First course in Artificial Intelligence taught to senior-level undergraduates and first year MS students

**CS 44201/54201 - Artificial Intelligence, Fall 2021**
Department of Computer Science  
Course Syllabus, Fall 2021  
Remote Course delivery  
Time: Tuesdays and Thursdays 12:30 PM – 1:45 PM  
Dates: Thursday, August 26, 2021 to Thursday, December 9, 2021

Elective course for BS (CS 44201)  
Meets MS (CS) requirement for core requirement in Theory or elective (CS 54201)  
Core course for MS in Artificial Intelligence (CS 54201)  
Recommended course for MS in Data Science (CS 54201)

**Pre-requisites:** Discrete Structures (CS 23022 or equivalent) and Data Structures (CS 23001) or graduate standing in CS, AI, Data Science, Information Science/Technology and related fields

**Instructor:** Professor Arvind Bansal, Room 214, Department of Computer Science  
**Phone:** (216)672-9035  
**Course Email:** arvindbansalohio@yahoo.com (preferred to avoid cluttering)  
**University Email:** akbansal@kent.edu (only for urgent need)

**Office hours:** 11 AM – 12 PM Tuesdays and Thursdays  
**Delivery:** Remote (75 minutes × two times / week in class) with exam on-ground in-class.  
**Final Examination:** Friday, December 17, 2021, 12:45 – 3:00 PM

**What is AI?**  
Artificial Intelligence (AI), also referred as computational intelligence, is mimicking human intelligence and reasoning using computational techniques. In early 1970s, the scope of artificial intelligence was limited to mimicking the knowledge based reasoning of a specialist and intelligent guessing (heuristics) for smart game playing. However, as the area of computational intelligence has matured, it has diverged to many areas such as intelligent search using heuristic search; constraint based reasoning; uncertainty based reasoning; knowledge based systems: rule based systems, case based reasoning, symbolic systems, neural networks, intelligent agent based system, common sense reasoning, decision support systems; shape and object recognition; pattern recognition and data mining; speech recognition, robotics, motion planning; learning; and their integration.

**Application**  
AI has been extensively used in diagnostics systems, simulating what-if scenarios, game playing, decision support systems with human in loop to assist humans, automated control of machines, automobiles, aircrafts, spacecrafts, intelligent industrial machines for specific functions, learning new trends from stock market and traffic and sales understanding systems for multimedia objects, more recently in phone based automated voice interactions, intelligent routing of the messages in the computer
networks, human like human-computer interaction, and development of humanoids to assist humans in hazardous and mundane tasks.

**Motivation and Learning Outcome**
Most of the real world problems (more than 90% as a rule of thumb) are NP-hard that means that it is very difficult and computationally prohibitive to execute algorithmic solution on computers. The motivation of this course is to help you learn various AI techniques and concepts as explained above to solve the real world problems in realistic time. The course will teach you above concepts and their implementation. After learning this course, you will develop the programmatic capability to solve the real world problem in realistic time the way humans do.

**Course Outline (total 27 lectures + 2 midterms during class hours)**
Introduction (2 lectures); heuristics and state space problems and searching (4 lectures) – Global vs. Local Search, Simulated Annealing, Evolutionary Search, Nature Inspired Search: Ant Colony; Game playing: adversarial search (2 lectures); tutorial (1 lecture); **Mid Term 1 (1 lecture)**, constraint satisfaction (2 lectures); Basics of Machine Learning (4 lectures): Supervised vs Unsupervised Learning, Classification Techniques: Clustering, Neural Networks, Markov Models, Hidden Markov Models, support vector machines; Prediction Techniques (1 lectures): Regression Analysis, Associative Data Mining, tutorial (1 lecture); **Mid Term 2 (1 lecture)**, Knowledge based systems (3 lectures): rule based inference, uncertainty reasoning, case based systems, fuzzy systems, Probabilistic Reasoning and Networks (2 lecture), semantic networks and Ontology (1 lecture); planning (1 lectures); tutorial (one lecture); *Final Exam* (Finals week)

**Textbook**

There will be material such as clustering, regression analysis, etc. that is not covered in the text book. In that case you would have to rely on your class notes taken during the class. Just relying on the slides is not sufficient. **You should also spend two hours after every class to understand and recollect the material, and ask lots of questions if you do not understand any material.**

**Notes and Slides**
Numerous notes and my slides and other resources will be available to you in the University’s flash login site. Slides will also be regularly e-mailed to you at least one day before the classes. Please check the site and your university flashpoint e-mail regularly. It is your responsibility to download them, and print them out, if needed.
Assignments

There will be four assignments. Three assignments will be conceptual type, and one assignment will be programming assignment on machine learning techniques. Programs can be written in any of these languages: Python, C++, Java, Prolog, LISP, and their variants. Each conceptual assignment will be 5%, and the programming assignment will be 10%. The total for four assignments would be 25%.

A Missed tests, homework, and attendance are only excused if absence was essential and can be fully documented. Unexcused late homework is not accepted. Class extensions on homework will be announced in class. They may also be announced by email and at the blackboard. You will be allowed to submit each assignment up to four times. After which, it will lock.

Examinations

There will be two midterms and one final examination. Each midterm will be 15%, and the finals would be 20%.

Tentative Exam Dates

First Midterm – Thursday, during the class hours, TBA
Second Midterm – Thursday, during the class hours, TBA
Final Examination – Tuesday, .

Final Project (group of two/three) any language – due by 11/28/2019

There will be one final team oriented project (3 members). Final project would be 20% (15% implementation, 5% presentation and 5 page report). Some representative topics for the final projects are as follows. However, additional projects can be chosen.

Heuristic Search

1. Write an A* based map refinement program for a robot which is given an old map of the city and a start point. It should be able to traverse and update the map. Old Map is modeled as a matrix of macroblocks. Each macroblocks will have the reachable places and distances. New content of macroblock should be generated using a realistic place-type generator and archived. The robot should be moving in the city until it covers 95% of the city. Use a realistic map of a city from twenty years back and the current map. You should be able to graphically show the simulation.
2. Write an AI program using heuristic search to solve the Rubik’s cube.

Adversarial Search and Game Playing

3. Write an AI system to play backgammon or checkers or any other mutually agreed game that uses adversarial search / local search and strategy. You should be able to clearly demonstrate the AI part.
**Metaheuristic Search (only for graduate students in CS 54201)**
4. Write an Ant colony optimization program to find out the shortest route between two locations in a given map.

**Learning Methods**
5. Write a neural network program to recognize the handwritten digits / alphabets by dividing the characters as a set of edge segments and inputting the segments for classification.
6. Write a clustering program to identify the various topics in a two page text using statistical / histogram matching / probabilistic analysis of keywords.
7. Write a program to find out whether two texts are very similar based upon statistical / histogram matching / probabilistic analysis of keywords and synonyms matching.
8. Write a prediction program based upon past several years data and last few weeks data using regression analysis to predict the temperature / rain for the next week. Create your own data based on weather data available over the Internet.

**Constraints-based solution**
9. Write a four color map coloring program for counties of Ohio using constraint based programming. Color the Lake Erie and inland water sources as blue, and adjoining states with four colors different than the counties.
10. Write a map coloring program to color a plane US map and sea using five given colors and blue color for sea. Color template should be user-defined, and could be changed. The map should be US map or the map of Ohio. In US map smallest unit is a state. In the state of Ohio, the smallest unit is a county. You should be able to color
11. write a realistic face coloring program which takes a black and white face-segments and colors them using palette of colors allocated to color different segments making sure that color allocations are not violated. For example, cheeks can not be blue, eyes can not flesh colored or red, lips can not be yellow or orange and so on. You should be able to display the colored segments on a laptop screen.
12. Write an AI program to solve simple Sudoku.

**Case-based Reasoning, Probabilistic Reasoning and Expert Systems**
13. Write an intelligent mail sorting system for handling spams, friends, buddies, business mails, and genuine external ads using keywords based text analysis.
14. Write an uncertainty based expert system to diagnose a car engine not starting with different uncertainty factors. Design your own nontrivial data.
15. Develop a toy planning system to schedule planes on runway so that delay time is minimal
16. Write an expert system for giving mortgage loan.
17. Additional projects will be added to this list.
18. Develop your own project in consultation with the instructor.

*All the projects must be running. Non running projects will not fetch more than 40% of the grade.*
**Attendance**

Attendance is a mandatory course requirement. **Attendance grades are nonlinear, and favor students attending most of the classes.** The attendance will be 10% of the grade. Those students attending less than 70% of the classes will get zero in the attendance. Students attending more than 90% of the classes will get 2% extra in the final grade.

*Those students who do not attend the class due to projects in other courses during the last two weeks of the semester will be penalized 50% of the attendance grades, and their assignments during that period would be rejected because a student who does not have time to attend an hour-long class is presumed to use other means to finish the assignment. If you miss a class, you must come to the instructor during office hours and prove through an oral exam that you understand the material before that part of the assignment (including programming assignment) is graded for you. It is your responsibility to learn the material for the missed class.*

**Grade Distribution**

<table>
<thead>
<tr>
<th>Method of Assessment</th>
<th>Weights</th>
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</thead>
<tbody>
<tr>
<td>Participation and attendance</td>
<td>10%</td>
</tr>
<tr>
<td>Assignments (3 + 1)</td>
<td>25% (3 × 5% + 10%)</td>
</tr>
<tr>
<td>Project</td>
<td>15%</td>
</tr>
<tr>
<td>Exam1</td>
<td>15%</td>
</tr>
<tr>
<td>Exam2</td>
<td>15%</td>
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<tr>
<td>Final Exam</td>
<td>20%</td>
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**Final Grading Scale**

<table>
<thead>
<tr>
<th>Scale:</th>
<th>&lt; 55%</th>
<th>55%</th>
<th>58%</th>
<th>62%</th>
<th>65%</th>
<th>68%</th>
<th>72%</th>
<th>75%</th>
<th>78%</th>
<th>82%</th>
<th>85%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade:</td>
<td>F</td>
<td>D</td>
<td>D+</td>
<td>C-</td>
<td>C</td>
<td>C+</td>
<td>B-</td>
<td>B</td>
<td>B+</td>
<td>A-</td>
<td>A</td>
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<tr>
<td>GPA:</td>
<td>0.00</td>
<td>1.00</td>
<td>1.30</td>
<td>1.70</td>
<td>2.00</td>
<td>2.30</td>
<td>2.70</td>
<td>3.00</td>
<td>3.30</td>
<td>3.70</td>
<td>4.00</td>
</tr>
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Grades will show on the blackboard. At any point, the percentage in total will show the overall percentage. Using the grade table, you will be able to estimate your running grade.
University Policies

Students are required to be aware of and follow all general and academic policies established by Kent State University. A list of the general academic policies is listed on the Kent State University Policy Register, which can be found in the University policies section of the Getting Started in Your Online Course link within the Start Here folder. Specific policies related to the successful completion of this online course can be located and reviewed in your Blackboard Learn course.

Registration Requirement

The official registration deadline for this course is **August 28, 2019**. University policy requires all students to be officially registered in each class they are attending. Students who are not officially registered for a course by published deadlines should not be attending classes and will not receive credit or a grade for the course. Each student must confirm enrollment by checking his/her class schedule (using Student Tools in FlashFast) prior to the deadline indicated. Registration errors must be corrected prior to the deadline. **The last day to withdraw before a grade of "W" is assigned is Wednesday, September 4, 2019.** No approval is necessary before this date. **The last day to withdraw with a grade of "W" assigned is Wednesday, October 30, 2019.**

Students with Disabilities

University policy 3342-3-01.3 requires that students with disabilities be provided reasonable accommodations to ensure their equal access to course content. If you have a documented disability and require accommodations, please contact the instructor at the beginning of the semester to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through Student Accessibility Services (contact 330-672-3391 or visit [www.kent.edu/sas](http://www.kent.edu/sas) for more information on registration procedures).

The Blackboard accessibility statement can be found in the University policies section of the Getting Started in Your Online Course link within the Start Here folder.

Code of Conduct in the Class

The following protocols will be strictly followed to make the class conducive for learning.

1. Students must come to the class before the class starts. However, if due to some unforeseen reason, they are delayed they can enter the class. Regular delays are strongly discouraged. It is the student’s responsibility to cover the material they have missed.
2. **No food or drinks will be allowed in the class** unless there is an established medical condition certified by the physician that forces the student to do otherwise. In case of medical conditions, the student should seek prior permission from the instructor before the class starts.

3. **The students will not get into any form of altercation or cross-talks.** All questions will be asked while maintaining the decorum in the class. During the class, the interaction will be between the student and teacher only. Anyone showing any form of violent behavior (such as abusive language or loud voice) in the class will be asked to immediately leave the class, and his case will be reported to the department administration for further action.

4. There will be complete radio silence during the class that means all the cell phones and/or PDAs will be turned off during the class unless there is an emergency situation and instructor has already given permission for the cell phone to be on for the specific student. Even in the case of emergency, student will have to go out to receive the call.

5. **Nobody will be allowed to surf the Internet or check e-mails or listen to music or perform any form of activity involving PDAs or cell phones while in the class.** PDAs will be turned off and put away in the backpack.

**Plagiarism and Academic Integrity**

**Academic Integrity**

Student-teacher relationships are built on trust. Students must trust that teachers have made appropriate decisions about the structure and content of the courses they teach, and teachers must trust that the assignments which students turn in are their own effort. Acts that violate this trust undermine the educational process. Academic dishonesty in any form will be penalized up to assigning grade F, and reporting to the department for university action.

**Academic Dishonesty in Homework Assignments and Programming Projects**

Learning is encouraged, and cheating is discouraged. Unfortunately, there is a fine line between where learning ends and cheating starts. You are encouraged to get involved in group study to understand the concepts if you do not know how to solve a problem. However, individual problems must be solved by individual students. If the grader finds that two answers are very similar: wordings are very similar and/or sentence structures are very similar, then it is a case of copying. Cheating and plagiarism constitute fraudulent misrepresentation for which no credit can be given and for which appropriate sanctions are warranted and will be applied.

You will be given a warning after the first case of academic dishonesty, and your score in that assignment will be 0. If you repeat the practice of dishonesty, your final grade will be lowered by one scale, and your activity will be sent to assistant chair for the record. For example, if you were getting a ‘B’ after the final calculation, you will be awarded only a ‘C’. After the third incidence, you will be given an ‘F’, and your case will be reported to the department for further disciplinary action.
University policy 3-01.8 deals with the problem of academic dishonesty, cheating, and plagiarism. None of these will be tolerated in this class. The sanctions provided in this policy will be used to deal with any violations. If you have any questions, please read the policy at http://www.kent.edu/policyreg/policydetails.cfm?customel_datapageid_1976529=2037779 and/or ask. According to the university policy, any case of suspicious activity will be reported to the university. **Taking any picture or text from the Internet or book is a serious case of plagiarism.**

"Cheat" means to intentionally misrepresent the source, nature, or other conditions of academic work so as to accrue undeserved credit, or to cooperate with someone else in such misrepresentation. Cheating includes, but is not limited to:

- Obtaining or retaining partial or whole copies of examinations, tests or quizzes before these are distributed for student use;
- Using notes, textbooks or other information in examinations, tests and quizzes, except as expressly permitted;
- Obtaining confidential information about examinations, tests or quizzes other than that released by the instructor;
- Securing, giving or exchanging information during examinations;
- Presenting data or other material gathered by another person or group as one's own;
- Falsifying experimental data or information;
- Having another person take one's place for any academic performance without the specific knowledge and permission of the instructor;
- Cooperating with another to do one or more of the above;
- Using a substantial portion of a piece of work previously submitted for another course or program to meet the requirements of the present course or program without notifying the instructor to whom the work is presented; and
- Presenting falsified information in order to postpone or avoid examinations, tests, quizzes, or other academic work.

`Plagiarize` means to take and present as one's own a material portion of the ideas or words of another or to present as one's own an idea or work derived from an existing source without full and proper credit to the source of the ideas, words, or works. As defined, plagiarize includes, but is not limited to:

- The copying of words, sentences and paragraphs directly from the work of another without proper credit;
- The copying of illustrations, figures, photographs, drawings, models, or other visual and nonverbal materials, including recordings of another without proper credit; and
- The presentation of work prepared by another in final or draft form as one's own without citing the source, such as the use of purchased research papers.

Academic Sanctions (from Section D). The following academic sanctions are provided by this rule for offenses of cheating or plagiarism. Kent campus instructors shall notify the department chairperson...
and the student conduct office each time a sanction is imposed. Regional campus instructors shall notify the regional campus dean and the student conduct officer each time a sanction is imposed. Regional campus student conduct officer shall notify the Kent student conduct office each time a sanction is imposed by a regional campus instructor. The following academic sanctions are provided by this rule for offenses of cheating or plagiarism. In those cases the instructor may:

- Refuse to accept the work for credit; or
- Assign a grade of "F" or zero for the project, test, paper, examination or other work in which the cheating or plagiarism took place; or
- Assign a grade of "F" for the course in which the cheating or plagiarism took place; and/or;
- Recommend to the department chair or regional campus dean that further action specified in the rule be taken. The department chairperson or regional campus dean shall determine whether or not to forward to the academic dean or to the vice president for the extended university a recommendation for further sanction under this rule.

Procedures for invoking sanctions (from Section E). Academic administrative procedures pertaining to paragraph (D)(1)(a) of this rule. In the event that an instructor determines that it is more probable than not that a student in a course or program under the instructor's supervision has presented work for university credit which involves an act of cheating, plagiarism or cooperation in either, then the instructor shall:

- Inform the student as soon as is practical, in person or by mail, of the belief that an act of cheating or plagiarism has occurred. If the student cannot be reached in a reasonable period of time, the instructor may proceed with sanctions, notifying the student in writing as promptly as possible of the belief and the procedural steps the instructor has taken.
- Provide the student an opportunity to explain orally, in writing, or both, why the student believes the evaluation of the facts is erroneous.
- If the explanation is deemed by the instructor to be inadequate or if no explanation is offered, the instructor may impose one of the academic sanctions listed in paragraph (D)(1)(a) of this rule. Where appropriate, the instructor may recommend the imposition of academic sanctions listed in paragraph (D)(1)(b) of this rule. In addition, the instructor may refer the matter to the dean of the college, campus, or school in which the student is enrolled for imposition of academic sanctions listed in paragraph (D)(1)(b) of this rule.
- The instructor shall notify the office of judicial affairs of the circumstances and action taken. Such notification will be used as background information in the event that formal conduct charges are initiated against the student.
- The instructor shall inform the student in writing of the right to appeal, and the procedure to follow.
- The instructor shall keep the evidence of cheating or plagiarism in a secure place and provide it upon request to any appeals officer or the conduct officer. The instructor shall provide copies on request to the student at the student's expense.
- The instructor shall cooperate with academic and student conduct personnel in any appeal of the decision, and/or in adjudication of any disciplinary proceedings.
For more information see the Kent State policy on plagiarism in the University policies section of the Getting Started in Your Online Course link within the Start Here folder.

**Student Survey of Instruction (SSI)**

Starting this semester, the end of the semester evaluation of the instruction has gone online. You must login on the website [https://ssi.kent.edu/](https://ssi.kent.edu/), and fill out the evaluation positively by **Thursday, December 5, 2019.**

**Subject to Change Statement**

The syllabus and course schedule may be subject to change due to unavoidable circumstances such as instructor's sickness, unexpected university closure etc. Changes will be communicated via email or the Blackboard Learn announcement tool. It is the responsibility of students to check email messages and course announcements to stay current.