

Family Name _____

First Name _____

Student Number

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Venue _____

Seat Number _____



No electronic/communication devices are permitted.

No exam materials may be removed from the exam room.

Computer Science and Software Engineering
EXAMINATION

Mid-year Examinations, 2018

COSC428-18S1 (C) Computer Vision

For Examiner Use Only

Examination Duration: 120 minutes

Exam Conditions:

Closed Book exam: Students may not bring in anything apart from writing instruments.

No calculators are permitted

Materials Permitted in the Exam Venue:

None

Materials to be Supplied to Students:

- 1 x Write-on question paper/answer book
- String to tie exam materials together
- Extra sheets of lined paper (if needed)

Instructions to Students:

- **Write your name and student ID above**
- This exam is worth a total of 100 marks
- Contribution to final grade: 40%
- Length: 10 questions
- Answer all questions.
- Check carefully the number of marks allocated to each question. This suggests the degree of detail required in each answer and therefore amount of time to spend on it.
- The amount of space provided also indicates the amount of detail expected.
- **Write strictly in the spaces allocated to each answer.** Do not write close to the margins, as the answer books will be scanned, and writing very close to the margin may not be picked up. If you require extra room, there is a blank page at the end of this booklet. You may also use additional sheets of paper; these must be fastened securely to your answer booklet. You should clearly indicate in the appropriate space that the answer is continued/provided elsewhere.

Question	Mark
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[illegible]

Total

Questions Start on Page 3

1 [12 marks total]

Briefly describe advantages and/or disadvantages of the following four different types of camera technologies **for acquiring image depth values**. [1 mark for each advantage or disadvantage cited]

- (a) structured light camera [3 marks]
- (b) time-of-flight camera [3 marks]
- (c) stereo camera [3 marks]
- (d) LIDAR (Light Detection and Ranging) [3 marks]

2 [8 marks total]

In the Canny edge detector, describe the impact of varying the

(a) σ (Gaussian kernel size) [4 marks]

(b) threshold [4 marks]

3 [12 marks total]

Briefly describe the following morphological operators and explain what effect they have on an image and why they have such an effect:

- (a) Erosion [3 marks]
- (b) Dilation [3 marks]
- (c) Open [3 marks]
- (d) Close [3 marks]

4 [12 marks]

Describe how correctly matched points in two images enable finding:

- (a) depth values in a stereo pair of images [4 marks]
- (b) optical flow points in two successive frames of video using the Lukas Kanade algorithm [4 marks]
- (c) Describe how depth from optical flow can be calculated. [4 marks]

5 [12 marks total]

Briefly describe the following four goals of deep learning:

- (a) classification [3 marks]
- (b) object detection [3 marks]
- (c) segmentation [3 marks]
- (d) instance segmentation [3 marks]

6 [8 marks]

In order for a natural feature registration algorithm to work well it must be robust to common image transformations and distortions. List eight such image transformations and distortions.

7 [6 marks]

Describe how to remove noise from a 3D point cloud using PCL (Point Cloud Library).

8 [6 marks]

List three advantages of fiducial marker tracking over natural feature tracking and list three advantages of natural feature tracking over fiducial marker tracking.

9 [8 marks]

PyTorch and TensorFlow are two popular deep learning frameworks. Describe two advantages for each of these two frameworks.

10 [16 marks]

You are to briefly describe **only four of the following** class projects [for 4 marks each] by just listing (one per line) at least four algorithmic steps, **naming the algorithms** used in the order they were used.

Do not select your own or similar project (e.g. face recognition projects - do not select other face recognition projects, etc).

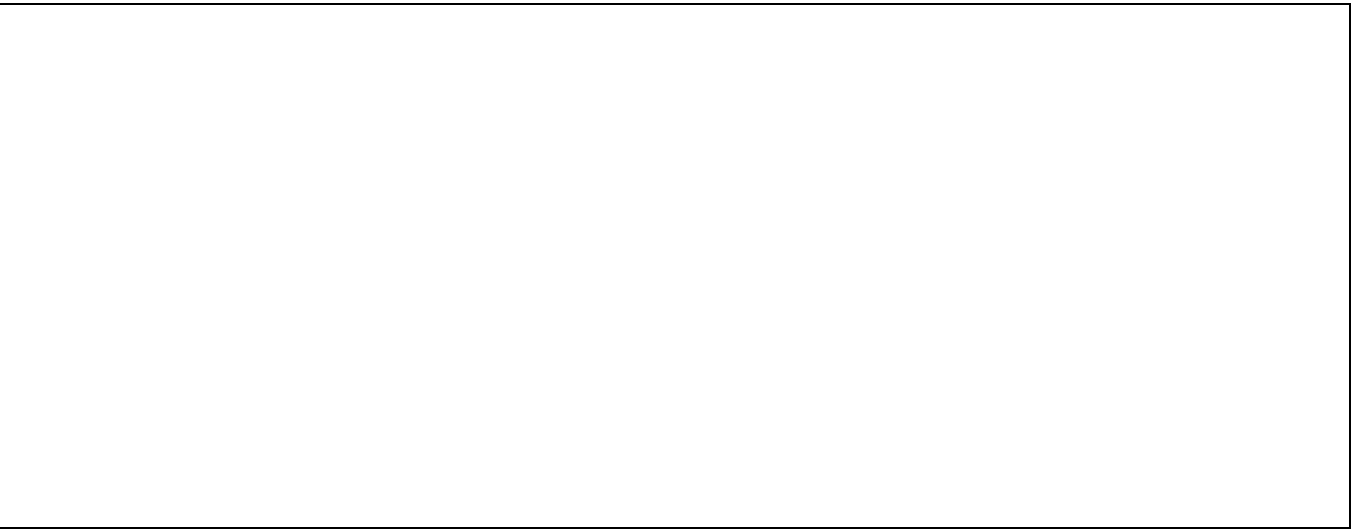
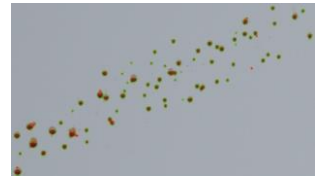
(a) “Wheelchair Docking” at a desk using an Intel Realsense D435 camera to locate a desk in front of the wheelchair.



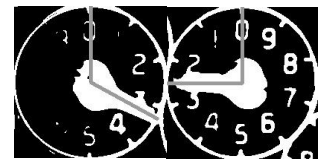
(b) “Navigation of Robotic Platform using a single webcam”



(c) “Blood Spatter Segmentation”



(d) “Automated Electricity Meter Dial Reading”



(e) “Always Clean Kitchen” to detect dishes left behind



(f) “REAL-time Hand Gesture Recognition Using Webcam”



(g) “Book Call Number Detection” on books on library shelves



(h) “Crop-row Detection for Agricultural Robots”



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If you use this page, please refer to it from the original question.

End of Examination