

An Integrated Data Science Curriculum: Networks, Cultures, and BS in Data

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Digital and Computational Studies [DCS] at Bates College was formed to embed methods and concepts from computer science, data science and digital studies across the liberal arts curriculum and our classes are intentionally interdisciplinary and inclusive. Because of this particular institutional framing, because our students are all undergraduates, and because we are a relatively new academic unit, our primary challenges have been 1) defining who we are as a program and then communicating that effectively to students and colleagues, and 2) building a program that will embrace institutional expertise while establishing a data science core which fully reflects our values and scaffolds student skills. To this end, we have co-created a framework for our curriculum which embraces a continuum of programming to digital studies, with an emphasis on application and critical inquiry. We have also developed a three course data science core curriculum which draws on the expertise of the faculty appointed to the program.

Context

The origins of DCS at Bates lie in the fact that Bates has no computer science department and its statistics and programming courses are distributed among many departments, with its heaviest emphasis within the Mathematics Department. The DCS program was created in response to these curricular particularities, and as a space to develop, in the words of Dr. Adriana Salerno, "a program that doesn't have the baggage and vices of some of the established programs, where people say, "Computer science is taught this way" ... We can decide what this major is going to be and who it is going to attract."¹ In 2015 the Bates faculty voted to establish the DCS program, and secured gift commitments from seven alumni families to endow three tenure and tenure-track lines. While some in the Bates community envisioned DCS filling gaps and bringing cohesion to programming instruction across campus, others have waited to see if it would embrace the scholarship involving the rest of the digital world as readily.

The first DCS courses were taught by faculty across multiple departments at Bates, including Earth and Climate Sciences, Economics, Math and Chemistry. In 2018 the co-authors were hired to fill two of the three funded DCS faculty lines. Dr. Diaz Eaton is a computational biologist and STEM education researcher, and Dr. ShROUT is a digital/computational historian and scholar of critical digital studies. In addition to the two appointed tenure-track faculty, DCS is currently charted by a program committee of 4 additional faculty - a visiting professor appointed to DCS, a mathematics professor who is also the program committee chair, a neuroscience professor, and a philosophy professor .

¹ "The Unique Proposition of Bates's New Digital and Computational Studies Program" *Bates News*, February 26, 2016

Defining and communicating DCS

Our first challenge as a new academic unit was to define who we were and communicate our identity to students and colleagues. There is no pre-existing model that we could find that embraced programming, data, and critical studies with a data science core. We approached this challenge first by aiming to develop an interdisciplinary and radically inclusive space built to support the students who have been historically marginalized in computing and data science spaces. In its interdisciplinarity, it seeks to embrace students with a variety of interests. In its pedagogical approach, the program focuses on supporting the success of our Black, Indigenous, Latinx, Asian American students, differently-abled students and women - thereby setting up all students to succeed. One of the ways that we have tried to do this is by offering classes that explicitly engage with the good and harm that data can inflict and the development of strategies to use data ethically and equitably. We also utilized evidence-based practices from STEM education - we explicitly discuss sexism and racism in class, we use projects that encourage students to explore their civic responsibilities, we ask students to interrogate assumptions in all representations, we employ community-based learning and course-based research, we prioritize hands-on and active learning, we choose open educational resources and open source software, and we work to create community in the classroom.

We also made an effort to be explicit about our goals and values as a program, and on our website to create a unified chorus for DCS. This included an explicit statement embracing DCS as comprised of a continuum of experiences, with courses in: 1) Critical Digital Studies, which interrogate the social construction and use of programming and computing and apply critical theory to the digital age 2) Programming and Computational Methods, which develop the theory and practice of computer programming and computational methods and 3) the DCS Integrated Core, which explores the interface of programming and computational methods and critical digital studies.

Developing an Integrated, Interdisciplinary Data Science Core

Our second challenge is to build a program that draws on a range of campus expertise while utilizing a data science core to provide a scaffolded set of experiences for students. While we did not set out to create a data science program, an external review panel formed in 2019 reflected that our Integrated Core classes constituted a strong data science core. As a first course we offer “Calling Bull” which adopts Bergstrom and West’s (mis)information literacy curriculum with an introduction to R programming and data visualization. As a second course, we offer “Data Cultures,” which introduces the data analysis lifecycle while exploring the ways in which data has historically been used to cause harm, and the ways in which data science methods might ameliorate that harm. As a final synthesis, we offer “Network Analysis” which brings together authentic data, quantitative modeling and analysis, data visualization, and information theory to explore how the world is connected, and to infer and theorize such connections.

This curriculum has been forged through innovation, collaboration and many conversations with stakeholders and colleagues - but at the end heavily relies on the expertise of the faculty who teach it. In addition to the unique vision of a data science core embracing both data science and critical studies while situated in a meaningful context, the Integrated Core also brings cohesion to the continuum of the DCS program.