CSC 576: Computational Advertising

Winter 2016
Thursdays: 5:45 – 9:00 pm, Room Lewis 1217
Professor Robin Burke
Office hours: Tu 2:30 – 4:00 pm; Th 11:45 am – 1:15 pm (CDM 841) and by appointment.
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(Email - better) rburke@cs.depaul.edu
(Piazza – best) www.piazza.com

Description
Computational advertising is the problem of finding the best advertisement for a given user in a given on-line context. It is a complex and emerging area at the intersection of quantitative marketing, web search, data mining, recommendation, optimization, and algorithmic game theory. Students will read current scientific papers and explore a range of models both mathematically and empirically. Students can choose from three types of final course projects: implementation projects, research papers, or data analysis projects.

Learning Objectives
Students will be able to:
- identify the major players and roles in the computational advertising ecosystem.
- identify the technical issues related to sponsored search, display advertising, and real-time bidding.
- analyze, discuss and present results from scientific literature.
- synthesize the results of independent inquiry in a final project.

Prerequisite:
IS 567, CSC 478, or ECT 584

Readings
As assigned, available online on D2L. See complete list below.

Tools
Piazza
We will be using Piazza for class discussion. The system is designed 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/winter2016/csc576/home.

Assignments
There are five graded components of this class:
- Homework (10%): 3 assignments due weeks 2, 3, and 6
    - Homework 1: Study of the relationship between advertising and context
    - Homework 2: Using Google AdWords
    - Homework 3: Game theory
- Quizzes (10%): 2 online quizzes due weeks 2 and 5
    - Quiz 1: Concepts and vocabulary
    - Quiz 2: Foundations
- Discussion leader (30%/DL 20%): responsible for 1 paper during weeks 5-9.
- Participation (15%/DL 25%): includes in-class and on-line participation.
- Final project (35%): including project proposal, progress report, final presentation, and final report.

See assignment handouts for details.

Late Assignments
Late assignments will be marked off by 10% per day, up to 3 days late. Work related to class discussions and project presentations will not be accepted late with prior permission of the instructor.

DL Students
Distance learning students differ from in-class students only in that they have different requirements related to presentations. They are not required to serve as discussion leaders for their assigned papers and therefore have greater weight placed on other forms of online participation.

Visiting speakers
Chicago is a global center for the advertising industry. When possible, we will have invited speakers from industry visit CSC 576 and discuss the technologies that their companies use and the challenges that they face in their work. Currently only one such speaker is on the schedule, but this may change as the quarter proceeds.

Tentative Schedule
Unit I: Foundations

1/7: Introduction / Overview
Course outline and expectations. Overview of computational advertising and research / application issues. Ethical issues. Standard terminology and roles.
Reading: Yuan, S. et al. "Internet Advertising: An Interplay among Advertisers, Online Publishers, Ad Exchanges and Web Users". Information Processing and Management, 2012.

1/14: Computational foundations: Algorithms, Information retrieval
Online algorithms. Competitive ratios. Web advertising as a matching problem. The BALANCE algorithm. Text representation. Statistical language modeling. Entity recognition. Implementation and scalability issues.
Reading: Chapter 8 in Leskovec, et al., *Mining Massive Datasets*; Chapters 1 and 6 in Manning, et al., *Introduction to Information Retrieval*.
Due: Quiz 1, Homework #1

1/21: Computational foundations: Multi-armed bandits
CTR estimation as a multi-arm bandit problem. Heuristics for MAB: UCB, ε-greedy, Thompson sampling.
Guest speaker: Sean Naismith, LeapFrog Online.
Reading: Chapters 1 and 2 in Bubeck & Cesa-Bianchi, *Regret Analysis of Stochastic and Nonstochastic Multi-armed Bandit Problems*.
Due: Homework #2

1/28: Economic foundations: Game and auction theory
Closed form games. Nash equilibria. Optimality. Externalities. Auctions as games. Second-price auctions. Combinatorial auctions. Mechanism design. Google Adwords and other applications.
Reading: Edelman, et al. Internet advertising and the generalized second-price auction.
Due: Project proposal

Unit II: Selected topics

2/4: NLP: Page processing / Query processing
Reading: Papers A-D
Due: Quiz 2

2/11: Auctions: Real-time bidding / Sponsored search
Reading: Papers E-H
Due: Homework #3

2/18: Revenue management: Yield optimization / CTR estimation
Reading: Papers I-L

2/25: Measurement
Reading: Papers M-P

3/3: Privacy and Fraud
Reading: Papers Q-T
Due: Project Progress Report

3/10: Project Presentations
Due: Project Presentation

3/17: Project Presentations
Due: Project Presentation

3/18: Final project due

Paper Presentations

Because computational advertising is an emerging field, the most reliable sources for developments in the field are research papers appearing in related conferences. The second unit of the class is devoted to reading and discussing recent research on a variety of related topics. Each student is expected to make a 10 minute presentation of one of these papers and to lead related on-line and in-class discussion. (See the handout for details.)

Week 5
Paper A: Yih, et al. Finding Advertising Keywords on Web Pages. WWW 2006.
Paper B: Chakrabarti, et al. Contextual Advertising by Combining Relevance with Click Feedback. WWW 2008.
Paper C: Broder, et al. Online Expansion of Rare Queries for Sponsored Search. WWW 2009
Paper D: Hillard, et al. Improving ad relevance in sponsored search. WSDM 2010.

Week 6
Paper E: Yuan et al., Real-time bidding for online advertising: measurement and analysis. AdKDD 2013
Paper F: Zhang, et al. Optimal real-time bidding for display advertising. KDD 2014.
Paper G: Aggarwal, et al. Truthful Auctions for Pricing Search Keywords. EC 2006.
Paper H: Zhang, et al. Price cycles in online advertising auctions. ICIS 2005.

Week 7
Paper I: Cheng, et al. Dynamic ad layout revenue optimization for display advertising. AdKDD 2012.
Paper J: Yuan, et al. An empirical study of reserve price optimisation in real-time bidding. KDD 2014.
Paper K: Li, et al. Exploitation and exploration in a performance based contextual advertising system. KDD 2010.
Paper L: Graepel, et al. Web-scale bayesian click-through rate prediction for sponsored search advertising in Microsoft's Bing search engine. ICML-10.

Week 8
Paper M: Barajas, et al. Marketing campaign evaluation in targeted display advertising. AdKDD 2012.
Paper N: Dalessandro et al., Evaluating and Optimizing Online Advertising: Forget the Click, But There are Good Proxies. Big Data 2015
Paper O: Becker, What happens after an ad click? Quantifying the impact of landing pages in web advertising. SIGIR 2009.
Paper P: Papadimitriou, et al. Display advertising impact: Search lift and social influence. KDD 2011.

Week 9
Paper Q: Zhao, et al. Have Your Cake and Eat It Too! Preserving Privacy while Achieving High Behavioral Targeting Performance. ADKDD 2012.

Paper R: Toubiana, et al. Adnostic: Privacy Preserving Targeted Advertising. NDSS 2010.
Paper S: Springbornand and Barford, Impression fraud in on-line advertising via pay-per-view networks. USENIX Security 2013
Paper T: Metwally, et al. On hit inflation techniques and detection in streams of web advertising networks. ICDCS 2007.

Course Policies

Attendance
Students are expected to attend each class and to remain for the duration. Coming 15 minutes late or leaving 15 minutes early constitutes an absence for the student. Students are individually responsible for material they may have missed due to absence or tardiness.

Assignment Submission
All assignments will be submitted to D2L or in some cases, handed in during class.. Do not submit assignments by email.

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 undisruptive 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 Spring Quarter 2014.

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.

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

Quarter at a Glance

Date	Topic	Due	Project
1/7	Introduction / Overview		
1/14	Algorithms, IR	Quiz 1, Homework 1	
1/21	Multi-armed bandits	Homework 2	
1/28	Game and auction theory		Proposal
2/4	NLP	Quiz 2	
2/11	Auctions	Homework 3	
2/18	Revenue management		Progress report 1
2/25	Measurement		
3/3	Privacy and Fraud		Progress report 2
3/10	Presentations 1		Presentation
3/17	Presentations 2		Presentation
3/18	Final project due		
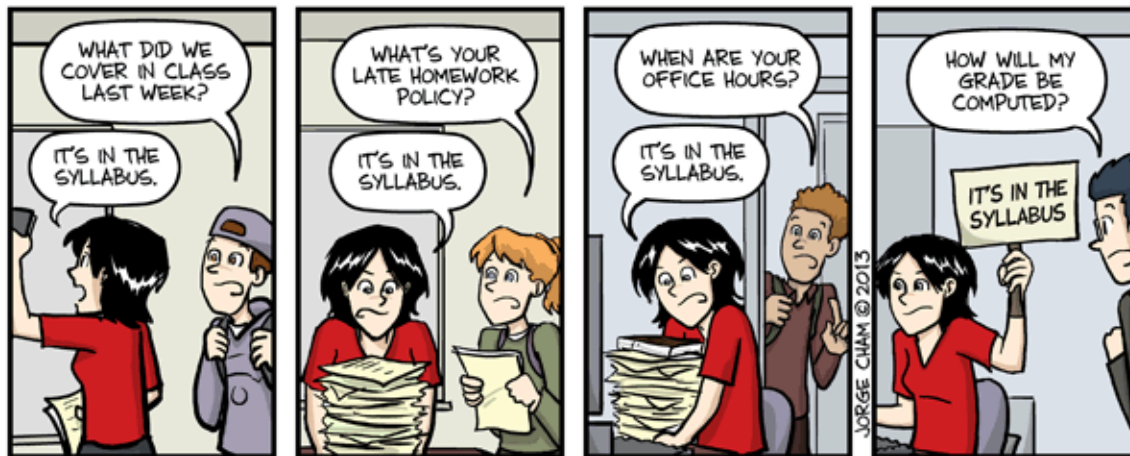
IT'S IN THE SYLLABUS

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