88-431 Dynamic Decision Making
Carnegie Mellon University-Qatar Campus
Syllabus
Summer, 2007

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Office hours:	Tuesday and Wednesday 5-6PM
Credits:	9 units
Lecture:	3:30 -4:50 PM, Sunday to Thursday MSB A156B
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OVERVIEW

Consider the following dynamic decision making scenario:

> You are in a city you have never been in before, you have rented a car and you must reach your destination in a limited amount of time. A simple map of the city has helped you plan your route, but things never result as planned. As soon as you start driving you find out that the street that was supposed to appear right when you turn left after exiting the rental car station is not there. You slow down, thinking that you need more time to be able to recognize the signs and determine what to do next. Cars are over passing you and drivers are looking back at you with anger. You just have to go with your instincts. You turn right in the following street and you find out that there is a sign that you recognize based on your readings of the map. You follow that sign and you seem to be on your way to your destination. An intersection approaches, you only have a few seconds to decide what to do and you barely can read the signs. A car honks on you as you are trying to move right… not left… not right…Ok just take right, and see what happens. You are lucky. Turning right seems to be taking you closer to your destination. Time has gone fast though, and you are not going to make it there as soon as you expected.

This scenario is prototypical of many real-world decision making situations: you make a series of small and simple decisions while you have to process multiple and evolving sources of information in *real-time*. Often, you have a long-range goal (i.e., reach your destination on time)

and to accomplish your goal you must make many decisions over time. How do people make effective decisions in these kinds of changing environments?

Faster economic, technological, social, and environmental change challenge decision makers. Effective decision making in dynamic environments may be aided if we become system thinkers: expand the boundaries of our mental models, find the commonalities among problems and disciplines, understand the structure of complex systems and the resulting structure on human behavior.

A powerful and sensible decision making mechanism in dynamic environments is the decision maker's *experience*. With multiple exposures to similar situations decision makers learn at increasing rates. However several aspects of nature prevent learning: complex systems include multiple feedback effects, long time delays, and nonlinear responses to our decisions. Human learning in such environments is difficult, because we don't have an opportunity to experience the consequences of our most important decisions, because we are provided very few chances to repeat our most important decisions, because we cannot comprehend the effect of our decisions, because we cannot understand what decisions led us to our consequent state. We believe that effective decision making in dynamic environments can be achieved by accelerating learning. Learning can be accelerated by the repeated and extended use of Microworlds or Management Flight Simulators (MFSs): tools that reproduce the essential characteristics of real world situations in a laboratory.

OBJECTIVES

When you complete this course, you will be a better dynamic decision maker. You would have become a better system thinker. You will learn to visualize a complex problem in terms of the structures and policies that create dynamics and regulate performance.

You will become a better dynamic decision maker through the use of Microworlds and MFSs. These simulators will help you learn and acquire experience on how to control dynamic systems, how to react under time constraints, how to gather information and adapt decisions while the environment is rapidly changing. You will learn to recognize and deal with situations where policy interventions are likely to be delayed, diluted, or defeated by unanticipated reactions and side effects.

TEXTBOOKS AND READINGS

Optional Textbook:

Sterman, J. (2000). *Business Dynamics: Systems Thinking and Modeling for a Complex World.* (Text and CD-ROM). Irwin/McGraw Hill. ISBN 0-07-238915X. (Available in reserve)

Readings:

Readings can be accessed electronically through blackboard.

BLACKBOARD

We will be using the university-supported system for course delivery called Blackboard. You will be able to access class slides and project assignments, read announcements, hold discussions about the course and submit homework etc. through Blackboard. To get started, go to http://www.blackboard.com/docs/r6/6_1/student/bbls_r6_1_student/ and follow the instructions about logging in and accessing class information. Once you are familiar with the

common Blackboard instructions go to http://blackboard.qatar.cmu.edu/ and login using your CMU ID and password. Our class is found under F07-Dynamic Decision Making.

Please make a regular habit of checking the Blackboard because all course announcements will appear there!!! It is your responsibility to be informed of the announcements posted in Blackboard.

REQUIREMENTS AND GRADING

You will be scored on the following requirements, with the weights used in the computation of final course grades indicated as well:

	Points
Homework projects	
1. Defining Dynamic Decision Making	15 (+1)
2. Complexity	15 (+1)
3. System Dynamics Modeling	15 (+1)
4. Learning in Dynamic Decision Making	15 (+1)
Total Homework assignments	**60 (+4)**
Exams (individual)	
Mid-term Exam	15
Final examination (during the last day of classes)	20
Total Exams	**35**
Attendance and class participation	**5**
Course Evaluation Essay	+ 1
Total POINTS	**100 (+5)**

Homework projects will help you practice the concepts presented in the lectures and also help you prepare for the exams. The homework projects consist of several deliverables due on the days presented in the schedule.

I expect your homework projects to be of high quality. Points will be subtracted for unprofessional project assignments. A homework project that receives all the 15 points is one that is complete, correct, and convincing in every respect. It demonstrates the author's initiative as well as thoughtfulness, insight, and depth of analysis into the methodologies and techniques.

You may get an EXTRA bonus point in each homework project when you demonstrate extra effort in your homework and exceed our expectations in every dimension.

Project assignments should be **done individually and independently**. You are not allowed to share any information concerning the solution of the project assignments with other students in this course**.** Any form of **cheating/copying/plagiarism will not be excused and will lead to failure in the course**.

Exams. There will be 1 mid-term exam and a final exam on the last day of classes (July 1). Exams will include multiple choice, short answer, short essay, modeling and diagramming questions. Exams will be based upon the readings, lectures, and assignments. I will hold in-

class review sessions the class before the exams. Exams are to be taken individually. The final exam is cumulative, meaning that it will include what was taught in the whole course.

Attendance and class participation. Class attendance is the easiest way to learn the material fundamental to this class. Given the interactive character of the course, you obviously need to be present in class as often as possible and be **able to make your contributions** to class by participating in class discussions and activities. There are 29 classes scheduled for the term. You will receive credit for full attendance if you are present for 27 of those sessions and if you contributed to the discussions and exercises in the class regularly.

You will learn a great deal through your contributions in a variety of class activities:

- **Exercises:** Our exercises will vividly illustrate key dynamic decision making principles and will demonstrate the concepts learned in lectures.
- **Article analyses:** The reading packet contains several "articles." A set of "Questions for Consideration" for each article will be posted on our course Blackboard site. These questions direct your attention to elements of the article that have special significance for dynamic decision making. Before coming to class, you should frame a response in your head for each of the questions. Be prepared to debate your arguments and conclusions in the class session for which that article is scheduled.
- **Microworlds and MFSs:** Throughout the course you will use different computer tools in class. Different microworlds will be used each week. These will be available for you in Blackboard. You will learn by acquiring extended practice through running our dynamic decision making tools. You will also need these computer simulations to prepare some of your homework projects.

Course Evaluation Essay. We are very interested in your opinion about this class. At the end of the semester we will ask you to write an optional 1-page essay describing what you have learned from this course, what were the good things and the things that could be improved. You will receive 1 extra point in the course if you decide to write this optional 1-page essay.

COURSE POLICIES

Cheating and Plagiarism. You are responsible for being familiar with the university standard for academic honesty and plagiarism. Please see the CMU Student Handbook for information. In order to deter and detect plagiarism, online tools and other resources are used in this class.

We will use www.turnitin.com online tool to collect all the assignments and to deter and detect plagiarism. You must create your user profile and read http://www.turnitin.com/static/training_support/tii_student_qs.pdf document for the use of the tool. Your class ID for using turnitin tool is: 1883233 and the enrollment password is: ddmk. Please use this class ID and password for submitting your assignments to www.turnitin.com.

You must deliver project assignments on time in your user profile on www.turnitin.com. No paper should be handed in. Project assignments are **due at 3:00 PM** as per the day appearing on the schedule.

An assignment is classified as *late* if received after 3:00PM on its due day. **Late submissions of project assignments will automatically reduce 3 points on the assignments**.

Thus, if turned in late the maximum number of points in the assignment will be 12 (+1 extra point if earned for excellence in content). An assignment is classified as *missing* if not received within 24 hours of its due day. **Missing project assignments will automatically reduce 15 points on the assignments with no possibility of extra points.**

Missing lectures, late or missing homework projects and missed examinations. The only circumstances in which there may not be a penalty for missing lectures, late or missing homework projects or missed examinations is a **documented medical emergency or death in the family**. Other kinds of trips or motives are **not valid** excuses for any reason. There will be no opportunities to recover from unexcused absences from any examination. If you arrive late for any examination, you will not be given extra time to complete it.

Review of grades. I will accept requests for review of grades of assignments or exams if they are accompanied by a **written statement** carefully highlighting and explaining the items you feel need to be reviewed within **one day** of the day the project assignments/exam has been handed back. You must submit this written statement in PAPER, directly to me. In the written statement you must explain how the contested items meets both the spirit and the letter of the assignment or effectively answers an examination question, and propose a revised score. When I receive your request for review of grades, I will review the **entire** assignment or examination. Your ultimate score on the project may therefore increase, decrease, or remain unchanged when I review it. Lengthy or complex statements and explanations of how we should have interpreted your work are generally prima facie evidence that the work was appropriately graded in the first place.

Use of E-mail. Please be advised that sending email to your Professor or TA does not create a responsibility or obligation to respond to it. Sending us email does not shift any responsibility from you to us; you are still responsible for the on-time, high quality completion of assignments and projects. Do not send complicated questions or requests to us via email. Replies will not be given for email questions or problems requiring lengthy (more than a couple of sentences) or complicated responses. These types of communications should be done in person preferably during office hours.

Religious observance. If you cannot attend a particular class because of religious reasons, please arrange with me at **least two days ahead of time** so we can make alternate plans for covering the material. I have planned the course in a way that exams or assignments do not conflict with religious observance, but if you find a conflict please tell me within the first week of the semester.

THE CLASS ROUTINE

You can expect the following activities during the class sessions (although not necessarily in this order):

- Presentation: I will briefly summarize critical dynamic decision making ideas that, generally, will have been introduced in the assigned readings.
- Exercise: Each exercise concretely illustrates key principles or techniques that you can use to great advantage in your decision management work.
- Article discussion: As noted before, we will discuss several of the primary "Questions for Consideration" for the articles assigned for that session.
- Microworlds and MFSs demonstrations: We will demonstrate the concepts discussed in class using microworlds. In particular, most of the Thursday's sessions you will involve hands-on experience in practicing with the microworlds and MFSs.

THE SCHEDULE

Week 1 5-22 to 5- 24	***TOPIC: Defining DDM***	***Readings Due***	***Homework***	***In-class Exercise***
1. 5-22	Introduction to Dynamic Decision Making (DDM): Syllabus.			Identify each of the characteristics of DDM in WPP
2. 5-23	Taxonomy of Dynamics	Edwards, 1962 Brehmer, 1992	Homework 1	Demonstrate DSF. How can DSF be real-time and event driven.
3. 5-24	Learning and DDM	Brehmer, 1980 Gonzalez, Lerch, Lebiere, 2003 (pages 591-600)		Demonstration of an expert and a novice player of WPP
Week 2 5-27 to 5-31	***TOPIC: COMPLEXITY***	***Reading Due***	***Homework***	***In-class Exercise***
4. 5-27	Views of Complexity: the demands	Dorner, 1996, Chapter 2 Gonzalez, Vanyukov and Martin, 2005		Defining complexity with WPP and DSF
5. 5-28	Humans dealing with Complexity	Dorner, 1987 Simon, 1998, Chapter 8	Homework 1 DUE	Mistakes we make in dealing with complex systems Build models of systems
6. 5-29	Decisions of diverse complexity	Anzai, 1984 Omodei & Wearing, 1995		The 2-choice problem: Melioration Firechief
7. 5-30	Dynamic Complexity	Diehl and Sterman, 1995	Homework 2	The board beer game
8. 5-31	LABORATORY – Controlling for Dynamic Complexity	Martin and Gonzalez, 2007		The computer beer game
Week 3 6-3 to 6-7	***TOPIC: THE BUILDING BLOCKS OF DYNAMIC SYSTEMS***	***Reading Due***	***Homework***	***In-class Exercise***

9. 6-3	Introduction to building blocks of System Dynamics	Sweeney and Sterman, 2000 Cronin, Gonzalez and Sterman, 2007		An inventory of basic building blocks problems
10. 6-4	Casual Thinking and Feedback loops	Sterman, 2000 (Chapter 1)	Homework 2 DUE	Examples of feedback loops
11. 6-5	Drawing Causal Loop Diagrams	Sterman, 2000 (Chapter 5)		Working examples of feedback loops
12. 6-6	Stocks and Flows	Sterman, 2000 (Chapter 6)		DSF – a feedback loop
13. 6-7	Laboratory- System Dynamics Concepts	Sterman, 2000 Section 5.4		Exercises Stock and Flow structures added to Casual Diagrams
Week 4 6- 10 to 6-14	***TOPIC: SYSTEM DYNAMICS MODELING***	***Reading Due***	***Homework***	***In-class Exercise***
14. 6-10	EXAM 1			
15. 6-11	Introduction to Modeling Human Decision Making Behavior.	Sterman, 2002		Demo with Vensim
16. 6-12	The modeling process	Breierova and Choudhari, 1996 Albin 1997	Homework 3	Beginner Modeling Exercises
17. 6-13	From Casual Loops and stocks and flows to Simulation Models with Vensim	Repenning1998 Adapted.docx + Vensim PLE Quick Reference Tutorial (VenPLE.pdf)		Vensim
18. 6-14	LABORATORY – Vensim modeling exercises	Sterman, 2000 Chapter 8: 8.1, 8.2.1, 8.2.3, 8.2.4, 8.3, 8.4, 8.5 Chapter 9: 9.2.1, 9.2.2		Vensim
Week 5 6-*17 to 6-21*	***TOPIC: DDM RESEARCH METHODS AND LEARNING FROM EXPERIENCE***	***Reading Due***	***Homework***	***In-class Exercise***

19. 6-17	DDM Research methods	Brehmer and Dorner, 1993 (pages 176-180) Funke, 1995 (chapter 10)		Experimental design examples
20. 6-18	The Individual Differences Approach	Rigas and Brehmer, 1999 Gonzalez, Thomas and Vanyukov, 2005	Homework 3 DUE	Visual Span task
21. 6-19	Implicit Learning in the Control of Complex Systems	Berry and Broadbent, 1996		Demo Verbal protocols – Novices and Experts
22. 6-20	Similarity and Analogy	Loewenstein and Gentner, 2001	Homework 4	Solve the similarity tasks in paper SF
23. 6-21	Instance-based learning models	Gonzalez and Lebiere, 2005		Definition of instances in microworlds
Week 6 6-24 to 6-28	***TOPIC: DDM Applications***	***Reading Due***	***Homework***	***In-class Exercise***
24. 6-24	Management: Resource Management and Supply Chain	Sterman, 1989 Crosson and Donohue 2006		Beer Game
25. 6-25	Military Command and Control	Bakken and Gillham, 2003	Homework 4 DUE	Command and Conquer
26. 6-26	Airport Security and visual search	Gonzalez and Madhavan, 2007		Luggage Screening
27. 6-27	Medical diagnosis	Kleinmuntz, 1985		MEDIC
28. 6-28	Training	Schmidt and Wulf, 1997		
29. 7-1	FINAL EXAM			