IF 100 - Fall 2017
Homework 3
Due November 29th 2017 Wednesday 23:55 (Sharp Deadline)

In this homework, you will implement the D'Hondt method, the method used for calculating how many seats each party will get in the parliament after an election. You will have a chance to work on a real dataset which is the result of the general election of 2002 in Turkey.

Proportional representation systems aim to allocate seats to parties approximately in proportion to the number of votes received. For example, if a party wins one-third of the votes then it should gain <u>about</u> one-third of the seats. In general, exact proportionality is not possible because these divisions produce fractional numbers of seats. As a result, several methods, of which the D'Hondt method is one, have been devised which ensure that the parties' seat allocations, which are of course whole numbers, are as proportional as possible.

Legislatures using this system include those of Albania, Argentina, Armenia, Austria, Belgium, Brazil, Bulgaria, Cambodia, Cape Verde, Chile, Colombia, Croatia, the Czech Republic, Denmark, the Dominican Republic, East Timor, Ecuador, Estonia, Fiji, Finland, Guatemala, Hungary, Iceland, Israel, Japan, Kosovo, Luxembourg, Macedonia, Moldova, Montenegro, Netherlands, Northern Ireland, Paraguay, Peru, Poland, Portugal, Romania, Scotland, Serbia, Slovenia, Spain, Turkey, Uruguay, and Wales.

Typically, the country is divided into *electoral districts* (also called as *voting districts*, or simply *districts*). In Turkey, each city is considered to be a separate electoral district. For some elections, big cities (like Istanbul, Ankara, etc.) are divided into smaller electoral districts (like Istanbul-1, Istanbul-2, etc). However, in this homework, we will consider each city as an electoral district. Each electoral district is given a certain number of seats, which is the total number of members of parliament to be elected from that district. For example, Istanbul sends 70 members, whereas Bolu sends 3 members to the parliament, which has 550 seats in total.

After the votes for the parties are counted within an electoral district, the D'Hondt method is used to calculate the number of seats each party will get in that district. The D'Hondt method is an iterative process, where each party is given a number

$$N = \frac{V}{(s+1)}$$

where
- V is the total number of votes that party received, and
- s is the number of seats that party has been allocated so far (s is initially 0 for all parties).

At each stage, the party with the highest N value is given a seat, and that party's s value goes up by one. This iterative process continues until all seats in the electoral district is allocated.

Let's give an example of how the D'Hondt algorithm works. Assume that a given electoral district has 5 seats to be allocated; and there are 3 parties, called as Party A, Party B, and Party C. Let's say in this district Party A, B, C got 100, 80 and 35 votes respectively.

STAGE	Seats taken by Party A so far (s for A)	Seats taken by Party B so far (s for B)	Seats taken by Party C so far (s for C)	N for Party A (V=100)	N for Party B (V=80)	N for Party C (V=35)
1	0	0	0	**100**	80	35
2	1	0	0	50	**80**	35
3	1	1	0	**50**	40	35
4	2	1	0	33.33	**40**	35
5	2	2	0	33.33	26.66	**35**
RESULT	2	2	1	33.33	26.66	17.5

Bold values in each row of the table indicates the maximum N value in that stage. For the example above, the D'Hondt method will allocate 2 seats to Party A, 2 seats to Party B, and 1 seat to Party C.

Prepared Dataset

For this homework, we provide you with a real dataset file (**elections_2002.py**) in the attachment, and this file contains the election results of 2002 in Turkey (we have omitted independent candidates for the simplicity of the homework). We have some variables that contain information regarding the elections. We will now explain these variables.

```
partyNames = ["Adalet ve Kalkınma Partisi", "Cumhuriyet Halk
Partisi", "Doğru Yol Partisi", "Milliyetçi Hareket Partisi",
"Genç Parti"]
```

partyNames is actually a list of strings, and it contains the names of the political parties.

```
countrywidePercentages = [34.28, 19.39, 9.54, 8.36, 7.25]
```

countrywidePercentages is another list which contains float values. These float values are percentage of votes that the parties got across the country. Any index of the *countrywidePercentages* represents the percentage of the corresponding party that is located in the same index of *partyNames* list. For instance, *"Adalet ve Kalkınma Partisi"* has 34.28 percent of the all the votes, *"Cumhuriyet Halk Partisi"* has 19.39 percent of all the votes across the country. Hence when you look at the data, you will realize that the length of *partyNames* and *countrywidePercentages* are the same.

We have a long list called as *electoralDistricts* containing the names of the electoral districts in Turkey. For each electoral district, the deputy numbers (i.e. the number of seats) for that district is given at the same index of the list *districtDeputyNumbers*. For instance, *electoralDistricts[0]* is "Adana" and *districtDeputyNumbers[0] is* 14, which means that Adana has 14 seats. Similarly, *electoralDistricts[1]* is "Adıyaman" and *districtDeputyNumbers[1] is* 5, which means that Adıyaman has 5 seats. Again, when you look at the data, you will realize that the length of *electoralDistricts* and *districtDeputyNumbers* are the same.

We have one more variable which is *voteNumbersOfParties*. This variable is actually a list of lists; and every sublist represents the number of votes of each political party for the corresponding electoral district which is located at the same index of *electoralDistricts* list. Additionally, every integer value in these sublists indicates the corresponding vote number of the party that is located in the same index of *partyNames* list. For instance, very first sublist at the 0th index of *voteNumbersOfParties* is the following sublist:

$$[229729, 182436, 98440, 97700, 75464]$$

This sublist represents the number of votes of each political party for the electoral district located at the 0th index of *electoralDistricts* which is "Adana". Additionally, 229729 is the number of votes of *"Adalet ve Kalkınma Partisi"* in "Adana", 182436 is the number of votes of *"Cumhuriyet Halk Partisi"* in "Adana", and so on. Similarly, the length of *voteNumbersOfParties* is equal to the length of *electoralDistricts* and *districtDeputyNumbers*.

In order to be able to use these variables in your newly created homework file (***username_hw3.py***), you should write the following line to the beginning of your program:

```
from elections_2002 import *
```

Note that, your ***username_hw3.py*** and ***elections_2002.py*** files should be located in the same directory (folder) on your computer.

Inputs and Outputs
There will be only a single input of your program, the index of the district. Since we have 81 districts in our data, the input should be between 0 and 80 (both are inclusive). Otherwise, you should give an error message and terminate the program. Additionally, you may assume that the input is composed of digits.

If the input entered is in the correct range, then you should print the name of the district and the number of deputies allocated for each party in that district on separate lines, after calculating the allocated deputy counts for each party by using the D'Hondt algorithm. Note that, while calculating the allocated deputy counts for each political party, you will assume that there is no threshold (barrage) value across the country. Thus, we will consider each vote of the political party even if they got small number of votes in a district.

One important point is that the format (sentences, spaces, newlines, order, and everything) of the input and the output should be exactly the same with the sample runs. The reason is that we will automatize the process of grading your homeworks. Therefore there should be an exact match in order to get a full grade. Please see sample runs for the input and output format.

Sample Runs

Below, we provide some sample runs of the program that you will develop. The *italic* and **bold** phrases are inputs taken from the user. Again, we want to emphasize that every single character (even spaces) in input and output should be exactly same with the sample run. Whenever you see a space in the sample runs, it means a single space (not multiple consecutive spaces).

Sample Run 1:

```
Please enter an index between 0 and 80 (both are inclusive): 81
You entered an invalid input!!!
```

Sample Run 2:

```
Please enter an index between 0 and 80 (both are inclusive): 0
Results for Adana as follows:
Adalet ve Kalkınma Partisi: 5
Cumhuriyet Halk Partisi: 4
Doğru Yol Partisi: 2
Milliyetçi Hareket Partisi: 2
Genç Parti: 1
```

Sample Run 3:

```
Please enter an index between 0 and 80 (both are inclusive): 20
Results for Bursa as follows:
Adalet ve Kalkınma Partisi: 9
Cumhuriyet Halk Partisi: 3
Doğru Yol Partisi: 2
Milliyetçi Hareket Partisi: 1
Genç Parti: 1
```

Sample Run 4:

```
Please enter an index between 0 and 80 (both are inclusive): 1
Results for Adıyaman as follows:
Adalet ve Kalkınma Partisi: 4
Cumhuriyet Halk Partisi: 1
Doğru Yol Partisi: 0
Milliyetçi Hareket Partisi: 0
Genç Parti: 0
```

Sample Run 5:

```
Please enter an index between 0 and 80 (both are inclusive): 37
Results for Iğdır as follows:
Adalet ve Kalkınma Partisi: 0
Cumhuriyet Halk Partisi: 1
Doğru Yol Partisi: 0
Milliyetçi Hareket Partisi: 1
Genç Parti: 0
```

How to get help?

You may ask questions to TAs, LAs or instructors. Information regarding the office hours of the TAs, LAs and the instructors are available at the SUCourse.

What and where to submit?

You should prepare (or at least test) your program using Python 3.6.x. We will use IDLE with Python 3.6.x while testing your homework.

It'd be a good idea to write your name and lastname in the program (as a comment line of course).

Submission guidelines are below. Students are expected to strictly follow these guidelines in order to have a smooth grading process. If you do not follow these guidelines, depending on the severity of the problem created during the grading process, 20 or more penalty points are to be deducted from your grade.

Name your py file that contains your program as follows:

"username_hw3.py"

For example: if your SuCourse username is "*inancarin*", then the name of the py file should be: ***inancarin_hw3.py***

Please make sure that this file is the latest version of your homework program.

<u>However, this is not the only file that you will submit. In this homework, **you will submit two files** together in one submission:</u>
username_hw3.py and ***elections_2002.py***
<u>If you forget to submit any of these files, then your program may not be executed and your grade may become 0.</u>

You may visit the office hours if you have any questions regarding submissions.

General Homework Rules
- Successful submission is one of the requirements of the homework. If, for some reason, you cannot successfully submit your homework and we cannot grade it, your grade will be 0.
- There is NO late submission. You need to submit your homework before the deadline. Please be careful that SUCourse time and your computer time <u>may</u> have a 1-2 minutes differences. You need to take this time difference into consideration.
- Do NOT submit your homework via email or in hardcopy! SUCourse is the only way that you can submit your homework.
- If your code does not work because of a syntax error, then we cannot grade it; and thus, your grade will be 0.
- Having a correct program is necessary, but not sufficient to get the full grade. Comments, meaningful and understandable identifier names will also affect your grade.
- Please do submit your **<u>own</u>** work only (even if it is not working correctly). It is really easy to find out "similar" programs!
- Plagiarism will not be tolerated. Please check our plagiarism policy given in syllabus of the course.

Good luck!
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