

CS486 Assignment 5

Due March 15th 10PM ET

1. (a) Explain what it means (as if to a student in CS231) for a problem to be in **NP**.
- (b) Show that $\text{SETCOVER} = \{\langle U, S, k \rangle \mid S \subseteq \mathcal{P}(U) \text{ and there is some subset } T \subseteq S \text{ of size } k \text{ that covers all of } U\} \in \mathbf{NP}$. I'm now realizing that this was probably unreadable for the majority of you. So to restate this problem in less mathy terms:

Problem 1 (SetCover). The MathSleeps company oversees maintenance of a large software package called MatStudio. To verify the functionality of the software, they have written a multitude of tests. Each test exercises the functionality of some subset of the MatStudio toolbox. However, over the years they have written so many tests that it takes practically forever to run them all - they want to know if there is a small number of tests they can run that still exercises the functionality of the whole MatStudio toolbox.

Input: $\langle U, S, k \rangle$: A set of tools U , a set S of tests, and a parameter k , where each test in S exercises a subset of U .

Output: TRUE if there are k tests that exercise the functionality of every tool in U ; otherwise FALSE.

2. (a) Explain what it means for a problem to be **NP-Hard**.
- (b) Show that $\text{VERTEXCOVER} \leq_p \text{SETCOVER}$.
- (c) Explain why this shows that SETCOVER is **NP-Hard**.