



University of Colorado **Boulder**

2018 Program Review

Department of Computer Science

Academic Review and Planning  
Advisory Committee Report

Approved

A handwritten signature in black ink, appearing to read 'Russell M. Neal'.

Provost and Executive Vice Chancellor for Academic Affairs. | Date

05/02/2019

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## Process Overview

The review of the Department of Computer Science (CS) was conducted in accordance with the 2018 program review guidelines. The unit prepared a self-study report during 2017. In January 2018, an internal review committee of two CU Boulder faculty members from outside of CS convened to check the self-study. The internal reviewers found the report to be “an introspective document” that “reads like an honest self-assessment.” An external review committee, consisting of two experts within the discipline from outside of the University of Colorado, visited the unit over April 30 – May 1, 2018, reviewed relevant documents, and met with faculty, students, staff, and university administrators. The external reviewers’ comments and recommendations are cited at appropriate points throughout this report. This public document reflects the assessment of and recommendations for the Department of Computer Science as approved by ARPAC.

# Academic Review and Planning Advisory Committee (ARPAC)

Ken Bickers, Professor, Department of Political Science

Paul Campos, Professor, School of Law

Robert Erickson, Professor, Electrical, Energy, and Computer Engineering

Erin Furtak, Professor, School of Education

Deborah Hollis, Associate Professor, University Libraries

David Korevaar, Professor, College of Music

Paul Moeller, Associate Professor, University Libraries

Bryan Taylor, Professor, Department of Communication

Academic year 2018-19  
voting members

Ed Van Wesep, Associate Professor, Leeds School of Business

Non-voting members

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Bob Boswell, Vice Chancellor for Diversity, Equity, and Community Engagement and Professor of Molecular, Cellular, and Developmental Biology

Katherine Eggert, Vice Provost for Academic Planning and Assessment and Professor of English

Mary Kraus, Vice Provost and Associate Vice Chancellor for Undergraduate Education and Professor of Geological Sciences

Michele Moses, Associate Vice Provost for Faculty Affairs and Professor of Education

Ann Schmiesing, Interim Senior Vice Provost for Academic Resource Management, Vice Provost for Graduate Affairs and Dean of the Graduate School and Professor of Germanic and Slavic Languages and Literatures

Staff

Andre Grothe, Office of Faculty Affairs

Emmanuel Melgoza Alfaro, Office of Faculty Affairs

## Unit Overview

The Office of Data Analytics (ODA) annually compiles standardized quantitative descriptions of campus academic units and makes these available online at

<https://www.colorado.edu/oda/institutional-research/institutional-level-data/information-department/academic-review-and-planning>.

This report cites data posted in November 2016, reflecting the state of the Department of Computer Science as of the academic year (AY) 2016-17.

CS offers undergraduate and graduate degrees, and performs research in a variety of areas related to computer science. In addition to its traditional BS, MS, ME, combined BS/MS, and PhD degrees, the department recently added a professional MS degree, a BA degree program aimed at College of Arts and Sciences undergraduates, and an online post-baccalaureate degree. Over the past few years, undergraduate enrollments have grown significantly. So, too, has the count of CS faculty members.

The CS self-study report states that among 176 US-based computer science programs, CU Boulder's consistently ranks in the top 40. Key research areas include: human-centered computing, artificial intelligence, machine learning, theoretical computer science, computational biology, computational science and engineering, cyber-physical systems, robotics, software engineering, programming languages and formal methods, mobile and wireless systems, and distributed and networked systems. The external reviewers lauded CS faculty members' strong interdisciplinary research collaborations, including with the BioFrontiers Institute on the areas of computational biology and mobile health, with the ATLAS Institute on language processing and learning technologies, and

with the Department of Linguistics and with the Institute of Cognitive Science on various points of shared interest.

Personnel  
and  
Governance

The unit reports that it employed 49 tenured and tenure-track faculty (TTT) in the 2017-2018 academic year, an increase from the 31 reported by the Office of Data Analytics (ODA) as of November 1, 2016. CS projects that it will employ 54 TTT faculty by fall 2018. A dramatic increase in the department's teaching production has fueled this growth. The CS self-study reports that as of fall 2017 the department had 1572 BS and BA majors and 346 graduate students. CS also relies on ten instructors and 14.33 full time equivalent staff members to help with the workload.

The external reviewers praised CS for its excellent hires and for the department's collegiality. In addition, they noted the challenges in managing and dealing with rapidly expanding student and faculty populations. They expressed concerns with the department's ability to successfully support a rapidly expanded junior faculty contingent.

In their interviews with CS junior faculty members, the external reviewers reported hearing from several about inadequate mentoring. They tied this shortfall to CS's lacking the resources to scale mentoring support to a suddenly expanded need. They suggested that CS junior faculty would benefit from strategically balanced work expectations, saying "several new faculty reported being so overwhelmed with large classes they were assigned (and lack of enough TA and grading support) that they put most of their time into teaching without time to get their research started."

The external reviewers likewise worried about the department's ability to develop and nurture the non-TTT teaching faculty.

They noted that the CS governance structure has not kept pace with the department's administrative needs. They suggested that CS's leadership team required more help and that strategic planning, faculty meeting efficiency, and policy-making should be the subject of increased attention.

Research  
and  
Scholarship

The external reviewers extolled several CS research programs, and the department's multiple interdisciplinary research efforts. The external reviewers recognized the current moment as a rare and significant opportunity for CS to grow its stature by leveraging the large increase in faculty numbers.

Computer science professional associations, including the Association for Computing Machinery, Society for Industrial and Applied Mathematics, and Association for Computational Linguistics count CU Boulder CS faculty as fellows. The department employs winners of Packard and Sloan fellowships, as well as of National Science Foundation and National Aeronautics and Space Administration career award winners.

The CS self-study lamented a lag in research funding relative to other College of Engineering and Applied Science departments. Research expenditures for FY 2016-2017 totaled \$6.6 million, the lowest in the college (other engineering units had expenditures of \$9.6 to \$15.4 million). The expenditures also fell below those of the top 25% ranked computer science programs (these programs' expenditures ranged from \$8.5 to \$10.6 million). To better its position, the department proposes new initiatives to pursue large contracts and grants and to attract star faculty who can lead such projects.

The CS self-study devoted over six pages to a strategic plan. Nonetheless, the external reviewers found this description inadequate, saying

The department lacks an effective strategic plan to guide future planning and decision making. The strategic plan in the [CS self-study report] has overarching goals not specific enough to CU Boulder or the department. It does not address how to achieve stated goals but rather discusses what the department has done in the past. An effective strategic plan is needed to guide departmental decision making, faculty and instructor hiring, and strategic decisions on collaborations.

To aid CS with gaining a useful focus, the external reviewers proposed a series of planning points directed at improving the department's standing, including:

- Hiring goals, needs, and opportunities,
- Strategies and tactics for achieving goals,
- Describing CS faculty member research collaboration opportunities and how to choose among them,
- A prioritization of possible interactions and collaborations between CS and other campus units.
- A structure for associate professors to gain leadership experience,
- A focus on education, community relations, and leadership opportunities within the broader computing community,
- Publicly stated diversity and inclusion goals.

The external reviewers said that because the department lacks a significant planning track record, CS might seek external guidance, perhaps from another campus unit or by hiring consultants. They suggested following an annual schedule to update the strategic plan.

#### Undergraduate Education

The department offers BS and BA computer science degrees. Additionally, the department offers a BS/MS CS track and a CS minor. The Accreditation Board for Engineering and Technology (ABET) accredits the BS degree.

Since the 2011 review, the number of CS undergraduate majors has increased from 254 to 1572, an increase largely built on growth in the new BA. The BA program began in 2013 and is pitched to College of Arts and Sciences students.



While the BA stands as a commendable CS success, growth on such a scale presents significant challenges. Indeed, the external reviewers identified “managing and dealing with enrollment growth” as the department’s foremost concern. They noted that “class sizes have gone up, but support has not.” They flatly state: “The size of the undergraduate programs and enrollment in undergraduate courses exceed the capacity and resources of the department.” They also add that that CS faculty members “uniformly feel that the support given to undergraduate courses is radically insufficient.”

The external reviewers observe that the BA and BS programs have different types of students, and that “there is the opportunity to explore and put in place degree programs that address the full range of future computing professions.” Additionally, “the department has the potential to be a national leader in such efforts.” They compliment the BS as already “nationally known as being top-notch.”

Statistics tracked by ODA show that in FY 2016-2017, CS TTT faculty taught 30% of the department’s undergraduate student credit hours (SCH), instructors taught 54%, graduate part-time instructors 6%, and others, 9%. Course enrollments for tenure stream faculty members averaged 74 students and for instructors 169 students. A spring 2016 senior satisfaction survey included the following overall responses:

- “Satisfaction with your major as a whole”: 64%, 44th of 45 campus departments; sixth of seven College of Engineering and Applied Science (CEAS) departments;
- “Satisfaction with faculty interaction opportunities”: 63% 43rd of 45 campus departments; sixth of seven in CEAS;
- “Effectiveness of courses in preparing student for employment or graduate/professional school”: 59%, 28th of 45 campus departments; sixth of seven in CEAS;
- How well UCB prepared student for job market: 69%, 12th of 45 campus departments; fourth of seven in CEAS.

For the 2016-2017 academic year, undergraduate FCQ course and instructor ratings ranked CS 49th out of 51 departments, and eighth of eight CEAS departments. In spring 2017, 79% of graduating seniors reported that they expected to pursue full- or part-time employment (eighth of 37 campus departments; third of six in CEAS); 4% expected to pursue full- or part-time graduate study (33rd of 37 campus departments; sixth of six units in CEAS).

The external reviewers urged focused attention on CS undergraduate education. These needs include: securing more qualified non-TTT instructors, more graduate students to provide TA and grader support, better teaching load management, enhanced undergraduate advising, better learning disability support, increased course and exam scheduling support, and improved processes to plan and manage course offerings, course scheduling, course assignments, and teaching loads.

The external reviewers also recommended steps to manage student numbers. They discouraged further growth, saying that the undergraduate program already exceeds the department's capabilities.

The external reviewers believed that the department's newly introduced online BS in applied computer science (ACS) plays a strategically significant role. The ACS functions as a professional post-baccalaureate degree for those with a bachelor's degree in another discipline. The ACS is well positioned for the distance market. The external reviewers suggested that the ACS degree could provide the department with needed income but asked whether the degree can succeed in attracting enough students to stay feasible or so many that it might make the teaching burden unmanageable.

Graduate  
Education

In 2017 CS enrolled 178 master's students and 128 PhD students, up from 94 master's students and 98 PhD students in 2011. The recent increase in CS TTT faculty numbers suggests that this already noteworthy expansion in graduate student enrollments will continue. The faculty's research ambitions will necessitate more PhDs, the external reviewers caution, saying that "the department needs a plan for gradually increasing the number of PhD students while maintaining quality cohorts and finding ways to pay for their education." The external reviewers suggest that CS rethink the balance between the professional MS program (with seven subplans), introduced since the last ARPAC review, and the more selective traditional MS that supplies needed TAs and serves as a pipeline of qualified PhD candidates.

Postdoctoral  
Program

The CS self-study indicates that the department employs six postdoctoral fellows and that, relative to other areas of science and engineering, computer science postdoctoral fellowships are rare. Accordingly, the CS self-study devoted only one paragraph to the mentoring of postdoctoral fellows, and the external reviewers did not address the topic.

Space  
and  
Infrastructure

The external reviewers echo concerns raised in the CS self-study about how the department's recent rapid growth strains its use of space and infrastructure. They state:

The departmental space is beyond full capacity and it seems everyone agrees on that. The administration needs to develop, jointly with the department, a concrete plan and a timeline for improving the space situation... The long-term view should be a separate CS building.

The chances for CS to nurture a cohesive and integrated faculty contingent depend on the department's acquiring sufficient contiguous space, the external reviewers say. They note that the department can only offer recent hires offices in widely

dispersed locations, a situation that they caution might lead to fragmentation by specialization or by office location.

Increased student enrollments likewise pose logistical space challenges. For undergraduates this means a compression of locations dedicated to TA office hours, help sessions, courses, and class projects. For graduate students, especially for PhD students, the shortage makes lab space hard to acquire. The likely future increase in graduate student numbers, especially PhD students numbers, will exacerbate the lab space shortage.

Inclusive  
Excellence

According to ODA, as of November 2016, 18% of CS faculty members identified as women and 23% as members of underrepresented minority populations. Hiring in 2017 added six women faculty members, according to the department's self-study. The self-study also states that "underrepresented minorities have been lacking among recent faculty hires, and future searches will strive to rectify that."

As with many other engineering fields, white men constitute the discipline's largest demographic for both students and postdoctoral fellows. For example, an NSF survey of US computer science postdoctoral fellows noted that in 2016, only 8% identified as Hispanic or Latino and 12% as Black or African American. A longitudinal comparison of CU Boulder CS student demographics reported in the self-study shows an increase from 14% to 19% for women undergraduates and from 22.5% to 27.5% for women graduate students over the past three years. The self-study reports that the percentage of students who identify as belonging to an underrepresented minority population remained unchanged in that time: 14% for BS and BA program students, and 3% for graduate students.

The external reviewers did not find the department's diversity efforts sufficient. They recommend that CD develop a plan to hire a more diverse faculty, and to implement programs targeted at inclusivity for minority, first-generation, and women students.

Unit  
Climate

The internal reviewers conducted a survey of the department's undergraduate students in January 2018. Of 1635 students addressed by the survey, 590 responded, consisting of 49% BS majors, 39% BA majors, 10% CS minors, and 2% students in other categorizations. The respondents rated their overall satisfaction with CS as follows: 11.9% "very satisfied," 62.5% "satisfied," 20.0% "dissatisfied," and 5.6% "very dissatisfied." Responses to specific satisfaction factors followed similar distributions. In response to the statement "CS encourages a climate that is tolerant and respectful of diversity," 30.7% "strongly agreed", 57.3% "agreed," 6.3% "disagreed," and 5.8% "strongly disagreed." The internal reviewers also surveyed CS graduate students in January 2018. Of the 322 CS graduate students addressed, 165 responded, consisting of 51.5% master's students and 48.5% doctoral students. Overall satisfaction with CS among graduate students broke down as: 23.6% "very satisfied," 60.6% "satisfied," 11.5% "dissatisfied," and 4.2% "very dissatisfied". As with the undergraduates, responses to specific satisfaction factors followed similar distributions. Prompted by the statement "CS encourages a climate that is tolerant and respectful of diversity," 43.6% of CS graduate students "strongly agreed," 47.3% "agreed", 5.5% "disagreed," and 3.6% "strongly disagreed."

A separate survey conducted by ARPAC staff in September 2017 and addressed to CS faculty and staff members and graduate students on teaching or research appointments covered a range of climate-related questions. The faculty

survey addressed 71 individuals; 49 responded. The staff survey addressed 14 individuals; 12 responded. The graduate student appointee survey addressed 107 individuals; 41 responded. In nearly all cases, 10% or less of respondents indicated problems. An exception to this was a prompt that read, "In CS, one or more faculty members say things or behave in ways that humiliate or intimidate..." Among CS faculty members, 16.4% "agreed" or "strongly agreed." Among staff members, 16.3% "agreed" or "strongly agreed." Among CS graduate student appointees, 14.35% "agreed" or "strongly agreed."

Also, among faculty member respondents, 23% (11 individuals) "agreed" or "strongly agreed" with the statement, "I feel excluded from informal networks in CS."

Staff members generally gave positive responses. One exception: in regard to a prompt that read, "One or more CS staff members say things or behave in ways that humiliate or intimidate other staff members," 64% of the staff members "agreed" or "strongly agreed."

Among CS graduate student appointees, 90% reported being treated respectfully by their graduate advisors, by staff members, and by fellow graduate students. However, the prompt, "One or more CS faculty say things or behave in ways that humiliate or intimidate graduate students," generated "agreement" or "strong agreement" among 30% of respondents.

## Past Reviews

The campus review committee (ARPAC) previously assessed the Department of Computer Science in 2011. At the time, the internal and external reviewers and ARPAC supported the department's proposed BA degree program. The department implemented the degree, with obvious success. ARPAC also suggested that CS diversify its funding sources and move away from an overreliance on National Science Foundation awards. A follow-up report from CS noted some success in this area, although the department's 2018 self-study continues to note the need for funding diversification.

The 2011 review also cautioned that CS should prioritize its research strengths prior to making additional hires. Considering the department's rapid growth since then the 2011 recommendation would appear moot, even as the lack of a significant strategic planning focus remains concerning.

In 2011, ARPAC suggested the use of department ICR funds to address the CS staff deficit. Happily, the college instead increased the department's staff budget. The 2011 review also recognized a pressing CS space shortage and expressed hope that the move of the Department of Chemical and Biological Engineering might open the map for CS. While that move enabled some space repurposing that favored CS, the rapid pace of the department's growth means that the CS space deficit remains chronic and urgent.

## Unit Impacts

CS degree programs count as campus strengths, serving students in the College of Engineering and Applied Science (via the BS) and the College of Arts and Sciences (via the BA). The CS minor attracts large numbers of undergraduates from other engineering departments and from many other disciplines. The department's tradition of interdisciplinary research has led to the growth of strong collaborative ties to other engineering departments and to multiple CU Boulder units and institutes outside the college. Notable collaborations include computational biology and mobile health, language processing and learning technologies, cognitive science, and computational linguistics, which involve, respectively, the BioFrontiers Institute, ATLAS, the Institute of Cognitive Sciences, and the interdisciplinary professional master's degree in Computational Linguistics, Analytics, Search and Informatics. The CS self-study notes that the "department is consistently ranked in the top 40 of the 176 computer science departments in the United States, according to . . . US News & World Report." The external reviewers' assessment affirms CS's standing as a leading computer science research enterprise. The reviewers in particular praise the CS PhD and BS programs as "top-notch." Their evaluation speaks well for the department's current and future prospects. The external reviewers also noted exciting possibilities arising from the department's broadened undergraduate degree offerings, saying, "with both BA and BS programs and different kinds of students in each, there is the opportunity to explore and put in place degree programs that address the full range of future computing professions. Given the unique and valued relationship with interdisciplinary institutes, the department has the potential to be a national leader in such efforts."



## Analysis

The Department of Computer Science accomplishes significant work for the Boulder campus, including in its development of innovative educational programs and in its opening up interdisciplinary research opportunities. The rapid growth precipitated by the introduction of the CS BA has accelerated these accomplishments and made new resources available to strengthen the department. But this development also invites significant challenges, including the stress of providing many more students a quality education and the puzzle of organizing space and mentoring support for a rapidly expanded faculty contingent. Further expansion seems almost certain and will only magnify these stressors.

### Personnel and Governance

ARPAC agrees with the external reviewers that the department's organizational structure has not kept pace with the new reality. The external reviewers expressed numerous concerns: they identified the size of the CS leadership team as too small to address governance needs, and they recognized a significant shortfalls or unmet needs in the areas of faculty development, strategic planning, effective faculty meetings, and policy-based processes and decision-making.

In particular, the external reviewers identified needs related to new and junior faculty as pressing. Based on their interviews with department personnel, they concluded that faculty development resources have not scaled as expected and that a lack of clear tenure or promotion guidelines unduly complicates career progress and places stress on faculty members. They also pointed to poorly managed teaching assignments, saying that new faculty members get overwhelmed with large classes and insufficient teaching assistance and grading support. Hiring more teaching assistants, lecturers, and instructors impressed the external reviewers as an immediate priority.

To help overcome the support shortfall, CS has employed a past CS chair, with the working title of “external chair,” to assist the current department chair with governance work. ARPAC urges CS to continue to innovate and think broadly in these ways. The department’s associate professors, as well as tenured faculty members in collaborating units, might help to bridge the gap in mentoring support for untenured faculty, for example. CS leadership might also do well to search the governance structures of other large and successfully organized campus units for ideas.

While the department bylaws conform to campus norms with regards to executive structure, voting rights, standing committees, and evaluation procedures, they do not include guidelines describing expectations for annual merit review or promotion and tenure. Regent policy requires each unit to have such guidelines.

Research and  
Scholarship

As already described, because surging undergraduate enrollments justify new faculty hires that, in turn, support growth in graduate programs, CS has a significant and rare opportunity to create stronger research and scholarship and to grow in stature.

ARPAC endorses the external reviewers’ call for CS to develop a strategic plan that can effectively guide the department forward in making faculty and instructor hiring decisions and in navigating strategic decisions on collaborations. ARPAC feels that the Department of Computer Science must resolve specific concerns in these areas before it proceeds with additional TTT faculty member hiring. Special consideration should go to questions like:

- What is the department’s financial state?

- What share of tenure track faculty member start-up packages can CS fund?
- How should CS leverage its interdisciplinary relationships to pursue new research funding opportunities?
- Given projected enrollments, and considering that departments generally grant junior faculty members reduced teaching loads, what is the best ratio of TTT faculty vs. instructors?
- How might future TTT faculty hiring increase the department's national stature?

The external reviewers also call on CS to consider outside guidance in creating a strategic plan, such as from other campus units or by hiring consultants. ARPAC endorses this suggestion.

#### Undergraduate Education

As noted earlier, the external reviewers identified undergraduate enrollment growth management as the primary challenge facing CS. Their previously quoted assessment makes the predicament clear: "The size of the undergraduate programs and enrollment in undergraduate courses exceed the capacity and resources of the department." Critical shortfalls include: instructional support from additional teaching assistants, graders, and non-TTT faculty; undergraduate advising support; support for instructors in their responsibility to accommodate students with disabilities, including learning disabilities; staff support for scheduling courses and exams; and support for the effective management of course offerings, course scheduling, course assignments, and teaching loads.

The external reviewers also recommended steps to manage student numbers. They discouraged further growth. They also suggested a related change to the department's MS degree programs, encouraging a rebalancing away from the professional MS and toward the more selective traditional MS that supplies much-needed pool of potential teaching

assistants and serves as a pipeline for possible PhD candidates. ARPAC agrees with these recommendations.

ARPAC also sees a need for CS to formulate and implement strategic planning regarding teaching issues, including:

- Overall low FCQ ratings: what measures can the department take to improve teaching quality?
- BS and BA degree differentiation: what are the program goals for each? What steps must CS take to assure good outcomes for students in both groups? ARPAC is concerned that the BA simply places the BA students in some of the same courses as BS students, with the result that those courses are larger. ARPAC is also concerned, however, that the BA provides a less thorough education in computer science that students may incorrectly assume is the equivalent of the BS. Either of these possibilities would appear to poorly serve the BA students. How should the department articulate these degrees as having justifiably different learning goals? How should teaching methodologies and curricula be tailored for BA students' needs relative to the needs of students pursuing the BS?
- The department business plan: does it reflect an adequate understanding of BA student needs?

Until CS answers such questions satisfactorily, the department should not increase its undergraduate enrollments or hire additional TTT faculty members

Graduate Education  
and Postdocs

The impact of the department's changed circumstances on graduate education and research support likewise requires careful consideration. The department will need an expanded PhD program to satisfy the expanded faculty's research ambitions. For this purpose, the department will need to attract a larger pool of qualified candidates. Finding and funding quality students poses a significant challenge. ARPAC endorses the external reviewers' suggestion for CS to recalibrate its graduate program focus away from the professional MS toward the more selective traditional MS that might serve as a source of qualified PhD candidates. ARPAC also echoes the external

reviewers' caution that CS take care to adequately fund its PhD students; otherwise, neither its own MS students nor other students will be attracted to the doctoral program. Securing those resources should be an urgent strategic planning priority.

The department should also reconsider its new online post-baccalaureate CS degree. While the degree is well positioned to attract a large number of distance-learning students, it also imposes a substantial burden on the department's teaching resources. In light of the multitude of challenges already confronting CS in developing its in situ high-enrollment degree programs, ARPAC questions whether the department can take on distance teaching, too. Needless to say, the place of the post-baccalaureate CS degree merits careful strategic planning. ARPAC sees such planning sorely lacking.

ARPAC endorses the idea that additional postdoctoral fellows would help develop the department's research programs. Tracking postdoctoral fellows' outcomes is one step toward improving their recruitment and participation. As with the PhD students, CS should think creatively about how to financially support postdoctoral fellows: could the unit leverage industry ties and collaborative programs?

Space and  
Infrastructure

ARPAC recommends that college and campus administrators develop short- and long-term plans to address CS space needs. The short-term approach should follow a timeline for improved Engineering Center spaces. While several departures of departments from the Engineering Center to East Campus space has opened room for units that stay behind, these will likely still fall short of needs, including for CS. In the longer term, efforts should be made to secure a computer science-dedicated building.

The current CS footprint poses dire challenges to nurturing a cohesive, integrated faculty. The faculty contingent's increased numbers, and the increased numbers of PhDs and postdoctoral fellows surely to follow, will challenge campus planners to identify sufficient lab and office spaces. The increased undergraduate population also creates shortfalls in accommodations for classrooms, labs, and teaching assistant offices.

Inclusive  
Excellence

In its self-study, CS acknowledged inadequate representation on its faculty by women and by individuals who identify as belonging to other underrepresented groups. The external reviewers called the department's diversity efforts insufficient and recommended that CS do more to recruit a diverse faculty and to develop programs targeted at underrepresented groups, including women and first-generation college students.

ARPAC is concerned by the lack of CS-specific inclusive excellence plans. The department's future hiring requests will be strengthened by explicitly addressing those needs. ARPAC also recommends that the unit familiarize itself with and respond to research showing the impact of including more than one woman/underrepresented minority candidate in each finalist pool.

ARPAC notes that CS has not filed a required inclusive excellence narrative with the Office of Diversity, Equity and Community Engagement.

Unit  
Climate

Surveys conducted in 2017 and 2018, as previously described in this report, support the external reviewers' general conclusion that "the work environment in the department is collegial and supportive." The survey data did indicate problems with civility between staff members, however. ARPAC recommends that the department actively address this concern.

# Recommendations

The members of the Academic Review and Planning Advisory Committee address the following recommendations to the Department of Computer Science (CS) and to the offices of responsible administrators:

To the Unit:

1. Prioritize development of a strategic plan to guide department decision making, including decisions about faculty and instructor hiring, collaborations with other units, requests for space, and size of the undergraduate and graduate programs and numbers of postdoctoral fellows. Update the plan annually. Consider acquiring outside help to develop the plan.
2. Determine and move toward the appropriate size and configuration of the department leadership team and governance structure to keep pace with the rapid growth of the department and its administrative needs. For possible models, consult with other campus departments of similar size that have well-functioning governance structures.
3. Address the needs of new and junior faculty, including for mentoring and clearly expressed expectations for tenure and promotion. Consider alternate forms of mentoring, including recruiting faculty members from related departments and scheduling group mentoring sessions. Implement changes to better manage teaching assignments to avoid overwhelming new faculty with large classes. Secure sufficient TA and grading support.
4. Address existing faculty member diversity imbalances. Work with the Office of Diversity, Equity, and Community Engagement (ODECE) and the Office of Faculty Affairs to develop a concrete faculty recruitment plan for women and members of underrepresented minorities, using tools such

as the STAR program and the Chancellor's Postdoctoral Fellowship program. In reporting progress on this recommendation, include the makeup of the finalist pools for each faculty recruitment. Aim for pools that include multiple diverse candidates.

5. Consider limiting the size of undergraduate programs, or the rate of their growth, to a level that does not exceed the department's capabilities.
6. Rearticulate the distinctions in learning goals between the BS and BA programs. Develop teaching methodologies and new curricula appropriate to BA program students.
7. Consider the market and needs for PhD graduates in industry and academia. If warranted, develop and implement a plan for increasing PhD student enrollments. Take care to ensure student quality and adequate funding.
8. Consider re-thinking the balance of MS program tracks to favor the more selective traditional MS that supplies a needed TA pool and a pipeline of highly qualified PhD candidates over the professional MS.
9. Create a sustainable business plan for the online post-baccalaureate degree program that fits within the larger CS strategic plan. The plan should justify further implementation of the degree program.
10. Submit and implement an inclusive excellence narrative.
11. Analyze the adequacy of the postdoctoral fellows mentoring program. If outcomes of the current program are not at the desired level, establish new mentoring practices that



prepares postdoctoral fellows to work within and outside of academia.

12. In cooperation with the college, establish and implement guidelines for tenure, promotion, and annual faculty merit evaluation that conform to regent law and policy and that incorporate standards for research quality, as well as quantity. University rules require that each unit have clear written criteria for annual merit, reappointment, tenure, and promotion evaluations.

To the Dean of the  
College of Engineering  
and Applied Science:

13. Work with the department to ensure that the BS and BA programs receive appropriate staffing support, including adequate teaching assistants and advisors.

14. Consider a pause in allocating new tenured and tenure-track faculty lines until CS develops an adequate strategic plan. A pause would require increased instructor funding.

15. Assist the department in thinking through ways to limit undergraduate enrollment growth in line with the numbers of instructional faculty. If warranted, explore ways to manage department admissions.

To the Dean of the  
College of Engineering  
and Applied Science and  
to the Office of the Senior  
Vice Provost for Academic  
Resource Management:

16. Work with the department to develop short- and long-term plans to address the space needs caused by the department's rapid expansion.

## Required Follow-Up

The chair of the Computer Science Department shall report annually on the first of April for a period of three years following the year of the receipt of this report (i.e., April 1st of 2020, 2021, and 2022) to the dean of the College of Engineering and Applied Science and to the provost on the implementation of these recommendations. Likewise, the dean shall report annually on the first of May to the provost on the implementation of recommendations addressed to the college. The provost, as part of the review reforms, has agreed to respond annually to all outstanding matters under her/his purview. In 2022, the dean and the provost will work jointly on a response in advance of a visit of a specially empaneled external advisory committee for engineering. All official responses will be posted online.