Course outline

How does an NPTEL online course work?
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- Lecture 11: More on Polynomial Hierarchy
- Lecture 12: Alternating Turing Machines
- Lecture 13: Equivalence of Quantifier and Oracle Based Definitions of Polynomial Hierarchy
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Assignment 4

The due date for submitting this assignment has passed.

Due on 2021-02-17, 23:59 IST.

As per our records you have not submitted this assignment.

1) A language L is in the class DP iff there are two languages $L_1 \in NP$ and $L_2 \in coNP$ such that $L = L_1 \cap L_2$ — *4 points*
Consider the following problems:
1.$SAT - UNSAT$: $\{(\phi, \phi') \mid \phi$ is satisfiable and ϕ' is not satisfiable$\}$
2.$ALMOST - SAT$: $\{\phi \mid \phi$ is unsatisfiable, but deleting any clause makes it satisfiable$\}$
Which of the following option(s) is(are) true?

- [ ] Only $SAT - UNSAT$ is in DP
- [ ] Only $ALMOST - SAT$ is in DP
- [ ] Both $SAT - UNSAT$ and $ALMOST - SAT$ are in DP
- [ ] Neither of $SAT - UNSAT$ or $ALMOST - SAT$ is in DP

No, the answer is incorrect.
Score: 0
Accepted Answers:
Both $SAT - UNSAT$ and $ALMOST - SAT$ are in DP

2) Define $P_{\parallel}^{NP}$ to be the set of languages decided by an oracle machine working as follows: — *6 points*
Given input x, the machine computes in polynomial time a polynomial number of non adaptive NP queries and receives all the correct answers at once. Then it decides whether $x \in L$ in polynomial time.
Define $P^{NP[\log n]}$ to be the class of all languages decided by a polynomial time oracle machine which on input x, asks a total of $O(\log(|x|))$ many NP queries (possibly adaptive) and decides whether $x \in L$.
Mark the correct option(s)

- [ ] $P_{\parallel}^{NP} \subseteq P^{NP[\log n]}$
- [ ] $P_{\parallel}^{NP} \subsetneq P^{NP[\log n]}$
- [ ] $P^{NP[\log n]} \subseteq P_{\parallel}^{NP}$
- [ ] $P^{NP[\log n]} \subsetneq P_{\parallel}^{NP}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$P_{\parallel}^{NP} \subseteq P^{NP[\log n]}$
$P^{NP[\log n]} \subseteq P_{\parallel}^{NP}$

3) Which of the following statement(s) is/are known to be true? — *2 points*

- [ ] The polynomial hierarchy does not have a complete problem
- [ ] If EXP is in PH, then PH collapses
- [ ] If Σ_i^p has a complete problem for some i, then PH collapses
- [ ] It is not known whether $PSPACE$ is in PH

No, the answer is incorrect.
Score: 0
Accepted Answers:
If EXP is in PH, then PH collapses
It is not known whether $PSPACE$ is in PH

4) Which of the following statements are known to be true? — *2 points*

- [ ] $P = \bigcup_{i \in \mathbb{N}} \Sigma_i^p$ unless $P \neq NP$
- [ ] $P = AP$ unless $P \neq NP$
- [ ] PH collapses unless $AP \neq PH$
- [ ] $PSPACE \neq APSPACE$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$P = \bigcup_{i \in \mathbb{N}} \Sigma_i^p$ unless $P \neq NP$
PH collapses unless $AP \neq PH$

5) Suppose a language $L \in NP \cap coNP$. Then which of the following is/are true? — *4 points*

- [ ] $L \notin P$
- [ ] $L \in P$
- [ ] $P^L \in NP$
- [ ] $P^L \in coNP$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$P^L \in NP$
$P^L \in coNP$

6) Consider a modified version of Traveling Salesman problem in which, given a graph G and a cost c, you have to decide whether the shortest tour in the graph has cost that is exactly equal to c. Recall that a tour is a hamiltonian cycle of the graph and its cost is the sum of costs of each edge in the cycle. — *2 points*
What is the smallest complexity class that contains this problem?

- [ ] NP
- [ ] $coNP$
- [ ] Σ_2
- [ ] Π_2

No, the answer is incorrect.
Score: 0
Accepted Answers:
Σ_2

7) Consider the polynomial space hierarchy SH: — *4 points*
$\Sigma_0^S = \Pi_0^S = PSPACE$. For all $i \geq 0$,
$\Sigma_{i+1}^S = NPSPACE^{\Sigma_i^S}$
$\Pi_i^S = co\Sigma_i^S$
Finally, $SH = \bigcup_i \Sigma_i^S$
Mark the correct statement(s) about SH:

- [ ] There exists a complete problem for SH
- [ ] There is no known complete problem for SH
- [ ] Every level of SH has a complete problem
- [ ] $SH \subseteq PSPACE$

No, the answer is incorrect.
Score: 0
Accepted Answers:
There exists a complete problem for SH
Every level of SH has a complete problem
$SH \subseteq PSPACE$

8) Suppose $NP^{NP^{NP}} = NP^{NP}$ Then what can we say about PH? — *2 points*

- [ ] PH collapses to P
- [ ] All the levels of PH cannot be distinct.
- [ ] If PH collapses then necessarily $P = NP$
- [ ] $PSPACE$ would be in PH

No, the answer is incorrect.
Score: 0
Accepted Answers:
All the levels of PH cannot be distinct.