GANPAT UNIVERSITY

M. Tech. Semester: I Mechanical Engineering (CAD-CAM)

CBCS Regular Examination Nov-Dec 2017

3ME114 Robotics and Artificial Intelligence

Time: 3 Hours   Total Marks: 60

Instruction: 1 Start a new question from new page.
                2 Draw the figure with right indications.
                3 Answer to the two sections must be written in separate answer sheet.
                4 Assume necessary data and mention your assumption.

Section - I

Que. 1

(a) Explain memory based learning. (05)

(b) Write all equations for '*error correction learning*'. Use the same to update the weights for given ANN for single iteration. Consider network is pure linear. Targeted output for network is 1 and learning rate $\eta = 0.5$. Take bias value $b = 0$. (05)
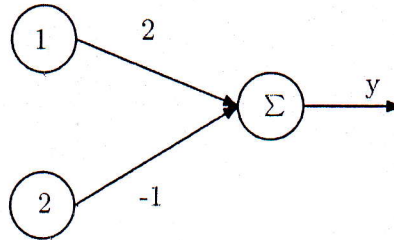
OR

Que. 1

(a) Give the characteristics of biological neural network. (05)

(b) Discuss gradient descent algorithm. (05)

Que. 2

(a) '*IF x is A THEN y is B*' where $A = \begin{bmatrix} \frac{0.4}{1} & \frac{0.6}{2} & \frac{0.7}{3} \end{bmatrix}$ and $B = \begin{bmatrix} \frac{0.2}{5} & \frac{0.7}{7} & \frac{0.6}{9} \end{bmatrix}$ infer B' for the following rule '*IF x is A' THEN y is B''*, where $A' = \begin{bmatrix} \frac{0.5}{1} & \frac{0.9}{2} & \frac{0.3}{3} \end{bmatrix}$, use Mamdani Implication using following compositions (05)
        1. Max-min composition
        2. Max-product composition
        3. Min-max composition

(b) Elaborate '*fuzzy complement*', and '*fuzzy intersection*'. (05)

OR

Que. 2

(a) What is concept of fuzzy number? Give brief discussion. (05)

(b) Consider the following two fuzzy sets representing a car image and truck (05)
image;

$$Car = \left\{ \frac{0.7}{truck} \quad \frac{0.5}{scooter} \quad \frac{0.3}{boat} \quad \frac{0.2}{car} \right\}$$

$$Truck = \left\{ \frac{0.8}{truck} \quad \frac{0.3}{scooter} \quad \frac{0.2}{boat} \quad \frac{0.6}{car} \right\}$$

Find the following
(1) Car ∩ Truck (2) $\overline{Car \cup Truck}$ (3) $\overline{Car}$
(4) Truck ∪ $\overline{Truck}$ (5) $\overline{Car \cup truck}$

Que. 3

(a) Discuss 'logistic function' and 'tanh' as activation functions for ANN. (03)

(b) Let $A = \{1, 2, 3\}$ and $B = \{1, 2\}$, if the membership function associated (04)
with each ordered pair (x, y) is given by $\mu_R(x, y) = e^{-(2x-y)^2}$ then derive the
fuzzy relation $R(x, y)$

(c) Define following terms for classical sets (03)
  a) Member
  b) Proper subset
  c) Null set

Section – II

Que. 4

(a) Draw frame assignment and obtain DH parameter for each joint link. Also (05)
find the forward kinematics model for following configuration.
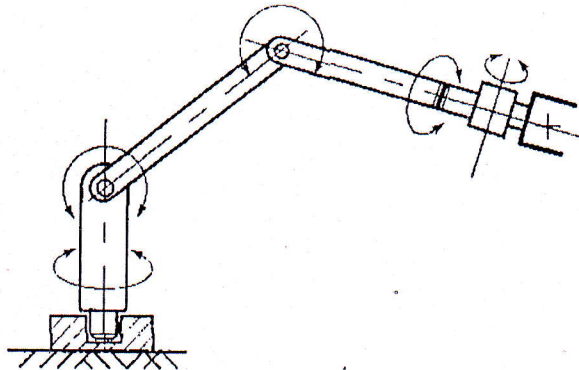
(b) The homogeneous transformation matrices between frames {i}-{j} and {i}-{k} are (05)

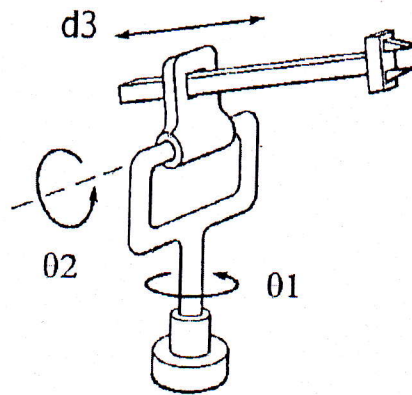$$^jT_i = \begin{bmatrix} 0.866 & -0.500 & 0 & 11 \\ 0.500 & 0.866 & 0 & -1 \\ 0 & 0 & 1 & 8 \\ 0 & 0 & 0 & 1 \end{bmatrix}; \quad {}^kT_i = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0.866 & -0.500 & 10 \\ 0 & 0.500 & 0.866 & -20 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Determine ^jT_k.

OR

Que. 4

    (a) Find DH parameters for robotics arm shown below and find direct kinematic model.   **(05)**

    (b) If frame {1} is obtained from frame {0} by a rotation about $90°$ about x-axis **(05)** followed by a rotation of $45°$ about fixed z-axis. Find rotation matrix R representing composite transformation. Sketch initial and final frames.

Que. 5

    (a) A vacuum gripper is supposed to lift up sheet of size $(914.4 \times 609.6 \times 6.35)$ mm³. If **(05)** density of sheet material is 2.7gm/cm³ and cup diameter is 127 mm, determine pressure needed to lift the object. Assume that while handling sheet, safety factor needed is 2 and number of cups are 3.

    (b) Explain how to derive inverse kinematics model for RR planar robot.   **(05)**

<div align="center">OR</div>

Que. 5

    (a) Explain working of Rack and Gear Mechanism to grip an object through robotic arm.   **(05)**

    (b) Write procedure to find end effector velocity, assume angular velocity of each link **(05)** for RR planar robot.

Que. 6   Attempt all.

    (a) Write a short note on camera calibration.   **(05)**

    (b) Name different robotic configurations and compare them.   **(05)**

<div align="center">END OF PAPER</div>