

CSC104, Assignment 1, Winter 2006

Sample solution

Danny Heap

SCAVENGER HUNT AND FINGER EXERCISES

Here I masquerade as a new user.

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`.

SOLUTION: Here's what I see when I log in from my machine. Your mileage may vary.

```
Last login: Thu Feb  2 11:48:03 2006 from lachesis.cs.toronto.edu
heap@seawolf:~$
```

When I log in on one of the CDF terminals, I see a graphical environment with various icons I can click on, and a terminal where I can type commands.

2. Create a directory called *A1*, by typing `mkdir A1`, then the *enter* key, in a terminal (for documentation, type `man mkdir`).

SOLUTION: Here's what I see when I type `ls -l` from my main (home) directory on CDF:

```
heap@seawolf:~$ ls -l
total 22
drwx-----  2 heap instrs  512 Feb  2 11:52 A1
drwx-----  3 heap instrs  512 Dec 15 12:11 Desktop
drwx-----  2 heap instrs  512 Oct 26  2004 Mail
drwx-----  2 heap instrs  512 Oct  8  2001 News
drwx-----  5 heap instrs  512 Jul  8  2002 Src
drwx-----  4 heap instrs  512 Apr  8  2005 Thunderbird_Folders
drwx-----  3 heap instrs  512 Mar 17  2003 bin
-rw-----  1 heap instrs 9445 Jan  4 15:35 config
drwx-----  2 heap instrs  512 Apr 19  2002 mail
-rw-----  1 heap instrs   0 Feb 17  2003 mbox
drwx-----  2 heap instrs  512 Sep  8  2001 nsmail
drwx-----  2 heap instrs  512 Jan 28 22:52 og+x
drwx--x--x  2 heap instrs  512 Feb  1 23:02 pub
drwx--x--x  2 heap instrs  512 Feb  9  2003 public_html
heap@seawolf:~$
```

Notice the *A1* at the top, and at the extreme left of that line the 'd', which indicates a directory.

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*.

SOLUTION: Here's my first journal entry:

```
February 2, 11:59 am
```

```
I can't believe I left starting my assignment soooo late! Even though I know
prof personally, I don't think he'll give me a break. Oh well, whatever.
```

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*.

SOLUTION: Here's what I get for those `ls` commands. The leading `~` is an alias for my home directory.

```
heap@seawolf:~/A1$ ls
journalA1
heap@seawolf:~/A1$ ls -l --si
total 1.1k
-rw----- 1 heap instrs 176 Feb  2 12:01 journalA1
heap@seawolf:~/A1$
```

The first version lists the file name *journalA1*. The second version gives a lot of other information, with the details *man ls*. The man page says that the `-l` gives a long listing, but no details of what "long" consists of. It also says that `--si` prints the sizes (of what, the files?) in human-readable format, except in powers of 1000, not 1024. It's not completely clear what part of the information printed refers to sizes in powers of 1000 (maybe the 176?) but I'm guessing that 12:01 is the time (close to what my watch says). My username also appears on the line, as well as some other inscrutable stuff.

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.

SOLUTION: Here's what I got for those `df` commands.

```
heap@seawolf:~/A1$ df --si
Filesystem      Size  Used Avail Use% Mounted on
/dev/sda5        2.2G   75M   2.0G   4% /
tmpfs            3.1G   4.1k   3.1G   1% /dev/shm
/dev/sda1        104M   6.9M   92M    7% /boot
```

```

/dev/sda13          5.6G  836M  4.8G  16% /data
/dev/sda12          5.2G  3.3G  1.9G  64% /local
/dev/sda11           11G   46M   11G   1% /tmp
/dev/sda9            5.2G  2.8G  2.5G  53% /usr
/dev/sda10           1.1G  624M  360M  64% /var
homesrv:/h/u2        73G   43G   30G  60% /h/u2
homesrv:/h/u1        73G   70G   2.1G  98% /h/u1
homesrv:/cdf         104M   16M   79M  17% /cdf
debmirror:/var/debmirror
                    72G   56G   17G  78% /debmirror
newssrv:/news        990M   69M  823M   8% /news
newssrv:/newslib     312M  132M  149M  48% /newslib
homesrv:/h/u4         72G   2.7G   70G   4% /h/u4
homesrv:/h/u3         73G   62G   9.6G  87% /h/u3
homesrv:/s/d0         4.1G   1.5G   2.6G  37% /s/d0
heap@seawolf:~/A1$ df --si --local
Filesystem          Size  Used Avail Use% Mounted on
/dev/sda5            2.2G   75M  2.0G   4% /
tmpfs                3.1G  4.1k  3.1G   1% /dev/shm
/dev/sda1            104M   6.9M   92M   7% /boot
/dev/sda13           5.6G  836M  4.8G  16% /data
/dev/sda12           5.2G  3.3G  1.9G  64% /local
/dev/sda11           11G   46M   11G   1% /tmp
/dev/sda9            5.2G  2.8G  2.5G  53% /usr
/dev/sda10           1.1G  624M  360M  64% /var
heap@seawolf:~/A1$

```

The man page (*man df*) says that the `--si` makes the sizes human-readable (presumably, without the `--si` squirrels would be able to read the output), and also uses powers of 1000 rather than 1024. Looking at the column headed by “sizes” I see numbers followed by “M” or “G” — Megs and Gigs, perhaps? The other columns have headings “Filesystems” (I don’t know what those are) and “Used” and “Available” and “Use” — well, the man page for *df* says it reports filesystems disk space usage, so “Used” and “Available” should add up to “size” (and they almost do). There’s another column that says “Mounted on”, but that just sounds rude.

When I add `--local` to the command, the rows that had a filesystem containing a colon (e.g. `homesrv:/s/d0`) disappear. The man pages says that `--local` limits the listing to local filesystems, so presumably those filesystems with colons are tourists of some sort.

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 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).

SOLUTION: After I realized that I needed to go back to exercise 2 to figure out how to create a directory things got better. Here’s what I got from the two versions of the `ls` command:

```
heap@seawolf:~$ ls -l --si
```

```

total 23k
drwx----- 2 heap instrs 512 Feb  2 12:01 A1
drwx----- 3 heap instrs 512 Dec 15 12:11 Desktop
drwx----- 2 heap instrs 512 Oct 26 2004 Mail
drwx----- 2 heap instrs 512 Oct  8 2001 News
drwx----- 5 heap instrs 512 Jul  8 2002 Src
drwx----- 4 heap instrs 512 Apr  8 2005 Thunderbird_Folders
drwx----- 3 heap instrs 512 Mar 17 2003 bin
-rw----- 1 heap instrs 9.5k Jan  4 15:35 config
drwx----- 2 heap instrs 512 Apr 19 2002 mail
-rw----- 1 heap instrs  0 Feb 17 2003 mbox
drwx----- 2 heap instrs 512 Sep  8 2001 nsmail
drwx----- 2 heap instrs 512 Jan 28 22:52 og+x
drwx--x--x 2 heap instrs 512 Feb  1 23:02 pub
drwx----- 2 heap instrs 512 Feb  9 2003 public_html
heap@seawolf:~$ chmod og+x public_html
heap@seawolf:~$ ls -l --si
total 23k
drwx----- 2 heap instrs 512 Feb  2 12:01 A1
drwx----- 3 heap instrs 512 Dec 15 12:11 Desktop
drwx----- 2 heap instrs 512 Oct 26 2004 Mail
drwx----- 2 heap instrs 512 Oct  8 2001 News
drwx----- 5 heap instrs 512 Jul  8 2002 Src
drwx----- 4 heap instrs 512 Apr  8 2005 Thunderbird_Folders
drwx----- 3 heap instrs 512 Mar 17 2003 bin
-rw----- 1 heap instrs 9.5k Jan  4 15:35 config
drwx----- 2 heap instrs 512 Apr 19 2002 mail
-rw----- 1 heap instrs  0 Feb 17 2003 mbox
drwx----- 2 heap instrs 512 Sep  8 2001 nsmail
drwx----- 2 heap instrs 512 Jan 28 22:52 og+x
drwx--x--x 2 heap instrs 512 Feb  1 23:02 pub
drwx--x--x 2 heap instrs 512 Feb  9 2003 public_html
heap@seawolf:~$

```

After suffering a bit of eyestrain, I realized that the two outputs are not identical. The row for *public_html* has a couple of extra 'x' characters in the first column after I do the *chmod* command. The man page for *chmod* says that it changes file access permissions (whatever that means). If I read a bit further, it says that some combination of the characters 'uoga' determines which users' access to the file will be changed. So I changed 'og', whoever that is. Wait, it then says that 'g' is other users in the files group, and 'o' is other users not in the files group. So I guess I've changed the access for other users (whoever they are). Apparently there's a user who owns the file (if there's any justice, this should be me), indicated by 'u', but I didn't change this. The man page says that the '+' adds some access, and the 'x' is execute (sounds grim) or access for directories. Putting this all together, I've allowed "others" to execute or access *public_html*. I hope they wear hoods.

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*.

SOLUTION: It sure helps to try to think of three unrelated words. I tried *+zither +apt +accrue*, since I figured a musical instrument, an adjective, and a financial-sounding verb might be unlikely to occur in that many pages. I got just 282 hits, so I win! When I removed the '+' signs, the number of hits increased a bit (to 349 and then 350). I clicked away at Google until the page <http://www.google.ca/help/refinesearch.html#domain> said that the '+' forces Google to include common words that it might otherwise ignore in the search. Some of the hits that had all three words were huge lists of English words — I guess these people like to turn up in Google searches. Another hit was a list of rhyming words (in case you needed to know, “accrue” rhymes with “bestrew”). One hit was an enormous list of limericks, and so my three words turned up in different limericks. Here’s a weird thing: I get 283 hits if I move *+ zither* to the end of my search list.

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*.

SOLUTION: Here’s what I put in my *flypaper.html*:

```
<html><head>
<title>I know what html is!</title></head>
<body>html is about web stuff.
This text looks very crowded and busy,
but if it has something to do with the web, I’m okay with that.
Why’s it called ‘flypaper.html’ anyway?
</body></html>
```

I knew that *chmod* was going to change some permissions, so I first did a listing, so I could see what difference it made. Here’s the before and after:

```
heap@seawolf:~/public_html$ ls -l --si
total 1.1k
-rw----- 1 heap instrs 246 Feb  2 13:10 flypaper.html
heap@seawolf:~/public_html$ chmod a+r flypaper.html
heap@seawolf:~/public_html$ ls -l --si
total 1.1k
-rw-r--r-- 1 heap instrs 246 Feb  2 13:10 flypaper.html
heap@seawolf:~/public_html$
```

The entry for the file *flypaper.html* has picked up some 'r' characters on the left-hand side. The man page for *chmod* says that I gave read access to "all". If I'd know everyone could read it, I would have taken care to write something intelligent.

EDGY ECOSYSTEM EXPLAINED

SOLUTION: There is no solution for this section. Since this section isn't part of the solution, it's part of the problem.

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 αM new mice every year, and that mice never die nor stop breeding. α 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 $\beta M F$ mice that get eaten each year. β is another parameter, the mouse-fox meal rate. Putting these together gives us ΔM , the yearly change in the mouse population:

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

Of course, the fox population is also affected by all this. Assume that γF foxes die each, that is, γ 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 $\delta M F$ new foxes are born each year. The parameter δ is the mouse-fox feed-and-breed rate (better-fed foxes are assumed to be better reproducers). Putting these together gives us ΔF , the yearly change in the fox population:

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

You will build this idyllic fox-eat-mouse world in the spreadsheet Gnumeric. You'll get to experiment with different values for the parameters α , β , γ , and δ , 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 α in the formula of the previous section)
- Mouse-fox meal rate (corresponding to β in the formula of the previous section)
- Fox death rate (corresponding to γ in the formula of the previous section)
- Mouse-fox eat-and-breed rate (corresponding to δ 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 δMF , 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*).

SOLUTION: I put a screenshot of the formulas I ended up with at the end of this report. Now I'll tell you how I got to that point.

In spite of a sinking feeling that this part of the assignment will turn me into an accountant, I started up Gnumeric and filled in the column headings, as asked. Formatting the headings to be more readable and saving my (minimal) version of *ecosystem.gnumeric* wasn't too bad, using the pull-down menus.

Filling in the next row went okay except for the bit about the last three digits of my student number preceded by “0.” — it looked like this value (mouse birth rate) was identical to the fox population. Then I noticed that the 0 is followed by a period. Oh.

I must have stared at the formula `=A2 - A2*D2`, and the “explanatory” paragraph above it, for an hour. The information discussed in these cells just didn't seem to match what I had in the cells. I finally asked the TA, and she said that the column headings mentioned in the handout don't have to

be in exactly the order that they are mentioned in the handout. I thought about changing my column headings and values so that they matched the discussion in the (so-called) explanatory paragraph, but then I decided that I could just draw myself a picture of which of my cells corresponded to A2, D2, and so on.

Once I got that sorted out, I could see that the formula takes last year's fox population and subtracts the number of foxes who died this year. It's not clear to me what the dollar signs are about, but maybe it will be come clearer. I need to add a term for the number of foxes born this year, which I did (see my *ecosystem.gnumeric* for details).

I used the same sort of thinking for my mouse population formula, except I had no clue where to put the dollar signs. I copied each formula to the next hundred cells, and they both generated errors of some kind. What do they mean???

I moved the cursor over some of the mouse population entries. The formula looks similar to what I typed, but different. I went back to the formula I typed, and it was what I expected. Okay, I see: the column portion of the formulas (A, B, C, ...) is the same, but the row numbers increase by 1 as each formula is copied down by a row. This means that each formula refers to the row above it, and in some cases THERE IS NO INFORMATION in the row above (no mouse birthrate, for example). That would explain the errors.

I now checked some of the formulas in the fox population column. Again I observe that the row numbers increase by in the references — A2 becomes A3, but what: \$D2\$ stays the same down the entire column! That makes some sense: the fox death rate isn't going to change over the years, but the fox population does, so we need to change A2 to A3, etc., but we want to keep going back to D2 — hence the dollar signs.

I use this insight to put some dollar signs around the reference to the other parameter that fox populations need: the mouse-fox-eat-and-breed rate, re-copied the formula to a hundred cells, but I still had errors. That's a bit discouraging, but then I figured that, since the mouse population still had errors, perhaps those were messing up the fox population (garbage in, garbage out).

I went to my first formula for mouse population, and surrounded the references to the mouse birthrate and to the fox-mouse-meal-rate with dollar signs, and then recopied the formula down to the next hundred cells. I must have broken something: both the fox and mouse populations became totally unchanging.

Oh. The handout says that the ecosystem is initially stable (no population change), and that I should tinker with the parameters. I make a change, and everything goes haywire again. I make a smaller change, in the last possible decimal place, and I get populations that go up and down in tandem. Mouse populations increase first (that would be the birthrate kicking in), and then fox populations increase (mouse snacks lead to more births), and this eventually drives down mouse populations (chewed mice tell no tales), which in turn eventually drives down fox populations. If I change the parameters too much I get negative populations — that makes no sense. And what about bits of mouse and fox to the right of the decimal point?

The handout says I should fix this. No population gets more extinct than 0 members, and nobody is interested in those fractional bits of mouse and fox. I read through the documentation for what seems like hours until I find the *max* function (I can make sure that the population is no less than 0) and the *floor* function (I'll round down, and throw out those fractional foxes and mice).

Looks good. I think I'll submit it before generating a graph, since that's just the icing on the cake.

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*

SOLUTION: Just to see where I stood, I sent email to the prof at about 2:30, asking how many other students had submitted stuff. Here's what he sent back:

```
heap@skywolf:/u/csc104h/submit$ ls
ajr      c6chenna  c6guoqia  c6kokabi  c6lopegg  c6okeiff  c6taiyau  c6yipvin
c5chengk c6chenya  c6hewlet  c6koobon  c6macint  c6parker  c6tkatch  c6zampar
c5gaofei c6cheung  c6hosinm  c6kungra  c6mageec  c6qadirs  c6tsangh  c6zhengz
c5lupeat c6chinje  c6iroaga  c6lancyn  c6mansfi  c6riffer  c6vieira  c6zillie
c6abadaw c6choies  c6iskand  c6lautob  c6markou  c6roseca  c6wangji  deadlines
c6alisye c6choiyo  c6jonesa  c6leechr  c6marsha  c6sadler  c6wongde  heap
c6austep c6clarks  c6joosoy  c6leekyu  c6mccull  c6shahsa  c6wongni  restrict
c6baikdi c6defrei  c6kimdae  c6leungy  c6modyvi  c6shares  c6wuyuch
c6beaton c6dragla  c6kimdan  c6liduan  c6mostac  c6sheikh  c6xulei
c6bogled c6estaci  c6kimhyu  c6limcho  c6mostaf  c6simpo  c6xutian
c6bogodi c6fellow  c6kimyou  c6liuwen  c6mowenz  c6singht  c6yantha
c6changy c6foksim  c6koeunb  c6liuyiw  c6ngjicu  c6songmi  c6yeungc
c6chengl c6fooleo  c6kohyej  c6liyikc  c6ningqi  c6sykesm  c6yeungk
heap@skywolf:/u/csc104h/submit$
```

I counted, and there were 94 submissions that begin with either c5 or c6, which is getting up closer to the class enrolment. I'd better submit what I've got.

The screenshot shows a spreadsheet with a formula bar at the top and a table below. The formula bar contains the formula: $=\max(\text{floor}(A2+(\$C\$2*A2*D2-\$B\$2*A2)),0)$. The table has columns A through G. Row 1 is the header: A: Foxes, B: Fox death rate, C: Fox-mouse eat-and-breed rate, D: Mice, E: Fox-mouse meal rate, F: Mouse birth rate, G: (empty). Row 2: A: 410, B: 0.1, C: 0.0001, D: 1000, E: 0.001, F: 0.41. Row 3: A: 410, B: (empty), C: (empty), D: 1000, E: (empty), F: (empty). Row 4: A: 410, B: (empty), C: (empty), D: 1000, E: (empty), F: (empty).

	A	B	C	D	E	F	G
1	Foxes	Fox death rate	Fox-mouse eat-and-breed rate	Mice	Fox-mouse meal rate	Mouse birth rate	
2	410	0.1	0.0001	1000	0.001	0.41	
3	410			1000			
4	410			1000			

Table 1: On top is a fragment of my Gnumeric spreadsheet showing the formula for the fox population, and below is a fragment showing my formula for the mouse population.