IS 365

Artificial Intelligence

Basic Information about the course

- Delivery mode:
  - Lectures: Thursday 12:00- 13:55 in B310 Kijitonyama
  - Course Materials -> lms.udsm.ac.tz
- Assessment Mode:
  - Coursework (40%) and University Examination (60%)
- Instructor: Dr. James Chambua.
- Office: Block A, room A026
  - Other assistance: schedule an appointment or consult CR

Objectives

1. Fundamental concepts of AI and intelligent systems
2. knowledge representation methodologies such as propositional and predicate logic, rule-based systems, and probabilistic systems;
3. Various search algorithms and identify when each is appropriate;
4. Provides an understanding of the representation and use of knowledge in inference-based problem solving by knowledge-based agents.

Course Content

- Unit I: Fundamental Issues
- Unit II: The role of heuristics
- Unit III: Knowledge Based Reasoning
- Unit IV: Agents
- Unit V: Robotics

Topics

- Three key topics: search, knowledge representation and inference, and machine learning.
- We will discuss a variety of other different topics in AI, such as planning, robotics and natural language.
- I will assume that you know basic differential calculus of several variables and vector algebra/matrices.
- You will not be able to understand machine learning without this basic mathematical background.

AI Motivation

- Games
- Non-game tasks, there are systems that achieve strong performance on reading comprehension, speech recognition, face recognition, and medical imaging benchmarks.
- Good performance on datasets does not necessarily mean good performance in actual real world tasks.
- In other words, “Passing an exam or a course does not necessarily imply you have perfect understanding or know how to apply that knowledge to real problems.”

Birth of AI

- General Principle (the core foundation for AI)
  - Every aspect of learning or any other feature of intelligence can be so precisely described that a machine can be made to simulate it.
- Aim:
  - to build a system that could do it all

- While they did not solve it all, there were a lot of interesting programs that were created: programs that could play checkers at a strong amateur level, programs that could prove theorems.
- Theorist actually found a proof that was more elegant than what a human came up with.
- From the beginning, people like John McCarthy sought generality, thinking of how commonsense reasoning could be encoded in logic.
- Despite some successes, certain tasks such as machine translation were complete failures

Birth of AI, Success and Failure

- What went wrong? It turns out that the real world is very complex and most AI problems require a lot of compute and data.
- The hardware at the time was simply too limited both compared to the human brain and computers available now.
- Also, casting problems as general logical reasoning meant that the approaches fell prey to the exponential search space, which no possible amount of compute could really fix.
- Even if you had infinite compute, AI would not be solved.

- There are simply too many words, objects, and concepts in the world, and this information has to be somehow encoded in the AI system.
- Though AI was not solved, a few generally useful technologies came out of the effort, such as Lisp (very advanced programming language).
- One particularly powerful paradigm is the separation between what you want to compute (modeling) and how to compute it (inference).

Fundamental Concepts

- Knowledge-based Systems
- Expert systems: elicit specific domain knowledge from experts in form of rules:
  - if [premises] then [conclusion]
- Knowledge-based systems which narrow practical systems in targeted domains are referred to as expert systems.
- ANN
- Training Networks
- Machine Learning
- Deep Learning

A Melting Pot

- Bayes rule (Bayes, 1763) from probability
- Least squares regression (Gauss, 1795) from astronomy
- First-order logic (Frege, 1893) from logic
- Maximum likelihood (Fisher, 1922) from statistics
- Artificial neural networks (McCulloch/Pitts, 1943) from neuroscience
- Minimax games (von Neumann, 1944) from economics
- Stochastic gradient descent (Robbins/Monro, 1951) from optimization
- Uniform cost search (Dijkstra, 1956) from algorithms
- Value iteration (Bellman, 1957) from control theory

Two Views of AI

- AI agents: how can we create intelligence?
- AI tools: how can the society benefit from this?