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| **State** | Finished |
| **Completed on** | Tuesday, 9 November 2021, 9:38 AM |
| **Time taken** | 37 mins 27 secs |
| **Grade** | **25.00** out of 25.00 (**100**%) |

Question **1**

Correct

Mark 1.00 out of 1.00

Which of the following languages are context-free?

$$L_1 = \{a^m b^m c^n, m \geq 1, n \geq 1\}$$
$$L_2 = \{a^m b^m c^n, n \geq m\}$$
$$L_3 = \{a^m b^m c^m, m \geq 1\}$$

Select one:

- a. $L_2$ and $L_3$.
- b. Only $L_2$.
- c. Only $L_3$.
- d. Only $L_1$. ✔

Your answer is correct.

The correct answer is: Only $L_1$.

Question **2**

Correct

Mark 1.00 out of 1.00

Consider $L = L_1 \cap L_2$ where $L_1 = \{0^m 1^m 2 0^n 1^n \mid m, n \geq 0\}$ and $L_2 = \{0^m 1^n 2^k \mid m, n, k \geq 0\}$. Then the language $L$ is

Select one:

- a. Not recursive.
- b. Context free but not regular. ✔
- c. Recursively enumerable but not context free.
- d. Regular.

Your answer is correct.

The correct answer is: Context free but not regular.

Question **3**

Correct

Mark 1.00 out of 1.00

Suppose that $L_1$ is regular and $L_2$ is a context free language. Which one of the following is not necessarily context free.

Select one:

- a. $L_1$ - $L_2$ ✔
- b. $L_1$ U $L_2$
- c. $L_1 \cap L_2$
- d. $L_1$ • $L_2$

Your answer is correct.

The correct answer is: $L_1$ - $L_2$

Question **4**
Correct
Mark 1.00 out of 1.00

The language generated by the following grammar is $S \longrightarrow ASA \mid BSB \mid \epsilon$.

Select one:
- a. Even length palindrome. ✔
- b. L = {$a^n b^m$, m ≥ 1, n ≥ 1}.
- c. Odd length palindrome.
- d. L = {$a^m b^n$, m ≥ 0, n ≥ 0}.

Your answer is correct.

The correct answer is: Even length palindrome.

Question **5**
Correct
Mark 1.00 out of 1.00

Consider the following languages:
$L_1 = \{\langle D_1, D_2\rangle \mid D_1 \text{ and } D_2 \text{ are DFAs and } \mid L(D_1) \mid < \mid L(D_2) \mid\}$
$L_2 = \{\langle M_1, M_2\rangle \mid M_1 \text{ and } M_2 \text{ are TMs and } \mid L(M_1) \mid < \mid L(M_2) \mid\}$
Which of the following option is correct?

Select one:
- a. Only $L_2$ is decidable.
- b. Both $L_1$ and $L_2$ are decidable.
- c. Only $L_1$ is decidable. ✔
- d. Both $L_1$ and $L_2$ are undecidable.

Your answer is correct.

The correct answer is: Only $L_1$ is decidable.

Question **6**
Correct
Mark 1.00 out of 1.00

A halting non-deterministic Turing machine (TM) is one which halts on all computation paths. Let $G_{M,x}$ denote the configuration graph of a non-deterministic Turing machine $M$ with respect to a string $x$. Which of the following statements are true?

Select one:
- a. M is a non-halting TM if there exists a pair of two nodes in $G_{\{M,x\}}$ which are reachable from the starting configuration and are also reachable from each other. ✔
- b. There exists at least one node with in-degree more than one in $G_{\{M,x\}}$ if M is a non-halting TM.
- c. Every node has in-degree at most one in $G_{\{M,x\}}$ if M is a halting TM.
- d. Every node has in-degree exactly one in $G_{\{M,x\}}$ if M is a non-halting TM.

Your answer is correct.

The correct answer is: M is a non-halting TM if there exists a pair of two nodes in $G_{\{M,x\}}$ which are reachable from the starting configuration and are also reachable from each other.

Question **7**
Correct
Mark 1.00 out of 1.00

Let $L_1$ be a decidable language and $L_2$ be a Turing recognizable but not decidable language. Which of the following statements are true?

Select one:
- a. $L_1 \cap L_2$ is a decidable language.
- b. $L_2/L_1$ is a Turing recognizable language. ✔
- c. $L_1 \cap L_2$ is a Turing recognizable language.
- d. $L_1/L_2$ is a decidable language.

Your answer is correct.

The correct answers are: $L_2/L_1$ is a Turing recognizable language., $L_1 \cap L_2$ is a Turing recognizable language.

Question **8**

Correct

Mark 1.00 out of 1.00

$L \rightarrow rLt \mid tLr \mid t \mid r.$

The given grammar produces a language which is:

Select one:

- a. All even palindromes.
- b. All palindromes. ✔
- c. All odd palindromes.
- d. Strings with same begin and end symbols.

Your answer is correct.

The correct answers are: All palindromes., All even palindromes., All odd palindromes., Strings with same begin and end symbols.

Question **9**

Correct

Mark 1.00 out of 1.00

Consider the following languages :
$L_1 = \{0^p1^q0^r \mid p, q, r \geq 0\}$ $L_1 = \{0^p1^q0^r \mid p, q, r \geq 0, p \neq r\}$ Which one of the following statements is false?

Select one:

- a. $L_1$ ' (complement of $L_1$ ) is context free but not regular. ✔
- b. $L_2$ ' (complement of $L_2$) is recursive.
- c. $L_1 \cap L_2$ is context free.
- d. $L_2$ is context free.

Your answer is correct.

The correct answer is: $L_1$ ' (complement of $L_1$ ) is context free but not regular.

Question **10**

Correct

Mark 1.00 out of 1.00

What is the language of the following grammar?
$S \rightarrow aS_1bS_3c \mid aS_4bS_2c$
$S_1 \rightarrow aS_1b \mid \epsilon$
$S_2 \rightarrow bS_2c \mid \epsilon$
$S_3 \rightarrow S_3c \mid \epsilon$
$S_4 \rightarrow S_4a \mid \epsilon$

Select one:

- a. L = $\{a^ib^jc^k \mid i+j = k\}$
- b. L = $\{a^ib^jc^k \mid i = j$ or $j = k\}$ ✔
- c. L = $\{a^ib^jc^k \mid i+j \geq k\}$
- d. L = $\{a^ib^jc^k \mid i = j = k\}$

Your answer is correct.

The correct answer is: L = $\{a^ib^jc^k \mid i = j$ or $j = k\}$

Question **11**

Correct

Mark 1.00 out of 1.00

Consider the following context free grammar over the alphabet $\Sigma = \{a, b, c\}$ with $S$ as the start symbol:
$S \rightarrow abScT \mid abcT$
$T \rightarrow bT \mid b$
Which one of the following represents the language generated by the grammar?

Select one:

- a. $L = \{(ab)^n cb^{m_1} cb^{m_2} .....cb^{m_n} \mid n, m_1, m_2, ...., m_n \geq 1\}$ ✔
- b. $L = \{(ab)^n(cb^m)^n \mid m,n \geq 1\}$
- c. $L = \{(ab)^n(cb)^n \mid n \geq 1\}$
- d. $L = \{(ab)^n(cb^n)^m \mid m,n \geq 1\}$

Your answer is correct.

The correct answer is:

$$L = \{(ab)^n cb^{m_1} cb^{m_2} .....cb^{m_n} \mid n, m_1, m_2, ...., m_n \geq 1\}$$

Question **12**

Correct

Mark 1.00 out of 1.00

For any two languages $L_1$ and $L_2$ such that $L_1$ is context free and $L_2$ is recursively enumerable but not recursive, which of the following are necessarily true?
1. $\overline{L_1}$ is recursive.
2. $\overline{L_1}$ is context free.
3. $\overline{L_1} \cup L_2$ is recursively enumerable.

Select one:

- a. 2 and 3.
- b. 1.
- c. 1 and 3. ✔
- d. 2.

Your answer is correct.

The correct answer is: 1 and 3.

Question **13**

Correct

Mark 1.00 out of 1.00

Let $A$ and $B$ be finite alphabets and let # be a symbol outside both $A$ and $B$. Let $f$ be a total function from $A^*$ to $B^*$. We say $f$ is computable if there exists a Turing machine $M$ which given an input $x$ in $A^*$, always halts with $f(x)$ on its tape. Let $L_f$ denote the language $\{x\#f(x) \mid x \in A^*\}$. Which of the following statement is true?

Select one:

- a. f is computable if and only if $L_f$ is recursively enumerable.
- b. If f is computable, then $L_f$ is recursive, but not conversely.
- c. If f is computable, then $L_f$ is recursively enumerable, but not conversely.
- d. f is computable if and only if $L_f$ is recursive. ✔

Your answer is correct.

The correct answer is:
f is computable if and only if $L_f$ is recursive.

Question **14**

Correct

Mark 1.00 out of 1.00

Which of the following are decidable?

1. Whether the intersection of two regular languages is infinite.
2. Whether a given context free language is regular.
3. Whether two pushdown automata accept the same language.
4. Whether a given grammar is context free.

Select one:

- a. 1 and 2.
- b. 2 and 3.
- c. 1 and 4. ✔
- d. 2 and 4.

Your answer is correct.

The correct answer is: 1 and 4.

Question **15**

Correct

Mark 1.00 out of 1.00

If G is a grammar with productions

$S \rightarrow SaS \mid aSb \mid bSa \mid SS \mid \epsilon$

where $S$ is the start variable, then which one of the following strings is not generated by G?

Select one:

- a. abbaa.
- b. babba. ✔
- c. abab.
- d. aaab.

Your answer is correct.

The correct answer is: babba.

Question **16**

Correct

Mark 1.00 out of 1.00

Which of the following pairs have different expressive power?

Select one:

- a. Single-tape Turing Machine and multi-dimensional Turing Machine.
- b. Multi-tape Turing Machine and multi-dimensional Turing Machine.
- c. Deterministic finite automata and Non-deterministic finite automata.
- d. Deterministic push down automata and non-deterministic pushdown automata. ✔

Your answer is correct.

The correct answer is: Deterministic push down automata and non-deterministic pushdown automata.

Question **17**

Correct

Mark 1.00 out of 1.00

$L_0 = \{\langle M, w, 0\rangle \mid M \text{ halts on } w\}$
$L_1 = \{\langle M, w, 1\rangle \mid M \text{ does not halt on } w\}$
Here $\langle M, w, i\rangle$ is a triplet. $M$ is an encoding of a Turing Machine. $w$ is a string and $i$ is a bit.
Let $L = L_0 \cup L_1$. Which of the following is true?

Select one:

- a. L' (complement of L) is recursively enumerable, but L is not.
- b. Neither L nor L' (complement of L) is recursively enumerable. ✔
- c. Both L and L' (complement of L) are recursive.
- d. L is recursively enumerable, but L' (complement of L) is not.

Your answer is correct.

The correct answer is: Neither L nor L' (complement of L) is recursively enumerable.

Question **18**
Correct
Mark 1.00 out of 1.00

Let $L = \{a^p \mid p \text{ is a prime }\}$. Then which of the following is true?

Select one:
- a. It is not accepted by a Turing Machine.
- b. It is neither regular nor context free, but accepted by a Turing Machine. ✔
- c. It is regular but not context free.
- d. It is context free but not regular.

Your answer is correct.

The correct answer is: It is neither regular nor context free, but accepted by a Turing Machine.

Question **19**
Correct
Mark 1.00 out of 1.00

A CFG is said to be in Chomsky Normal Form (CNF) if all the productions are of the form $A \to BC$ or $A \to a$. Let $G$ be a CFG that is in CNF. The number of productions to be used to derive a string of terminals of length $x$ is?

Select one:
- a. 2x.
- b. 2x-1. ✔
- c. 2x+1.
- d. $2^x$.

Your answer is correct.

The correct answer is: 2x-1.

Question **20**
Correct
Mark 2.00 out of 2.00

Consider the following language
$L = \{a^n b^n \mid n \geq 0\}$.

If $L^k$ represents the language $\overbrace{L \cdot L \cdots L}^{k\text{-times}}$, where $\cdot$ is the concatenation operation. Then which of the following statements are true?

Select one or more:
- a. $L^k$ is a CFL. ✔
- b. L' (complement of L) is a CFL. ✔
- c. $L^*$ is a CFL. ✔
- d. $L^2$ is a CFL. ✔

Your answer is correct.

The correct answers are: $L^2$ is a CFL.,
$L^k$ is a CFL.,
L' (complement of L) is a CFL., $L^*$ is a CFL.

Question **21**
Correct
Mark 2.00 out of 2.00

Language $L_1$ is polynomial time reducible to language $L_2$. Language $L_3$ is polynomial time reducible to $L_2$, which in turn is polynomial time reducible to language $L_4$. Which of the following are true?

Select one or more:
- a. If $L_4 \in P$, $L_2 \in P$. ✔
- b. If $L_1 \in P$ or $L_3 \in P$, then $L_2 \in P$.
- c. $L_1 \in P$, if and only if $L_3 \in P$.
- d. If $L_4 \in P$, then $L_1 \in P$ and $L_3 \in P$. ✔

Your answer is correct.

The correct answers are: If $L_4 \in P$, $L_2 \in P$., If $L_4 \in P$, then $L_1 \in P$ and $L_3 \in P$.

Question **22**

Correct

Mark 2.00 out of 2.00

Let $L$ be non-Turing recognizable language. Which of the following statements are true?

Select one or more:

- [x] a. L' (complement of L) is necessarily undecidable. ✔
- [ ] b. L' (complement of L) is necessarily non-Turing recognizable.
- [x] c. L' (complement of L) can be non-Turing recognizable. ✔
- [ ] d. L' (complement of L) can be decidable.

Your answer is correct.

The correct answers are: L' (complement of L) is necessarily undecidable., L' (complement of L) can be non-Turing recognizable.

◄ Midsem Exam

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