Machine Learning with Networks *ECEN765.600, Fall 2018*

# Course Project Guidelines

One of this course's goals is to prepare you for deriving, applying, and analyzing machine learning algorithms in practical applications. The final project provides one of such opportunities. I would love to see you delve into a project that **uniquely** suits you, in which you can apply your creativity, knowledge, and efforts to get familiar with, and even become an expert of one or two machine learning problems so that you may distinguish yourself from others. One way to be unique is to think how you can utilize the possible **network** information to formulate graph-based machine learning problems in your project. More critically, I hope that the course project has the potential to solve significant real-world challenges using machine learning. In order to do that, I would love to have you think about the course project as early as possible so that you can carry out your course study and programming projects to center around the final project. Hence, I request the submission of your project proposal as early as possible.

## 1. Important dates

The important dates for the final project are:

- Proposals: Due at **Sept. 13th, 2018** (Thursday) in class
- Midterm Reports: Due at **Nov. 1st, 2018** (Thursday) in class
- Presentations: Last week of classes
- Final Reports: Due at **Dec 12th, 2018** (Wednesday) 5PM

## 2. Project topics

Your projects can be any from the following categories:

1. **Applications:** Pick an application that interests you, and explore how best to solve it using machine learning algorithms we will discuss (by tentative syllabus) or you have learned from reading the literature. Ongoing challenges from the machine learning community are recommended.
2. **Algorithms:** You can have several choices for this category. You can either: (a) develop a new algorithm, or a novel extension of an existing algorithm, to solve a problem and evaluate the performance; or (b) compare state-of-the-art algorithms for solving one problem, by implementing them, applying to *significant real-world* problems, and evaluating the results.
3. **Theory:** Prove some interesting/non-trivial properties of a new or an existing machine learning algorithm.
4. **Literature Review:** Review a recent paper with criticism, corrections, and improvements. For this category, I expect a *deep theoretical review* of the selected paper. Otherwise, the final grade of your course project will be significantly lower than the projects in the other categories.

Again, I personally do not recommend literature review projects unless you have something interesting and novel regarding its algorithmic or theoretic findings. Of course, the projects that combine elements of applications and algorithms and theory would be nice.

Projects can be **only done individually**. I occasionally give permission to exceptional cases as team projects when the proposed projects have considerable scope and difficulty. But you would need my written permission to do so.

## 3. Project proposal

For the project proposal, it should contain the following necessary but brief information for evaluation:

- Introduction and Motivation: What do you want to do and why it is worthwhile doing?
- Deliverable: What results do you expect from the project? (Hypothesis, Algorithm, Empirical understandings, etc.)
- Methodology: How are you going to achieve that?
- Resources: What data and knowledge (mathematics or discipline-specific based on the project) do you need to collect and learn?
- Progress schedule (Milestones): How do you plan to finish the project? (I would like to have at least 3 check points during the semester before your final presentation. )
- References.

Your proposal will be evaluated and will contribute to the final grade.

**3. Midterm Reports**

For the midterm report, it should contain the following necessary but brief information for evaluation:

- Progress schedule (Milestones): What has been done? What needs to be done for the final results.
- Existing challenges and the ways to address these challenges.
- Any change from the original proposal?

The corresponding points will be taken off if I do not receive your midterm reports by the due date.

**5. Presentation**

You will give one presentation (either poster or oral presentation depending on the time availability with respect to the number of final presentations) at the end of the semester. You will need to prepare for a 5 minute lecture for your project as well as answering all questions from the class.

**6. Project report**

At the end of the semester, you will submit a final report for the project, following the traditional format for either a IEEE or ACM conferences. Typically, your final report should contain:

- Abstract: Summary of the project;
- Introduction and Motivation: What you have done and why it is important and novel;
- Methodology: Mathematical or computational methods for your project;
- Results: Data resources; Experimental results; Analysis and interpretation of results;
- Conclusions: Discussion on the obtained understanding and future research directions;
- References.

**Note:** In case we have team projects, I expect **each student writes his/her own final report** with both the description of the project and the detailed introduction their unique contributions to the project. The grade will be given based on the actual individual contributions as well as the overall quality of the project.

**7. Evaluation**

Projects will be evaluated based on:

- The technical quality of the work: Are the proposed algorithms or applications clever and interesting? Does the technical material make sense? Are the things tried reasonable? Do the authors convey novel insight about the problem and/or algorithms?
- Significance: Is the problem interesting and have impact? Is the proposed work likely to be useful?)
- The novelty of the work: How it is unique from the others' work?
- The clarity of the presentation and final report.

Finally, the ultimate objective of this course is hopefully to train you both as a "thinker" and a "doer" in analyzing large-scale data in practical applications. Please do emphasize the novelty, uniqueness, and self-evaluated learning outcomes for this course in your final report.

**8. References**

In addition to reading research papers from recent conference or journal publications, here are some of the relevant webpages:

Important Machine Learning Conferences:

- ICML (machine learning): `http://www.machinelearning.org/icml.html`
- NIPS (machine learning): `http://books.nips.cc/`
- CVPR (computer vision): `http://ieeexplore.ieee.org/xpl/conhome.jsp?punumber=1000147`

Other resources:

- `http://www.cs.purdue.edu/homes/dgleich/nmcomp/`
- `http://cs229.stanford.edu/`
- `http://cs229.stanford.edu/projectIdeas_2016.html`
- `https://www.kaggle.com/datasets`

**9. Final suggestions (from Prof. Andrew Ng)**

"Pick something that you can get excited and passionate about! Be brave rather than timid, and do feel free to propose ambitious things that you're excited about."