Course Project

CSL2050 - Pattern Recognition and Machine Learning

NOTE:

1. Please go through this document carefully.

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1 Objective

The objective of the course project in Pattern Recognition and Machine Learning (PRML) is to enable students to understand traditional machine learning techniques comprehensively. This entails learning and applying these techniques to address a chosen task, conducting systematic performance evaluations, comparing different methods, and developing innovative ideas. While gaining technical knowledge and applying it is important, the project also gives equal weight to other aspects like designing an aesthetically pleasing project page, coming up with a demo, creating an innovative recorded presentation, and writing a proper report.

2 Tasks and Deliverables

1. **Task-0:** Form a group of Five to Six. Smaller groups are highly discouraged and may not be easily permitted and may be merged with other small group.

2. **Task-1:** Some project ideas are given in Section 7. Choose a problem statement and fill this Google Form: `https://forms.gle/3KrZ3dwiGJfoeFSG6`.

3. **Task-2:** Implement the **minimum** four to five techniques from the curriculum, e.g. (but not limited to), KNN, SVM, Decision Tree, PCA, LDA, ANN, Bayesian learning, perceptron, GMM, Kmeans, regression, etc. Compare the results systematically using different performance measures and qualitative analysis. Perform failure case analysis. It is **highly discouraged** to use

the advanced modern concepts and domain-specific techniques such as Computer Vision, NLP, and Speech understanding as part of this project until asked. Your emphasis should be on rigorously exploring traditional ML techniques. We offer reference implementations for feature extraction that can be utilized. Innovation within classical concepts will be positively rewarded.

4. **Task-3:** Submit a two-page mid-report describing the problem statement, dataset, some early results (if any), the proposed approaches. Google Form: `https://forms.gle/CGpmtmPszxiSciDE7`

5. **Task-4:** Prepare and submit the following items: (a) **Report:** A technically well-written report of a minimum of five pages in the template provided is expected. (b) **Spotlight Video:** Prepare a five-minute video recording using a short highlight presentation of the task you solved and your major findings and learning. Longer videos will be penalised. Example spotlight videos can be found here: `https://www.youtube.com/watch?v=BdSWAXUA_0E&list=PLD-7XrNHCcFKoBxPyFd0p3F9znfnYhe7H` Upload this video to YouTube and share the link. (c) **Code:** A well-documented Github page with multiple commits over project duration, proper documentation, and README. (d) **P**roject Page: A project page that links all the materials and gives a high-level idea of the project. One example project page is here: `https://vl2g.github.io/projects/cstbir/`. (e) **Web Demo or Demo code:** A code of your best approach that can be used for inferring new data points with proper usage instructions. This can be linked to the project page and Github code base. Google Form: `https://forms.gle/voVZkrBn7SC4Jy8C7` (f) **Minutes of Meetings:** Each group is expected to meet weekly once at least and maintain minutes in the attached format.

6. **Task-5:** Appear for project viva with the Instructor.

3 Important Dates

1. **Feb 28, 2025:** Group Formation and broad problem idea preference (refer Task-0 and Task-1).
   Submission Link: `https://forms.gle/3KrZ3dwiGJfoeFSG6`

2. **March 31, 2025:** Mid Progress report (refer Task-3).
   Submission Link: `https://forms.gle/CGpmtmPszxiSciDE7`

3. **April 10, 2025:** Final Submission (refer Task-4).
   Submission Link: `https://forms.gle/voVZkrBn7SC4Jy8C7`

4. **April 12-17, 2024:** Viva (refer Task-5)

4 Rubrics

1. Deliverables (70 points): Report (35), Project Page (5), GitHub Code (10), Spotlight Video (5), Demo code (5), Minutes of Project Meetings (10). A well-written report, a well-documented Github code with proper naming and comments, and a high-quality presentation will be required to get higher marks.
2. Viva to assess contributions of each member and ML concept understanding (30 points)
3. Any innovative idea or extra effort will be rewarded with bonus points/higher grades.

5 Submission Instruction and Late Policy

- Each group is required to make one submission.
- A proper file naming convention is a must and will be looked into while grading.
- All submissions will be made via Google Forms.
- The late submission policy of this course will apply to the course project.

6 Bonus Points: Use of Google Cloud

As this course is supported by the Google Cloud Teaching Award, we shall share the Google Cloud Coupon code. You are encouraged to explore and use Google Cloud features such as AutoML, Colab Pro/Colab Enterprise, Deployment & Monitoring, etc. If you use Google Cloud, please write a paragraph on it. There will be Bonus Points for using any Google Cloud Feature as additional feature.

7 Project Ideas

1. **Music Genre Classification:** To automatically classify different musical genres from audio files. Dataset Link: `https://www.kaggle.com/datasets/andradaolteanu/gtzan-dataset-music-genre-classification`

2. **Stroke Prediction** Stroke is the second leading cause of death globally, responsible for approximately 11% of total deaths. The given dataset can be used to predict whether a patient is likely to get a stroke based on input parameters like gender, age, various diseases, and smoking status. Dataset Link: https://www.kaggle.com/datasets/fedesoriano/stroke-prediction-dataset

3. **Fruits Recognition:** For this project, students need to recognise the fruits from the dataset. Dataset Link: `https://www.kaggle.com/datasets/moltean/fruits`

4. **Handwritten Digit Recognition:** Your goal is to classify handwritten digits into one of 10 classes. Develop ML models for doing so. You may use simple raw pixel features or profile features and compare various ML models. Dataset: `https://gitdisl.github.io/GTDLBench/datasets/mnist_datasets/`

5. **Sentiment Classification:** Sentiment analysis is the process of computationally determining the emotional tone or opinion expressed in a piece of text (e.g., Tweet or product review), helping to understand whether the sentiment is positive, negative, or neutral. Dataset: `https://www.kaggle.com/datasets/abhi8923shriv/sentiment-analysis-dataset`

6. **Image Retrieval**: Given an image query, your goal is to retrieve the relevant images. You may extract HoG and CNN features using the provided implementation and try different approaches, including classification and clustering-based techniques. Dataset (use CIFAR-10 dataset): `https://www.cs.toronto.edu/~kriz/cifar.html`

7. **Face Identification:** Identify a face image by classifying to one of K classes. Extract LBP, HoG and CNN Features using the code provided and compare different techniques. Dataset: `https://www.kaggle.com/datasets/jessicali9530/lfw-dataset`

8. **Object Recognition:** Recognizing objects in natural scene has numerous applications. In this project, your goal is to compare the ML techniques for object recognition task. Dataset: Dataset (use CIFAR-10 dataset): `https://www.cs.toronto.edu/~kriz/cifar.html`

9. **Webpage Classification:** This dataset contains webpages from 4 universities, labeled with whether they are professor, student, project, or other pages.

   `http://www-2.cs.cmu.edu/~webkb/`

   Project ideas: Learning classifiers to predict the type of webpage from the text. (Hint: you may use the bag of words to represent webpages.)

10. **Handrawn Sketch Recognition**: Hand-drawn sketches differ significantly from natural images, requiring robust feature extraction techniques for accurate classification. Your goal is to classify sketches into one of several object categories. Experiment with traditional features and to compare their performance. Dataset: `https://cybertron.cg.tu-berlin.de/eitz/projects/classifysketch/`

11. **Leaf classification** Identifying plant species from leaf images is an important task in agriculture and biodiversity research. Your goal is to classify leaf images into different species using ML techniques.

    Dataset: `https://www.kaggle.com/competitions/leaf-classification`

12. **Script Identification** Given a scene text word, identify which script it is from. Dataset: `https://github.com/Bhashini-IITJ/BharatSceneTextDataset.git` (We will provide exact data splits to work on)

13. **Book Genre Classification** Classifying books into genres based on textual and visual cues is useful for digital library organization and recommendation systems. Your goal is to develop a machine-learning model that classifies books into genres using metadata, textual descriptions, and/or cover images. Dataset: `https://github.com/uchidalab/book-dataset`

14. **Speaker Recognition:** Identify who is speaking from the audio data.

    Dataset: https://www.kaggle.com/datasets/vjcalling/speaker-recognition-audio-dataset

15. **Open Ideas**: You are also welcome to come up with a project idea of your own. However, please ensure that your focus should still be on using traditional ML techniques and **NOT** the advanced and domain-specific techniques (Computer Vision, NLP, Speech understanding). Open Ideas need to be approved by the instructor.

8 Academic Honor Code

Academic Honor Code for Course Project on Pattern Recognition and Machine Learning (Please read it carefully, and strictly adhere to it):

1. **Original Work:** All work submitted for this course project must be the original work of the individual or group unless properly cited. Plagiarism, which includes but is not limited to copying, paraphrasing, or closely imitating the work of others without appropriate acknowledgement, is strictly prohibited.

2. **Collaboration:** Collaboration among students in the group is encouraged, but all collaborative work must be acknowledged appropriately and explicitly listed out after the conclusion of the report. Each student or group is responsible for ensuring that their contributions to collaborative efforts are clearly delineated and credited.

3. **Citing Sources:** Any external sources of information, including books, academic papers, online resources, and conversations with others, must be properly cited. Failure to give credit to the original sources constitutes academic dishonesty.

4. **Data Integrity:** All data used in the project must be obtained and manipulated ethically and legally. Any manipulation or misrepresentation of data is prohibited.

5. **Code Integrity:** All code used in the project must be written by the individual or group, or properly attributed if obtained from external sources. Copying code without attribution or claiming another's work as one's own is considered academic dishonesty.

6. **Acknowledgment of Assistance:** Any assistance received from instructors, teaching assistants, classmates, or any other individuals must be acknowledged in the project report or presentation.

7. **Adherence to Instructions:** All project instructions provided by the instructor must be followed meticulously. Deviating from these instructions without prior approval is not permitted.

8. **Respect for Academic Integrity:** Students are expected to uphold the highest standards of academic integrity and to report any suspected violations of the honor code to the instructor or appropriate authorities.

9. **Use of Large Language Models (LLMs):** The use of Large Language Models (LLMs) such as GPT, Claude, or similar AI-powered tools is strictly regulated. While these models may assist in concept clarification, brainstorming, or debugging, students must ensure that all submitted work is their own. Directly copying text, code, or solutions generated by LLMs—whether in whole or with minor modifications—is strictly prohibited and will be considered a violation of academic integrity. Students are expected to develop their own solutions, demonstrate their understanding, and justify their approaches. Any use of LLMs (however minor it is) must be appropriately documented, including precise citations specifying how the tool was used. Excessive reliance on LLMs that diminishes the student's independent effort will be severely penalised.

10. **Consequences of Violations:** Violations of the academic honor code may result in penalties, including but not limited to an F grade in the course, zero points in continuous evaluation, or sending the case to a disciplinary action committee.

    By participating in this course project, students agree to abide by this Academic Honor Code and understand the seriousness of academic dishonesty.

9 Report Template and Reference Code

Please clone the LaTex template for the report and reference code that can be used for feature extraction from here:
`https://github.com/anandmishra22/PRML-Spring-2023.git`

Please review the report's instructions (main.tex) and add your content.

End of Paper