MM2090 : Introduction to Scientific Computing
April-June-2021

Assignment – 1

Make a PDF of your assignment submission clearly indicating on the first page showing your roll number, name, batch and for each solution, the corresponding question number. Shrink or reduce the resolution of the images if your PDF is larger than 10 MB. Upload the PDF on the moodle site in the link provided for assignment-1. You can use `pdftk` to bundle different PDF documents together in a particular sequence. Make sure your script is included as a text (and not image) so that the TAs could copy-paste and check if it works the way you described.

[1] Download and use RollList.csv for this question. Assume that each year the hostel fee of freshers is incremented by 10 percent of the previous year's fees. This fee you pay as a fresher continues to be paid every semester thereafter without increment. Eg., fees for students who joined in 2018 will be lower than those who joined in 2019, but the 2019 batch will pay the same fees every semester and so on. The students who joined in the year 2017 had to pay INR 20,000 as hostel fees.
The solution includes a script to calculate and the output of total fees received this semester by the hostel administration from the students on the Roll List. [2 Marks]
Hint: You can use a shell script or awk script to achieve this.
Application: Minor numerical operations on a regular dataset in a csv file is a typical task in data analysis.

[2] As part of data file submission to a platform, the administrator needs to create a set of initial passwords for the students. The password creation is done in the following way. The first part of the password is department code in capital letters followed by the numeric part of the roll number (the last 3 characters of the roll number) followed by the length of the string in their name (this will also count the spaces). Followed by the program in which the student is enrolled in small letter. For example, if the roll number is ME18B009 and the name is Bharath Chandar then the password will be ME00915b. Use the RollList.csv file available from the above question and write a script to generate the password for all the students.
The solution includes the script and the password list. [2 Marks]
Hint: You can use a shell script or awk script to achieve this.
Application: Applications may need to generate clear text passwords according to certain rules to be given to first time users.

[3] Download the file screenshots.tar.gz from course page on the moodle site. The screenshots contain images of the terminal window with few commands that expose the hardware / configuration details of my laptop I use for this course instruction. You need to make a clean pdf that contains two terminal images per page. This involves trimming of the images. Your script should take the pixel values for trimming as a user input and then do the task automatically for all the images in the directory and generate the pdf.
The solution includes the script and one sample page the output pdf. [2 Marks]
Hint: Install imagemagick with `sudo apt install imagemagick` and check man page of `convert` command.
Application: You may need to trim a large set of images from an experiment and use them for image analysis, to create a video sequence and to extract events. High speed imaging

of experiments is an important scientific technique.

[4] Discuss within your group and pick one hardware item type that is different from the rest of the group. The groupings are listed in the roll list in the folder for the course on google drive. Look up the internet to identify at least 3 latest entries of that hardware item and put down their specs. Comment what kind of gadgets / workstations / servers / clusters from OEMs include such a hardware item. Give the source of your information. (a) CPU (b) GPU (c) DRAM (d) SATA hard disc (e) Network switches for cluster (f) Network card.
The solution includes a tabular listing of specs along with source of information as a reference below. [2 Marks]
Hint: Start with leading OEMs for these items using wikipedia and then look up latest releases.
Application: One should know hardware limitations for program execution as part of scientific computing in real life.

[5] Download the transcripts of text chat from the google drive folder for this course into a folder. Create a script that can calculate your attendance as a percentage by looking for your roll number in each of the files.
The solution includes the script, total number of transcript files considered, lecture numbers missed and attendance percentage. [2 Marks]
Hint: Use the features of grep and wc for the task.
Application: When you run a large FEM program, you receive a log output in which certain warnings will be listed about change of algorithm or convergence failure etc., Looking for their occurance and analysis is a part of engineering simulation work.

[6] In the following URLs, the atomic radii are given as a list that you can readily copy-paste into a csv file.

`http://crystalmaker.com/support/tutorials/atomic-radii/index.html`

or

`https://en.wikipedia.org/wiki/Atomic_radii_of_the_elements_(data_page)`

Skip empty rows as needed. Pick an element that has the atomic number ending with the same digit as your roll number and list all elements whose atomic radii are within a certain percentage. Choose this percentage to be 10% to start with and increase if needed to be able to list at least 3 elements that are of comparable size.
The solution includes your script, the element chosen, its radius in picometers, criterion for closeness in size and the list of elements that are close in size. [3 Marks]
Hint: First create a csv file for input data and try a mix of shell and awk scripts.
Application: Analysis of data available in the open domain in not so readily usable form is part of scientific computing research. Webpage scraping, scripts to atomate it and storing historical data is part of research.

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