Full Stack Development with AI

Lab 5.5 – Summary Exercises on JavaScript Programming Methodology

Lab Overview

In this lab, you will combine all the JavaScript language constructs and programming techniques that you have learnt thus far to solve intermediate to advanced programming problems.

Exercise 1 – Perfect Square

Write a JavaScript that asks user to input a positive integer from 1 to 100. Thereafter, the JavaScript should print out whether the integer is a perfect square. A perfect square is the square of an integer.

Do not use the `Math.sqrt()` and `Number.isInteget()` methods.

Sample Input	Sample Output
14	Not a perfect square
36	Perfect square
81	Perfect square

Exercise 2 – Infinite Perfect Square

Write a JavaScript that extends the problem in Exercise 1 to any positive integer, i.e., including integers that are greater than 100.

Do not use the `Math.sqrt()` and `Number.isInteget()` methods.

Sample Input	Sample Output
200	Not a perfect square
576	Perfect square
4761	Perfect square

Exercise 3 – Find the First Digit

Write a JavaScript to print out the first digit, i.e., the leftmost digit, of any positive integer input by the user. You may assume that the input integer has at most 8 digits although this constraint is not essential. The input must be treated as a number.

Sample Input	Sample Output
1	1
5	5
17	1
258	2
45644478	4

Exercise 4 – Find Any Digit

Write a JavaScript to print out the n^{th} digit, starting from the left, of any positive integer input by the user. You may assume that the input integer has at most 8 digits although this constraint is not essential. The input must be treated as a number.

Sample Input	Sample Output
2345, 0	Error: Digit position must be greater than 0
2345, 1	2
2345, 2	3
2345, 3	4
2345, 4	5
2345, 5	Error: Digit position is more than the number of digits.

Exercise 5 – Guess the Computer's Age

Write a JavaScript that generates a random positive integer between 1 and 100 that represents the computer's age.

The JavaScript should then ask user to guess the computer's age. If the user guesses the correct age, print out a congratulatory message. Otherwise, print out a message to tell the user whether the guess is too small or too big. The JavaScript should also keep track of the number of attempts that the user has taken to guess the correct age. This information should be printed out as part of the congratulatory message after a correct guess has been made.

You may assume that the random positive integer may be generated by calling some system specific code. In our context, calling the `Math.random()` function will return a random number between 0 (inclusive) and 1 (exclusive).

The JavaScript should continue to generate a new random positive integer after the user has correctly guessed the current age until the user chooses to exit.

```
Enter your guess = 50
Your guess is too small
Enter your guess = 75
Your guess is too big
Enter your guess = 60
Your guess is too big
Enter your guess = 55
You have guessed 55 correctly in 4 attempts
Do you want to continue playing the game? (Y to continue) =
```

Exercise 6 – Simple Integer Sorting

Write a JavaScript that asks the user to enter any number of integers. Thereafter, the JavaScript should arrange or sort the integers in ascending order, that is smallest integer first and the largest integer last, before printing out the sorted integers. You are not allowed to use the `Array.sort()` function.

Sample Input	Sample Output
5, 4, 3, 2, 1	1, 2, 3, 4, 5
4, -2, 8, -4, 1	-4, -2, 1, 4, 8
-1, -2, -3, -4, -5	-5, -4, -3, -2, -1

```
Enter an integer (invalid integer to stop) = 5
Enter an integer (invalid integer to stop) = 4
Enter an integer (invalid integer to stop) = 3
Enter an integer (invalid integer to stop) = 2
Enter an integer (invalid integer to stop) = 1
Enter an integer (invalid integer to stop) = a
Sorted numbers = 1,2,3,4,5
```

Exercise 7 – Palindrome Checking

A palindrome is a word that can be read the same way in either direction (such as “Madam” and “Level”) without regard to the capitalisation of the alphabets.

Write a JavaScript that asks the user to input a word of any length.

The JavaScript should then check whether the input word is a palindrome and print out a message accordingly to inform the user.

You are not allowed to use any JavaScript String functions.

Sample Input	Sample Output
Madam	It’s a palindrome
Elephant	Not a palindrome
Tattarrattat	It’s a palindrome (the longest palindrome in the Oxford English Dictionary, coined by James Joyce in Ulysses for a knock on the door)

Exercise 8 – Collatz Conjecture

The Collatz Conjecture asks whether repeating two simple arithmetic operations will eventually transform every positive integer into one. It concerns sequences of integers in which each term is obtained from the previous term as follows:

- If the previous term is even, the next term is one half of the previous term.
- If the previous term is odd, the next term is 3 times the previous term plus 1.

The conjecture is that these sequences always reach 1, no matter which positive integer is chosen to start the sequence. Thus, this conjecture is also commonly known as the $3n + 1$ problem or sequence.

Write a program that prompts user to input a positive integer and then print out its $3n + 1$ sequence using a `while` statement.

Sample Input	Sample Output
3	3, 10, 5, 16, 8, 4, 2, 1
19	19, 58, 29, 88, 44, 22, 11, 34, 17, 52, 26, 13, 40, 20, 10, 5, 16, 8, 4, 2, 1
21	21, 64, 32, 16, 8, 4, 2, 1
16	16, 8, 4, 2, 1

Exercise 9 – Mean Calculator

Write a program that asks the user to input an `array` of positive numbers (including floating point numbers), as many as required, one at a time. Thereafter, the program should calculate the three mean numbers of the dataset.

The formulas of the three mean numbers are provided below:

- Arithmetic mean: $A = \frac{x_1 + \cdots + x_n}{n}$
- Geometric mean: $G = \sqrt[n]{x_1 \cdot \ldots \cdot x_n}$
- Harmonic mean: $H = \frac{n}{\frac{1}{x_1} + \cdots + \frac{1}{x_n}}$

Round the output results to at most 3 fractional digits.

You are encouraged to apply procedural programming using JavaScript functions.

Sample Input	Sample Output
1, 2, 3, 4, 5, 6, 7, 8, 9, 10	5.500, 4.529, 3.414
15, 55, 9, 63, 80, 100, 45, 63, 26, 75	53.100, 42.813, 30.843
3.142, 55.5, 80, 90, 10, 65.6, 75.5, 45.5, 30, 25.5	48.074, 34.161, 17.155

```
Enter an integer number: 3.142
Enter an integer number: 55.5
Enter an integer number: 80
Enter an integer number: 90
Enter an integer number: 10
Enter an integer number: 65.6
Enter an integer number: 75.5
Enter an integer number: 45.5
Enter an integer number: 30
Enter an integer number: 25.5
Enter an integer number: f
Invalid integer number
[
  3.142, 55.5,   80,
     90,   10, 65.6,
   75.5, 45.5,   30,
   25.5
]
Arithmetic mean is 48.074
Geometric mean is 34.161
Harmonic mean is 17.155
```

-- End of Lab --