CS 426 - Discrete Mathematics 2

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1 General Information

(a) Instructor: K. Subramani

(b) Meeting Times: MWF, 11:00 am - 11:50 am˙ Location: ESB 251.

(c) Contact Information: 347 AERB.

(d) Office Hours: MWF, 08:30 am - 9:30 pm.

(e) Prerequisites - Discrete Mathematics, Probability, Linear Algebra.

(f) Textbook - There is no required textbook for the course, although the course material is largely based on the contents of [Sta98], [Spa11] and [GM08].

(g) Assessment:

(a) Quizzes (4) - There will be four quizzes as per the schedule in Table 1.

Assignment	**Date**
Quiz I	January 31
Quiz II	February 21
Quiz III	March 27
Quiz IV	April 17

Table 1: Quiz Schedule

Each quiz is worth 15 points for a total of 60% of your grade.

(b) Midterm - The midterm will be held on March 3 (in-class, closed-book and open-notes) and is worth 20% of your grade.

(c) Final - The final exam will be held on May 7 from 11 am to 1 pm. The examination will be closed-book, open-notes and is worth 20% of your grade.

(d) You may **earn** a maximum of 5 bonus points through classroom performance.

(e) 5 points will be awarded for classroom conduct, including attendance on certain days and adhering to class policies and procedures. These points are awarded **solely** at the discretion of the instructor.

(h) Grade Boundaries

(a) **A**: 85 and up

(b) **B**: $70 - 84$

(c) **C+**: $61 - 69$

(d) **C-**: $50 - 60$

(e) **D**: $45 - 49$

(f) **F**: $0 - 44$

(i) Attendance is **mandatory** on the following days: February 3, February 24, March 5, March 20 and April 20. Failure to attend class on these days **will** result in the loss of conduct points.

(j) Grading policy - If you have any questions about the grading, you must contact the instructor within two days of your paper being returned.

(k) Makeup Policy - If for some reason, you are unable to attend a test or an exam, please meet me at the earliest and I will set an alternate date.

(l) **Course Objectives** - The objectives of this course are as follows:

(a) Learning how to model situations using games.

(b) Learning how to classify games.

(c) Learning concepts such as Nash Equilibrium, Best Responses and Strategies.

(d) Exposure to a number of classical games such as Prisoner's Dilemma, Coordination games, Battle of the Sexes and so on.

(m) **Expected Learning Outcomes** - Upon successful completion of this course, students will be able to:

(i) Model situations using games.

(ii) Apply the notion of Best Response to compute a Pure Strategy Nash Equilibrium.

(iii) Compute the Nash Equilibrium of selected games.

(iv) Apply backwards induction to selected games.

(v) Apply game theory to problems in economics.

2 Syllabus Sketch and Weekly Schedule

2.1 Introduction

Notion of conflict and differing objectives, Sample Games, Applications.

2.2 Zero-Sum Games

Formal definitions, Optimal responses to specific strategies, The Maximin and Minimax strategies, Solutions of zero-sum games, Dominance, Symmetric games, Pure maximin and minimax strategies.

2.3 Non-zero Sum Games

The Prisoner's Dilemma and Strict Dominance, Iterated Elimination of Strictly Dominated Strategies, Pure Strategy Nash Equilibrium, Dominance and Nash Equilibrium, Mixed Strategy Nash Equilibrium, Computing Payoffs, Strict Dominance in Mixed Strategies.

2.4 Game Trees

Game Trees and Sub-game Perfect Equilibrium, Backward Induction, Multiple Sub-game Perfect Equilibria, Credibility of threats, Commitment problems, Problems with Backward Induction, Forward Induction.

2.5 Mixed Equilibria

Probability distributions, Mixed Strategy Nash Equilibria in Generalized Games, Knife-edge equilibria, Generalizing Mixed Strategy Nash Equilibria, Rock-Paper-Scissors.

2.6 Advanced Topics

Infinite Strategy Spaces, Second Price Auctions, Duels, The Median Voter Theorem.

2.7 Stable Matching

The Stable Matching problem with examples, The Gale-Shapley algorithm, Existence of stable matchings, Number of courtship stages in Gale-Shapley, The Assignment problem, Optimality, Existence of a Unique Stable Matching.

I would like to reiterate that this is a sketch of the topics that we will be covering. For various reasons, I may choose to drop a mentioned topic or cover a new topic. In such cases, advance notice will be given. I have also reserved some lectures for discussions on Homework Assignments, Quizzes and Exams.

3 Inclusivity Statement

West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Accessibility Services (293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu.

4 Civility Statement

In this course, you are expected to act in a manner consistent with the behavior expected in the professional workplace. Respect each other, come to class prepared, be supportive of others, be attentive, contribute when appropriate, and be engaged in your learning. Civility is expected and assumed.

In order for everyone to have the opportunity to maximize learning, inappropriate or disruptive behavior is prohibited and may result in a request to leave the classroom at a minimum.

Examples include, but are not limited to, using cell phones in class, texting in class, excessive tardiness or late arrivals, demanding special treatment, challenges to the instructor's authority, leaving class early, shuffling backpacks and book bags, using offensive language or remarks, chewing gum, wearing caps, prolonged side discussions, playing games in class, sleeping, overt inattentiveness, and using a laptop during class unless instructed to do so.

5 Policies and Procedures

1. Grades assigned during the semester on exams, quizzes, reports, or homework assignments are considered final and are not subject to negotiation for any reason other than an indisputable mistake in grading.

2. Use of cell phones, smart wearable devices, or possession of other external communication devices, including laptops is **strictly prohibited** during lectures. Violations **will** lead to expulsion from the class.

3. Common standards of academic integrity prohibit not only cheating or plagiarizing, but also the unethical conduct of trying to obtain grades that the student has not earned. Violations of academic integrity are described in the WVU Catalog: http://bit.ly/2hDAeUa.

4. Students have the right to appeal final grades that do not involve charges of academic dishonesty. Students may appeal charges of academic dishonesty. The appeal process is outlined in the WVU Catalog: http://bit.ly/2uiMM9E.

5. Incidents of student misconduct or academic dishonesty will be handled promptly and appropriately in accordance with the WVU Student Conduct Code and Discipline Procedure. The case will be referred to the Office of Student Conduct. Detailed academic policies on syllabus and class conduct can be found at: https://tlcommons.wvu.edu/syllabus-policies-and-statements.

6. Violations of the policies and procedures (including the Civility Statement) will lead to the loss of conduct points and possible dismissal from the course.

7. Student evaluation of instruction will be conducted, **in class**, on a suitable date after March 20.

References

[GM08] Ein-Ya Gura and Michael B. Maschler. *Insights into Game Theory: An Alternative Mathematical Experience*. Cambridge University Press, 2008.

[Spa11] William Spaniel. *Game Theory 101: THe Complete Textbook*. CreateSpace Independent Publishing Platform, 2011.

[Sta98] Saul Stahl. *A Gentle Introduction to Game Theory*. American Mathematical Society, 1998.