

EECE 431 Design and Analysis of Algorithms

Problem Set 8

May 23, 2011

- This problems set consists of 5 problems.
- Never due (but material included in the Final).
- Related reading:
 - Topics from Chapter 34 [CLRS] we covered in class
- See the footnote ¹ for various rules and regulations.

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Collaboration and honesty rules:

You are encouraged to collaborate on problem sets as long as:

- H1:** you acknowledge your collaborator(s) on each problem
- H2:** you spend independently enough time on each problem
- H3:** you write the solutions in your own language.

H4: If you use in your homework material from books, articles, the web, etc., you should give a reference. Rules 2 and 3 are applicable to this setting, i.e., you are supposed to spend independently enough time on each problem and write the solutions in your own language.

The course staff have access to your sources, and severe measures will be taken if this rule is violated. You should keep in mind that, due to the course nature, there are usually many ways to solve the same problem and it is very easy to tell if what you are handing in is your own work.

You should keep in mind also that it is not acceptable at all to simply read the solution of the problem from somewhere else, write it in your own language, and give a reference. Such a strategy will be strongly penalized also.

Breaking any of those rules will not be tolerated.

Writing algorithms and proofs: When asked to describe an algorithm, you should give:

- A1:** an English description of the algorithm idea
- A2:** a pseudocode if the English description is not sufficient to communicate the fundamental details
- A3:** an example to illustrate the idea
- A4:** a clear correctness proof if the proof is not a part of the algorithm description
- A5:** a clear analysis of the running time

When asked to prove a statement

- P0:** write a solid argument including all the details
- P1:** never write an argument you are not convinced in because this may damage your brain
- P2:** if the proof is long, explain the proof idea before explaining the details

Finding proofs. The following few tips for producing proofs are quoted from [Sipser, page 19]:

F1: *Be patient.* Finding proofs takes time. If you don't see how to do it right away, don't worry. Researchers sometimes work for weeks or even years to find a single proof.

F2: *Come back to it:* Look over the statement you want to prove, think about it a bit, leave it, and then return a few minutes or few hours later. Let the unconscious, intuitive part of your mind have a chance to work.

F3: *Be neat.* When you are building your intuition for the statement you are trying to prove, use simple clear pictures and/or text. You are trying to develop your insight into the statement, and sloppiness gets in the way of insight. Furthermore, when you are writing a solution for another person to read, neatness will help that person understand.

Problem 1. NP-completeness definition

Show that if $P = NP$, then every problem $\Pi \in NP$ such that $\Pi \neq \Pi_{NO}, \Pi_{YES}$ is NP-complete, where Π_{NO} and Π_{YES} are the trivial problems given by $\Pi_{NO}(x) = NO$ for all inputs x and $\Pi_{YES}(x) = YES$ for all inputs x .

Problem 2. Finding a satisfying assignment

Do Exercise 34.4-6 [CLRS2, page 1002] [CLRS3, page 1086].

Problem 3. 2-SAT (*)

Do Exercise 34.4-7 [CLRS2, page 1003] [CLRS3, page 1086].

Problem 4. 0-1 Integer Programming Problem

Do Exercise 34.5-2 [CLRS2, page 1017] [CLRS3, page 1100].

Problem 5. Graph coloring (*2)

Do Problem 34-3 [CLRS2, page 1019] [CLRS3, page 1103].

F4: *Be Concise.* Brevity helps you express high-level ideas without getting lost in details. Good mathematical notation is useful for expressing ideas concisely. But be sure to include enough of your reasoning when writing up a proof so that the reader can easily understand what you are trying to say.

Format: You are supposed to solve each problem on a **SEPARATE** sheet(s) of paper (starting with: your name, the problem number, and the the name(s) of your collaborator(s)). This is required as the problems might be graded by different graders.

Due date rule: Late homeworks are not accepted.