

Intelligent Robotic Systems - Assignment 2

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Question 1 [10 pts] - Terms definitions

1. Define and explain the following terms [2pts/term]:
 - Shutter speed
 - Camera field of view
 - Digitization bias
2. Describe the difference between continuous and event-driven replanning [4 pts]

Question 2 [60 pts] - Single camera calibration

In this task you will perform camera calibration for obtaining intrinsic and extrinsic camera parameters. You will need to use the Matlab camera calibration tool or write your own Python script using opencv (references in relevant lecture notes). Create a camera calibration setup by generating a calibration object (example here: <https://ch.mathworks.com/help/vision/ug/calibration-patterns.html>), and placing it in-front of a static camera (it can be your phone or any other camera as long as it takes static images e.g. no auto focus/auto-exposure/ and other auto settings). Then you will take a number of images while moving the calibration object you generated (keep the camera static!).

Your task is to:

1. Describe the setup and experimental design (e.g., photos of the camera and the object, description of how you chose the object and moved it, etc) [10 pt]
2. Generate extrinsic and intrinsic matrix. Explain the meaning of each of the exported parameters, and the values you obtained. Use your lecture notes and online resources. Don't forget to cite the resources you used. [40 pt]
3. Change the camera location and repeat the previous step. Explain differences in the matrix generated. [10 pt]

Question 3 - Point-clouds manipulation [15 pts]

In this task you will learn to practically work with pointclouds in python. Use the *Stanford Bunny* model shown in class¹. You can rely on the sample python code from the lecture or use other libraries if you wish. The data includes 6 side scans (bun000-bun315). Use those scans to do the following assignments.

1. Visualize one of the side scans, attach an image to the report [2 pts]
2. Find the size of the bunny. Explain how it was obtained and how you defined the size (HINT: You can fit some bounding shape, for example) [6 pts]
3. Color the full bunny model to have red ears and blue body. Explain how you segmented the pointcloud [7 pts]

Question 4 - A* search [10 pts]

In Figure 1 below, the start node is **S**, and the goal node is **G**. Next to each edge is the cost of going from one node to the next. To the right, three different heuristic functions h_1 , h_2 and h_3 are defined, describing the estimated cost of getting to the goal from each node.

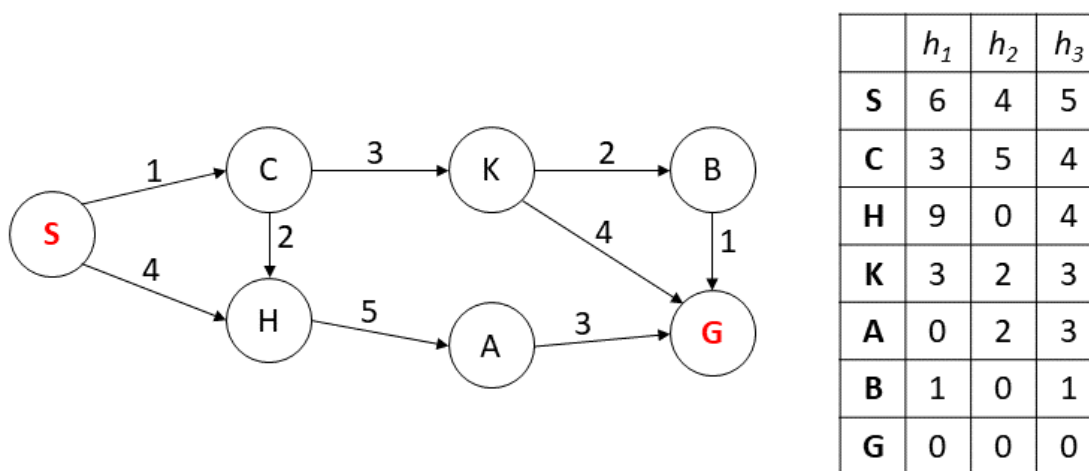


Figure 1: Search graph

1. Which path will be found by A* search using h_3 ? In case of ties (same cost), choose the node that comes first alphabetically.
2. Which (if any) of the heuristic functions h_1 , h_2 and h_3 above will generate an optimal path when using A*?

¹<http://graphics.stanford.edu/data/3Dscanrep/>

Question 5 - A* search [5 pts]

Consider the search tree in Figure 2, produced after expanding nodes A and B. Next to each edge is the cost of going from one node to the next, and the leaves are labelled with the value of a heuristic function h .

Which node will be expanded next using A*? In case of ties, expand in alphabetical order. Explain your choice

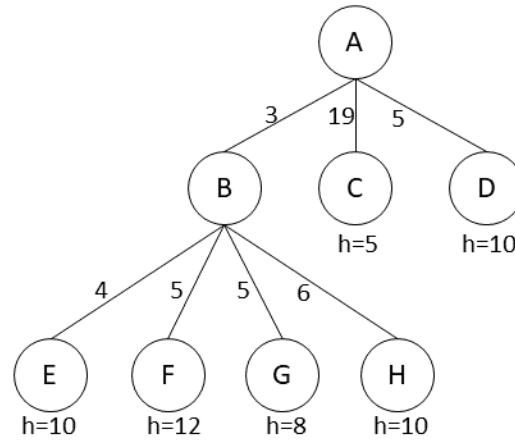


Figure 2: Search tree

Submission

A report will be submitted through moodle no later then 25/11/2021.