

Module 7 Graded Homework

Due Nov 19, 2021 at 11:59pm**Points** 3**Questions** 3**Available** Nov 6, 2021 at 12am - Jan 21 at 11:59pm 3 months**Time Limit** None

Instructions

Question 1

For each of the two questions below, decide whether the answer is (i) “Yes,” (ii) “No,” or (iii) “Unknown, because it would resolve the question of whether $P = NP$.” Give a brief explanation of your answer.

a.) Let's define the decision version of the Interval Scheduling Problem from Chapter 4 as follows: Given a collection of intervals on a time-line, and a bound k , does the collection contain a subset of non-overlapping intervals of size at least k ? Question: Is it the case that Interval Scheduling \leq_P Vertex Cover?

b.) Question: Is it the case that Independent Set polynomially reduces to Interval Scheduling?

Question 2

Consider a set $A = \{a(1), \dots, a(n)\}$ and a collection $B(1), \dots, B(m)$ of subsets of A (i.e., $B(i) \subseteq A$ for each i).

We say that a set $H \subseteq A$ is a hitting set for the collection $B(1), \dots, B(m)$ if H contains at least one element from each $B(i)$ --that is, if $H \cap B(i)$ is not empty for each i (so H “hits” all the sets $B(i)$).

We now define the Hitting Set Problem as follows. We are given a set $A = \{a(1), \dots, a(n)\}$, a collection $B(1), \dots, B(m)$ of subsets of A , and a number k . We are asked: Is there a hitting set $H \subseteq A$ for $B(1), \dots, B(m)$ so that the size of H is at most k ?

Prove that Hitting Set is NP-complete.

Question 3

The Subgraph Isomorphism problem takes two undirected graphs $G=(V,E)$ and $H=(V',E')$ and asks whether H appears as an induced subgraph of G --i.e.,

whether there exists a one-to-one mapping $f : V' \rightarrow V$ such that for every pair of nodes $u, v \in V'$, the edge (u, v) exists in E' if and only if the edge $(f(u), f(v))$ also exists in E . Show that the Subgraph Isomorphism problem is NP-complete.

Attempt History

| | Attempt | Time | Score |
|--------|------------------|------------|------------|
| LATEST | <u>Attempt 1</u> | 22 minutes | 3 out of 3 |

Score for this quiz: **3** out of 3

Submitted Nov 19, 2021 at 6:35pm

This attempt took 22 minutes.

Question 1

1 / 1 pts

Regarding question 1(a) in this week's graded assignment, identify the correct answer?

☐ Unknown

☐ No

☒ Yes

Correct!

Question 2

1 / 1 pts

Regarding question 2 in this week's graded assignment, what is a valid reduction to Hitting Set?

☐ From 3SAT, by constructing a formula for each of the elements in the hitting set.

Correct!

From Vertex Cover, by creating an n -element set for all the nodes, and then a set for all vertex covers in the graph.



From Vertex Cover, by creating a 2-element set for every edge in the given graph.

Question 3**1 / 1 pts**

Regarding question 3 in this week's graded homework, what would be the most precise runtime of the certifier, if the given graph G has n nodes?

☐ $O(n)$ ☒ $O(n^2)$ ☐ The answer depends on the graph.☐ Polynomial in n **Correct!****Quiz Score: 3 out of 3**