Course Project One for
Digital Image Processing

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Goals

Practise the knowledge and skills you have learnt so far from this course. The problems that you will solve---"Counting Money"---may involve image histograms and spatial domain filtering.

Description

The figure below shows two images. The left image (aud-notes.jpg) contains five Australian notes, and the right image (search_noise.png) is the test image that contains three Australian notes. Please note that the test image has been contaminated by pepper and salt noise. Your task is to design an approach to accurately locate the three notes in the test image, and figure out the face value of each note. By "accurate" I mean the locations of the three notes should be delineated in the test image. For example, the four corners of each note can be marked in the test image to show that you really know where they are in the image. You are free to use the aud-notes.jpg however you like, e.g., you may want to crop a sub-image from it and use the sub-image as a template.

Hint: The correlation is a popular tool for image matching. But with the rotated bills, correlation is not directly applicable.

Figure 1. Given the left image, please design a method to recognize the three bills in the right image.

Marking policy

Your work will be rated based on the accuracy, efficiency, creativity, and clarity of your algorithms and essay.

The project score consists of the following parts:

Oral presentation (50%) + Report (50%) = Total (100%)

Assessment matrix for Oral Presentations of Individual Projects (worth 50%)

Grade Range	Descriptor	Delivery (Weighting = 2)	Slides (Weighting = 1)	Technical Content (Weighting = 1)	Structure (Weighting = 1)	Response to Questions (Weighting = 2)
A1 (97-100), **A2** (94-96), **A3** (91-93), **A4** (88-90), **A5** (85-87)	Excellent	Confident, clear and unhesitating delivery. Held attention of audience. Easy to follow arguments.	Exceptionally clear slides. Simple design, large enough font, not too much material on slides. A professional quality presentation.	There is a good quantity of high level technical content in the presentation.	Structure of the presentation makes understanding the technical arguments exceptionally clear.	Answered all questions clearly and confidently. Gave the impression of having an excellent grasp of the subject.
B1 (81-84), **B2** (78-80), **B3** (75-77)	Very Good	Was confident but perhaps a few minor flaws (such as hesitation, talking too fast etc).	Clear slides but perhaps the occasional flaw (font size, colour scheme etc), but overall impressive presentation.	Overall, the content is sufficient to give the audience a clear account of a challenging technical task.	A very well structured presentation with everything where it should be to provide clarity.	Answered all questions competently. Has clearly developed a very good understanding of the subject
C1 (71-74), **C2** (68-70), **C3** (65-67)	Good	Perhaps slightly lacking in confidence or possibly not speaking quite clearly enough.	There may be a number of errors, on the slides but overall still clear and flaws do not detract significantly from content.	The presentation has a good level of technical content with only a small amount of superfluous information.	Overall a well structured presentation but perhaps one or two slides are misplaced.	Answered most questions well enough to conclude that the student has a developed a good understanding of the subject.
D1 (63-64), **D2** (61-62), **D3** (60)	Satisfactory	Overall a reasonable delivery, but there were issues regarding clarity, or fluency.	Consistent errors on many slides but not of a significant nature. A reasonable effort but flaws have detracted from presentation.	There is some irrelevant non-pertinent material, but overall the technical content is satisfactory.	Some elements of the presentation are not clear as the structure is slightly confused.	Gave some good answers but also some poor ones. Evidence of reasonable understanding of the subject.
E1 (55-59), **E2** (50-54), **E3** (45-49)	Weak	A hesitant or unclear delivery made understanding the presentation difficult.	Significantly flawed slides. Basic errors such as small font size, too much content on slides, over-elaborate design.	The presentation has only limited technical content with too much general background information.	A badly structured presentation giving a confused picture of the project making it difficult to follow arguments.	Answered the majority of the questions poorly suggesting a lack of knowledge in the subject.
F1 (40-44), **F2** (35-39), **F3** (30-34)	Poor	Hesitant, unclear, monotonous, hard to maintain attention. Difficult to follow argument.	Not only are slides poor, but they make it difficult to follow argument.	The technical content is relatively low in terms of level and quantity.	Although there is some structure to the presentation it is very confused and it is almost impossible to follow.	Gave some superficial answers, but appears to have very little understanding of the subject.
G1 (22-29), **G2** (15-21), **H** (0-14)	G:Very Poor H: No Attainment	No fluency or clarity. Too many basic errors, e.g. mumbling or talking to screen.	Very poor slides, basic errors on every slide. Impossible to follow technical argument.	Superfluous or possibly no relevant technical content evident.	No discernable attempt at a logical structure.	Unable to give any sort of competent answer to any question.
Grade Awarded						

Assessment Matrix for Final Reports of Individual Projects (worth 50%)

Grade Range	Descriptor	Writing (Weighting = 1)	Presentation & Figures (Weighting = 1)	Organisation & Structure (Weighting = 1)	Literature Survey (Weighting = 1)	Technical Content & Quality of Analysis (Weighting = 3)
A1 (97-100), A2 (94-96), A3 (91-93), A4 (88-90), A5 (85-87)	Excellent	Exceptionally clear, precise and concise English. Excellent spelling &grammar, few typos.	Professional standard of presentation. All illustrations are well formatted and presented.	Structure is entirely correct with all sections correctly placed. Reading contents gives clear overview.	Exemplary range of references used and discussed in great depth, indicating comprehensive background reading.	Well informed and authoritative discussion and a comprehensive analysis of a significantly complex technical problem.
B1 (81-84), B2 (78-80), B3 (75-77)	Very Good	Clear and well written, easy to understand, and mostly free of errors.	A clear and consistent presentation style making it easy to read. Most of the figures are clear and well presented.	A well organised report with all sections logically placed enhancing understanding of work.	An appropriate range of relevant references used and discussed suggesting substantial background reading.	Clear and reasoned arguments backed up with a significant analysis indicating a very good grasp of a difficult technical problem.
C1 (71-74), C2 (68-70), C3 (65-67)	Good	Most of the text is clear and easily understood. There are some issues with grammar and spelling.	There are some minor flaws in the presentation and the clarity of the figures, but overall a well presented report.	A report which is sufficiently well organised to make reading the report easy.	Sufficient references used and discussed to indicate a good level of background reading.	Arguments presented are of a reasonable technical level, supported by a good quality analysis, and have been well considered and clearly stated.
D1 (63-64), D2 (61-62), D3 (60)	Satisfactory	The text can be understood, but some elements are not entirely clear. A sizeable volume of errors is noticeable.	A number of basic errors present – inconsistent use of styles, margins etc. Figures are satisfactory.	There may be some issues with the structure, but these do not detract from overall quality.	Perhaps just enough references used and discussed to suggest some background reading was undertaken. Too many "www" references.	The arguments presented are of reasonable technical depth, supported by some analysis and show a satisfactory understanding.
E1 (55-59), E2 (50-54), E3 (45-49)	Weak	Hard to understand much of the text. Significant spelling errors and grammatical flaws.	Significant flaws in the presentation detracting from the overall impression of the report. Flawed figures, e.g. badly drawn and untidy,	There are flaws in the way the report is structured which damages the overall quality of the report.	Too few relevant references used and discussed and possibly an over reliance on www sources indicating insufficient background work.	Only limited critical discussion of the technical problem studied. Little analysis or a low level of analysis. Suggests limited understanding of problem.
F1 (40-44), F2 (35-39), F3 (30-34)	Poor	The volume and nature of the grammatical errors, combined with poor writing makes this report difficult to read.	Unacceptable presentation: untidy and inconsistent use of styles. Figures are messy and unclear.	Serious flaws in structure which makes it difficult to read and understand the report.	Only a few references used and discussed and majority are irrelevant. Little evidence of background reading.	Very little evidence of critical discussion of technical work or results. Superficial understanding of problem. Minimal analysis included.
G1 (22-29), G2 (15-21), H (0-14)	G: Very Poor H: No Attainment	Unintelligible. Impossible to read due to exceptionally poor use of English.	A messy report, e.g. no evidence of any effective effort on the quality of the presentation. Report is hard to follow due to unclear figures.	No discernable structure. Illogical placement of sections. Impossible to follow argument.	Very few (or no) references used or discussed. No evidence of any background reading.	The lack of quality of the technical argument suggests that the student has very little understanding of the problem. No analysis.

How to mark. Suppose that the final score won by a group of three is 4.5. Then, 4.5×3=13.5 is shared among the three members.

A warning: You MUST NOT use deep learning to solve this problem. To be honest, I personally do not think deep-learning is a good choice for this task. In addition, computer-vision-based approaches such as SIFT matching are not allowed either. The techniques you adopt should by and large come from what you have learned so far in this course. However, smart utilization of simple geometric knowledge is welcome.

Submitting your work

1. Make a PPT file, and present your work in the class (I will notify you the exact date when decided). Each group has a maximum of 6 minutes.

2. Due date (again, not decided yet).

3. Materials.

Submit the following materials to our TA (Mr. Dong) before the due date：

A. Source code. I highly recommend MATLAB, which should make things easier in that you may directly use the code snippets in my PPT. Your code MUST have a one-stop file that calls all the supportive sub-routines or functions. Hence, with just one click, you should be able to show your results. Comment your code when necessary for the sake of readability.

B. A document describing your source code. The document should contain such information as what each function does, the input and output of each function, and how

to run your code.

C. Project report (in word or pdf format). This report details your approach and experimental results. Its format is the same as that of a scientific essay. It should at least contain 1) Introduction, 2) method description, 3) results, and 4) conclusion. Two extras are welcome: 5) a reference list (if applicable), and 6) a complexity analysis of your method. Note that a complexity analysis is perhaps the most convincible thing to show the efficiency of your methods.

List the names and student IDs of all team members on the first page of the report. It's recommended that you send a single zipped file named as YourGroupID+ProjectX (e.g. Group5+Project1.rar/ Group5+Project1.zip).

3. Your presentation and project report must be in English. All team members share the same project score. A team should consist of up to three students. However, as we have 91 students, one team is allowed to have four members while all the other teams should have three members.