CSCE 5210: Fundamentals of Artificial Intelligence - Fall 2020

Instructor: Paul Tarau, Professor - see my home page for contact info and office hours.

course directory

Grader(s):

contact via Canvas

Midterm exam: Wednesday October 28 (open net)

Final Project: TBD

Description and Objectives: A comprehensive overview of today's AI, with emphasis on Knowledge Representation and Deep Learning. Case studies will provide a hands-on introduction to some popular Deep Learning frameworks and their application to Natural Language Processing.

Syllabus

Introduction to AI as a Research and Application Field

- "Intelligent Systems"
- Knowledge vs. Perception in AI
- Symbolic vs. Connectionist AI
- Successful AI Applications

Logic and Knowledge Representation

- Logic and Natural Language
- Knowledge Representation
- Ontologies vs. Models and Simulations
- Inductive, Deductive vs. Abductive Inferences
Basic Concepts of Machine Learning

- Learning from Data vs. Programming
- Supervised, Unsupervised and Reinforcement Learning
- Representing the Data
- Splitting the Data into Learning, Validation and Test Sets
- Regressions vs. Classification Tasks

Fundamentals of Deep Learning

- The Math behind Deep Learning
- The Neurons: working with Sigmoid, Tanh, RELU etc.
- Feed-forward Neural Networks
- Backpropagation
- Training vs. Inference
- Network Types: Convolutional Neural Networks, LSTM, GRU, etc.
- Frameworks for Deep Learning
  - Keras and Tensorflow
  - Pytorch

- Case studies with Deep Learning
  - Learning with seq2seq
  - Learning the workings of simple theorem provers and recursive algorithms
  - Differentiable Programming

AI tools for Natural Language Processing

- Symbolic NLP resources, WordNet, VerbNet, Knowledge Graphs
- Logic Representations for Syntax and Semantics
- Graph based NLP, Summary and Keyword Extraction
- POS tagging, Dependency Grammars, Named Entity Extraction
- Python NLP resources, NLTK, Spacy, StanfordNLP
- Transformers, Google BERT, Question Answering
- Building an Intelligent Dialog Agent

Overview of a Few AI Applications

- Winning Go and Chess games against the Best Human Players
- Google's Deep Dream
- Tesla's Autopilot
- Amazon Alexa

**Prerequisites:** Coding Experience, Data Structures, Algorithms

**Evaluation:**

- Assignments (teams of at most 3): 20%
- Midterm Exam: 30%
- Research Topic Presentation: 20%
- Final Project: 30%

**Recommended books:**

- [Deep Learning with Python](#)
- [Artificial Intelligence: A Modern Approach](#)
- [Graph-based Natural Language Processing and Information Retrieval](#)

**Software, online, tutorials and related links:**

- [Keras](#)
- [Tensorflow](#)
- [Pytorch](#)
- Python 3 [tutorial](#)
- [NLTK](#)
- [StanfordNLP](#)
- [Spacy](#)
- [some code to be seen in class at github](#)