Problem Set 3

This problem set is due **at 11:59 PM** on **Thursday, November 18, 2021.**

Please make note of the following instructions:

- This assignment, like later assignments, consists of *exercises* and *problems*. **Hand in solutions to the problems only.** However, we strongly advise that you work out the exercises for yourself, since they will help you learn the course material. You are responsible for the material they cover.
- Remember that this problem set requires submissions both on **Gradescope** and **Classroom**. If you haven't done so already, please signup for this course on Gradescope, with the entry code 4PZV7W.
- For the coding parts of problems **3-1, 3-2, and 3-3**, name each .py file according to the problem number and zip all the files into a single zipped folder. It should be named as: **FirstName_LastName_PSET3.zip**. Remember to include the given *.txt* files in your zip. Finally, submit this on Classroom. Note, incorrect formatting will receive negative marking.
- On Gradescope, we require that your solutions are submitted as a single PDF file. Each submitted solution should start with your name, the course number, the problem number, the date, and the names of any students with whom you collaborated. Each problem should start on a new page (sub-parts need not follow this rule).
- You may be called upon to "give an algorithm" to solve a certain problem. Your write-up should take the form of a short essay. A topic paragraph should summarize the problem you are solving and what your results are. The body of your essay should provide the following:
  1. A description of the algorithm in English, step by step.
  2. Optionally, a proof (or indication) of the correctness of the algorithm. ("Why is this correct?" – we will explicitly ask for this on occasion). You may find it useful to include a worked example or diagram to show more precisely how and why your algorithm works.
  3. An analysis of the asymptotic running time behavior of the algorithm. (You'll learn what this is later in the semester.)

EXERCISES (NOT TO BE TURNED IN)

Art and Craft

- Read the book ”The soul of a new machine” by Tracy Kidder.
- If you want to kill some time, check out XKCD comics.
- Watch the episode ”The Entire History of You” of the TV show ”Black Mirror” and think about the merits and demerits of being surrounded by technology, and devices continuously recording user data. Think about whether you are okay with the piece of technology featured in the episode.
- Read the following article by Jonathan Franzen-”Liking is for cowards, go for what hurts”. It may turn out to be more useful than it seems - `https://www.nytimes.com/2011/05/29/opinion/29franzen.html`

Reading

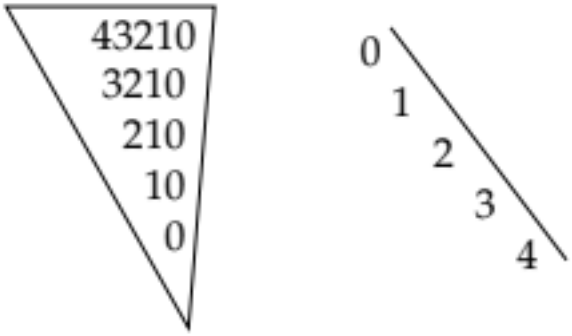
In general, you should read everything that is posted on Google Classroom. You should be able to find everything listed below for free on the internet.

- Read ”Discipline and Punish” by Michel Foucault
- Read the entire article to get a better sense of what privacy means in today’s world: `https://magazine.factor-tech.com/factor_winter_2017/richard_stallman_and_the_vanishing_state_of_privacy`
- Check out the ’Privacy Project’ by the New York Times. While this reading is not essential, it can help you with answering this PSET. You can find it at: `https://www.nytimes.com/interactive/2019/opinion/internet-privacy-project.html`
- Ever wondered what those small-font 1000 line privacy policies that you click ”I Agree” impulsively on contain? Read this: `https://www.nytimes.com/interactive/2019/07/10/opinion/google-privacy-policy.html`

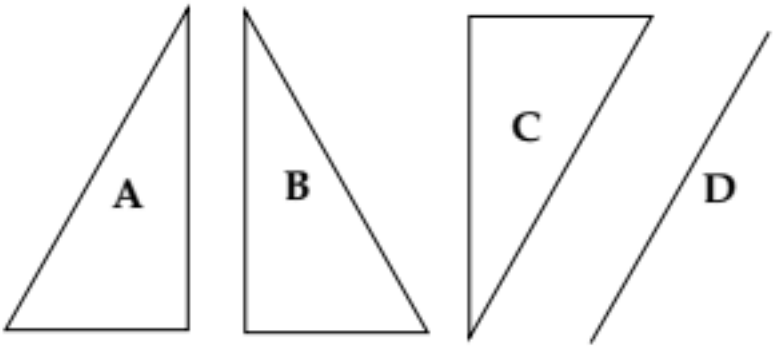
Problem 3-1. Trikon [25 points]

A 'cool triangle' is an increasing/decreasing lists of consecutive integers stacked over each other in a way that aligns each list's start or end-point with every other list's start or end-point respectively. Similarly a 'cool diagonal' is a list of consecutive integers arranged in a way that represents a diagonal. To be clear - these triangles and diagonals are just numbers and whitespace. We don't actually want you to draw any triangles or diagrams. We just want you to print numbers and whitespace.

You are given the code to print a 'cool triangle' and a 'cool diagonal' in file *3-1.py*. They look something like this. (The lines are not for reproduction, only for guidance) The



same code can be used to print these following figures as well (just imagine that there are numbers inside).



(a) [15 points] How would you modify the given code, or write new code to print the triangles, A, B, and C?

(b) [10 points] How would you print the diagonal D?

Implement your modifications in python for both these sub-parts.

Problem 3-2. Subliminal *Speak*ing [30 + 20 Extra Credit points]

The recent number of late assignment submissions in the course *Foundations of Computer Frogramming* has soared significantly. Late submissions result in additional work for the Teaching Assistants and are, therefore, a source of tremendous tribulation. The typically tenacious TAs currently have a tenuous work-life balance and are, therefore, at the end of their tethers. The TAs who thrive on schadenfreude are tired of perfunctory warnings and decide to devise a creative scheme that will serve to discipline some of the recalcitrant students.

The TAs have the timestamps of all the students' assignments and want to identify the 20 students who submitted last. They decide to penalize these 20 students by forbidding them from using any indentations in the frogramming question of the next assignment. They decide to use a modified version of the quickSort algorithm to get these names, but are too impatient to implement it themselves.

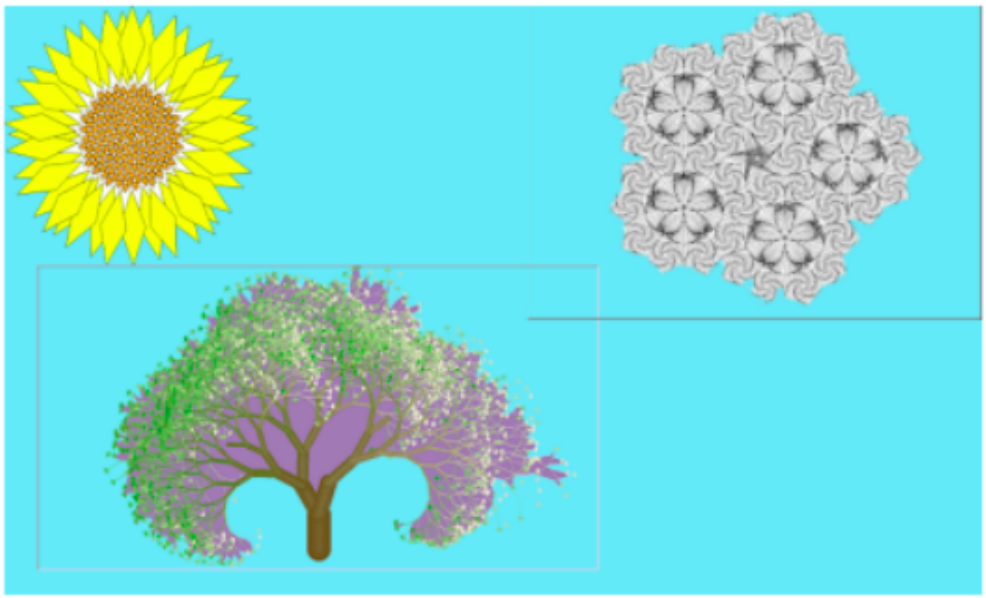
Eager to curry favor with them, you volunteer to change the quickSort algorithm so that you can output the names of the 20 students who submitted the last, as fast as you can. To be clear - given a list of students with respective timestamps of their submissions, your modified quickSort algorithm needs to output the names of the students that have the 20 latest timestamps in the data set (The ordering of the output set does not matter as long as given constraints are met).

Extra Credit [20 points**]**: Another student has managed to modify the quickSort before you. Unwilling to give up, you decide to use another sorting algorithm whose worst case complexity (for this problem) is $O(n)$. Justify your choice of algorithm, explain your modifications and implement it in python.

Problem 3-3. Some Art is More Equal Than Others [25 points]

While experimenting with turtle we saw that sometimes the combination of various patterns result in even more (although unsymmetrical) beautiful shapes/designs. Your task, should you choose to accept it, is to explore the capabilities of turtle and try to come up with one such strikingly fascinating image (made using turtle, of course).

You must, however, include an epicycloid-like shape in your art. It can be of any form with however many cusps you'd like. Mention where you've used this shape. You may combine various spirals, use multiple patterns together, maybe even draw inspiration from your favorite cartoon (a nicely drawn and colored Pikachu should be good enough) or do something else entirely. The ball is in your park. Surprise us.



Think of the drawings in the above figure as the gold-standard for what you can achieve (yes, these were drawn using turtle)

Problem 3-4. Our Orwellian Reality [25 points]

The term ”Internet of Things” has been gaining a lot of popularity lately. There have been many questions raised about user privacy when it comes to being surrounded by devices that collect all sorts of data and are continuously connected to the internet. Go through the given readings to find out more about the impact of the internet of things on privacy. You have been provided with differing opinions and you may choose to side with either of them.

How would you define privacy and do you think it should be a fundamental right? Do you find similarities between big tech companies collecting their users' data and the Panopticon mentioned in *Discipline and Punish*?

Also, comment on the extent to which you would be willing to trade your privacy for comfort.