

CS3230: Assignment for Week 11

Due: Sunday, 17th Apr 2022, 11:59 pm SGT.

Please upload PDFs containing your solutions (hand-written & scanned, or typed) by 17th Apr, 11:59 pm to `Assignments/Assignment11/Submissions`. Name the file **Assignment11_SID.pdf**, where SID should be replaced by your student ID.

You may discuss the problems with your classmates or read material online, but you should write up your solutions on your own. Please note the names of your collaborators or online sources in your submission; failure to do so would be considered plagiarism.

1. (1 point) Which of the following **could be** true, given our current state of knowledge? Justify your answers.
 - (a) The problem 3-SAT can be solved in polynomial time.
 - (b) The problem INDEPENDENT SET cannot be solved in polynomial time.
 - (c) Some NP-complete problems can be solved in polynomial time while others cannot.

2. (7 points, graded for correctness) For a positive integer k , in the k -LABEL problem, you are given an undirected graph, and your goal is to decide whether you can label each vertex with one of the labels $1, 2, \dots, k$ (a label can be used more than once, or not used at all), so that no two adjacent vertices receive the same label. Assuming that the problem 2021-LABEL is NP-complete, prove that the problem 2022-LABEL is also NP-complete.
(Hint: For the reduction, add one new vertex connected to all existing vertices.)

3. (1 point) In the 3-SATTWICE problem, you are given a 3-SAT formula,¹ but your goal is now to decide whether there exist **at least two** satisfying assignments. Prove that 3-SATTWICE is NP-complete.

Well, that's it, everyone! Hope these assignment problems were (at least at times!) fun ☺

¹We allow each clause to contain the same literal more than once, e.g., $(x \vee x \vee x)$ or $(x \vee x \vee \bar{x})$.