University of Hargeisa

Course Title: Selected Topics in Computer Science

Course Code: CS~~401~~

Credit Hours: 3

Prerequisite(s): Probability, Statistics, Linear Algebra & Calculus.

Course Description: This course aims to provide advanced background on Artificial Intelligence. It provides the basic concepts of AI & ML to apply it to CV & NLP problems.

Mode of Delivery: *Lectures* - preferably interactive (ask questions, intervene in discussions) & *Lab sessions*.

Instructor(s): Suleiman Gargaare *(MSc in CS, MSc in PM & BSc in IT).*

Learning Outcomes: At the end of this course, students will be able to

- Understand the scope of Artificial Intelligence.
- Understand the application areas of Artificial Intelligence.
- Explain Artificial Intelligence as representation and search problem.
- Explain and Implement Machine Learning Algorithms.
- Solve Image Processing and Computer Vision Problems.
- Solve Natural Language Processing issues that Human Languages have.
- Understand the concepts and algorithms of deep learning & neural networks

Course Content:

Topic 1:

- **Review** of Artificial Intelligence, Machine Learning, Image Processing, Natural Language Processing and Deep Learning with Python.
    - **Artificial Intelligence (AI):** Roots and Scope of AI, Definition, Knowledge Base in AI, Search Problems in AI including Heuristic Search. In this topic we will cover the following Algorithms
        - Dept First Search & Breadth First Search

- Greedy Best First Search & A* Search
- Mini Max

❖ **Machine Learning (*co-requisite*):** Types of Machine Learning including Supervised, Unsupervised and Reinforcement Learning. Classification, Regression and Clustering Algorithms.

In this topic we will cover the following Algorithms

- Support Vector Machine (SVM)
- K Nearest Neighbor (KNN)
- Perceptron
- Gaussian Naïve Bayes

Topic 2:

- **Computer Vision and Image Processing (CV & IP):** Low-level techniques, such as color enhancement and noise removal, Medium-level techniques, such as compression and binarization, and higher-level techniques involving segmentation, detection, and recognition algorithms extract semantic information from the captured data.

✓ In this topic we will cover the following Algorithms

- Histogram Equalization.
- Binarization
- Erosion and Dilation

Topic 3:

- **Natural Language Processing (NLP):** Phonetics, Phonology, Morphology, Syntax, Semantics, Pragmatics, Discourse, Parsing & Part of Speech Tagging.

✓ In this topic we will cover the following algorithms

- Stemming
- Context Free Grammar
- POS Tagging

Topic 4:

- **Introduction to Neural Networks and Deep Learning:** Definitions, Applications & Algorithms of Neural Networks and Deep Learning.

Reference Books:

1. Artificial Intelligence A Modern Approach, 3rd Edition by Stuart J. Russell & Peter Norvig.
2. Natural Language Processing with Python by Steven Bird, Ewan Klein and Edward Loper.
3. Programming Computer Vision with Python Jan Erik Solem.