MACM 202 Assignment 4, Spring 2000

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This assignment is worth 10% of your grade. It is due Monday March 8th at 10:30am. A late penalty of 20% will apply for each day late. Do (question 1 or question 2) and the other questions. For the exercises in the text use Maple where appropriate.

Question 1 (30 marks)

Write a Maple program to construct a picture of the Mandelbrot set shown on 136. If you do as suggested in project 3 on page 144, you will compute whether z_0 escapes for say a 500 by 500 grid of complex numbers for c. This will, of course, take quite a long time. To speed it up you may want to try a different algorithm rather than this "try all values for c" approach.

Question 2 (30 marks)

Write a Maple program to draw the paper folding fractal starting at the origin $[0, 0]$ with first vector $[1, 0]$. Once you get it right, rotate it by 90, 180 and 270 degrees and draw all four fractals in a different color on the same plot. See the `plots[display]` command.

Question 3 (10 marks)

Consider a list of values $L = [x_1, ..., x_n]$ where $n > 0$. Write a *recursive* Maple procedure called **search** such that **search**(L, x) outputs true if $x \in L$ and false otherwise. If $n > 1$ your procedure is to split L into two sublists L_1 and L_2 of approximately the same length and search L_1 and then L_2 for x recursively. Note, if you find x in L_1 you should not search L_2. Read the Maple help page for ?or and what it says about "McCarthy evaluation rules". Run your program on

```
> L := [1,4,2,3,9,8,1,6,7];
> search( 3, L );
> search( 5, L );
```

To watch the program execute, do `trace(search);` The purpose of this exercise is to practice writing a recursive algorithm.

Questions From the Text (60 marks)

Do exercises 3.3, 4.2, 4.4, 4.9, 4.14, and 4.18 from the text.

For question 4.2 use the **fit** command to find the linear function and then the exponential function that fit the data in the least-squares sense. Then plot the data and both functions that you obtain on the same graph in Maple, and, by eye, state which is the best fit. Note, to fit an exponential function of the form $x = ce^{kt}$, to some (t_i, x_i) data first note that $\log x = \log c + kt$, hence, if you fit a straight line to $(t_i, \log x_i)$ data, you will obtain $\log c$ and k from which you can recover c. A worked example of this is shown in the fit.mws worksheet.

For question 4.9, there are three unknowns to determine, a, b and γ. The book is suggesting that you use (i) N(0), (ii) N(∞), and (iii) N($t_{1/2}$) which you may read off from the plot, i.e., you are not being asked to do a least-squares fit to the data.

For question 4.18 generate also plots which illustrate the qualitative behaviour for $m = 1$ and $m = 2$.