

CSC 576: Computational Advertising

Sections 801 / 810

Winter 2018

Mondays: 5:45 – 9:00 pm, Room CDM 206

Professor Robin Burke

Office hours: Tu / Th 10:00 – 11:30 am and by appointment, CDM 841

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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

Wang, J., Zhang, W. & Yuan, S. *Display Advertising with Real-Time Bidding (RTB) and Behavioural Targeting*. 2017. arXiv preprint [arXiv:1610.03013](https://arxiv.org/abs/1610.03013). Available on D2L. (DARB below).

Optional: Cristal, Gregory. *Ad Serving Technology*. CreateSpace Independent Publishing Platform. 2014. ISBN: 978-1484867570. This book is a non-technical survey of concepts in advertising technology.

Others as assigned, available online on D2L.

Tools

Slack

We will be using Slack for class discussion and communication. Slack has a mobile app and a web front-end. The course site is csc576win2018.slack.com. I will set up student accounts during the first week of class using your email address listed in CampusConnect. Note that questions I receive by email that are not of a personal nature may be posted to the forum together with my answer.

SCuiz

We will be using the SCuiz student-generated quiz system: scuiz.org. You are required to generate at least 2 of your own questions each week, and to answer correctly at least 20 questions from your fellow students per week. Note that questions from other students will only appear when you create your own questions. You can challenge questions as too hard or too easy and also questions that are incorrect.

Assignments

There are five graded components of this class:

- Homework (20%): 4 assignments due weeks 2, 3, 5, and 6
 - Homework 1: Advertising ecosystem
 - Homework 2: Advertising in context
 - Homework 3: Game theory
 - Homework 4: Using Google AdWords
- Quizzes (15%): up to 180 SCuiz points
- Participation (15%): includes in-class and on-line participation.
- Research paper (10%):
 - In-class students: Preparing slides summarizing a research paper
 - Distance students: Moderating an online discussion of a research paper
- Final project (30%): including project proposal, progress report, final presentation, and final report.

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 without prior permission of the instructor or completion of the Dean of Students's Absence Notification process.

Tentative Schedule

1/8: Introduction / Overview

Course outline and expectations. Overview of computational advertising and research / application 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.
Section 1 "Introduction" in DARB.

1/15: Martin Luther King Day – No class

Watch: Helen Nissenbaum lecture on

Due: Homework 1, Article preferences

Article: Pinder, C. The Anti-Influence Engine. *CHI 17 Extended Abstracts*, 2017. pp. 770-781.

1/22: Web technologies / Ethics

Reading: Chapter 1, Local vs Remote Technologies, in Cristal, G. Ad Serving Technology.

Section 2, How RTB Works, in DARB.

Wicker, S. & Karlsson, K. Internet Advertising: Technology, Ethics, and a Serious Difference of Opinion.

Communications of the ACM 60(10), 70-77, 2017.

Due: Homework 2

Article: A

1/29: Games and auctions

Closed form games. Nash equilibria. Optimality. Externalities. Extensive form games. Auctions as games. Second-price auctions. Combinatorial auctions. Mechanism design.

Reading: Jackson, A Brief Introduction to the Basics of Game Theory.

Edelman, et al. Internet advertising and the generalized second-price auction. *American Economic Review* 97(1), 242-259, 2007.

Section 3 "RTB Auction & Bid Landscape" in DARB.

Due: Project proposal

Articles: B, C

2/5: Information retrieval / Sponsored search

Text representation. Statistical language modeling. Entity recognition. Implementation and scalability issues.

Advertising as an IR problem. Query expansion. Keyword auctions and reserve prices.

Reading: Chapters 1 and 6 in Manning, et al., *Introduction to Information Retrieval*.

Due: Homework 3

Articles: D, E

2/12: Scalable learning / Recommender systems

Learning with sparse feedback. Hashing. Gradient-boosted decision trees. Optimization-based learning. Mass personalization and recommendation. Latent factor methods. Reciprocal recommendation.

Due: Homework 4

Reading: Section 4 in DARB.

Koren, Bell and Volinsky. Matrix factorization techniques for recommender systems. *IEEE Computer* 42(8), 2009.

Articles: F, G

2/19: Online algorithms / Multi-armed bandits

Online algorithms. Competitive ratios. Web advertising as a matching problem. The BALANCE algorithm. CTR estimation as a multi-arm bandit problem. Heuristics for MAB: UCB, ϵ -greedy, Thompson sampling.

Reading: Chapter 8 in Leskovec, et al., *Mining Massive Datasets*.

Chapters 1 and 2 in Bubeck & Cesa-Bianchi, *Regret Analysis of Stochastic and Nonstochastic Multi-armed Bandit Problems*.

Articles: H, I

2/26: Real-time bidding / Metrics

Display advertising markets. Demand- and supply-side platforms. Pricing and bidding. Performance metrics in advertising. Auditing.

Reading: Sections 5 and 6 in DARB.

Articles: J, K

3/5: Privacy / Fraud

Privacy issues in digital advertising. Privacy-preserving technologies. Ad blocking and obfuscation. Fraud in digital advertising. Impression and click fraud. Fraud detection.

Reading: Section 8 in DARB.

Additional reading TBA

Articles: L, M

3/12: Project presentations

3/19: Project due

Research Papers

Because computational advertising is an emerging field, the most reliable sources for developments in the field are research papers appearing in related conferences and journals. In conjunction with covering the fundamentals of the field, we will also read and discuss recent research on a variety of related topics. Most weeks we will cover two papers. Each paper will have an online student assigned to manage the online Slack discussion for the paper. Each paper will also have an in-class student who will prepare slides that the instructor will use to present the paper and will lead the in-class discussion. (See the assignment description for details.)

Tentative selections

Week 3: Ethics

Article A: Speicher, T. et al. Potential for Discrimination in Online Targeted Advertising. Conference on Fairness, Accountability, and Transparency, 2018. Appearing in *Proceedings of Machine Learning Research* 81:1-15, 2018.

Week 4: Games and auctions

Article B: Tingting Cui et al. Data-Driven Reserve Prices for Social Advertising Auctions at LinkedIn. AdKDD 2017.

Article C: Xie, Z., Lee, K.-C. & Wang, L. Optimal Reserve Price for Online Ads Trading Based on Inventory Identification. arXiv preprint arXiv:1709.10388 (2017).

Week 5: Search

Article D: Hillard, et al. Improving ad relevance in sponsored search. WSDM 2010.

Article E: Grbovic, Mihajlo, et al. Context-and Content-Aware Embeddings for Query Rewriting in Sponsored Search. *Proceedings of the 38th International ACM SIGIR Conference on Research and Development in Information Retrieval*, ACM, 2015, pp. 383–392.

Week 6: Machine learning

Article F: Ling, Xiaoliang, et al. “Model Ensemble for Click Prediction in Bing Search Ads.” *Proceedings of the 26th International Conference on World Wide Web Companion*, International World Wide Web Conferences Steering Committee, 2017, pp. 689–698.

Article G: Aryafar, Kamelia, et al. An Ensemble-Based Approach to Click-Through Rate Prediction for Promoted Listings at Etsy. *AdKDD 2017*.

Week 7: Online learning

Article H: Flavian Vasile, et al. Cost-Sensitive Learning for Utility Optimization in Online Advertising Auctions. *AdKDD 2017*.

Article I: Xu, Jian, et al. Smart Pacing for Effective Online Ad Campaign Optimization. *KDD 2015*, pp. 2217–2226.

Week 8: Real-time bidding

Article J: Dalessandro et al., Evaluating and Optimizing Online Advertising: Forget the Click, But There are Good Proxies. *Big Data 2015*

Article K: Yuan, Shuai, et al. Real-Time Bidding for Online Advertising: Measurement and Analysis. *AdKDD 2013*, Article 3.

Week 9: Privacy / Fraud

Article L: Zhao, et al. Have Your Cake and Eat It Too! Preserving Privacy while Achieving High Behavioral Targeting Performance. *AdKDD 2012*.

Article M: Stone-Gross, Brett, et al. “Understanding Fraudulent Activities in Online Ad Exchanges.” *Proceedings of the 2011 ACM SIGCOMM Conference on Internet Measurement*, ACM, 2011, pp. 279–294.

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. 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 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. 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).

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.

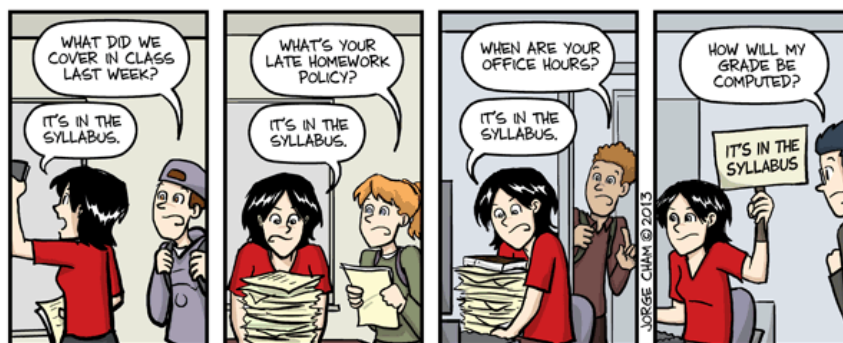
Students with Disabilities

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, 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	Assignments	Project
1/8	Introduction / Overview		
1/15	No class: University closed	Homework 1	
1/22	Web / Ethics	Homework 2	
1/29	Games and auctions		Proposal
2/5	IR / Sponsored search	Homework 3	
2/12	Learning / RecSys	Homework 3	
2/19	Multi-armed bandits		
2/26	RTB		Progress report
3/5	Privacy / Fraud		
3/12	Presentations		Presentation
3/19	Final project due		



IT'S IN THE SYLLABUS

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

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