3MD3020- Deep Learning
MVA, October '20 - December '20

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Project Description

One of the main goals of the course is to provide the fundamental deep learning tools, theory and algorithms that one can use in order to analyze data from various domains and applications. To this direction, the main component of the course is the final project, where you will have the opportunity to develop quantitative and qualitative skills on deep learning methods and algorithms, and to obtain practical experience working with software tools. Furthermore, for those of you that are interested in research, the project will give a taste of deep learning research.

In particular, there are several types of projects that one can choose to work on (some of them are related to each other; also think of interesting combinations among them):

- Experimental evaluation of algorithms and models on an interesting image dataset. For example, select a deep learning task that you are interested in, pick 2-3 different algorithms for this problem and do an empirical experimental evaluation (e.g., take three different object detection algorithms (or stereo vision algorithms), find a good dataset or construct your own dataset and compare the performance of the algorithms).
- A new algorithm for a deep learning task and evaluation on real/artificial data (e.g., a new language processing algorithm).
- Formulation of a problem using deep learning modeling, propose an algorithm that solves the problem (or use/adapt an existing one) and experimental evaluation (e.g., select an algorithm for grouping or segmentation and propose a modification which can lead to some better results).
- Efficient implementation of a deep learning algorithm and experimental evaluation.
- Participation to an open challenge. There are a lot of challenges that are open. You can develop your own algorithm and submit your results to compare them with other techniques.
- Theoretical aspects of deep learning. Your project can be theoretical, analyzing some open issues of deep learning.
- A problem that is related to your own research. If you are already working on a research project that deep learning might be applicable to, then finding out how to apply deep learning techniques to it will often make a very good project topic.

Note that, the above list is not exhaustive and you can come up with other interesting types of projects. Ideally, projects will be a combination of an interesting application, algorithm implementation, experimentation on real/artificial data and some theoretical analysis.

Moreover, our advice is to pick a project that you can get excited and passionate about. Do feel free to propose ambitious things that you are excited about. We will always be available to discuss with you on potential projects ideas.

The projects will be evaluated based on:
- *Significance:* Is the problem "real" and "interesting", or just a "toy" problem? How original, important and well defined are the questions posed? How novel is the approach? Is the work likely to be useful and/or have impact?
- *Technical Quality:* Is the approach and the methods appropriate and well described? Are sufficient details provided? Is the technical material correct? Are the proposed algorithms or applications creative and interesting? Are the methods and algorithms reproducible? Is the interpretation (discussion and conclusions) well balanced and supported by the data? It is important to be noted, that we will not only judge the quantitative performance of your algorithm, but also your innovation and way to address the problem you chose. Your code will also be judged therefore you shall provide clean, well-documented code.
- *Organization:* Is the final project report well organized (e.g., following the structure of a paper published in a top deep learning conference)? Is the write-up clear and easy to read? Are the results presented in the most appropriate manner? Are figures and tables used appropriately?

Students should work individually or in a team of two people.

Keep in mind that replication of existing github/ gitlab repositories is not allowed. You can base our method in a publicly available repository, however you need to clearly specify what you used and what you added on it. Any violation of this will lead to the failure of the project!

In general there are two main deliverables for the project:

Deliverables	Weight	Due Date
Proposal	Not graded but mandatory	**November 09**
Final Report + Presentation	50% of the final grade	**December 17**
Grading of a project	Not graded but mandatory (Source of Bonus!!! ;-))	**December 22**

All deadlines are at 23:00 (unless stated otherwise).

Deliverable 1: Project Proposal

In the proposal, you have to concisely describe your project: you have to clearly define the problem your project proposes to solve and how you plan to achieve it. In particular, the project proposal should be based on a number of related research papers. The idea is to survey the related work and identify what are strengths and weaknesses of the paper(s) you read and how they can be addressed. The proposal should then focus on what are some promising further research directions and questions. You should try to provide a concrete proposal for a model or algorithm that potentially extends or improves the topics discussed in the papers you've read. If no related work exists for your project, you should clearly mention it in the proposal. In general, from the proposal, one should easily identify the following:

Given <dataset X > **Use** <technique(s)> **To** <achieve "XYZ">
E.g., **Given** CamVid dataset **Use** object detection algorithms **To** detect pedestrians
Given text dataset **Use** deep learning algorithm **To** translate text

The proposal should be consisting of the following parts:
- **Motivation and Problem Definition:** What is the problem you are trying to solve? Why the problem is important? What are a few potential applications? What is the main related work for the problem?
- **Methodology:** How do you plan to address the problem? What are the steps you need to take? Which algorithms/models/tools do you plan to develop or extend? How your methodology is related to prior work for this problem?
- **Evaluation:** How will you evaluate your work? What experiments do you plan to do? What dataset will be used (existing datasets or are you planning to create new ones)?
- **References:** The proposal should include a preliminary list of at least 4-5 related papers that have been published in conferences/journals. *[You can find in the introductory lecture conferences and journals that you can look for references.]*

Formatting and Page Limits: The suggested length of the proposal is **2 pages** and should be in PDF format. Please include in the header of the report the title of your project and the name/ names of the members of the team. Also, indicate that this is the project proposal (adding "Project Proposal" as subtitle). All reports should be formatted according to the Computer Vision and Pattern Recognition (CVPR) Conference Proceedings Template (format either for Latex or MS Word): http://cvpr2021.thecvf.com/node/33#submission-guidelines

Tips: There are a lot of very interesting topics that you can choose. However, be sure while choosing your topic that (i) you have defined properly your topic, (ii) you can find the available dataset and (iii) you have the computational power for your experiments!

How to submit? Please, send your proposal in a PDF format with name PP_nameoftheteam.pdf to 3md3020@gmail.com, with **DL-Project_Proposal in the subject of your email**.

Deliverable 2: Project Final Report and Project Presentation
The final report should represent all the completed work, having the following structure:

- **Abstract:** Short (200-250 words) abstract of your project.
- **Introduction/Motivation:** What is the project about? What is the problem you are trying to solve? What are the questions you want to answer? Why the problem is important? What are a few potential applications?
- **Problem Definition:** Introduce notation, provide formal definitions as needed, define any constraints or restrictions, define what you try to solve/optimize (e.g., maximize or minimize an optimization function, or the accuracy of an algorithm). Describe the problem in a formal way. Describe the hardness of the problem in a formal way.
- **Related Work:** Position the problem among the body of existing research. How does your project relate to previous research? How is your project replicating/different/complimentary to previous research? References to papers you cite should be explicit followed by a comment that describes how it is relevant.
- **Methodology:** How did you address the problem? What are the steps you had to take? Describe the data collection process. Provide any mathematical background necessary for the methods. Describe any algorithms or variations of the methods. Describe limitations or difficulties with your approach. Formally describe any important algorithms used from the literature. Try to be as specific as possible.
- **Evaluation:** How did you evaluate your work? What experiments did you run? What datasets did you use? Describe clearly your findings.
- **Conclusions:** What are the conclusions of your work? Are there any highlights? What are some ideas for future work?

- **References:** In the final report, you should provide full list of references.

Note: Keep in mind however, that if there is a good reason why your project doesn't match the above description, we will take that into consideration when grading your report.

The evaluation of the final report and oral presentation will be based on the following guidelines:

Outline	Weight
Introduction/Motivation/Problem Definition	15%
Related Work	10%
Model/Methodology/Algorithm	20%
Evaluation/Results	25%
Discussion	10%
Style and writing	10%
Presentation	10%

Formatting and Page Limits: The suggested length of the proposal is **7-8 pages** and should be in PDF format (same template as above). Please include all team member names (as authors) and indicate that this is the final project report (adding "Final Project Report" as subtitle).

How to submit? Please, send your final project either with a link to a repository where you have uploaded everything or a .zip format with name FP_name.pdf to **3md3020@gmail.com**, with **DL-Final_Project_ProjectID in the subject of your email**. The link or .zip should include the PDF with the report, the code/ data (in case you have not used publicly available datasets) and a video with the project presentation.

Project Presentation
Finally, you will need to include a video with the presentation of your project. You will prepare slides for your presentation, where you should briefly discuss each of the main parts of the project (e.g., introduction and motivation, briefly refer to the related work, description of the model/methodology/algorithm, experimental evaluation and some conclusions - take home messages). The exact duration of the presentation should be 5 minutes.

Deliverable 3: Grading of another projects
After the submission of all the projects, you will receive the project of another person/ team that you will have to review and provide a small description about it together with a grade. This can be seen like the usual review process that any research paper has to follow before its publication. You will have to provide a grade following the grading instruction summarized before. You will need to submit your review/ grade to **md3020@gmail.com**, with **DL-Evaluation_ProjectID in the subject of your email**. People that provide good reviews/ comments for their assigned project will have a bonus on their final project grade!

We are also very happy to discuss with you in any aspect of the project :-)