Laboratory Exercises for Scripting and Programming for Modeling and Simulation

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To our colleagues and families, who supported us in trail-breaking.
To our students, who learn how to work with the new and different.
1 Lab 1 CS 121 Computation Lab I Fall 2009
Directions and Problems

1.1 Overview

This lab introduces the use of Maple, the primary computer language used for this course. You will learn how to do simple arithmetic calculations, as well as annotated plots. A ecology management problem is introduced that can be solved with the calculational facilities introduced.

This lab also introduces Maple TA, the primary homework/quiz/exam site for the course. You will log onto Maple TA with your personal account, and taking a practice quiz. Starting next week, there will be required/graded work on Maple TA for you to do.

1.2 Introduction to Lab 1 (20-25 minutes).

The instructor will introduce themselves and present a brief overview of course, Maple, and the lab.

The lab staff will hand out verification sheets along with paper copies of these directions. In later weeks, these directions will be posted on-line and can be read from your lab computer. The verification sheets will still be passed out, to be the permanent record of your attendance and accomplishments during the lab.

1.3 Problems -- Part 1 (20 minutes)

1. Sit down with your lab partner and if you haven't previously met, introduce yourself to them. Write both of your names down on the verification sheet in the space provided.

2. All of the partners should log onto a computer, following the demo given by the instructor in the introduction.

3. Do the calculations below. Everyone should try doing the computations on their own computer. To gain more confidence that you are getting the right answer, look at what your partners are getting. Get their help if they appear to be more successful than you. Sometimes just talking about what problems you are facing may produce useful insight towards overcoming them. If there is a problem that you can't collectively resolve, call the lab staff over and get some help.

4. You are to do all of the steps below. Some of the answers should be transcribed onto the verification sheet as indicated, for grading by the staff. Have a staff member come over to sign the verification sheet for part 1. Be prepared to show your work to the staff member, and to explain how you got your answers. This is also the opportunity to clear up any questions or uncertainties you may have even after doing the work.

5. When you complete part 1, get a staff member to verify your work before moving onto part 2.
1. a) Get Maple to calculate the sum of 2+2. Presumably you will be able to tell whether or not you got the right answer pretty easily.

b) What is exact fraction you get from adding together \( \frac{1}{2} \), \( \frac{1}{3} \), and \( \frac{1}{4} \)? What about the sum of \( \frac{1}{2} \), \( \frac{1}{3} \), \( \frac{1}{4} \), \( \frac{3}{2} \), \( \frac{4}{3} \) and \( \frac{5}{4} \)?

Note that if you are doing a calculation that is highly similar to a previous one, cutting and pasting can save you some effort entering the second expression.

2. Use Maple to perform the following exact calculations. To enter \( \pi \), you can select the letter from the Common Symbols palette on the left hand side of the Maple window (it's a few segments below the Expression palette). Note that Maple does not regard \( \Pi \) as the same as \( \pi \). To enter \( e \), the base of the natural logarithm, use the \( e \) from the expression palette, or the \( e \) from the "Common Symbols" palette. Typing "e" from the keyboard unfortunately does not produce the same result -- that kind of \( e \) Maple will regard as an symbol for an algebraic unknown like \( x \) or \( y \).

a) \[
\frac{1}{2} + \frac{1}{3} = \frac{47}{42}
\]

b) \[
\sin \left( \frac{\pi}{3} \right)
\]

c) \[
\sqrt{\ln(e^8)} \quad \text{(You should get } 2\sqrt{2})
\]

d) \[
\sqrt{1 + \frac{2}{5} + \frac{3}{15}} \quad \text{(You should get } 2)
\]

e) \[
\log_{55} \left( \sum_{k=0}^{10} \right) \quad \text{(You should get } 1)
\]

3. A state lottery allows you to pick six numbers from the numbers from 1 to 52 to win. Maple exact arithmetic to calculate the exact odds of winning. This can be done by using the "choose" function from the expression palette: \( \binom{a}{b} \) means "the number of ways you can choose b things from a things". For example, if the lottery asked you to pick three numbers from the numbers from 1 to 6, the chances of winning would be 1 out of \( \binom{6}{3} = 20 \).

4. Calculate \( 2^3 \). Note that \( (2^3)^4 = 8^4 = 4096 \). Why doesn't Maple give that as its answer?

5. Get Maple to reproduce this plot: \( \log_{10} \left( \sin \left( \frac{1}{x^2+1} \right) \right) \) →
6. You should use the right-click->plots->Plot Builder menu to specify things such as the plot range, the plot color, etc. Get Maple to reproduce this plot exactly, including the color and the proper horizontal and vertical ranges, and the title with the proper font size and style.

\[(x - 1) \cdot (x - 2)^2 \cdot (x - 5) \cdot e^{-\frac{x}{10}} \rightarrow\]
1.4 Maple TA (15 minutes)

1. The instructor will give a brief demo of how to use Maple TA, including how to log in, and how to take simple quizzes. (5 minutes)

2. Take Maple TA quiz 0. (10 minutes)

Notes on Maple TA

1. Maple TA is a quiz-administration system running separately from Blackboard Vista and Drexel One. Your userid should initially be your Drexel One userid (e.g. egk23) and the password should be your Drexel student ID number (e.g. 10096739). Note that the password is probably Drexel One password. You can change your Maple TA password after you log in.

2. The address for Maple TA will be given in class. Links to it will also appear on the class web site www.cs.drexel.edu/cs121/Fall2009 as well as the class site on Blackboard Vista, under "Maple TA".

3. After logging onto Maple TA, you need to select the correct class, and then the correct test to take. Usually your choices will be limited, but the choices may change during the term depending on the need.

4. After you have finished answering all the questions, you should hit the "Grade" button so that your score is recorded. If you don't do this this, Maple TA will record your answers but you will receive no credit for your work because your recorded score will remain at 0.

5. If you encounter any technical difficulties, you should contact the course staff by visiting the Cyber Learning Center (University Crossings 147) or on-line in the Blackboard class discussion group. If you have questions about the grading of an Maple TA assignment, you should contact your section instructor (the person listed in the schedule of courses).

6. The quiz server will only handle 150 simultaneous users and will turn away the excess, so don't wait until the last moment to take the quiz. You will be given credit for only that part of the quiz that you finish before the deadline. If there is a catastrophic system failure, the deadline will be adjusted. An announcement will be made on Blackboard and the course website.

1.5 Problems -- Part 2 (30 minutes)

Complete part 1 problems if you haven't finished. Then work on part 2 of Lab. Get verification.
1. Find the exact solution to $3x + 5 = 0$.

2. Find the exact solution to $ax^2 + bx + c = 5$ (solve for $x$).

3. From Anton, Calculus, 8th edition, ch. 1 review exercises, problem 37, p. 99. A breeding group of 20 bighorn sheep is released in a protected area in Colorado. It is expected that with careful management the number of sheep, $N$, after $t$ years will be given by the formula:

$$N = \frac{220}{1 + 10^{-0.83t}}$$

and that the sheep population will be able to maintain itself without further supervision once the population reaches a size of 80.

(a) Graph $N$ versus $t$. (b) How many years must the state of Colorado maintain a program to care for the sheep? Show your work. (c) How many bighorn sheep can the environment in the protected area support? (hint: examine the graph for large values of $t$.)

### 1.6 Problems -- Extra Credit

Only do these problems if you are far ahead of everyone else. You can get a little extra credit for them.

**Problem -- extra credit**

Do this for Lab extra credit if you have finished parts 1 and 2 with plenty of time to spare. In general, doing extra credit will bump your score for this lab beyond 100%. The final grade for the course includes the weighted sum of lab grades for this course, so by doing extra credit you will be smoothing out any deficiencies you may be incurring in other parts of the course such as the exam or the quizzes. Unless stated otherwise, extra credit is available only if done in the student's assigned lab session, and is not available in make-up labs. It may be possible to get partial extra credit even if you do not completely finish the extra credit work.

Explore a mathematical phenomenon jotting notes and observations as you go. In a fresh Maple document, show the trail of your computation and your written explanation of what you found and how you found it. Here's the problem. Consider the following sequence of expressions:

$$\frac{1}{2}$$

$$\frac{1}{2 + \frac{1}{2}}$$

$$\frac{2}{5}$$

$$\frac{1}{2 + \frac{1}{2 + \frac{1}{2}}}$$

$$\frac{5}{12}$$

What is the next number in the sequence? What is the next one after that? Can you predict what the next one after that is without computing it first? Write down your prediction and your reasons for it.
Problem -- extra extra credit

If you've finished the extra credit problem, this one may take a little longer to do. It is meant for people who already know something about recursive programming or recurrence relations -- or who are superaccurate typists. What is the 47th number in the sequence? (We aren't interested in approximations, we want the exact fraction.) If you've finished the extra credit problem in the lab, then come back in two weeks with the answer to this problem and an explanation of how you can with just a little more computer time and no more typing get almost any number in the sequence, and you will get three points extra extra credit.

You will get five points extra extra credit if you use Maple to get the 47th number, or any other number in the sequence.

1.7 Saving your work (5 minutes)

1. The instructor will demo how to save a Maple worksheet file, and how to upload the work to Blackboard (occasionally required for some labs).

2. Save your work into a .mw file. The resulting file should show up on your Desktop, although it depends on your computer's notion of current working directory. If you have problems finding the file on the Desktop and your partners can't help you, call over a staff member. After saving the file, upload a copy of the file to Blackboard so that you can refer to it later on. (Most public computers at Drexel automatically wipe out all files created during a student session after the student logs out.) Ask a lab staff member for a demo of this if they haven't done it already. You can also send yourself a copy via email as an attachment. This is good for those who want to remember how they did things, or wish to look at the worksheet again after lab. If you upload the file to Blackboard, you can download it to your home computer from there.

1.8 Final actions (End of class)

1. Before you leave, get the staff to grade, sign, and collect the verification sheet. You don't get credit for the lab unless they have a score recorded for you in a signed verification sheet that they have at the end of lab. You may leave the lab after you do this. You can get partial credit for the lab if a portion of your work is verified.

2. Final grades for the course will be curved if necessary, so don't fret excessively if you don't finish but it looks like others are in the same shape. However, you should try to learn the material you don't complete in lab so that you can pass the quizzes and be ready for the next lab. Computer work at this introductory level introduces a lot of ideas and concepts that appear pervasively in subsequent work. The plus side is that you'll probably see next time more of what you worked on this time, so you'll have another chance to practice and improve. The down side is that you can't ignore tough details and hope that they won't matter much.