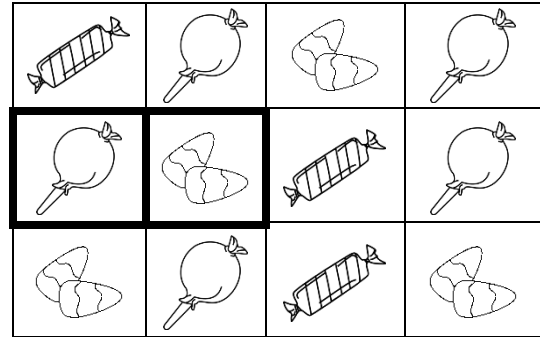





**CS 105: Final Exam**  
Final Exam from Fall 2014

Consider a popular mobile and Facebook game where you swap adjacent squares of candy pieces in order to match three-in-a-row.

As an example, swapping the two cells highlighted in bold in the image to the right (→) results in three lollipops lining up in the second column.



For processing this grid in JavaScript, we will assign each image a specific letter. Specifically:

- Let  be represented by the letter "A" ...possibly for Green Apple Jolly RanCher?
- Let  be represented by the letter "B" ...possibly for Bubblegum-Pop?
- Let  be represented by the letter "C" ...possibly for Candy Corn?

Based on this translation, we can generate an array that represents the original state of the board. The original board shown above is represented in JavaScript as the following:

```
var board = [ ["A", "B", "C", "B"],
              ["B", "C", "A", "B"],
              ["C", "B", "A", "C"] ];
```

Each element of `board` is a single row within our grid and each element within that row is a letter that represents a candy. The two cells highlighted in bold in the original image, the lollipop ("B") and candy corn ("C") are at `board[1][0]` and `board[1][1]` in our array..

1. What type of variable is `board`?

- An array of strings
- An array of array of strings
- An array of objects
- An array of array of objects
- An array of objects with arrays

Array: `[]`  
String: `"` or `'`  
Object: `{}`

For the next three questions, consider the following answers:

- 0
  - 1
  - 2
  - 3
  - 4
- From the above answers, what is the value of `board.length`? 3
  - From the above answers, what is the value of `board[0].length`? 4
  - From the above answers, what is the value of `board[0][0].length`? 1

Continuing from the previous page, we are still working with a board array with the following general layout (reprinted for reference):

```
var board = [ ["A", "B", "C", "B"],
              ["B", "C", "A", "B"],
              ["C", "B", "A", "C"] ];
```

Consider a function designed to check for a three-in-a-row match on a board:

```
1 function foundMatch(board)
2 {
3     for (var i = 0; i < board.length - 2; i++) i- index of board
4     {
5         for (var j = 0; j < board[i].length - 2; j++)
6         {                                     j-index of board[i]
7             // Check vertically
8             if ( _____ )
9                 return true;
10
11            // Check horizontally
12            if ( _____ )
13                return true;
14        }
15    }
16
17    return false;
18 }
```

- What Boolean expression can be placed inside of Line 8 to complete the conditional in order to check if there are three candies in-a-row vertically?
  - `board[i] == board[i + 1] && board[i + 1] == board[i + 2]`
  - `board[j] == board[j + 1] && board[j + 1] == board[j + 2]`
  - `board[i][j] == board[i][j + 1] && board[i][j + 1] == board[i][j + 2]`
  - `board[i][j] == board[i + 1][j] && board[i + 1][j] == board[i + 2][j]`
- Suppose we want to increase a score variable by 20 points when a three-in-a-row match is made. Using the function defined above, which snippet of code correctly increases the score when a match was made?
  - `if (foundMatch(board) = true) score++;`
  - `if (foundMatch(board) == true) score++;`
  - `if (foundMatch(board) = true) score += 20;`
  - `if (foundMatch(board) == true) score += 20;`
  - `if (foundMatch(board) != true) { score += 20; }`

Consider the following spreadsheet for the next four questions:

	A	B	C	D	E
1	<b>Date</b>	<b>Merchant</b>	<b>Type</b>	<b>Amount</b>	
2	Dec. 10, 2014	App Multiverse	Department Store	\$ 1.99	
3	Dec. 11, 2014	Caffeine Comrade	Restaurant	\$ 4.57	
4	Dec. 12, 2014	Pizza Portal	Restaurant	\$ 17.57	
5	Dec. 13, 2014	Akihabara Aces	Department Store	\$ 56.20	
6	Dec. 14, 2014	Grub2Go	Restaurant	\$ 3.56	
7	Dec. 15, 2014	Produce Peddler	Grocery	\$ 30.15	
8	Dec. 16, 2014	Pizza Portal	Restaurant	\$ 18.08	
9					
10			Average Expenditure:		
11			Expenditure of Restaurants:		
12			Number of Department Store Expenditures:		

7. Which of the following formulas will indicate the day of the week (eg: return some value that could be translated to Saturday, Sunday, Monday, etc) about Dec. 10, 2014?
- =DAY (A2)
  - =WEEK (A2)
  - =WEEKDAY (A2)
  - =MONTH (A2)
  - =YEAR (A2)
8. If the average expenditure per transaction is to be calculated in D10, which one of the following formulas should be used?
- =AVG (E4 : E10)
  - =AVERAGE (D2 : D8)
  - =SUM (D2:D8) / (A8 - A2)
  - =(E4 : E10) / COUNTA (E4 : E10)
  - =E2:E8 / COUNT (E2:E8)
9. If the expenditure on restaurants is to be calculated in D11, which one of the following formulas should be used?
- =VLOOKUP ("Restaurant", SUM (D2:D8), 2, TRUE)
  - =VLOOKUP ("Restaurant", SUM (D2:D8), 2, FALSE)
  - =SUM (D2 : D8) IF (D = "Restaurant")
  - =SUMIF (C2:C8, "Restaurant", D2:D8)
  - =SUMIF (C2:C8, ="Restaurant", D2:D8)
10. If the Number of Department Store Expenses is to be calculated in D12, which one of the following formulas should be used?
- =COUNT (C:C, "Department Store")
  - =COUNT (D2:D8, "Department Store")
  - =COUNTIF (C2:C8, "Department Store")
  - =SUM (C2:C8, "Department Store")
  - =SUMIF (C2:C8, "=Department Store")

When you graduate from the University of Illinois, you can graduate with an honors distinction by fulfilling some college-specific requirements and earning a certain GPA. The following spreadsheet shows these GPA requirements:

	A	B	C	D	E
1	<b>GPA (Min)</b>	<b>GPA (Max)</b>	<b>Honors Type (Latin)</b>	<b>English Translation</b>	
2	3	3.499	Cum Laude	With Honors	
3	3.5	3.749	Magma Cum Laude	With High Honors	
4	3.75	4.0	Summa Cum Laude	With Highest Honors	
<b>Sheet Name: Requirements</b>					

11. When entered into cell E2, which formula displays “Summa Cum Laude”?

- A. =VLOOKUP(3.7, A2:C4, 2, TRUE)
- B. =VLOOKUP(3.8, A2:C4, 2, TRUE)
- C. =VLOOKUP(3.7, A2:C4, 3, TRUE)
- D. =VLOOKUP(3.8, A2:C4, 3, TRUE)

True - Requires the closest match

12. When entered into cell E3, which formula displays “Cum Laude”?

- A. =INDEX(2.9, MATCH(C:C, A:A, 1), 1)
- B. =INDEX(3.1, MATCH(C:C, A:A, 1), 3)
- C. =INDEX(3.1, MATCH(A:C, A:A, 1), 3)
- D. =INDEX(C:C, MATCH(3.1, A:A, 1), 1)
- E. =INDEX(A:C, MATCH(2.9, A:A, 1), 3)

match type:  
 1 (default): largest value less than or equal to value  
 0: first value that is equal to value.  
 -1: smallest value that is greater than or equal to value

13. What is the result of the formula:

=INDEX(A:E, COUNTIFS(A:E, ">3.7"), MATCH(D:D, "With Honors", 0))

- A. 3
- B. 3.499
- C. 3.5
- D. 3.749
- E. 3.75

=INDEX(A:E, 3, 2)

\*\*\*Index in excel starts from 1, in javascript starts from 0

Now, consider a new sheet, `students`, of students and GPAs within the same file:

	A	B	C	D	E
1	<b>Student</b>	<b>GPA</b>	<b>Honor Qualification</b>		
2	Alice	3.2			
3	Bob	2.7			
4	Charlie	3.74			
<b>Sheet Name: Requirements</b>					

**FR1.** Write a formula that can be placed in `students!c2` that can be copied and pasted down in `c3` and `c4` that displays the Honors Type (Latin) for which the student qualifies if they qualify for one. If the student does not qualify for any honors, the cell should display “Does not qualify”.

Your formula must reference the data on the `Requirements` sheet in order to determine the correct qualifications (as they may change at a later data).

...answer this question on your free response answer sheet as question FR1.

=IF(B2>=Requirements!A\$2, VLOOKUP(B2, Requirements!A:C,3,TRUE),"Does not qualify)

Consider the following spreadsheet of historical weather data in Champaign-Urbana:

	A	B	C	D	E
1	Month	Avg. High	Avg. Low	Precipitation	
2	Nov. 2014	43.9	24.9	2.42	
3	Oct. 2014	63.3	44.0	4.96	
4	Sept. 2014	75.9	53.2	3.44	
5	Aug. 2014	82.5	64.3	1.52	
...					

14. Which formula returns the month with the most precipitation occurring in the dataset?

- A. =VLOOKUP(MAX(D:D), A:D, 1, FALSE)      VLOOKUP does not work for this problem.  
 B. =VLOOKUP(MAX(D:D), A:D, 2, FALSE)      ONLY can search from left to right  
 C. =VLOOKUP(MAX(D:D), A:D, 3, FALSE)  
 D. =VLOOKUP(MAX(D:D), A:D, 4, FALSE)  
 E. None of the above      INDEX(A:A, MATCH(MAX(D:D),D:D,0),1)

15. Which formula returns the total number of months in the dataset?

- A. =COUNT(B:B)      Why count on B column?  
 B. =SUM(B:B)      COUNT() only works for numbers!  
 C. =AVERAGE(B:B)      COUNTA() counts the num. of cells that is not empty  
 D. =TOTAL(B:B)      COUNTA(A:A)=5    COUNT(A:A)=0  
 E. =ISNUMERIC(B:B)      COUNTA(E:E) = 0

Consider the following spreadsheet for the next two questions:

	A	B	C	D	E
1	Day	Weather	Temp.	Play Tennis?	Go Running?
2	Monday	Sunny	High		
3	Tuesday	Windy	High		
4	Wednesday	Raining	Medium		
5	Thursday	Sunny	Low		
6	Friday	Sunny	Medium		

For the next two questions, consider the following answers:

- A. Monday  
 B. Monday and Friday  
 C. Monday and Tuesday  
 D. Thursday and Friday  
 E. Monday, Thursday, and Friday

16. Suppose the formula =IF(B2 = "Sunny", IF(C2<>"Low", "Yes", "No"), "No") is entered into D2 and then the cell is copied and pasted to D3:D6. On what days does Column D report "Yes"?      <>: Not Equal      B. Monday and Friday

If B column is "Sunny" and C column is not "Low" --> "Yes"

17. Suppose the formula =IF(B2 <> "Raining", IF(C2="High", "No", "Yes"), "No") is entered into E2 and then the cell is copied and pasted to E3:E6. On what days does Column E report "Yes"?      D. Thursday and Friday

If B column is not "Raining" and C column is not "High" --> "Yes"

18. What is the result of 1001 XOR 0101?

- A. 0000                       $0 \oplus 0 = 0, 1 \oplus 0 = 1, 0 \oplus 1 = 1, 1 \oplus 1 = 0$
- B. 0100
- C. 1100                      1 0 0 1
- D. 1110                      0 1 0 1
- E. 1111                      -----

Check lecture notes on Mon, Apr. 20 for these two problems.

1 1 0 0

19. In CS 105, an implementation of TLS was described using Diffie-Hellman key exchange by imagining very large numbers (keys) as colors of paint. Which of the following was an assumption that must be true in order for the algorithm to be secure?

- A. The public, shared certificate (“yellow paint”) must be different for each person visiting a website Text
- B. The act of combining two keys (“colors of paint”) to make a new key is irreversible (eg: you cannot subtract paint colors)
- C. The inner-workings of the operation (XOR) that is applied to the message being translated must not be known to the attacker
- D. An attacker must not be able to read the Internet communications made when connecting via TLS; you are only secure if your weren’t spied on when you connect

20. Which of the following best summarizes d3.js?

- A. d3.js helps the computer to execute JavaScript code faster
- B. d3.js provides increased security to web-based applications
- C. d3.js allows the programmer to write complex matrix multiplication
- D. d3.js simplifies drawing visualizations in web-based applications
- E. d3.js adds styling to an HTML document in place of a CSS file

21. What is ASCII code?

- A. A special version of JavaScript that we are using in CS 105
- B. A universally recognized translation between letters and numbers
- C. An encryption technique that makes text hard to read
- D. A programming language used to make Android and iPhone apps
- E. The five primary colors of light used on a computer screen

It is based on the English alphabet, it encodes 128 specified characters into 7-bit binary integers

22. What is the decimal (base 10) value of the following binary number: 1001

- A. 3
- B. 5
- C. 6
- D. 7
- E. 9

Start from unit digit:

$$1 \cdot 2^0 + 0 \cdot 2^1 + 0 \cdot 2^2 + 1 \cdot 2^3 = 1 + 0 + 0 + 8 = 9$$

23. What is the binary (base 2) value of the following decimal number: 5

- A. 001
- B. 010
- C. 100
- D. 101
- E. 110

Consider the following Excel spreadsheet:

	A	B	C	D	E	F
1	<b>Coffee House</b>	<b>Rating 1</b>	<b>Rating 2</b>	<b>Rating 3</b>	<b>Average</b>	<b>Comment</b>
2	ERC: Union	4.9	3.1	1.5		
3	ERC: Library	4.1	4.2	3.1		
4	ERC: Daniel St.	4.0	4.7	3.4		
5	ERC: Goodwin St.	3.7	4.9	3.5		
6	ERC: BIF	3.2	3.7	3.8		
7	Starbucks: Bookstore	2.9	3.9	3.9		
8	Starbucks: Green St.	2.9	4.1	4.1		
9	Bevande (Siebel)	1.7	1.0	4.4		

24. What is the value of the formula: `=INDEX(A2:A9, COUNTIF(A:A, "ERC*"))`
- A. 0
  - B. 5
  - C. 6
  - D. A:A
  - E. ERC: BIF
- Ambiguous matching: Start with "ERC"  
=INDEX(A2:A9, 5, 1)
25. To ensure that you get a correct result, which is the only column that can be used to find the `lookup_value` in `VLOOKUP` when the `range_lookup` is `TRUE`?
- A. Column A
  - B. Column B
  - C. Column C
  - D. Column D
  - E. Column E
- ROUND-OFF  
Need to be sorted!!!
26. Suppose we want calculate an average rating in Column E that includes only the **two lowest ratings** for each coffee house. Which formula, typed into E2 and then copied and pasted into E3:E9, would calculate this average correctly?
- A. `=AVERAGE(B2:D2)`
  - B. `=AVERAGE(MAX(B2:D2), MIN(B2:D2))`
  - C. `=AVERAGE(IF(B2<B2, B2, C2), IF(C2<D2, C2, D2))`
  - D. `=AVERAGE(IF(B2<C2, B2, C2), IF(B2<D2, B2, D2))`
  - E. `=(SUM(B2:D2) - MAX(B2:D2)) / 2`
27. Which formula can be placed in cell F2, and be copied and pasted into F3:F9, displays "Highest Rated" in the cell if and only if the rating calculated in column E is the highest rating among all of the coffee houses listed.
- A. `=MAX(E:E, "Highest Rated")`
  - B. `=IF(E2=MAX(E:E), "Highest Rated", "")`
  - C. `=VLOOKUP(MAX(D:D), D:E, 1, FALSE)`
  - D. `=INDEX(D:D, MATCH(MAX(D:D), D:D, 1), 0)`
  - E. `=IF(VLOOKUP(MAX(D:D), D:E, 1, FALSE)=MAX(D:D), "Highest Rated", "")`



Suppose we now want to visualize data on our spreadsheet using d3.js. A portion of the spreadsheet is re-printed here for convenience:

	A	B	C	D	E	F
1	<b>Coffee House</b>	<b>Rating 1</b>	<b>Rating 2</b>	<b>Rating 3</b>	<b>Average</b>	<b>Comment</b>
2	ERC: Union	4.9	3.1	1.5		
3	ERC: Library	4.1	4.2	3.1		
4	ERC: Daniel St.	4.0	4.7	3.4		
5	ERC: Goodwin St.	3.7	4.9	3.5		

28. Suppose we want to organize a new sheet in a way that allows Excel to export a D2:D5 in a format that can be directly copied and pasted as a JavaScript array. When we copy D2:D5 and paste it onto a new sheet, what special operation is needed when the data is pasted?

- A. Add Operation
- B. Subtract Operation
- C. Transpose
- D. Values Only
- E. Formulas Only

29. Based on the previous question, what file format must be used when exporting the data from Excel?

- A. CSV
- B. JSON
- C. TSV
- D. XLSX
- E. XML

Consider the following function:

```

1 function x(data)
2 {
3   var value = data[0]; First value in data
4   for (var i = 0; i < data.length; i++)
5     {
6       if (data[i] > value)
7         {
8           value = data[i];
9         }
10    }
11
12    return value;
13 }

```

[0,2,4,1,2,...]

FR2. (10pts) If the input parameter to the function x() is an array of numbers, as would be exported by the process described in the previous two questions, what does this function return?

Your answer should either be:

- (a): The name of the Excel function that this function replicates **OR** MAX()
- (b): A two or three word description of the return value of the function

...answer this question on your free response answer sheet as question FR2.

After completing the operations on the previous page, our data is now inside of a data variable within JavaScript:

```
1 var scores = [1.5, 3.1, 3.4, 3.5];
```

Suppose we use d3.js to begin to process the data with the following code:

```
3 // Create the SVG element
4 var svg = d3.select("body")
5     .append("svg")
6     .attr("width", 5)
7     .attr("height", 5);
8
9 // Draw on the SVG
10 svg.selectAll("rect")
11     .data(scores)      Enter data
12     .enter()
13     .append("rect")
14     .attr("x", function(d, i) { return 0; } )
15     .attr("y", function(d, i) { return i; } )
16     .attr("width", function (d, i) { return d; } )
17     .attr("height", function (d, i) { return 1; } )
18     .attr("fill", "black");
```

30. Given that the two code segments shown above are in the same file, how many times does each attribute in Lines 14-18 get executed?
- A. 0 times
  - B. 1 time
  - C. 2 times
  - D. 3 times
  - E. 4 times

Depends on how many number in the array

On your free response sheet, you have a grid marked as **FR (d3)** where each box is a pixel. As an example, we have drawn a rectangle at pixel (1,1) with a width of 1 and a height of 1 on the grid to the right (→).

Using the code and data shown above, draw the result of the d3 code in the grid.

Sample Grid	x:	0	1	2	3	4	5
	y						
0							
1							
2							
3							
4							

**FR (d3).** Draw your answer to the above problem on the free response sheet. **Your answer (10pts) must appear on the free response sheet,** what is drawn here will **NOT** be graded. *...answer this question on your free response answer sheet as question FR (d3).*

In various athletics events that contain a subjective assessment of performance (such as diving, gymnastics, and others), a multi-judge panel is used and the lowest and highest scores are dropped. For example, consider an event where five judges judged a performance:

	A	B	C	D	E	F	G	H	I	J	K
1		<b>Judges</b>							<b>Adj.</b>		<b>Final</b>
2	<b>Performer</b>	<b>#1</b>	<b>#2</b>	<b>#3</b>	<b>#4</b>	<b>#5</b>	<b>High</b>	<b>Low</b>	<b>Average</b>	<b>DD</b>	<b>Score</b>
3	Alice	8.4	8.2	8.5	8.1	8.3				4.5	
4	Bob	7.9	8.4	6.1	8.1	9.2				4.0	
5	Charlie	6.2	6.4	6.3	6.9	6.8				5.5	
6	Eve	6.6	7.9	5.4	6.8	7.3				5.0	

31. Which formula can be used to in G3 to calculate the **highest** judge score for the performer?

- A. =SUM(B3:F3)
- B. =COUNT(B3:F3)
- C. =AVERAGE(B3:F3)
- D. =MAX(B3:F3)
- E. =MIN(B3:F3)

32. Which formula can be used to in H3 to calculate the **lowest** judge score for the performer?

- A. =SUM(B3:F3)
- B. =COUNT(B3:F3)
- C. =AVERAGE(B3:F3)
- D. =MAX(B3:F3)
- E. =MIN(B3:F3)

33. Which formula can be used in I3 to calculate the “Adjusted Average”, the average of all scores after the highest and lowest scores are dropped?

- A. =AVERAGE(B3:F3)
- B. =AVERAGE(B3:F3) - G3 - H3
- C. =AVERAGE(B3:F3) - (G3 + H3) / 2
- D. =AVERAGE(B3:H3) - AVERAGE(G3 + H3)
- E. =(SUM(B3:F3) - SUM(G3 + H3)) / 3

34. The “Final Score” (Column K) is calculated by taking the “Adjusted Average” and multiplying that score by the Degree of Difficulty (DD, shown in Column J). Which formula(s) can be used in K3, and can be copied and pasted into K4:K6, to calculate the “Final Score”?

- A. =I3 \* J3
- B. =\$I3 \* \$J3
- C. =\$I\$3 \* \$J\$3
- D. (A) and (B) are both correct
- E. (A), (B), and (C) are all correct

35. With the setup of the spreadsheet above, is it possible to use VLOOKUP to find the name of the performer with the highest final score?

- A. Yes, VLOOKUP can be used
- B. No, it is not possible to use VLOOKUP

Suppose you design your own turn-based card game similar to many popular card games (Pokémon, Hearthstone, and others). In this game, each card has a name that identifies the card and two attributes:

- Attack Power, the amount of damage the card does when used
- Health, the initial amount of health of the card

As an example, consider several cards:

<b>Bloodfen Raptor</b>	<b>Chillwind Yeti</b>	<b>Boulderfist Ogre</b>
3 Attack   2 Health	4 Attack   5 Health	6 Attack   7 Health

Each card can be represented as a JavaScript object. For example, the JavaScript objects for the cards shown above are each defined in their own variable:

```
1 var yeti = { name: "Chillwind Yeti", attack: 4, health: 5 };
2 var raptor = { name: "Bloodfen Raptor", attack: 3, health: 2 };
3 var ogre = { name: "Boulderfist Ogre", attack: 6, health: 7 };
```

36. Suppose you wrote the following line of code:

```
var deck = [ yeti, raptor, ogre ];
```

What type of variable is `deck`?

- A. An array of strings
- B. An array of arrays
- C. An array of objects
- D. A string of arrays
- E. An object of arrays

37. Consider the following function:

```
function f(deck)
{
  var card = deck[0];
  for (var i = 0; i < deck.length; i++)
  {
    if (deck[i].health > card.health)
      card = deck[i];
  }
  return card.health;
}
```

If the `deck` variable from the previous question was passed into this function as `deck`, what is the return value of this function?

- A. 0
- B. 1
- C. 3
- D. 5
- E. 7

Continuing with the card game from the previous page, suppose our game has only one interaction: two cards may attack each other. When this occurs, we define one card as the **attacker** and the other as the **defender**. The rules are:

- The attacker subtracts from its health the attack value of the defender **AND**
- The defender subtracts from its health the attack value of the attacker.

Simply stated, both the attacker and defender lose health equal to the attack value of the other card involved. As an example, if a Boulderfest Ogre (6 attack, 7 health) attacks a Chillwind Yeti (4 attack, 5 health):

- The Ogre loses 4 health (attack value of the Yeti), bringing the health of the Ogre down from 7 health to 3 remaining health.
- The Yeti loses 6 health (attack value of the Ogre), bringing the health of the Yeti down from 5 health to -1.

When the health of a card is **at or below zero**, we consider that card to be **destroyed**. In the previous example, the Yeti is destroyed since its health ended at -1.

38. If the cards involved in the attack are stored in the variables `attacker` and `defender`, which conditional will be true when **both** the attacker **and** the defender are **not** destroyed?

- A. `if (attacker.health > defender.attack || defender.health > attacker.attack)`
- B. `if (attacker.health >= defender.attack || defender.health >= attacker.attack)`
- C. `if (attacker.health == defender.attack || defender.health == attacker.attack)`
- D. `if (attacker.health > defender.attack && defender.health > attacker.attack)`
- E. `if (attacker.health >= defender.attack && defender.health >= attacker.attack)`

39. Which line of JavaScript correctly updates the health of the `attacker` after the attack?

- A. `attacker.health = attacker.health - defender.attack;`
- B. `attacker.health = defender.attack - attacker.health;`
- C. `attacker.health = attacker.health - attacker.attack;`
- D. `attacker.health = attacker.attack - attacker.health;`

40. After the health is updated (from the code in the previous question), which line of JavaScript checks if the `attacker` has been destroyed?

- A. `if (attacker.health > 0)`
- B. `if (attacker.health >= 0)`
- C. `if (attacker.health == 0)`
- D. `if (attacker.health <= 0)`
- E. `if (attacker.health < 0)`

41. Suppose we replace `attacker` with `defender` and `defender` with `attacker` in the previous two questions. Would making **only this change** correctly update the defender after the attack?

- A. Yes
- B. No

One recent trend in social networking is location-aware or location-based social networking. In these apps, a post can only be made and/or seen if the user is within a certain distance from a set point. For example, in order to post as part of the University of Illinois, you must be within 10 miles of the University of Illinois within a location-aware app.

In order to check the distance, we have a `findDistance()` function has already been defined for you. This function takes in two JavaScript objects that define a location and returns the approximate distance between the two locations in miles:

```

1 function findDistance( location1, location2 )
2 {
3     /* Find the distance in the x-direction */
4     var dx = location2.x - location1.x;
5
6     /* Find the distance in the y-direction */
7     var dy = location2.y - location1.y;
8
9     /* Use the Pythagorean Theorem to find the distance */
10    Line 10
11
12    /* Each latitude/longitude degree is about 65 miles */
13    return (dist * 65);
14 }

```

42. In mathematics, the Pythagorean Theorem,  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{x^2 + y^2}$ , tells us the distance between two points in 2D-space. If `Math.sqrt()` is a JavaScript function to find the square root of an input parameter, what line of code should be placed in Line 10 to find the distance between the two locations passed into the function `findDistance()` above?

- A. `var dist = Math.sqrt( location1 + location2 );`
- B. `var dist = Math.sqrt( location1.x + location2.y );`
- C. `var dist = Math.sqrt( (location1.x)^2 + (location2.y)^2 );`
- D. `var dist = Math.sqrt( dx + dy );`
- E. `var dist = Math.sqrt( (dx * dx) + (dy * dy) );`

43. Given the location of The University of Illinois is at 40.1105° N, 88.2284° W, which of the following lines of code correctly defines a JavaScript object that can be passed into `findDistance()` as one of its two input parameters?

- A. `var location = 40.1105, -88.2284;`
- B. `var location = [40.1105, -88.2284];`
- C. `var location = [x: 40.1105, y: -88.2284];`
- D. `var location = <x>40.1105</x><y>-88.2284</y>;`
- E. `var location = { x: 40.1105, y: -88.2284 };`

JavaScript object is in brace

44. Suppose we have a program where we are searching through data in an array millions of times. If we want our program to run as fast as possible while getting the correct result, how should we search our data?

- A. Set up our data in any order and use a linear search
- B. Set up our data in any order and use a binary search
- C. Set up our data in any order and use a selection search
- D. Set up our data in sorted order and use a linear search
- E. Set up our data in sorted order and use a binary search

Binary Search --> Sorted!!!!

Consider the following representation of a hand of standard playing cards:

```
1 var hand = [
2   { suit: "Diamond", rank: "K" }
3   { suit: "Club", rank: "10" }
4 ];
```

45. What type of variable is `hand`?

- A. A string
- B. A number
- C. A function
- D. An array
- E. An object

46. Consider the following code snippet:

```
var s = "";
for (var i = 0; i < hand.length; i++)
{
  s += hand[i].rank;
}
```

What is the value of `s` after the code has completed?

- A. "", (An empty string)
- B. "K10"
- C. "10K"
- D. "DiamondClub"
- E. "ClubDiamond"

47. Consider the following code snippet that calculates the score of a hand based on the rank of a card. If the card's rank is a "K", "Q", or "J", it is scored as 10; if the card's rank is "A", it is scored as 1; otherwise, the card is scored the value of its rank.

```
var score = 0;
for (var i = 0; i < hand.length; i++)
{
  var c = hand[i].rank[0];
  if (c == "J" || c == "Q" || c == "K") { score += 10; }
  else if (c == "A") { score += 1; }
  else { score += parseInt(c); }
}
```

Which of the following is true for a standard deck of playing cards?

- A. The score is **always** calculated correctly for hands of **at least one card**
- B. The score is **sometimes** calculated correctly for certain hands of **at least one card**
- C. The score is **never** calculated correctly for any hand with **at least one card**
- D. The score is **sometimes** calculated correctly for hands with **zero cards**
- E. The score is **never** calculated correctly for hands with **zero cards**

When `rank = 10`, `rank[0] = 1`

For the next three questions, consider the sales of iPhones by Apple. The data for each quarter of sales is reported to you in a table to the right (→), and also represented as an array:

```
var sales = [ 0.27, 1.12, 2.32, 1.70, 0.72, 6.89,
             4.36, 3.79, 5.21, 7.37, 8.74, 8.75,
             8.40, 14.10, 16.24, 18.65, 20.34, 17.07,
             37.04, 35.06, 26.03, 26.91, 47.79, 37.43,
             31.24, 33.80, 51.03, 43.72 ];
```

Quarter & Year	iPhone Sales (m)
Q3 '07	0.27
Q4 '07	1.12
Q1 '08	2.32
Q2 '08	1.70
Q3 '08	0.72
Q4 '08	6.89
Q1 '09	4.36
Q2 '09	3.79
Q3 '09	5.21
Q4 '09	7.37
Q1 '10	8.74
Q2 '10	8.75
Q3 '10	8.40
Q4 '10	14.10
Q1 '11	16.24
Q2 '11	18.65
Q3 '11	20.34
Q4 '11	17.07
Q1 '12	37.04
Q2 '12	35.06
Q3 '12	26.03
Q4 '12	26.91
Q1 '13	47.79
Q2 '13	37.43
Q3 '13	31.24
Q4 '13	33.80
Q1 '14	51.03
Q2 '14	43.72

48. Which of the following lines of JavaScript correctly accesses the total number of iPhone sales during the second quarter of 2008 (“Q2 ‘08”)?
- A. `sales[0]`
  - B. `sales[1]`
  - C. `sales[2]`
  - D. `sales[3]`
  - E. `sales[4]`

49. Which line of JavaScript correctly accesses the total number of data entries (quarters of years) available as part of our data?
- A. `sales.totalQuarters()`
  - B. `total(sales)`
  - C. `sizeof(sales)`
  - D. `sales.size`
  - E. `sales.length`

50. If we wanted to search the array `sales` for a specific sales number, which search options are available to us?
- A. Only binary search would get the correct result
  - B. Only linear search would get the correct result
  - C. Both binary search and linear search would get the correct result

**FR-JS.** (20pts) Assuming that the data **always** starts at Q3 '07, write a JavaScript function that returns the quarter and the year for the period with the largest number of iPhone sales within the array `sales`.

In writing this answer, you should not simply provide 20+ if-statements. (This would be marked as incorrect.) Additionally, your answer must use the `sales` array specified as part of this problem.

...answer this question on your free response answer sheet as question FR-JS.



*This page was intentionally left blank.*

