

# GAM 376: Artificial Intelligence in Computer Games

Professor Robin Burke

Winter 2015, Sections 801/810, Rm. CS&T 216

Th 5:45 – 9:00 pm

Office: CS&T 849

Office hours: Tu 10:00 – 11:30 (Loop) 2:30 – 4:00 pm (Lincoln Park)

Phone: 312-362-5910 / 773-325-4910

Email (preferred): [rburke@cs.depaul.edu](mailto:rburke@cs.depaul.edu)

Piazza (best): [piazza.com/depaul/winter2015/gam376/home](http://piazza.com/depaul/winter2015/gam376/home)

## Description

Artificial Intelligence (AI) is one of the essential components of a computer game. The course introduces basic concepts of AI in the gaming context such as finite state machines, fuzzy logic, subsumption architectures, planning and search. Emphasis will be placed on applications of AI in various genres of computer games. Students will work with implementations of common game AI algorithms for behaviors such as pathfinding and behavior selection.

## Prerequisite

CSC 300, 383 or 393

## Course Text

Buckland, Matt *Programming Game AI by Example*. Wordware Publishing. 2005. ISBN: 1-55622-078-2

On-line materials as assigned.

## Resources

Students in the class will have access to the CDM labs for programming assignments. We will be using Visual Studio 2010 for our C++ work. The course web site will be an important resource for all aspects of the course: <http://d2l.depaul.edu/>. The schedule and other syllabus information may change during the quarter: the web site will contain the most up-to-date information.

## Piazza

This term we will be using Piazza for class discussion. The system is design to get you help quickly and efficiently from your classmates and the instructor. Rather than emailing questions, I encourage you to post your questions on Piazza. Find our class page at: [piazza.com/depaul/winter2015/gam376/home](http://piazza.com/depaul/winter2015/gam376/home)

## Grading

The course will include both lecture and hands-on lab components. Participation will be extremely important. Students are expected to attend all classes, do the assigned reading and homework before class time. Student grades will be determined through programming assignments and projects, a midterm and final, and class participation:

- Homework Assignments (3) – 30%
- Group Programming Projects (2) – 30%
- Participation / Labs – 10%
- Midterm – 10%
- Final Exam – 20%

## Distance Learning Students

The requirements for distance-learning students differ from in-class students in two respects.

1. Lab assignments will become additional homework assignments due the week following the lab session. Lab sessions will be recorded and distance-learning students are encouraged to follow along with the class in completing these assignments.

2. The labs will count for the entire participation portion of the grade.

## **Programming Projects**

There will be three homework assignments and two group programming projects. On the due date for the projects, we will hold tournaments in which the programs will compete against each other.

## **Tentative Class Schedule**

1/8: Introduction to the course / Physics

Discussion of syllabus, grading and requirements. AI and Game AI. Game physics. Basic physics and math concepts needed for the course. Vector and matrix algebra. Coordinate transformations.

Assigned: Homework #1

Reading: Buckland, Ch. 1

1/15: Finite State Machines + Lab

Uses and applicability of FSMs in games. FSM implementations and design choices. Hierarchical state machines and other extensions. Buckland's implementation.

In-class: Lab #1

Assigned: Homework #2

Reading: Buckland, Ch. 2

Due: Homework #1

1/22: Steering behaviors / Graphs

Flocking, following, obstacle avoidance and other steering behaviors. Managing groups of agents. Spatial partitioning. Graphs and trees. Graph implementations. Uses of graphs in game AI: navigation graphs, dependency graphs, state graphs. Graph algorithms.

Assigned: Homework #3

Reading: Buckland, Ch. 3 and 5

Due: Homework #2

1/29: Simple Soccer + Lab.

Detailed discussion of a sport simulation. Integrating steering behaviors and finite state machines in a game architecture.

In-class: Lab #2

Assigned: Soccer project

Reading: Buckland, Ch. 4

Due: Homework #3

2/5: Midterm / Soccer discussion

Due: Soccer team design

2/12: Presentations + Tournament.

Presentations by GAM 476 students on AI middleware systems. Soccer tournament.

Due: Soccer team implementation (2/12)

2/19: Raven + Lab.

An agent-based AI example. Sensing and sensory memory. Issues of path finding and planning.

In-class: Lab #3

Reading: Buckland, Ch. 7

2/26: Path planning / Goals.

Handling navigation graphs and navigation meshes. Hierarchical path planning. Smoothing and caching. Goal-driven behavior. Issues in behavior modeling. Personality, state memory, and emotion. Tradeoffs between scripting and simulating.

Reading: Buckland, Ch. 8 and 9

3/5: Fuzzy Logic / Path planning lab.

Fuzzy set operations and hedges. Applications in game AI. Fuzzy state machines. Optimizations for fuzzy logic operations.

In-class: Lab #4

Reading: Buckland, Ch. 10

3/12: Presentations + Tournament.

Presentations by GAM 476 students on AI in production games. Raven tournament.

Due: Raven implementation (3/12)

3/19: Final exam due (take home)

## **Policies**

Students are expected to attend all classes and participate in in-class exercises. Class will start promptly. Students are individually responsible for material they may have missed due to absence or tardiness.

Most assignments will be submitted via Subversion commits. Do not submit assignments by email. Late assignments except for project and paper assignments will be accepted up to one week late with a one grade penalty. In addition to the code files that you commit, you must commit the relevant homework marker file (h1.txt, h2.txt, etc.) so that I know the committed code is the final version.

Except for group projects, assignments must represent a student's individual effort. While students are permitted to discuss assignments at the conceptual level, under no circumstances should students share specific answers (electronically or otherwise).

## **Attitude**

A professional and academic attitude is expected throughout this course. Measurable examples of non-academic or unprofessional attitude include but are not limited to: talking to others when the instructor is speaking, mocking another's opinion, cell phones ringing, emailing, texting or using the Internet whether on a phone or computer. If any issues arise a student may be asked to leave the classroom. The professor will work with the Dean of Students Office to navigate such student issues.

## **Civil Discourse**

DePaul University is a community that thrives on open discourse that challenges students, both intellectually and personally, to be socially responsible leaders. It is the expectation that all dialogue in this course is civil and respectful of the dignity of each student. Any instances of disrespect or hostility can jeopardize a student's ability to be successful in the course. The professor will partner with the Dean of Students Office to assist in managing such issues.

## **Cell Phones/On Call**

If you bring a cell phone to class, it must be off or set to a silent mode. Should you need to answer a call during class, students must leave the room in an undistruptive manner. Out of respect to fellow students and the professor, texting is never allowable in class. If you are required to be on call as part of your job, please advise me at the start of the course.

## **University Policies**

### **Changes to Syllabus**

This syllabus is subject to change as necessary during the quarter. If a change occurs, it will be thoroughly addressed during class, posted under Announcements in D2L and sent via email.

### **Online Course Evaluations**

Instructor and course evaluations provide valuable feedback that can improve teaching and learning. The greater the level of participation, the more useful the results. As students, you are in the unique position to view the instructor over time. Your comments about what works and what doesn't can help faculty build on the elements of the course that are strong and improve those that are weak. Isolated comments from students and instructors' peers may also be helpful, but evaluation results based on high response rates may be statistically reliable (believable). As you experience this course and material, think about how your learning is impacted. Your honest opinions about your experience in and commitment to the course and your learning may help improve some components of the course for the next group of students. Positive comments also show the department chairs and college deans the commitment of instructors to the university and teaching evaluation results are one component used in annual performance reviews (including salary raises and promotion/tenure). The evaluation of the instructor and course provides you an opportunity to make your voice heard on an important issue – the quality of teaching at DePaul. Don't miss this opportunity to provide feedback!

### **Academic Integrity and Plagiarism**

This course will be subject to the academic integrity policy passed by faculty. More information can be found at <http://academicintegrity.depaul.edu/>.

The university and school policy on plagiarism can be summarized as follows: Students in this course should be aware of the strong sanctions that can be imposed against someone guilty of plagiarism. If proven, a charge of plagiarism could result in an automatic F in the course and possible expulsion. The strongest of sanctions will be imposed on anyone who submits as his/her own work any assignment which has been prepared by someone else. If you have any questions or doubts about what plagiarism entails be sure to consult the instructor. While students are permitted to discuss assignments at the conceptual level, under no circumstances should students share specific answers (electronically or otherwise).

### **Withdrawal**

Students who withdraw from the course do so by using the Campus Connection system (<http://campusconnect.depaul.edu>). Withdrawals processed via this system are effective the day on which they are made. Simply ceasing to attend, or notifying the instructor, or nonpayment of tuition, does not constitute an official withdrawal from class and will result in academic as well as financial penalty.

### **Retroactive Withdrawal**

This policy exists to assist students for whom extenuating circumstances prevented them from meeting the withdrawal deadline. During their college career students may be allowed one medical/personal administrative withdrawal and one college office administrative withdrawal, each for one or more courses in a single term. Repeated requests will not be considered. Submitting an appeal for retroactive withdrawal does not guarantee approval. College office appeals for CDM students must be submitted online via MyCDM. The deadlines for submitting appeals for this quarter is the last day of the last final exam of Winter Quarter 2016.

### **Excused Absence**

In order to petition for an excused absence, students who miss class due to illness or significant personal circumstances should complete the Absence Notification process through the Dean of Students office. The form can be accessed at <http://studentaffairs.depaul.edu/dos/forms.html>. Students must submit supporting documentation alongside the form. The professor reserves the sole right whether to offer an excused absence and/or academic accommodations for an excused absence.

Exceptions to the late assignment policy and requests for makeup exams will only be permitted if the Absence Notification protocol is followed.

### **Incomplete**

An incomplete grade is a special, temporary grade that may be assigned by an instructor when unforeseeable circumstances prevent a student from completing course requirements by the end of the term and when otherwise the student had a record of satisfactory progress in the course. CDM policy

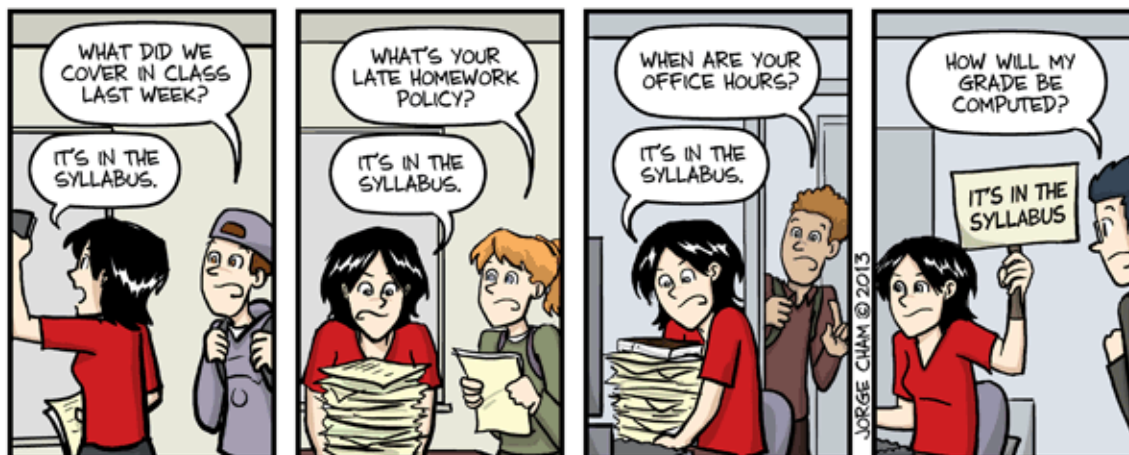
requires the student to initiate the request for incomplete grade before the end of the term in which the course is taken. Prior to submitting the incomplete request, the student must discuss the circumstances with the instructor. Students may initiate the incomplete request process in MyCDM.

- All incomplete requests must be approved by the instructor of the course and a CDM Associate Dean. Only exceptional cases will receive such approval.
- If approved, students are required to complete all remaining course requirement independently in consultation with the instructor by the deadline indicated on the incomplete request form.
- By default, an incomplete grade will automatically change to a grade of F after two quarters have elapsed (excluding summer) unless another grade is recorded by the instructor.
- An incomplete grade does NOT grant the student permission to attend the same course in a future quarter.

### Students with Disabilities

Students who feel they may need an accommodation based on the impact of a disability should contact the instructor privately to discuss their specific needs. All discussions will remain confidential.

To ensure that you receive the most appropriate accommodation based on your needs, contact the instructor as early as possible in the quarter (preferably within the first week of class), and make sure that you have contacted the Center for Students with Disabilities (CSD) at: Student Center, LPC, Suite #370 Phone number: (773)325.1677 Fax: (773)325.3720 TTY: (773)325.7296



# IT'S IN THE SYLLABUS

This message brought to you by every instructor that ever lived.

[WWW.PHDCOMICS.COM](http://WWW.PHDCOMICS.COM)

### Syllabus at a glance

Week	Date	Topic	Reading	Lab	Homework
1	1/8	Intro & Physics	Ch.1		
2	1/15	Finite State Machines	Ch. 2	L1	H1
3	1/22	Steering & Graph review	Ch. 3 & 5		H2

4	1/29	Soccer	Ch. 4	L2	H3
5	2/5	Midterm & Soccer Discussion			Soccer Design
6	2/12	Presentations & Soccer Tournament		T1	Soccer
7	2/19	Raven	Ch. 7	L3	
8	2/26	Path Planning & Goals	Ch. 8 & 9		Raven Design
9	3/5	Fuzzy Logic	Ch. 10	L4	
10	3/12	Presentations & Raven Tournament		T2	Raven
Finals	3/19	Final Exam (take home)			