Educational program in Data Analytics

MDA103 – Script Languages

✍ 4th Set of Problems – MDA103

✎ material of 4TH WEEK

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This set of exercises is based on the Sections 2.1-2.2 of the file "Chapter 2.ipynb" in CoCalc.

Exercises

Problem 1. (6 points)

1. Suppose that `sol` is a list or an array in SageMath. Given the following code snippet, explain what it does. Please provide a detailed, step-by-step explanation of the performed operations.

```
for i in range(len(sol)):
    show(f"Solution {i+1}:")
    show(sol[i])
```

2. Consider the following system of nonlinear equations involving two variables x, y:

$$\left\{x^2 + y^2 = 1, \quad x^3 - y = 0\right\} .$$

Use Sage to solve the system of equations symbolically. For the readability of the output use a `for` loop (as above), and a proper formatting for each solution. In particular, your output should resemble the following format:

```
Solution 1:
x = value, y = value
Solution 2:
x = value, y = value
-----
```

3. Repeat for the following system of equations, where a is a parameter:

$$\left\{ ax + y = 2, \quad x^2 + y^2 = 4 \right\} .$$

Problem 2. (**6 points**)

1. Suppose that `solutions` is a list in SageMath. Given the following code snippet, explain what it does. Please provide a detailed, step-by-step explanation of the performed operations.

```
for i, root in enumerate(solutions):
    print(f"Solution {i + 1}: x = {root}")
```

2. Solve the equation $P(x) = 0$ where $P(x) = x^4 - 5x^2 + 4$, using the `roots` command in SageMath. Note that Sage should present the solutions in the following specified format (use a `for` loop based on the `enumerate` function, as in the first part of Problem 2).

```
Solution 1:
x=value
Solution 2:
x=value
-----
```

Problem 3. (**3 points**)

1. Use the `plot` command in Sage to sketch the graph of the function $f(x) = x^3 - 4x^2 + 5\sin(x) - 7$, for $x \in [-2, 6]$. In the figure add the title "Plot of $f(x) = x^3 - 4x^2 + 5\sin(x) - 7$".

2. Use the `plot3d` command in Sage to sketch the graph of the function $h(x, y) = \sin\left(\sqrt{x^2 + y^2}\right)$, with $-5 \le x \le 5$ and $-5 \le y \le 5$.