Introduction to Mathematical Software Exercise 2

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Problem 1 `plot` and `plot3d`

a) Let

$$f(x) = \sin(\pi \cdot x^3), \qquad g(x) = e^{-x^2}.$$

Plot $f(x)$ and $g(x)$ with $x \in [-2,2]$. Get familiar with the `plots`-package. Try to plot f and g into one picture.

b) Plot $h(x) = x^2$ and its derivative from $x = 0$ to ∞. Enjoy the result!

c) How can you plot the function MonkeySaddle$(x,y) = x^3 - 3 \cdot x \cdot y^2$, $x \in [-2,2]$, $y \in [-2,2]$? Take a look into Maple's help in order to find out more about plotting.

Problem 2 Lists and Sets in Maple

a) Explain the difference between lists and sets in Maple.

b) Use Maple to find the common divisors of 23545800, 25491186 and 229420674. *Hint:* How can the package `numtheory` help you?

c) Solve the equation

$$x^4 - 4 \cdot x^3 \cdot \pi + \frac{26}{9} \cdot x^2 \cdot \pi^2 + \frac{4}{9} \cdot x \cdot \pi^3 - \frac{1}{3} \cdot \pi^4 = 0$$

and then let Maple evaluate the function `sin` for all solutions by using

i) `map`,

ii) the element-wise operator $\sim$ (only if you are using Maple 14, as this is not implemented in Maple 11).

Hint: Remember using lists.

Problem 3 Solving Systems of Linear Equations

Try to solve the following systems of linear equations. What is happening?

$$\begin{aligned} 2 \cdot x + 8 \cdot y + 4 \cdot z &= 7 \\ 6 \cdot x + 2 \cdot y + 4 \cdot z &= 9 \\ x + z &= 8 \end{aligned} \qquad \begin{aligned} 2 \cdot x + 8 \cdot y + 4 \cdot z &= 7 \\ 6 \cdot x + 2 \cdot y + 4 \cdot z &= 9 \end{aligned}$$

$$\begin{aligned} 2 \cdot x + 8 \cdot y + 4 \cdot z &= 7 \\ 6 \cdot x + 2 \cdot y + 4 \cdot z &= 9 \\ 3 \cdot x + 8 \cdot y + 5 \cdot z &= 15 \\ x + z &= 8 \end{aligned} \qquad \begin{aligned} 2 \cdot x + 8 \cdot y + 4 \cdot z &= 7 \\ 6 \cdot x + 2 \cdot y + 4 \cdot z &= 9 \\ 3 \cdot x + 8 \cdot y + 5 \cdot z &= 9 \\ x + z &= 8 \end{aligned}$$

Hint: You do not need any matrices here. Just have a look at the `solve`-command.

Problem 4 Curve Sketching

Let

$$f(x) = \frac{x^2 + 5 \cdot x - 12}{2 \cdot x^2 - 12 \cdot x + 16}.$$

a) Plot $f(x)$ for $x \in [-10, 10]$. Use the same Interval as range of your plot. Have a look at help topic `plot/options` in order to find out how to do that. Also try to find out how to avoid ugly discontinuities in your plot.

b) Find the domain [Definitionsbereich] of f.

c) Find the zeros [Nullstellen] of f.

d) Find local minima and maxima of f.

e) Find inflection points [Wendepunkte] of f.

f) Calculate the area under the graph between the first two zeros (there should be at least two zeros).

Don't Drink and Derive – Episode 1

Two math professors are sitting in a pub.
"Isn't it disgusting", the first one complains, "how little the general public knows about mathematics?"
"Well", his colleague replies, "you're perhaps a bit too pessimistic."
"I don't think so", the first one replies. "And anyhow, I have to go to the washroom now."
He goes off, and the other professor decides to use this opportunity to play a prank on his colleague. He makes a sign to the pretty, blonde waitress to come over.
"When my friend comes back, I'll wave you over to our table, and I'll ask you a question. I would like you to answer: x to the third over three. Can you do that?"
"Sure." The girl giggles and repeats several times: "x to the third over three, x to the third over three, x to the third over three..."
When the first professor comes back from the washroom, his colleague says: "I still think, you're way too pessimistic. I'm sure the waitress knows a lot more about mathematics than you imagine."
He makes her come over and asks her: "Can you tell us what the integral of x squared is?"
She replies: "x to the third over three."
The other professor's mouth drops wide open, and his colleague grins smugly when the waitress adds: "...plus C."