CSE 140: Introduction to Intelligent Systems
Assignment-2
Max Marks: 20 (Programming: 10, Theory: 10) **Due Date**: 17/05/2023, 11:59 PM

Instructions

- Keep collaborations at high level discussions. Copying/Plagiarism will be dealt with strictly.
- Late submission penalty: As per course policy.
- Your submission should be a single zip file **2022xxx_HW2.zip** (Where *2020xxx* is your roll number). Include **all the files (code and report with theory questions)** arranged with proper names. A single **.pdf report** explaining your codes with results, relevant graphs, visualization and solution to theory questions should be there. The structure of submission should follow:

  2022xxx_HW2
  |− code_rollno.py/.ipynb
  |− report_rollno.pdf
  |− (All other files for submission)

- Anything not in the report will **not** be graded.
- Remember to **turn in** after uploading on Google Classroom. No excuses or issues would be taken regarding this after the deadline.
- Start the assignment early. Resolve all your doubts from TAs in their office hours at-least **two days before the deadline.**
- Your code should be neat and well commented.

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1. (10 points) **Section A (Theoretical)**
   (a) (3 marks) How can natural language processing (NLP) be leveraged to enhance the performance of mobile search engines? (3 marks) What specific techniques and strategies can be employed to achieve this goal? Mention at least 3 techniques and strategies.
   (b) Imagine that you are designing a smart room-cleaning robot for your home. It needs to be able to navigate through the house, detect obstacles, collect dust, sweep the floors, remove dirt etc. Now answer the following questions -
      (i) (1 point) What kind of robot is it?
      (ii) (1 point) What sensors will you use to solve this problem? Will you use Passive or active sensors? Give reasons for the same.

(iii) (1 point) What kind of effectors will be required for this problem statement? Give reasons for the same. (Hint - effectors for movement, collecting dust, mopping the floors, etc.)?

(iv) (1 point) Think of the type of knowledge base and reasoning that can be used for making this robot intelligent.

2. (10 points) **Section B (Code Implementation)**

(a) Write a Python script that takes a text corpus (e.g., a collection of news articles) as input and performs the following tasks:

(i) (0.5 points) Tokenizes the text into individual words or phrases.

(ii) (0.5 points) Removes stop words (e.g., "the", "and", "a", etc.) from the tokenized text.

(iii) (0.5 points) Performs stemming or lemmatization to reduce words to their base form.

(iv) (0.5 points) Counts the frequency of each word or phrase in the text.

(v) (0.5 points) Outputs the most frequent words or phrases in the text, along with their frequency count.

(b) (2.5 marks) Perform the following image augmentations using the image data set by the name 'Images (BMP, 1.27GB)' available here: **Cancer Imaging**
Pick a set of 3 different random images from the data set for each augmentation task [In case storing entire 1.27 GB folder is a problem, make a folder of first 10 images and then randomly select 3 images each time].

(i) Resize

(ii) Pad

(iii) Grayscale

(iv) Contrast

(v) Saturation

(c) (3 marks) Derive the geometric solution for the inverse kinematics of a 2 DOF manipulator given below in the closed form. (2 marks) Finally, implement the closed-form solution in a Python program to control the manipulator's end-effector position. The code should take as input the end-effector position (x, y) and the lengths of the two links (L1, L2) and return the joint angles ($\theta 1$, $\theta 2$) in radians. (Fig-1)

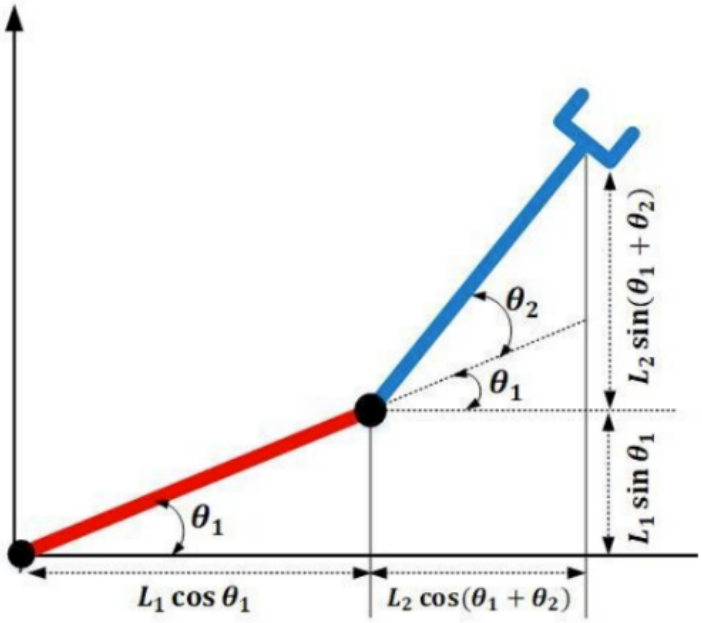
θ_2
θ_1
$L_2 \sin(\theta_1 + \theta_2)$
$L_1 \sin \theta_1$
θ_1
$L_1 \cos \theta_1$
$L_2 \cos(\theta_1 + \theta_2)$

Figure 1: