Dongseo University

Division of Computer Engineering

Artificial Intelligence

Instructor(s): Dae-Ki Kang   **Classroom:**
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Course Description:
This course introduces students to the basic knowledge of artificial intelligence topics including knowledge representation, problem solving, reasoning, uncertainty, perception, and learning methods. Upon completion of this course, students should be able to develop intelligent systems by assembling solutions to concrete computational problems; understand the role of knowledge representation, problem solving, and learning in intelligent-system engineering; and appreciate the role of problem solving, vision, and language in understanding human intelligence from a computational perspective.

Course Goals & Objectives:
At the conclusion of this course, the successful (passing) students will have an understanding of the basic areas of artificial intelligence including problem solving, knowledge representation, reasoning, decision making, planning, perception and action, and learning - and their applications (e.g., machine learning, data mining, information retrieval). Students will also be able to design and implement key components of intelligent agents of moderate complexity in Java, Python, R, Lisp or Prolog and evaluate their performance. Advanced level students are expected to develop familiarity with current research problems, research methods, and the research literature in AI.

Course Outline:

- **Week 1**

  Introduction to knowledge-based intelligent systems
  - Intelligent machines, or what machines can do
  - The history of artificial intelligence, or from the 'Dark Ages' to knowledge-based systems

- **Week 2**

  Rule-based expert systems
  - Introduction, or what is knowledge?
  - Rules as a knowledge representation technique
  - The main players in the expert system development team

- Structure of a rule-based expert system
- Fundamental characteristics of an expert system 33
- Forward chaining and backward chaining inference techniques
- MEDIA ADVISOR: a demonstration rule-based expert system
- Conflict resolution
- Advantages and disadvantages of rule-based expert systems

- **Week 3**

  Uncertainty management in rule-based expert systems
  - Introduction, or what is uncertainty?
  - Basic probability theory
  - Bayesian reasoning
  - FORECAST: Bayesian accumulation of evidence

- **Week 4**

  Uncertainty management in rule-based expert systems
  - Bias of the Bayesian method
  - Certainty factors theory and evidential reasoning
  - FORECAST: an application of certainty factors
  - Comparison of Bayesian reasoning and certainty factors

- **Week 5**

  Fuzzy expert systems
  - Introduction, or what is fuzzy thinking?
  - Fuzzy sets
  - Linguistic variables and hedges
  - Operations of fuzzy sets

- **Week 6**

  Fuzzy expert systems
  - Fuzzy rules
  - Fuzzy inference
  - Building a fuzzy expert system

- **Week 7**

  Frame-based expert systems
  - Introduction, or what is a frame?
  - Frames as a knowledge representation technique
  - Inheritance in frame-based systems
  - Methods and demons
  - Interaction of frames and rules

- **Week 8**   Mid-Term Week

- **Week 9**

  Artificial neural networks
  - Introduction, or how the brain works
  - The neuron as a simple computing element
  - The perceptron
  - Multilayer neural networks
  - Accelerated learning in multilayer neural networks

- **Week 10**

  Artificial neural networks
  - The Hopfield network
  - Bidirectional associative memory
  - Self-organizing neural networks

- **Week 11**

  Evolutionary computation
  - Introduction, or can evolution be intelligent?
  - Simulation of natural evolution
  - Genetic algorithms
  - Why genetic algorithms work

- **Week 12**

  Evolutionary computation
  - Case study: maintenance scheduling with genetic algorithms
  - Evolution strategies
  - Genetic programming

- **Week 13**

  Hybrid intelligent systems
  - Introduction
  - Neural expert systems
  - Neuro-fuzzy systems
  - ANFIS: Adaptive Neuro-Fuzzy Inference System
  - Evolutionary neural networks
  - Fuzzy evolutionary systems

- **Week 14**

  Machine learning and data science: learning probabilistic models
  - Maximum-likelihood parameter learning: discrete models
  - Naive Bayes models
  - Maximum-likelihood parameter learning: continuous models
  - Bayesian parameter learning
  - Learning Bayes net structures

- **Week 15**   Dead Week

  Machine learning and data science: reinforcement learning
  - Passive reinforcement learning
  - Active reinforcement learning
  - Generalization in reinforcement learning

- **Week 16**   Final Week

Textbook(s)
- Required: Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition by Michael Negnevitsky (Pearson Education, 2011)
- Recommended: Artificial Intelligence: A Modern Approach, 3rd edition by Stuart Russell and Peter Norvig (Pearson, 2009)

Class Website: e-Class
- Exams: mid-term exam 20%, final-term exam 20%

- Quizzes: N/A

- Course Projects: 30%

- Assignments: 20%

- Bonus Credit: 10%

- Grading: Curved

Grading Policies:

Course Policies:
- Attendance: Mandatory
- Academic Misconduct Policy: