Inf1B

Conditionals and Loops[1]

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adapting earlier version by Perdita Stevens and Ewan Klein

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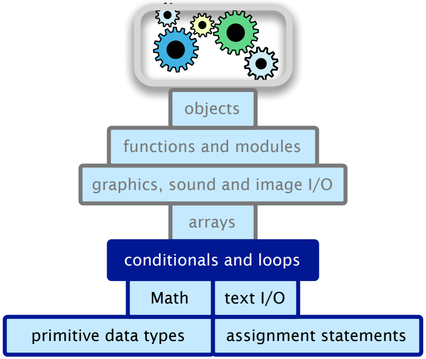
[1]Thanks to Sedgewick&Wayne for much of this content

A Foundation for Programming

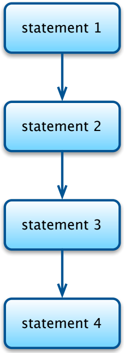


Conditional Statements

Control Flow

Control flow:

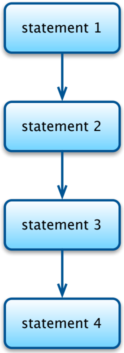
- A sequence of statements that are actually executed in a program

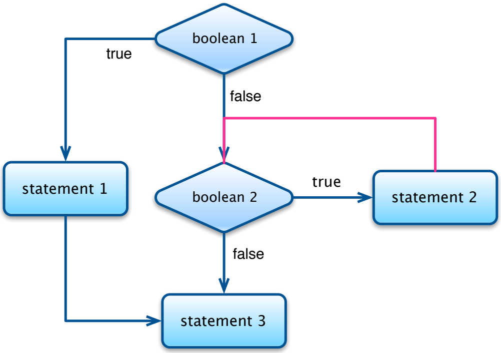


Control Flow

Control flow:

- A sequence of statements that are actually executed in a program
- Conditionals and loops enable us to choreograph control flow





If Statement

If / conditional statement:

- Evaluate a `boolean` expression E.
- If value of E is `true`, execute some statements.
- If value of E is `false`, execute some other statements — this is the *else* part of a conditional statement.

If Statement

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- Evaluate a `boolean` expression E.
- If value of E is `true`, execute some statements.
- If value of E is `false`, execute some other statements — this is the *else* part of a conditional statement.

```
if (boolean expression) {
    statement T;
}
else {
    statement F;
}
```

can be any sequence of statements

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If / conditional statement:

- Evaluate a `boolean` expression E.
- If value of E is `true`, execute some statements.
- If value of E is `false`, execute some other statements — this is the *else* part of a conditional statement.

```
if (boolean expression) {
    statement T;
}
else {
    statement F;
}
```

can be any sequence of statements

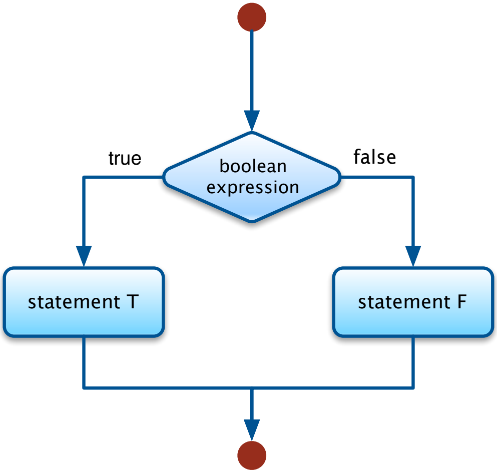
boolean expression

```
if (x > y) {

    int t = x;
    x = y;
    y = t;

}
```

sequence of statements

If Statement

If / conditional statement — sometimes called branching structures:

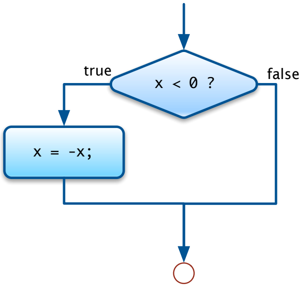


If Statement

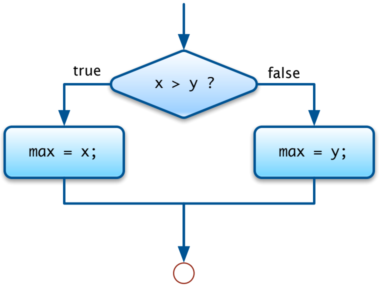
If / conditional statement:

- Evaluate a `boolean` expression.
- If `true`, execute some statements.
- If `false`, execute some other statements.

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



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



If Statement: Examples

absolute value

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

put x *and* y *into ascending order (swap)*

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

maximum of x *and* y

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

error check for division operation

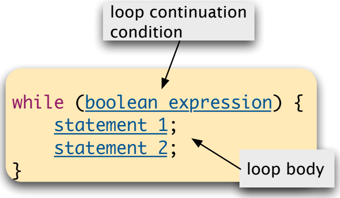
```java
if (den == 0) {
    System.out.println("Division by zero");
} else {
    System.out.println("Quotient = " + num / den);
}
```

Loops (While)

While Loop

The `while` loop is a structure for expressing repetition.

- Evaluate a `boolean` expression.
- If `true`, execute some statements.
- Repeat.



```
while (boolean expression) {
    statement 1;
    statement 2;
}
```

While Loop

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- Evaluate a `boolean` expression.
- If `true`, execute some statements.
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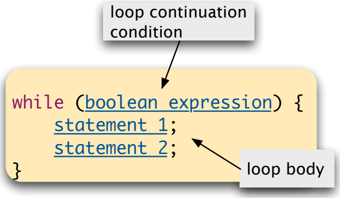

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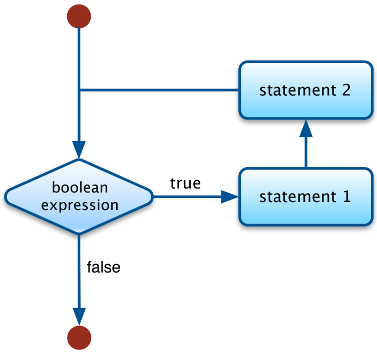

While Loop: Powers of Two

Print powers of 2 that are $\leq 2^n$ for some n.

- Increment loop counter `i` by `1`, from `0` to `n`.
- Double `val` each time.

```
int i = 0;
int val = 1;
while (i <= n) {
  System.out.println(i + " " + val);
  i = i + 1;
  val = 2 * val;
}
```

```
i
0
```

Start Again

While Loop: Powers of Two

Print powers of 2 that are $\leq 2^n$ for some n. Set `n = 6`.

- Increment loop counter `i` by `1`, from `0` to `n`.
- Double `val` each time.

```
int i = 0;
int val = 1;
while (i <= n) {
  System.out.println(i + " " + val);
  i = i + 1;
  val = 2 * val;
}
```

i	val
0	1

Start Again

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  i = i + 1;
  val = 2 * val;
}
```

i	val	i $\leq$ n
0	1	true

▸ Start Again

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i	val	i ≤ n	Output
0	1	true	0 1

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}
```

i	val	i $\leq$ n	Output
0	1	true	0 1
1			

Start Again

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i	val	i $\leq$ n	Output
0	1	true	0 1
1	2		

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0	1	true	0 1
1	2	true	

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i	val	i ≤ n	Output	
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i	val	i $\leq$ n	Output	
0	1	true	0	1
1	2	true	1	2
2				

Start Again

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while (i <= n) {
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}
```

i	val	$i \leq n$	Output	
0	1	true	0	1
1	2	true	1	2
2	4			

Start Again

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i	val	i $\leq$ n	Output	
0	1	true	0	1
1	2	true	1	2
2	4	true		

▸ Start Again

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i	val	$i \leq n$	Output	
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0	1	true	0	1
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2	4	true	2	4
3				

Start Again

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i	val	i $\leq$ n	Output	
0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8			

Start Again

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```

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0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true		

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4				

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i	val	i ≤ n	Output	
0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true	3	8
4	16			

Start Again

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0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true	3	8
4	16	true		

▸ Start Again

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0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true	3	8
4	16	true	4	16

▸ Start Again

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0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true	3	8
4	16	true	4	16
5				

Start Again

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i	val	i ≤ n	Output	
0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true	3	8
4	16	true	4	16
5	32			

Start Again

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i	val	i ≤ n	Output
0	1	true	0 1
1	2	true	1 2
2	4	true	2 4
3	8	true	3 8
4	16	true	4 16
5	32	true	

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```

i	val	$i \leq n$	Output	
0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true	3	8
4	16	true	4	16
5	32	true	5	32
6				

Start Again

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}
```

i	val	i ≤ n	Output	
0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true	3	8
4	16	true	4	16
5	32	true	5	32
6	64			

▸ Start Again

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i	val	i ≤ n	Output	
0	1	true	0	1
1	2	true	1	2
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4	16	true	4	16
5	32	true	5	32
6	64	true		

▸ Start Again

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i	val	i ≤ n	Output	
0	1	true	0	1
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4	16	true	4	16
5	32	true	5	32
6	64	true	6	64

Start Again

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0	1	true	0	1
1	2	true	1	2
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3	8	true	3	8
4	16	true	4	16
5	32	true	5	32
6	64	true	6	64
7				

Start Again

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}
```

i	val	i $\leq$ n	Output	
0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true	3	8
4	16	true	4	16
5	32	true	5	32
6	64	true	6	64
7	128			

Start Again

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```

i	val	i ≤ n	Output	
0	1	true	0	1
1	2	true	1	2
2	4	true	2	4
3	8	true	3	8
4	16	true	4	16
5	32	true	5	32
6	64	true	6	64
7	128	false		

Start Again

Powers of Two

```
public class PowersOfTwo {
   public static void main(String[] args) {
      int n = Integer.parseInt(args[0]);
      int i = 0;
      int val = 1;
      while (i <= n) {
         System.out.println(i + " " + val);
         i = i + 1;
         val = 2 * val;
      }
   }
}
```

```
% java PowersOfTwo 3
0 1
1 2
2 4
3 8
```

While Loop Challenge

Q: Is anything wrong with the following version of `PowersOfTwo`?

```
int i = 0;
int val = 1;
while (i <= n)
   System.out.println(i + " " + val);
   i = i + 1;
   val = 2 * val;
```

While Loop Challenge

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while (i <= n)
   System.out.println(i + " " + val);
i = i + 1;
val = 2 * val;
```

A: Need curly braces around statements in `while` loop. Otherwise, only the first of the statements is executed before returning to `while` condition; enters an infinite loop, printing `0 1` for ever.

(How to stop an infinite loop? At the Linux command-line, hit Control-c.)

The Increment Operator

```
int i = 0;
int val = 1;
while (i <= n) {
   System.out.println(i + " " + val);
   i = i + 1;
   val = 2 * val;
}
```

The Increment Operator

```
int i = 0;
int val = 1;
while (i <= n) {
   System.out.println(i + " " + val);
   i = i + 1;
   val = 2 * val;
}
```

- standard assignment: `i = i + 1;`
- semantically equivalent shorthand: `i++;`

The Increment Operator

```
int i = 0;
int val = 1;
while (i <= n) {
   System.out.println(i + " " + val);
   i = i + 1;
   val = 2 * val;
}
```

- standard assignment: `i = i + 1;`
- semantically equivalent shorthand: `i++;`

```
int i = 0;
int val = 1;
while (i <= n) {
   System.out.println(i + " " + val);
   i++;
   val = 2 * val;
}
```

Loops (For)

For Loop

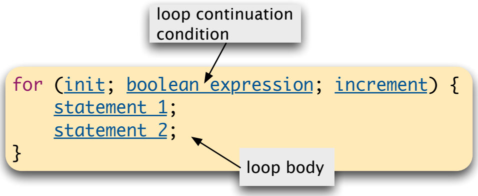
The `for` loop is another common structure for repeating things.

- Execute initialization statement.
- Evaluate a `boolean` expression.
- If `true`, execute some statements.
- Then execute the increment statement.
- Repeat.

For Loop

The `for` loop is another common structure for repeating things.

- Execute initialization statement.
- Evaluate a `boolean` expression.
- If `true`, execute some statements.
- Then execute the increment statement.
- Repeat.



```
for (init; boolean expression; increment) {
    statement 1;
    statement 2;
}
```

For Loop

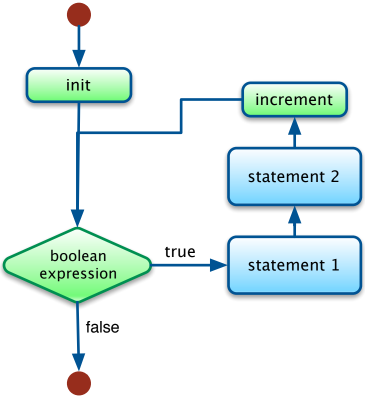
The `for` loop is another common structure for repeating things.

- Execute initialization statement.
- Evaluate a `boolean` expression.
- If `true`, execute some statements.
- Then execute the increment statement.
- Repeat.

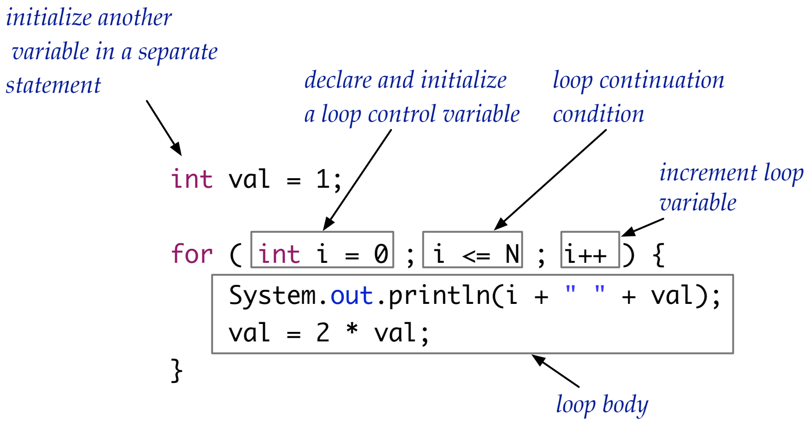
loop continuation condition

```
for (init; boolean expression; increment) {
    statement 1;
    statement 2;
}
```

loop body



Anatomy of a For Loop



```
int val = 1;

for ( int i = 0 ; i <= N ; i++ ) {
    System.out.println(i + " " + val);
    val = 2 * val;
}
```

initialize another variable in a separate statement
declare and initialize a loop control variable
loop continuation condition
increment loop variable
loop body

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

```
val
 1
```

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i
1	0

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	i ≤ n
1	0	true

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output
1	0	true	0 1

▸ Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output
1	0	true	0 1
2			

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	i ≤ n	Output
1	0	true	0 1
2	1		

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \le n$	Output	
1	0	true	0	1
2	1	true		

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```java
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4				

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \le n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2			

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true		

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8				

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	i $\leq$ n	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3			

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	i ≤ n	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true		

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	i $\leq$ n	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16				

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \le n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4			

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \le n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true		

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32				

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5			

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5	true		

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5	true	5	32

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	i $\leq$ n	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5	true	5	32
64				

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5	true	5	32
64	6			

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5	true	5	32
64	6	true		

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5	true	5	32
64	6	true	6	64

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	i $\leq$ n	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5	true	5	32
64	6	true	6	64
128				

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	i ≤ n	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5	true	5	32
64	6	true	6	64
128	7			

Start Again

For Loop: Powers of Two

Print the first *n* powers of 2. Set `n = 6`.

- Double `val` each time.

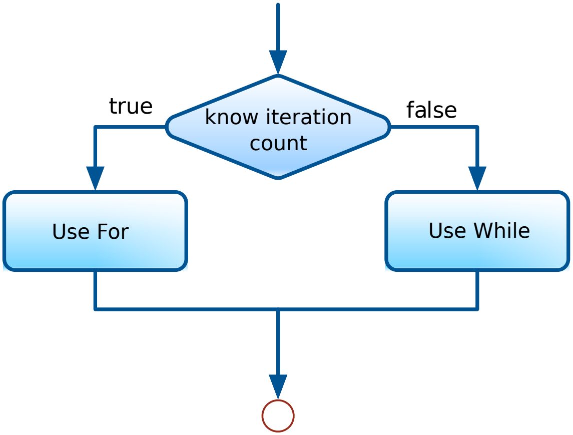
```
int val = 1;
for (int i = 0; i <= n; i++) {
  System.out.println(i + " " + val);
  val = 2 * val;
}
```

val	i	$i \leq n$	Output	
1	0	true	0	1
2	1	true	1	2
4	2	true	2	4
8	3	true	3	8
16	4	true	4	16
32	5	true	5	32
64	6	true	6	64
128	7	false		

Start Again

When to use While and when to use For?

Rule of thumb



Let's practice that

TOP HAT

Bailing Out Early

What if you need to leave a loop early?

Sometimes you don't want to end the execution of a loop but instead break out early, e.g. for search algorithms.

- `break`: allows you to break out of a loop immediately

What if you need to leave a loop early?

Breaking out early

```java
// find first number dividable by n
int start = 50;
int end = 5000;
int n = 344;
for(int i = start; i < end; i++) {
 if (i % n == 0) {
  System.out.println("Number found: " + i);
  break;
 }
 // some complex calculations
}
```

What if you need to leave a loop early?

At other times, you might want to skip a loop iteration for certain input and continue with the next one, e.g. when processing data and skipping invalid entries.[5px]

- `continue`: allows you to skip the remainder of the loop body and continue with the next iteration

What if you need to leave a loop early?

Skipping iterations

```
// skip numbers dividable by n
int start = 0;
int end = 100;
int n = 5;
for (int i = start; i < end; i++) {
 if (i % n == 0) {
  continue;
 }

 // run some complex calculations
}
```

Nested Conditionals

Nested If Statements

How to classify Scottish weather:

degrees C	verdict
< -5	wear a sweater
-5 to 0	nippy
1 to 10	normal
> 10	roastin'

4 mutually exclusive alternatives

Nested If Statements

How to classify Scottish weather:

degrees C	verdict
< -5	wear a sweater
-5 to 0	nippy
1 to 10	normal
> 10	roastin'

4 mutually exclusive alternatives

```
String verdict;
if (temp < -5) verdict = "wear a sweater";
else {
    if (temp < 1) verdict = "nippy";
    else {
        if (temp < 11) verdict = "normal";
        else verdict = "roastin'";
    }
}
```

Nested If Statements

We don't necessarily need all those braces.

```
public class ScottishWeather {
    public static void main(String[] args) {
        String verdict;
        int temp = Integer.parseInt(args[0]);
        if      (temp < -5) verdict = "wear a sweater";
        else if (temp < 1)  verdict = "nippy";
        else if (temp < 11) verdict = "normal";
        else                verdict = "roastin'";
        System.out.println("Verdict: " + verdict);
    }
}
```

Output

```
% java ScottishWeather -1
Verdict: nippy

% java ScottishWeather 1
Verdict: normal
```

Nested If Statements

Is there anything wrong with the logic of the following code?

degrees C	verdict
< -5	wear a sweater
-5 to 0	nippy
1 to 10	normal
> 10	roastin'

4 mutually exclusive alternatives

```
String verdict;
int temp = Integer.parseInt(args[0]);
if (temp < -5) verdict = "wear a sweater";
if (temp < 1)  verdict = "nippy";
if (temp < 11) verdict = "normal";
if (temp >= 11) verdict = "roastin'";
```

Summary

Control flow:

- Sequence of statements that are actually executed in a program run.
- Conditionals and loops: enable us to choreograph the control flow.

Control Flow	**Description**	**Examples**
straight-line programs	all statements are executed in the order given	
conditionals	certain statements are executed depending on the values of certain variables	`if`, `if-else`
loops	certain statements are executed repeatedly until certain conditions are met	`while`, `for`

Reading

Java Tutorial

pp68-86, i.e. Chapter 3 *Language Basics* from *Expressions, Statements and Blocks* to the end of the chapter.

Objects First

Appendix *C.2* - *C.3*, Appendix *D.1* - *D.3*