

An Interdisciplinary Approach to Undergraduate Computing Education

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Institutional and departmental context

Location: Washington, PA

Undergraduate student body size: 1200

Degree(s) offered: BA

Department/major name: Computing and Information Studies

Number of contributing faculty: 5

Number of majors annually: 15

Does the department offer any graduate programs? No

Other context: Starting with the class of 2026, all W&J students are required to complete two courses of study (a major and a minor or a double major).

Description of Curricular Innovation

The Computing and Information Studies Department was created to develop a computing program for W&J that would reflect a uniquely liberal arts approach to computing education and that would intentionally not be bound to follow the structure of existing curricula in computer science, information technology, etc. The result is a program that values interdisciplinary approaches to computing and collaborations across the liberal arts curriculum. It is also reflected in the staff of the department; currently, the tenured/tenure-track faculty of the CIS department hold graduate degrees in Classical Archaeology, Computer Science, Education Technology, English, and Physics.

A key element of our interdisciplinary approach to computing education is structuring the requirements of the major around skills and competencies rather than traditional knowledge areas. All students take a set of common courses that equip them with fundamental skills in databases, programming, visual and social media literacy, user-centered design, and ethics; these courses also introduce students to the idea that computing can be engaged with in various disciplinary contexts. Within their electives, students must all take courses where they develop additional skills in “Coding and Production”, “Design and Interaction”, and “Analysis and Modeling”. However, the program has ensured that students can elect to develop these skills in ways that best reflect their interest in computing. There are both programming courses and a digital video course that meet the Coding and Production requirement, for example. Information visualization and web design courses both meet the Design and Interaction requirement. Data mining and information security courses both meet the Analysis and Modeling requirement. In this way, students can customize the program to fit their own disciplinary and interdisciplinary goals. This flexibility also allows students to have many different starting points and

multiple paths through the major. A visualization of the major requirements is provided below.

A shared pedagogical commitment to active/experiential learning has also been built into the CIS curriculum. CIS courses involve hands-on learning, generally project-based or problem-based, at all levels of the curriculum. As a whole, the CIS curriculum has been explicitly constructed to scaffold students through the process of becoming independent problem solvers capable of engaging in large scale problem-based learning coursework in their 300- and 400-level courses. The culminating capstone course is a service-learning project management course where students work in teams to address the technological needs of a non-profit client in the local community.

The CIS program also actively supports the college-wide curriculum, offering courses satisfying the writing requirement as well as courses in five of our six breadth categories (Artistic, Behavioral, Historical, Literary, and Logical). This enables students to encounter computing content embedded within coursework related to their general education requirements and is yet another way that the department works to make computing education accessible to the entire student body as these are mostly courses without pre-requisites available to any student looking for a course to satisfy one of these requirements. The CIS program also offers courses that contribute to academic programs outside of the department. Currently, the program offers courses that meet requirements in the college's Communication Arts, Environmental Studies, Gender and Women's Studies, Music, Professional Writing, and 3-2 Engineering programs.

It is important to note that in all cases the courses taught in support of the college-wide curriculum or other academic programs also count towards the CIS major. CIS does not offer any "non-majors" courses and any student in a CIS course is ensured they are receiving the same education and professional preparation whether they have declared a major or are selecting isolated courses to take to enhance their education. In part this is possible by not structuring the curriculum around an entry-level CS1/CS2 sequence that other courses then rely upon. Instead, this content is shifted to an intermediate-level object-oriented programming course (CIS 220) that requires students to have previous experience with coding through either one of our entry level offerings or through work in high school or courses offered by other departments. Unlike most models where students may start their studies with a "CS0" course, these preparatory offerings fulfill requirements within the major and students may choose how many of them they take before they decide they are prepared for CIS 220. This shifts this content from being an entry-level gatekeeper to being a midpoint gateway into upper-level coursework.

In addition to the broad CIS major, the program also offers emphases for its majors in Computer Science, Data Science, Digital Media, Interaction Design, and Web and Mobile Technologies. These emphases follow the structure of the CIS major but indicate particular courses that students must take to meet their elective requirements. In the case of the Computer Science emphasis, students must take an upper-level data structures and algorithms course and also take five mathematics courses (Calc I, Calc II, Linear Algebra, Proof Theory, and a 300-level course in number theory, graph theory, or discrete

structures). These emphases play an advising role, helping students select courses that align with their interests and career goals, but also play a role in admissions by providing recognizable labels to the range of paths possible within the CIS program.

The program also offers a minor in CIS that is similarly broad and flexible. Students take six courses total including our IT & Society course, two coding courses, an Analysis and Modeling course, a Design and Interaction course, and at least one course at the 300-level. There is steady interest in the CIS minor from students in majors across the institution. The CIS program also graduates many CIS majors who do not come to W&J with an intent to study computing and often they start as CIS minors before converting to the full major.

Challenges/Limitations

Because of the flexibility of the program and the variety of ways students can enter the program, personalized advising is required to help students make appropriate choices. First-year students are not assigned academic advisors within their intended major so it is important to educate first-year advisors on the structure of the CIS program. A member of the CIS faculty usually reviews the intended placement of all incoming students with CIS in their schedule over the summer to ensure fit with their background and stated interests.

Having entry-level courses that meet program requirements but do not have math or programming pre-requisites requires creativity in developing courses. Existing course materials that assume CS 1 content are often not usable and CIS faculty often develop their own course materials or draw on excerpts from a variety of sources. Courses must be designed to include instruction in fundamental background as needed for the content being covered.

We have been fortunate that W&J is supportive of our interdisciplinary department structure and our choice to hire faculty with doctorates in a range of disciplines. Our faculty can include scholarly work from disciplines outside computing in their tenure and review portfolios at equivalent weight to publications in computing or computing education. This allows us to attract faculty from a range of disciplines who use computational tools in their research and teaching. We are aware that this is a unique level of flexibility and not all institutions would be able to allow this within their faculty structures.

Visual Guide to the CIS Major

Catalog Text: 11 CIS courses, including CIS 100, 112, 220, 271, either CIS 301 or CIS 310, and CIS 400 (the capstone experience). In addition, students must take at least one additional course with each of the following designations: Coding and Production, Design and Interaction, and Analysis and Modeling. At least four of the eleven total courses must be at the 300-level or higher.

