Deep Learning (BHCS18B) Discipline Specific Elective - (DSE)

Credit: 06

Course Objective

The objective of this course is to introduce students to deep learning algorithms and their applications in order to solve real problems.

Course Learning Outcomes

On successful completion of this course, the student will be able to:

1. Describe the feed-forward and deep networks.
2. Design single and multi-layer feed-forward deep networks and tune various hyper-parameters.
3. Implement deep neural networks to solve a problem
4. Analyse performance of deep networks.

Detailed Syllabus

Unit 1

Introduction: Historical context and motivation for deep learning; basic supervised classification task, optimizing logistic classifier using gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient method.

Unit 2

Neural Networks: Feedforward neural networks, deep networks, regularizing a deep network, model exploration, and hyper parameter tuning.

Unit 3

Convolution Neural Networks: Introduction to convolution neural networks: stacking, striding and pooling, applications like image, and text classification.

Unit 4

Sequence Modeling: Recurrent Nets: Unfolding computational graphs, recurrent neural networks (RNNs), bidirectional RNNs, encoder-decoder sequence to sequence architectures, deep recurrent networks, LSTM networks.

Unit 5

Autoencoders: Undercomplete autoencoders, regularized autoencoders, sparse autoencoders, denoising autoencoders, representational power, layer, size, and depth of autoencoders, stochastic encoders and decoders.

Unit 6

Structuring Machine Learning Projects: Orthogonalization, evaluation metrics, train/dev/test distributions, size of the dev and test sets, cleaning up incorrectly labeled data, bias and variance with mismatched data distributions, transfer learning, multi-task learning.

Practical

1. Implement logistic regression classification with (a) gradient descent and (b) stochastic gradient descent method. Plot cost function over iteration.
2. Experiment with logistic regression by adding momentum term, and adaptive sub-gradient method
3. Write the code to learn weights of a perceptron for Boolean functions (NOT, OR, AND, NOR, and NAND).
4. Implement a feed-forward neural network for solving (a) regression and (b) 2-class classification problem. Also experiment with hyper-parameter tuning.
5. Train and test a feed-forward neural network for multi-class classification using softmax layer as output.
6. Create a 2D and 3D CNN for image classification. Experiment with different depth of network, striding and pooling values.
7. Implement (a) RNN for image classification, (b) GRU network and (c) Implement LSTM networks
8. Implement an auto-encoder, denoising autoencoders and sparse autoencoders.
9. Design a stochastic encoders and decoders.

References:

1. Bunduma, N. (2017). *Fundamentals of Deep Learning*. O'reilly Books.

2. Heaton, J.(2015). *Deep Learning and Neural Networks*, Heaton Research Inc.

Additional References:

1. Goodfellow, I. (2016). *Deep Learning*. MIT Press.

2. Deng, L., & Yu, D. (2009). *Deep Learning: Methods and Applications (Foundations and Trends in Signal Processing).* Publishers Inc.

3. Hall, M.L, (2011). *Deep Learning*. VDM Verlag

Course Teaching Learning Process

- Use of ICT tools in conjunction with traditional class room teaching methods
- Interactive sessions
- Class discussions

Tentative weekly teaching plan is as follows:

Week	Content
1	Introduction: Historical context and motivation for deep learning; basic supervised classification task
2-3	Optimizing logistic classifier using gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient method
4-5	Neural Networks: Feedforward neural networks, deep networks, regularizing a deep network, model exploration, and hyper parameter tuning
6-7	Convolution Neural Networks: Introduction to convolution neural networks: stacking, striding and pooling, applications like image, and text classification
8	Sequence Modeling: Recurrent Nets: Unfolding computational graphs, recurrent neural networks (RNNs), bidirectional RNNs
9	Encoder-decoder sequence to sequence architectures, deep recurrent networks, LSTM networks
10	Autoencoders: Undercomplete autoencoders, regularized autoencoders, sparse autoencoders
11-12	Denoising autoencoders, representational power, layer, size, and depth of autoencoders, stochastic encoders and decoders.
13	Structuring Machine Learning Projects: Orthogonalization, evaluation metrics, train/dev/test distributions,
14-15	Size of the dev and test sets, cleaning up incorrectly labeled data, bias and variance with mismatched data distributions, transfer learning, multi-task learning.

Assessment Methods

Written tests, assignments, quizzes, presentations as announced by the instructor in the class.

Keywords

Convolution Neural Networks, Recurrent nets, autoencoders

Unix Network Programming (BHCS18C) Discipline Specific Elective - (DSE)

Credit: 06

Course Objective

This course introduces the concepts of Internet protocols, ports used during communication, Client/Server concepts and various transport protocols used in computer network applications and services. The objective is to equip the students with technical knowledge of it comprises of the study of the sockets used with TCP and UDP include IPV4 & IPV6.

Course Learning Outcomes

On successful completion of the course, students will be able to:

1. Describe and analyse the various Internet Transport layer protocols used in TCP/IP AND UDP.
2. Comprehend the concepts and structures of both TCP based connection-oriented and UDP based connection-less client server applications.
3. Write various real-life client-server applications using socket programming.
4. Modify, maintain and extend the present internet client-server applications and write any new type of internet applications to suit the current needs of Internet users.

Detailed Syllabus

Unit 1

Introduction: Basics of Client Server applications, Example of day time client server, concurrent servers, protocols, sockets, port numbers.

Unit 2