MONASH University

Unit Guide

ECE4076
Computer vision

Semester 2, 2017

Table of contents

Unit handbook information

Synopsis

This unit aims to develop an understanding of methods for extracting useful information (eg 3-D structure; object size, motion, shape, location and identity, etc) from images. It will allow students to understand how to construct computer vision systems for robotics, surveillance, medical imaging, and related application areas.

Mode of delivery

Clayton (Day)

Workload requirements

2 hours lectures, 4 hours laboratory and practice classes and 6 hours of private study per week

Unit relationships

Prerequisites

ENG2092 or ENG2005, ECE2071 or TRC2400 and ECE2011 or TRC3500 or FIT1002 for students studying double degrees with science

Prohibitions

ECE4711, ECE4712, ECE5076, ECE5711, ECE5712

Co-requisites

None

Chief Examiner(s)

Professor Manos Varvarigos

Unit Coordinator(s)

Name: Professor Tom Drummond
Email: Tom.Drummond@monash.edu

Campus Coordinator(s)

Name: Professor Tom Drummond
Email: Tom.Drummond@monash.edu
Building: 36, Room: G14

Academic Overview

Engineers Australia Stage 1 competencies

The Engineers Australia Policy on Accreditation of Professional Engineering Programs requires that all programs ensure that their engineering graduates develop to a substantial degree the stage 1 competencies. Listed below are the activities in this unit that will help you to achieve these competencies.

Note: that not all stage 1 competencies are relevant to each unit.

Stage 1 competencies	Activities used in this unit to develop stage 1 competencies
PE1.1 Knowledge of science and engineering fundamentals	Theoretical lecture material, prescribed texts and recommended reading, follow-up tutorials and laboratory experiments, assessed through examination.
PE1.2 In-depth technical competence in at least one engineering discipline	To be able to take a written specification and using techniques developed in the lectures and student's home reading to turn the specification into a tested and functioning program to perform a visual processing task in lab exercises. Ability to give in-depth answers to technical questions in examination.
PE1.3 Techniques and resources	Not applicable
PE1.4 General knowledge	Not applicable
PE2.1 Ability to undertake problem identification, formulation, and solution	Laboratory exercises
PE2.2 Understanding of social, cultural, global, and environmental responsibilities and the need to employ principles of sustainable development	Not applicable
PE2.3 Ability to utilise a systems approach to complex problems and to design and operational performance	The unit is about the development of intelligent systems. Taught in lectures, reinforced in tutorials and practised in labs.
PE2.4 Proficiency in engineering design	Lab exercises require students to design software solutions to computer vision problems.
PE2.5 Ability to conduct an engineering project	Not applicable
PE2.6 Understanding of the business environment	Not applicable

Stage 1 competencies	Activities used in this unit to develop stage 1 competencies
PE3.1 Ability to communicate effectively, with the engineering team and with the community at large	Not applicable
PE3.2 Ability to manage information and documentation	Laboratory exercises require students to integrate information from documentation, prescribed text and instructions.
PE3.3 Capacity for creativity and innovation	Laboratories require lateral thinking and innovative solutions to complete.
PE3.4 Ability to function effectively as an individual and in multidisciplinary and multicultural teams, as a team leader or manager as well as an effective team member	Not applicable
PE3.5 Ability to function effectively as an individual and in multidisciplinary and multicultural teams, as a team leader or manager as well as an effective team member	Not applicable
PE3.6 Capacity for lifelong learning and professional development	Not applicable
PE3.7 Professional attitudes	Not applicable

Teaching and learning method

- Laboratory-based classes
  - Hands-on exercises provide a chance to experience the application of the techniques presented in lectures
- Lecture and/or tutorials
  - Lectures are used to present the core material for the unit, while tutorial sessions are used to provide a risk-free environment for students to attempt problems, receive feedback and deepen their understanding

Learning outcomes

At the successful completion of this unit you will be able to:

1. Describe camera models.

2. Describe the elements of the human visual system and perception.
3. Apply geometry and photometry to image analysis.
4. Generate implementations for low level vision processes such as linear filtering, edge detection, texture, multi view geometry, stereopsis, structure from motion and optical flow and mid-level vision processes, such as segmentation and clustering, model fitting and tracking.
5. Design high-level vision processes such as model-based vision, surfaces and outlines, graphs, range data, templates and classifiers and learning methods.
6. Generate code to complete computer vision programming exercises in programming languages such as C and MatLab.

Your feedback to us

One of the formal ways students have to provide feedback on teaching and their learning experience is through the Student Evaluation of Teaching and Units (SETU) survey. The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied with and areas for improvement.

Previous student evaluations of this unit

In response to previous SETU results of this unit, the following changes have been made:

Introduction of Tutorial classes.

Student feedback has highlighted the following strength(s) in this unit:

Content. Lecture delivery is fantastic. Clear, concise and to the point.

Tutorials help a lot and labs actually make us have a deeper understanding.

If you wish to view how previous students rated this unit, please go to:
https://unitevaluations.connect.monash.edu.au/unitevaluations/index.jsp

Unit schedule

Week	Lecture	Lab
1	Introduction Image representations, image noise, filtering	None
2	Edge and keypoint detection Keypoint detection and matching (FAST and SSD)	None
3	Keypoint matching (SIFT, MSER) Keypoint matching as classification (Trees)	Lab 1a
4	Image projection, camera models, homographies Homographies, image stitching, panoramas	Lab 1b
5	Image segmentation, thresholding, K means clustering Gaussian distributions, mixture models, mean shift, texture	Lab 2a
6	Fourier transforms, Gabor filters, Bag-of words Viola-Jones face detection, Integral images, Eigen faces,	Lab 2b
7	Neural Networks 1 Neural Networks 2	Lab 3a
8	Projection Matrices, Lens distortion Vanishing points; points and lines in 2D	Lab 3b
9	Conics and lines in 3D Multi-view geometry	Lab 4a
10	Stereo reconstruction, Voxel Carving Light, colour, reflection	Lab 4b
11	Tracking from points and lines	None
12	Revision	None

Assessment requirements

Assessment summary

Continuous assessment: 40%

Examination (2 hours): 60%
Students are required to achieve at least 45% in the total continuous assessment component (assignments, tests, mid-semester exams, laboratory reports) and at least 45% in the final examination component and an overall mark of 50% to achieve a pass grade in the unit. Students failing to achieve this requirement will be given a maximum of 45% in the unit.

Assessment task	Value	Due date
Laboratory Exercises	40%	Bi-weekly
Examination	60%	To be advised

Assessment tasks

Assessment title: Laboratory Exercises
Mode of delivery: Not applicable
Details of task: Hands-on programming exercises for Computer Vision
Release dates (where applicable): Not applicable
Word limit (where applicable): Not applicable
Due date: Bi-weekly
Value: 40%
Presentation requirements: Not applicable
Hurdle requirements (where applicable): Students are required to achieve at least 45% in the total continuous assessment component (laboratory assignments) and at least 45% in the final examination component and an overall mark of 50% to achieve a pass grade in the unit. Students failing to achieve this requirement will be given a maximum of 45% in the unit.
Individual assessment in group tasks (where applicable): Not applicable
Criteria for marking: Marking scheme for will be self-contained in lab notes provided online for each exercise.

Students will be marked during the 2nd lab session (lab exercises are across 2 sessions).

Additional remarks: Not applicable

Examination(s)

Exam title: Examination
Weighting: 60%
Length: 2 hrs
Type (Open/closed book): closed book
Hurdle requirements (where applicable): Students are required to achieve at least 45% in the total continuous assessment component (laboratory assignments) and at least 45% in the final examination component and an overall mark of 50% to achieve a pass grade in the unit. Students failing to achieve this requirement will be given a maximum of 45% in the unit.
Electronic devices allowed: Faculty of Engineering approved calculators are permitted

Remarks (where applicable): Not applicable

Calculators
A list of the Faculty of Engineering approved calculators and the process for obtaining a sticker is available online at:
http://www.eng.monash.edu.au/current-students/calculators.html

IMPORTANT: Only these listed calculators with the **authorised Monash University-Science or Monash University-Engineering STICKER** will be allowed into the examination by the invigilators.

Not applicable

Plagiarism and collusion

Intentional plagiarism or collusion amounts to cheating under Part 7 of the Monash University (Council) Regulations.

Plagiarism: Plagiarism means taking and using another person's ideas or manner of expressing them and passing them off as one's own. For example, by failing to give appropriate acknowledgement. The material used can be from any source (staff, students or the internet, published and unpublished works).

Collusion: Collusion means unauthorised collaboration with another person on assessable written, oral or practical work and includes paying another person to complete all or part of the work. Where there are reasonable grounds for believing that intentional plagiarism or collusion has occurred, this will be reported to the Associate Dean (Education) or delegate,

Referencing requirements

Not applicable

To build your skills in citing and referencing, and using different referencing styles, see the online tutorial Academic Integrity: Demystifying Citing and Referencing at
http://www.lib.monash.edu.au/tutorials/citing/

Assignment submission

Hard Copy Submission:

Not applicable

Online Submission: If Electronic Submission has been approved for your unit, please submit your work via the Moodle site or other; as directed by your demonstator for this unit.
Please keep a copy of tasks completed for your records.

Feedback to you

Verbal feedback will be given by lab demonstrators when lab exercises are marked

Learning resources

Monash Library Unit Reading List (if applicable to the unit):
http://readinglists.lib.monash.edu/index.html

Required resources

Students generally must be able to complete the requirements of their course without the imposition of fees that are additional to the student contribution amount or tuition fees. However, students may be charged certain incidental fees or be expected to make certain purchases to support their study. For more information about this, go to Administrative Information for Higher Education Providers: Student Support, Chapter 21, Incidental Fees at: http://www.innovation.gov.au/HigherEducation/TertiaryEducation/ResourcesAndPublications/Pages/default.aspx

Other information

Policies

Monash has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University's academic standards, and to provide advice on how they might uphold them. You can find Monash's Education Policies at:
http://www.policy.monash.edu/policy-bank/academic/education/index.html

Graduate Attributes Policy

http://www.monash.edu/policy-bank/academic/education/course-governance-and-design/course-design-policy

Student Charter

http://www.monash.edu/students/policies/student-charter.html

Student Services

The University provides many different kinds of services to help you gain the most from your studies. Contact your tutor if you need advice and see the range of services available at:
http://www.monash.edu/students

Monash University Library

The Monash University Library provides a range of services, resources and programs that enable you to save time and be more effective in your learning and research.
Go to http://www.monash.edu/library or the library tab in http://my.monash.edu.au portal for more information.

Disability Support Services

Students who have a disability, ongoing medical or mental health condition are welcome to contact Disability Support Services.

Disability Support Services also support students who are carers of a person who is aged and frail or has a disability, medical condition or mental health condition.

Disability Advisers visit all Victorian campuses on a regular basis.

- Website: monash.edu/disability
- Telephone: 03 9905 5704 to book an appointment with an Adviser;
- Email: disabilitysupportservices@monash.edu
- Drop In: Level 1, Western Annexe, 21 Chancellors Walk (Campus Centre) Clayton Campus