

ECE656 - Machine Learning and Adaptive Systems

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List of Possible Individual Projects:

Please select one topic (with certain application in mind) from this list. Duplicate projects are not acceptable. Proposals (1-2 pages with references) are due by October 15th.

1. *Independent Component Analysis (ICA) Learning:* ICA is widely used for many source separation problems. One application is to apply ICA learning to learn to separate speech signals from multiple speakers in a room and further classify each speaker (e.g., female vs male or English vs non-English speaking, etc.)
2. *Detection and Recognition of Spam in Emails:* Idea of this project is to represent the email data as features, design classifiers to classify spam emails from normal emails, and test the overall system on novel data.
3. *Deep Learning for Classification:* Idea is to apply deep learning methods for text recognition or other similar applications (e.g., malware).
4. *Adaptive Control of Linear/Nonlinear Plants:* Idea is to develop an adaptive function approximator to (a) identify an unknown linear/nonlinear plant and (b) track plant's variations (slow) over time. This could be used for robot control systems.
5. *Detecting and Classifying Transient events:* Many phenomena are transient by nature e.g., an irregularity in heart beat or acoustic signal of passing vehicles. The goal here is to design detection and classification methods for such events.
6. *Image Data Compression:* Idea is to develop a fast and effective learning algorithm for compressing images (e.g., stereo images) so that the data can be transmitted in real-time over low bandwidth channels.
7. *Hidden Markov Models (HMM):* HMM can be used for many interesting applications such as speech recognition, human habitual recognition system for certain categories of interests (e.g., young vs old people, religious vs nonreligious, etc.) based upon the temporal information in the web searching data, and detection and recognition system for monitoring credit card purchases and habits and detect the onset of misuse.
8. *Manifold Learning for Data Representation:* Idea is to design learning schemes that map the high dimensional data into a lower dimensional manifold that capture all essential characteristics of the data. It is desirable that the mapping is invertible i.e. allows for synthesis of the original domain data from lower dimensional representations.
9. *Incremental Learning for Pattern Classification in New Environments:* Idea is to develop an in-situ learning (supervised, semi-supervised, unsupervised or combinations) for updating parameters of classifiers when encountered new patterns and/or classes in the deployment environments.

10. *Flexible Image Retrieval Systems:* Idea is to develop a flexible image retrieval system (e.g., finger print images) that can retrieve images in a medium-size database based upon either text or pattern (features) queries and at the same time be able to learn from expert users clicks (or relevance feedback).
11. *Flexible Text Retrieval Systems:* Idea is to develop a flexible text retrieval system that can retrieve documents in a medium to large-size databases based upon either a text or image queries and at the same time be able to learn from expert users clicks (or relevance feedback).