CSCE 440/840 Final Project Instructions and Guidelines

School of Computing, University of Nebraska–Lincoln

March 5, 2024

1 Description

The purpose of the final project is threefold: first, to utilize algorithms and ideas discussed throughout the semester for real-world problem solving; second, to develop a deeper understanding of the advantages and limitations of learned algorithms and theories when they are applied to reality; and third, to provide a platform for students to design and develop solutions, as well as to discuss their findings with peers.

2 Evaluation Criteria

The final project contributes to 25% of the final grade, which is evaluated based on the following criteria:

1. Merit of ideas (8%)
2. Midterm report (3%)
3. Final presentation (6%)
4. Final report (5%)
5. Quality of code (3%)

2.1 Merit of Ideas (8%)

This is to evaluate the creativity and originality of the topic. A clear description of the problem of interest and motivation behind choosing the specific is necessary to justify its creativity and originality. A simple rule of thumb to determine if your ideas are creative is that the topic should not be the same or similar to the sample topics listed below. You are encouraged to research interesting and exciting topics and find appropriate algorithms learned from lectures (and beyond, if applicable) to implement. Bonus points could be rewarded for ideas with a very high level of creativity.

The ideas can be based on your research directions for graduate students, application-related problems, or deeper theoretical analyses of algorithms. If you are not sure about how to choose a topic, please feel free to discuss it with the professor.

Some sample topics are listed in Section 3. Please be advised that choosing one of the topics below will lead to a lower (or even zero if there are ≥ 2 teams choosing the same sample topic) grade in the evaluation of the merit of ideas, since it will not be convincing in terms of justifying the originality of the topic.

2.2 Midterm Report (3%)

The midterm report is due April 9, 2024. The purpose of the midterm report is to ensure proper progress is made toward the completion of the proposed problem and solutions. The following evaluation criteria will be used to grade the midterm report:

- Each team member's technical contributions should be explicitly described.
- The page length requirement for the midterm report is 2 pages minimum, where the description of the team's progress should be provided.
- It is required that your midterm report should follow technical writing rules. The references should follow the IEEE Transactions format. Figures should have clear captions, legends, and formats (i.e., .eps, and .pdf).
- A good midterm report should have the following sections: Introduction, Problem Description, Progress, and Remaining Tasks.

2.3 Final Presentation (6%)

The following evaluation criteria will be used to grade the final team presentation:

- Whether the topic (and related papers, if applicable) is clearly identified and presented.
- Fluency in presentation.
- Well-structured slides.
- Q&A after the presentation.
- Meet time limit (20-minute presentation + 3-minute Q&A)

2.4 Final Report (5%)

The final report should be built on top of the midterm report with the remaining work and analysis of results. The following evaluation criteria will be used to grade the final report:

- Each team member's technical contributions should be explicitly described. If any changes are made after the submission of the midterm report, they should be explicitly described in the final report.

- The page length requirement for the final report is 4 pages minimum, where the description of the topic and justification of its creativity and originality should be clearly described.
- It is required that your report should follow technical writing rules. The references should follow the IEEE Transactions format. Figures should have clear captions, legends, and formats (i.e., .eps, and .pdf).
- A complete final report should have the following sections: Introduction, Related Work (or State of the Art), Problem Description, Methodology, Result Analysis, and Conclusion.

Comprehensive how-to instructions can be found at `http://ieeeauthorcenter.ieee.org/wp-content/uploads/How-to-Write-for-Technical-Periodicals-and-Conferences-1.pdf`.

2.5 Quality of Code (3%)

The submitted code package should include all source code to recreate your results, a clear README file, and screenshots/textfile of relevant output in a single zip file.

3 Sample Topics

High-level descriptions of some topics can be found below. The topics have been or will be briefly mentioned in lectures and related knowledge can be found in lecture notes.

1. **Analysis of 5G signal interference to aircraft:** This topic was introduced in the very first lecture this semester in the syllabus, which aims to use root-finding problems to find a good and safe range for 5G base station towers to be away from airports so that the signal strength received by aircraft landing or taking off will not be sufficiently strong to cause any noticeable interference.
2. **License plate identification:** With a snapshot of a vehicle with a full license plate or a license plate itself, this project aims to use piecewise interpolation methods to identify digits on the license plate.
3. **COVID-19 data analysis:** Based on open databases available, students will explore numerous algorithms in interpolation and extrapolation to compute important metrics to understand the spread of the SARS-CoV-2 virus and its variants. Key metrics include mortality rate by different age groups, population density, and time. Analysis of herd immunity is another topic of interest.
4. **Edge detection of an image:** This is similar to what we discussed at the beginning of the numerical differentiation lecture. An object in an image can be sketched out by its edge using two-dimensional differentiation.

5. **Deep learning for root finding problem:** This topic can be either application-oriented or more heavily on theoretical analysis based on the mathematical foundation of selected deep learning algorithms. The idea is to compare the performance of learned approaches in lectures (e.g., Newton's, bisection, or secant method) with deep learning algorithms (e.g., neural networks).

4 Deliverables and Important Dates

4.1 Deliverables

Final project report, final presentation, and code package.

4.2 Important Dates

- March 25: Team members and topic finalization. Submission of project title, team members' names, and an abstract.
- April 7: Final presentation schedule finalization.
- April 9: Midterm report submission.
- The weeks of April 22, April 29, and May 5: Final presentation dates.
- May 10: Deliverables submission through Canvas. No late submissions will be accepted.

5 Submission Instruction for Final Package

The midterm report will be submitted by April 9, 2024, and is not part of the final package. The final package includes the final report, presentation slides, and code package. Please compile both the final report and slides in PDF files and the code package in a zip file. All **three files** should be submitted through Canvas.