# CSC104, Assignment 1, Winter 2006
# Due: Thursday February 2nd, 11:59 pm

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## Scavenger hunt and finger exercises

The following exercises are intended to introduce some basic skills you'll need in this course. One of the trickier skills is finding useful instructions for carrying out a computer task. Normally you would ask a friend, or the person sitting beside you, but for this assignment this won't be allowed. You must find your instructions from the sources mentioned in the exercise or one of the following sources:

- Asking a CSC104 TA or the instructor.
- Reading documentation included with the software (e.g. the "help" menu).
- Reading the on-line "man" pages (see below).

Some of these sources of documentation are difficult to understand, and part of your job will be to understand them (at least long enough to carry out the exercise).

1. Log in to your CDF account. Some information on how to do this will be included in lecture and the course web page. If you have access to email other than on CDF, you may write for help to `admin@cdf.toronto.edu`.
2. Create a directory called *A1*, by typing *mkdir A1*, then the *enter* key, in a terminal (for documentation, type *man mkdir*).
3. Change your current working directory so that it is A1 (type *cd A1*, then *enter*, and verify by typing *pwd*, in a terminal), and start the editor called *scite*. You may use the general system menu (probably at the lower left, left-click on *Programs/editors/scite*) or type *scite* (case-sensitive), then the *enter* key, in a terminal. Once you have scite running, open a new file (click on the file menu in *scite*'s application menu), type the current date in the text area, and then save the file as *journalA1*. For all the remaining exercises, you must record the date, what you tried, what worked, what didn't work, and any of your observations, in *journalA1*.
4. At a terminal type *ls* (that's a lower-case ell, not a 1), then push the *enter* key. Then type *ls -l --si*, and push the *enter* key. Compare the results, and read about the first 28% of the output of *man ls* until you can explain the difference between the output of the two commands. Your (short) explanation should, of course, go in *journalA1*.
5. Type the command *df --si --local*, and then the command *df --si* in a terminal. Compare the results. Type *man df* and browse about the first 45% of the output, or until you can explain why the two variants of the df command give different outputs.

6. Type the command *cd* and then *enter*, to ensure that you are at the top of your home directory. Then create a directory called *public_html* (notice the underscore). Type *ls -l --si*, and pay particular attention to information corresponding to your new directory. Now type *chmod og+x public_html* and *enter*, type *chmod og+x ~* followed by *enter*, and and then repeat *ls -l --si* and *enter*. Read the output of *man chmod* until you can explain (in *journalA1*) what this command achieved (noting your observations in *journalA1*, of course).

7. Start *Firefox* (a web browser) by clicking on the appropriate icon. In the top right corner there's a box with a "G" beside it for typing searches to Google. Experiment with typing choices of three legitimate English words, possibly preceded by a "+" character, for example: *+fax +pyx +castigate*, or *fax +pyx castigate*, to see which finds the fewest matches (you should be able to get well below 500). Words that appear as underlined in the light blue Google bar are legitimate words. Summarize the results of your search in *journalA1*.

8. In the directory *public_html*, create a file called *flypaper.html*, using the *scite* editor. Use *scite* to make sure this file contains the following:

   (a) `<html>` at the beginning, with a matching `</html>` at the end.

   (b) `<head>`, followed by `</head>` somewhere between the opening and closing `<html>` tags.

   (c) `<title>`, followed by `</title>`, somewhere between the opening and closing `<head>` tags.

   (d) `<body>`, followed by `</body>`, somewhere between the closing `</head>` tag and the closing `</html>` tag.

   Fill in the space between `<title>` and `</title>` with a meaningful title. Write a few meaningful sentences between `<body>` and `</body>`. Save your file, exit *scite*, make *public_html* your working directory, and from a terminal type *chmod a+r flypaper.html*.

## Edgy ecosystem explained

Imagine an ecosystem inhabited only by immortal mice and ravenous foxes. The mice need the foxes to prevent the mouse population from spiraling out of control, leaving the ecosystem several kilometers deep in squirming mice. The foxes need the mice to fill their bellies so that the foxes can be strong and reproduce.

This mutual dependence can be expressed symbolically, using the Lotka-Volterra equation (see Wikipedia). Let $M$ stand for the number of mice and $F$ stand for the number of foxes. Assume that $M$ mice give birth to $\alpha M$ new mice every year, and that mice never die nor stop breeding. $\alpha$ is a positive number you can experiment with (a parameter) that expresses the mouse birth rate. If that was the only thing going on, we'd see an exponential growth in the mouse population, however you can also assume that with $M$ mice and $F$ foxes, there are $\beta MF$ mice that get eaten each year. $\beta$ is another parameter, the mouse-fox meal rate. Putting these together gives us $\Delta M$, the yearly change in the mouse population:

$$\Delta M = \alpha M - \beta MF.$$

Of course, the fox population is also affected by all this. Assume that $\gamma F$ foxes die each, that is, $\gamma$ is the fox death rate. Without any mouse snacks, this would lead to an exponential decay of the fox population, but luckily (for the foxes, at least) we can also assume that $\delta MF$ new foxes are born each year. The parameter $\delta$ is the mouse-fox feed-and-breed rate (better-fed foxes are assumed to be better reproducers). Putting these together gives us $\Delta F$, the yearly change in the fox population:

$$\Delta F = \delta MF - \gamma F.$$

You will build this idyllic fox-eat-mouse world in the spreadsheet Gnumeric. You'll get to experiment with different values for the parameters $\alpha$, $\beta$, $\gamma$, and $\delta$, to see what different settings mean to the long-term survival of these species. You may create a Gnumeric line graph to visualize the fox-mouse interaction.

## Building the edgy ecosystem in Gnumeric

Be sure to record what steps you take, what works, and what doesn't work in *journalA1*.

Open the spreadsheet *Gnumeric*, either by typing *gnumeric* in a terminal, or from the general system menu. Across the first row, type the following titles for separate columns:

- Mice (corresponding to $M$ in the formulas of the previous section)
- Foxes (corresponding to $F$ in the formulas of the previous section)
- Mouse birth rate (corresponding to $\alpha$ in the formula of the previous section)
- Mouse-fox meal rate (corresponding to $\beta$ in the formula of the previous section)
- Fox death rate (corresponding to $\gamma$ in the formula of the previous section)
- Mouse-fox eat-and-breed rate (corresponding to $\delta$ in the formula of the previous section)

To make your table more readable, with one of your headings highlighted click on *Format/column*, follow the arrow and select *Auto-fit selection*. Before continuing, save your spreadsheet as *ecosystem.gnumeric*.

In the next row, type the last 3 (right-most) digits of your student number in the column headed by *Foxes*. This is the initial population of foxes. Type 1000 in the column headed by *Mice*. This is the initial population of mice. Type 0.1 in the column *Fox death rate* and type 0.0001 in the column headed by *Fox-mouse eat-and-breed rate*.

In the same row, type the last 3 digits of your student number, preceded by "0." in the column headed by *Mouse birth rate*. Type 0.001 in the column headed by *Fox-mouse meal rate*.

These initial settings will give you a stable ecosystem.

Now you need to express the formulas in the previous section as Gnumeric formulas. In the cell directly under the initial fox population (the last 3 digits of your student number), you need to type a formula that tells us how many foxes there will be a year later. Suppose the initial fox population is in cell A2 and the fox death rate is in D2, then the Gnumeric formula formula:

```
=A2 - A2*$D$2
```

. . . will give you the previous fox population minus the number of foxes who died during the year. This formula isn't quite right (it doesn't have anything corresponding to $\delta MF$, the number of new foxes born during the year), so you'll have some work to fix it up. To guide your work, you should probably read the Gnumeric manual (click the "Help" menu in Gnumeric) section on "Working with data." Before proceeding too far, you should have some idea of why there are dollar signs around the "D," but none around the "A."

Similarly, in the cell directly under the initial mouse population (1000), you need to type a formula that tells us how many mice there will be a year later.

With those two formulas in place, you can copy a formula cell into the next hundred cells below it (click on the cell, put your cursor over the bottom-right corner, and drag). Do this with both formulas to get an idea of the mouse and fox populations over the next century.

If all went well, you can play with the parameters a bit. by making a very small changes in the parameters (one at a time), you'll see the pattern of mouse and fox populations change.

If your formulas for fox and mouse populations allow negative or fractional populations, you should consider how to modify them to prevent this. A reasonable formula should not allow populations lower than 0 (extinction), and should round to an integer (animals occur in whole units, except in mid-meal). Check in the manual under *Function Reference/Statistics* for functions *MAX* and *MIN*, and under *Function Reference/Mathematics* for *Ceil* and *Floor* to help with this.

Of course, "seeing" the pattern by scanning a column of numbers is not as compelling as seeing a graphical representation. As an optional feature for this assignment, you may explore making a graph of the fox and mouse populations (see *Insert/Chart*).

## What to hand in

Under *Assignments* on the course web page you will find a link to the CDF submit facility. Submit the following files:

- *journalA1*
- *ecosystem.gnumeric*
- *flypaper.html*

You should submit your files early and often. The first time you create a file with meaningful content, submit it. You may re-submit the same file as many times as you wish, and only the last submission is stored. A good habit is to re-submit your files each time you improve them.