CS Speaks 2016 Report

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1 Foreword

Herein lies the 2016 report of the CS Speaks committee of the Rice CS Club. We aim to provide a snapshot of the department from the perspective of current undergraduates and recent alumni. We hope our thoughts are well-received and can act as the jumping-off point for conversations about the future of the department.

2 Executive Summary

Rice Computer Science has seen an incredible increase in the demand for Computer Science degrees. Over the past 6 years, the number of declared majors has ballooned from barely over 40 to more than 300. The number of faculty has remained constant. As a result, some classes have lost the personalized atmosphere so heavily advertised by Rice, with the 6:1 student to faculty ratio no where to be found in the department. Although some classes have managed to adapt to the increasing enrollment, others have struggled to maintain the same caliber of teaching that Rice prides itself on.

Data on alumni opinion is less plentiful than on student opinion due to a lack of a robust way to contact alumni en masse, but some valuable insights can still be drawn. In an online survey completed by twelve alumni, there is unanimous praise in a general manner for the department's effectiveness in terms of career preparation. Alumni who have graduated more recently, however, express less satisfaction with class sizes than alumni graduating further in the past.

A current weakness of the department is the lack of availability of meaningful advising. At a school of Rice's size and caliber, parents expect their students to be afforded the opportunity to engage in discussion and receive personal advice from faculty advisors. However, due to resource constraints, the faculty is forced to resort to mass group advising sessions, and unrealistic loads of advisees placed on advisors. Currently each faculty advisor must manage an average load of 45 students, and it is unreasonable to expect them to form personal relationships with students with this high a load.

The growth trend seen at Rice is a result of a larger national trend of increased study in Computer Science. Many of issues today resemble those of the first tech boom in the 1980s. At that time, computer science academia faced a shortage in available spots to candidates. Today that problem has re-emerged, and the ratio of available faculty positions to candidates is around 4:1.[3] Top universities around the nation are understanding the deficit in staff and pushing hard to meet the demand for Computer Science education. However, Rice, over the past 5 years, has answered this growth with inaction. According to a study done by Brown University, Rice University ranks 52nd out of 60 top Computer Science schools in size of faculty. The more troubling statistic is that in the last 5 years, we rank 55th out of 60 in total hires. With hiring competition coming from fellow universities, industry positions, and national research labs, the glaring truth is that if Rice seeks to maintain its status

as a top tier international institution and to continue the incredible quality of education that it is beloved for, taking a more aggressive approach to hiring Computer Science faculty is paramount. To quote the Summary of the Computer Science Advancement Committee Findings from 2014, "To put it more bluntly, by not making an absolute strategic choice to invest in CS we are making a relative strategic choice to play a diminished role in one of the most fundamental and pervasive engineering domains of our time." [5]

3 Student Opinion

Rice has seen its share of growth in the Computer Science Department. Computer Science is not only one of the fastest growing departments in engineering at Rice to date, but also is currently the largest major at Rice University. From 2008 to 2015, the size of the department has more than quadrupled. This growth calls for adaptation in the department.

In order to collect data on current student opinion, the Committee sent out a survey aimed at the current undergraduate Computer Science student body. The survey was hosted on Google Forms and distributed through listserv emails and relevant Facebook pages, and was successful in garnering 97 responses. The survey asked the following questions:

- Please rate your overall satisfaction with the COMP major
- Rice CS has sufficient courses on the subject areas I'm interested in (on a scale of 1 to 5, 1 being highly insufficient and 5 being highly sufficient)
- If any, what fields that Rice CS does not have classes in are you interested in?
- Please rate how comfortable you feel talking to professors
- How often would you like to participate in class? (1 to 5 with an option for free response)
- Particular class ratings

We first take a look at the overall satisfaction of Rice students. Taking a look at the figure 1, we can see that satisfaction is trending down over time, with the exception of the freshman class. Although drawing conclusions from student opinions that are taken at varying points in the curriculum is dubious, we think this may be the first indication of a troubling trend.

Another finding of note was a correlation between the feeling of class sufficiency and overall satisfaction. In figure 2, lower satisfaction rates are correlated with a desire for more classes. In a less prominent trend, students who were more comfortable talking to professors also appeared to be increasingly satisfied with the department. From this data, we can postulate that sources of the dissatisfaction rise from lack of class offerings and lack of attention of professors. Both of these consequences may stem from having a small faculty.

Data from the Registrar shows that some courses have been more negatively affected by increasing class sizes, suggesting that some courses have more scalable classroom models

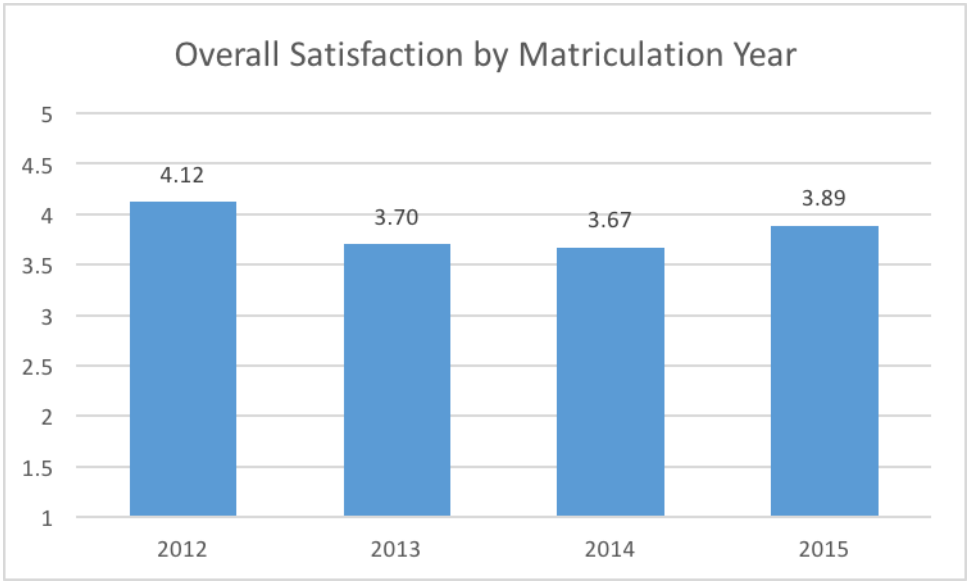

Figure 1: Overall satisfaction by matriculation year. 5 corresponds to very satisfied, and 1 corresponds to very dissatisfied. Collected from CS Speaks survey

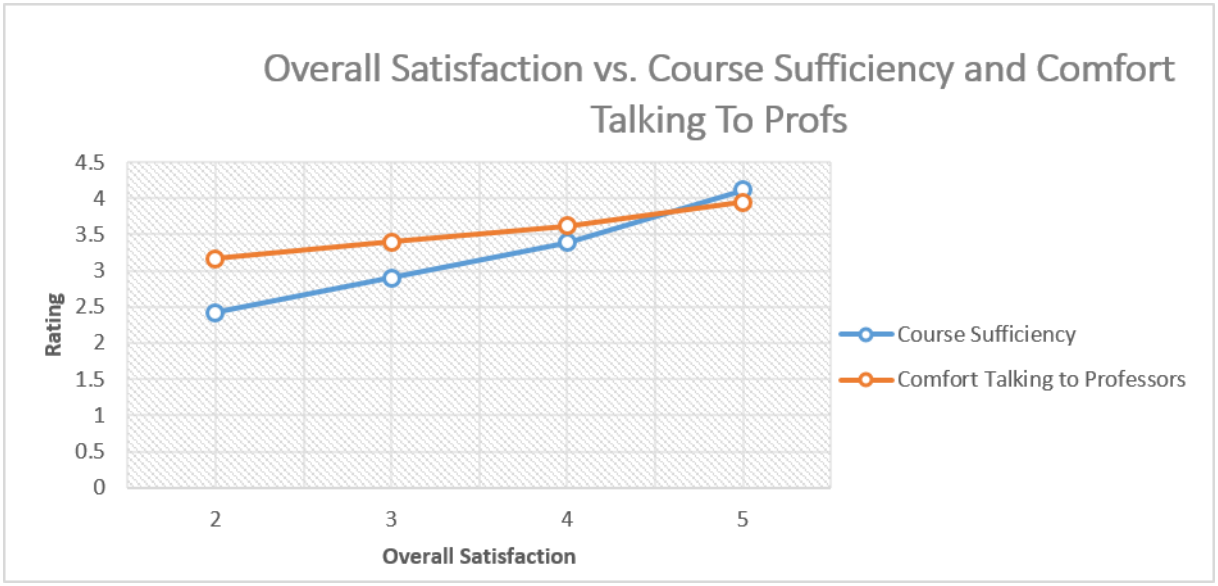

Figure 2: Feelings of course sufficiency and comfort talking to professors plotted against overall satisfaction

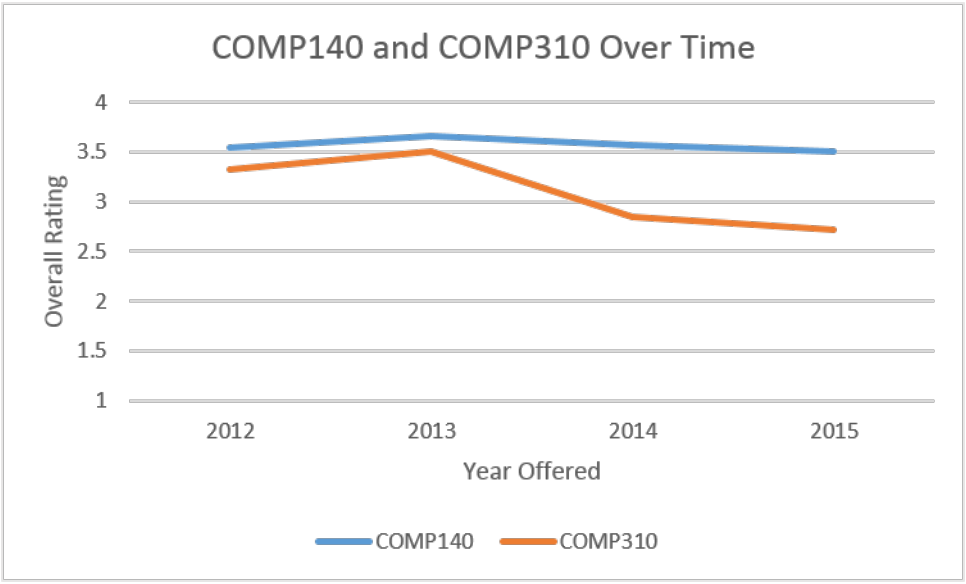

Figure 3: Course satisfaction data from the Registrar

than others. For example, in figure 3, we see that the course ratings for COMP 140 have stayed largely the same over time while those for COMP 310 have dropped. Speculatively, we might say that COMP 140 has a more scalable classroom model: students work in groups of constant size - as class size increases, the number of groups increases. In COMP 310, however, the number of groups for the group projects has stayed the same, but the number of students in the class has increased from 50 in 2012 to 85 in 2015. The actual reason for the drop in ratings may be more nuanced than this simple explanation, yet we still get an idea of how increasing class sizes are disproportionately negatively affecting student opinion of some courses.

4 Alumni Survey Results

In order to gain a perspective on these trends as they've developed over the last few years, the following survey questions were asked of alumni via an online survey:

- What year did you graduate from undergrad?
- Detail your occupation(s) since graduating from Rice.
- What effect did class sizes have on the quality of your undergraduate CS education? (1 to 5 scale, 1 being highly detrimental and 5 being highly beneficial)
- Would you like to see changes in the course curriculum offered by the Computer Science Department? (yes or no)
- If yes, please be specific in the courses you would like to see offered or would prefer

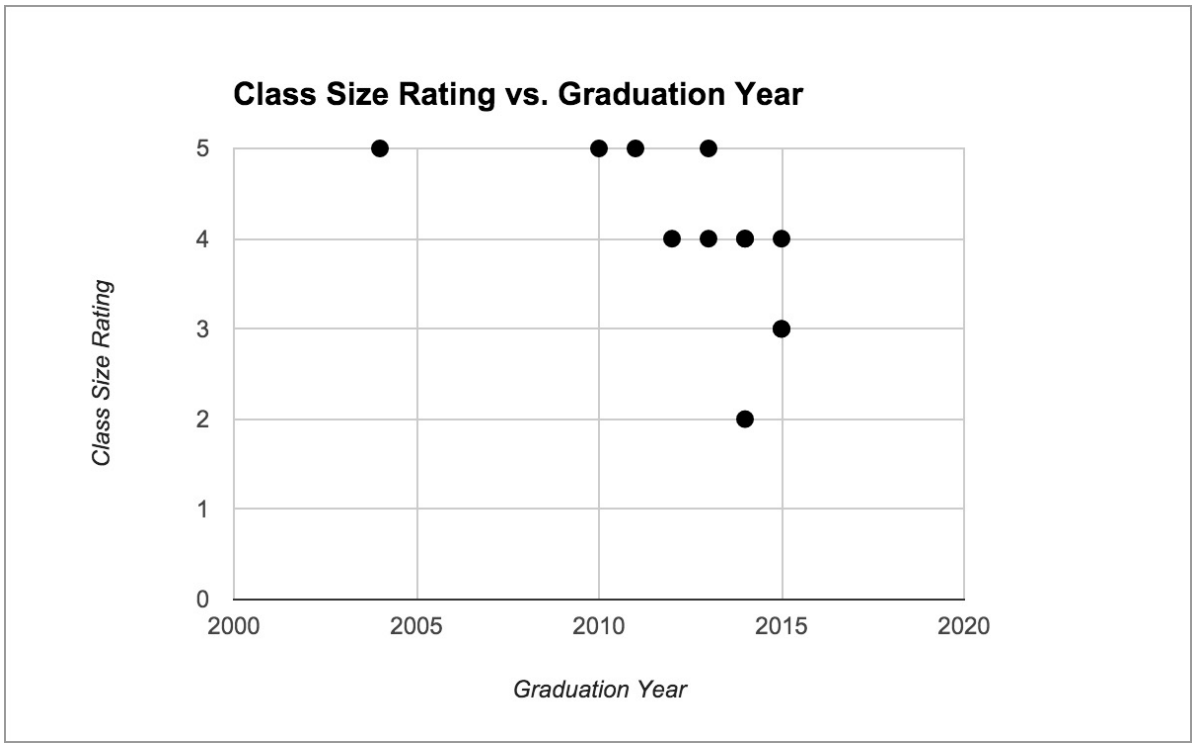

Figure 4: Alumni survey plotting rating of Class Size vs. Graduation Year

were not mandatory.

- Comparing yourself to those who graduated with computer science degrees from our peer institutions within 5 years of your own graduation, how well do you think your Rice undergraduate computer science experience prepared you for your career? Please be as specific as possible.

Twelve responses were received from alumni. We attribute the relatively low number of responses to a lack of a viable way to contact the alumni population in a systematic manner. We recommend the department distribute an exit survey to graduating seniors that, at a minimum, collects post-graduation contact information to facilitate future data collection such as this initiative. (We believe that this year such contact information was, in fact, gathered.)

4.1 Class sizes

Not enough alumni have responded to see a statistically significant trend, but in figure 4 it is interesting to see that a small downward trend in satisfaction with class sizes in graduates from 2010 through 2015.

4.2 Course catalog

Alumni who responded to our survey did suggest changes to the course curriculum, but the only changes that were suggested by more than one survey respondent have already been addressed in the last calendar year — namely (1) making the introductory course pipeline more flexible by adding a class like COMP 130 and (2) adding a course on functional programming. There was not a strong enough consensus on other requested changes from our survey data to report here.

4.3 Preparation for career success

Alumni unanimously agreed that the CS program has prepared them well for their careers with respect to their peers. They specifically emphasized the good job the department does in teaching students how to think and solve problems in a general way, providing them with skills that can be applied to a variety of roles and situations. A selection of the responses:

- "I feel about on average compared to others. I think at some level the challenge of starting your career is learning the environment and codebase you are working in, which is mostly just experience and not something Rice can be good or bad at providing. I think Rice does a good job at providing the skill set you need to be able to solve your own problems or learn whatever you need to learn."
- "Very well. Other universities place less emphasis on testing and large projects. I've also noticed that few other universities have a parallel programming class. In general, however, the vast majority of learning is on the job and specific classes matter less than learning a way of thinking, which Rice does well."
- "Extremely well, many of my peers have poor understanding of oop principles and have a more difficult time adapting their education to learning new skills "
- "I think I was equally unprepared for the real world as everyone else. I pretty much didn't know anything about real software architecture or even how real software development actually works (although that stuff is easy to learn). However, I think I was sufficiently equipped to solve complex algorithmic and performance-related problems because of Rice's curriculum."

5 Advising

One of the areas in which the increased number of Computer Science majors has affected the educational track is in the field of faculty advising. According to the website of the Office of Academic Advising, "after declaring a major or minor, students should meet with their major and minor advisors each semester" and that "the beginning of your third year is a great time to sit down with your Major Advisor. Review your academic plan together.

Discuss what you can do inside and outside of the classroom to take full advantage of the department's opportunities and optimize your learning."

However, these suggestions from the OAA are sometimes difficult for CS students to follow because of the advising situation in the CS department. Currently, due to the high demand and limited time of the faculty, very few students have time to meet with their major advisors as frequently as desired. This year the department has instituted two significant changes: a once-a-semester advising day where all the major advisors sit in a room together for an afternoon and collectively advise as many students as they are able to (or as many as choose to attend), and an official assignment of students to major advisors so that every student has an advisor.

Or rather, so that every student has an advisor on paper. Under the new division, each major advisor is tasked with advising on average 45 undergraduate students in addition to their duties related to graduate students, research, and teaching. With this load, they don't have time to develope meaningful relationships with their advisees. Instead of being mentors to discuss graduate school options, career goals, or simply have a conversation with about classes or concepts, they only have time to sign paperwork and inform students about the standard major track. This is one of the areas that Rice has for massive improvement. Despite overall growth over the past 10 years, we are one of the smallest institutions of our caliber, and with that, students should be able to interact with our incredible faculty in a way that they currently cannot.

6 Accelerated Introductory Courses

One of the CS department's strengths is the breadth and quality of the upper level classes. However, we see enough desire for an intro-level honors track for new CS students that would have the dual purpose of exposing more advanced students to some of the material covered in these upper level classes earlier in their undergraduate careers, as well as reducing enrollment in the standard intro level classes. Since such desires have been expressed by students on more than one occasion, we shall further investigate the idea here.

This committee sees a couple of problems that are currently affecting the department which could be alleviated if an honors introductory track were to be implemented. First, that there are students in COMP 140 that are finding the class too easy and are not being challenged to the proper extent, and second that the demand for 140 is higher than the number of available slots in the class. If the Computer Science department were to implement an honors introductory course track, it would allow the students who are finding 140 too easy to enroll in that course instead, and open up seats for other students in 140.

In addition, providing an honors track to qualified students would not be unprecedented, either at Rice or in Computer Science departments nationwide. Rice's Physics and Math departments already have honors version of their introductory courses (PHYS 111/112

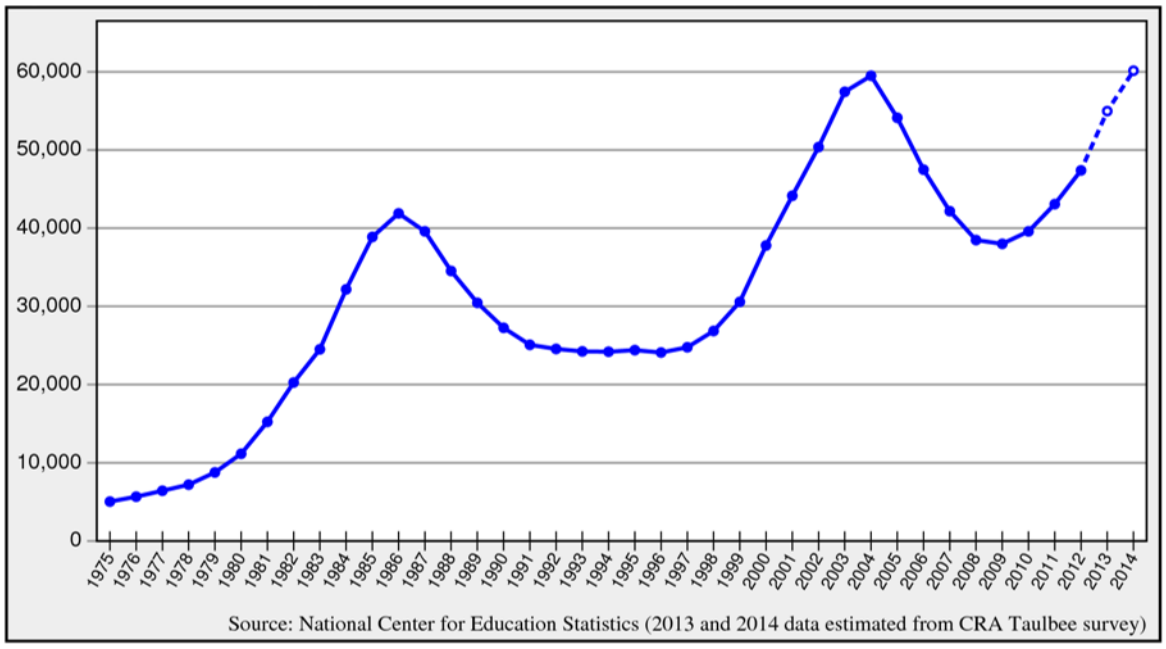

Figure 5: Number of declared CS majors from 1975 to 2014. The number has continued to grow in 2015

and MATH 221/222), and Stanford and Harvey Mudd both offer normal and accelerated introductory courses in Computer Science (CS106B vs CS106X and CS42 vs CS60, respectively).

7 National Context

7.1 Growth on a National Scale

The boom in the computing industry has had effects nationwide. The number of declared majors continues to increase, forcing an incredible burden on institutions of higher learning. However, as documented by Stanford professor Eric Roberts in his essay "A History of Capacity Challenges in Computer Science" [3], this isn't the first time computer science departments have seen sudden and immense increases in enrollment. In the early 80s and the late 90s, the massive influx of declared computer science majors caused demands for computer science faculty to rise. Historically, universities have been unable to adapt to the influx due to a shortage of labor. In the 80s, the number of available PhD positions outnumbered the number of applicants by 7 to 1 [3]. This caused institutions to institute a limit on accepted CS majors, artificially deflating interest in Computer Science.

What we're seeing now is something very similar. As the tech industry continues its rapid growth, start-ups and industrial research positions provide stiff competition for universities. Rice has observed first-hand the difficulty in hiring faculty. Even when offers are made,

there's no guarantee that a new hire will accept. The current shortage of talent, reflected in these figures, indicates that hiring new faculty is not a simple undertaking.

However, even without this disparity, many financial considerations need to be taken into account. As shown in Figure 5, there has been overwhelming net increase in the number of CS bachelor's degrees over the past 30 years. Even though the demand curve is cyclic, the trough of one bust seems to be well above the trough of the previous bust, even if these troughs are well below the peaks of their associated booms. If such trends continue in the future, it should be understood that a long-term excess of professors is unlikely were the department to hire enough faculty to meet current needs.

7.2 A Look at Peer Institutions

Rice University is consistently valued and ranked as one of the best higher learning institutions in the nation, and as such, comparisons to other institutions naturally arise. Across multiple academic disciplines, Rice tends to excel. CS is no exception, as it is ranked among the top 20 universities in the nation in the field.

However, rankings are limited in scope to the past and to the present. As previously mentioned, there has been and continues to be a momentous increase in the study of Computer Science. At other universities, this has warranted changes within departments that span from hiring more faculty to allocating and building space for CS. If Rice seeks to maintain its position as a top Computer Science school, we can look to the actions these other institutions have taken in order to guide our own decisions.

At some institutions, the increase in CS Majors is not accounted for with a corresponding increase in resources for that student body. Students at some of the highest performing institutions have spoken out against this, most notably at Yale University. There, Graduate and Undergraduate students alike came together in an effort to voice their displeasure with the inactivity of the university administration. Their petition garnered over 1000 signatures and brought incredible donations from alumni to improve the department. What the students proved to the administration is that Yale's ongoing reputation "is inextricably tied to the health and well-being of its computer science department."[2]

Recently, Brown University has began to keep track of certain metrics for CS and CS related departments across the nation [1]. When looking at these metrics, one can find some interesting trends on how CS departments are reacting to the increase in students.

The first and most obvious solution that would allow a university to adapt to more students is to hire more teachers. Many institutions have seen the influx in students and reacted with an energized effort to bulk up their staff. As evident in the data from the Brown study, many of the top universities have taken incredible measures to hire and secure the best CS faculty and faculty candidates possible to answer the needs of a growing field. Out of the 60 schools reporting, Rice fell into a three-way tie for 55th with only *one* hire. This is not on par with *any* comparable peer institution, and certainly not consistent with other universities ranked

as highly as Rice is in CS. Even small institutions like Duke, MIT, Georgia Tech, and Brown have hired a significant number of faculty over the past five years. Not having recent growth also would not be an issue if Rice was sufficiently staffed. However, the Rice is ranked 52nd out of 60 in total faculty size.

Rice's inaction puts its future as a top tier institution in jeopardy. As the most talented students begin their search for their future universities, whether they seek to pursue graduate or undergraduate studies, many will undoubtedly be looking at which Computer Science departments can provide them with the most opportunities. Rice's apparent unresponsiveness to the burgeoning CS field not only harms the current student experience, but also severely damages the future of the department as the top talent chooses to go elsewhere.

8 Final Thoughts

This concludes our thoughts on the current state of the department. As can be gathered from the data, student satisfaction is trending down, accessing advisers has become difficult, and class sizes have become uncomfortably large, all contributing to a deteriorating student experience. Nationally, we can see that CS Faculty are in high demand as the field continues grow its influence. Thus, it is our recommendation that, in order to maintain it's high-achieving standards, Rice University should take a significantly more aggressive approach to hiring computer science faculty and should devote more resources to the computer science department. We understand that change can be slow, but we also believe that taking immediate action in order to resolve these problems is paramount. To this end, we will continue to collect data from the student and alumni populations and will develop targeted recommendations for the university in order to salvage Rice's position as one of the leading computer science departments in the nation.

References

[1] Papoutsaki, Alexander. `cs.brown.edu/people/alexpap/faculty_dataset.html`

[2] Reinking, Alex. `alexreinking.com/petition`

[3] Roberts, Erik. `cs.stanford.edu/people/eroberts/StanfordCSCapacity/`

[4] Sarkar, Vivek. "Computer Science Department Overview" 2015. Presentation.

[5] "Summary of the Computer Science Advancement Committee Findings" 2014. Rice Confidential.

A Results from Town Hall

The following are the transcribed written notes from the CS Townhall held in Early November 2015. Questions that were asked included

- What are the strengths of Rice CS?
- What are the weaknesses of Rice Cs?
- What are the positive and negative effects of growth in the department
- What would you think of an advisory board of CS Students that would interface with the faculty and administration?

A.1 Group A

A.1.1 Strengths

- Introductory courses (140, 182)
- Ratio male : female (high for engineering/compared to peers)
- CS Clubs
- Job placement
- Undergraduate research easy to get involved
- Undergraduate TAs usually very good
- Piazza (online forums) for class material
- Professors available, helpful during office hours

A.1.2 Weaknesses

- Intro course 160 not as helpful as 140
- More web development classes needed
- Courses only offered fall or spring, making it difficult to stay on track if one class skipped
- Some disagreement about what students expected to know, learn in prerequisite classes
- Classes have major assignments due at the same time
- Easier to get help from student TAs than from the professors (especially since professors are busier)

- Piazzas not monitored adequately
- Software changes (ex. Dr Java, Stratocode) can make it difficult to learn
- Project classes scaled upwards → groups becoming too large

A.1.3 Results of growth of the department

- (-) Classroom environment → less participation, individual focus, fewer people have opportunities to talk
- (-) Bad classrooms: Herzstein
  - Need adequate space, room for material
- (+) Piazza & online forums: lots of posts & responses
- (-) Access to teaching staff: OH crowded
- (+) More small/college/study groups for students to work in
- (-) Improve rewards of undergrad TA experience to get more students to TA - leadership?
  - Not that many undergrads are TAs
- (+) More CS events, clubs, groups – ex. Rice Apps
- (-) More out-of-class events, learn less in class
- (-) Has become easier to cheat, violate Honor Code; but this could occur anyway, and reporting is easier
- (-) More people slack off in large group projects
- (+) Offer more classes on more topics
- (-) Getting into classes, esp. freshmen/sophomores
- (-) Don't have a designated CS space/lounge

A.1.4 Advisory Board

Issues: Sequence of classes ([illegible]) – prerequisites & required knowledge for different courses; consider major course restructuring – ex) whether or not a course should be flipped classroom, provide feedback on teaching techniques & technology used (compare experiences from different years); getting more interaction between students & faculty (format) on running of the CS department (undergrads all-hand mtg?); convey issues from student body to the faculty

A.2 Group B

A.2.1 Strengths

- Job Placement: Direct positive relationship between growth of dept and number of companies recruiting CS majors
- Approachability and openness of faculty. The relationship between students and faculty re a strength. Personable staff.
- Size of the CS Community provides networking opportunities, such Rice CS in Bay Area
- Accessibility of Research.
  - Opportunities for undergrads, even freshman
  - Collaborative emphasis

A.2.2 Weaknesses

- Lack of practical courses (like no Android programming class)
- Amount of faculty -student interaction. Lack of faculty advisors for students, classes are getting crowded.

A.2.3 Results of growth of the department

- (-) Growth has caused lack of major advisors for declared majors
- (-) Bad classrooms: Herzstein. Need adequate space, room for material
- (+) Larger hackathons, more funding, greater opportunities for networking, job opportunities, recruitment
- (-) Crowded classes

A.2.4 Advisory Board

- Address issue of lack of undergrad major advisors
- Representing student body - advocate for students
- liaison between Dean and students
- Throwing events
- Preserve approachability of faculty

- Preserve sense of community

A.3 Group C

A.3.1 Strengths

1. Strong intro courses
2. CS club/CSters
3. Research accessible to undergrads
4. Okay gender balance
5. Students more collaborative

A.3.2 Weaknesses

1. Large classes are disorganized, communication between students, profs, and TAs is more difficult
2. Upper level classes are as large as intro, but in these classes its much more necessary to have 1 on 1 interaction with the prof to grasp the material
3. Lack of upper-level subjects
4. People with declared majors waiting $>$ 1 year to get an advisor
5. More information about planning for job/grad school for freshmen/new sophomores

A.3.3

- (+) More companies recruiting
- (+) More networking/friends
- (+) Club activity
- (+) Potential positive could be more class subjects, but increase in faculty size would be necessary
- (-) Overbooked classrooms
- (-) Sitting on stairs to take exams
- (-) Overbooked labs even though the point of labs is interaction
- (-) Faculty size not increasing

A.4 Group D

A.4.1 Strengths of Rice CS

- CS relatively smaller compared to other schools
- at least Rice accommodates (special register) vs. at like UT
- upper level, less intimate more lecture based
- random partners :(
- from the beginning, theory based classes, no like intro java classes
- women

A.4.2 Changes

- More recruiting (positive)
- Meet more people, more opportunities (positive)
- More money, funding, experimentation (positive)
- Hard to tell, this is just how it is
- Advisors. Starts to feel like a formality rather than mentor when they have so many undergrads.

A.4.3 Advisory Board

- Discuss what form of advising students want. What structure?

A.5 Group E

A.5.1 Strengths

- strong peers
- growing network sizes
- open research opportunities

A.5.2 Growth

Collect data to make case for ↑ tenure track faculty

A.6 Group F

A.6.1 Strengths/Weaknesses

- only know python throughout freshman year.
- professors can customize curriculum (which is cool and good) but sometimes not relevant to job search/industry
- not a lot of consistency in expectations
  - 215 not taught Java OOP but expected to know Java 8
- want a data structures course
- worried faculty may not care to change the curriculum
- 182 is a great class, felt like we learned a lot, didn't feel like things were useless, had clear expectations for us
- 140 was good b/c it didn't assume we came in with prior knowledge
- maybe splitting up students based on prior experience levels
- 481 seems to have lost quality
- faculty can't quality check all courses, need more staff
- Wallach puts in a lot of time and effort for students
- unify resources and platforms (coursera, owlspace, wiki...)
- good at attracting companies

A.6.2 Growth

- lots of support for people who switch in later or take a less traditional path
- almost every year the courses have changed dramatically, hard to know what to expect, each year is different
- we feel bad. faculty look sad and overworked
- intructors have to adapt along the way which contributes to inconsistency
- TA's sometimes aren't given all the info and work still falls on professors
- major advisors
- growing isn't bad, it's how we respond to adapt to it
- some class structures don't support larger class sizes, ELEC 220 demos didn't work out, also no in-class TA's

- TA hours were overcrowded
- more students = more social support in the major

A.6.3

- can communicate feedback on how to change classes year to year
  - keep a middleman b/w students and faculty
- more documents and assistance in understanding graduation reqs since few major advisors
- extend our discussion to students from other majors to see what problems are limited to CS vs Rice
- include administrators in the board (and faculty)

A.7 Group G

A.7.1 Strengths

- Great freshman curriculum (unless you walking in with Python knowledge)
  - very approachable for new people
  - engaging/interesting problem solving
  - get good info early
- Professors are very approachable
  - names known

A.7.2 Weaknesses

- Lack of breadth of upper level courses (computer vision, cryptography, NLP)
  - some of this cov [sic]
- Lack of data structures/algo course (upper-level)
  - Union-Find, Red/Black trees
  - 382 not significant enough step up
- Class size a problem in certain classes
  - ChatApp in 310...

  - 310 should be updated... or renamed to design patterns
- Recitation sections for 382

A.7.3 How to improve courses

- text survey responses is a poor method