CS303B Assignment-1

Aim

The book cover in Figure 1 is a composite image of the Mona Lisa; it consists of many tiles each of which is a painting. The aim of this assignment is to develop, evaluate and report on image processing software to automatically create composite images of various types, using images automatically selected as being of certain classes of scene.

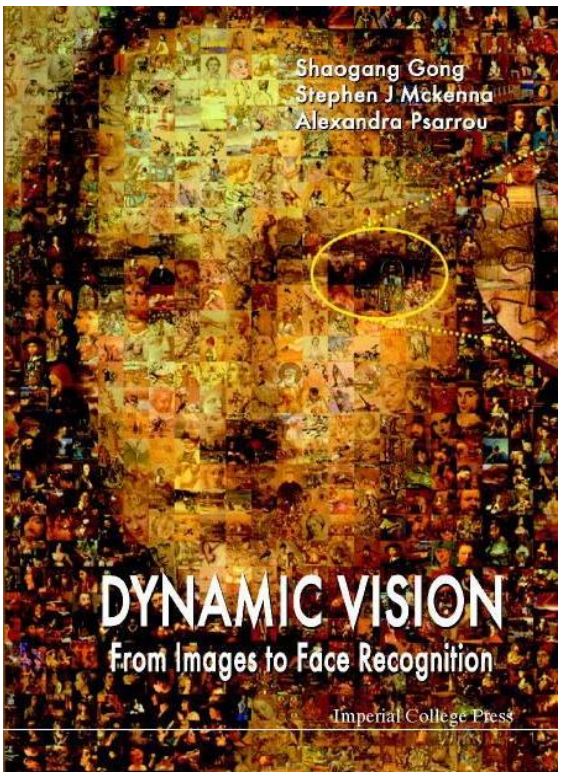


Figure 1

Terminology

The image to be approximated is called the *target image*. The images used to create the tiles are called *source images.* In Figure 1, for example, the Mona Lisa is the target image, and the source images are various paintings.

Image Data

You will be provided with sets of images of several hundred outdoor scenes. Each image has been labelled as either *natural* or *manmade*. The *natural* images are of scenes dominated by mountains, hills, desert, or sky, for example. The *manmade* images are of scenes dominated by commercial buildings, shops, markets, cities, and towns. You should use these image sets for each Part of this assignment. The images sets are divided into disjoint subsets for *training* and *testing*.

Training set:	500 *natural* images & 500 *manmade* images
Test set:	250 *natural* images & 250 *manmade* images

PART A: Composite image generation

The first part of your assignment is to develop software capable of creating composite images.

The user should be able to select the number of pixels and the number of tiles in the output composite image. You should use the training set of 1000 images to obtain source images.
To expand the data source, each student is required to provide 10 manmade pictures and 10 natural pictures in jpg format. When doing image composition, try to use each image once if possible. You may take minor adjustments to image parameters (such as HSV) as needed to better match the corresponding tile.
Optionally, you might want to source other image sets to create your own composite images. If you do so, make sure that their use is not prevented by regulations (e.g., specific stipulations on some websites limiting the use of published material) or decency considerations.

Source images should be cropped and have their sizes adjusted appropriately prior to inserting them into the composite image (e.g. by Gaussian smoothing and resampling).

Which source image to use for a given tile should be determined by computing a *measure of similarity* between the tile in the target image and each source image. You should design and implement an appropriate similarity measure. A good starting point is to compute image histograms and use a measure of histogram similarity. However, obtaining satisfying result might require taking into account other characteristics of the images such as their texture and structure. You might even consider taking into account neighboring tiles when deciding which source image to use.

PART B: Binary image classification

The second part of your assignment is to develop and quantitatively evaluate software to classify images as belonging to one of two classes: *natural* or *manmade*. You should implement a K-nearest neighbor classifier based on an image-image similarity measure.

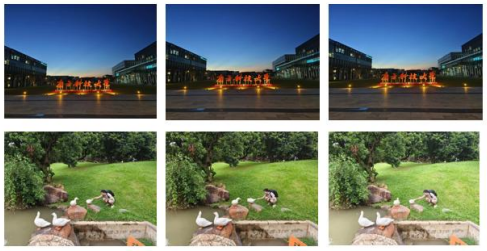
Start by using the similarity measure you developed in PART A. Subsequently, you might want to design a different similarity measure better suited to this classification task. (Think about what differentiates these two classes of image and about methods you have learned about in this course.)

You should evaluate the performance of your classification system on the test set. Test results should be given in terms of computation time, misclassification rates for each class, and overall accuracy. Of course, the system must not make use of images from the test set when making classification decisions.

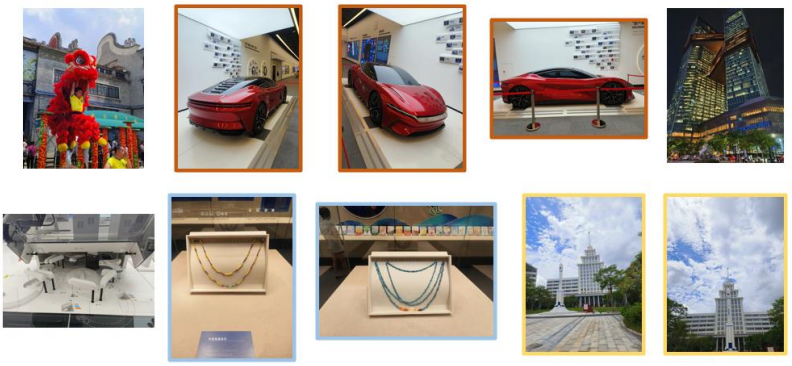
PART C: Deduplication and re-identification

Similarity measurement can also be used to deduplicate nearly identical pictures or pick out similar pictures. In this part, a group of images will be provided. First, you should remove unnecessary duplicate images. Then, filtering out similar images like template.

Deduplication



Filtering



PART D: Competition

During week 9 we will run a competition in which each team's image classifier will be directly compared in a controlled setting. You will be given a new set of 250 *natural* and 250 *manmade* images on which to test your system. You can use all 1500 previously available images as training images (the data collected together can also be used). You should submit the test classification results along with the code you used to produce them.

Teamwork and Assessment

This assignment will be assessed based on written reports, presentations, and competition results. This will include an element of moderated self/peer assessment.

The class will split into ***teams***. Each team should produce its own ***integrated*** solution. Every team member should contribute to some aspect of all three of the following: (i) software development (ii) report preparation (iii) presentation/competition.

Competition ***(Thursday of week 9)***

This will be held during the lab session. The results will be collated and presented to the class by the lecturers during week 12.

Team Report ***(due Thursday of week 9)***
Each team should submit a technical report (approximately 15-20 pages including images) bo

th electronically and as a hardcopy. The report should describe the algorithm design, implementation, testing and evaluation of the software developed. Clear justification should be given for the choice of methods compared with possible alternatives. References to the literature should be made to set your project in context and cite relevant work. You should use an accepted citation style. Code produced should be submitted in electronic form. Your team might want to appoint an editor for the report but every member of the team should contribute material to the report. You should submit the electronic version of the team report and code to VLE.

Individual Report ***(due Thursday of week 9)***

Each student should also submit a short individual report. Half a page is all that is required; it should certainly be no longer than a page. This individual report should be submitted to VLE. It need not be seen by any other students. It should contain:
1. An assessment of the extent to which you contributed to the outcome of your team, including the three ways in which you personally contributed most to the project.
2. A brief assessment of the contribution of each member of your team.
3. A suggested overall mark (%) for this assignment for each member of your team, including yourself.

Presentations (***Thursday Week 9)***

Each team will give a short presentation in which choices of method should be carefully justified in the context of alternative methods that could have been used. The final system design and results should then be presented before drawing conclusions and making suggestions for future work. Each team member should contribute (either in preparation or delivery or both). Each team will be allocated around 15 minutes plus 5 minutes for questions and discussion. The presentation should begin by introducing the team members and stating briefly their contributions.

Marking Scheme

This assignment counts for 30% of the total module mark

For the purposes of marking, the relative weighting of Parts A, B and C is 45:45:10

The relative weighting of the team report, the competition results, and the presentation is 70:10:20.

The individual reports will be used to assist the markers in the relative marking of team members, in combination with the markers' own observations of performance.

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