B657 Final Project

Spring 2017
Due dates:
– Proposal: Friday March 3, 11:59pm
– Interim progress report: Friday March 31, 11:59pm
– Poster draft: Wednesday April 19, 11:59pm
– Poster session: Monday April 24, 7:15pm-8:30pm
– Final report and source code: Monday May 1, 11:59pm

The final project is a chance for you to explore a specific topic related to computer vision in depth. You may choose a project topic of your choice, and you may work in a group of up to 3 people (i.e. you and two other people), also of your choice. You can also choose to work alone.

Project scope. You should choose the scope of your project based on your interests, the size of your group, your skills, and the difficulty of the topic you choose. The two major deliverables of your project are a written report (with any source code developed during the project) and a poster presented at a public poster session. It may be helpful to think about what you'd like to show in these deliverables, i.e. what would make for an interesting "story" to tell at your poster, and work backwards from there to define a project topic and plan.

It's notoriously difficult to predict how long projects will take, or whether an idea is even possible, before you get started. Even expert researchers are often surprised by problems that seem hard and turn out to be easy, or that seem easy and turn out to be hard. To deal with this uncertainty, it's best to define a staged project plan that includes contigencies depending on what you find in early stages. For instance, maybe you want to detect all photos of Pomeranians in the 10 billion images on Flickr. You can give this as your eventual project goal, but identify various specific stages you'll move through to get there: (1) collect a small set of 100 images for initial testing, (2) develop an initial dog detecting algorithm, (3) test on your small set, (4) collect 1000 images of Pomerarians, (5) develop the Pomeranian detector, (6) evaluate on your 1000 images, etc. This way, you'll hopefully still have interesting results to show, even if you fall short in your overall goal.

Even the best plan will likely need to change as the project proceeds. This is fine. The important thing is to start with a good plan so that problems can be noticed early and plans adjusted accordingly.

Project success. Note that the point of the project is to explore a computer vision topic in detail, and to go through the key stages of a research project. The success of a research project is not defined purely by whether or not the results are "good" or not, and negative result are okay. Your goal may be to see if state-of-the-art computer vision techniques can accurately recognize pictures of food, for instance, and you can define a goal of 75% correct performance on that task. The answer might turn out to be "no," and your results may be far below that. As long as your report and poster convinces us that you've tried hard to make it work, that you've developed and implemented competently and conducted thorough experimentation, this is fine and will not likely impact your grade. It is much better to do a high-quality project that ends up failing than to do a half-hearted project that ends up succeeding.

Project types. A variety of different types of projects is possible. Here are some common types that often work well:

1. New application project: Apply computer vision to some new application that is of interest to you. These projects often involve defining a new problem, collecting data, implementing an existing computer vision technique, testing it on the new application, making improvements to get good results, and performing experiments to evaluate your approach's strengths and weaknesses.

2. New implementation project: Choose a paper or paper(s) from the literature and re-implement it from scratch (or using some existing components, depending on the scope and difficulty). Replicate results presented in the original papers. Then do a "bit more:" test the algorithm on a somewhat different dataset, run some additional experiments not reported in the original paper, try to optimize the algorithm for speed, etc.

3. New method project: Take an existing paper in the literature and apply a new method to the problem they studied. (For instance, you could take an interesting segmentation paper from several years ago and update it by applying CNNs.) Test your performance against theirs in experiments, making improvements to your technique to get the best results possible.

4. Survey paper: Write a detailed, comprehensive survey paper on a computer vision topic of your choice. Like any good survey paper, yours should not simply summarize other papers, but should also categorize and organize them to give a coherent snapshot of work in this area. For instance, you may want to organize them according to different approaches or application areas, and you may want to compare and contrast different approaches, pointing out strengths and weaknesses. You may want to read some survey papers to get a sense for how to do this; articles from the high-quality journal *ACM Computing Surveys* are a good place to start. For more hints about writing survey papers, check out online resources such as: `http://www.cs.ucf.edu/~lboloni/Teaching/EEL6788_2008/slides/SurveyTutorial.pdf`. Typical survey papers usually involve citing and discussing about 25-30 papers in detail.

Academic integrity expectations. Note that unlike in previous assignment, we do not require that you implement everything from scratch, but instead you are likely to use some existing ideas, code, libraries, and datasets of others. Nonetheless, the University's academic integrity policy will govern this project. All material you submit (including written reports and source code) must be your own work which you and/or your partners personally completed, unless you explicitly indicate otherwise. If any portion of your submitted material is not your own work, you must make this explicitly clear using proper citations. For instance, all source code that you submit must be your own unless you (1) explicitly cite it in your project report and the header of your source code, and (2) explicitly mark which part(s) of the code are borrowed from or based on work from others. All sentences and figures in your reports and posters must be your own unless you place the relevant sentences in quotation marks and give a citation to the source. *Note that descriptions and discussions of existing work are to be in your own words based on your understanding of the work; it is* ***not*** *acceptable to copy or paraphrase even a small part of another work.*

Proposal

The proposal should be a brief description of your final project idea. If you're working in a group, submit only one proposal. The format should be as follows:

1. Project title and name(s) of students in group.
2. Project description: 1-2 paragraphs describing your idea. Please be as specific as possible. Make sure to propose something that is do-able within the 2 months remaining in the semester. It's okay if your project ends up deviating from the specific idea you propose. It's better to start with a concrete idea and broaden it later, then to start with an impossibly broad project and make no progress.
3. Reading list: a list of papers that you plan to read as a starting point for the paper. At least one paper should be directly related to your proposal (e.g., if you're proposing to study image retrieval on scientific diagrams, cite at least one paper that looks at this exact problem, if such a paper exists). Other papers might include background reading (e.g. in the case of the scientific diagram retrieval project, you might list papers on image feature extraction, image matching, image indexing, etc.). (See below for suggestions on finding good papers.)

4. Research plan and time-line: a step-by-step plan for completing the project, with approximate completion dates for each step. It's fine if this plan changes throughout the semester. If you are working in a team, also describe how the work will be divided.
5. Plan for data and experiments: Describe how you'll evaluate your project. What image data will you use? How will you measure whether or not the output of your approach is "correct"? How many images will you use?

Finding related papers. Whether you've decided on a topic and would like to find out what work has already been done in this area, or you're trying to think of topic ideas, I'd suggest finding and reading a few high-quality vision papers. Even if you know nothing about an area, you should be able to read a paper, figure out the parts you understand and don't understand, and then use the paper's references to do background reading on the parts you don't understand. If you're just starting out, a particularly good type of paper is a "survey article"; these are typically journal papers whose main purpose is to give new people a guide to existing work in an area, typically with dozens if not hundreds of references to other papers you can read for more information.

To find papers, go to Google Scholar (scholar.google.com) and type in a few keywords. If you're looking for survey papers, type "survey" in the title. You typically want to look for papers that either have a lot of citations (over 50 is a good sign), especially if you're just starting out. You probably want to avoid papers that are more than 5-10 years old unless they are very important papers that are cited a lot (e.g. hundreds of times).

The top venues in computer vision are:

- IEEE Conference on Computer Vision and Pattern Recognition (CVPR)
- IEEE International Conference on Computer Vision (ICCV)
- European Conference on Computer Vision (ECCV)
- Neural and Information Processing Systems (NIPS)
- International Journal of Computer Vision
- IEEE Transactions on Pattern Analysis and Machine Intelligence

Almost any paper in the above conferences and journals is worth reading. Other venues that are less prestigious, or perhaps more specialized to a particular area, include:

- British Machine Vision Conference (BMVC)
- IAPR International Conference on Pattern Recognition (ICPR)
- ACM Multimedia
- International Conference on Document Analysis and Recognition (ICDAR)
- Pattern Recognition (journal)
- Pattern Recognition Letters (journal)
- International Journal on Document Analysis and Recognition (IJDAR)
- IEEE Transactions on Image Processing
- IEEE Winter Conference on Applications of Computer Vision (WACV)

These places have lower quality control, so they have a mixture of good and less good papers. You should be very skeptical of papers at places like:

- any place with "Congress" in the title.
- any place with "Workshop" or "Symposium" in the title, although good papers sometimes appear in these.
- any conferences with SPIE in the title.
- technical reports
- student papers or class reports

- patents
- conferences and journals that are country-specific, e.g. First Australian Conference on _____. (Exceptions are European Conference on Computer Vision and British Machine Vision Conference, which are both good.)
- conferences and journals with very vague names (with words like communications systems, information technologies, etc.) (There are exceptions; ACM Computing Surveys is a good journal, for instance.)

These are not hard and fast rules, but you should raise your skepticism level whenever you see one of the above. There is, unfortunately, a fairly vast network of "fake conferences" and "fake journals" that exist to publish papers that are not good enough to appear elsewhere, and these are generally not worth reading. (But again, this is not a precise rule – good papers do sometimes go to these places, but these "diamonds in the rough" are much harder to find, especially if you are new to an area.)

Recently, many vision people publish technical reports on ArXiv. Some of these papers are very good, but it's important to remember that they have not been peer-reviewed; it is possible for literally anyone to submit literally anything and have it published. Look for papers that have been cited many times (e.g. using Google Scholar) or that are from top universities or reserach groups.

Progress update

This is a short report that describes your progress on the project so far, and a detailed plan for finishing it. Your paper should include the following sections:

- Introduction
- Background and related work
- Progress so far
- Revised research plan
- References

Much of this material may be based on your proposal, but with updates to reflect any changes in your project since the proposal. The paper should tell a self-contained story, so that a reader understands your project even if they have not seen your proposal. Hopefully you have made substantial progress on your project and have many details to report in the "Progress so far" section! Please include details, like which part(s) of your implementation or experiments are complete so far, and any initial results that you have so far. Figures, photos, plots, and tables are great to show off what you've done! (Make sure to include captions on any of these and explain them in the text of your report.)

The revised research plan section should present your plan to finish the project by the end of the semester. Please give as much detail here as possible, showing target deadlines for each task and who will do what. For instance, saying something like "Week 10: Conduct experiments" is much too general. Which experiments? Who will do them? The plan should convince a reader that you have thought through the details of what you have left to do, and now it's just a matter of doing them.

Poster

Prepare and present a poster at the poster session during the last day of class. The poster should give an overview of your project, including the motivation, background information, how you answered the research questions, your results, and conclusions. You may want to include a few key references. A good poster should be mostly understandable even if you are not there to explain it to someone, but at the same time should

avoid using too much text. During the poster session, you will be standing by the poster and explaining it to people, so think about which visual aid(s) you'd like during these one-on-one explanations.

It's a good idea to rehearse your explanations ahead of time to make sure the important points come across effectively. I generally try to rehearse a 1-minute version, a 2-minute version, and a 5-minute version, so that I can customize the explanation according to how interested a particular visitor seems to be.

The size of the poster should be between about 2 feet x 3 feet and 3 feet x 4 feet. The media center in Wells Library can print posters for a small fee of about $10. The printers are sometimes busy, especially at the end of the semester, so plan to print your poster well ahead of time.

We'll invite the public to attend the poster session and have prizes for best posters. You're also welcome to show a demo, e.g. on your laptop, but you'll have to make arrangements for any equipment that you need. Note that all group members must be present at the poster session and participate in the poster presentation.

Final paper

Your final paper should tell the complete story of your project. Most papers (except for survey papers) will have the following sections:

1. Introduction
2. Background and related work
3. Methods, where you explain how you tried to answer the research questions (making sure to give all details that someone would need if they wanted to replicate your studies)
4. Results, where you describe and analyze the results of your research
5. Discussion, where you explain how the results answered (or did not answer) the research question, what they reveal about the broader research area, and any limitations or caveats of the study
6. Conclusion, where you summarize the contributions of the project, explain the potential impact on science and/or society, and speculate on future work that you or others might do to continue the project
7. References

Much of this material may be based on your proposal and midterm paper. The paper should tell a self-contained story, so that a reader understands your project even if they have not seen your proposal or midterm paper. Use figures, photos, graphs, and tables (when appropriate) to present your results in a compact and easy-to-understand way. Make sure to include captions on any of these and explain them in the text of your report. When appropriate, use statistical tests to check if your results are statistically significant.