CSC 340 Artificial Intelligence **4 cr.**

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Section	Time	Room	Final Exam
nn	days and times	location	date and time

Catalog description:

This course studies the theory and application techniques which allow a computer to "behave intelligently". Various operational definitions of intelligence are discussed, along with the concept of "mechanized intelligence". The course includes case studies of expert systems which solve engineering design problems, diagnose disease, and learn from their environment via natural language and/or visual interaction with a user. The role of planning, goal formation, search analysis and evaluation, and various forms of representation will be discussed extensively. Four lecture hours per week, plus programming work outside of class.

Prerequisites: **CSC 105 and CSC 260.**

Goals:

This course is intended to introduce the basic concepts of artificial intelligence. The student will employ hands-on case studies to internalize the techniques of AI. The course will develop an understanding of:

CG01: the concepts of the fundamental branches of artificial intelligence;
CG02: the basic approaches to problem-solving using AI techniques;
CG03: knowledge representation and automated reasoning;
CG04: the concept of machine learning and its various technical issues.

Objectives:

Upon successful completion of this course the student will have

CO01: explained the rudimentary concepts of artificial intelligence techniques;
CO02: selected an artificial intelligence method of solution based on stated problem constraints;
CO03: mastered heuristic functions and search strategies such as uninformed search and informed search;
CO04: demonstrated knowledge of expert systems;
CO05: demonstrated knowledge of computer-based knowledge representation, reasoning, and planning;
CO06: demonstrated through projects and written assignments the ability to apply methods and techniques of machine learning (e.g. supervised learning, unsupervised learning, reinforcement learning, neural networks, genetic algorithms, and/or Bayesian Belief networks).

Student Outcome vs. Course Objectives matrix

SO	CO01	CO02	CO03	CO04	CO05	CO06
SO-1	✓	✓	✓	✓	✓	✓
SO-2		✓	✓		✓	✓
SO-3					✓	
SO-4						
SO-5					✓	
SO-6	✓	✓	✓	✓	✓	✓

Notes:

SO-1: Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

SO-2: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

SO-3: Communicate effectively in a variety of professional contexts.

SO-4: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

SO-5: Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline. Apply computer science theory and software development fundamentals to produce computing-based solutions.

SO-6: Apply computer science theory and software development fundamentals to produce computing-based solutions.

Topics:

- Functional definitions of intelligence **IS1(0, 1, 0)**
  - the Turing test
  - rational vs. non-rational reasoning
  - adversarial search and game playing
- Problem characteristics **IS1(0, 2, 0)**
  - fully versus partially observable
  - single versus multi agent
  - deterministic versus stochastic
  - static versus dynamic
  - discrete versus continuous
- Nature of agents **IS1(0, 2, 0)**
  - autonomous versus semi-autonomous
  - reflexive, goal-based, and utility based
- Problem spaces **IS2(0, 1, 0)**
  - states
  - goals
  - operators
- Solving problem by searching **IS2(0, 8, 0)**
  - classical approaches to search
  - search spaces, search trees, goal trees
  - uninformed search strategies
  - informed search strategies
  - heuristic functions
  - two-player games
  - constraint satisfaction
- Adversarial search and game playing **IS5(0, 0, 6)**
  - constructing search trees, dynamic search space

- implementation of A* search, beam search
- minimax search, alpha-beta pruning
- expectimax search and chance nodes

- Problem-solving approaches
  - generate and test
  - rule-based systems
- Knowledge representation and reasoning **IS3(0, 8, 0)**
  - review of basic techniques
  - propositional logic
  - predicate logic
  - resolution and theorem proving
  - forward chaining, backward chaining
- Expert systems **IS6(0, 0, 4)**
  - rules for knowledge representation
  - forward/backward chaining
  - rule-based expert systems
- **Uncertain knowledge and reasoning** **IS7(0,0,4)**
  - Quantifying Uncertainty
    - Acting under Uncertainty
    - Basic Probability Notation
    - Bayes' Rule and its Use
    - Naïve Bayes Models
  - Probabilistic Reasoning
    - Representing Knowledge in an Uncertain Domain
    - Bayesian Networks
      - Semantics
      - Inference
    - Causal Networks
- Machine learning **IS4(0, 10, 0)**
  - definition and examples of a broad variety of machine learning tasks, including classification
  - inductive learning
  - rules and rule-like paradigms
  - over-fitting problem
  - measuring classifier accuracy
- Advanced machine learning and applications **IS9(0, 0, 10)**
  - supervised learning
    - decision trees
    - neural networks
    - support vector machines
  - unsupervised learning
    - clustering
    - self-organizing maps
  - reinforcement learning
  - performance evaluation
    - cross-validation
    - ROC curve
  - ensemble learning
  - applications of machine learning algorithms

Assignments and Examination:

The emphasis of this course in on the understanding of the basic approaches to knowledge acquisition, representation and retrieval with respect to the general concept of simulating intelligent behavior. Various techniques for representing knowledge and rules are presented and discussed with emphasis on generalized problem-solving paradigms. Specific examples of AI and AI-related systems are included as a means of solidifying theoretical concepts.

The course grade will be determined using the following approximate weights: final exam: 30%, written homework, and projects: 70%.

Course Objective / Assessment Mechanism matrix

	Homework	Projects	Final Examination
CO01	✓		✓
CO02	✓		✓
CO03	✓	✓	✓
CO04	✓	✓	✓
CO05	✓	✓	✓
CO06	✓	✓	✓

Bibliography:

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- Richard E. NeaPolitan. **Artificial Intelligence: With an Introduction to Machine Learning.** Second Edition. CRC Press 2018.
- Russell, Stuart; Norvig, Peter. **Artificial Intelligence: A Modern Approach**. **Third Edition.** Prentice Hall, 2010.
- Schalkoff, Robert J. **Intelligent Systems: Principles, Paradigms and Pragmatics**. Jones & Bartlett, 2010.
- Stephen Lucci and Danny Kopec. **Artificial Intelligence in 21st Century.** Second Edition. Mercury Learning and Information 2015.

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In the event of a university-declared emergency, Salem State University reserves the right to alter this course plan. Students should refer to www.salemstate.edu for further information and updates. The course attendance policy stays in effect until there is a university-declared critical emergency.

In the event of an emergency, please refer to the alternative educational plans for this course, which will be distributed via standing class communication protocols. Students should review the plans and act accordingly. Any required material that may be necessary will have been previously distributed to students electronically or will be made available as needed via email and/or

Internet access.

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Note: This syllabus represents the intended structure of the course for the semester. If changes are necessary, students will be notified in writing and via email.