

Resources for Teaching Web Science to Computer Science Undergraduates

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ABSTRACT

This poster reports on course materials that have been developed for teaching an Introduction to Web Science course to computing majors at the undergraduate level. This is the first comprehensive collection of resources that we are aware of that targets undergraduates in the exciting new field of Web Science. The course materials include slides, reading assignments, homework assignments, programming projects, and exams. We hope these materials will make adopting a Web Science course easier for a computing department or for creating an interdisciplinary course which could expose computing to a more diverse and broader group of students.

SIGNIFICANCE AND RELEVANCE

Web science is a relatively new field of study, having been promoted by Tim Berners-Lee et al. in 2006 as an interdisciplinary science which studies the Web as an independent subject [1]. Web science seeks to identify, understand, and explain the phenomena which constitute the Web, and to create and use this knowledge to engineer a better Web. There is an active research community forming around Web Science with an annual ACM conference which showcases work from a number of disciplines. As society continues to become more dependent on the Web for work, study, and play, the need for computing professionals who are trained in web science will be increasingly important.

When a new field of study emerges, it often takes a significant amount of time before teaching materials (textbooks, slides, projects) are made available for instructors at the undergraduate level. While there are a number of efforts at the graduate level to teach web science, little attention has been given to web science initiatives at the undergraduate level [2]. And while efforts are being made to provide a shared web science repository for educators [3], there still remains a dearth of web-science teaching materials.

With the support of NSF grant 1008492, Harding University and Old Dominion University have offered an "Introduction to Web Science" course to undergraduate computing students in spring 2011, spring 2013¹, and fall 2013². We have created course materials including slides, reading assignments, homework assignments, programming projects, and exams that would make adopting a Web Science course easier for a CS department. We hope to promote and share this material with computing faculty at the SIGCSE symposium.

The Computer Science Curricula 2013 [4] suggests a number of elective that CS departments might offer like Social Networks and Natural Language Processing which are captured in our Web Science materials. Web Science also shares many commonalities with the popular research areas of Data Science and Network Science with an emphasis on "big data" [5]. Because of the interdisciplinary character of Web Science and the variety of problems it addresses, offering a Web Science course can be one method for attracting underrepresented groups to computing.

¹ <http://www.harding.edu/fmccown/classes/comp475-s13/>

² <http://www.cs.odu.edu/~mln/teaching/cs595-f13/>

DESCRIPTION

In developing our introductory course to web science, we selected four major themes to address:

- I. **Studying the Web:** Defining web science, the Web's architecture, characterization, archiving
- II. **Web Search Engines:** Web crawling, web information retrieval, ranking, adversarial IR techniques
- III. **Social Networks:** Graphs, social theory, social influence, visualization
- IV. **Collective Intelligence:** Recommender systems, clustering algorithms, document filtering

The poster will give several visually appealing examples of the types of problems addressed within these themes. For example, Figure 1 illustrates a simple graph where we can apply the PageRank algorithm to determine which of the web pages should be ranked higher in a set of search results. Figure 2 illustrates a student's social network from Facebook; students can mine data from Facebook and determine if the "friendship paradox" applies to them [6].

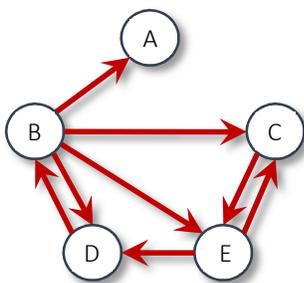


Figure 1: Calculating PageRank

PageRank: $R = TR$

T_{ij} is the probability of going from page j to i :

$$T_{ij} = \frac{\alpha}{|P|} + (1 - \alpha) \frac{1}{|P_j|}$$

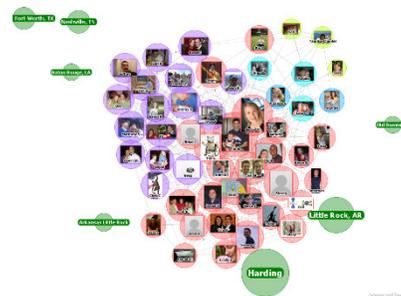


Figure 2: Visualizing a Social Network

Our

introduction class was designed particularly for computing majors who were already proficient in at least one programming language. The programming assignments used Python because of the numerous libraries available for it and so we could expose our students to a language they had not previously used. Many of the materials, however, could be used in an interdisciplinary course with students that have little computing background.

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