Processing Boot Camp
Control Structures

Creative Coding & Generative Art in Processing 2
Ira Greenberg, Dianna Xu, Deepak Kumar

Key Computing Ideas

- The computer follows a program's instructions. There are four modes:
  - **Sequencing**
    All statements are executed in sequence
  - **Function Application**
    Control transfers to the function when invoked
    Control returns to the statement following upon return
  - **Repetition**
    Enables repetitive execution of statement blocks
  - **Selection**
    Enables choice among a block of statements
- All computer algorithms/programs utilize these modes.

Sequencing

- Refers to sequential execution of a program's statements

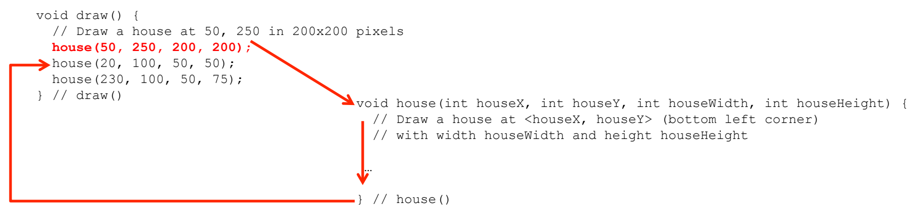
```
do this;
then do this;
and then do this;
etc.
```

```
size(200,200);
background(255);

stroke(128);
rect(20, 20, 40, 40);
```

Function Application

- Control transfers to the function when invoked
- Control returns to the statement following upon return



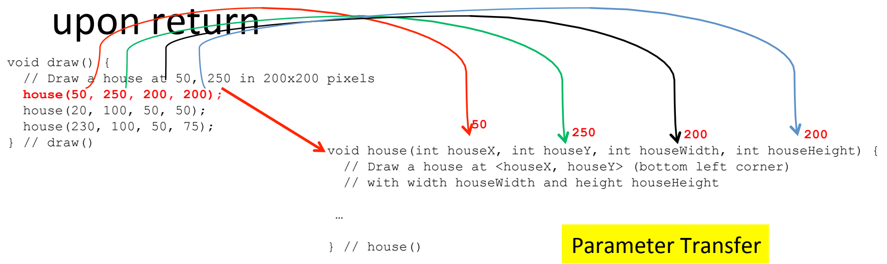
```
void draw() {
  // Draw a house at 50, 250 in 200x200 pixels
  house(50, 250, 200, 200);
  house(20, 100, 50, 50);
  house(230, 100, 50, 75);
} // draw()
```

```
void house(int houseX, int houseY, int houseWidth, int houseHeight) {
  // Draw a house at <houseX, houseY> (bottom left corner)
  // with width houseWidth and height houseHeight

  …
} // house()
```

Function Application

- Control transfers to the function when invoked
- Control returns to the statement following upon return



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  // Draw a house at 50, 250 in 200x200 pixels
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void house(int houseX, int houseY, int houseWidth, int houseHeight) {
  // Draw a house at <houseX, houseY> (bottom left corner)
  // with width houseWidth and height houseHeight

 …

} // house()
```

Parameter Transfer

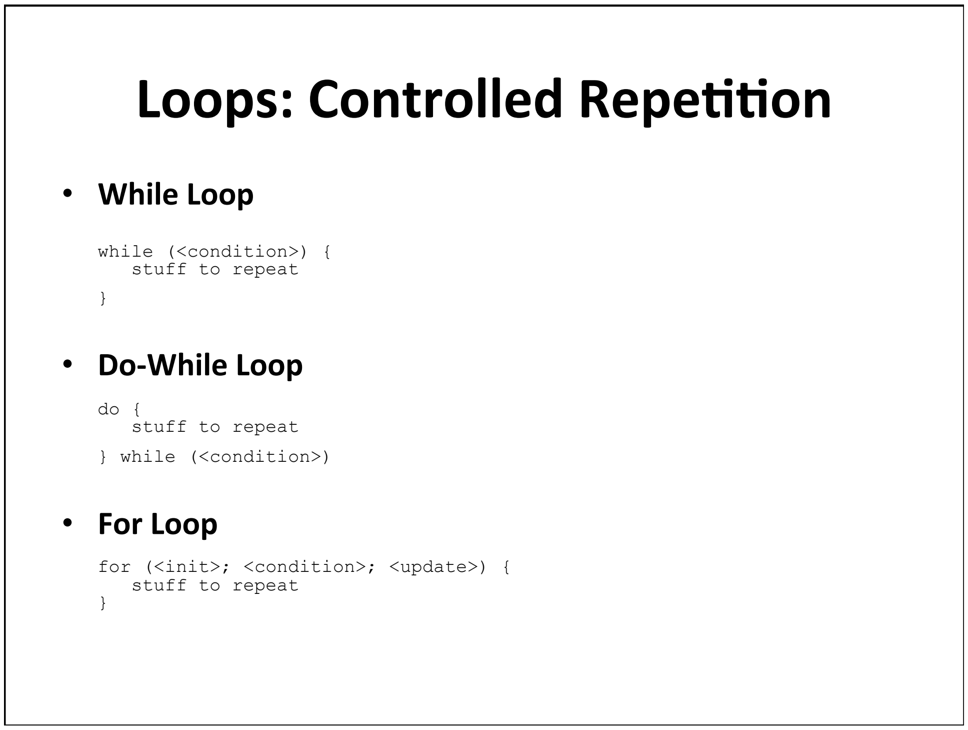
Repetition

- Enables repetitive execution of statement blocks

```
lather
rinse
repeat
```

Repeat frameRate times/second
Default frameRate = 60

```
void draw() {
   do this;
   then this;
   and then this;
   etc.
} // draw()
```



Loops: Controlled Repetition

- **While Loop**

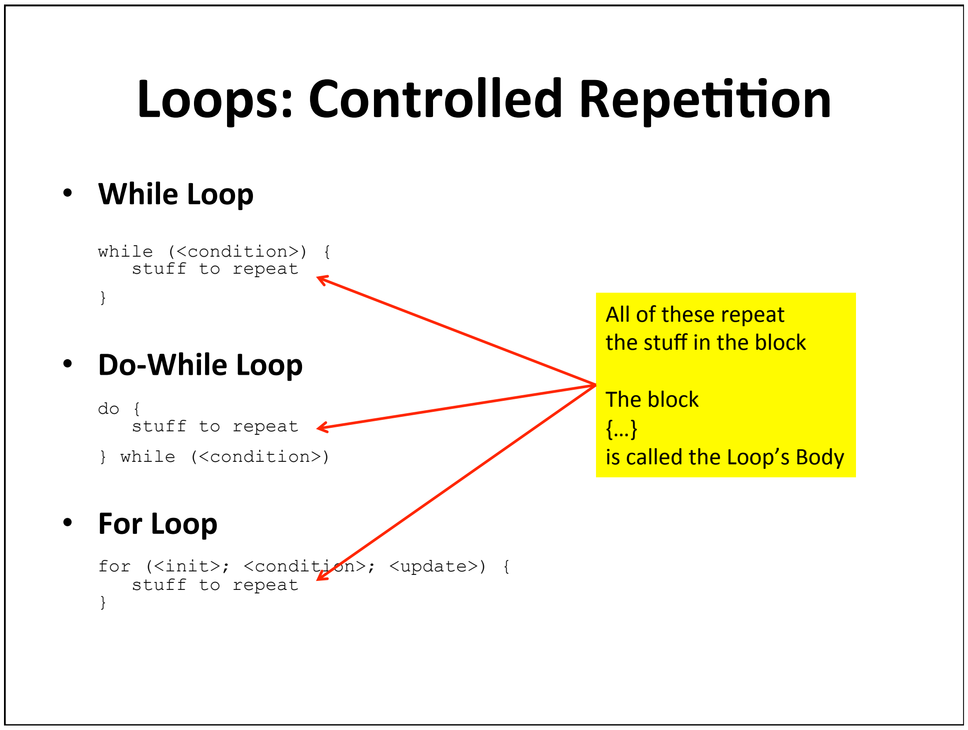
```
while (<condition>) {
   stuff to repeat
}
```

- **Do-While Loop**

```
do {
   stuff to repeat
} while (<condition>)
```

- **For Loop**

```
for (<init>; <condition>; <update>) {
   stuff to repeat
}
```



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- **For Loop**

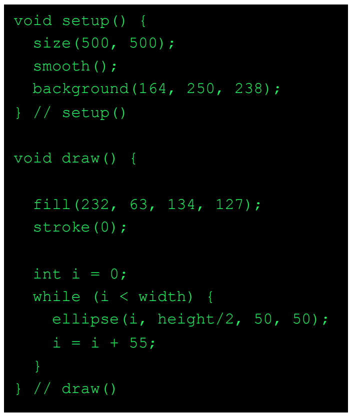
```
for (<init>; <condition>; <update>) {
   stuff to repeat
}
```

All of these repeat
the stuff in the block

The block
{…}
is called the Loop's Body

While Loops

while **(** *<condition>* **) {**
stuff to repeat
}

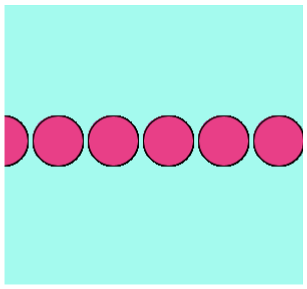


```
void setup() {
  size(500, 500);
  smooth();
  background(164, 250, 238);
} // setup()

void draw() {

  fill(232, 63, 134, 127);
  stroke(0);

  int i = 0;
  while (i < width) {
    ellipse(i, height/2, 50, 50);
    i = i + 55;
  }
} // draw()
```



Conditions

- Conditions are **boolean** expressions.
- Their value is either **true** or **false**

  e.g.

  POTUS is a woman

  5 is greater than 3

  5 is less than 3

Conditions

- Conditions are **boolean** expressions.
- Their value is either **true** or **false**

  e.g.

POTUS is a woman	false
5 is greater than 3	true
5 is less than 3	false

Writing Conditions in Processing

- Boolean expressions can be written using boolean operators.

  Here are some simple expressions…

<	less than	5 < 3
<=	less than/equal to	x <= y
==	equal to	x == (y+j)
!=	not equal to	x != y
>	greater than	x > y
>=	greather than/equal to	x >= y

Logical Operations

- Combine two or more simple boolean expressions using logical operators:

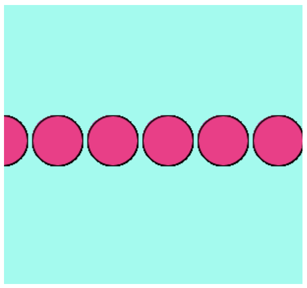
&&	and	(x < y) && (y < z)
||	or	(x < y) || (x < z)
!	not	! (x < y)

A	B	A && B	A || B	!A
false	false	false	false	true
false	true	false	true	true
true	false	false	true	false
true	true	true	true	false

Conditions in While Loops

```
while ( <condition> ) {
  stuff to repeat
}
```

```
int i = 0;
while (i < width) {
  ellipse(i, height/2, 50, 50);
  i = i + 55;
}
```



10,000 circles!

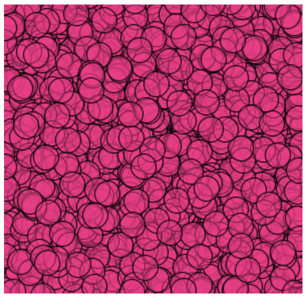
```
while ( <condition> ) {
  stuff to repeat
}
```

```
void setup() {
  size(300, 300);
  smooth();
  background(164, 250, 238);
} // setup()

void draw() {

  fill(232, 63, 134, 127);
  stroke(0);

  int i = 0;
  while (i < 10000) {
    ellipse(random(width),
            random(height),
            25, 25);
    i = i + 1;
  }
} // draw()
```



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- **While Loop**

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while (<condition>) {
   stuff to repeat
}
```

- **Do-While Loop**

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do {
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} while (<condition>)
```

- **For Loop**

```
for (<init>; <condition>; <update>) {
   stuff to repeat
}
```

Do-While Loops

do {
stuff to repeat
} while (*<condition>* **) ;**

```
void setup() {
  size(300, 300);
  smooth();
  background(164, 250, 238);
} // setup()

void draw() {

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} // draw()
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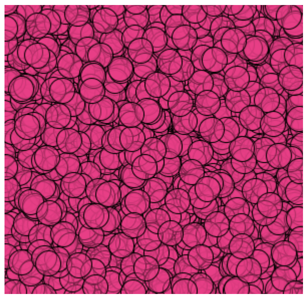

For Loops

for (*<init>*; *<condition>*; *<update>*) {
stuff to repeat
}

```
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void draw() {

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  for (int i = 0; i < 10000; i++) {
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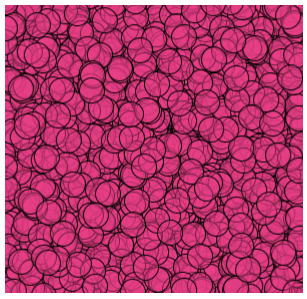


Loops: Critical Components

- **Loop initialization**

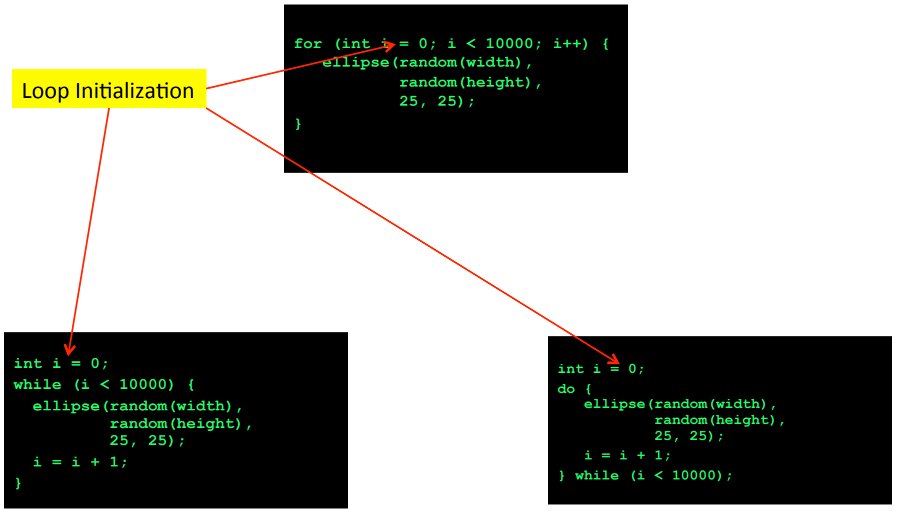
  Things to do to set up the repetition
- **Loop Termination Condition**

  When to terminate the loop
- **Loop Body**

  The stuff to be repeated
- **Loop update**

  For the next repetition/iteration

Loops: Critical Components



```
for (int i = 0; i < 10000; i++) {
   ellipse(random(width),
           random(height),
           25, 25);
}
```

```
int i = 0;
while (i < 10000) {
  ellipse(random(width),
          random(height),
          25, 25);
  i = i + 1;
}
```

```
int i = 0;
do {
   ellipse(random(width),
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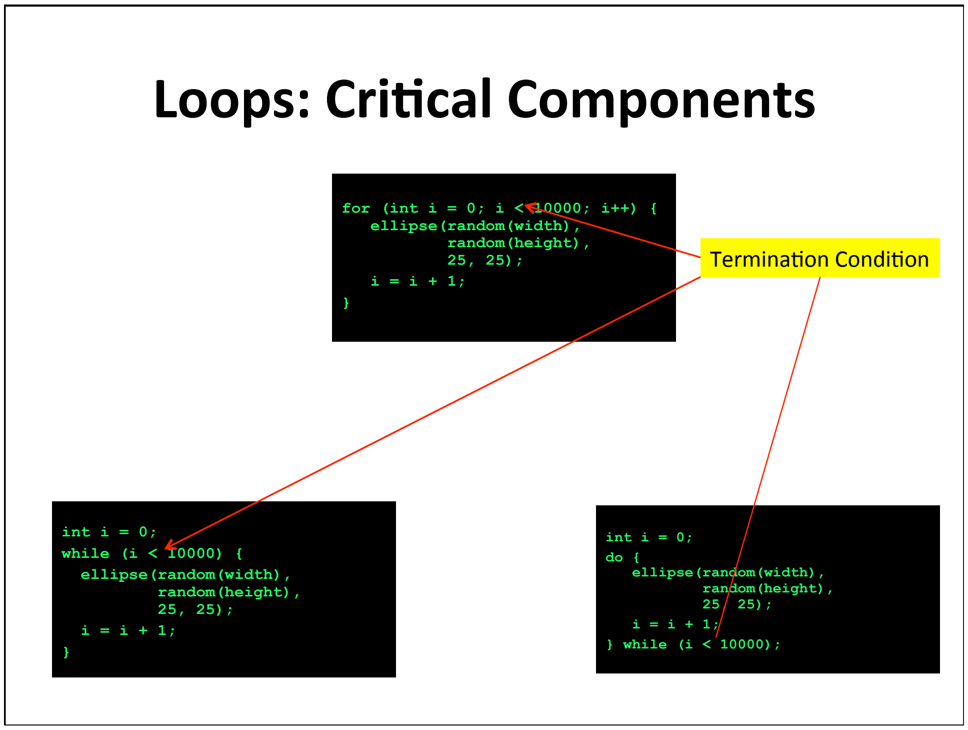
   i = i + 1;
} while (i < 10000);
```



Loops: Critical Components

```
for (int i = 0; i < 10000; i++) {
   ellipse(random(width),
           random(height),
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}
```

Termination Condition

```
int i = 0;
while (i < 10000) {
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          random(height),
          25, 25);
  i = i + 1;
}
```

```
int i = 0;
do {
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   i = i + 1;
} while (i < 10000);
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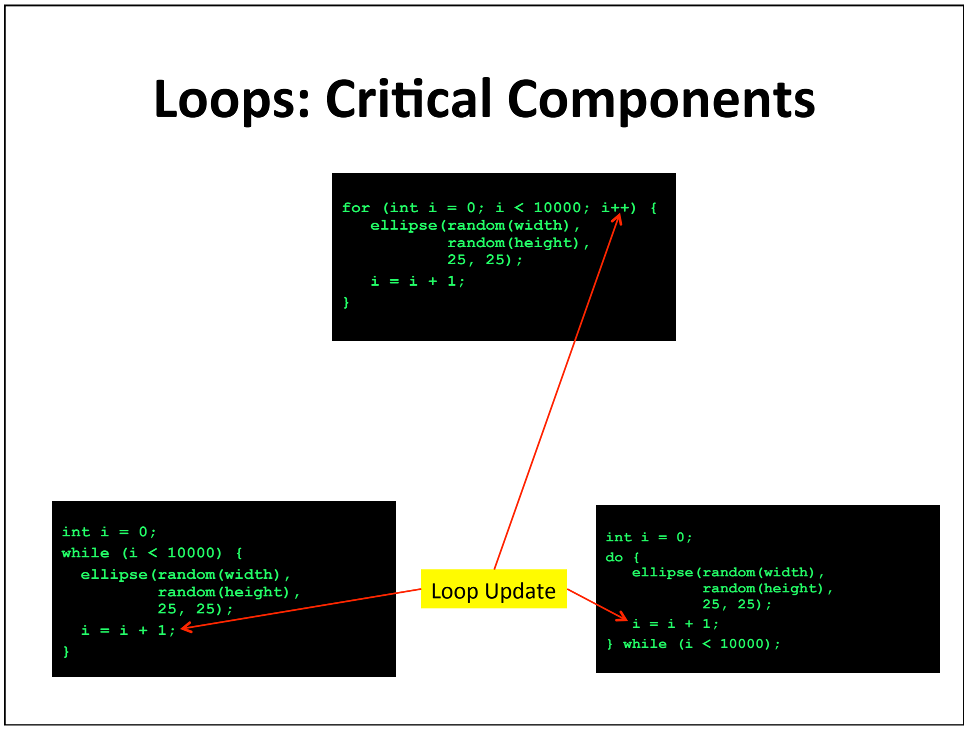

Loops: Critical Components

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   ellipse(random(width),
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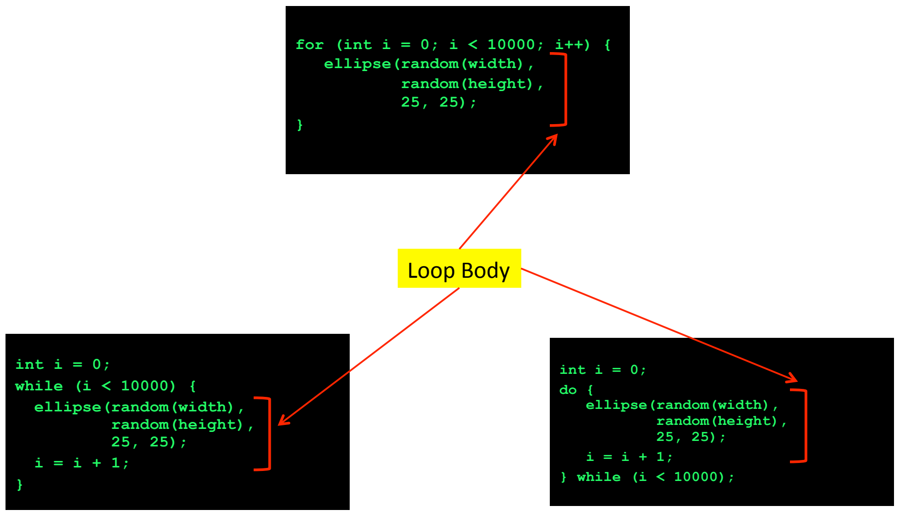
           25, 25);
   i = i + 1;
}
```

```
int i = 0;
while (i < 10000) {
  ellipse(random(width),
          random(height),
          25, 25);
  i = i + 1;
}
```

Loop Update

```
int i = 0;
do {
   ellipse(random(width),
           random(height),
           25, 25);
   i = i + 1;
} while (i < 10000);
```

Loops: Critical Components



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Loops: Critical Components

- **Loop initialization**

  Things to do to set up the repetition
- **Loop Termination Condition**

  When to terminate the loop
- **Loop Body**

  The stuff to be repeated
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  For the next repetition/iteration

What happens when

any one of these is

missing

or incorrectly encoded??

Key Computing Ideas

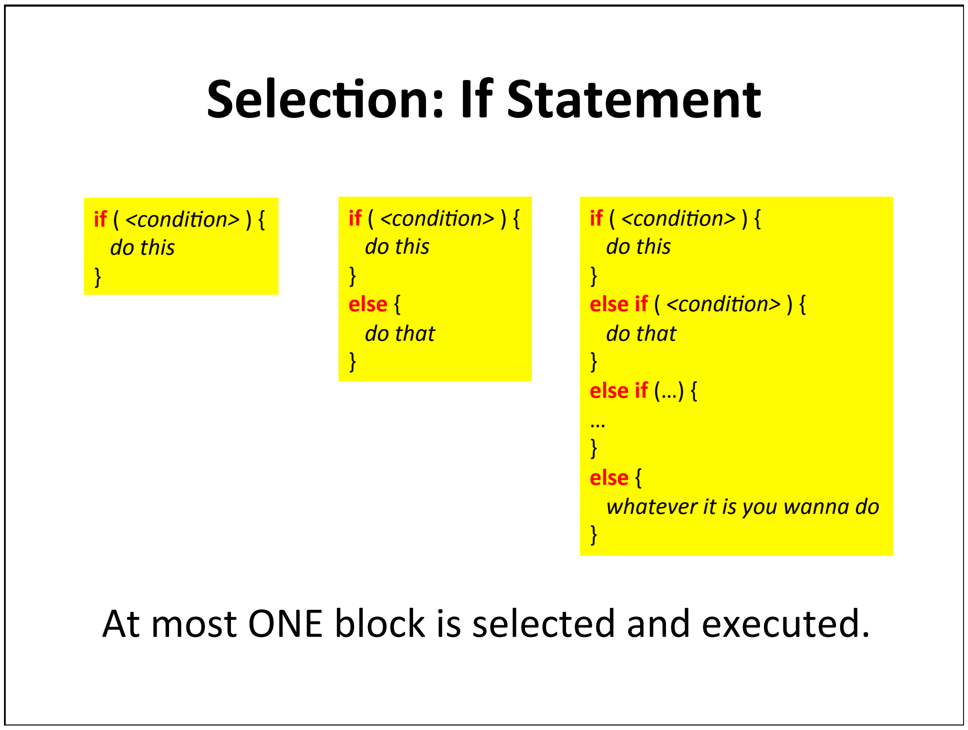
- The computer follows a program's instructions. There are four modes:
  - **Sequencing**
    All statements are executed in sequence
  - **Function Application**
    Control transfers to the function when invoked
    Control returns to the statement following upon return
  - **Repetition**
    Enables repetitive execution of statement blocks
  - **Selection**
    Enables choice among a block of statements
- All computer algorithms/programs utilize these modes.

Selection

- Enables choice among a block of statements

  Should I… { study }
  { sleep }
  { watch a movie }
  { veg out }
  { etc. }

- **If-statements** are one way of doing this



Selection: If Statement

```
if ( <condition> ) {
  do this
}
```

```
if ( <condition> ) {
  do this
}
else {
  do that
}
```

```
if ( <condition> ) {
  do this
}
else if ( <condition> ) {
  do that
}
else if (…) {
…
}
else {
  whatever it is you wanna do
}
```

At most ONE block is selected and executed.