

Education

Teaching-Oriented Faculty at Research Universities

Developing a well-rounded university through specialization.

TITLES AND JOB details vary from university to university, but teaching-oriented faculty (TOF) contribute significantly to the mission of CS departments in U.S. and Canadian research universities. The nine collaborators of this column are TOF in computer science departments at research universities in the U.S. or Canada; some of us even have the word “Professor” in our job titles. Here, we describe how positions like ours work, how they contribute to education—and as a side effect, to research—at our institutions, and how departmental policies can influence TOF’s success and satisfaction.

Excellent Teachers Who Prioritize Teaching

The unifying characteristic of TOF is excellent teaching. We teach large classes, introductory classes, specialized classes; we typically teach more classes and more students than other faculty in our departments and by common measures we do it very well. Unlike our non-TOF colleagues, we are also evaluated primarily on the basis of our teaching.

TOF are not hired as inexpensive, one-shot instructors to fill temporary gaps in the course list. Most of our institutions have different job titles for this kind of faculty appointment. Nor are TOF positions intended for traditional faculty who are no longer active in research. TOF have a primary profes-

Ever since I taught my first undergraduate class, when I was a graduate student, many of my students have called me “Professor.” I wasn’t a professor then, and I’m not one now, even though I have a tenured faculty position at a research university. My title is “Senior Instructor” and I’m one of a growing category of faculty in research universities CS departments, faculty whose primary focus is teaching.

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sional focus on teaching computer science at the undergraduate level and a passion for excellence in CS education.

At the University of British Columbia (UBC), for example, many CS faculty are excellent teachers but only TOF are hired and promoted primarily as educators. A TOF member teaches twice as many courses as a non-TOF member and a disproportionate share of the undergraduate students. Over the last three years, nine TOF taught 47% of the undergraduate enrollment while 42 non-TOF taught 42% (and other temporary instructors taught 11%). How well do the TOF teach? UBC's campuswide teaching award is a plausible, succinct measure of teaching excellence, awarded on a broad basis including peer and student observations, student evaluations, and a teaching portfolio. Five of the 10 current TOF and three of the 49 current non-TOF have received the award.

Judicious use of TOF furthers the university's teaching mission by enabling some specialization. A department can favor assignment of TOF to courses—often those with large and academically diverse student populations—that demand particular effort and attention from experienced, committed faculty with a strong focus on teaching. Likewise, a department can favor assignment of research-oriented faculty to courses—likely advanced—in which their research naturally connects to instruction. (In the UBC example mentioned previously, 65% of the undergraduate courses taught by non-TOF were upper-division electives.)

A common criticism of such specialization is that all good university teaching requires active research. This is an attractive idea for research universities balancing research and teaching missions and their stakeholders. However, research on university teachers has established that active research is not a predictor of effective teaching.¹ On the other hand, TOF do indirectly support the university's research mission by allowing non-TOF to take a lighter teaching load with a tighter connection to their research.

...And Something Else

TOF have impact outside of the classroom as well. TOF jobs typically involve teaching *and something else* that affects

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undergraduate education. For example, the University of California (UC), Berkeley hired its first TOF member in CS not just to teach but also to radically restructure the introductory CS curriculum. Indeed, all of the authors engage in professional activity beyond teaching, even where our departments impose no official requirement to do so.

We briefly describe some key types of “something else” contributions TOF make here. The majority of our institutions have TOF engaged in most of the contribution types we list, but for brevity and concreteness we illustrate each type with a few specific examples.

Curriculum Development. Introductory curriculum development is a common task for TOF. As with the Berkeley example earlier, UC Santa Barbara (UCSB) TOF contributed substantially to a lower-division curriculum redesign, integrating recent research in computer science pedagogy such as pair programming and foreshadowing of advanced research concepts to improve retention. At Princeton, TOF co-developed and teach an interdisciplinary introduction to CS taken by almost half of Princeton undergraduates. Such a large service course would not be possible without the focused support of TOF.

TOF often contribute in specialized areas as well. At UC Irvine, a TOF member developed and teaches a year-long capstone project course, recruiting project clients from industry. Another TOF member developed and taught a computer game development course and later co-designed a new “Computer Game Science” major.

Undergraduate Advising. TOF's extensive contact with undergraduates

makes them natural mentors for the students. UCSB's two TOF piloted the faculty undergraduate advising program there, developed an undergraduate research course, provided undergraduate research opportunities, and brought undergraduates onto department committees. At UBC, TOF created and maintain a second degree program and a broad array of popular combined majors.

Research. Many TOF maintain research programs, especially research on CS education. At UBC, TOF have published computer science education research in SIGCSE and similar venues. They also supervise many undergraduate research assistants and sometimes co-supervise graduate students in both CS education and more traditional CS research. UCSB TOF have advised 11 undergraduate research assistants in the past three years and published during that time (often with the students) in top-tier architecture conferences and at SIGCSE.

Textbook and e-Course Authorship. Authorship of course materials is a common contribution of TOF. At Princeton, a TOF member co-authored a CS 1 textbook and updated a best-selling CS 2 textbook. A TOF member also curates two freely accessible book sites—with code, data sets, algorithm visualizations, assignments, and exercises—that receive half a million hits per month. One UCSB TOF member contributed to the past two editions of the top-selling computer architecture textbook. Similarly, TOF often design pedagogical software, such as the aforementioned textbook-support software and the WebCT course management system created by a TOF member at UBC.

K-12 Outreach. TOF have a special interest in how we recruit undergraduate CS students. At the University of Texas at Austin (UT), TOF created and sustain long-running K-12 outreach programs including a summer camp for high school girls—with 20% of 2010 participants now majoring in CS at UT—and an annual CS4HS program for 20–30 high school teachers. UT TOF also support high school computer science contests (similar to the ACM programming contest) for several thousand students each year. UCSB TOF recently developed and offered a summer camp with 40 students—most members of minority groups underrepresented in

computer science—30% of whom are now considering CS as a career.

University and Professional Service.

As with other faculty, TOF often perform significant university and professional service. A UC Irvine TOF member recently chaired the UC-wide faculty senate committee on educational policy, helping develop the position of the faculty on issues such as the quality of online education, proposed measures to deal with budget cuts, and course transfers from community colleges. A TOF member at UBC has served for many years as Associate Dean for Curriculum and Learning. Another recently served as Program and then General chair for SIGCSE, ACM's major annual Computer Science Education symposium.

External Support. Many TOF secure external funding for projects like those listed here, including several of the specific projects described in this column. In addition, three Duke TOF have acted as principal investigators on grants from the National Science Foundation (NSF); received gifts from corporate sources to further education; and participated in multi-institution grants. One Berkeley TOF member's collaboration with an education researcher led to several NSF- and industry-funded projects.

Best Practices for Hiring, Retaining, and Supporting TOF

We have illustrated ways that talented, dedicated, and expert TOF can contribute to the mission of a research university. How then do research universities recruit the best talent, maintain their dedication, and retain them as they develop their expertise?

We believe the most successful TOF positions—measured from both TOF

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and non-TOF perspectives—are those viewed as approximately equivalent to other faculty positions but with a different focus. Problems occur when the position, the person hired as TOF, or the job responsibilities create a divide between the TOF member and their colleagues. Departments and institutions can “tune up” their TOF positions by moving toward practices that encourage a positive relationship.


For example, in hiring, favor full-time appointments and treat the hiring process with similar care and deliberation to that used for non-TOF positions. To support new TOF, provide mentorship, gradual ramp-up of duties, and regular feedback from peer observations. When evaluating TOF for promotion and merit, create a real career path including increased security (for example, through longer-term appointments) and recognize both teaching and the “something else” in reviews. To retain and support TOF in the long run, keep teaching loads sustainable, accounting for labor-intensive activities like managing the teaching staff of a large course, and provide TOF with the logistical resources they need given their high teaching loads and limited access to research funds. To integrate TOF into a department, grant and encourage full rights to participate in university affairs (for example, department meetings, committee membership, voting rights, and PI eligibility), emphasize the importance and challenge of effective teaching to all faculty, encourage TOF to participate (at a manageable level) in research groups, and encourage non-TOF to participate (also at a manageable level)

in the aspects of undergraduate education primarily controlled by TOF.

Departments should also exploit their TOF's expertise—intense practical experience and (often) currency in general or disciplinary educational literature—by encouraging dissemination and use of pedagogical best practices among their faculty. The advice provided in this column to foster TOF will facilitate dissemination by marking both TOF and undergraduate education as valued by the institution. That status legitimizes formal discussions and “hallway chat” about pedagogical problems. Of course, departments should encourage all faculty (not just TOF) to excel in teaching and the study of learning and to contribute that expertise to these conversations.

Some of these practices may require changes to or novel interpretations of existing policy, but CS departments at many excellent schools have adopted them. To the extent official change cannot be achieved, a department can still create a strong and public cultural commitment to these practices and to its teaching-oriented faculty.

Conclusion

In the ultra-specialized world of the research university, it should come as no surprise that specialization in teaching serves the university's mission. University administrators benefit from increased stability and quality in undergraduate education and, indirectly, in research. Traditional faculty benefit from reduced and specialized teaching loads. Most importantly, students benefit from studying under a mixture of specialists, experts in groundbreaking areas of research but also experts in teaching. Faced with a general shortage of educated workers in computing, teaching-oriented faculty can be an essential part of a CS department's solution. 

Reference

1. Prince, M.J., Felder, R.M., and Brent, R. Does faculty research improve undergraduate teaching? An analysis of existing and potential synergies. *Journal of Engineering Education* 96, 4 (Apr. 2007), 283–294; [http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/Teaching-Research\(JEE\).pdf](http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/Teaching-Research(JEE).pdf)

This column is a collaborative effort of teaching faculty at several institutions, with editorial contributions by Steve Wolfman, Owen Astrachan, Mike Clancy, Kurt Eiselt, Jeffrey Forbes, Diana Franklin, David Kay, Mike Scott, and Kevin Wayne.

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