Drawing

2D Coordinates
Statements
Commenting
Sequential Control Flow

Chapter 3, Examples 3-1, 3-2, 3-3, 3.4, 3-5, 3-6, 3-10, 3-11
Skip Exercises 3-7, 3-8, 3-9

activate clicker:
hold ON/OFF, wait for power light to flash, enter 2-letter room code
What kind of error is this?

A. Syntax

B. Runtime

C. Logic

D. Not an error

E. I'm not sure

MoveRight(RED);

Language: moveUp(✪);
moveDown(✪);
moveLeft(✪);
moveRight(✪);

Where ✪ can be: RED, GREEN, ORANGE, TEAL, YELLOW, BLUE, or PURPLE
What do you need to draw a picture?

- Something to draw on
- Something to draw with
- A method to draw shapes
- A plan of your drawing
What do you need to draw a picture?

- Something to draw on (canvas)
- Something to draw with (pen)
- A method to draw shapes (function)
- A plan of your drawing (algorithm)
What do you need to draw a picture?

- Something to draw **on** (canvas)
- Something to draw **with** (pen)
- A **method** to draw shapes (function)
- A **plan** of your drawing (algorithm)
Setup a Drawing Canvas

function setup() {
    createCanvas(100, 100);
    background(220);

    // The code to make our drawing goes here
}

Create a drawing area with a width and height
Make the drawing area a certain colour

The code to make our drawing goes here
```javascript
function setup() {
    createCanvas(100, 100);
    background(220);
}
```

https://editor.p5js.org/cs105/sketches/NkJs2dQiM
function setup() {
    createCanvas(100, 100);
    background(220);
}

Syntax: brackets are required

Style: semicolons are required
Remember

- We are telling computer what & how to draw
How Do You Get Someone to Draw for You?

Exact Instructions Challenge Drawing (4:24 - 6:24)
https://www.youtube.com/watch?v=fjF2ALrdd5A
Why was it challenging?

- Did not say ...
Why was it challenging?

- Did not say ...
  - **where** to draw (e.g., “a little above ...”, “mouth...”)
  - **how** to draw (e.g., “reasonably sized”, “long nose...”)

How do we specify a location?

- At the mall?
- In a city?
- On an ocean?
How do we specify a location?

longitude W  longitude E

latitude N

latitude S
How do we specify a location?
How do we specify a location?

latitude N  longitude W  longitude E

e.g. (43.5° N, 80.5° W)

University of Waterloo

86MXFFC4+VC

(43.4721517, -80.5439318)
How do we specify a location?

How To Play Battleship
https://www.youtube.com/watch?v=4gHjlYLomrs
How do we specify a location?

- Rows & Columns
How do we specify a location?
General idea

- Use horizontal and vertical axis (e.g., *rows & columns*)
General idea

- Use horizontal and vertical axis (e.g., rows & columns)

Notice that origin for coordinate systems can be different.
function setup() {
    createCanvas(100, 100);
    background(220);
}
Origin

(10, 20)

(74, 28)

(10, 79)

(99, 99)
Pixels
Pixels Per Inch (PPI)

Apple iPhone - X

Credit: AndroidGuys, dimensions.guide
(live demos)

point(x, y)

line(x1, y1, x2, y2)

https://editor.p5js.org/cs105/sketches/NkJs2dQiM
Function Call Statement

- function name: point
- arguments: (40, 77)
- terminator: ;

statement: `point(40, 77);`
Draw a point at 40th row & 77th column.
Coding Style when Calling Functions

✔  point(10, 20);

One space after commas in function arguments:

✗  point(10,20);

No space between function name and opening bracket:

✗  point (10, 20);

No space before the semicolon at the end of a statement:

✗  point(10, 20) ;

No space after opening bracket or before closing bracket:

✗  point( 10, 20 );
hi

https://editor.p5js.org/cs105/sketches/uYIgbdkpS
Which statement draws this picture?

A. `line(50, 10, 1, 80);`
B. `line(10, 50, 10, 90);`
C. `line(50, 10, 50, 90);`
D. None of the above
Reference Sheet

- We provide a language reference sheet in exams.
- Don’t memorize function syntax, understand their semantics: what functions do and what parameters mean.

Processing Reference

<table>
<thead>
<tr>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>size(w, h)</code></td>
</tr>
<tr>
<td><code>width</code></td>
</tr>
<tr>
<td><code>height</code></td>
</tr>
<tr>
<td><code>cursor()</code></td>
</tr>
<tr>
<td><code>frameRate(r)</code></td>
</tr>
<tr>
<td><code>frameCount</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>strokeJoin(join)</code></td>
</tr>
<tr>
<td>where join = BEVEL, MITER, ROUND</td>
</tr>
<tr>
<td>change how lines join when drawing</td>
</tr>
<tr>
<td>default is MITER</td>
</tr>
<tr>
<td><code>strokeCap(cap)</code></td>
</tr>
<tr>
<td>where cap = SQUARE, PROJECT, ROUND</td>
</tr>
<tr>
<td>change rendering style of line endings, default is ROUND</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>background(gray)</code></td>
</tr>
<tr>
<td>clear the canvas and set the background to a colour</td>
</tr>
<tr>
<td><code>fill(gray)</code></td>
</tr>
<tr>
<td><code>fill(gray,a)</code></td>
</tr>
<tr>
<td><code>fill(hex,a)</code></td>
</tr>
<tr>
<td><code>stroke(gray)</code></td>
</tr>
<tr>
<td><code>stroke(hex)</code></td>
</tr>
<tr>
<td><code>stroke(gray,a)</code></td>
</tr>
<tr>
<td><code>stroke(hex,a)</code></td>
</tr>
<tr>
<td><code>noFill()</code></td>
</tr>
<tr>
<td><code>colorMode(HSB, h, s, b, a)</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>int(n)</code></td>
</tr>
<tr>
<td>convert n to an int, convert n to a float</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Math</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>degrees(r)</code></td>
</tr>
<tr>
<td>convert r radians to degrees or convert d degrees to radians</td>
</tr>
<tr>
<td><code>map(v, start1, stop1, start2, stop2)</code></td>
</tr>
<tr>
<td>remaps v in range start1 to stop1, to a number in range start2 to stop2</td>
</tr>
<tr>
<td><code>random(high)</code></td>
</tr>
<tr>
<td>generate random number from 0 to high, or from low to high</td>
</tr>
<tr>
<td><code>randomSeed(seed)</code></td>
</tr>
<tr>
<td>set seed to a constant number to make random generate the a repeatable sequence of numbers</td>
</tr>
<tr>
<td><code>dist(x1, y1, x2, y2)</code></td>
</tr>
<tr>
<td>returns distance from x1, y1 to x2, y2</td>
</tr>
<tr>
<td><code>constrain(v, low, high)</code></td>
</tr>
<tr>
<td>constraints v to between low and high</td>
</tr>
<tr>
<td><code>min(a, b)</code></td>
</tr>
<tr>
<td>returns min or max value of a and b</td>
</tr>
</tbody>
</table>
(live demos)

triangle($x_1, y_1, x_2, y_2, x_3, y_3$)

quad($x_1, y_1, x_2, y_2, x_3, y_3, x_4, y_4$)

https://editor.p5js.org/cs105/sketches/NkJs2dQiM
sailboat

https://editor.p5js.org/cs105/sketches/iCmF693Ps
Commenting Code

- Code comments provide information that is not otherwise available from reading the code
- Comments are often a message to your “future self”
  - in CS 105, comments are a message to lab instructors, marking TAs, professor, etc.

```cpp
// draws a sailboat

// left sail
triangle(48, 10, 48, 60, 15, 60);

// right sail
triangle(50, 10, 50, 60, 75, 60);
```
(live demos)

rect(?, ?, ...)  

ellipse(?, ?, ...)  

https://editor.p5js.org/cs105/sketches/NkJs2dQiM
live demos

rect(x, y, width, height)

ellipse(x, y, width, height)

https://editor.p5js.org/cs105/sketches/NkJs2dQiM
man with hat

https://editor.p5js.org/cs105/sketches/DEetu9rg_
cat

https://editor.p5js.org/cs105/sketches/6gWGb-lkv
Spray Paint Sequential Control Flow
- [http://youtu.be/ghHxTjXAnM4](http://youtu.be/ghHxTjXAnM4)
Trace Through: Sequential Control Flow

// sequential control flow demo
function setup() {
    createCanvas(100, 100);
    background(220);
    line(99, 0, 0, 99);
    ellipse(50, 50, 40, 40);
    rect(25, 25, 50, 50);
    }


// sequential control flow demo

function setup() {
    createCanvas(100, 100);
    background(220);
    line(99, 0, 0, 99);
    ellipse(50, 50, 40, 40);
    rect(25, 25, 50, 50);
    HALT
}
// sequential control flow demo

function setup() {
  createCanvas(100, 100);
  background(220);
  line(99, 0, 0, 99);
  ellipse(50, 50, 40, 40);
  rect(25, 25, 50, 50);
  HALT
}
function setup() {
  createCanvas(100, 100);
  background(220);
  line(99, 0, 0, 99);
  ellipse(50, 50, 40, 40);
  rect(25, 25, 50, 50);
  HALT
}
// sequential control flow demo
function setup() {
  createCanvas(100, 100);
  background(220);
  line(99, 0, 0, 99);
  ellipse(50, 50, 40, 40);
  rect(25, 25, 50, 50);
  HALT
}
// sequential control flow demo

function setup() {
  createCanvas(100, 100);
  background(220);
  line(99, 0, 0, 99);
  ellipse(50, 50, 40, 40);
  rect(25, 25, 50, 50);
  HALT
}
// sequential control flow demo

function setup() {
  createCanvas(100, 100);
  background(220);
  line(99, 0, 0, 99);
  ellipse(50, 50, 40, 40);
  rect(25, 25, 50, 50);
  HALT
}
// sequential control flow demo
function setup() {
  createCanvas(100, 100);
  background(220);
  line(99, 0, 0, 99);
  ellipse(50, 50, 40, 40);
  rect(25, 25, 50, 50);
  HALT}

WHAT TO DO NEXT?
// sequential control flow demo

function setup() {
  createCanvas(100, 100);
  background(220);
  line(99, 0, 0, 99);
  ellipse(50, 50, 40, 40);
  rect(25, 25, 50, 50);
  HALT
}
function setup() {
  createCanvas(100, 100);
  background(220);
  // code goes here
}

Which code draws this picture?

A. ellipse(50, 50, 30, 30);
   ellipse(50, 50, 80, 80);

B. ellipse(50, 50, 80, 80);
   ellipse(50, 50, 30, 30);

C. Both A and B

D. Neither
car (extra example)

https://editor.p5js.org/cs105/sketches/1-uBo1P3v
Coding Train Video: Basics of Drawing

- [https://thecodingtrain.com/Tutorials/1-p5js-basics/1.3-basics-of-drawing.html](https://thecodingtrain.com/Tutorials/1-p5js-basics/1.3-basics-of-drawing.html)

In this video, I teach you about the basics of drawing shapes in a web browser using the p5.js library.