Course Description
CAI3303C | Natural Language Processing | 3.00 credits
Students will further explore Natural Language Processing domains. Focus on deep learning application and use of the latest pre-trained models on real world applications. Prerequisite: CAI2300C.

Course Competencies:
Competency 1: The student will demonstrate an understanding of the workings of fundamental deep learning applications of Natural Language Processing (NLP) by:
1. Describing Recurrent Neural Networks its usage and shortcomings within NLP
2. Explaining LSTMs, GRUs and Bidirectional RNNs including when usage is appropriate and evaluation of model performance
3. Identifying the key components of the Transformer architecture and attention

Competency 2: The student will explore and apply the latest deep learning pre-trained NLP model architecture by:
1. Discussing the history of Generative Pretrained Transformer (GPT) architecture
2. Explaining the general concept behind OpenAI's GPT-3
3. Applying GPT-2 via Hugging Face application and GPT-3 via OpenAI API interface
4. Describing the general concept behind Google's BERT and explaining the nature of bidirectional encoder representations
5. Applying BERT using tensor flow on a sample application

Competency 3: The student will explore the field of Automatic Speech Recognition (ASR) by:
1. Exploring traditional ASR algorithms such as Hidden Markov Models and Dynamic Time Warping applied to audio samples
2. Implementing state-of-the-art speech recognition models such as Quartznet, Citrinet, and Conformer.
3. Using implementation tools for deep learning models such as Kaldi, Mozilla Deep Speech and NVIDIA NeMo

Competency 4: The student will explore Question and Answering (Q&A) models by:
1. Explaining the unique challenges that come with a Q&A dataset such as SQU AD 2.0
2. Evaluating Q&A models available from various platforms such as Hugging Face
3. Creating and training their own Q&A model

Competency 5: The student will explore the field of Machine Translation by:
1. Comparing and contrasting different types of machine translation
2. Using Tf- seq2seq to create and train a transformer for operation of machine translation
3. Exploring machine translation datasets such as the WMT2014 English German dataset and their unique challenges
4. Researching high benchmark translation models

Competency 6: The student will explore the field of Information Retrieval by:
1. Comparing and contrasting traditional methods of Information Retrieval vs Deep Methods
2. Exploring Information Retrieval by applying pre-trained models
3. Exploring the CQADupStack dataset and the unique challenges of this dataset in relation to the field
4. Researching the latest models created with the highest benchmarks for the CQADupStack dataset

Learning Outcomes:
- Use quantitative analytical skills to evaluate and process numerical data

Updated: Fall 2025

- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information
- Use computer and emerging technologies effectively

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