CZ3106 Symbolic Computing, Lab 1

Dr. Wang Jian-Sheng — For the week 13-18 Jan 03, due one week after the lab

1. Try to familiarize with the notebook interface. Read the first few sections of the Mathematica Book. Use the help system to find out the command `N[ ]`. Type some text (as document) and enter a command. Change the font/color of the text. Change the stylesheet. Try cut and paste, etc. You need not hand-in anything for this problem.

2. We want to be familiar ourselves to arithmetics in Mathematica. We can use it as a pocket calculator. Consider entering the following mathematical expressions to the system and watch the reaction of the system:

$$\begin{array}{lll} 1+2, & 2-3\times 5-1/2, & 2/3-0.5, \\ \sqrt{4}, & i^2, & 2^{10}. \end{array}$$

3. All symbolic systems can handle arbitrarily large integers without overflow. Try the following:

$$2^{100}, \qquad 30!, \qquad 123456789 * 987654321.$$

4. Mathematica can do arbitrarily precise floating-point computation. `N[ ]` convert an exact number into accurate precision floating-point value. Find the numerical values of the following numbers accurate to 30 decimal places (quad precision):

$$\begin{array}{lll} \pi, & e, & \sqrt{2}, \\ 355/113, & \sin\frac{\pi}{7}, & e^{\pi\sqrt{163}}. \end{array}$$

In Mathematica, make the assignment `pi = N[Pi,30]`. What is the digits of precision of `2*pi`, and what is `2.0*pi`? Why the second expression gives you only six digits? How to remove the symbol `pi` from the system when you have finished using it?

5. In this exercise we like to see how Mathematica deal with symbols. What happens when the following mathematical expressions are typed in into symbolic systems:

$$\begin{array}{lll} \pi, & x+y, & x-x, \\ 2x\times x+1 & (1+x)^2 & \sin\frac{\pi}{2}. \end{array}$$

Note that π should be typed in as the constant `Pi`, not a numerical approximation.

6. Consider the cubic equation

$$f(x) = x^3 + 6x^2 + 9x + 1 = 0.$$

(a) Make a plot to see how many real roots this equation has. Read from the plot the rough values of the solutions.

(b) Solve the equation numerically.

(c) Solve the equation symbolically. The resulting expressions are complicated with imaginary number i. But we know the solution has to be real (from the plot). Simplify the expressions if you can.

7. Plot the curve (using `ParametricPlot[ ]`) given by $r = \theta$ (polar coordinates). Plot two curves given by $r = \theta$ and $r = 1$ on the same plot, using two different color.