1S3 Mathematica Exercises

[To be done during computer tutorials]

Generate a Mathematica notebook with the solutions to the following three sets of problems and save them as `exa.nb`, `exb.nb` and `exc.nb`. Save your work using "Save As ..." under "File" in the Mathematica menu. See section 2.14 of the notes.

Send in your work electronically by using the program `submit-work` to send in the files `exa.nb`, `exb.nb` and `exc.nb`. Submit the first under `1S3:a`, the second under `1S3:b` and the third under `1S3:c`.

When you run the `submit-work` programme the first time (which you do by typing that followed by return into a terminal window), it will ask for your name and ID and finally the name of the file you want to submit (which should be `exa.nb`).

You should **not** give the full path to the file, only the file name and you should be in the directory containing the file when you run `submit-work`.

If you run `submit-work` again before the above deadline, you can see your previous submissions and send an updated one if you like.

This work will be graded and will count (along with the tutorial sheets and other computer lab work) for part of the final mark for 1S3.

1 Assignment A (first week)

1. Factor your student ID number with the digits reversed as a product of primes.

   [For most of you it begins with 06, say 06123456 and so the idea is to factor 65432160. Use the `FactorInteger[ ]` command.]

2. Then multiply the primes together to see that you get the number.

3. Get Mathematica to factor $3x^2 + 2x - 1$.

4. Get Mathematica to find the solutions of the equation $2x^3 - 6x^2 - x + 6 = 0$ in two ways. First get an exact formula for the solutions (no decimals) and then get the solutions as decimals (approximate values).

5. Plot $y = \sinh x$ for x in the range $-5 \leq x \leq 5$.

Save all this work as `exa.nb`. Exit out of Mathematica. You should see your file when you run the **ls** command in a command window (xterm or konsole, for example). Use the `submit-work` program from a command window.

2 Assignment B (second week)

1. Make a parametric plot of the curve

$$\begin{aligned} x &= 3\cos t \\ y &= 3\sin t \qquad (0 \leq t \leq 7\pi/4) \end{aligned}$$

Are you happy with the result? [Ask yourself what is $x^2 + y^2$ when (x, y) is a point on this curve. Then maybe you can say what the curve should be part of? And does it look right? Have a look at how to control AspectRatio in section 1.9.3 of the online Help.]

2. Define a quantity v to be $x^2 + 1$ and calculate v^{15}. Get Mathematica to expand out the answer.

3. Define a new function $f(x) = a_3x^7 + a_4x^6 + a_5x^5$ where a_3 is the third digit of your student ID number (counting from the left), a_4 is the fourth digit and a_5 is the fifth digit.

   Check that your function is working right by finding first $f(t)$ and then $f(1.2)$. [If you did not do it right, then $f(t)$ will not turn out as $a_3t^7 + a_4t^6 + a_5t^5$ and $f(1.2)$ won't be a number.]

4. Plot the graph of the function $f(x)$ defined above for $-3 \leq x \leq 3$.

5. Find the derivative of the same function $f(x)$.

6. Use the `Integrate[ ]` command of Mathematica to find an antiderivative for $f(x)$ (meaning a function the derivative of which turns out to be your $f(x)$).

Save this work as `exb.nb` and use `submit-work` to submit it under `1S3:b`.

3 Assignment C (third week)

1. Use the `Sum[ ]` command to calculate $\sum_{n=1}^{10} n^4$.

2. Calculate $\sum_{n=1}^{10} \cos n$ as a decimal.

3. Use the command `DSolve[ ]` (for solving diferential equations) to find the function $y = y(x)$ that solves $\frac{dy}{dx} + (x^3 + x)y = x^8 + x^6 + 5x^4$.

   (You have to specify the **equation**, the unknown function and the independent variable.)

4. Plot $y = \sin x$ together with its tangent line at $x = \pi/4$ on the same graph.

5. Make a shaded plot of the region between the curves $y = \cos x$ and $y = x^2 - 2$. [Look in the Help for how to use `FilledPlot[ ]`. You need to load something to make it work. Look at the examples.]

Save this work as `exc.nb` and use `submit-work` to submit it under `1S3:c`.

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