CSCI 3104 Spring 2022
Instructor: Profs. Chen and Layer

Midterm 2 Standard 27 - Showing problems belong to NP

Due Date ..... May 3rd
Name ..... **Your Name**
Student ID ..... **Your Student ID**

Contents

1 Instructions

- The solutions **should be typed**, using proper mathematical notation. We cannot accept hand-written solutions. Here's a short intro to LaTeX.
- You should submit your work through the **class Canvas page** only. Please submit one PDF file, compiled using this LaTeX template.
- You may not need a full page for your solutions; pagebreaks are there to help Gradescope automatically find where each problem is. Even if you do not attempt every problem, please submit this document with no fewer pages than the blank template (or Gradescope has issues with it).
- You **may not collaborate with other students**. **Copying from any source is an Honor Code violation. Furthermore, all submissions must be in your own words and reflect your understanding of the material.** If there is any confusion about this policy, it is your responsibility to clarify before the due date.
- Posting to **any** service including, but not limited to Chegg, Discord, Reddit, StackExchange, etc., for help on an assignment is a violation of the Honor Code.

2 Standard 27 - Showing problems belong to NP

2.1 Problem 1

Problem 1. Consider the Set Cover decision problem, which takes as input a set of elements $U = \{1, 2, \ldots, n\}$, a collection $S = \{s_1, \ldots, s_m\}$ where $s_i \subset U$ for $i = 1 \ldots m$, and an integer k, and returns Yes if there is a subset of S of size k whose union equals U, and No otherwise. Show that the Set Cover decision problem is in NP.

Answer. To show this problem is in NP we present a poly-time algorithm that verifies a potential solution. A solution to this problem is when there is a subset of S of size k whose union equal U. First we need to ensure that there is a subset of S that is size k. Next we make sure that the union of that subset equals U. We do this by taking the union of S and comparing each element in the subset to the corresponding element in U. This comparison is done in polynomial time which means that the Set Cover decision problem is in NP. □