Guideline for Term Project

CAP 5415, Computer Vision, Fall 2016
Department of Computer Science, Florida State University

_____

Points: 100
Maximum Team Size: 2 (In other words, this can be a two-person team project or an individual project)
Due: Brief Proposal, at the beginning of class, Monday, November 7, 2016
Final Report, 5:00PM, Friday, December 16, 2016

Purpose: To gain research experience using computer vision techniques to solve real world problems or gain further understanding of implementation issues of computer vision techniques for large scale datasets.

Background: There is very rich literature on various computer vision techniques and in particular on applying computer vision techniques to real world applications (see 3.6.3, 4.1.5, 5.5.1, Chapter 9, Chapter 10, 12.2.2, 12.7.2, 13.1.2, 13.3.3, 13.5.3, 13.5.3, 14.2.3, 14.3.3, 14.4.4, and 14.5.2 in the textbook). There are also several commercially successful applications (including face detection for camera focusing, face recognition for social web sites, and computer vision algorithms for self-driving cars). This class has focused the basic principles and algorithms for various computer vision techniques. As in any engineering efforts, solving practical problems requires implementations and other considerations to achieve the best performance under constraints.

Assignment: Recognizing the diverse background of this class and the availability of implementations of computer vision techniques on the web, there are four general options for this assignment.

- **Implementation of a set of computer vision techniques** – In this option, you need to implement computer vision techniques that involve substantial programming/coding. There are two options here.
    - **Implementation for educational purpose** – In this case, you need to provide nice graphical user interfaces that allow users to set/change parameters and some working examples, and tools/ways to visualize results; you have to make the programs available on-line with reasonable documents. While you can use components that are available on the web or other sources, you have to write the majority of all the components. Possible topics include corner detection, Hough transform, normalized cut, segmentation, and object detection. Note that you may need to implement more than one topic, depending on the features you include and the topics you choose.

    - **Implementation of a particular task** – In this case, you need to implement a set of programs to solve a particular task. While you can duplicate some existing programs on the web or in other sources, your implementation has to provide some distinctive features, such as efficiency. You have to make the programs available on-line with reasonable documents. Possible topics here include face recognition, face detection, and object detection.

- **In-depth literature review**
    If you do not have a strong programming background, you can take this option by reviewing advances in a particular aspect of computer vision techniques or computer vision techniques used in a particular field. In this case, the project must be an individual one and your report must

demonstrate that you understand clearly the key issues, different proposed solutions (advantages and disadvantages of these methods), and open questions/future research problems. Please note that this is not necessarily the easiest option as you must demonstrate sufficient understanding of the topic in breadth and in depth.

- **Computer vision research** – There are three choices for this option.
  - **Novel research** – In this option, you need to have either a problem that requires some novel ways of using computer vision techniques or a new computer vision method that provides features that are not available in existing methods. If your research is related to computer vision, this may be the best option for you.

  - **Novel application** – In this option, you need to create a novel application of your own using computer vision techniques. For example, you can create a system to recognize a face based on a picture taken by a mobile phone camera; you can also automatically estimate the strokes of a player and compare with other players or previous plays from tennis or golf videos.

  - **Recreation of a research project** – In this case, you can choose a paper from the literature on a computer vision topic and then duplicate the research or significant components of it. The following papers may give you some ideas.
    - H. A. Rowley, S. Baluja, and T. Kanade, "Neural network-based face recognition," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 20, no. 1, pp. 23-38, 1998.
    - J. Fririch, T. Pevny, and J. Kodovsky, "Statistically undetectable JPEG Steganography: Dead ends, challenges, and opportunities," in the Proceedings of ACM Multimedia and Security Workshop, 2007.
    - Alex Krizhevsky, Ilya Sutskever, and Geoffrey E. Hinton, "ImageNet Classification with Deep Convolutional Neural Networks," *Advances in Neural Information Processing Systems* 25, 2012. (available from http://papers.nips.cc/paper/4824-imagenet-classification-with-deep-convolutional-neural-networks.pdf.)
    - I suggest that you first decide a topic of interest to you and then read the relevant sections in the book very carefully, which should provide a good coverage of existing methods. Of course, you can always talk to me.

- **Real-time face detection programming assignment**
  If you just want to take a well-defined problem and work on it, then you can work on an additional programming assignment on real-time face detection. **If you choose this option, the grading will be based on the criteria in the programming assignment, not the grading given below. You do not need to turn in a brief proposal but you need to let me know your choice.**

The assignment consists of two steps.
- **A brief proposal** -You need to prepare a one- or two-page proposal, stating clearly your choice and specifics of your proposed task and outlining clearly your goals and a plan to achieve your goals. Only one copy is required for each team.

- **Final report** – You need to write a report on what you have achieved by doing this project. While the details depend on your choice, you must include all the important aspects to support that you have achieved the specified goals as outlined in the assignment and in your proposal. Only one copy of report is required for each team.

Grading

- **Proposal** – 10 points
  - However, the penalty of missing a proposal is 30 points.
- **Final report** – 30 points
  - You need to include
    - A report summarizing what you have achieved.
    - All programs you developed/used for the project.
    - Typical results to demonstrate the correctness and significance of the methods you used, and comparisons with other existing related techniques.
- **Correct understanding/implementation/significance** – 60 points
  - Significance of the problem(s)
  - Significance of the dataset(s)
  - Correctness of your computer vision techniques
  - Amount of work
    - In case that you have used other programs' in your project, you will be graded based on your efforts beyond other's programs.
  - Experimental results if applicable

Additional Information

Please note that copying of other's work without proper references is a violation of the academic honor code and is an example of plagiarism. To avoid this, you must cite references properly; in case that you have used some of the programs available on the web, you need to reference them clearly in your report. In case that your project is based on other's work, yours will be graded based on your own contributions, i.e., the parts you have done beyond the other's work.