps to spot mistakes

```
int numPoints = Integer.parseInt(args[0]);
int startX = Integer.parseInt(args[0]);
int startY = Integer.parseInt(args[2]);
double velX = Integer.parseInt(args[3]);
double velY = Integer.parseInt(args[4]);
```

```
int    numPoints = Integer.parseInt(args[0]);
int    startX    = Integer.parseInt(args[0]);
int    startY    = Integer.parseInt(args[2]);
double velX      = Integer.parseInt(args[3]);
double velY      = Integer.parseInt(args[4]);
```

Style: curly bracing

```
public class HelloWorld
{
   public static void main(String [] args)
   {
      System.out.println("Hello world!");
   }
}
```

BSD-Allman style

```
public class HelloWorld {
   public static void main(String [] args) {
      System.out.println("Hello world!");
   }
}
```

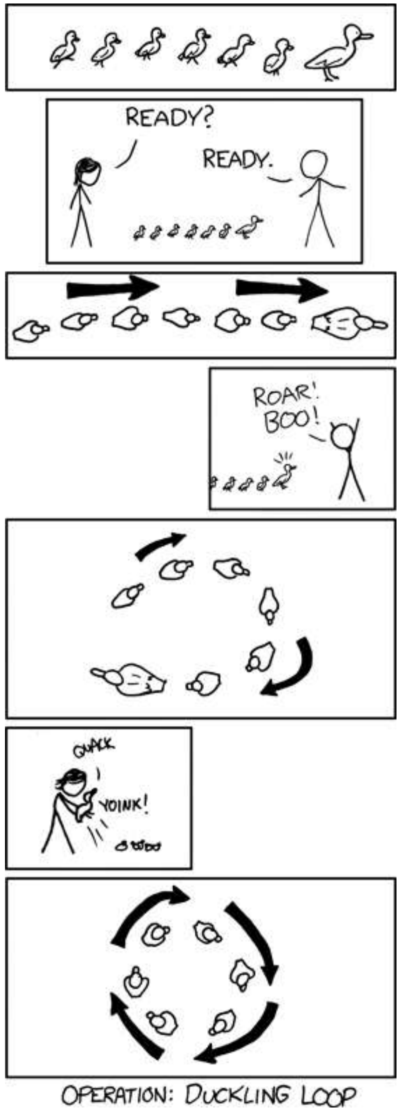
K&R style

```
public class HelloWorld {
   public static void main(String [] args)
   {
      System.out.println("Hello world!");
   }
}
```

Choose a bracing style and stick with it!

Summary

- Program flow of control
  - Conditionals skip sections
    - if statement
  - Loops repeat sections
    - while loop, for loop, do while loop
  - Conditionals and loops can be nested
  - Best loop depends on the situation
- Style
  - Makes code easier to read + grade
  - Good style = fewer bugs



http://xkcd.com/537/