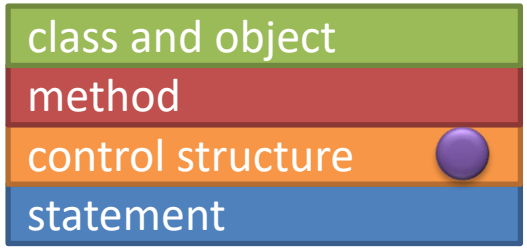
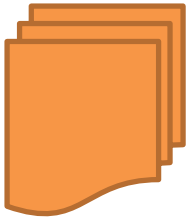
Repeating Actions with Loops

Part 1: Loops, while and do-while





09 Repeating Actions with Loops

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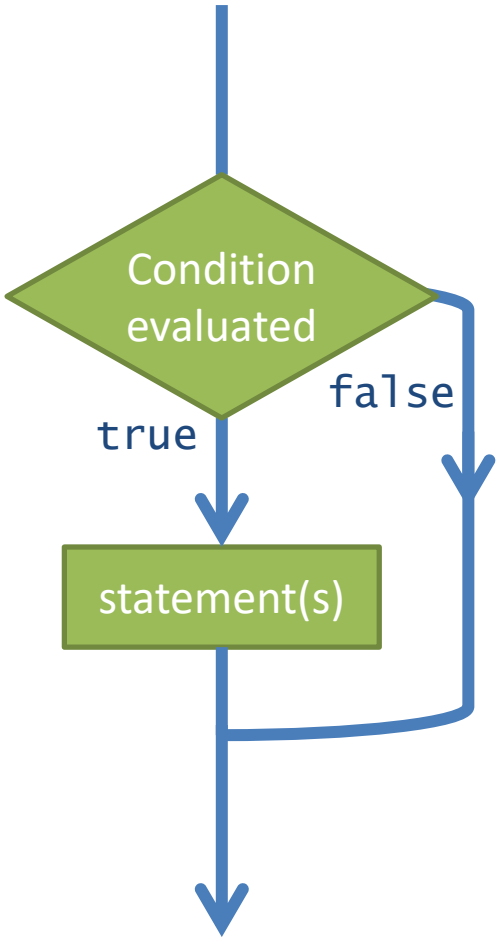
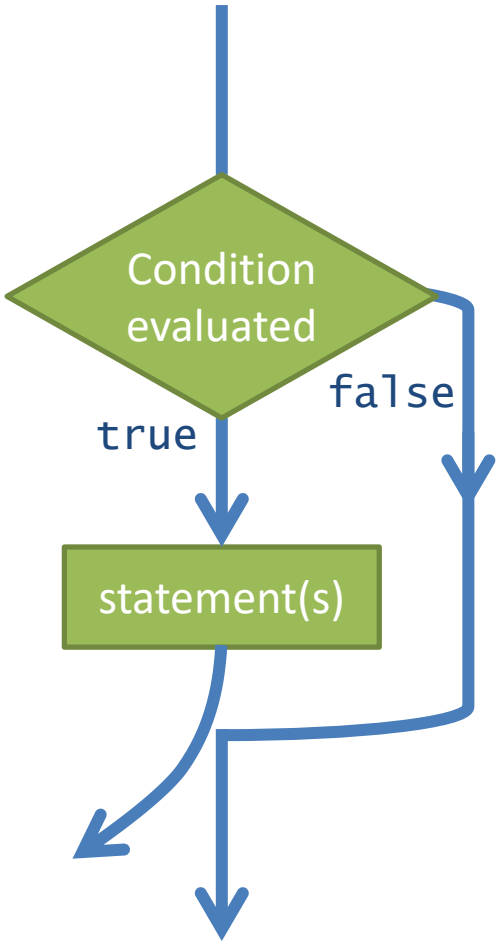
Loops are just (special) branches

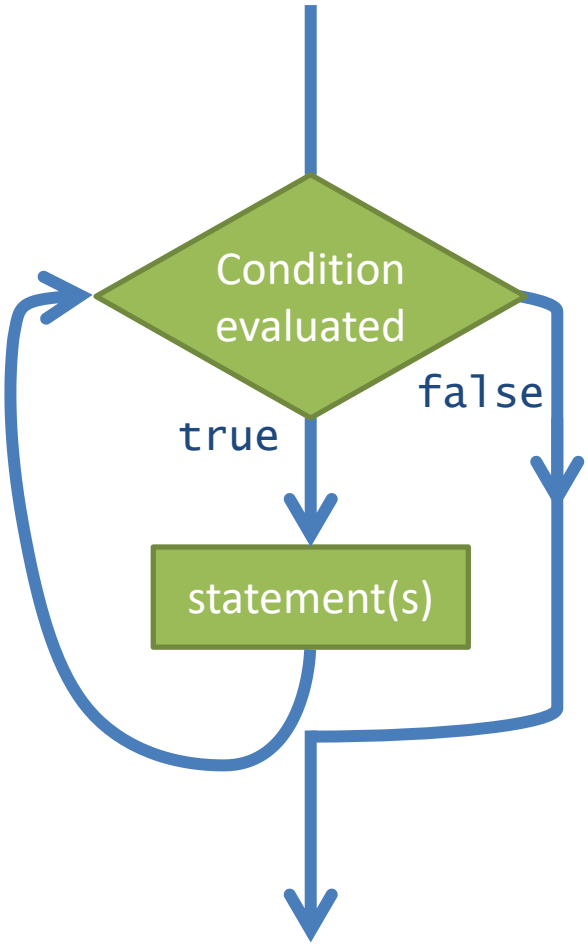
Simple `if`



Imaginary intermediate

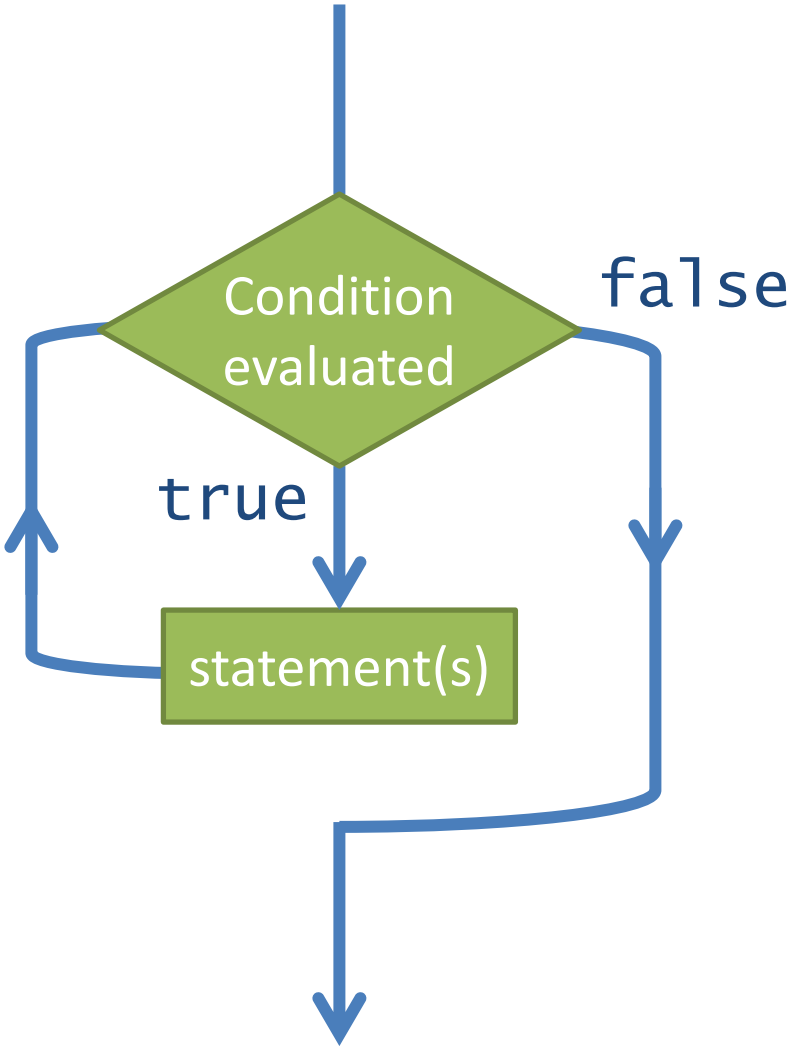


A basic loop

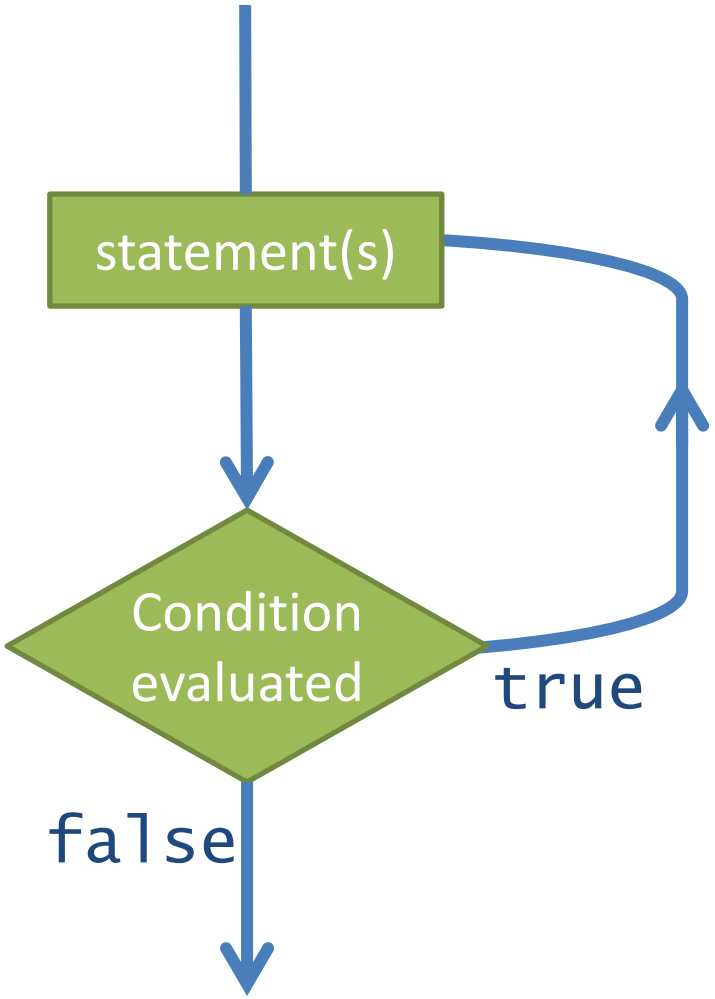


Two kinds of loop

Pre-tested



Post-tested



Loop Components — IBUT

Initialisation

- Preparing for the *first* step of repetition
- May declare additional variables to control loop

Body

- The *work* done inside the loop
- Same *kind* of action every time; different data (state)

Update

- Something must *change* as a result of the loop (a counter, position in a list, etc.)

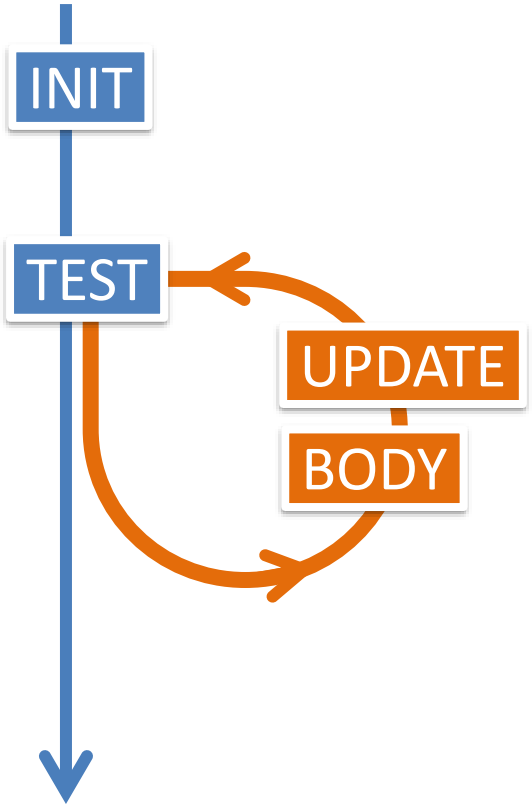
Test

- Should we continue to repeat, or even start?
- The **update** affects the **test**

Loop Constructs in Java

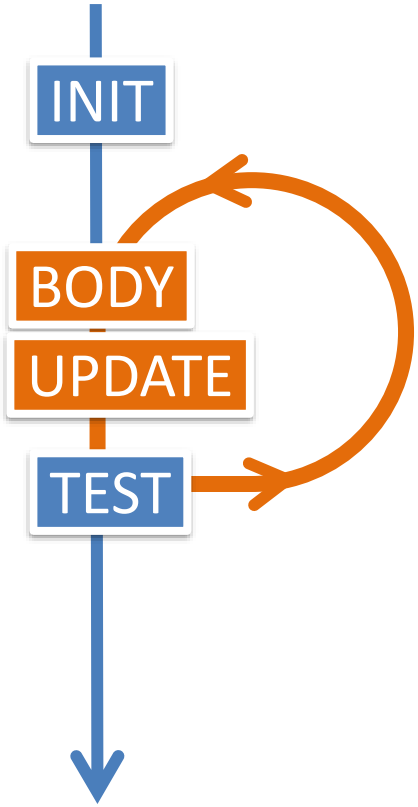
pre-tested

`while`



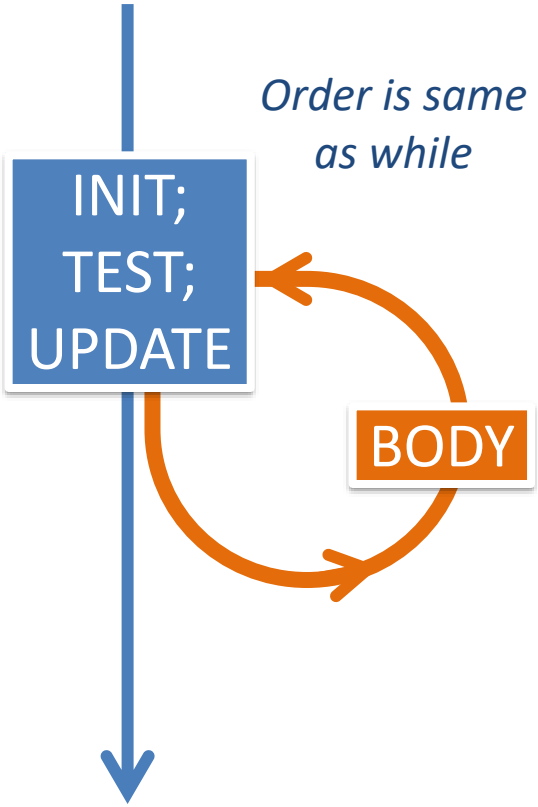
post-tested

`do-while`



pre-tested

`for`



Order is same as while

There is also a 'for-each' we'll look at near the end of semester

Code templates for loops

while statement

```
while ( boolean expression ) {
    statements
}
```

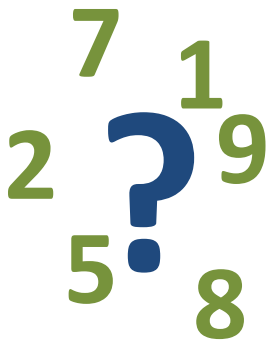
do-while statement

```
do {
    statements
} while ( boolean expression );
```

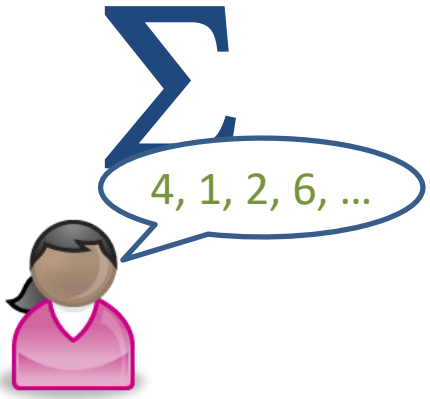
for statement

```
for ( initialisation ; boolean expression ; increment ) {
    statements
}
```

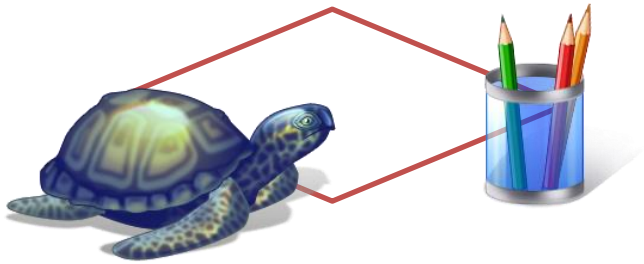
Three example tasks that require a loop



Number guessing game

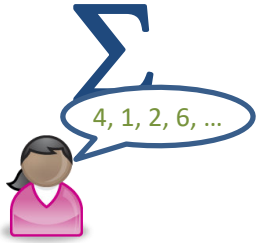


Add up zero or more digits entered by the user



Turtle draws a square

Adding >= 0 numbers with `while`



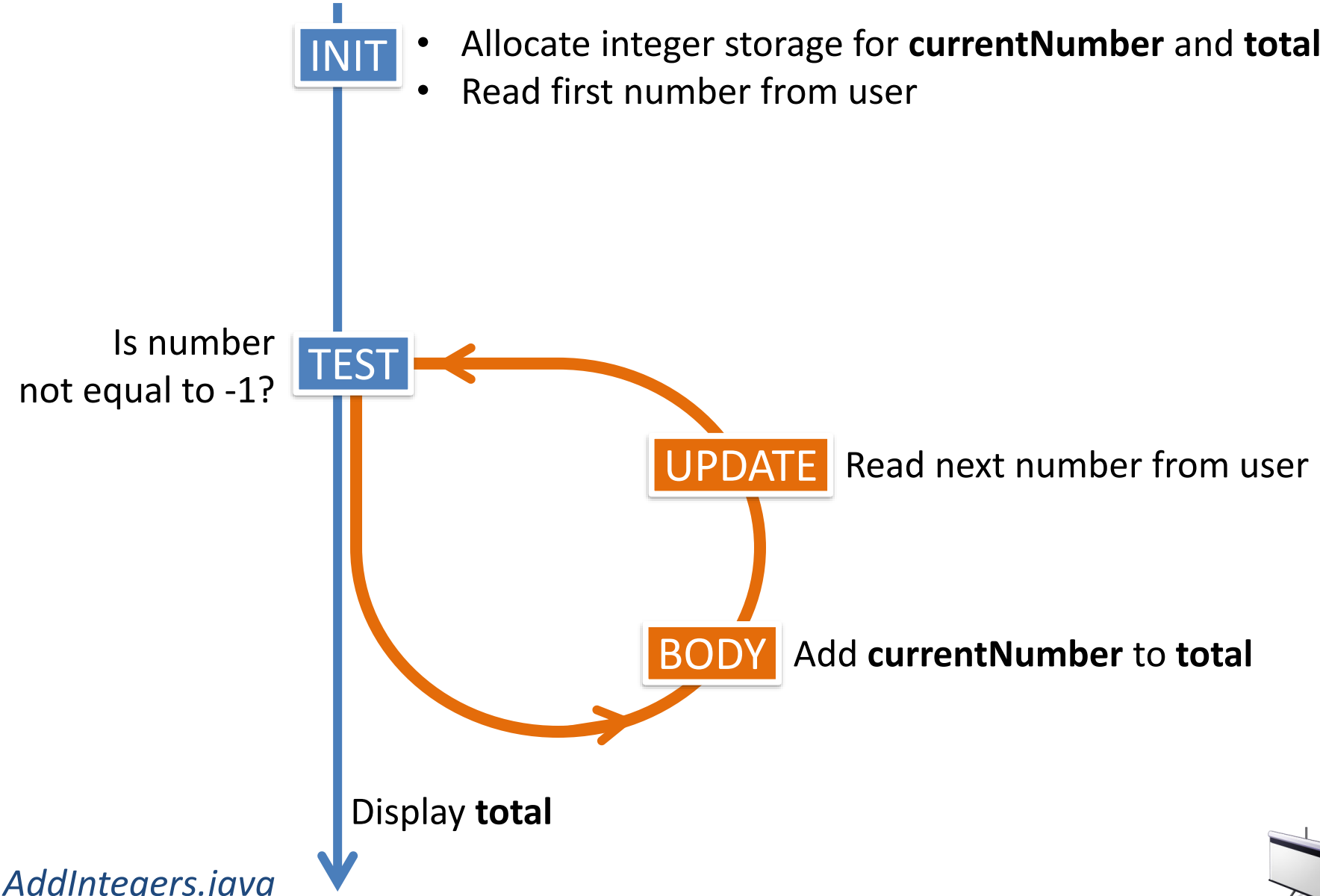
Task: add up integers entered by the user

START User *may* have numbers to add up

GOAL Program has calculated correct total

Special case: In solving *this* problem we will take a value of -1 to mean there are no more values to add (called a ‘sentinel’ value)

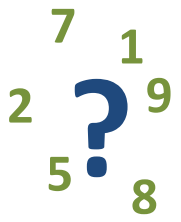
Using `while` to add >= 0 numbers



See AddIntegers.java

Number guessing game with do-while

Task: user must guess a randomly generated number (cannot opt-out)

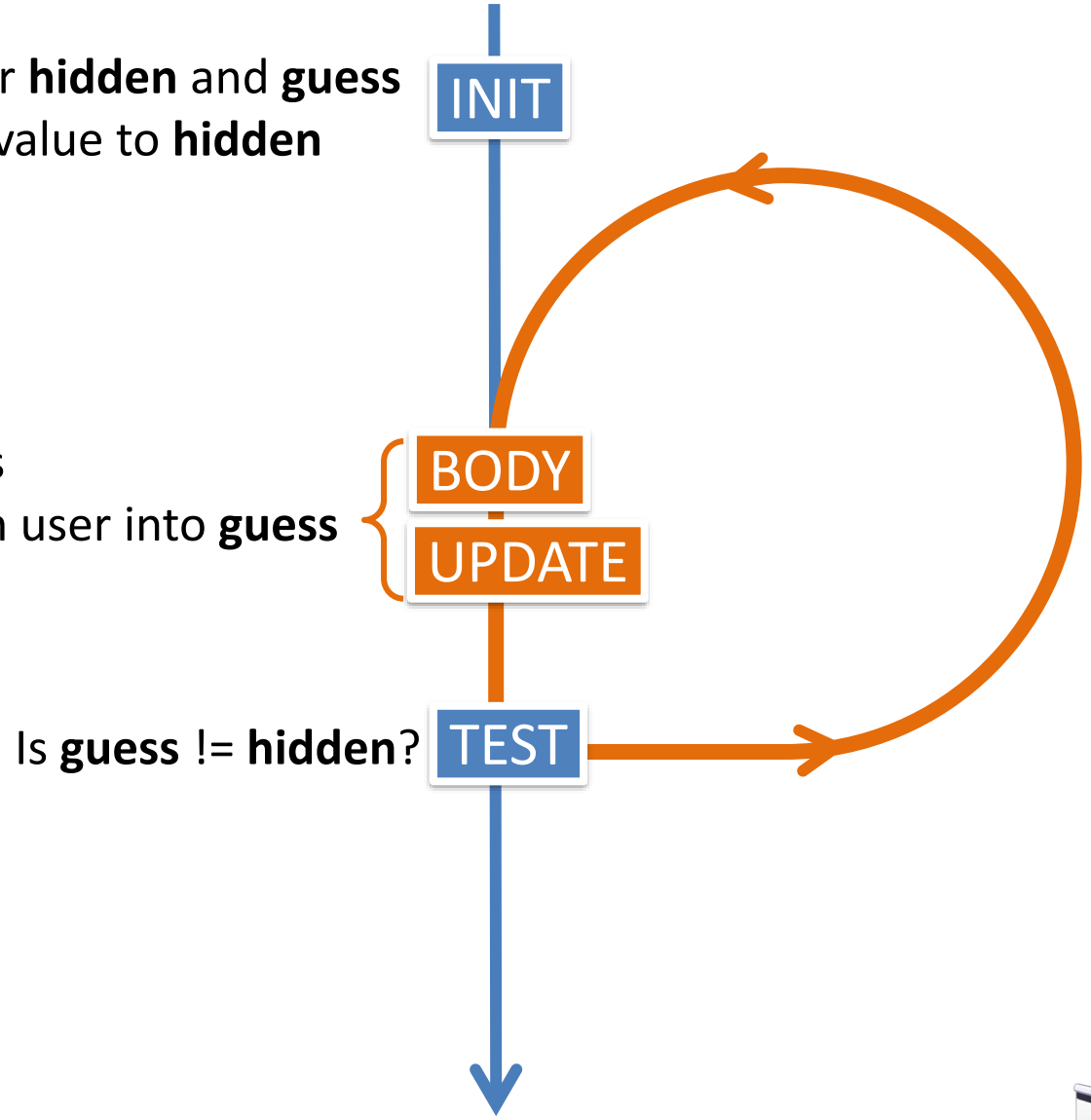


START Program has generated a ‘hidden’ number

GOAL User has found the correct number

Guessing numbers with do-while

- Allocate integer storage for **hidden** and **guess**
- Assign randomly selected value to **hidden**

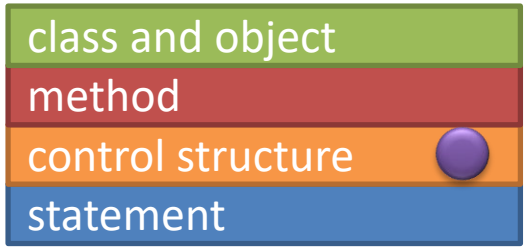


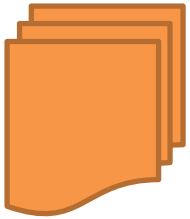
- Prompt user for a guess
- Read next number from user into **guess**

See BasicNumberGuess.java

Repeating Actions with Loops

Part 2: The for loop *plus* debugging tips





09 Repeating Actions with Loops

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Repeating an action *n* times with `for`

```
for ( init ; test ; increment ) {
      statement(s) (body)
}
```

Initialisation can declare new variable, e.g.,

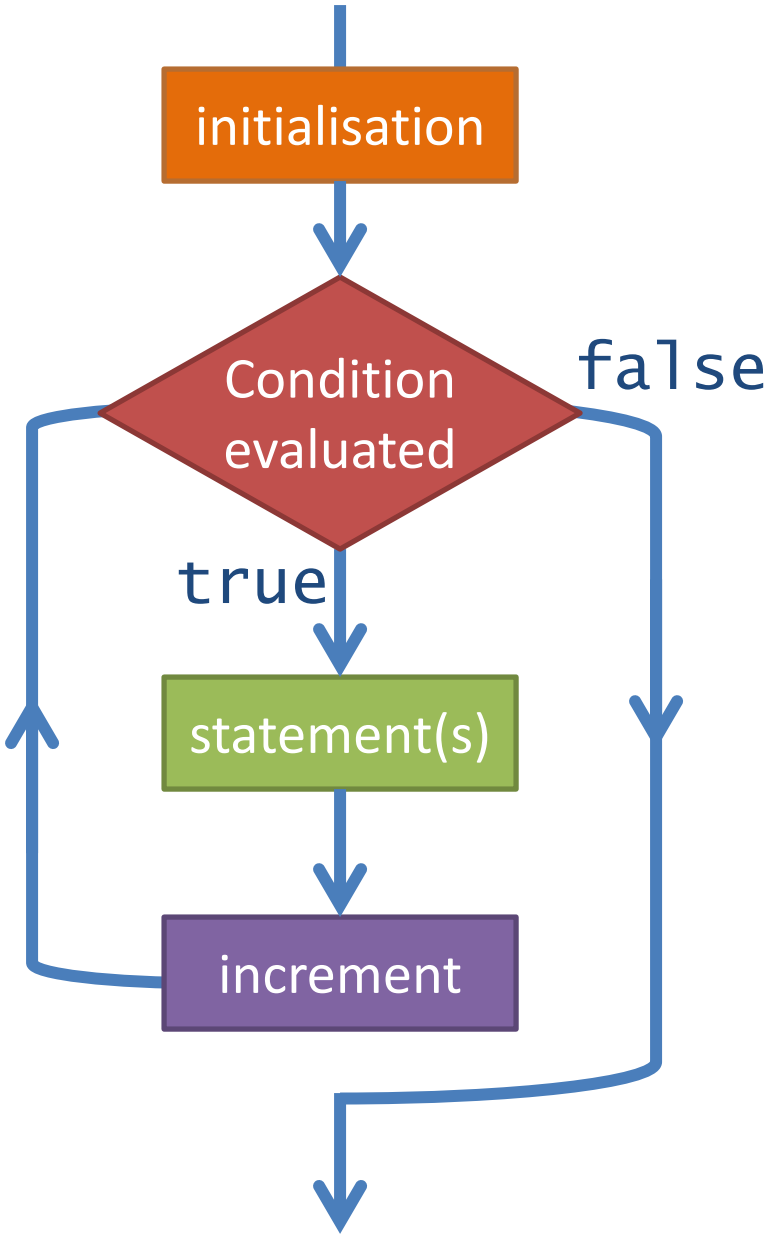
```
int i = 0
```

Test can check if end point reached, e.g.,

```
i < 10
```

Increment (update) steps loop variable, e.g.,

```
i = i + 1   or
i += 1   or
i++
```



A really common pattern

You will most commonly use a for loop to repeat an action *n* times, where *n* may be known ahead of time, or is based on another variable, like the length of a String

So you will be very commonly write

```
for (int i = 0; i < n; i++) {
    //Do action once, possibly using value of i
}
```

Read as “for i is 0 through to n – 1 do”

Examples

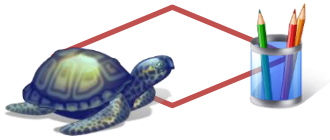
Print a String down the screen

```
String s = sc.next();
for (int i = 0; i < s.length(); i++) {
   System.out.println(s.charAt(i));
}
```

Beethoven’s fifth symphony

```
final int TRIPLET = 3;
for (int i = 0; i < TRIPLET; i++) {
   System.out.println("dum");
}
System.out.println("daaa");
```

Draw a square with a Turtle and for



Task: Make a Turtle object draw a square

START Turtle declared & instantiated, sitting in space

GOAL Square drawn

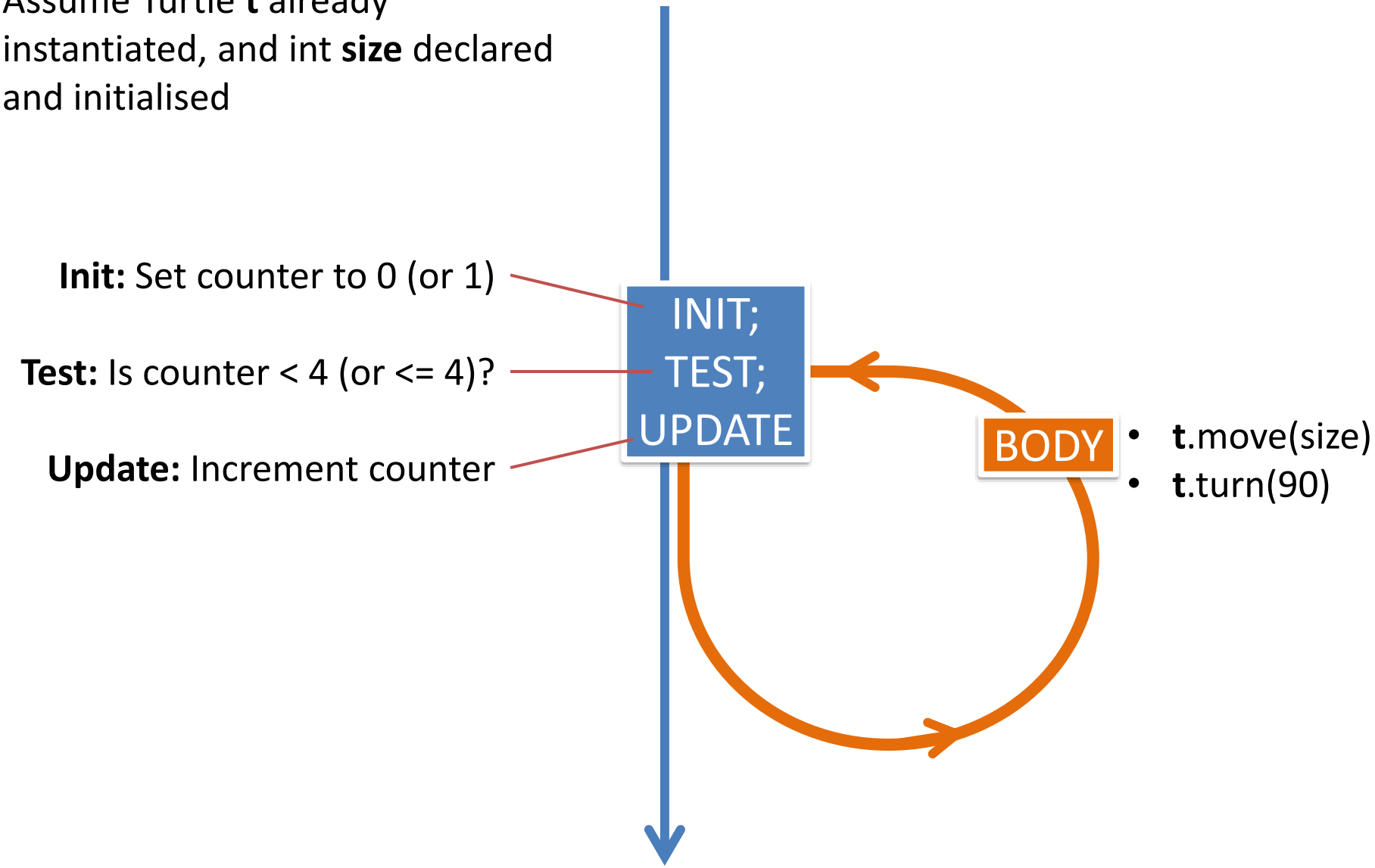
Activity: Create an algorithm (ignore Java for the moment) to draw a square by repeating the same actions some number of times

What is the I, B, U and T?

There are several alternative valid solutions

Draw a line 4 times with for

Assume Turtle **t** already instantiated, and int **size** declared and initialised



See TurtleSquare.java

Troubleshooting Loops (reference)

1. Where is the problem?

Symptom	Check
Not entering loop	I & T
Not leaving loop	U & T
Loop producing wrong effect	B

Distrust your first impression: the problem may be somewhere else!

Use “debugging” statements to help trace execution

2. What is causing it?

Type of error	Indicator/indicates
Syntax error	won’t compile
Conceptual error	possibly wrong construct, wrong sort of loop, wrong test
Strategic error	wrong algorithm

See Notes 09 Repeating Actions with Loops for some debugging activities