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**GAME DESIGN  
UNDERGRADUATE CERTIFICATE**

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**REQUEST:** Approval of an Undergraduate Certificate in Game Design offered through the Potter College of Arts and Letters.

**FACTS:** Data provided to WKU by the consulting firm Gray Associates suggests that game and interactive media design is a ripe area for growth at WKU. Data demonstrate the viability of a game and interactive media design program using three regional market indicators to support this conclusion. First, student demand for the program is strong. Paid-for inquiries into game and interactive media design are in the 95th percentile of all CIP codes in our region. This demand is likely to continue; year-over-year change in inquiries is also in the 95th percentile of all CIP codes. Second, the lack of competition in the region supports entering this market. According to Gray Associates data, there are no bachelor degree programs offered by any institution in Kentucky or our broader region offered under this CIP code. Finally, employment outcomes show some promise. Last year there were 825 total job postings to BurningGlass in our region over the last 12 months (as of January 23rd, 2020) matched to this CIP code. This was in the 90th percentile of all CIP codes available in the data. Even more impressively, there was a 159 unit increase in postings in our region from the previous year; this was in the 98th percentile of CIP codes.

**BUDGETARY IMPLICATIONS& IMPLEMENTATION DATE:** Courses can be staffed with existing faculty, with existing hardware and software, and in existing classrooms / labs in each of the three areas. No new faculty resources are needed at this time.

**RECOMMENDATION:** President Timothy C. Caboni recommends approval of an Undergraduate Certificate in Game Design with implementation Fall 2020.

**MOTION:** Approval to establish an Undergraduate Certificate in Game Design effective Fall 2020.

Potter College of Arts and Letters  
Department of Art  
Proposal to Create a New Certificate Program (Action Item)

Contact Person: Kristina Arnold; [kristina.arnold@wku.edu](mailto:kristina.arnold@wku.edu); 270-745-6566

**1. Identification of program:**

1.1. **Program title:** Game Design

1.2. **Required hours in program:** 18

1.3. **Special information:** Game Design is an interdisciplinary certificate including departments from PCAL (Art, Communication) and OCSE (Computer Science). It is open to all students with an interest in computer game design. The certificate will be administered by the Department of Art for the PCAL Dean's office as one of PCAL's *Interdisciplinary Programs*. RAMP credit for students enrolled in the certificate (for certificate coursework) will be split evenly between OCSE and PCAL. (This split is possible, per October 8 email conversation with Tuesdi Helbig.)

1.4. **Catalog description:** This 6-course, 18-hour Game Design Certificate includes one basic Computer Science course (to be selected from CS 146 "Introduction to Programming" or CS 170 "Problem Solving and Programming" or CS 180 "Computer Science I" or CS 239 "Problem Solving with Computational Techniques"), one required Computer Science course (CS 301 "Game Programming"), one foundations-level art course (to be selected from ART 130 "2D Design" or ART 131 "3D Design" or ART 140 "Drawing 1"), one required art course (ART 244 "Computer Animation 1"), one Communication course (UX 380 "Gaming: Culture, Theory and Practice"), and one restricted elective to be selected from: ART 105; ART 106; ART 344; ART 390; ART 405; ART 431; ART 436; BCOM 264; CS 270; CS 290; ENG 203; ENT 312; MUS 120; PERF 101; POP 201; THEA 101; THEA 303; SOCL 245; UX 330; or an additional selection from the basic computer science courses (CS 146; CS 170; CS 180; CS 239). Within Computer Science, courses must be taken in numerical sequence, no other specific course sequences are necessary. This flexibility allows for multiple entry points into the program.

1.5. **Classification of Instructional Program Code (CIP):** 50.0411 – Game and Interactive Media Design

**2. Learning outcomes of the proposed certificate program:** Students who successfully complete the certificate will:

- Design and build a functioning game
- Demonstrate practical skills in at least one industry-standard programming language
- Explore at least one industry-standard game design engine
- Demonstrate the ability to successfully use the elements and principles of design to visually communicate ideas
- Demonstrate logic thinking, critical thinking skills, and problem solving

**3. Rationale:**

**3.1 Reason for developing the proposed certificate program:**

- Prospective Art and Computer Science students express significant interest in Game Design. It is one of the top programs that prospective students and families enquire about at recruiting events for *both Art and Computer Science*.
- Currently neither Art nor CS have a game design track, though for the past several years, both areas have been interested in creating one. Neither unit has the resources to create the track on their own, and the current team approach emerged through conversations begun in Spring 2019.



- Game design and its related components encompass a fast-trending jobs field.
- Being able to offer any Game Design program, with a related and sustained PR push, would assist with incoming student recruitment for two colleges.
- Few Game Design programs exist in our region, but they are developing quickly.

Additionally, data provided to WKU by the consulting firm Gray Associates suggests that game and interactive media design is a ripe area for growth at WKU. Data demonstrate the viability of a game and interactive media design program using three regional market indicators to support this conclusion. First, student demand for the program is strong. Paid-for inquiries into game and interactive media design are in the 95th percentile of all CIP codes in our region. This demand is likely to continue; year-over-year change in inquiries is also in the 95 percentile of all CIP codes. Second, the lack of competition in the region supports entering this market. According to Gray Associates data, there are no bachelor degree programs offered by any institution in Kentucky or our broader region offered under this CIP code. Finally, employment outcomes show some promise. Last year there were 825 total job postings to BurningGlass in our region over the last 12 months (as of January 23rd, 2020) matched to this CIP code. This was in the 90th percentile of all CIP codes available in the data. Even more impressively, there was a 159 unit increase in postings in our region from the previous year; this was in the 98th percentile of CIP codes.

**3.2. Relationship of the proposed certificate program to other programs now offered by the department:** This interdisciplinary certificate program will add a new art / design option to the areas currently offered by the Art Department. The area of game design is one currently requested by incoming students, but an area in which we do not yet offer a program. The discipline is related to animation, and will use coursework from this quickly growing departmental area. As the certificate is interdisciplinary, we anticipate students from both in and outside of the Art Department will enroll. This is the first certificate proposed by the Art Department, and we anticipate that it will add to the curricular options for our current students as well as introducing non-art students to our area.

**3.3. Relationship of the proposed certificate program to certificate programs offered in other departments:** As a corollary, this interdisciplinary certificate program will add a new curricular option to the areas currently offered by the Computer Science Program. The area of game design is one currently requested by incoming students, but one in which they do not yet offer a program. The discipline is related to programming, and will use coursework from that CS area. As the certificate is interdisciplinary, we anticipate students from both in and outside of the Computer Science Program will enroll. We anticipate that this certificate will add an option for students already in the CS program, and introduce students from outside the program to Computer Science.

**3.4. Projected enrollment in the proposed certificate program:** 25 – 35 students, with planned potential growth (based on similar growth in the related new Art Department animation program)

**3.5. Similar certificate programs offered elsewhere in Kentucky and in other states (including programs at benchmark institutions):** Game Design offerings elsewhere in Kentucky and at our benchmark institutions are across the board, ranging from none to one or two courses offered; to certificates in game design; to related animation or interactive media programs; to degrees with a focus in Game Design. While most Universities in Kentucky have some game design offerings, no four-year degree programs specifically in Game Design exist in Kentucky and very few benchmark institutions outside of the state have specific programs in game design. Most of our benchmark institutions do have

programs in related areas such as animation or interactive design, with most of these programs originating in Art and Design units.

Within this cohort, Game Design programs originate and reside in many places, including Computer Science, Art, Communication, and Business schools and departments. *This proposed certificate at WKU is distinct in that it bridges disciplines and offers coursework in both computer science and visual art / design.*

### 3.6 Relationship of the proposed certificate program to the university mission and objectives:

This certificate prepares students for the global stage, as it “develops hard and soft skills,” providing a job-ready and industry-specific skillset. As a cutting-edge, interdisciplinary program, it **promotes a culture of innovation**. The program will promote WKU as a **regional lighthouse**, with a certificate that enables students to “graduate with skills to think critically (and) solve problems.” A Game Design certificate in a trending field will provide **continuing education** as one of WKU’s “certificate programs to match job market opportunities”.

## 4. Curriculum:

### Game Design Certificate: 18 hours

#### Computer Science (6 hours)

- CS 146 “Introduction to Programming” (existing Colonnade course) OR CS 170 “Problem Solving and Programming” (existing course) OR CS 180 “Computer Science I” (existing course) OR CS 239 “Problem Solving with Computational Techniques” (existing course)
- CS 301 “Game Programming” (new course developed by current faculty)

#### Art (6 hours)

- ART 130 “Design” OR 131 “3D Design” OR 140 “Drawing” (Art & Design Foundations courses) (existing courses)
- ART 244 “Computer Animation I” (existing course)

#### Communication (3 hours)

- UX 380 “Gaming: Culture, Theory and Practice” (new course developed by current faculty)

#### Restricted Elective, select from (3 hours):

ANTH 448 Visual Anthropology  
 ART 105 Art Survey: Prehistory to the Renaissance  
 ART 106 Art Survey: Renaissance to Contemporary  
 ART 344 Animation II  
 ART 390 Contemporary Art  
 ART 405 Art Theory and Criticism  
 ART 431 Illustration  
 ART 436 Electronic Illustration  
 BCOM 264 Digital Video Production and Distribution – R. DeMarse, Jan 7  
 CS 270 Introduction to Web Programming  
 CS 290 Computer Science II  
 ENG 203 Creative Writing  
 ENT 312 Entrepreneurship – W. Peake, Dec 16  
 MUS 120 Music Appreciation



POP 201 Introduction to Popular Culture Studies  
 THEA 101 Acting I  
 THEA 303 Acting for the Camera  
 SOCL 245 Sociology of Popular Culture – Drummond; Dec 10  
 UX 330 Interactive Design

Or another selection from:

CS 146 Introduction to Programming  
 CS 170 Problem Solving and Programming  
 CS 180 Computer Science I  
 CS 239 Problem Solving with Computational Techniques

**5. Budget implications:**

Courses can be staffed with existing faculty, with existing hardware and software, and in existing classrooms / labs in each of the three areas.

**6. Proposed term for implementation: Fall 2020**

**7. Prior committee approvals:**

COMM approves their participation in the certificate, per Communication Departmental Undergraduate Curriculum Committee (email Jan 24, 2020); approval Dr. Helen Sterk (email Dec 17, 2019). Engineering and Applied Sciences (home of CS) approves their participation in the certificate, per Dr. Greg Arbuckle, Interim Dean OCSE (email Dec 5, 2019) and Dr. Stacy Wilson, Director, Engineering and Applied Sciences (email Dec 5, 2019).

<b>Committee</b>	<b>Approval Dates</b>
Department of Art	12/06/2019
PCAL Curriculum Committee	02/04/2020
Undergraduate Curriculum Committee	02/25/2020
University Senate	03/19/2020
Provost	03/26/2020
Board of Regents	

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## GRAPHIC DESIGN UNDERGRADUATE CERTIFICATE

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**REQUEST:** Approval of an Undergraduate Certificate in Graphic Design offered through the Potter College of Arts and Letters.

**FACTS:** Data provided to WKU by the consulting firm Gray Associates suggests that Graphic Design is a potential area for growth at WKU. According to Gray, student demand regionally for graphic design programs is high. National data show high student demand, and high student employment following graduation with a graphic design degree.

Additionally, research conducted last year for our CAPE evaluations showed there is projected growth in Kentucky in *Arts, Design, Entertainment, Sports, and Media Occupations*, the sector most likely to hire graduates from this program, over the next five years, with an anticipated addition of more than 5,000 positions with a mean salary over \$45,000. The Kentucky Future Skills Report predicts more than 1,000 jobs will be added in graphic design-related positions alone, with salaries as high as \$60,000. In Spring 2019 there were over 1,000 print-related jobs in Kentucky, just *one* profession that is an offshoot of graphic design, posted on Indeed.com.

Last, as the Art Department has sustained 100+ majors in our 79-hour Graphic Design BFA program and 40+ Graphic Design minors for well over a decade, we can also attest to the continued demand for this type of training.

**BUDGETARY IMPLICATIONS& IMPLEMENTATION DATE:** Courses can be staffed with existing faculty (including full and part-time), with existing hardware and software, and in existing classrooms and computer labs. No additional budgetary needs are needed at this time. Fall 2020 implementation date.

**RECOMMENDATION:** President Timothy C. Caboni recommends approval of an Undergraduate Certificate in Graphic Design with implementation Fall 2020.

**MOTION:** Approval to establish an Undergraduate Certificate in Graphic Design effective Fall 2020.



Potter College of Arts and Letters  
Department of Art  
Proposal to Create a New Certificate Program (Action Item)

Contact Person: Kristina Arnold; [kristina.arnold@wku.edu](mailto:kristina.arnold@wku.edu); 270-745-6566

**1. Identification of program:**

1.1. **Program title:** Graphic Design

1.2. **Required hours in program:** 18

1.3. **Special information:** The Graphic Design certificate is open to all students with an interest in graphic design. It is a slightly shorter version of the current Art Department 24-hour minor in graphic design, for students who would like an official certificate on their transcript or who want the increased flexibility in their overall curriculum that a shorter program offers. The certificate will pair well with Studio Art and P-12 Art Education majors and with majors outside of the Art Department. All courses in the certificate are offered in the Department of Art.

All of the Art Department's programs in art and design are accredited by the National Association for Schools of Art & Design; our accrediting body supports and promotes certificate programs and oversees all programs with a focus in graphic design.

1.4. **Catalog description:** This 6-course, 18-hour Graphic Design Certificate includes four required courses and two restricted electives, all taught in the Department of Art. Required courses are ART 130 Design OR ART 140 Drawing; ART 243 Digital Media; ART 231 Graphic Design; and ART 334 Graphic Design Survey (an art history course). Electives can be selected from ART 330 Graphic Design; ART 331 Visual Thinking; ART 430 Graphic Design; ART 431 Illustration; ART 432 Portfolio: Graphic Design; ART 433 Package Design; ART 436 Electronic Illustration and ART 438 Advanced Media Design. 100-level courses are prerequisites for 200-level courses; 200-levels are prerequisites for 300-levels; and 300-levels are prerequisites for 400-levels. If no 400-level courses are selected, the certificate can be completed in three semesters, or two semesters and a summer / January term.

This certificate will teach students to become more effective visual communicators. Students will learn the basic tenets, strategies and tools of visual communication and graphic design, including how to generate and edit images and visually-based multi-media content. Students will learn industry-standard tools and software for both analog and computer-aided design for digital, print and web applications; including page layout, image editing, and illustration. Students will gain experience in creating assets for use in book and scientific illustration and layout, advertising or marketing campaigns, and infographics. Elective courses allow for students to cater to more specific interests (for example illustration) if desired. Can be paired with any majors that would benefit from an enhanced ability in visual communication, including studio art, professional writing, marketing, advertising, journalism, broadcasting, film, entrepreneurship, and biology, among others.

1.5. **Classification of Instructional Program Code (CIP):** 50.0409 – Graphic Design

**2. Learning outcomes of the proposed certificate program:** Students completing the certificate in Students who successfully complete the certificate will be able to:

1. Utilize design thinking, processes and strategy to identify and solve visual communication problems
2. Create visual messages that address audiences and contexts by recognizing the physical, cognitive, cultural, and social human factors that influence design effectiveness



3. Demonstrate concepts, conduct necessary research, and synthesize ideas to create and analyze design solutions
4. Develop, produce, and implement a diverse collection of design assets for various platforms, including print and web, using a variety of tools and technologies
5. Demonstrate an understanding of the elements and principles of effective design (including visual organization and composition; information hierarchy; symbolic representation; typography; motion; sequencing; and the use of images and diagrams) to create original meaningful visual forms
6. Demonstrate aesthetic fluency by recognizing and applying principles of design history, theory, and criticism from a variety of perspectives
7. Demonstrate an understanding of industry practices, including proficiency in industry standard software and knowledge of the basic business practices and ethics related to graphic design
8. Demonstrate the ability to organize complex projects and work productively in teams, including the effective implementation and evaluation of projects.

### 3. Rationale:

**3.1 Reason for developing the proposed certificate program:** As our world becomes increasingly dominated by images and technology, the ability to communicate ideas (and in the corporate world to compete for viewers and buyers) becomes more and more tied to an individual or company's ability to create effective visual images and design strategies. Successful students graduating with a certificate in graphic design will be able to pair the skills, tools, and knowledge developed in the program with a wide variety of majors and interests to help them more effectively communicate content in their interest areas and to become more attractive candidates for employment in their fields.

Until Fall 2018, the Art Department's Graphic Design minor was restricted to Advertising Majors only. When advertising eliminated the Graphic Design minor as a requirement, it enabled the Art Department to open the minor to students across campus. The Graphic Design minor enrollment quickly increased by 25%, illustrating the broader interest in the program, and advisors across campus have been pleased that the minor is now available to their interested students. This certificate will give students in a variety of fields even more flexibility in tailoring their educational program by providing a second, less time-intensive graphic design option.

This certificate will also give working adults interested in shifting careers an option to retrain or enhance their skills. Based on the discipline and the reputation of the program, we get multiple inquiries about our graphic design program and courses weekly. One recent potential candidate reached out to find out more about the Art Department's design options, stating that "most of the working designers that she talked to [in the region] recommended WKU over any other options because of our strong program and quality reputation."

With a curriculum that requires progressively independent-level critical thinking and creative problem-solving skills, a disciplined work ethic and the ability to realize effective progress on multiple simultaneous projects, this program develops the skills needed to be effective in any position. Students develop strategies to effectively set and meet short and long-term goals and the skills to excel in a workforce position that demands creativity, attentiveness to detail, time and material management, hand and organizational skills, and the ability to research and synthesize multidisciplinary knowledge to create production-oriented solutions.

Data provided to WKU by the consulting firm Gray Associates suggests that Graphic Design is a potential area for growth at WKU. According to Gray, student demand regionally for graphic design programs is high. National data show high student demand, and high student employment following graduation with a graphic design degree.



Additionally, research conducted last year for our Comprehensive Academic Program Evaluation (CAPE) evaluations showed there is projected growth in Kentucky in *Arts, Design, Entertainment, Sports, and Media Occupations*, the sector most likely to hire graduates from this program, over the next five years, with an anticipated addition of more than 5,000 positions with a mean salary over \$45,000. The Kentucky Future Skills Report predicts more than 1,000 jobs will be added in graphic design-related positions alone, with salaries as high as \$60,000. In Spring 2019 there were over 1,000 print-related jobs in Kentucky, just *one* profession that is an offshoot of graphic design, posted on Indeed.com.

Last, as the Art Department has sustained 100+ majors in our 79-hour Graphic Design BFA program and 40+ Graphic Design minors for well over a decade, we can also attest to the continued demand for this type of training.

**3.2. Relationship of the proposed certificate program to other programs now offered by the department:** While the art department currently has no certificate programs, the Graphic Design Certificate is a more industry-focused subset of the current Graphic Design minor offered. With a 24-hour minor and an 18-hour certificate, the department hopes to be able to offer programs that complement majors both below 36 hours, and majors of 36 hours or more [to meet the magic number of 54 hours required in major / minor combinations for majors under 48 hours in total].

**3.3. Relationship of the proposed certificate program to certificate programs offered in other departments:** The proposed Graphic Design Certificate is related to the Certificate in User Experience (Communication) and the Game Design Certificate (Art / Comm / Computer Science) that is currently under development. While the certificates share an exploration of design thinking and industry tools used, they are each distinct in their specific focus areas.

**3.4. Projected enrollment in the proposed certificate program:** 25 – 35 students, with planned potential growth (based on similar growth in the related new Art Department animation program).

**3.5. Similar certificate programs offered elsewhere in Kentucky and in other states (including programs at benchmark institutions):** No Graphic Design certificate programs exist at any of the other seven public institutions in Kentucky or at any of the 18 current out-of-state WKU benchmarks listed ([www.wku.edu/instres/benchmark.php](http://www.wku.edu/instres/benchmark.php)); in fact, no certificates of any kind are offered through the Departments of Art / Art & Design at any public institution in Kentucky, though we believe with the increased focus on certificate programs both at the state level and nationally, it is only a matter of time before they develop.

The only art and design-related certificates in this 28-school cohort currently offered are: a certificate in Apparel Design & Merchandising at ECU offered by the College of Health Sciences, with a similar certificate offered at the University of Southern Mississippi through Theatre and Merchandising; an 18-hour graduate-level certificate at Ball State in Emerging Media Design and Development (through the Journalism Department); a graduate certificate in Art History at Northern Illinois University; a post-baccalaureate certificate in Interactive Media Design at Towson University; and a post-baccalaureate certificate in Design and Making in Education (through the School of Education) at UNC Greensboro. A certificate in instructional design (more of an educational-psychology program than one based in art and design) is offered by BGSU, ETSU, Indiana State University, and the University of South Alabama.

**3.6 Relationship of the proposed certificate program to the university mission and objectives:**

This certificate prepares students for the global stage, as it “develops hard and soft skills,” providing a job-ready and industry-specific skillset. As a technology-centric program, it promotes a culture of innovation. The program will promote WKU as a regional lighthouse, with a certificate that enables students to “graduate with skills to think critically (and) solve problems.” A Graphic Design Certificate will provide continuing education as one of WKU’s “certificate programs to match job market opportunities”.

**4. Curriculum:**

Graphic Design Certificate: 18 Hours

*All courses are existing Art Department Courses.*

Required Courses (12 hours):

ART 130 Design OR ART 140 Drawing

ART 243 Digital Media

ART 231 Graphic Design

ART 334 Graphic Design Survey

Restricted Electives (6 hours):

ART 330 Graphic Design

ART 331 Visual Thinking

ART 430 Graphic Design

ART 431 Illustration

ART 432 Portfolio: Graphic Design

ART 433 Package Design

ART 436 Electronic Illustration

ART 438 Advanced Media Design

**5. Budget implications:** Courses can be staffed with existing faculty (including full and part-time), with existing hardware and software, and in existing classrooms and computer labs.

**6. Proposed term for implementation:** Fall 2020

**7. Prior committee approvals:**

Committee	Approval Dates
Department of Art	01/24/2020
PCAL Curriculum Committee	02/04/2020
Undergraduate Curriculum Committee	02/25/2020
University Senate	03/19/2020
Provost	03/26/2020
Board of Regents	



**Potter College of Arts & Letters**  
**Department: ART**  
**Proposal to Create a New Certificate Program**  
**(Action Item)**

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**Identification of program:** Program title: Game Design

**ADDENDUM: additional budget and market data**

Contact Person: Kristina Arnold, [Kristina.arnold@wku.edu](mailto:Kristina.arnold@wku.edu); 270-745-6566

The Game Design Certificate provides an opportunity to develop a program that pairs design with computer technology and programming skills.

**Game Design was identified as one of 5 areas of growth at the campus-wide January workshop with Gray Associates.** Gray data also supports game design as a ripe area for growth at WKU based on three regional market indicators that include student interest, lack of similar programs in the region, and employability of graduates.

- Student demand for the program is strong. Paid-for inquiries into game and interactive media design are in the 95th percentile of all CIP codes in our region. This demand is likely to continue; year-over-year change in inquiries is also in the 95 percentile of all CIP codes.
- The lack of competition in the region supports entering this market. According to Gray Associates data, there are no bachelor degree programs offered by any institution in Kentucky or our broader region offered under this CIP code.
- Employment outcomes are promising. Last year there were 825 total job postings to BurningGlass in our region over the last 12 months (as of January 23rd, 2020) matched to this CIP code. This was in the 90th percentile of all CIP codes available in the data. Even more impressively, there was a 159 unit increase in postings in our region from the previous year; this was in the 98th percentile of CIP codes.

Initially, there will be no additional costs for the gaming certificate program, as it pulls existing courses together strategically to provide students with the necessary skills to enter the Game Design industry. Given extensive interest in this area, we are testing the market with a certificate, which could grow into an academic major. Growth beyond initial projections could require additional faculty and equipment resources that would be supported by revenue generated through the decentralized budget model. Success in this program could lead to growth of an academic major in game design as well as other market driven interdisciplinary pairings with computer science skills.

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**Identification of program:** Program title: Graphic Design

**ADDENDUM: additional budget and market data**

Contact Person: Kristina Arnold, [Kristina.arnold@wku.edu](mailto:Kristina.arnold@wku.edu); 270-745-6566

The Graphic Design Certificate is a strategic 18-hour subset of the existing 79-hour major program. The content focuses on developing the concepts and tools needed for effective visual communication, including creating content for digital and print advertising, corporate and personal branding, and social media marketing. The certificate pairs well with any major in which developing and communicating ideas visually is necessary, including marketing, advertising, entrepreneurship, as well as professional writing and the sciences.

While the certificate lends itself to pairing with other majors on campus **it also** targets adult learners that have interest in shifting careers or need additional skills to excel in their workplace. With its certificate structure and focus on career retraining, it has the capacity to recruit new non-traditional students to WKU.

Data provided to WKU by the consulting firm Gray Associates show Graphic Design as a growth area for WKU. According to Gray, student demand regionally for graphic design programs is high. National data show high student demand, and high student employment following graduation with a graphic design degree.

Initially, there will be no additional costs for the graphic design certificate program. Growth beyond initial projections could require additional faculty and equipment resources, which would be supported by revenue generated through the decentralized budget model.

Enrollment projections reported are likely at the low end of what will be actualized. They are based on the growth and development of a recent allied minor program in the Department of Art (Animation) and on the continued requests from on and off campus for this type of program.



# THE CHRONICLE OF HIGHER EDUCATION

## The Discipline That Is Transforming Higher Ed

The computer-science boom is straining colleges. But it could save some, too.



Harry Campbell for The Chronicle

By Alexander C. Kafka April 15, 2020 Premium

On a Tuesday afternoon last spring, Daniel Zhang, a junior at the University of California at Berkeley, showed up to lead his first two-hour lab section in a computer-architecture course. A teaching assistant, he expected to find maybe 25 students needing his help. Instead he was met by some 200 frenzied faces, a quarter of the lecture course's enrollment.

The pattern continued. "There would be a line of people stretched around the corner through the corridors waiting to get checked off," he says, "as well as people sitting on the floors inside the lab itself."

"I started really getting the sense that this is insane."

Insane, maybe, but similar scenes play out in colleges across the country. Zhang is one of an army of undergraduate and graduate-student TAs who help thousands of Berkeley computer-science students navigate the hugely popular and hypercompetitive major. The number of computer-science majors there increased from 1,116 in 2009 to 3,387 in 2019. Nationally, since 2007, as some fields in the humanities and social sciences have withered, the number of computer-science majors has more than quadrupled.

Even that vastly understates the enrollment pressures, because departments face huge additional demand from nonmajors. This spring at Berkeley, 3,847 students are majoring in related data-science fields, and 705 students in unrelated majors are enrolled in three lower-division computer-science courses.

"It's just a phenomenal level of growth that is unprecedented in our discipline," says Stuart Zweben, a professor emeritus of computer science at Ohio State University who has led key studies of enrollment in the field. His research suggests that nationally, more than 300,000 undergraduates are enrolled in, or preparing for, computer-science majors. Students in related fields — among them cybersecurity, bioinformatics, robotics, and computer animation — lean on courses offered by computer-science departments. To get a sense of scale, visualize a couple of moderately large cities populated by nothing but computer-science students.

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The popularity would seem like manna from admissions heaven, but it also creates problems. Most departments can't recruit nearly enough faculty members, because of budget constraints and competition from industry. The scramble to gain entry into the capped-enrollment programs puts low-income, underrepresented-minority, and female students at a disadvantage. And the increasing tilt toward tech curricula creates frictions with other disciplines.

But in the face of a Covid-19-induced recession and the enrollment cliff forecast for 2025, the boom also creates intellectual and business opportunities for colleges. Adequately funded, computer-science programs could be an even more powerful recruitment draw than they already are. Increasingly sophisticated cross-fertilization with other fields could transform waning majors from competitors into allies. And in a society increasingly based on machine learning, a nuanced understanding of automation's potential, as well as its limits, could better prepare graduates for careers not just in STEM but also in the social sciences and the humanities.

The challenge, says Katherine S. Newman, interim chancellor of the University of Massachusetts at Boston, will be to include a diverse pool of students in "what is probably the most profound intellectual revolution of our time."



Students and professors alike say that the initial appeal of computer science most often is the prospect of a lucrative career. Not only can top graduates from elite programs get entry-level software-engineering or similar jobs with six-figure salaries, signing bonuses, and superb benefits, but along the way they can lasso summer internships paying \$7,000 or \$8,000 a month, with housing allowances ranging from \$6,000 to \$9,000, says Ed Lazowska, a professor in the Paul G. Allen School of Computer Science & Engineering at the University of Washington.

Career opportunities aside, on an intellectual level computer science has become fundamental to almost every aspect of society. "You want to know why the sky is blue and how a light bulb works," says Robert Sedgewick, a professor and founding chair of computer science at Princeton University. "You should know how the internet works, too."

The Covid-19 crisis has only underscored how essential computer technology is. The discipline touches nearly every aspect of the response — epidemiological tracking, molecular modeling in vaccine research, 3D printing of medical supplies, shifts to online work and classes. Online teaching tools pioneered by necessity in computer science may now, however flawed, point the way for distance-learning innovations in other fields. And data tracking and measurement of the results of those teaching methods will help to evaluate and refine them.

"Even if you never write a line of code," says Sedgewick, computer science "is a way of logical thinking that will serve you well in addressing a variety of situations."

Most scholars in the field, and many outside it, believe computer science should be part of every student's education, like expository writing or a math, statistics, or foreign-language course. When demand is so high that some colleges hold [lotteries](#) for enrollment in these classes, the notion of a "requirement" seems almost beside the point. Students are increasingly requiring it of themselves. But an intro course, at least, should be available to all, Sedgewick says.

At Princeton, about 70 percent of undergraduates take Sedgewick's introductory course, "Computer Science: An Interdisciplinary Approach." The proportion used to be around 80 percent, he says, but now a growing number of students place out after taking good high-school or online courses. Forty percent of the undergraduates take Sedgewick's course on algorithms, and 25 percent of all Princeton students major or earn a certificate in computer science.

But, he says, "many colleges do not even aspire to reach those levels."

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In part, that's because there aren't nearly enough faculty members to keep up with demand. Among universities responding to a Computer Research Association survey in 2016 of Ph.D.-granting institutions, from 2006 to 2015 the number of computer-science majors increased

almost fourfold (from an average of 192 students to 753) while growth in tenure-line faculty grew by only 22 percent (from an average 23 to 28).

The enrollment surge has continued since then, says Craig E. Wills, who heads the computer-science department at Worcester Polytechnic Institute and tracks hiring in the field. Over the past three years, however, new tenure-track positions for computer-science faculty peaked and have remained steady.

Faculty salaries can't compete with industry pay, which can be several times higher and is often accompanied by excellent benefits. So great is the need for faculty members, says Dan Garcia, a teaching professor in Berkeley's computer-science department, that some colleges are filling full-time teaching positions with candidates who have a four-year bachelor's degree and a one-year master's.

The sparse faculty ranks are supplemented by armies of teaching assistants. Berkeley's computer-science classes and combined electrical-engineering and computer-science courses together employ 444 TAs. In decades past, Garcia says, he'd try to learn the names of all of his students, but now he has trouble learning the names of all of his teaching assistants. Instructors have become more like generals now, he says, overseeing, for a single course, dozens of TAs. The scale is such that the assistants have become specialists, with niche skills in creating tests, grading, running labs, or tutoring.

These battalions cost millions of dollars. Unions argue that colleges are getting off cheap — too cheap. An arbitrator in January [ruled](#) that Berkeley must stop employing TAs for less than the 10-hour weekly threshold at which they would contractually receive partial tuition reimbursement and other benefits. The ruling also awarded them a collective \$5 million in back pay. Some TAs, at least the undergraduates, worry that such rulings will force departments — and not just at Berkeley — to shrink their TA programs, denying students valuable teaching experience.

Department heads say they're caught in the middle. The University of Washington's computer-science program employs 590 TAs, 470 of whom are undergraduates. The undergrads earn a stipend that works out to \$16 to \$20 an hour, says Lazowska. Waiving tuition, he says, would cost roughly \$5.7 million, "a staggering number that would more than double our annual TA costs."

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As it is, he says, "we are siphoning funds from everywhere" to pay the TAs — unrestricted gifts, vacant staff and faculty positions — a scramble for dollars that is happening at colleges across the country.

"Most of us have been pleading with our deans to grow our programs," says Berkeley's Garcia. "People are just struggling under the weight, and overworked."



Capping enrollments in computer-science majors and classes, as many colleges are doing, is not the answer, many experts argue. In fact, for students' intellectual and professional development, as well as for the sake of diversity, Sedgewick says doing so is "bordering on immoral."

Newman, of UMass Boston, was previously provost and senior vice chancellor on the Amherst campus. Before she left, in 2017, demand for computer science was so high that the university could easily have filled an entire freshman class with nothing but computer-science students. The program was turning away most applicants with grade-point averages below 3.9 (Advanced Placement courses raise the maximum GPA to 4.5). Since then the competition for computer-science spots, there and across the nation, has become only more intense.

That's a problem most departments would be thrilled to have. But it has exacerbated computer science's gender and racial imbalance. Newman, a sociologist, says training in computer science is a ticket to the upper-middle class, much as medical and law school once were. But it is out of reach for many women and underrepresented minorities.

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On average, reports from the National Academy of Sciences and elsewhere show, women account for only about a fifth of computer-science students. And while Asians and Asian-Americans are well represented, African American, Hispanic, and Native American students, collectively, make up roughly just 16 percent. Educators blame, among other factors, disparate preparation and resources at the K-12 level, cultural stereotypes about and within the field, and an imbalance in types of role models.

The percentage of female students has inched up in the past several years, but the percentage of underrepresented minorities hasn't. While the federal government, through the National Science Foundation, has significantly subsidized training in cybersecurity, Newman says, a broader effort is needed.

Some college leaders tell computer-science department heads that continued rapid growth in the programs would be unfair to other disciplines competing for tenure lines, and lab, office, and classroom space. They also worry that the surge is temporary, similar to the enrollment bubble in the mid-1980s after personal computers took off, or the bubble around 2005 after the dot-com boom.

The program directors understand that apprehension — a new tenure line is, after all, a 30- or 40-year commitment — but they think the fears are ill-founded. That's because high tech in the past decade has been woven into every industry.

An influential 2018 [report](#) by the National Academy of Sciences cites data from the Bureau of Labor Statistics showing that "employment in computer occupations grew by nearly a factor of 20 between 1975 and 2015," almost twice as fast as bachelor's degrees in the field. Demand will continue to grow, the federal figures suggest. "It doesn't look like a bubble," says Jennifer Hunt, a professor of economics at Rutgers University at New Brunswick who has studied this market.

And program expansion is not a zero-sum game that will happen only at the cost of other programs, says Susanne E. Hambrusch, a professor of computer science at Purdue University who analyzes enrollment trends in the field. Particularly as colleges face a recession triggered by Covid-19, integrating data science into a wide variety of disciplines makes good curricular and business sense, she says. Fifteen years ago, it was mostly software companies and a few financial firms that recruited at computer-science job fairs. Now it's corporations of many types.

Princeton's Sedgewick says that once-resentful academics in other departments warmed to computer science when they saw that its courses could be tailored to the needs of their students. That's the approach many programs now take.

The University of Illinois at Urbana-Champaign offers degrees in computer science, math and computer science, statistics and computer science, and a minor in computer science. But it has also established "[CS + X](#)" programs in advertising, animal sciences, anthropology, astronomy, chemistry, crop sciences, economics, geography, linguistics, music, and philosophy.

Elsa L. Gunter, a research professor in the computer-science department, says CS + X hybrids don't work when they're dictated from on high. "We want everyone involved to know why it's desirable," she says. The hybrids generally include 11 courses in the computer-science core, at least eight in the X topic, one or two technical electives, and a course or two specifically designed for the [combined program](#).

CS + Philosophy students, for example, might prepare for a profession like intellectual-property law, learning to consider not just the technical but also the ethical aspects of an invention. The combination is organic, Gunter says. "It was philosophy that gave birth to logic that gave birth to the various foundations of computer science."

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Colleges' next step should be to flip the order and create "X + CS" programs, says Newman, so "you've got enrollment flowing into that home discipline." That would ease other departments' resentment toward computer science and would relieve, to some extent, demand on overwhelmed computer-science departments.

"There are a lot of students out there who don't want to be computer-science majors but really do want to have data-analysis and tech skills," says Laura Haas, dean of the College of Information and Computer Sciences at the University of Massachusetts at Amherst. In the X + CS programs she and colleagues are creating for those students, "the other department owns the major," while computer science provides tailored technical skills in what might constitute 40 percent of the



coursework. In computational linguistics, for example, among the computer-science elements would be machine learning, statistics, and natural-language processing.

Combine the CS and the X in any order you like, though, and problems remain, says Princeton's Sedgewick. In some such hybrid programs, computer science isn't taught by computer-science professors. "We don't tolerate that in other disciplines," he says. Moreover, "developing multiple curricula is just plain inefficient and cannot scale to solve the problem." And many of the hybrid programs don't provide sufficient preparation for advanced courses, like those on algorithms.

What's more, professors in other departments may, at least initially, be skeptical of the role that computer science can play in their fields. In the early 2000s, scholars began to explore humanistic questions with the help of data. Christopher Warren, an associate professor of English at Carnegie Mellon University, offers some examples: Who knew whom in Shakespeare's England? What life patterns emerge through analyses of 60,000 entries — 72 million words — in the Oxford Dictionary of National Biography?

Early on, some humanists saw research projects along those lines as a techie invasion of the liberal arts. One objection was that applying quantitative approaches to humanistic matters would shortchange ethical considerations. But digital humanists have internalized such concerns, and ethics has become integral to their work, says Warren. Now the digital humanities have become mainstream. He points to his university's minor in ["humanities analytics"](#) as an example.

There are still skeptics. Mark Bauerlein, editor of the journal *First Things* and an emeritus professor of English at Emory University, says some humanities scholars "enjoy the energy that comes with an alliance with computer science, but most professors won't. They have neither the equipment nor the disposition to do so."

Whether or not humanists are ready for the technological convergence, it is well under way, says Brian Christian, a visiting scholar at Berkeley and author of the forthcoming book *The Alignment Problem: Machine Learning and Human Values*. In the past few decades, he says, machine-learning systems have become elemental to technology, and technology has become elemental to society.

He cites a controversial recent California bill, SB 10, which seeks to eliminate cash bail and to use algorithmic software to quantify the risk of a suspect's fleeing or committing an offense while awaiting trial. Christian has studied the algorithms' inherent biases, their inability to recognize outlying factors in suspects' circumstances or behavior. When he watched judges at arraignment hearings, he says, "the impression that I got was very much that no one knew what the score meant or how it was generated."

Or consider dermatologists who rely on computer analyses that show 99-percent confidence that a skin discoloration is not a malignancy. How and when should doctors weigh experience-based judgments against technology's predictions?

Students who are "age 18 or 19 today cannot avoid the fact that their job will put them in contact with machine learning on an almost daily basis," Christian says. Engineers will have to realize

that the tools they design must mesh with the messiness of society — and society, in turn, will have to understand the limits of those tools.

"We need everyone fluent in computing and technology," says Berkeley's Garcia, "so that they're not just passive users of it but active creators of it."

"Computing," he says, "is the literacy of the 21st century."

*Audrey Williams June created the graphics for this article.*

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