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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

Make up EXAMINATION - JULY 2024

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| **Semester: 5th** | **Date:10/07/2024** |
| **Course Code: CSE3076** | **Time: 9.30 am to 12.30pm** |
| **Course Name: Artificial Intelligence for Robotics** | **Max Marks: 100** |
| **Program: CAI** | **Weightage: 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 4 QUESTIONS 4Q X 5M=20M** | | | |
| 1 | Illustrates a closed-loop control system for maintaining a constant temperature in a pot of water. And describe how the components in this system, such as the Valve, Temperature Sensor, and Controller, collaborate to maintain the desired temperature? What are the advantages of using a closed-loop control system in this scenario? | (CO 1) | [Knowledge] |
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| 2 | Imagine you are a robotics programmer working on a project to design a robot capable of picking up a toy and dropping it into a toy box. To help illustrate the robot's behaviour, can you draw a state machine diagram that outlines the steps involved in this process, including the various states and transitions the robot goes through to complete the task? | (CO 1) | [Comprehension] |
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| 3 | What are the four different approaches to designing intelligent systems, and how do they differ in terms of whether they prioritize modelling human behaviour or maximizing performance? | (CO 2) | [Comprehension] |
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| 4 | Explain the components of the ANN architecture, including input layer, hidden layers, output layer, activation functions, and connections between neurons. | (CO 3) | [Knowledge] |
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| 5 | Explain how GoogLeNet works, highlighting its unique features, and provide a neat diagram illustrating its key components. | (CO 4) | [Comprehension] |
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| 6 | Explain the various processes involved in speech recognition. | (CO 4) | [Comprehension] |
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| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 7 | How does the control loop described, with a timer as the control mechanism and a 4-second set point for a robot moving 3 inches per second, help ensure precise control over the robot's movement? Could you explain the role of the error signal in this process and how it influences the control decisions, especially when the robot needs to stop? | (CO 1) | [Comprehension] |
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| 8 | Bring out the difference between Hard Real Time System and Soft Real Time System | (CO 1) | [Comprehension] |
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| 9 | You are a robotics enthusiast who has decided to participate in an Unmanned Ground Robotics Competition. In this competition, the task is to design a robot capable of navigating through a series of challenging obstacles and completing specific objectives. You want to ensure your robot is well-prepared and competitive. What are the steps involved in designing your robot for this Unmanned Ground Robotics Competition? | (CO 2) | [Comprehension] |
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| 10 | Define Data Augmentation and explain its role in enhancing the diversity of a dataset during training and Provide examples of real-world applications where CNNs are utilized for real-time. | (CO 3) | [Comprehension] |
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| 11 | A computer vision project involves recognizing objects in high-resolution images with a focus on addressing the challenges of training very deep networks. Explain the architecture of ResNet and provide a neat diagram illustrating its key components, particularly emphasizing the concept of residual learning. | (CO 4) | [Comprehension] |
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| 12 | As a machine learning engineer, you are tasked with implementing a perceptron for a binary classification task, such as distinguishing between spam and non-spam emails. Illustrate the basic components of a perceptron using a neat diagram. Then, describe how the perceptron works in the context of processing input features, applying weights, generating an output, and adjusting weights during the learning process. Provide a step-by-step explanation of the perceptron's operation in this scenario. | (CO 3) | [Comprehension] |
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| 13 | As a robotics enthusiast gearing up for an Unmanned Ground Robotics Competition, outline the strategic steps you would take to design a competitive robot. Discuss the key considerations, planning, and technical aspects involved in ensuring your robot can adeptly navigate through challenging obstacles and successfully accomplish the specified objectives of the competition. | (CO 3) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 15M=30M** | | | |
| 14 | You are a machine learning engineer tasked with developing a deep learning model for image recognition. As part of your project, you decide to use a Convolutional Neural Network (CNN) due to its effectiveness in handling image data. Explain the key types of layers in a CNN, namely the Convolution Layer, Pooling Layer, and Fully Connected Layer. Provide a detailed description of each layer's purpose, operation, and significance in the overall architecture of the CNN. | (CO 3) | [Application] |
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| 15 | Find the weights required to perform the following classification using perception network. The vectors (1,1,1,1) and (-1,1, -1, -1) are belonging to the class 1, vector (1,1,1, -1) and (1, -1, -1,1) are belonging to the class -1.  Assume learning rate as 1, and initial weights as 0 and bias as 0.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Input | | | | | Target(t) | | X1 | X2 | X3 | X4 | b | | 1 | 1 | 1 | 1 | 0 | 1 | | -1 | 1 | -1 | -1 | 0 | 1 | | 1 | 1 | 1 | -1 | 0 | -1 | | 1 | -1 | -1 | 1 | 0 | -1 | | (CO 3) | [Application] |
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| 16 | i) A data scientist is working on a project involving image classification. The project has a limited labeled dataset, and training a deep learning model from scratch might be challenging due to resource constraints. Explain the concept of Transfer Learning and discuss its advantages in the context of this scenario. ii) A computer vision project involves recognizing objects in high-resolution images with a focus on addressing the challenges of training very deep networks. Explain the architecture of ResNet and provide a neat diagram illustrating its key components, particularly emphasizing the concept of residual learning. | (CO 4) | [Application] |
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