MAC0214 - Extracurricular Activities

15/3 Project proposal

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First Semester of 2019

OBJECTIVE

Last semester, I was sincerely amused to discover the Fenwick Tree data structure, which can speed up a $\mathcal{O}(n)$ linear probing to $\mathcal{O}(\log n)$. Although representing only a modest improvement to a greedy or dynamic programming algorithm, this simple and easy to implement detail makes up an impressive practical gain.

With that in mind, the purpose of this project is to learn algorithms and data structures not covered by MAC0121 - Algorithms and Data Structures I, MAC0323 - Algorithms and Data Structures II, MAC0338 - Analysis of Algorithms and other mandatory courses in the Bachelor of Computer Science at IME-USP.

METHODOLOGY

The competitive programing problems offer a neat environment to both development algorithm design and enrich an undergraduate CS student's data structures tool belt. Every problem solved during the semester will be tagged accordingly with its strategies, e.g. in Table 1. This compiled problem sheet will offer to both myself and my colegues not only a fast look up for algorithms and data structures, but also a list of use cases to understand and practice them.

Since the project focuses on algorithmic problem solving, usually from Codeforces, SPOJ, URI, HackerRank, CodeChef and MaratonUSP lists, [CRLS] and [SW] are the base reference books. Nonetheless, more specific texts may be added for more advanced formulations, such as number theory or discrete computacional geometry.

SCHEDULE

As a very conservative approach to fulfill the required hundred hours, from March 15 to June 30, Table 2 contains a detailed schedule of problems carefully chosen, considering their contexts and strategies. Ranging from lower- to upper-intermediate difficulty, it is safe to state that each problem of the former will take at least 20 minutes to solve, whilst each of the latter problems will consume 30 minutes.

No.	Tags	Description	Problems
1	`#binary_search`	Find the position of a value in a sorted array	### ### ### ...
2	`#fenwick_tree`, `#binary_indexed_tree`	Balance element update and prefix sum in arrays	### ### ### ...
2	`#shortest_paths`, `#shortest_paths_from_source`, `#dijkstra`	Find the shortest paths from a source to all vertices in a graph	### ### ### ...

Table 1: Example of the compiled problem sheet

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No.	Week	Activities	Workload
-	11/3 – 17/3	Write project proposal	-
1st	18/3 – 24/3	Problems 1009C 1006D 960C 631C 935C 540B 1131F 501C 850A 1000C 507C 616D 682C 255C 1132C 493C 269A 1073D 923A 337C 766C	8h
2nd	25/3 – 31/3	Problems 203D 98A 1044A 1057A 596C 159A 68B 238A 22C 46C 161B 1138B 756B 958F1 117B 409A 630H 319A 314A 34D 813B	8h
3rd	1/4 – 7/4	Problems 364A 411A 200C 202B 158B 527C 407B 585B 207B1 1073C 30B 675D	4h
		Google Code Jam Qualification Round	3h
4th	1/4 – 7/4	Problems 301A 1081D 830B 513G1 928B 436C 845D 1082D 1042D 930B 452B 223A 1102E 888E 822D 232A 769D 792D 1076D 549D 637C	7h
		Google Code Jam Round 1A	?
5th	8/4 – 14/4	Problems 727D 291A 67B 690B1 290C 48C 67A 459C 207A2 234G 37B 130E 926D 56C 180A 76D 85B 216D 162B 79C 295B	7h
6th	15/4 – 21/4	Problems 472D 292E 961E 656A 1054D 566D 95C 999D 19B 294C 196B 490D 770C 847C 1012B 1000D 652D 722D 500D 982D 615D	7h
		Google Code Jam Round 1B	?
7th	22/4 – 28/4	Problems 470E 630I 491B 37C 101B 69C 846C 178B3 43D 457B 269B 120H 309C 291B 176B 126A 257D 82C 29D 72E 661B	7h
		Google Code Jam Round 1C	?
8th	29/4 – 5/5	Problems 582B 117C 1088D 598E 792C 959D 766D 739B 767C 940E 301B 777E 749D 27C 814D 778B 843B 864E 1133E 476D 721D	7h
9th	6/5 – 12/5	Problems 896B 784E 1067B 855C 960F 893E 119C 266C 245F 263C 14E 1080D 180D 975D 1089F 15C 811D 362C 847E 121C 164A	7h
		Google Code Jam Round 2	?
10th	13/5 – 19/5	Problems 191C 132B 100G 345B 235B 343C 337D 840B 527D 837D 590B 720A 963B 20C 125D 514D 1030E 621E 510D 1010D	7h
11th	20/5 – 26/5	Problems 784G 638C 960D 955C 1029F 56D 313D 1083B 630E 645E 1056E 909E 909D 899E 156C 65C 226D 817E	7h
12th	27/5 – 2/6	Problems 386C 464B 1110D 7D 207D3 599E 1002D1 39E 11D 72F 132D 656E 819A 86B 592D 551C	7h
		Google Code Jam Round 3	?
13th	3/6 – 9/6	Problems 500E 620D 538F 793C 217B 908D 1003E	4h
		Facebook Hacker Cup Qualification	3h
14th	10/6 – 16/6	431D 995C 853C 232B 404D 1065D 1001A 356C 821E 615E 723F 809B 1044C 238C	7h
		Facebook Hacker Cup Round 1	?
-	24/6 – 30/6	Write final report	-
	Total		100h

Table 2: Detailed schedule

Those problems might be anticipated or changed by similar ones (from any of the platforms listed earlier), as not only it is desired to the broaden complied problem sheet's variety, but also I'll take part on weekly contests whenever I'm both qualified and available, as well as simulate past ones virtually. In practice, I plan to devote these credits on both more advanced contests and lecturing for MaratonUSP, however only the problems that I will actually be able to solve will are being accounted, as a safe ground for the required hours.

Moreover, two great contests are going to take place soon: Google's Code Jam 2019 and Facebook's Hacker Cup 2019. Only their classifications rounds were taken into account, as it is not guaranteed that I will be competing through the following rounds.

FOLLOW-UP

Every code and report made for this project will be weekly available at the github.com/VitorSRG/MAC0214 git repository. There will also be scanned versions of the weekly schedule signed by the supervisor in up to three weeks.

REFERENCES

[CRLS] CORMEN, Thomas H.; LEISERSON, Charles E.; RIVEST, Ronald L.; STEIN, Clifford (2009). **Algorithms**. Third edition. Cambridge: MIT Press.

[SW] SEDGEWICK, Robert; WAYNE, Kevin (2011). **Introduction to Algorithms**. Fourth edition. Boston: Pearson Education.