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JFB

Introduction to Information Technology
E01 – Note 4

Lecture, October 1

We continued talking about algorithms from chapters 2 (from section 2.3.2 to the end of the chapter). In addition, some explanation for the statistics lab in Excel was given and Maple, a program for symbolic computation, was presented and demonstrated. Section 11.4 in the textbook deals with symbolic computation.

Lecture, November 2

We will continue in chapter 3 of the textbook. In addition, some types in Maple (for example, integers, reals, sets, lists, lists of lists, and functions) will be demonstrated and discussed.

Announcement repeated

You can buy a CD containing Maple from the bookstore, so that you can install it on your own computer. It only costs 25 kr. Maple is installed on the computers you will use in the laboratories, so there is no requirement that you buy the program. It is, however, a very useful program, and this is a very good price arranged through the university.

Primary Lab 4 - for week 43

Read chapter 1 in *Calculus the Maple Way* before this lab and bring it to your lab. Note that you are using Maple 7, and this manual is written for earlier versions of Maple. Fortunately, most of the changes will not bother you. For example, your toolbar has an extra button for "restart", not shown in your lab manual. This button is useful – see page 9 to read about "restart". For referring to the last output, use % as in Release 5 (since Maple 7 is closer to Maple 5 than to Maple 4). A few of the examples in the manual will give slightly different results if you try them on Maple 7. In addition, the saving of variables does not seem to work in Maple 7 unless you specify the variables.

The purpose of this lab is to introduce you to Maple. Maple is a program for symbolic computation, as is Mathematica, which is very similar in many ways. Read section 11.4 in the textbook to get an understanding of what symbolic computation is. In this first lab about Maple, you will perform some of the calculations described in that section.

Exercise 1

Start by opening the Maple 7 program: click on **Start** → **Programmer** → **Maple 7** → **Maple 7** (the 4th item in the first Maple 7 menu). This will start up the program, and you will have a new *worksheet* open and called **Untitled**. Make your Maple window and the worksheet as large as possible. Get rid of the introduction.

To find out how to use the Expression Palette. Click on the menu button **Help** and then on **Topic Search...**. Type `palettes` and double click on **palette,show**. Read about how to show the palettes and then read about **Use the Expression Palette**. Read this description and then iconify this Help window, since you may want to look at it later. Notice that using the expression palette is similar to using the $f*$ button in Excel, though it gives a little less help (you can get the help through Help commands, though).

Exercise 2

First, try using the symbol palette to see Maple's infinite precision arithmetic in action. Try using π. Then, try evaluating π to 250 digits.

Now type "200!;" and **Enter** to compute $200! = 200 \times 199 \times 198 \times ... \times 2 \times 1$.

Exercise 3

Use the **Expression Palette** to evaluate the following more complicated formula from the textbook (keep watching what effect your actions have):

$$(\frac{13.182}{1.976}\sin(2.1\pi))^{\frac{1.0}{3.0}} + 0.0406893$$

The result you get is still symbolic. To approximate, you can right click on the blue result and choose **approximate** and some number of digits of precision, say 10.

If you did it correctly, you should get 1.313387932. (If you forgot parentheses in the exponent, you got .7278455123. Go back and edit the formula to correct this. You can hit **Enter** as usual to have Maple perform the operation again. Then remove the approximation calculation by clicking by the square bracket at the left, then on **Edit** → **Delete Paragraph**. Try approximating again.) If you did it correctly, you might want to try editing to create this error and see what happens.

Explanation

Notice that the result of the approximation was assigned to the variable `R0`. That is the effect of the symbol ":=". You can type `R0;` and hit **Enter** to see its value, and it can be used in further computations, such as `2*R0;`.

When you enter new commands, you should be within a new paragraph (it looks like [>). If there is one at the bottom of your worksheet, you can click just after it to move the

cursor there. If you need a new one somewhere, you can use the **Insert** menu and click on **Execution Group**, or use the button that looks like [> from the toolbar.

Exercise 4

Try simplifying the following formula:

$$(x-1)^2 + (x+2) + (2x-3)^2 + x.$$

Comment: The function *simplify* does not always simplify as you would wish. Other functions you can use when you want to try simplifying are *expand* and *factor*. (The examples below may not show this, but keep these functions in mind, anyway.)

Try out *factor* on $x^{10} - 1$. You should get four factors.

Try out *expand* on $(1 + x + 3y)^4$. If you do not use the expression palette, remember the multiplication symbol "*" between the 3 and the y. The result should have 15 terms.

Exercise 5

To find solutions of equations, we can use the function *solve*. Use it to find the roots of $x^2 - 5x + 4$.

To plot the function so that you can see where the roots are, type in the formula, right click on the blue result from that formula, and choose **Plots** → **2-D Plot**. In order to better see where the roots are, change the ranges on the axes.

Now try left clicking on some point on the curve. Look in the box at the left end of the row just below the toolbar. This should contain the coordinates of the point you clicked on. Try clicking on other points in the plot to see how this changes.

To check that you got the correct answers, create a function $f(x) = x^2 - 5x + 4$ and calculate $f(4)$ and $f(1)$. Are the results both zero?

Use one of the above methods to solve $e^x - 1.5 = 0$ for x. (Note that e is **exp(1)** in Maple.)

Maple can solve a system of equations to find solutions which simultaneously satisfy more than one equation. For example, solve the two given linear equations for x and y by typing `solve({2*x+y=11,6*x-2*y=8},{x,y});`. You get the solution $\{y = 5, x = 3\}$. Note that Maple has a linear algebra package called *LinearAlgebra* and a linear optimization package called *simplex* for solving more complicated, but similar problems. We will not work with them now.

Exercise 6 - no help on the Web

Do the following problems in *Calculus the Maple Way*: (If you do the optional problems, you may skip the others. If you have time, do all of them.)

Problems 2 and 3 on page 13. (Note that you can get roots of a polynomial by right clicking on the blue output from the polynomial and choosing **Solve**.)

Problems 2b and 2c on page 20.

Optional: Problem 11 on page 14. (Note that the operation $p :=' p'$ clears the variable p. If you use the correct type of quotes, the blue result should look like $p := p$.)

Optional: Problem 3 on page 20.

Exercise 7

Save your worksheet. (As with other programs, you can do this through the **File** menu button. You should probably first create a new folder to save it in.) E-mail your worksheet to your lab instructor as an attachment. (It is very similar to sending a spreadsheet, as you did in the last two labs.) Remember to logoff your computer, but do not push any of the buttons on it.