BITS F327 AI for Robotics

BITS-Pilani, Hyderabad, 2022-23-I

Mid-sem Exam

Duration: 90 mins.   [***Close Book/Note Exam***]   Total Marks: 45

Answer all Questions

1. Let the population of chromosome in Genetic Algorithm is represented in terms of binary number. The strength of fitness of a chromosome in decimal form x is given by

$$Sf(x) = \frac{f(x)}{\sum f(x)} \quad where \quad f(x) = x^2$$

   The population is given by P where: P = {[01101], [11000], [01000], [10011]}

   a. What is the strength of fitness of chromosomes?   [4]

   b. Write a pseudocode for Roulette wheel selection for the above population of chrosomes, given the four binary chromosomes only.   [4+4]

2. For a differential drive mobile robot – Assume that its left wheel speed is V_l, its right wheel speed is V_r, the robot speed is V_o, and the track (distance between the wheels) is W.

   a. Derive its kinematic equations for position and orientation.   [3+3]

   b. With a proper diagram show the odometry calculation for one step.   [2+2]

3. The following two images represent the map constructed in different methods -
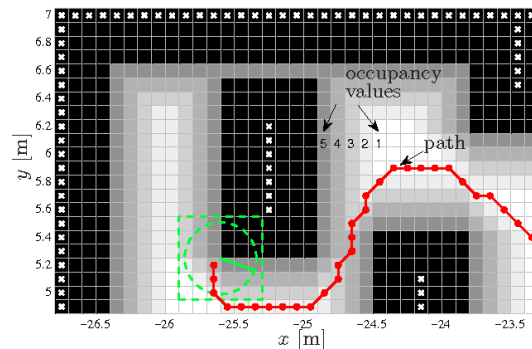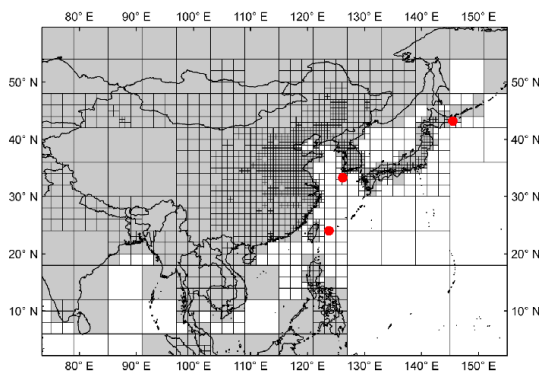
   a. What are the names for each of these maps or representations?   [2]

   b. Describe briefly the basic idea of each of these maps or representations.   [2+2]

4. The state evolution and measurement are governed by

$$x_{k+1} = \frac{x_k}{2} + 25\frac{x_k}{1+x_k^2} + 8\cos(1.2(k+1)) + v_k$$

$$y_k = \frac{x_k^2}{20} + e_k$$

with independent Gaussian noise $v_k \sim N(0, 10)$, $e_k \sim N(0, 1)$, and the initial state $x_0 \sim N(0, 1)$.

Show the estimate of the state after the implementation of Kalman filter for two steps.

[5+5]

5. What is uninformed search algorithm? Give one example with description.   [1+2]

6. Describe how local inconsistencies are resolved in D* algorithm?   [2+2]