B4 - Computer Numerical Analysis – Trade

B-CNA-410

Groundhog

Let's get an extended weather forecast today from a jittery, inconsistent, reddish brown rodent

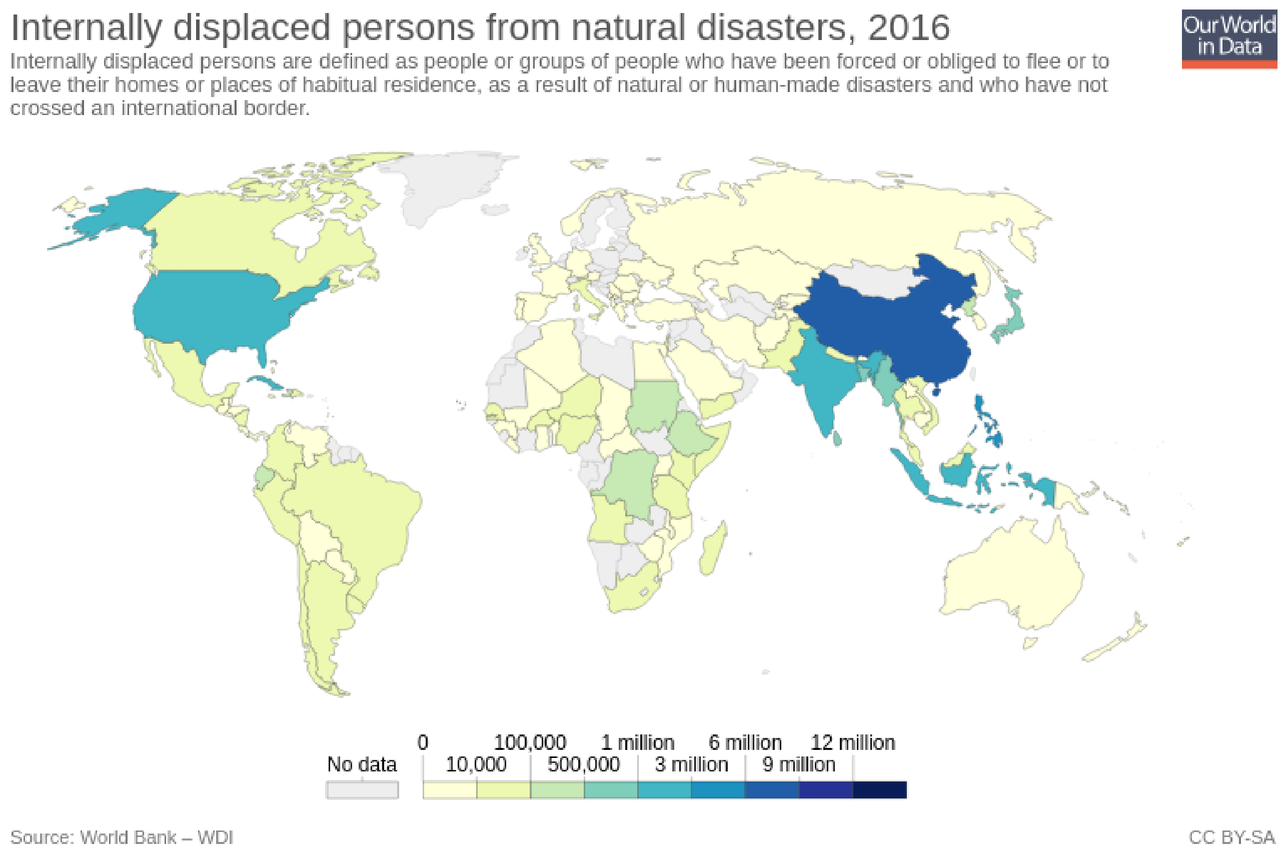
3.0

Groundhog

binary name:	groundhog
language:	everything working on “the dump”
compilation:	via Makefile, including re, clean and fclean rules

- The totality of your source files, except all useless files (binary, temp files, obj files,...), must be included in your delivery.
- 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).

You need to include a Makefile that builds a binary named groundhog - and remove the previous one if it exists



Internally displaced persons from natural disasters, 2016
Internally displaced persons are defined as people or groups of people who have been forced or obliged to flee or to leave their homes or places of habitual residence, as a result of natural or human-made disasters and who have not crossed an international border.
Our World in Data
No data
0
10,000
100,000
500,000
1 million
3 million
6 million
9 million
12 million
Source: World Bank – WDI
CC BY-SA

In 2016, weather disasters caused the displacement of 250 billion people and cost more than 100 billion dollars (*source*).

As usual, be sure to fully understand the meaning of each term that follows, it may be quite helpful!

Several industries rely on weather forecasts: insurance, farming, construction, airlines, shipping, power generation and supply, drinks, clothing, sports, etc... In fact, it's quite challenging to find a business which is not affected by climatic conditions. That's why the weather forecasting market is so burgeoning.

Despite popular opinion, weather forecasts are becoming more accurate than ever. Thanks to ingenious and talented people like you, who use smart tools to get better, faster and stronger predictions than the others.

Your job is to extract some relevant information from the data received in real-time on standard input (each float representing a temperature), in order to detect weather **aberrations** (droughts, severe colds, hurricanes or any other extreme climatic condition whatsoever) as soon as possible.

> ***aberration****: deviation from what is normal, expected, or usual.*
> ***forecast****: a forecast is a statement of what is expected to happen in the future, especially in relation to a particular event or situation.*
>
> *collinsdictionnary.com*

Later, you may want to predict things on another timescale.

To do so, your program must, given a number of days (called *period*) as argument:

1. **wait** for the next value to be written on the standard input,
2. output, once enough data has been gathered, some technical indicators:
   a. the **temperature increase average**, *g*, observed on the last period (decrease in temperature are not taken into account),
   b. the **relative temperature evolution**, *r*, between the last given temperature and the temperature observed n-days ago,

   c. the **standard deviation**, *s*, of the temperatures observed during the last period,
   d. when appropriate, an **alert** as soon as it detects a switch in global tendency,

3. return to the first step, until the *STOP* keyword is read.

It is impossible to detect a switch at the precise moment it happens - otherwise your algorithm would be way too sensitive to noise. However, you need to detect it quite soon, not at the very end of the algorithm.

Eventually, once the keyword is entered, it must output:

1. the total number of tendency switches observed on the whole time-series,
2. the list of the five biggest aberrations observed on the whole time-series (sorted by decreasing weirdness).

A tendency is perceived when the temperatures are moving in a particular direction over time.

When it can be done, there is not one unique method to define trend.
As a consequence, outputs may vary from one program to another.
Keep calm and carry on coding: your program will be proved with reasonable tests.

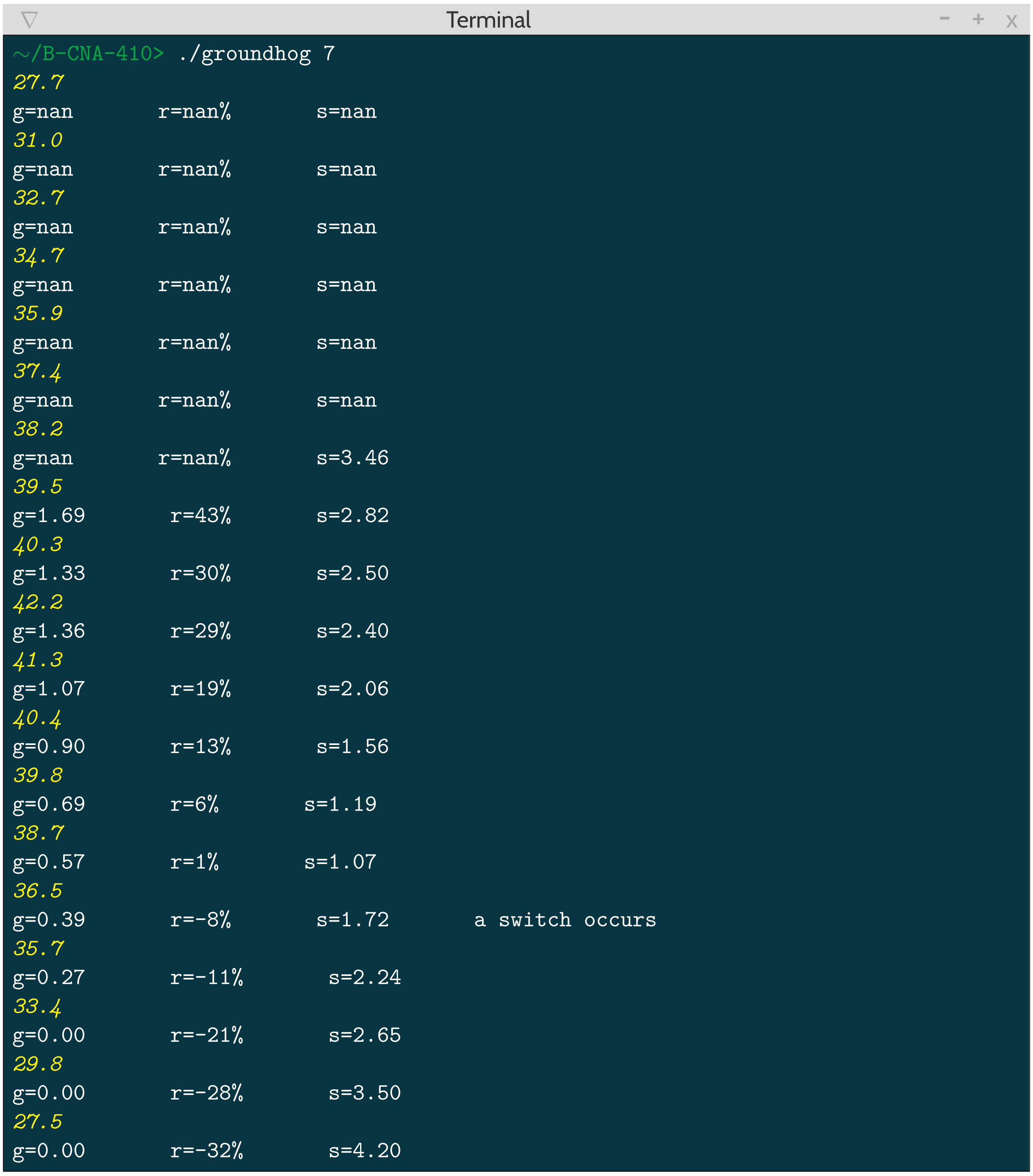
```
~/B-CNA-410> ./groundhog -h
SYNOPSIS
    ./groundhog period

DESCRIPTION
    period        the number of days defining a period
```

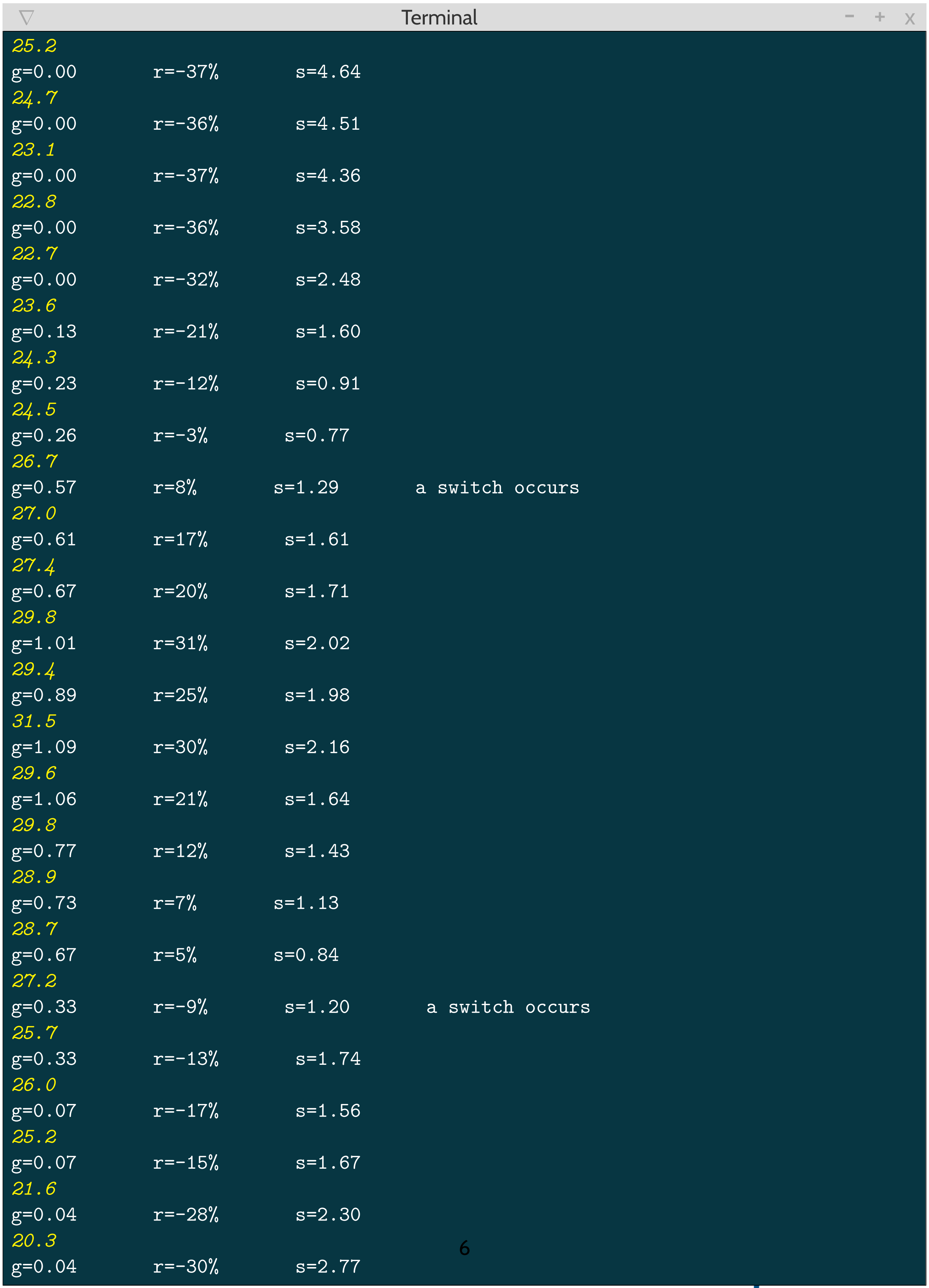
Rigor is one key to success. Be thorough and stay accurate.

Example

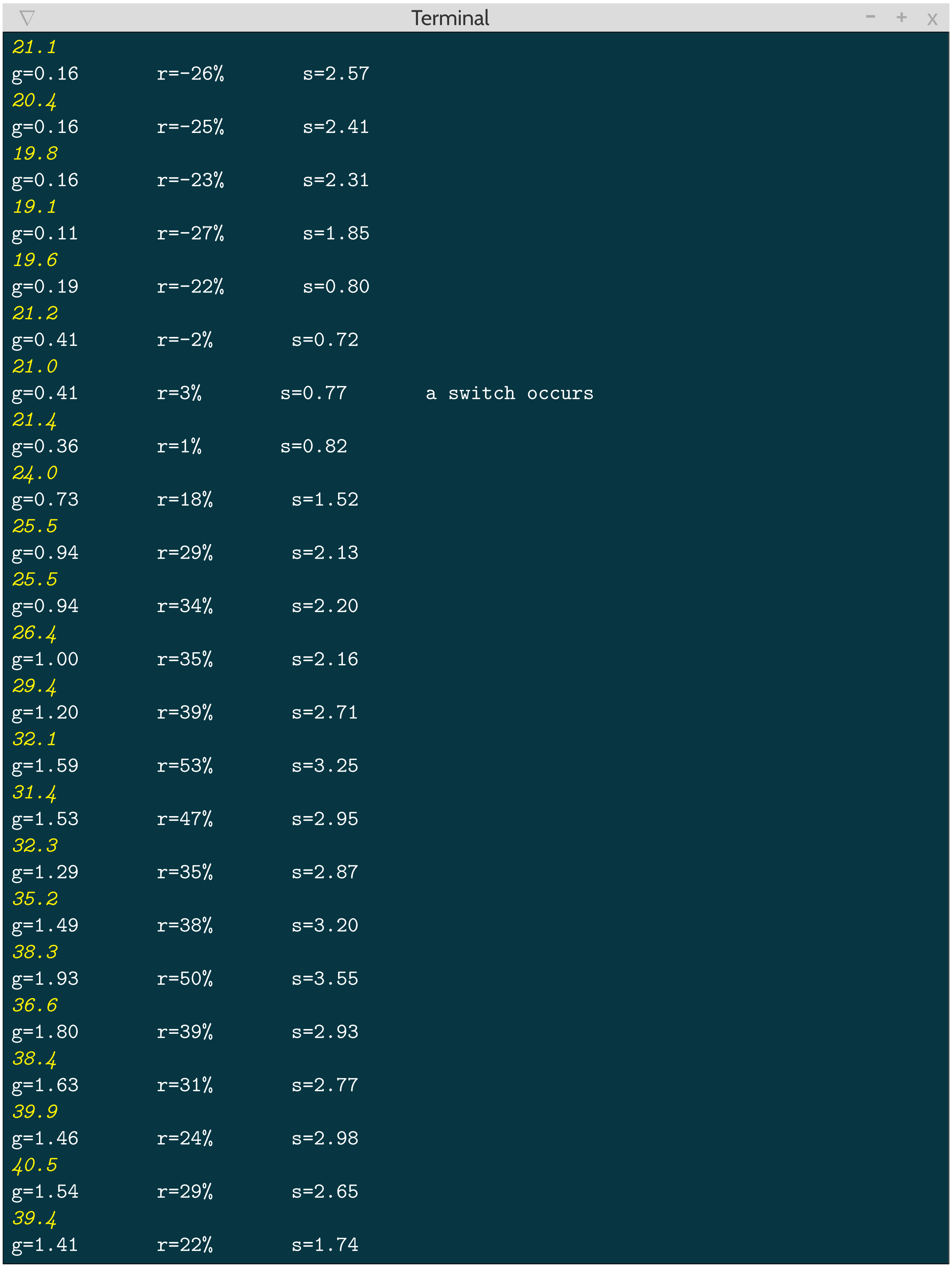
You are expected to respect the following output formatting!



```
~/B-CNA-410> ./groundhog 7
27.7
g=nan        r=nan%       s=nan
31.0
g=nan        r=nan%       s=nan
32.7
g=nan        r=nan%       s=nan
34.7
g=nan        r=nan%       s=nan
35.9
g=nan        r=nan%       s=nan
37.4
g=nan        r=nan%       s=nan
38.2
g=nan        r=nan%       s=3.46
39.5
g=1.69        r=43%       s=2.82
40.3
g=1.33        r=30%       s=2.50
42.2
g=1.36        r=29%       s=2.40
41.3
g=1.07        r=19%       s=2.06
40.4
g=0.90        r=13%       s=1.56
39.8
g=0.69        r=6%       s=1.19
38.7
g=0.57        r=1%       s=1.07
36.5
g=0.39        r=-8%       s=1.72       a switch occurs
35.7
g=0.27        r=-11%       s=2.24
33.4
g=0.00        r=-21%       s=2.65
29.8
g=0.00        r=-28%       s=3.50
27.5
g=0.00        r=-32%       s=4.20
```



```
25.2
g=0.00       r=-37%       s=4.64
24.7
g=0.00       r=-36%       s=4.51
23.1
g=0.00       r=-37%       s=4.36
22.8
g=0.00       r=-36%       s=3.58
22.7
g=0.00       r=-32%       s=2.48
23.6
g=0.13       r=-21%       s=1.60
24.3
g=0.23       r=-12%       s=0.91
24.5
g=0.26       r=-3%       s=0.77
26.7
g=0.57       r=8%       s=1.29       a switch occurs
27.0
g=0.61       r=17%       s=1.61
27.4
g=0.67       r=20%       s=1.71
29.8
g=1.01       r=31%       s=2.02
29.4
g=0.89       r=25%       s=1.98
31.5
g=1.09       r=30%       s=2.16
29.6
g=1.06       r=21%       s=1.64
29.8
g=0.77       r=12%       s=1.43
28.9
g=0.73       r=7%       s=1.13
28.7
g=0.67       r=5%       s=0.84
27.2
g=0.33       r=-9%       s=1.20       a switch occurs
25.7
g=0.33       r=-13%       s=1.74
26.0
g=0.07       r=-17%       s=1.56
25.2
g=0.07       r=-15%       s=1.67
21.6
g=0.04       r=-28%       s=2.30
20.3
g=0.04       r=-30%       s=2.77
```



```
21.1
g=0.16         r=-26%         s=2.57
20.4
g=0.16         r=-25%         s=2.41
19.8
g=0.16         r=-23%         s=2.31
19.1
g=0.11         r=-27%         s=1.85
19.6
g=0.19         r=-22%         s=0.80
21.2
g=0.41         r=-2%        s=0.72
21.0
g=0.41         r=3%        s=0.77         a switch occurs
21.4
g=0.36         r=1%        s=0.82
24.0
g=0.73         r=18%        s=1.52
25.5
g=0.94         r=29%        s=2.13
25.5
g=0.94         r=34%        s=2.20
26.4
g=1.00         r=35%        s=2.16
29.4
g=1.20         r=39%        s=2.71
32.1
g=1.59         r=53%        s=3.25
31.4
g=1.53         r=47%        s=2.95
32.3
g=1.29         r=35%        s=2.87
35.2
g=1.49         r=38%        s=3.20
38.3
g=1.93         r=50%        s=3.55
36.6
g=1.80         r=39%        s=2.93
38.4
g=1.63         r=31%        s=2.77
39.9
g=1.46         r=24%        s=2.98
40.5
g=1.54         r=29%        s=2.65
39.4
g=1.41         r=22%        s=1.74
```

```
39.0
g=1.00       r=11%       s=1.18
40.5
g=0.77       r=6%       s=1.27
42.1
g=1.00       r=15%       s=1.12
38.7
g=0.74       r=1%       s=1.07
37.5
g=0.53       r=-6%       s=1.39       a switch occurs
38.1
g=0.53       r=-6%       s=1.43
36.5
g=0.53       r=-7%       s=1.74
35.4
g=0.53       r=-9%       s=2.13
STOP
Global tendency switched 5 times
5 weirdest values are [26.7, 24.0, 21.6, 36.5, 42.1]
```

Bonus

You could implement a lot of extra features that you may find relevant (and will be very useful for the trade algorithm anyway):

- a graphical interface
- a forecast for the next days
- an evaluation of the difference between your forecast and the actual result
- different metrics for detecting switches and/or outliers
- a benchmark of various methods

Analysis relies on observation, so diagrams could be a (huge) advantage, and should easily be an extra feature!