

**IDC101 (Introduction to Computation) :
Lab Exercise 8(a) :****General Instruction :**

First decide how you will solve the problem on paper. Only after this, you should start writing your program.

Here's the checklist :

- a) Read the problem carefully. Decide the inputs required.
 - b) Decide your step-by-step algorithm. That is, decide how you will solve your problem step-by-step.
 - c) Then, write your program following your algorithm.
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1. Two sample programs are given to you; `food1.py` and `food2.py`. Run these programs and understand how they work. In `food2.py`, an external file is opened and the result of the program is written to it. Understand how files can be opened, results written and closed. Spend some time to understand all the features of these two programs. You will have to use these features in the next two problems.

2. A data file `food.dat` is given to you. Write a python program to compute the following quantities. Your program should write the output to an external file and not display the result on the computer screen.

- a) Number of rows and columns in the data.
- b) Average of each column of data.
- c) During the three decades from 1997 to 2000, what is the average increase (per decade) in the production of rice and wheat.
- d) Write the following output : first column should be years and second column should be the corresponding sugarcane production.
- e) Write the following output : first column should be the years. Second column should be the sum of production of cereals, pulses, rice, wheat, jowar, maize and bajra.
- f) Consider the years between 2007 to 2011. For each crop, list the years in which the food production in any year was lower than the previous year.
- g) Consider the crop production data for the years 1970 and 2011. For each crop, calculate the percentage increase in the crop production with respect to the production in 1970.

3. You are given another data file ; `rainfall.dat`

This data is obtained from `data.gov.in`. This file gives monthly rainfall in millimeters for every month for years from 1901 to 2014. Compute the following quantities and write the result to an external output file;

- a) Annual summer rainfall is defined as the sum of the rainfall received during the months June, July, August and September. Compute the annual summer rainfall for all the years. Compute the average annual rainfall. This average is often called the long-term average rainfall.
- b) According to India Met Department, a year is said to be a drought year if the annual rainfall in that year is less than 90% of the long-term average. Use this criteria and compute a list of year since 1901 when droughts have occurred.
- c) Similarly, excess rainfall years are those in which the annual rainfall is more than 110% of long term average. Compute a list of excess rainfall years.
- d) Find the standard deviation of the annual rainfall. Compute some interesting statistics; Find the maximum and minimum annual rainfall and the years in which they occurred. Find the historical max and min rainfalls each month. For example, you should be able to answer questions such as, “Historically, what is the minimum rainfall recorded in the month of March ?”.
- e) The rainfall in Oct-Nov-Dec mainly comes from north-east monsoon, which affects some parts of south India. For each year, compute the sum of rainfall during Oct-Nov-Dec. Also, compute (for each year) what percentage of summer rainfall is the north-east monsoon rainfall.
- f) Let's do a simple prediction algorithm. Let us say that the predicted rainfall R_{pre} in a given year is just the average observed rainfall values R_{obs} during the previous 10 years. Use this technique and predict the annual rainfall for the years from 2000 to 2014. Find how effective was this prediction technique by computing prediction error. Percentage prediction error is given by,

$$p = \left| \frac{R_{pre} - R_{obs}}{R_{obs}} \right| 100$$

In this, R_{obs} is the observed data given to you in the data file.

Your final output should give the following three-column data;
year, predicted rainfall, percentage error.

The output should be written to an external file.