Loops & Nested Loops

CSE 120 Winter 2019

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❄☃ SNOW LECTURE – SNOW DAY ☃❄

Outline

- **Loops**
  - **while-loop**
  - **for-loop**
- Nested Loops

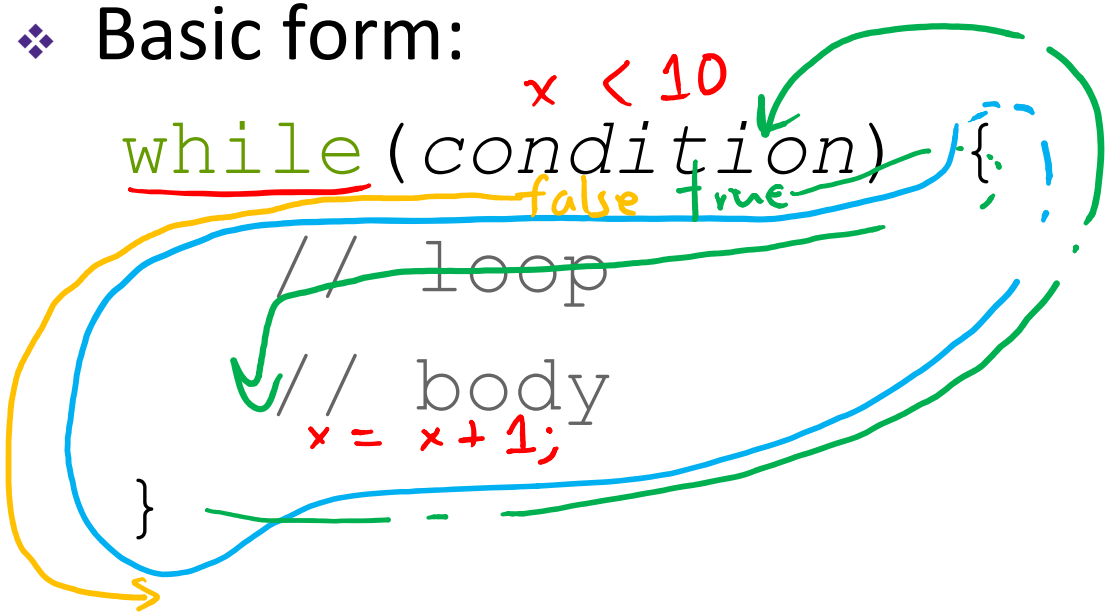
Looping

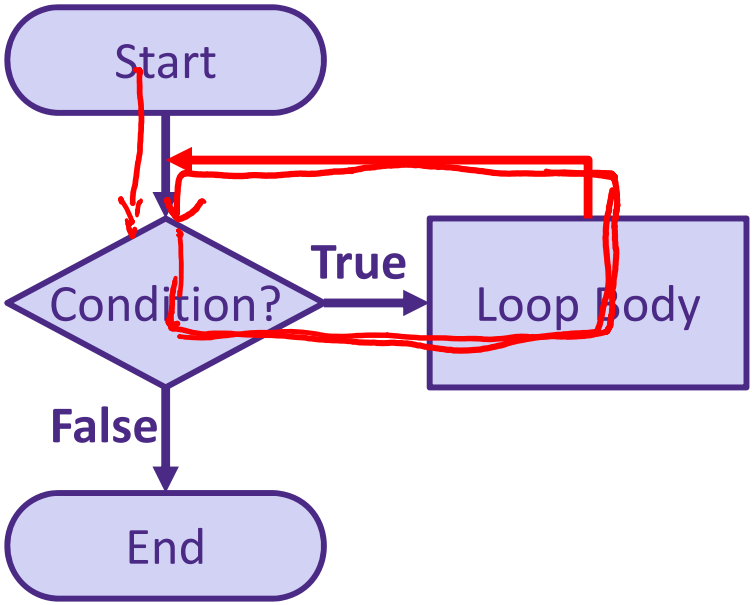
- Sometimes we want to do the same (or similar) things over and over again
  - Looping saves us time from writing out all of the instructions
- Loops control a sequence of *repetitions*

While-Loop

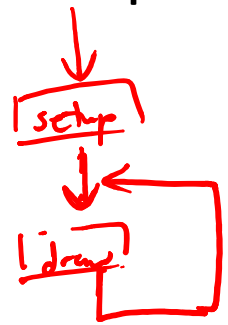
- Basic form:

```
while(condition) {
    // loop
    // body
}
```





- Repeat loop body until condition is `false`
  - Must make sure to update conditional variable(s) in loop body, otherwise you cause an infinite loop



- **`draw()`** is basically a `while(true)` loop

While-Loop Example [Demo]

- Row of six animals:

```
void drawRow() {
  ???  // draw six mice
}

void drawMouse(float x, float y, color c) {
  ...  // drawing commands
}
```

- Using a while-loop:

```
void drawRow() {
  int count = 0;
  while (count < 6) {
    drawMouse(80*count, 20, color(150));
    count = count + 1;
  }
}
```

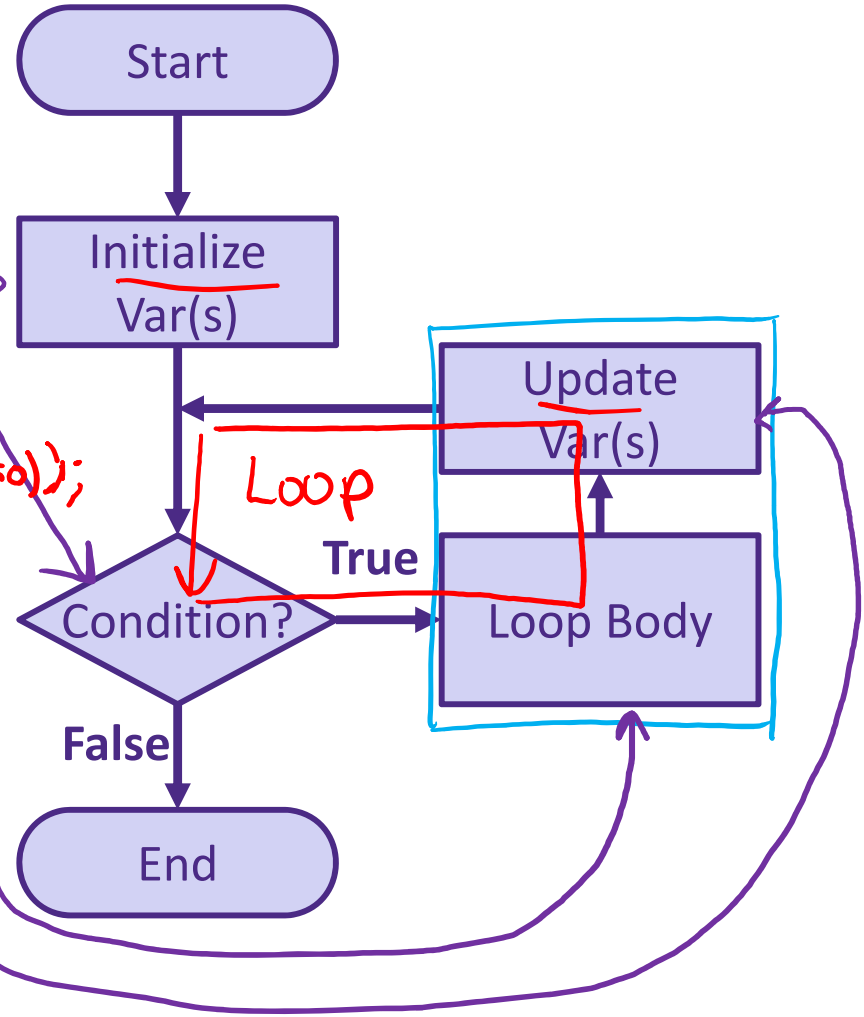
While-Loop

- More general form:

```
int count = 0;
// init cond var(s)
while(condition) {
    // loop body
    count = count + 1;
    // update var(s)
}
```

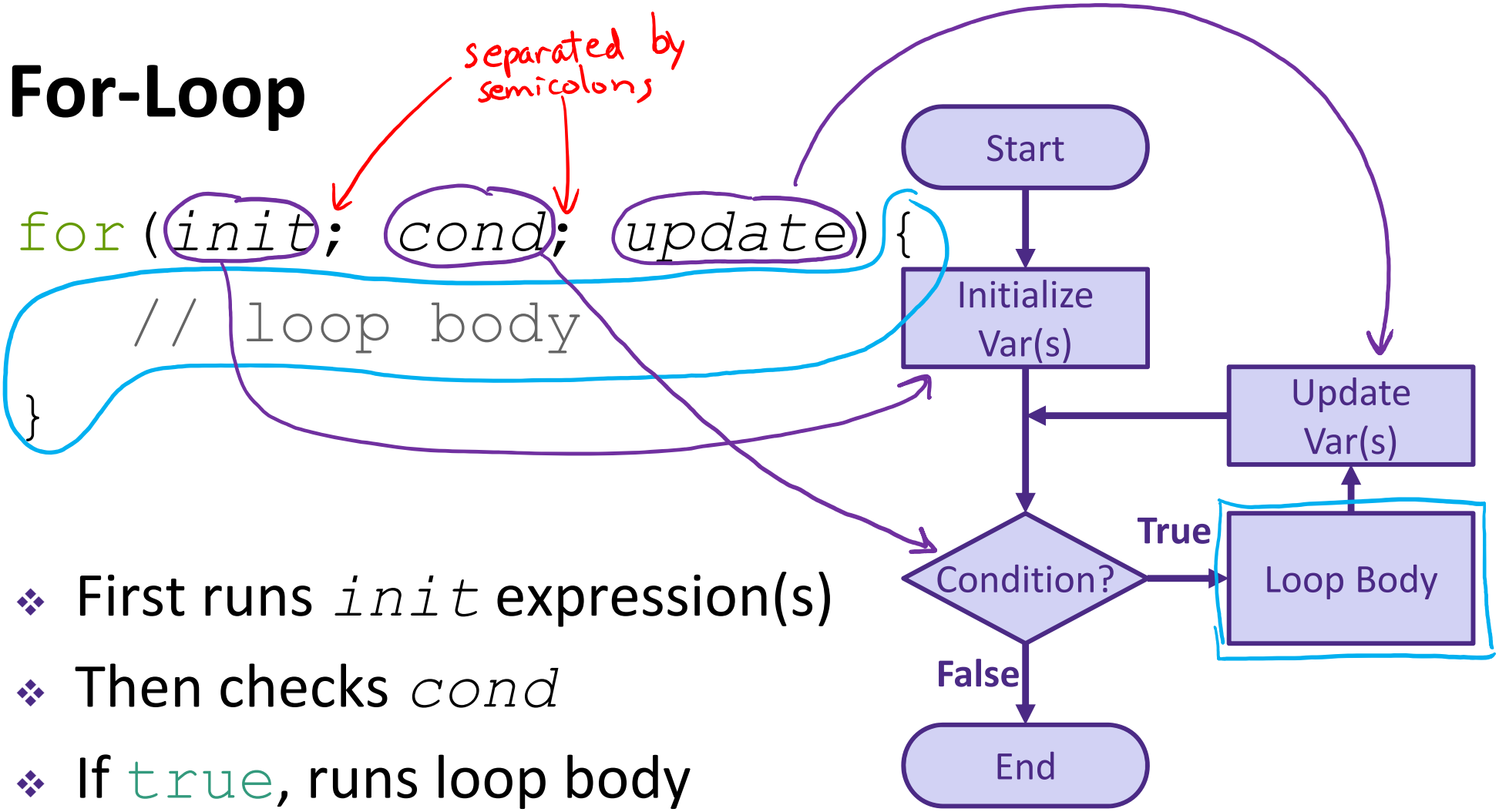
count <. 6

drawMouse(80+count, 20, color(150));



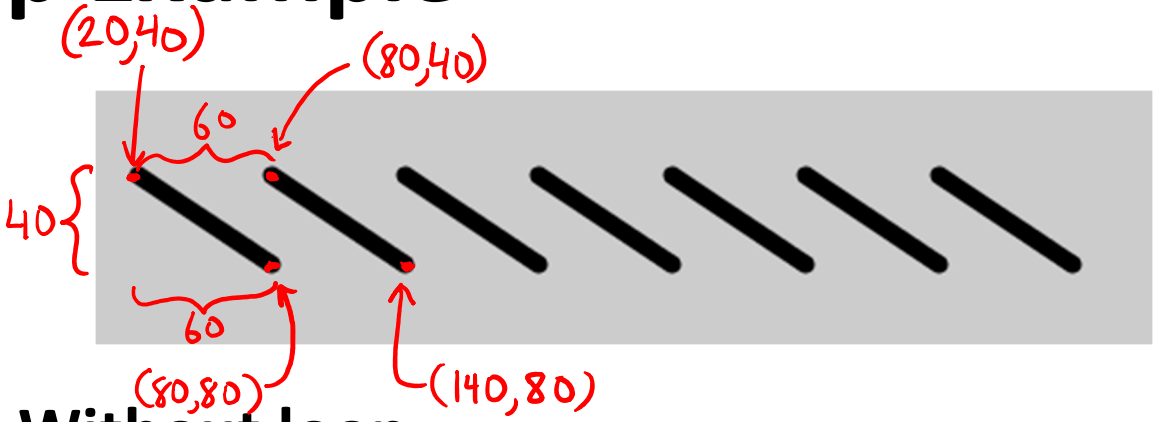
- This occurs so commonly that we create a separate syntax for it!

For-Loop



- First runs *init* expression(s)
- Then checks *cond*
- If `true`, runs loop body followed by update statement(s)

For-Loop Example



Without loop:

```
line( 20, 40,  80, 80);
line( 80, 40, 140, 80);
line(140, 40, 200, 80);
line(200, 40, 260, 80);
line(260, 40, 320, 80);
line(320, 40, 380, 80);
line(380, 40, 440, 80);
```

+60 +60 +60 +60

always 40 always 80

With loop:

```
for (int i = 20; i < 400; i = i + 60) {
  line(i, 40, i + 60, 80);
}
```

init cond update stops once i=440

20 20
80 80

Understanding the For-Loop

initialization

```
for (int i = 20; i < 400; i = i + 60) {
  line(i, 40, i + 60, 80);
}
```

- Choice of variable name(s) is not critical
  - Represent the value(s) that vary between different executions of the loop body
  - Think of as temporary variable(s)

- If variable `i` is *declared* in the initialization statement, then it only exists *within this loop*

Understanding the For-Loop

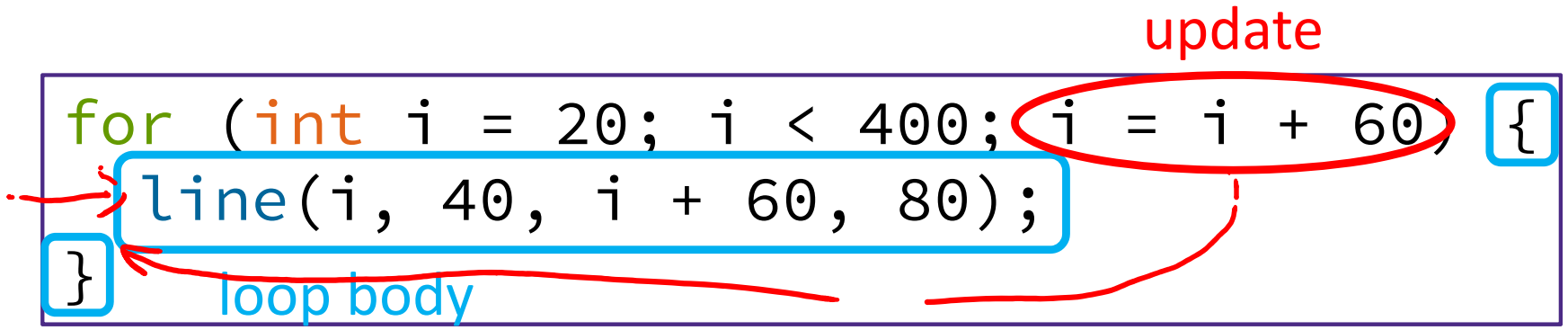
condition

```
for (int i = 20; i < 400; i = i + 60) {
  line(i, 40, i + 60, 80);
}
```

- Condition evaluated *before* the loop body and must evaluate to `true` or `false`
  - Reminder:

>	greater than
<	less than
>=	greater than or equal to
>=	less than or equal to
==	equal to
!=	not equal to

Understanding the For-Loop

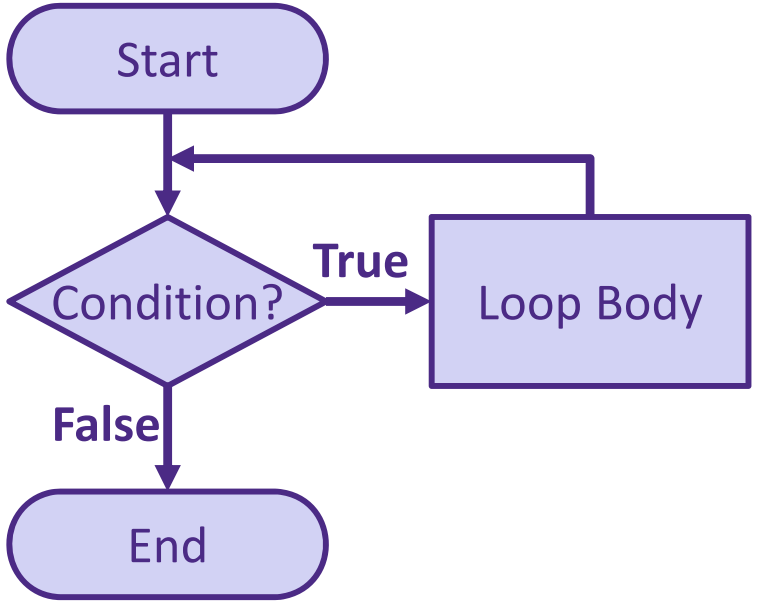


- Update is an assignment that is executed *after* the loop body
- Loop body is enclosed by curly braces { } and should be *indented* for readability

Loops Worksheet

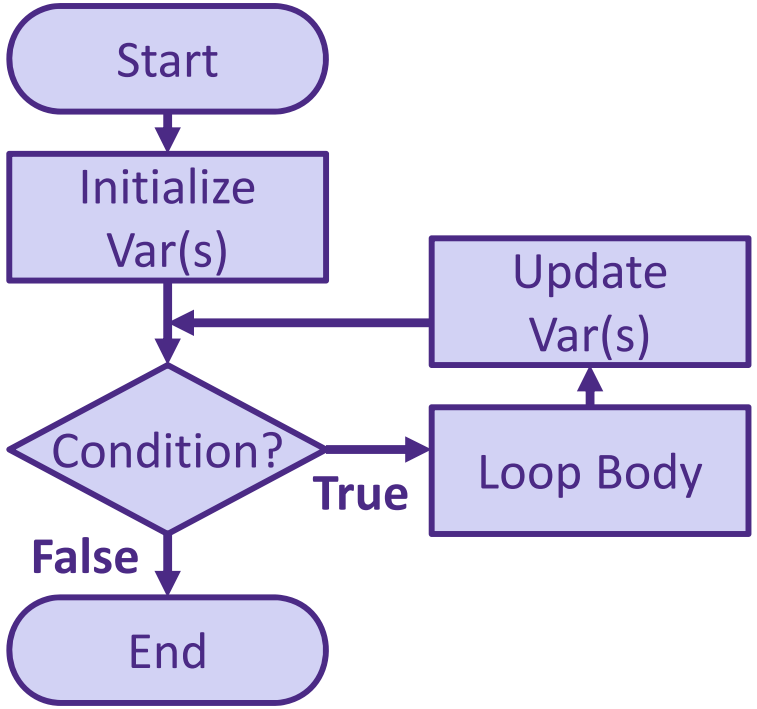
- While-loop:

```
while(condition) {
    // loop body
}
```

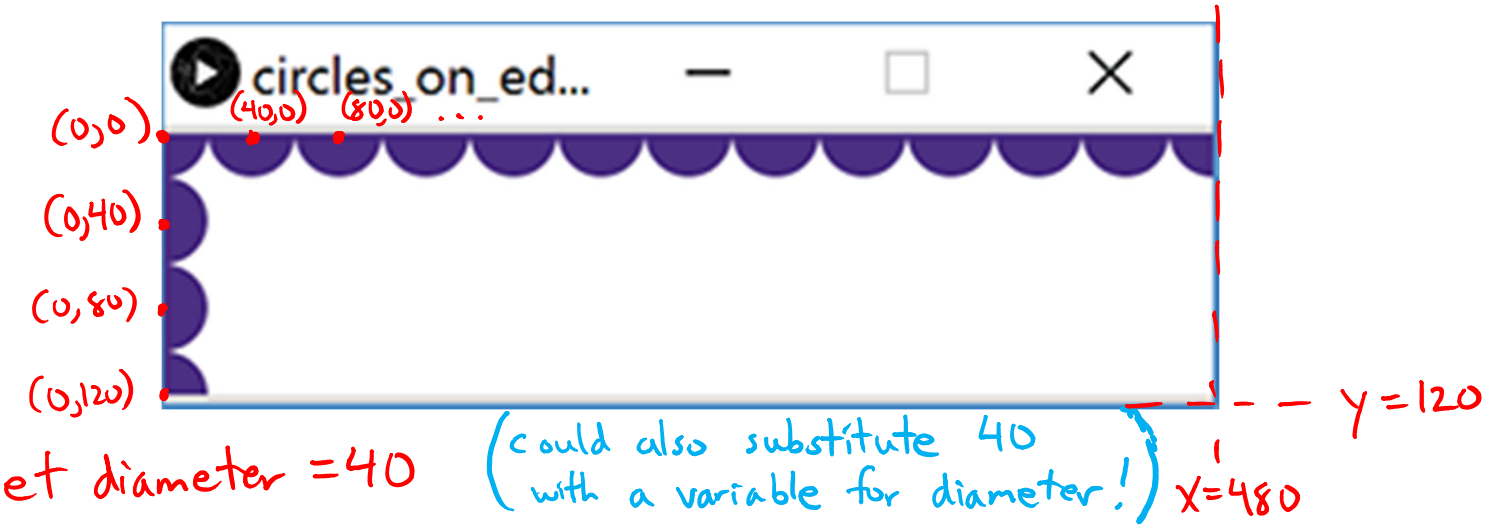


- For-loop:

```
for(init; cond; update){
    // loop body
}
```



Processing Demo: Circles on Canvas Edge



left edge:

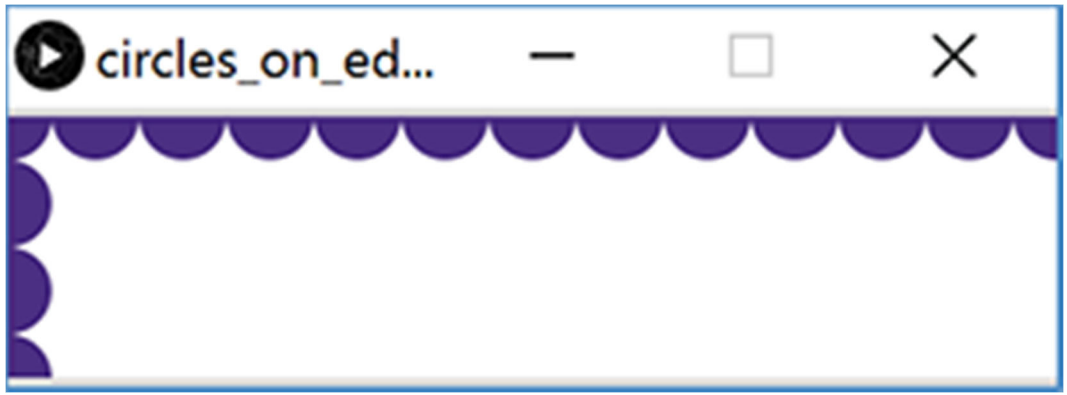
+40 each time in this argument

want
```
ellipse (0,0,40,40);
ellipse (0,40, 40,40);
ellipse (0,80, 40,40);
ellipse (0,120, 40,40);
```

```
ellipse(0, i, 40, 40);   Body
i = i+40;                Update
int i = 0;               Init
i <= height;             Cond
```

```
for(int i=0; i <= height; i=i+40) {
    ellipse (0, i , 40, 40);
}
```

Processing Demo: Circles on Canvas Edge




```
size(720, 120);     // canvas size
background(255);    // white background
noStroke();         // no outline on circles
fill(75, 47, 131); // UW purple

int diam = 40;

// loop for circles along the top edge
for (int x = 0; x <= width; x = x+diam) {
  ellipse(x, 0, diam, diam);
}

// loop for circles along the left edge
for (int y = 0; y <= height; y = y+diam) {
  ellipse(0, y, diam, diam);
}
```

Outline

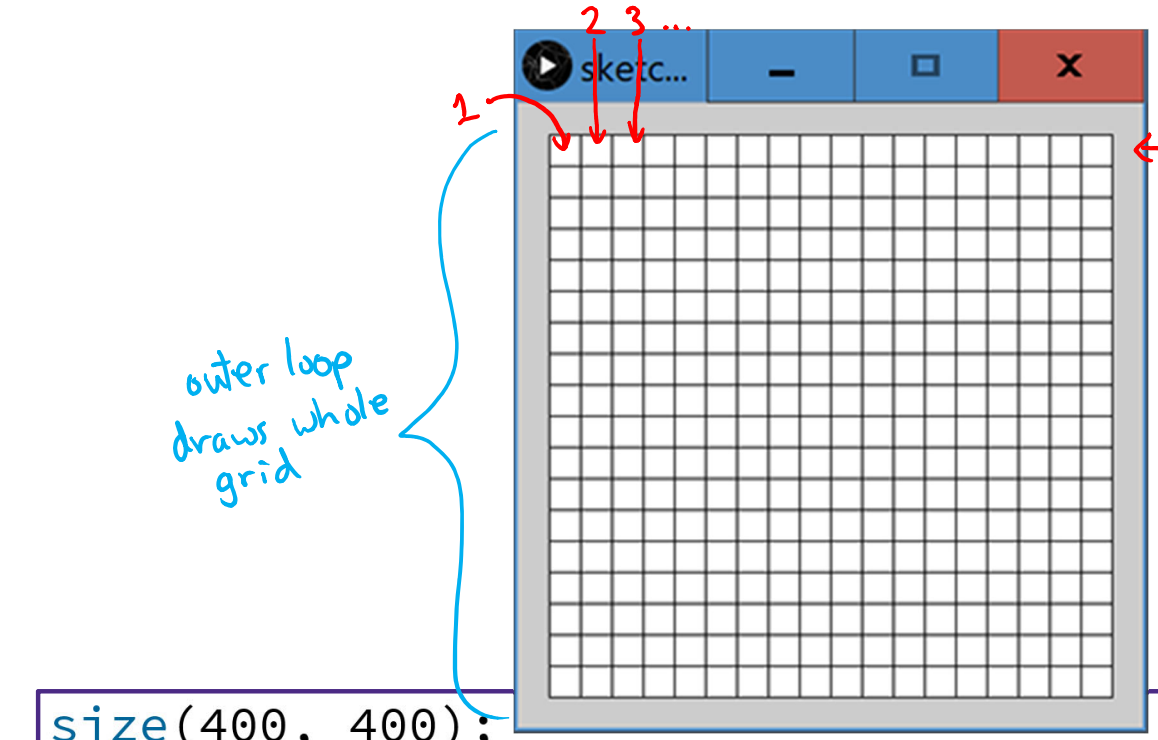
- Loops
  - while-loop
  - for-loop
- **Nested Loops**

Nested Loops

- Generally a for-loop has a single loop variable that changes with each iteration

- What if you need/want more things to change?
  - Can nest loops – *i.e.* put a loop inside of another loop

Example: Rectangle Grid




```
size(400, 400);

for(int y = 20; y < height-20; y = y + 20) {

  for(int x = 20; x < width-20; x = x + 20) {
    rect(x, y, 20, 20);
  }

}
```

body of OUTER loop

body of INNER loop