Geology 175
Module 1.2.1 – Supplement: Shell arithmetic

So far you have done basic shell scripting, and have been able to incorporate unix commands into simple shell programs. Let's go a bit further and make scripts to perform basic integer arithmetic.

`expr` and using forward single quotes `…`

The expression command **`expr`** allows newer shell versions to be able to perform arithmetic using the following operators:

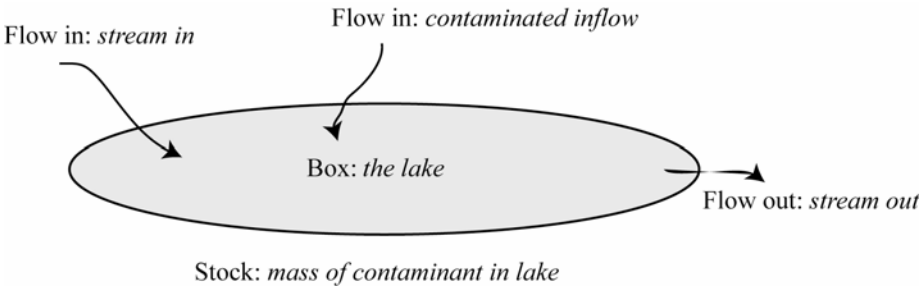
Arithmetic operator	Action/Comment
+	addition
-	subtraction
*	multiplication; must be used in quotation marks, i.e. "*"
/	division
%	modulus (to obtain the remainder from division)

The following script **`maths`** shows how these operators are used:

```
#!/bin/sh
echo "Enter a first number: "
read x
echo "Enter a second number: "
read y
a=`expr $x + $y`
echo "The sum of $x and $y is $a"
b=`expr $x - $y`
echo "The difference of $x and $y is $b"
c=`expr $x "*" $y`
echo "The product of $x and $y is $c"
d=`expr $x / $y`
e=`expr $x % $y`
echo "The quotient of $x and $y is $d with a remainder of $e"
```

Quiz 2

Contaminated water is being dumped into a lake. What will be the concentration of this contaminant in the lake as a consequence? Consider the figure below:



Keeping track of the mass in the lake, designate the flow in units of mass/time and stock in mass:

stream flow in = $Q_{in}C_{in}$
contaminated flow in = Q_cC_c
stream flow out = $Q_{out}C_{lake}$
total mass in lake = $C_{lake}V_{lake}$

$$\frac{\Delta M}{\Delta t} = \frac{\Delta\left(C_{lake}V_{lake}\right)}{\Delta t} = Q_{in}C_{in} + Q_cC_c - Q_{out}C_{lake} \qquad \text{Equation 1}$$

Assuming that you would like to know the maximum concentration, we assume that the lake is in a *steady state* condition, where the in and out flows of the contaminant and the water are equal, and there is no net change in the stock of the contaminant in the lake.

$$\frac{\Delta\left(C_{lake}V_{lake}\right)}{\Delta t} = 0 = Q_{in}C_{in} + Q_cC_c - Q_{out}C_{lake} \qquad \text{Equation 2}$$

Rearranging the equation yields:

$$0 = Q_{in}C_{in} + Q_cC_c - Q_{out}C_{lake}$$
$$Q_{in}C_{in} + Q_cC_c = Q_{out}C_{lake}$$
$$\frac{Q_{in}C_{in} + Q_cC_c}{Q_{out}} = C_{lake} \qquad \text{Equation 3}$$

Instructions

Construct a shell program that will solve for the concentration of the contaminant in the lake. It must ask for the values of stream inflow, contaminated inflow, and discharge outflow, and then do the calculation for C_{lake}. Its output must be a text file containing the values of the parameters that were input, and the resulting concentration.