Guideline for Term Project

CAP 5619, Deep and Reinforcement Learning, Fall 2018
Department of Computer Science, Florida State University

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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, Wednesday, November 7th, 2018
      Final Report, 5:00PM, Friday, December 14th, 2018

Submission: You need to submit electronically via Canvas by uploading a) a pdf file (named "**term-proposal-Lastnames.pdf**") as your proposal on November 7th, 2018, b) a pdf file (named "**term-report-Lastnames.pdf**") report (including analysis and experimental results) on December 14th, 2018, and c) the program(s) you have created (named as "**term-prog-Lastnames.???**"); on December 14th, 2018 if there are multiple program files, please zip them as a single archive. Here replace "Lastnames" using your last names of the group members in the file names. Only one submission is required for each group.

Purpose: To gain research experience using deep learning and reinforcement learning techniques to solve real world problems or gain further understanding of research and implementation issues of deep learning and reinforcement learning techniques for new problems.

Background: There is very rich literature on various deep learning and reinforcement learning techniques and in particular on applying them to real world applications. This class has covered the fundamental principles and algorithms for different deep learning techniques with emphasis on regularization and optimization techniques.

Assignment: Recognizing the diverse background of this class and the availability of implementations of deep learning and reinforcement learning techniques on the web, there are two general options for this assignment.

- **Implementation of a set of pattern recognition techniques** – In this option, you need to implement deep learning and reinforcement learning 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 the components. Possible topics include regularization techniques for deep learning, optimization techniques for deep learning, different variations of convolutional neural networks, different variations of recurrent neural networks, generalization issues, residual networks, new deep architectures. 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, object detection, image caption generation, natural language modeling, speech recognition, and reinforcement learning for checker, chess or another interesting game.

- **Deep and reinforcement learning 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 deep learning and/or reinforcement learning techniques or a new deep learning or reinforcement learning architecture or method that provides features that are not available in existing methods. If your research is related to deep/reinforcement learning, this may be the best option for you.

  - **Novel application** – In this option, you need to create a novel application of your own using deep/reinforcement learning techniques.

  - **Recreation of a research project** – In this case, you can choose a paper from the literature that is closely related to deep learning and reinforcement learning and then duplicate the research or significant components of it. The following papers may give you some ideas.
    - Deep learning architecture
      - G. E. Hinton, S. Osindero, and Y.-W. Teh, "A fast learning algorithm for deep belief nets," Neural Computation, 18, pp 381-344, 2006.
      - M. Ranzato, J. Susskind, V. Mnih, and G. Hinton, "On deep generative models with applications to recognition," IEEE Conference on Computer Vision and Pattern Recognition, 2011.
      - Y. Bengio, "Learning Deep Architectures for AI," Technical Report, University of Montreal. (Available from http://www.iro.umontreal.ca/~lisa/pointeurs/TR1312.pdf).
      - Y. Bengio and Y. LeCun, "Scaling Learning Algorithms towards AI," in Large-Scale Kernel Machines, 2007 (Available from http://www.iro.umontreal.ca/~lisa/bib/pub_subject/language/pointeurs/bengio+lecun-chapter2007.pdf).
      - References in the deep learning textbook.
      - Systems developed for ImageNet Competition (available from http://www.image-net.org/.)
    - Natural language processing
      - Ronan Collobert , Jason Weston , Léon Bottou, Michael Karlen, Koray Kavukcuoglu, and Pavel Kuksa, "Natural Language Processing (Almost) from Scratch," The Journal of Machine Learning Research, Volume 12, 2/1/2011, Pages 2493-2537 (Available from http://jmlr.org/papers/volume12/collobert11a/collobert11a.pdf).
    - Speech recognition
      - W. Xiong, L. Wu, F. Alleva, J. Droppo, X. Huang, A. Stolcke, "The Microsoft 2017 Conversational Speech Recognition System," 2017 (Available from https://arxiv.org/abs/1708.06073.)
    - Reinforcement learning
      - References in the Reinforcement Learning textbook.

Additionally, you can search on the web, the IEEE web site (http://ieeexplore.ieee.org/Xplore/dynhome.jsp) or the ACM digital library site (http://portal.acm.org/dl.cfm). (Note that you do have access to the IEEE and ACM sites from any machine on the FSU network.)

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 deep learning and reinforcement learning 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
- **Optional in-class presentation** – 5 points (extra credit)
  - Your group can earn up to five extra credit points if you choose to give an in-class presentation that is about ten minutes long; you need to schedule your presentation with the instructor in advance; the presentation slots are available during the last week of classes (in other words, you need to complete your project earlier.).

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.