

Exam 19 January

Due Jan 19 at 5pm **Points** 30 **Questions** 30**Available** Jan 19 at 4pm - Jan 19 at 5pm about 1 hour**Time Limit** 50 Minutes

Instructions

Notation: _ denotes the blank symbol in questions on configurations

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	50 minutes	20 out of 30

! Correct answers are hidden.

Score for this quiz: **20** out of 30

Submitted Jan 19 at 4:49pm

This attempt took 50 minutes.

Question 1

1 / 1 pts

Suppose, that p is a predicate symbol and f is a function symbol in first order logic, both of arity 2.

Which one of the following is a string representation of a first order formula? (x and y are variables)

1. $\forall x p(x, p(y, y))$ 2. $p(x, y) \vee p(f(y, y), x)$ ☐ only the 1st one☒ only the 2nd one☐ both of them☐ none of them

Incorrect**Question 2****0 / 1 pts**

$$f(n)=10n^4, \quad g(n)=n^4+2\log_2 n.$$

Which one of the following statements holds?

1st statement: $f(n)=\Omega(g(n))$.

2nd statement: $g(n)=\Omega(f(n))$.

- ☐ Only the 1st statement holds.
- ☒ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☐ None of the two statements holds.

Question 3**1 / 1 pts**

Suppose that $f(n)/g(n) \rightarrow 5/3$ as n tends to infinity holds for non-negative valued functions $f(n)$ and $g(n)$. Then

Claim 1: $f(n)=\Omega(g(n))$.

Claim 2: $g(n)=\Omega(f(n))$.

Which one of the 2 claims holds?

- ☐ Claim 1 only
- ☐ Claim 2 only
- ☒ both claims hold
- ☐ none of the two claims holds

Question 4**1 / 1 pts**

Which one of the following two words can be a configuration of one-tape Turing machine $M = (\{q_0, q_1, q_2\}, \{a, b\}, \Gamma, \delta, q_0, q_a, q_r)$?

q_1aab or $aabq_1$?

- ☒ q_1aab only
- ☐ $aabq_1$ only
- ☐ both of the two words
- ☐ none of the two words

Question 5

1 / 1 pts

Let $M = (Q, \Sigma, \Gamma, \delta, q_0, q_a, q_r)$ be a one-tape Turing machine. Which configuration follows $abaqa$ if $\delta(q, a) = (r, b, L)$?

$(q, r \in Q, a, b \in \Gamma)$

- ☐ $abarb$
- ☐ $abrba$
- ☒ $abrab$
- ☐ $ababr_$

Question 6

1 / 1 pts

Let $M = (\{q_0, q_a, q_r\}, \{a, b\}, \{a, b, c, _ \}, \delta, q_0, q_a, q_r)$, where the transitions are

$\delta(q_0, a) = (q_a, b, S),$

$\delta(q_0, b) = (q_0, _, L),$

$\delta(q_0, c) = (q_a, c, S),$

$\delta(q_0, _) = (q_a, _, L).$

Is it true, that $b \in L(M)$? Is it true, that $c \in L(M)$?

- ☒ $b \in L(M)$ only
- ☐ $c \in L(M)$ only
- ☐ both $b \in L(M)$ and $c \in L(M)$ holds
- ☐ none of $b \in L(M)$ and $c \in L(M)$ holds

Question 7

1 / 1 pts

Which one of the following statements hold?

1st statement: If $L \in \text{NTIME}(f(n))$ then $L \in \text{TIME}(2^{O(f(n))})$.

2nd statement: If $L \in \text{TIME}(f(n))$ then $L \in \text{NTIME}(f(n))$.

- ☐ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☒ Both statements hold.
- ☐ None of the two statements holds.

Question 8

1 / 1 pts

Suppose, that L can be decided by an $f(n)=2n+3\log_2 n$ time bounded deterministic Turing machine.

Which one of the following statements follows from this assumption?

1st statement: L is in P .

2nd statement: L is in NP .

- ☐ Only the 1st statement follows.

- ☐ Only the 2nd statement follows.
- ☒ Both statements follow.
- ☐ None of the two statements follows.

Incorrect**Question 9****0 / 1 pts**

Let L be a language and M be a nondeterministic Turing machine, such that $L(M)=L$ holds.

Which one of the following statements follows from this assumption?

1st statement: $L \in R$

2nd statement: $L \in RE$

- ☐ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☒ None of the two statements holds.

Incorrect**Question 10****0 / 1 pts**

Let $M = (Q, \Sigma, \Gamma, \delta, q_0, q_a, q_r)$ be a NONDETERMINISTIC Turing machine and $u \in \Sigma^*$.

1st statement: If there exist a sequence of transitions from the starting configuration of u to an accepting configuration then u is in $L(M)$.

2nd statement: If there exist a sequence of transitions from the starting configuration of u to a rejecting configuration then u is not in $L(M)$.

Which one of the above statements hold?

- ☐ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.

- ☒ Both statements hold.
- ☐ None of the 2 statements holds.

Incorrect**Question 11****0 / 1 pts**

Which one of the following statements holds?

1st statement: The cardinality of the family of undecidable languages is countably infinite.

2nd statement: The cardinality of $\{L \mid L \subseteq \{0,1\}^*\} \setminus \text{RE}$ is countably infinite.

- ☒ Only the 1st statement.
- ☐ Only the 2nd statement.
- ☐ Both statements.
- ☐ None of the two statements.

Question 12**1 / 1 pts**

Which one of the following statements holds?

1st statement: L_h can be reduced to a decidable language.

2nd statement: The complement language of L_h is in RE.

- ☐ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☒ None of the two statements holds.

Question 13**1 / 1 pts**

Which one of the following statements holds?

1st statement: VALIDITYPRED can be reduced to a decidable language.

2nd statement: The complement language of VALIDITYPRED is in R.

- ☐ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☒ None of the two statements holds.

Question 14**1 / 1 pts**

Let $D = \{(u,v), (w,x), (y,z)\} \ (u,v,w,x,y,z \in \Sigma^+)$ be an instance of the Post Correspondence Problem. (There are 3 dominos, the first one has u at the top and v at the bottom, the second one has w at the top and x at the bottom, the third one has y at the top and z at the bottom.)

Which one of the following statements holds?

1. If $uwuu = vxvv$ then D has a solution.
2. All solutions of D is a sequence of at most 3 dominos.

- ☒ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☐ None of the 2 statement holds.

Incorrect**Question 15****0 / 1 pts**

Which one of the following statements holds (using the concepts of Rice's theorem)?

1st statement: $\{ L \mid L \subseteq \{0,1\}^* \text{ and } L \text{ is finite} \}$ is a non-trivial property of the recursively enumerable languages.

2nd statement: \emptyset is a non-trivial property of the recursively enumerable languages.

- ☐ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☒ None of the two statements holds.

Question 16

1 / 1 pts

Which one of the following statements can be stated being TRUE?

1st statement: The language of unsatisfiable formulas of propositional logic is in NP.

2nd statement: The language of valid formulas of first order logic is in R.

- ☒ Only the 1st statement.
- ☐ Only the 2nd statement.
- ☐ Both statements.
- ☐ None of the two statements.

Question 17

1 / 1 pts

1. REACHABILITY 2. GRAPH ISOMORPHISM 3. 5-COLORING 4. 3SAT

- 5. conjectured to be non-NP-complete
- 6. its complement is in P
- 7. it is decidable
- 8. it is an NP-complete graph problem

Find a good matching.

☐ 1-7 2-8 3-5 4-6

☐ 1-7 2-5 3-6 4-8

☒ 1-6 2-5 3-8 4-7

☐ 1-6 2-7 3-8 4-5

Incorrect

Question 18

0 / 1 pts

Which one of the following languages can be a language not in P?

☒ PERFECT MATCHING

☐ REACHABILITY

☐ GRAPH ISOMORPHISM

☐ 2SAT

Question 19

1 / 1 pts

Which one of the following two propositional formulas is a Horn formula?

1. $(\neg x \vee y) \wedge (\neg x \vee \neg z) \wedge y$

2. $(\neg x \vee y \vee \neg z) \wedge (\neg x \vee \neg z \vee \neg w)$

(x,y,z,w are atomic variables)

- ☐ only the 1st one
- ☐ only the 2nd one
- ☒ both of them
- ☐ none of them

Question 20

1 / 1 pts

Which one of the following languages is not in NP?

- ☒ UNSATPRED
- ☐ REACHABILITY
- ☐ 2SAT
- ☐ INDEPENDENT SET

Incorrect

Question 21

0 / 1 pts

Which one of the following statements holds?

1st statement: If SUBGRAPH ISOMORPHISM is in P, then $P=NP$.

2nd statement: If 2SAT is in P, then $P=NP$.

- ☐ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☒ None of the two statements holds.

Question 22**1 / 1 pts**

Complete the sentence to make it true.

If then $P=NP$.

- ☐ 2SAT is in P
- ☒ there are no NP-intermediate problems in NP
- ☐ every NP-complete problem is decidable
- ☐ every problem in NP is reducible to an NP-complete problem

Question 23**1 / 1 pts**

Let G be a simple undirected graph of 20 vertices.

Which one of the following statements holds?

1st statement: If G has a clique of size 7 then G has an independent set of size 13.

2nd statement: If G has an independent set of size 13, then G has a vertex cover of size 7.

- ☐ Only the 1st statement holds.
- ☒ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☐ None of the two statements holds.

Question 24**1 / 1 pts**

Let L and L' be languages and assume that L is in NP. Then the following proves NP-completeness of L .

- ☐ $L \leq L'$ and L' is NP-complete
- ☐ $L \leq_p L'$ and L' is NP-complete
- ☒ $L' \leq_p L$ and L' is NP-complete
- ☐ $L' \leq L$ and L' is NP-complete

Question 25**1 / 1 pts**

Which one of the following statements holds?

1st statement: If GRAPH ISOMORPHISM is an NP-intermediate language, then P is a proper subset of NP .

2nd statement: If $P=NP$ is FALSE, then there exists a non-NP-complete language in $NP \setminus P$.

- ☐ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☒ Both statements hold.
- ☐ None of the two statements holds.

Question 26**1 / 1 pts**

Which one of the following statements holds?

1st statement: $\text{coNP} \subseteq R$.

2nd statement: Time complexity class coNP is the complement of time complexity class NP .

- ☒ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.

- ☐ Both statements hold.
- ☐ None of the two statements holds.

Question 27**1 / 1 pts**

Which one of the following statements holds?

1st statement: Size of the input is an asymptotic lower bound for the space complexity of nondeterministic offline Turing machines.

2nd statement: For every 3 tape deterministic offline Turing machine there exists an equivalent 2 tape deterministic Turing machine.

- ☐ Only the 1st statement holds.
- ☒ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☐ None of the two statements holds.

Incorrect**Question 28****0 / 1 pts**

Which one of the following statements can be stated being TRUE?

1st statement: SUBGRAPH ISOMORPHISM is in PSPACE.

2nd statement: Every PSPACE-complete language is in NP.

- ☐ Only the 1st statement.
- ☐ Only the 2nd statement.
- ☒ Both statements.
- ☐ None of the two statements.

Incorrect**Question 29****0 / 1 pts**

Which one of the following statements holds?

1st statement: Every type 2 language (according to Chomsky's hierarchy) can be recognized by a linear bounded automaton.

2nd statement: Every language which can be recognized by a linear bounded automaton is a type 2 language.

- ☐ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☒ Both statements hold.
- ☐ None of the two statements holds.

Incorrect**Question 30****0 / 1 pts**

Which one of the following statements holds?

1st statement: Every decidable language is context sensitive.

2nd statement: Every context sensitive language is decidable.

- ☒ Only the 1st statement holds.
- ☐ Only the 2nd statement holds.
- ☐ Both statements hold.
- ☐ None of the two statements holds.

Quiz Score: 20 out of 30

