Study Guide 1 - Intro to Canvas **Name:**_____

Due: See dropbox. Submit this DOC and the zipped source files. Answer the questions and fill in the blanks. Late submissions will not be accepted.

• The `<canvas>` tag defines an area on the page that we can draw into using a procedural drawing API. This bitmap drawing API has methods for drawing lines, paths, rectangles, arcs, circles, curves, and text.

• The canvas drawing API allows a developer to create Flash-like games and experiences without using the Flash SDK and with no need for a browser plug-in.

• The canvas API is focused on drawing, and is fairly lightweight. The full specification is here: http://www.w3.org/TR/2dcontext/

• Our free canvas "textbook" is located here: https://developer.apple.com/library/safari/documentation/AudioVideo/Conceptual/HTML-canvas-guide/Introduction/Introduction.html

• Apple invented canvas in 2004 as a way to add customized dashboard widgets to OS X. It has since been adopted by all major browsers and is supported by the current versions of Chrome, Firefox, Internet Explorer (8>), Konquerer, and Opera.

• We will mostly be using Chrome in class because it is cross-platform, ubiquitous, and has a built-in debugger.

• You can check the canvas compatibility of your browser at these sites: http://caniuse.com/#feat=canvas

https://html5test.com

I. About Canvas

1) Read the "At a glance" section under *About Canvas*

A. **You can add a Canvas element with a few lines of code**
(*no answer required* - we'll do this in the next section)

B. **There are Methods for Drawing** _____

You draw shapes other than rectangles by creating a path, adding line segments, curves, or arcs, and closing the path. Begin a path using `beginPath()`. Set the starting point, or start a discontinuous subpath, by calling the `moveTo(x, y)` method. The `closePath()` method draws a line from the current endpoint to the starting point of the path, creating a closed shape.

The path is not actually drawn until you _____

Canvas supports matrix transforms—anything you draw can be _____

C. **It's Easy To Include** _____

D. **You Can Also Render** _____

E. **Canvas is Great for InfoGraphics** - give examples:

F. **Canvas Can Create Fast, Lightweight Animations**.
(*no answer required* - note: Apple's examples use `setInterval()` for animation - we'll instead be using `requestAnimationFrame()` in our examples)

G. **You Can Manipulate Pixels Directly for Image Processing** - give examples:

H. **Make Games That Play on Desktop and iOS Devices**.
(or Android, Blackberry, Windows, … - *no answer required*)

I. **The Web Inspector Provides Built-in JavaScript Debugging**

To access the Web Inspector on Chrome and Safari, right-click in the browser window and select "Inspect Element" to bring up the debugger. On Safari, you'll first have to Choose **Safari > Preferences > Advanced** and check the "Show Develop in menu bar" box.

no answer required

J. **Export to Canvas is Possible from Illustrator or Flash**

no answer required

II. Setting Up the Canvas

1) Read over the “Setting Up the Canvas” section - the following steps are listed:

- Start by Adding a `<canvas>` Tag

- Specify the Fallback Behavior

- Create a Drawing Context

- Support Retina Displays from the Start
(a good practice, but we’re not going to worry about this in the course)

- Save and Restore the Context
(we’ll get into this soon)

2) Your first canvas App:

The canvas drawing API allows a developer to create interactive experiences and games without the need for a browser plug-in.

You need to do the following to get started drawing in canvas on an HTML page:

i. Wait for the HTML page to load

ii. Get a reference to the `<canvas>` tag on the page

iii. Get a reference to the “drawing context”, which is the 2D drawing API we use to do the actual drawing.

iv. Start issuing drawing commands!

Here is a simple example (see mycourses for **sg-1.html**):

```
<!DOCTYPE html>
<html lang="en">
<head>
	<meta charset="utf-8" />
	<title>Canvas 1</title>
	<script>

		"use strict";
		// #1
		window.onload = init;

		function init(){
			// #2
			let canvas = document.querySelector('canvas');

			// #3
			let ctx = canvas.getContext('2d');

			/* #4 - start drawing! */
			// draw filled square
			ctx.fillStyle = "red";
			// ctx.fillRect(x,y,width,height);
			ctx.fillRect(20,20,100,100);

		}

	</script>
</head>
<body>
	<canvas id="canvas" width="750" height="500">
	   Get a browser that supports Canvas!
	</canvas>
</body>
</html>
```

Go ahead and load this example in the browser so you can see the exciting red square on the screen. Note that (0,0) is in the upper-left corner of the screen. x-values get larger as you move to the right, and y-values get larger as you move down the screen.

The **sg-1.html** example that's posted to mycourses has additional JS code that you can uncomment and see more drawing examples.

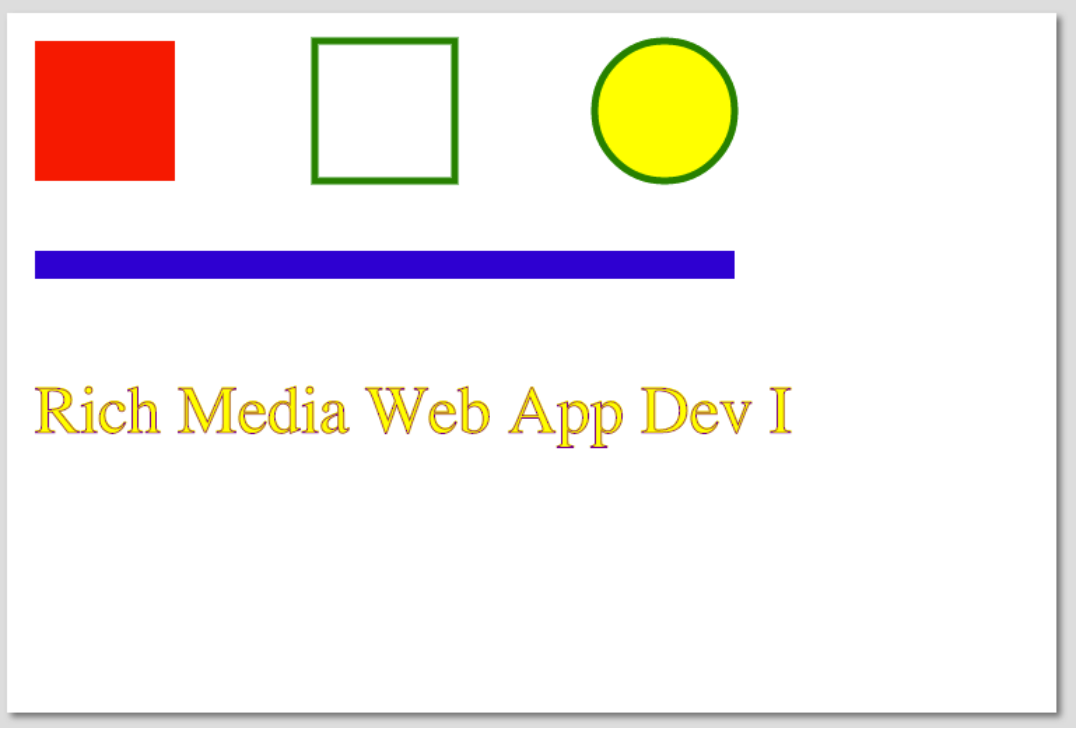
Before you move on, go get this file and play with it now. Uncomment the remaining code section-by-section and experiment:

- change the `x/y/width/height` values,
- change the `.fillStyle` and `.strokeStyle` values
- change the `startAngle` and `endAngle` values

to see what happens.

Also note that `.strokeText()` strokes the outline of the text with the current `.strokeStyle`, and `.fillText()` fills the text with the current `.fillStyle` You can use these together to get some nice effects.

Here's the default version:



3) For the following, modify the **sg-1.html** example file to get the answer (first comment out all of the drawing code under step #4).

For your answers, assume that you already have a variable named `ctx` that points at the drawing context. Note: The squares only require 1 or 2 lines of code, the circles will require a few more.

A. Write code that will **fill** a black 50x50 square at (0,0)

B. Write code that will **fill** a purple 50x50 square at (300,300)

C. Write code that will **stroke** a purple 50x50 square at (300,300)

D. Write code that will **stroke** a 5 pixel thick green line between (0,100) and (100,500)

E. Write code to **fill** a black circle at (0,0) that has a radius of 50 pixels.

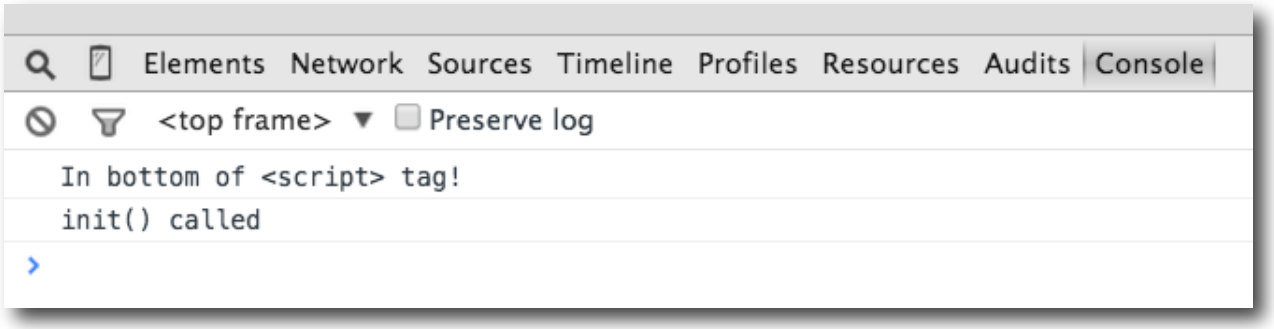
F. Write code to **fill** a yellow semi-circle (180 degrees ie. `Math.PI` radians) at (200,200) that has a radius of 100 pixels.

G. What are the default colors for `.fillStyle` and `.strokeStyle` if you don't specify them?

H. Try giving `.fillStyle` a non-existent CSS value for a color like "pukegreen" - what color do you get instead?

I. What is the default value of `.lineWidth` if you don't specify a value?

J. Check the console tab in the web inspector - why is `"init() called"` being logged later than `"In the bottom of the <script> tag"` even though `"init() called"` appears first in the source code?



K. What is the default `height` and `width` of the `<canvas>` tag if you don't specify a value (use google or the Web Inspector to find out)

III. More above the Canvas API

1) Read over **Set the Stroke and Fill Styles**:

A.Color can be specified in all of the usual CSS ways - give the `.fillStyle` color for white in each format below :

i) CSS Keyword: `ctx.fillStyle = "white";`

ii) Longhand hexadecimal:

iii) Shorthand hexadecimal:

iv) RGB percentage:

v) RGB value:

vi) RGBa value:

Note that a gradient or pattern can also be used for `.fillStyle` *and* `.strokeStyle` *values. HSL and HSLA values are also supported:*
http://www.w3schools.com/cssref/css_colors_legal.asp

2) Read over **Drawing Rectangles**:

List the 3 rectangle methods below:

There's also a 4th one, `rect()`*, that creates a rectangle path without filling or stroking it. We'll get into that one later.*

3) Read over **Paths and Subpaths**
A. You draw shapes other than rectangles by _____

B. Calling `stroke()` or `fill()` _____

C. A path ends when you call `closePath()` or _____

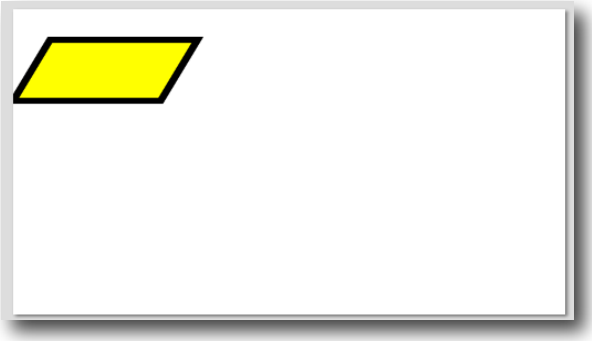
Apple mysteriously left out illustrative example code, so here's some:

```
// Bonus: A Parallelogram
ctx.beginPath();
ctx.moveTo(50, 50); // "pick up" pen and move to top-left corner
ctx.lineTo(250, 50); // extend path to top-right corner
ctx.lineTo(200, 150); // extend path to bottom-right corner
ctx.lineTo(0, 150); // extend path to bottom-left corner

// closing the path will automatically extend the path back to (50,50) where it started
ctx.closePath();

// we can't yet see the path, so stroke and fill it.
ctx.fillStyle = "yellow";
ctx.fill();
ctx.strokeStyle="#red";
ctx.lineWidth=10;
ctx.stroke();
```

This code drew a parallelogram with side lengths of 200 and 100 units. Note that the stroke goes outside the boundaries of the path. Also note that if you change the order of the `.fill()` and `.stroke()` calls, you will get different results.



4) Skip down to **Drawing Arcs and Circles**:

```
arc(x,y,radius,startAngle,endAngle)
```

A) What do `x` and `y` represent? (note that this is different from the rectangle methods)

B) Are angle values specified in *degrees* or *radians*?

C) By default, which way is the arc drawn, *clockwise* or *counter-clockwise*?

5. A little review - write a line of code:

A. that sets the current fill color to green

B. that sets the current stroke color to purple

C. that sets the stroke width to 20

D. that sets the current font to `courier`

E. that clears an entire `<canvas>` that is 640 x 480

F. Lastly, where is 0,0 located in the canvas coordinate system?

IV. Make something!

HW! - worth 10 points

Create a scene with a “smiley face”:

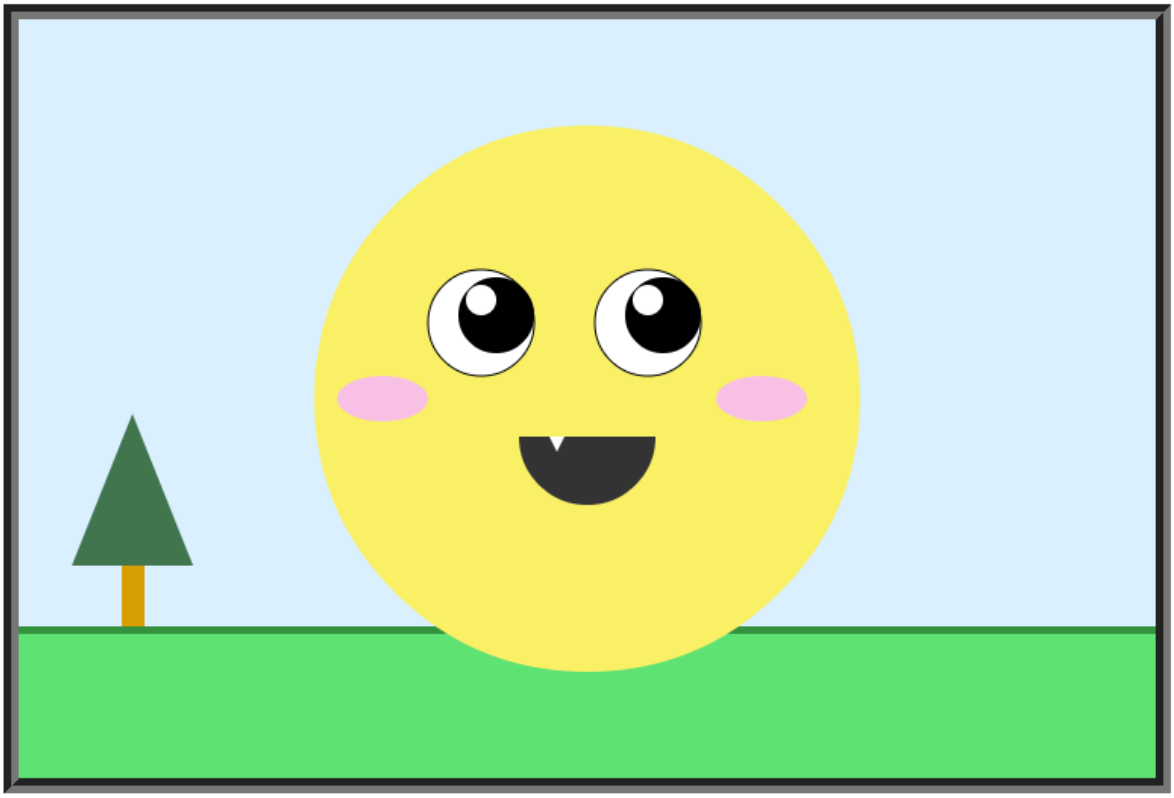
- 4 arcs

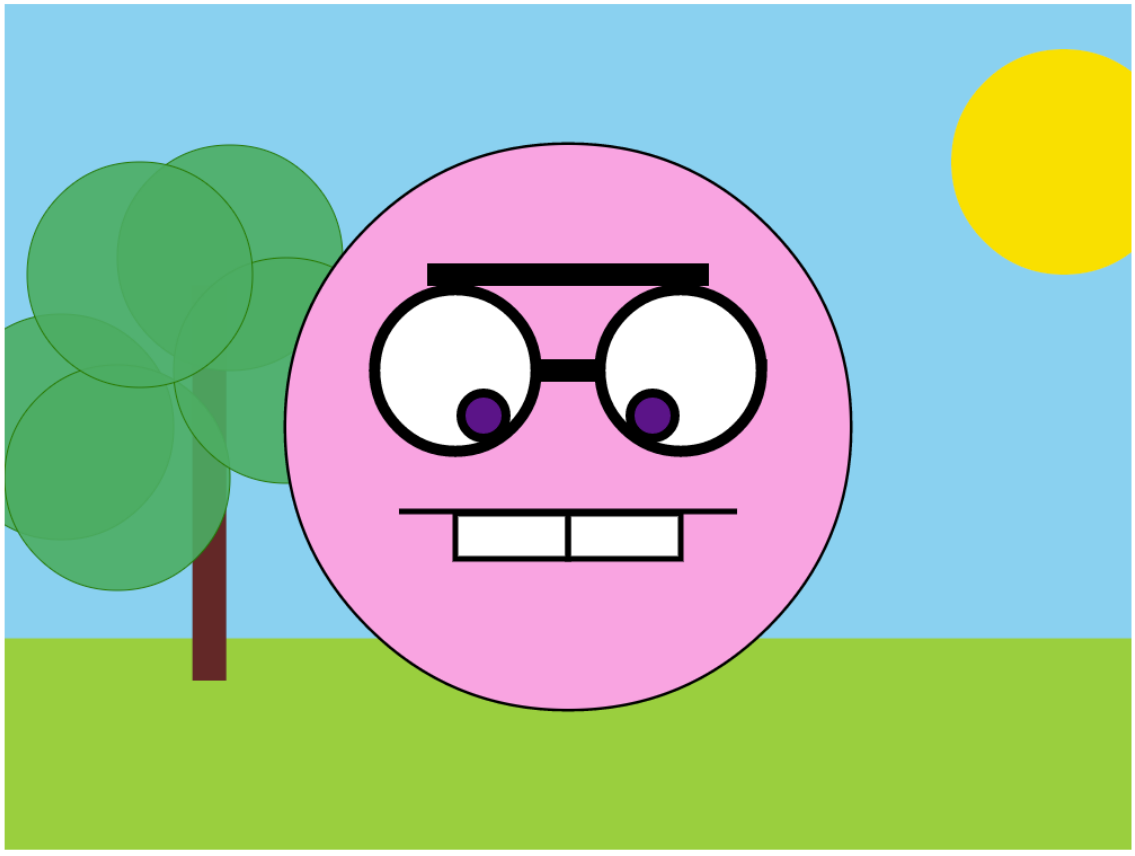
- a horizon line (a line)

- and a tree (a path with 3 points plus a line for a trunk).

- The Smiley face is black and yellow. The tree is brown and green. See the first example and hints below - it doesn’t have to look exactly like mine.

- Be sure things are drawn in the right order (ex. The horizon line should be behind everything else). Canvas uses the “painters model” where new drawing is drawn on top of and obscures (or partially obscures) old drawing.





Hint I: My example canvas is 750 x 500

```
<canvas width="750" height="500">
         Get a browser that supports Canvas!
</canvas>
```

Hint II: Here's the code for the oval of the face:

```
var canvas = document.querySelector('canvas');

// get pointer to "drawing context" and drawing API
var ctx = canvas.getContext('2d');

// set state variables
ctx.fillStyle = "yellow";
ctx.strokeStyle = “black”;
ctx.lineWidth = 5;

// start drawing
ctx.beginPath();
//  ctx.arc(x,y,radius,startAngle,endAngle, clockwise)
ctx.arc(375, 250, 200, 0, Math.PI*2, false);
ctx.closePath();

// fill inside of arc with yellow
 ctx.fill();

// stroke outside of arc with black
 ctx.stroke();
```

Hint III: If nothing is getting drawn, check the debugger console for errors!

ExtraCredit - 1 point each - max grade 15/10

- Make the “sky” a skyish color - - use `ctx.fillRect();`
- Make the “ground” a groundish color - - use `ctx.fillRect();`
- Other elements? see examples above for ideas

V. Submission

This SG is worth 2 HW assignments.

1) ZIP up your smiley file and submit it to the mycourses dropbox - you can earn up to 15/10 points on this first assignment if you do the extra credit.

Study Guide Rubric

DESCRIPTION	SCORE	VALUE %
Answered Questions – All questions answered correctly. Questions with A,B,C parts are counted as separate questions. Questions with i,ii,iii parts are counted as the same question.		**4% (each)**
TOTAL		**100%**

Smiley Rubric

DESCRIPTION	SCORE	VALUE %
Arcs – Smiley contains at least four arcs.		**20**
Horizontal Line for Ground – Smiley includes at least one horizontal line for the ground.		**10**
Tree – Smiley contains at least one tree in the background. The tree does not need to have exactly three points as shown in the exercise.		**20**
Smiley – Smiley is completed appropriately including at least one semi-circle.		**30**
Drawing Order – Order of drawing (layering) is correct.		**20**
(Extra Credit) – Sky with color. It should be clear it is a sky.		**10% (bonus)**
(Extra Credit) – Ground with color. It should be clear it is the ground.		**10% (bonus)**
(Extra Credit) – Extra elements in the drawing. You can earn up to this maximum amount for the number of extra elements you add to the drawing, such as more complex trees, glasses, dimples, sun, etc.		**20% (bonus)**
(Extra Credit) – Exceptional Effort. If you do really incredible work, you can earn an extra bonus.		**10% (bonus)**
Errors Thrown – Any errors thrown in the console.		**-15% (this time)**
Additional Penalties – These are point deductions for poorly written code or improper code. There are no set values for penalties. The more penalties you make the more points you will lose.		
TOTAL		**100%**