Computer Algebra with Maple – assignment

Instructions

- This assignment should be completed out-of-class (not in-class).

- Please *email* me well before the deadline if you encounter any problems.

- Action will be taken if your file is exactly the same as any other student.

- Hint: if you don't know how to do part of a question, try to do the other parts.

- Please indicate **clearly** to which question your answer corresponds (up to 5 marks may be subtracted otherwise).

- Do everything within a single Maple document file (which has extension `.mw`) and submit the resulting file to blackboard.

Questions

1. (a) [10 marks] Determine the following integral. One may need to use a numerical approximation.
$$\int_0^{\pi/4} \exp(x^3)\sin(x^4)\mathrm{d}x$$

   (b) [10 marks] Using Maple, compute the 5th order Taylor series around $x = 0$ for
$$\tanh(\sin(x))$$
   and plot the accompanying polynomial.

   (c) [15 marks]   i. Using Maple, calculate the following sum
$$\sum_{n=1}^{N}\sum_{m=1}^{M}\frac{(-2)^n}{x^{n+m}}$$
   ii. What is the sum for $x = 3$, $N = 20$ and $M = 43$?

   (d) [15 marks] Let
$$A = \begin{bmatrix} 3 & 0 \\ 2 & -1 \end{bmatrix}$$
   and
$$B = \begin{bmatrix} 1-i & -i \\ -2 & x2 \end{bmatrix}$$
   Using Maple, calculate $A + B$ and $(AB - BA)^2$. For which value of x is the latter equal to the zero matrix?

2. [30 marks] Consider the following polynomial

$$f(x) = 3x^4 - 4x^3 - 2x^2 + x + \frac{1}{6}$$

Using MAPLE, define the function $f(x)$, plot the polynomial for $x \in [-1, 2]$, determine its (real) zeros (numerically), and determine its (analytical) derivative. Also plot in the same graph for $f(x)$ the points $(x, f(x))$ for which the function obtains local minima and maxima, as large red dots.

3. [20 marks] The Fibonacci numbers can be defined as:

$$F_n = F_{n-1} + F_{n-2}$$

with $F_0 = 0$ and $F_1 = 1$. Alternatively, an explicit expression is

$$F_n = \frac{a^n - (-a)^{-n}}{\sqrt{5}}$$

with $a = \frac{1+\sqrt{5}}{2}$. Plot the points $(x_n, y_n) = (n, F_n)$ for the first 50 Fibonacci numbers.

If you don't submit the MAPLE document file with extension .mw file grading can not be carried out.