UNIVERSITY OF TECHNOLOGY SYDNEY
DEPARTMENT OF MATHEMATICAL AND PHYSICAL SCIENCES

37233 Linear Algebra

Written Assignment on: Image Processing

[14 marks]

Due: Your scheduled Week-9 tutorial on 15–17 May 2019

Linear algebra is one of the key tools in image processing, with applications including:

- geometric transformation of images (rotation, reflection, magnification, etc);
- image sharpening and softening;
- deblurring and blurring;
- automatic shape recognition (including edge detection);
- segmentation (object extraction) and composition of image components;
- ghost images (overlays).

Choose one of the above areas and describe (using simple language, understandable for a non-specialist), in approximately 1000 words:

(a) [2 marks] the nature of the image processing application you have chosen;

(b) [2 marks] the significance of this application — that is, what are the major social, technological and/or economic uses to which it is put, and what are the major impacts of these uses;

(c) [4 marks] which specific linear algebraic and related mathematical techniques are employed in this application. These might include, for example:

- solution of linear systems;
- finding eigenvalues/eigenvectors of a matrix;
- singular value decomposition of a matrix;
- orthogonal projections;
- best approximations (including trigonometric polynomial approximations, discrete Fourier transforms (FFTs), and linear filters).

Note that this list is far from exhaustive — you should include in your discussion any mathematical issues on which your chosen application relies. Your answer to part (c) should include a description of the mathematical problem addressed by the linear algebraic technique, but need not address the detail of the mathematical theory underpinning the technique.

(d) [6 marks] Illustrate the application to image processing of the algebraic techniques selected got your assignment, using an image or images of your choice. (note that, if an image contains images of other people, you should obtain their written permission to use their image).

You should ensure that your submission is well presented, with a careful attention to expression and appropriate formatting. Up to 50% of marks can be deducted for poorly presented submissions.

Submission:

The assignment should be handed to your tutor during Week 9 (15 to 17 of May). Late submission of your assignment will be accepted until one week after the due date for the assignment (up to Friday 24 May)—however, a penalty of 2 marks per day late will be deducted for late submissions.

Resources:

You may use any relevant resources (library, internet). The following list can be useful:

[1] Pratt, W.K. Digital image processing. John Willey and Sons, Inc., 3rd edition, 2001.

[2] Karam, L.J., and Rice, D. Teaching image processing to high-school students. Signal Processing Education Workshop, 2000.

[3] Gonzalez, R.C., and Woods, M.P. Digital image processing. Prentice Hall, 2nd edition, 2002.

[4] Foley, J.D., Dam, A., Feiner, S.K., and Hughes, J.F. Computer Graphics: Principles and Practice, (2nd edition), Addison-Wesley Publishing Company, 1990.

Academic integrity:

Please be reminded that the University's policy on malpractice in final examinations also applies to assignments. For further details, please see the section on academic misconduct and appeals at:
http://www.sau.uts.edu.au/assessment

This assignment is to be completed individually—any work that you submit for assessment must be your own work. In most university assignments you are expected to refer to the ideas of people with "authority" in the subject area. Referring to ideas from books, journal articles, internet sites etc shows readers that you have researched your topic and considered a range of evidence. But when you use ideas from these sources — either by directly quoting (copying word-for-word) or rewording from the source (paraphrasing and summarising), you need to reference the source. This shows that you acknowledge the original authors of the theories, ideas, findings and materials that you have used. You are expected to use the academic referencing conventions described in the Faculty of Business "Guide to writing assignments" (http://www.business.uts.edu.au/teaching/guide/) in this assignment.

If you do not reference your sources, or if you copy work from others, you are implicitly taking someone else's words or ideas and trying to pass them off as your own. This is plagiarism.

Plagiarism is cheating and academic fraud. Plagiarism includes:

- Quoting, rewording or summarising ideas from books, journals, newspapers, internet sites, the text book, lecture notes or other sources without referencing the original source;
- Copying and pasting phrases or sentences from material on the internet without referencing the original source (cutting and pasting chunks of material with an acknowledgement is not a plagiarism but is a poor academic practice);
- Downloading or purchasing assignments from internet sites and submitting them under your own name;
- Copying from another student or submitting an assignment done by another student under your own name. This includes submitting something which you have modified or paraphrased but is substantially someone else's work.

Students who are found to have plagiarised will be penalised in line with university policy. Penalties may include failing the assessment task or failing the entire subject. Serious cases of plagiarism may attract more severe penalties. Allowing your work to be plagiarised is allowing for cheating and will also be penalised.

What is the difference between working with others and plagiarism? Learning with other students is a valuable part of university education. You can learn a lot from studying in groups, discussing assessment topics, debating ideas, sharing some resources, or reading and giving feedback on other students' draft assignments. These learning activities are not plagiarism. But if you are doing an individual assignment, you must prepare, write and submit the work yourself. If you are not clear about whether something might be plagiarism, consult your lecturer or tutor.

Further information about academic integrity and avoiding plagiarism can be found in the UTS "Advice to Students on Good Academic Practice" at: http://www.gsu.uts.edu.au/policies/academicpractice.html.

If in any doubt, you should seek advice from the subject coordinator. The UTS: Avoiding Plagiarism website helps students work out an understanding of how to acknowledge sources accurately and how to avoid plagiarism, see:
http://www.uts.edu.au/teachlearn/avoidingplagiarism/