Knight Foundation School of Computing and Information Sciences

Course Title: Artificial Intelligence **Date:** 3/12/2020

Course Number: CAP 4630

Number of Credits: 3

Subject Area: Artificial Intelligence	**Subject Area Coordinator:** Leonardo Bobadilla **email:** bobadilla@cs.fiu.edu
Catalog Description: Introduction to all major topics in artificial intelligence, including search, logic, optimization, constraint satisfaction, planning, multiagent systems, and machine learning.	
Textbook: Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, ISBN-13: 978-0136042594, ISBN-10: 0136042597	
References: None	
Prerequisites Courses: COP 3530	
Corequisites Courses: None	

Type: Elective for CS (Applications group).

Prerequisites Topics:

- Familiarity with basic techniques of algorithm analysis and data structures
- Familiarity with at least one modern programming language (e.g., C, C++, Java, Matlab, Python)

Course Outcomes:

1. Introduce the core topics of AI.
2. Prepare students for further advanced study in each area.
3. Introduce students to the major tools from AI that are useful for industrial applications.
4. Identify problems where artificial intelligence techniques are applicable.
5. Students will be able to implement standard AI algorithms.

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Relationship between Course Outcomes and Program Outcomes

BS in CS: Program Outcomes	Course Outcomes
a) Demonstrate proficiency in the foundation areas of Computer Science including mathematics, discrete structures, logic and the theory of algorithms	1,2,3
b) Demonstrate proficiency in various areas of Computer Science including data structures and algorithms, concepts of programming languages and computer systems.	1,2,3
c) Demonstrate proficiency in problem solving and application of software engineering techniques	1,3
d) Demonstrate mastery of at least one modern programming language and proficiency in at least one other.	5
e) Demonstrate understanding of the social and ethical concerns of the practicing computer scientist.	4
f) Demonstrate the ability to work cooperatively in teams.	5
g) Demonstrate effective communication skills.	1,2,3

Assessment Plan for the Course & how Data in the Course are used to assess Program Outcomes

Student and Instructor Course Outcome Surveys are administered at the conclusion of each offering, and are evaluated as described in the School's Assessment Plan: https://abet.cs.fiu.edu/csassessment/

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Outline

Topic	Lecture Hours	Outcome
Introduction ● Overview ● History of AI ● Intelligent Agents	4	1,4
Search & Logic ● Informed search ● Constraint Satisfaction Problems ● Logic ● Satisfiability	10	1,3,4,5
Planning ● Probability ● Decision Theory ● Markov Decision Processes ● Reinforcement Learning	10	1,2,3,4,5
Machine Learning and Probabilistic Reasoning ● Graphical Models ● Hidden Markov Models ● Bayesian Networks ● Classification ● Clustering	12	1,2,3,4
Total	36	

Learning Outcomes (Familiarity, Usage, Assessment)

Introduction

1. Describe Turing test and the “Chinese Room” thought experiment. [Familiarity]
2. Differentiate between the concepts of optimal reasoning/behavior and human-like reasoning/behavior. [Familiarity]
3. Determine the characteristics of a given problem that an intelligent system must solve. [Assessment]

Search & Logic

1. Formulate an efficient problem space for a problem expressed in natural language (e.g., English) in terms of initial and goal states, and operators. [Assessment]
2. Describe the role of heuristics and describe the trade-offs among completeness, optimality, time complexity, and space complexity. [Familiarity]
3. Describe the problem of combinatorial explosion of search space and its consequences. [Familiarity]

4. Select and implement an appropriate uninformed search algorithm for a problem, and characterize its time and space complexities. [Usage]
5. Select and implement an appropriate informed search algorithm for a problem by designing the necessary heuristic evaluation function. [Familiarity]
6. Formulate a problem specified in natural language (e.g., English) as a constraint satisfaction problem and implement it using a chronological backtracking algorithm or stochastic local search. [Usage]
7. Compare and contrast basic search issues with game playing issues. [Familiarity]
8. Translate a natural language (e.g., English) sentence into predicate logic statement. [Usage]
9. Convert a logic statement into clause form. [Assessment]

Planning

1. Make a probabilistic inference in a real-world problem using Bayes' theorem to determine the probability of a hypothesis given evidence. [Usage]
2. Describe the relationship between preferences and utility functions. [Familiarity]
3. Explain how utility functions and probabilistic reasoning can be combined to make rational decisions. [Usage]
4. Implement simple algorithms for Markov Decision Processes and Reinforcement Learning. [Assessment]

Machine Learning and Probabilistic Reasoning

1. List the differences among the three main styles of learning: supervised, reinforcement, and unsupervised. [Assessment]
2. Identify examples of classification tasks, including the available input features and output to be predicted. [Familiarity]
3. Design and implement an HMM as one example of a temporal probabilistic system. [Usage]
4. Evaluate the performance of a simple learning system on a real-world dataset. [Assessment]

Course Outcomes Emphasized in Laboratory Projects / Assignments

Outcome	Number of Weeks
Homework problems addressing Introduction (Outcomes 1,4)	2
Homework problems addressing Search and Logic (Outcomes 1,3,4,5)	3
Homework problems addressing Planning (Outcomes 1,2,3,4,5)	3
Homework problems addressing Machine Learning and Probabilistic Reasoning (Outcomes 1,2,3,4)	3

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Oral and Written Communication

No significant coverage

Written Reports		Oral Presentations	
Number Required	Approx. Number of pages	Number Required	Approx. Time for each
0	0	0	0

Social and Ethical Implications of Computing Topics

No significant coverage

Topic	Class time	Student Performance Measures

Approximate Number of Credit Hours Devoted to Fundamental CS Topics

Fundamental CS Area	Core Hours	Advanced Hours
Algorithms	1	1
Software Design	0.5	-
Computer Organization and Architecture	-	-
Data Structures	0.5	-
Concepts of Programming Languages	-	-

Theoretical Contents

Topic	Class time
Artificial Intelligence	12

Problem Analysis Experiences

None

Solution Design Experiences

None

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The Coverage of Knowledge Units within Computer Science Body of Knowledge[1]

Area	Topic	Type	Lecture Hours
AL	Algorithmic Strategies	Tier1	1
AL	Algorithmic Strategies	Tier2	1
AL	Fundamental Data Structures and Algorithms	Tier1	1
CN	Modeling and Simulation	Elective	3
DS	Discrete Probability	Tier1	2
IS	Fundamental Issues	Tier2	4
IS	Basic Search Strategies	Tier2	4
IS	Basic Knowledge Representation and Reasoning	Tier2	4
IS	Basic Machine Learning	Tier2	4
IS	Advanced Search	Elective	4
IS	Reasoning Under Uncertainty	Elective	4
IS	Agents	Elective	4
Total			**36**

[1]See Appendix A in *Computer Science Curricula 2013.* Final Report of the IEEE and ACM Joint Task Force on Computing Curricula, available at:
https://www.acm.org/binaries/content/assets/education/cs2013_web_final.pdf