CSIS 4463: Artificial Intelligence
Spring 2018: Syllabus

Instructor: Dr. Vincent Cicirello **Office:** G-116
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Office Hours: Monday/Wednesday, 10:45am-12:15pm
Available other times by appointment; drop-ins welcome (if I'm there, I'd be happy to talk to you).

Course Time and Location: Monday, Wednesday, Friday: 12:45pm-2:00pm, G108

Minor in Behavioral Neuroscience: This course is an elective in the Behavioral Neuroscience Minor.

Q2: This course is a Q2 (Quantitative Reasoning Across the Disciplines). Course topics involve application of mathematics, especially discrete mathematics, such as but not limited to set theory, graphs, trees, logic, discrete probability, etc.

Course Description: A study of tools, techniques, and applications associated with intelligent computer systems. The course will include topics from classical symbolic AI as well as topics from computational intelligence. Topics will include intelligent problem-solving methods, knowledge representation, heuristics, genetic algorithms, and selected topics from machine learning.

Course Objectives: The objectives of this course include:

- Gaining knowledge of the terminology, methods, trends of the field of artificial intelligence with particular emphasis on computational intelligence.
- Learning the fundamental principles and theories of the field of artificial intelligence, focusing specifically on the theories underlying artificial intelligence search and problem solving strategies.
- Learning to apply the algorithms of the field of artificial intelligence to solving problems of real-world importance.

Prerequisites: CSIS 3103, Data Structures and Algorithms I

Required Textbooks/Readings:

(1) S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach, Third Edition*, 2010. ISBN: 0-13-604259-7

- You must have the 3rd Edition. In the 20 year history of this textbook, there have only been 3 editions, with extremely substantial changes in coverage from one edition to the next. Rare occurrence of a textbook where new editions are actually always meaningful (e.g., not the more common "let's reorder chapters to make more money").
- Before buying a new copy (or a used copy from the Stockton bookstore for that matter), search online for a less expensive used copy. This is the most common textbook for courses on Artificial Intelligence (used in approximately 1350 universities worldwide). It is used by far more AI courses worldwide than all other AI textbooks combined, and is otherwise widely read outside of courses (e.g., it's been cited in well over 32000 journal articles, conference proceedings, and other books, it's the 4th most cited computer science publication of this century, and the 22nd most cited computer science publication overall). **In other words, there should be a huge supply of used copies available to purchase for less than college bookstore prices.**

Supplemental Books/Readings/Etc:

(1) The Code Repository on Russell and Norvig's textbook webpage: http://aima.cs.berkeley.edu/
(2) Others as indicated in class.

Academic Honesty: Please familiarize yourself with Stockton's policy on academic honesty. Unless indicated for a specific assignment, all problem sets and other homework assignments are to be your own individual work. You are to individually solve problems. You are to individually do any required programming. Code found on the Internet, etc is prohibited. **Any first violation will be penalized with a 0 on the relevant exam or assignment, AND 10 points off your overall course grade. Any subsequent violation will result in a course grade of F.**

Incomplete Policy: In general, no **I** grades will be given. The only exception is an institutionally documented medical emergency that necessitates your complete absence from Stockton for at least two continuous semester weeks. Additionally, you must be caught up on all work up to when your medical emergency began and currently in the "C" range or better.

Grading:
Each of you has the option of choosing one of the following as will be explained in more detail later in the syllabus. Note that option 2 includes extra credit (this will be the only way to obtain extra credit in the course).

	Option 1	**Option 2**
Exam 1	23.75%	17.5%
Exam 2	23.75%	17.5%
Homework / Problem Sets	47.50%	35.0%
Participation	5.00%	5.0%
Optional Research Project	N/A	35.0%
Total	**100%**	**110%**

Grading Scale:

A: at least 90.00	**A-:** at least 89.00	**B+:** at least 88.00
B: at least 80.00	**B-:** at least 79.00	**C+:** at least 78.00
C: at least 70.00	**C-:** at least 69.00	**D+:** at least 68.00
D: at least 60.00	**D-:** at least 59.00	**F:** less than 59.00

I reserve the right to adjust the scale at the very end of the semester. Such adjustments are rare, but will only be in your favor; and are highly unlikely to occur at the D-/F boundary. Note the 2 decimal places in the chart above (i.e., I do not round to the nearest whole number): e.g., unless I adjust the grade scale, an 89.99 is an A-, etc.

Exams: The exams are not cumulative. They are closed book. You are allowed 2 pages of notes on standard letter sized paper (8.5" by 11") for each exam. You may use both sides of the paper for your notes, for a maximum of 4 sides, but may not have more than 2 pages (e.g., you may not have 4 one-sided pages). Prior to each exam, I will inform you of whether or not a calculator will be allowed for that specific exam. In the event that a calculator is allowed, it must be a real calculator (i.e., you may not use a cell phone under any circumstances during an exam).

Make-Up Exams: Make-up exams will not be given (i.e., if you miss an exam, you get a 0). The only exceptions are:

1. Documented medical excuse: provide a note on doctor's letterhead the first class you return after the missed exam.
2. Other institutional excuses: Situations may arise related to Stockton that prevents you from being able to attend an exam. In most such cases, you should be aware of the conflict beforehand. Thus, I must be notified one week prior to the missed exam. Send me e-mail with the details of the planned absence, and provide me with proper documentation (e.g., memo from sports coach, from other faculty sponsoring a field trip, etc).
3. Other similar situations: similar documentation must be provided, generally beforehand, unless the nature of the situation makes this impossible.

Homework / Problem Sets: Homework will consist of sets of problems related to course topics; and some will involve programming or use of some other AI related system. Unless otherwise indicated, homework is to be done individually.

Due Dates: Depending on the nature of the homework assignment, they will either be due: (a) on paper at the beginning of a class session; or (b) electronically via Blackboard for assignments involving programming. Assignments (involving programming) that must be submitted electronically will be due by 11:59pm. Problem Sets can optionally be submitted electronically, but will be due by class time whether submitted on paper or electronic. Late assignments are penalized 25% if less than 24 hours late, 50% if less than 48 hours late, and 75% if less than 72 hours late. The first time an assignment is late (within 72 hours of deadline), the late penalty will be waived.

Participation: A portion of your overall grade will come from participation. This will include general participation elements such as contributing to class discussion, etc. I do not explicitly factor attendance into your grade. However, if you miss class frequently, then you must not be participating very well, and your class participation grade will be affected. Participation grades are most often negatively affected by disruptive behavior, such as the following: ringing cell phones, making phone calls, answering phone calls, arriving late or leaving early in a distracting way (e.g., dropping books, talking, using front door to classroom during class), using computers/devices for non-course purposes, etc.

Optional Research Project: The optional research project provides you the opportunity to explore any course topic in greater depth. It is also a means of earning extra credit in the course (see the grading section earlier in the syllabus). It is NOT a replacement for either problem sets or exams. If you choose to work on this optional project, it will be over and above the required assignments of the course. Here are the details, such as expectations, deliverables, etc:

- **What?** You will experimentally study one or more AI algorithms for a problem of your choosing. The project can be within any topic of AI, whether covered in the course or not. You might skim the table of contents of the book, chapter intros, summaries, etc to get ideas. You will be expected to implement at least one AI algorithm. Though as part of the project you can compare its performance to existing implementations of other algorithms for your problem of choice. I recommend something related to a topic covered in the first half of the semester.
- **Deliverables:**
  - **Proposal (you):** By the mid-point of the semester (will provide specific date), you must submit a proposal for what your project will be. You are encouraged to submit this proposal earlier—the earlier you do, the sooner I will provide feedback and give you the go ahead for the project. There are no page limit or formatting requirements for the proposal—it should be as long as it needs to be, and preferably no longer. In the proposal, you should: (a) indicate what problem you are trying to solve; (b) describe the algorithm or algorithms you intend to implement for the problem; (c) indicate why you chose those algorithms; (d) indicate any existing algorithms for the problem that you plan on comparing yours to; (e) explain your proposed experimental methodology (e.g., if you plan to study the effects of varying any of the algorithm's parameters, describe how you intend to do that; if you plan on comparing 2 or more algorithms' performance, then describe how you will do that; etc); and (f) summarize what you hope to learn from the experiment.
  - **Proposal Feedback (me):** I will provide you with feedback on your project proposal. This might be as simple as "looks like a good plan" (**an approved proposal**) or it may be more detailed and include specific required modifications to your proposed project (**a contingently approved proposal**). In other cases, my feedback might explain why your proposal is not feasible within the context of the semester (**a rejected proposal**). If your proposal is rejected, then as long as the deadline for project proposals has not yet arrived, you may submit a completely new project proposal. If your proposal is approved, then you can simply proceed with your project. If your proposal is contingently approved and if you are willing to accept the changes I provide, then you can also proceed with your project. If you don't like the changes I indicate then you can optionally submit a new project proposal provided the deadline for proposals has not elapsed. If you do not have an approved or contingently approved proposal, then you may not proceed with the optional research project. Any projects received from someone without an approved or contingently approved proposal will not be graded. If you have an approved or contingently approved proposal, but later change your mind (e.g., don't have enough time), then simply notify me at any time and I won't expect the project from you (you may back out of the project option at any time).
  - **Project (you):** By a specified date at the end of the semester, you must submit: (a) all source code that you implemented; and (b) a written report. The report should clearly: (1) explain the problem your algorithm solves and its importance; (2) provide a survey of existing approaches to the problem with appropriate citations; (3) explain the details of the AI algorithm you implemented to solve this problem (including pseudocode), along with a discussion of anything novel about your approach; (4) describe your experimental approach; (5) provide an analysis and discussion of your experiments; and (6) include a properly formatted reference list.
- **Who?** If you choose to complete the optional research project, you must have your own individual project. If you want to work with other students, it is possible under the following conditions. **First**, each must have their own individual project. These individual projects, however, can be closely related. For example, two or more students might be interested in designing an AI algorithm to solve the same problem. Each would experimentally study their own algorithm (e.g., examine how any parameters affect performance). **Second**, each must implement at least one AI algorithm on their own (i.e., can't have one student do all the implementation). **Third**, each must write their own independent report. Even though you might be solving the same problem, each approach will have different relevant background, etc. **What you can share:** If you are trying to solve the same problem as another, you might collaborate on the code necessary to implement the problem itself, or the code necessary to drive the experiments (e.g., code to do any necessary timings, etc). Or you might compare the performance of your algorithm with that of another student, in which case you may collaborate on the part of your project reports concerning such an experiment. **Joint Proposal:** If you intend to collaborate in this manner with one or more other students, then although at the end you will each submit your own independent reports, you are allowed to jointly write the proposal. In a joint proposal, you must clearly indicate what work is being shared and what your individual projects will be. In the event that later in the semester a student you planned to collaborate with decides not to pursue the project, there will be no modifications to the expectations of your own project.
- **Programming Language Requirements:** None. Use whatever language you are comfortable with.
- **Operating System:** I must be able to compile and run your code on either Windows or Linux. If you have a preference for Macs, please ensure that your code can also be compiled and run on either Windows or Linux (the Mac OS is Unix based so this should be straightforward provided you don't use any Mac-specific libraries).

- **Timing Code**: If you will be timing the execution of your algorithm as part of your experiments, make sure you do it right. Do not measure "wall-clock time." You want to measure CPU time. Make sure you know how to do this in your language of choice. CPU time is the sum of "user time" and "system time". In Java, DO NOT use System.currentTimeMillis() or System.nanoTime(). Any approach involving these will give you "wall-clock time" which can be affected by things completely unrelated to your code (e.g., other processes running on your system). Using "wall clock time" basically times everything your system is doing, and not just the thing you actually want to time. In Java, to access CPU time, you'll want to use the ManagementFactory class. I will show an example of this during the semester at some point so that you'll know how to correctly measure CPU time in Java. The one exception to this is that if you implement something using concurrency (multiple threads or multiple processes), and want to explore the speedup gained through parallelization, then you actually do want to measure wall-clock time.
- **Grading Criteria:** I will provide the detailed grading rubric that I will use to grade the project shortly after the project proposals are due. Your project's grade will depend on the following: (a) correctness of your algorithm's design; (b) correctness of any code you implement; (c) statistical validity of your experiments; and (d) the various parts of your written report.

Topics/Schedule: Schedule subject to change (highly approximate). Changes will be announced in Blackboard and in class.

Date	Textbook	Highlight	Topic
January 17	Chapter 1		Syllabus, Course Overview, What is AI? History of AI, AI's foundations
19	Chapter 1		What is AI? History of AI, AI's foundations
22	Chapter 2		Intelligent Agents: what they are, rational behavior, an agent's environment, structure of an agent
24	Chapter 2		Intelligent Agents: what they are, rational behavior, an agent's environment, structure of an agent
26	3.1—3.4		Solving Problems by Searching; Uninformed Search
29	3.1—3.4		Solving Problems by Searching; Uninformed Search
31	3.1—3.4		Solving Problems by Searching; Uninformed Search
February 2	3.1—3.4		Solving Problems by Searching; Uninformed Search
5	3.5—3.7		Informed (heuristic) search; Heuristic functions
7	3.5—3.7		Informed (heuristic) search; Heuristic functions
9	3.5—3.7		Informed (heuristic) search; Heuristic functions
12	Chapter 6		Constraint satisfaction
14	Chapter 6		Constraint satisfaction
16	Chapter 6		Constraint satisfaction
19	Chapter 5/6		Finish constraint satisfaction and/or start Game Search
21	5.1–5.5,5.7		Adversarial search (also known as game search)
23	5.1–5.5,5.7		Adversarial search (also known as game search)
26	5.1–5.5,5.7		Adversarial search (also known as game search)
28	Review		Review for Exam
March 2	**EXAM 1**	**EXAM 1**	**EXAM 1**
5	4.1++++		Local Search: Hill-climbing, simulated annealing, local beam search, tabu search (Will supplement textbook coverage)
7	4.1++++		Local Search continued (Will supplement textbook coverage)
9	4.1++++	**Project Proposals Due**	Local Search continued (Will supplement textbook coverage) **Also, Project Proposals are also due this week by 11:59pm**
12	**NO CLASS**	**Spring Break**	**Spring Break**
14	**NO CLASS**	**Spring Break**	**Spring Break**
16	**NO CLASS**	**Spring Break**	**Spring Break**
19	4.1++++		Local Search: Genetic Algorithms (Will supplement textbook coverage)
21	4.1++++		Local Search: Genetic Algorithms (Will supplement textbook coverage)
23	4.1++++		Local Search: Genetic Algorithms (Will supplement textbook coverage)
26	Not in Book		Other Evolutionary Computation topics (e.g., genetic programming, permutation-based genetic algorithms, etc).
28	Not in Book		Other Evolutionary Computation topics (e.g., genetic programming, permutation-based genetic algorithms, etc).
30	Not in Book		Other Evolutionary Computation topics (e.g., genetic programming, permutation-based genetic algorithms, etc).
April 2	Not in Book		Swarm Intelligence (Ant Colony Optimization, Wasp Task Allocation, etc)
4	**NO CLASS**	**Advising Day**	**No Class (Advising Day)**
6	Not in Book		Swarm Intelligence (Ant Colony Optimization, Wasp Task Allocation, etc)
9	Not in Book		Swarm Intelligence (Ant Colony Optimization, Wasp Task Allocation, etc)
11	Chap 7, 8, 9		Knowledge Representation (Chap 7 and parts of 8 and 9)
13	Chap 7, 8, 9		Knowledge Representation (Chap 7 and parts of 8 and 9)
16	Chap 7, 8, 9		Knowledge Representation (Chap 7 and parts of 8 and 9)
18	TBD		Machine Learning: Specific topic TBD
20	TBD		Machine Learning: Specific topic TBD
23	TBD		Machine Learning: Specific topic TBD
25	TBD		Machine Learning: Specific topic TBD
27	Review		Review for Exam
30	**NO CLASS**	**NO CLASS**	**Optional Project Due, 11:59pm, electronically in Blackboard**
May 2	**EXAM 2**	**EXAM 2**	**EXAM 2: Special Time: 12:45-2:45**
4	**NO CLASS**	**NO CLASS**	**NO CLASS**