# Exam 29 December

**Due** Dec 29 at 11am **Points** 30 **Questions** 30
**Available** Dec 29 at 10am - Dec 29 at 11:05am 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 | 48 minutes | 16 out of 30 |

ⓘ Correct answers are hidden.

Score for this quiz: **16** out of 30
Submitted Dec 29 at 10:48am
This attempt took 48 minutes.

Incorrect

### Question 1 — 0 / 1 pts

$f(n)=9n^4+5n$ $g(n)=2^{n-2}$

Which one of the following statements holds?

1st statement: f(n)=O(g(n)).

2nd statement: g(n)=O(f(n)).

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

### Question 2 — 1 / 1 pts

$f(n)=n^4+2n$ $g(n)=(2/3)^n$

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**

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

$(q,r\in Q, u,v \in \Gamma^*, v\neq\lambda, a,b,c\in\Gamma)$

- ( ) ucrbv
- (●) urcbv
- ( ) ucrbLv
- ( ) ucbrv

## Question 4

**1 / 1 pts**

Let M = $(Q, \Sigma, \Gamma, \delta, q_0, q_a, q_r)$ be a 2-tape Turing machine. Which one is the starting configuration for input word abb?

- (●) $(q_0,\lambda,abb,\lambda,\_)$
- ( ) $(q_0,abb,\_)$

- $(q_0, \lambda, abb, \lambda, \lambda)$
- $(q_0, abb, \lambda)$

Incorrect

## Question 5

0 / 1 pts

Let M = $(Q, \Sigma, \Gamma, \delta, q_0, q_a, q_r)$ be a 2-tape Turing machine and let _ denote the blank symbol.

Which one of the following statements holds?

1st statement: $(q_0,\lambda,\lambda,\lambda,\lambda)$ is the starting configuration for input λ.

2nd statement: $(q_r,\lambda,\_,\lambda,\_)$ is a rejecting configuration.

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

Incorrect

## Question 6

0 / 1 pts

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

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

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

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

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

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 can be stated as being TRUE?

1st statement: Let M be an $n^3$ time bounded nondeterministic Turing machine. Then there exist a deterministic $O(n^7)$ time bounded deterministic Turing machine equivalent with M.

2nd statement: Let M be an $n^3$ time bounded deterministic 2-tape Turing machine. Then there exist a deterministic $O(n^7)$ time bounded 1-tape deterministic Turing machine equivalent with M.

Only the 1st statement holds.

Only the 2nd statement holds.

Both statements hold.

None of the two statements holds.

Incorrect

## Question 8

0 / 1 pts

Which one of the following statements can not be stated as being TRUE?

For every deterministic Turing machine there exist an equivalent nondeterministic one.

For every nondeterministic Turing machine there exist an equivalent deterministic one.

For every deterministic 3-tape Turing machine of polynomial time complexity there exists an equivalent deterministic 2-tape Turing machine of polynomial time complexity.

For every nondeterministic  Turing machine of polynomial time complexity there exists an equivalent deterministic Turing machine of polynomial time complexity.

Incorrect

## Question 9

0 / 1 pts

Which one of the following statements holds?

1st statement: Every recursively enumerable language can be recognized by a nondeterministic Turing machine.

2nd statement:  Every NP-complete language can be decided by a deterministic Turing machine.

- 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

Which one of the following sequences is NOT a code of 3-state ($q_0$,$q_r$,$q_a$) 1-tape deterministic Turing machine according to the coding given on the lecture? [Before assigning a specific macine for non-codes.]

- 0101010001000110100100100010001101000100101000
- 0101000101011010010010001001101000100101010
- 0101010001011110100100100010001101001001010100

- 0101000100010001101001000100010001101000100010001000

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 | L⊆ {0,1}*}\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: $L_u$ can be reduced to a decidable language.

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

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

Incorrect

## Question 13

0 / 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.

Incorrect

## Question 14

0 / 1 pts

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

1st statement: { L | L ⊆ {0,1}* and L is finite } is a non-trivial property of the recursively enumerable languages.

2nd statement: ∅ 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 15

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 P.

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

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

## Question 16

1 / 1 pts

Consider a first order logic including a predicate symbol p and a function symbol f, both of arity 2.

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

1. $\forall xf(x,y)$

2. $p(x,y) \vee p(f(y,y),x)$

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

## Question 17

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 18

0 / 1 pts

Which one of the following statements holds?

1st statement: For every nondeterministic Turing machine M there exists a grammar generating L(M).

2nd statement: For every grammar G there exists a nondeterministic Turing machine recognizing L(G).

- (●) Only the 1st statement holds.
- ( ) Only the 2nd statement holds.
- ( ) Both statements hold.
- ( ) None of the two statements holds.

## Question 19

1 / 1 pts

Which one of the following statements holds?

1st statement: For every nondeterministic Turing machine M there exists a context sensitive grammar generating L(M).

2nd statement: For every context sensitive grammar G there exists a nondeterministic Turing machine recognizing L(G).

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

Incorrect

## Question 20

0 / 1 pts

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

- HORNSAT
- 2-COLORING
- PRIMES
- PRIME FACTORIZATON

## Question 21

1 / 1 pts

Which one of the following languages is not in NP?

- GRAPH ISOMORPHISM
- SUBGRAPH ISOMORPHISM
- UNSATPRED
- SAT

Incorrect

## Question 22

0 / 1 pts

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

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

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

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

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

Incorrect

## Question 23

0 / 1 pts

Complete the sentence to make it true.

If ..... then P=NP.

- REACHABILITY is in NP
- there is an NP-complete problem in NP
- there are no NP-intermediete problems in NP
- every problem in NP is reducible to an NP-complete problem

Incorrect

## Question 24

0 / 1 pts

Let G be a simple undirected graph of 20 vertices.

Which one of the following statements holds?

1st statement: If G is 4-colorable, then G is 5-colorable.

2nd statement: If G has a vertex cover of size 7, then G has a vertex cover of size 8.

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

## Question 25

1 / 1 pts

Let L and L' be languages. Then the following proves undecidability of L.

- L' is not an element of R and L'≤L
- L' is not an element of R and L≤L'
- L' is not an element of RE and L≤L'
- L' is not an element of RE and $L \leq_p L'$

## Question 26

1 / 1 pts

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

1st statement:  GRAPH ISOMORPHISM is an NP-intermediate problem.

2nd statement: All NP-intermediate problems are in R.

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

## Question 27

1 / 1 pts

Which one of the following statements holds?

1st statement: Space complexity class coNL is the complement of space complexity class NL.

2nd statement: NL⊆ coNL.

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

## Question 28

1 / 1 pts

Which one of the following statements holds?

1st statement: There is a language which can be decided by nondeterministic offline Turing machine of O(nlog n) space complexity, but can not be decided by a deterministic offline Turing machine of polynomial space complexity.

2nd statement: There is a language in NP which can not be decided by a deterministic offline Turing machine of polynomial space complexity.

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

## Question 29

1 / 1 pts

Which one of the following statements holds?

1st statement: REACHABILITY can be decided by a nondeterministic Turing machine in polynomial time.

2nd statement: REACHABILITY is recursively enumerable.

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

## Question 30

**1 / 1 pts**

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

1st statement: Every PSPACE-complete language is in NPSPACE.

2nd statement: 3SAT is PSPACE-complete.

- ◉ Only the 1st statement.
- ○ Only the 2nd statement.
- ○ Both statements.
- ○ None of the statements.

Quiz Score: **16** out of 30