Advanced Topics in Artificial Intelligence
Answer the following questions
(21 marks)

(10 Marks)

Question 1

a) Consider the probabilistic context-free grammar:

Grammar		Lexicon
S → NP VP	[0.8]	ProperNoun → Aswan [1.0]
S → Aux NP VP	[0.1]	Verb → Book [0.5] | serve [0.5]
S → VP	[0.1]	Preposition → through [1.0]
NP → Nominal	[0.2]	Det → the [0.5] | this [0.2] | a [0.3]
NP → Det Nominal	[0.2]	Noun → flight [0.4] | breakfast [0.3] | Book [0.3]
NP → ProperNoun	[0.6]	Aux → Does [1.0]
Nominal → Noun	[0.3]	
Nominal → Nominal Noun	[0.2]	
Nominal → Nominal PP	[0.5]	
VP → Verb	[0.3]	
VP → VP PP	[0.5]	
VP → Verb NP	[0.2]	
PP → Preposition NP	[1.0]	

Give two different parse trees for the sentence: Book the flight through Aswan and then calculate the probability of each tree.

b) Write the CKY algorithm, then use it to show that the sentence: Does this flight serve breakfast is grammatical by filing in the CKY table.   (11 Marks)

Question 2
(21 marks)

a) Compute the Levenshtein minimum edit distance (using insertion cost 1, deletion cost 1, and substitution cost 2) of the pair of source and target strings:

actress and crest

then find the operations used by using backtrace   (6 Marks)

a) Write short notes on each of the following: (15 Marks)
   1) Coordinate ambiguity
   2) N-gram models.
   3) False positive and false negative errors

Question 3

1) Choose the correct answer:

1. ... ... is the study of lexicon as a highly systematic structure that governs what is the meaning of words, and how they can be used.
   a. Syntax   b. Lexical semantics   c. Pragmatic   d. Morphology

2. ...... refers to a single lexeme with multiple related meanings.
   a. Polysemy   b. Synonymy   c. Antonyms   d. Hyponymy

3. ...... are words that have the same meaning in some or all contexts.
   a. Polysemy   b. Synonymy   c. Antonyms   d. Hyponymy

4. ... ... refers to senses that are opposites with respect to one feature of the meaning.
   a. Polysemy   b. Synonymy   c. Antonyms   d. Hyponymy

5. Which of the following context-free grammar rules is NOT in Chomsky-normal form?
   a. $S \rightarrow NP\ VP$ c. $S \rightarrow Aux\ NP\ VP$
   b. $Verb \rightarrow prefer$ d. $Det \rightarrow the\ |\ some$

6. The regular expression ... ... matches the language {car, cars, Car, Cars}
   a. /Cars?/   b. /[Cc]ars?/   c. /cars?/   d. /[Cc]ar/

7. If *the, this, and Adam* are terminals and *Det, Noun, and NP* are non-terminals, then all the following rules are legal context-free grammar rules except:
   a. $Det \rightarrow the\ |\ this$ c. $Noun \rightarrow Adam$
   b. $Adam \rightarrow Noun$ d. $NP \rightarrow Det\ Noun$

8. The Byte-Pair encoding algorithm uses the... ...
   a. white space tokenization   c. subword tokenization
   b. single character tokenization   d. none of the previous

9. Lexeme is an individual entry in the lexicon.
   a. True   b. False

10. The regular expression /^The/ matches any letters except T, h, and e.
    a. True   b. False

11. Wordform is the inflected word as it appears in texts.
    a. True   b. False

Good Luck!

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Level 4
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Advanced Topics in Artificial Intelligence (Multi-Agent Systems Part 52.5 marks)

Answer the following questions

Question 1 (20 marks 10+5+5)

i. Define the following:

   a. DAI

   b. The main trends in computing history

   c. Exploration and Exploitation

   d. Weak and strong agents' characteristics

   e. Positive and negative impacts of agents on society

ii. Compare between software agent and software program with respect to nature, interactivity, flexibility, temporal continuity, autonomy, and mobility.

iii. Suppose making a robot that can roll a die which rolls the die using its arm then leaves it. It uses two cameras that can see the whole rolling area at once. The goal is getting a pre-determined side of a die. Consider the environment that include the robot, die, and rolling area. We took seven types of environments then how many types does this problem satisfy? (Justify your answers!), for example, is it non-observable, dynamic and so on?

Question 2 Answer the following Multiple choice and Complete Question *(20 marks)*

1- A model based Reflex agent is the one who always does the right thing.
   a) False   b) True

2- Which agent will always try to maximize its performance by only gathering information?
   a) IA   b) RA   c) SRA   d) MRA

3- Agents can be implemented as ------------ computing.
   a) distributed   b) parallel
   c) distributed and parallel   d) none of them

4- Which type of agents involves not only condition-action rules
   a) SRA   b) GBA   c) MRA   d) table-driven

5- In which agent does the problem generator component is present?
   a) IA   b) UBA   c) MRA   d) none

6- Agents runs continuously means
   a) Reactive   b) Autonomous   c) Proactive   d) All of the mentioned

7- Swarm robotic work is an example of _____ interaction
   a) cooperative   b) collaborative   c) collective   d) coordinative

8- Mention three disadvantages and one advantage of a table-lookup agents ....

9- The information agents are .... While temporal agents are....................

10- MDP which is used by RL agent is defined as...

Question 3 (12.5 marks 9+3.5)

a) Write the Q-learning algorithm then consider the drawn-below deterministic reinforcement environment. Assuming that the RL agent **exploits** its policy so the current status of the Q-table is indicated on the arcs and the other Q-values are zero. Let $\gamma=1$, and $\alpha=1$. Immediate rewards (R) are indicated at the nodes. Once the agent reaches the end state the current episode ends:

    i.   Make your 5x5 Q-table and 5x5 R-table then **Run the Q-learning algorithm** to update the Q-table for only two (2) episodes.

    ii.   **Determine** the path it will take from start to end? Briefly explain your answer.
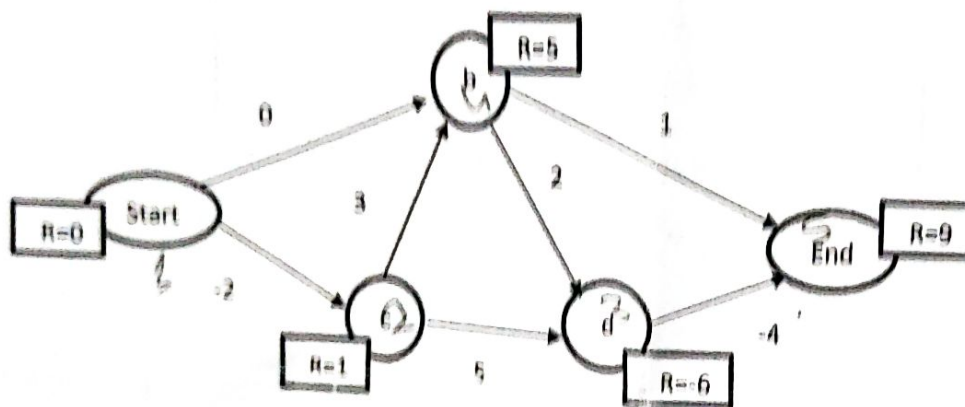
b) Consider the email spam filter agent, every 10 seconds the agent runs a code that checks the user's inbox for new messages and returns the unread messages or nothing if nothing is new. For all the unread messages, the agent runs another code to classify each unread email as either spam or non-spam and then sends the new email to either the inbox or the spam folder. Then do the following:

    i.   Determine the possible type of the agent, a percept, an actuator, and an action for this agent.

    ii.   Choose a suitable agent-type function we took in our class and modify it to be a function for this agent then write an agent function for this email spam filter agent that maps from the percept to the suitable action. The function should include two rules that map the percept to a one of two possible actions (spam or inbox folder).

With my best wishes