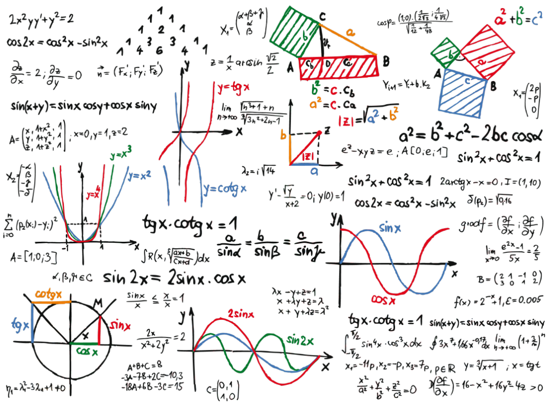
B2 - Mathematics

B-MAT-200

106bombyx

Bombyx booming bylaw



2.1

106bombyx

binary name: 106bombyx
repository name: 106bombyx_*$ACADEMIC_YEAR*
repository rights: ramassage-tek
language: C, C++, python3, perl, ruby, php or bash
compilation: when necessary, via Makefile, including re, clean and fclean rules

- Your repository must contain the totality of your source files, but no useless files (binary, temp files, obj files,...).
- All the bonus files (including a potential specific Makefile) should be in a directory named *bonus*.
- Error messages have to be written on the error output, and the program should then exit with the 84 error code (0 if there is no error).

In the 70's, chaos theory opened the way for a better understanding of the evolution of some animal species. Butterflys for instance. Let's look at... bombyx.

If a generation is crowded, chances are that the next generation will be crowded too, regarding the natural rules of reproduction. But resources may lack for this new generation, so it may not be able to develop. Therefore, the number of bombyx depends on those two contradictory factors, and its evolution is far from trivial.

Let's call x_i the number of the i^{th} generation of butterflys. Here is a model for the evolution of x_i:

$$\begin{cases} x_1 = n & \text{where } n \text{ is the number of first generation individuals} \\ x_{i+1} = kx_i\frac{1000-x_i}{1000}, & \text{for } i \geq 1,\ k \text{ being the \textit{growth rate}, from 1 to 4.} \end{cases}$$

In order to study this evolution, you are asked to plot two things:

- The curve representing the number of individuals in relation to the generation (varying from 1 to 100);
- A synthetic scheme summing all the results for a given n; it consists in plotting every value of x_i (between two given bounds), in relation to k (k varying from 1 to 4 by 0.01 steps).

In both cases, your program shall print on the standard outuput the values to be entered into *gnuplot* to draw the graphes.

Usage

Terminal

```
~/B-MAT-200> ./105torus -h
USAGE
    ./106bombyx n [k | i0 i1]

DESCRIPTION
    n        number of first generation individuals
    k        growth rate from 1 to 4
    i0       initial generation (included)
    i1       final generation (included)
```

Examples

Your program output has to be strictly identical to the one below

Terminal

```
~/B-MAT-200> ./106bombyx 10 3.3 > data
~/B-MAT-200> head data
1 10.00
2 32.67
3 104.29
4 308.26
5 703.68
6 688.10
7 708.24
8 681.89
9 715.82
10 671.29
~/B-MAT-200> tail data
91 823.60
92 479.43
93 823.60
94 479.43
95 823.60
96 479.43
97 823.60
98 479.43
99 823.60
100 479.43
```

Terminal

```
~/B-MAT-200> cat drawer.gnu
set terminal dumb
set nokey
plot "data"
```

Terminal

```
~/B-MAT-200> ./106bombyx 10 10000 10010 > data
~/B-MAT-200> head -n 30 data
1.00 0.10
1.00 0.10
1.00 0.10
1.00 0.10
1.00 0.10
1.00 0.10
1.00 0.10
1.00 0.10
1.00 0.10
1.00 0.10
1.00 0.10
1.01 9.90
1.01 9.90
1.01 9.90
1.01 9.90
1.01 9.90
1.01 9.90
1.01 9.90
1.01 9.90
1.01 9.90
1.01 9.90
1.01 9.90
1.02 19.61
1.02 19.61
1.02 19.61
1.02 19.61
1.02 19.61
1.02 19.61
1.02 19.61
1.02 19.61
```

```
~/B-MAT-200> cat drawer.gnu | gnuplot


1000 +-------------------------------------------------------------------+
     |          +           +          +          +           +    AAAAAA|
 900 |-+                                                      AAAAAAAA A-|
     |                                                   AAAAAAAAAAAAAAAA|
 800 |-+                                             AAAAA    AAAAAAAAAAA|
     |                                             AAA           AAAA AAA|
 700 |-+                                           A             AAAA AAA|
     |                                     AAAAAAAAA             AAAAAAA |
 600 |-+                            AAAAAAAA       AA           AAAAAAAAA|
     |                        AAAAAAA               AAA        AAAA AAAAA|
 500 |-+                  AAAAA                       AAAA   AAAAA AAAAAA|
     |                AAAA                                AAAA  AAAAA A A|
 400 |-+           AAAA                                      AAAAA  A AA-|
     |          AAA                                           AAAA  AA A |
 300 |-+      AAA                                               AAAAAA AA|
     |      AA                                                    AAA AAA|
 200 |-+  AAA                                                      AAAAAA|
     |  AAA                                                          AAAA|
 100 |-AA                                                             AAA|
     |AA        +           +          +          +           +        AA|
   0 +-------------------------------------------------------------------+
     1         1.5          2         2.5         3          3.5         4
```