July 20, 2010

Dear Dr XXX,

Greetings from Computer Science!

Recently a departmental colleague forwarded me a copy of your undated memo to the Deans and Associate Deans regarding "Consideration of AP Computer Science to Fulfill Purdue High School Curriculum Expectations in Mathematics." I must say that the memo came to me as a big surprise and disappointment. I strongly believe that making the change you suggest will be a backward step and would set a bad example for other institutions. Reasons and concerns follow.[1]

1. [**Math and student success**] In 2009 Purdue took a bold step forward by revising its Math requirement for incoming freshman. A related announcement indicated ``The Indiana commissioner for higher education says completing one additional unit of intensive high school Math increases the odds of completing a bachelor's degree by 73 percent." Is there similar data available regarding AP Computer Science? Whether or not one agrees with the statistics given by the Indiana commissioner, the value of a rigorous education in Math is recognized throughout the world.

2. [**CS as lab science**] Indeed, Computer Science is now a discipline in its own right, stands on its own, and has proven to be important for the betterment of the society at large. Its pervasiveness, as that of many other engineering disciplines, is indicative of its importance. While at many universities CS grew out of mathematics, it is now neither mathematics nor natural or social science; it is clearly an engineering discipline as recognized by a large majority of universities within and outside the United States. Regardless of the importance of CS, I hesitate to support replacing a Math course by AP CS for engineers and scientists; Math is simply too important to be replaced by any other course. Instead, I propose that Purdue initiate a discussion on whether CS should be placed under the Science requirement category. For example, instead of the Science requirement being "3+1 chem", consider "3+1 (Chem or CS)".

3. [**Quality of math and CS education**] While Math education in US schools has a rather long history, CS education is relative new. Many universities provide sound programs in training Math teachers for high schools; this however is not true for CS. Hence, any decision regarding the possible replacement of a Math course by a CS course must be based on (a) a thorough study of the quality of CS courses in US high schools and (b) the nature of the material covered in CS courses and its relationship to what a student would miss if she or he did not take a Math course. I strongly believe that it would be premature for Purdue to alter its proposed Math requirement and allow incoming freshman to replace a Math course by a CS course without a detailed study mentioned in (a) and (b).

4. [**United States and Math**] As you might be aware, if we go by the Trends in International Mathematics and Science Study (TIMSS) study, Math education in the US seems to have improved. Based on the average Math scores of grade 8 students, United States was ranked

---

[1] I have read the document dated June 23, 2010 sent to Associate Provost XXXX by a group of four members of Purdue faculty/staff.

9th among 48 countries, an improvement over the 15th rank in 2003 and 19th in 1999. By requiring four years of Math for all incoming students, Purdue can only benefit from this improvement in Math education. In return, it would encourage Math teachers to further improve Math education and students to take Math and do well in it.

5. [**Purdue: leader or follower?**] Indeed, the importance of computing has led several universities to consider AP CS as a replacement for a Math course in high school. Certainly, one might be tempted to use this as a reason for Purdue to follow suit. However, I believe that Purdue's preeminence requires that we thoroughly discuss this issue on our own without biasing ourselves by what others have done.

6. [**Rigor of Math and CS courses**] In your memo you mention "The Office of Admissions has always considered AP Computer Science a rigorous course and looked with favor in the admissions evaluation when students have elected the course. However, because the course is housed in various departments at the high school level, it has not been considered as a Math course per se." My interpretation of your memo is that you consider the rigor of the AP CS to be an appropriate reason for it to serve as a replacement for a fourth Math course. Are there other courses in the high school curricula that are as rigorous as AP CS? And if that is the case, then I wonder why only AP CS is to be considered as a replacement for a Math course.

7. [**Berkeley and Stanford**] I am told that a few universities in the US have agreed to use AP CS as a replacement for a Math course. However, when going through the Math requirements for engineering students at Berkeley and Stanford, I found that they specifically urge high school students to take as many Math courses as possible beyond the required three credits.

8. [**Math for CS, Engineers, and Scientists**] It is widely believed that a sound high school education for students, who wish to be computer scientists, engineers, physicists, mathematicians, and statisticians, requires a rigorous training in Mathematics. This training includes an AP Calculus and other courses offered in high school curricula. Changing Purdue's requirements as per your proposal would enable students to replace one Math course by one AP CS course. It would likely discourage at least some students from taking a Math course, and this could be a calculus course. I therefore believe replacing calculus by an AP CS course would not be in the best interest of many high school students.

9. [**Foundation: Math or CS?**] An AP CS course certainly does not provide knowledge that is as foundational as that provided by, for example, AP calculus. Thus, why replace a Math course by an AP CS course?

10. [**NSF**] The NSF is actively pursuing strategies to improve CS education in high schools across the nation. While I fully support NSF's role in this venture, I believe that it would be inappropriate for Purdue, or any university, to use replacement of a Math course by an AP CS course as a means to achieve this goal.

11. [**Math for non CS, Engineers and Scientists**] I do understand that despite the generic value of Mathematics education, for students aiming at certain disciplines not in engineering and science, four-years of Math might be overkill. Certainly such disciplines ought to be given an option to decide what would be the best alternative: an AP CS course or something else.

12. [**Computing requirement**] Recently in a message to Associate Dean XXXX dated July 16, 2010, Professor XXXX indicated "I think it makes a lot of sense to add AP CS to what is listed

at http://www.purdue.edu/Admissions/Undergrad/Admissions_Criteria/Math_Courses.html." Forgive me, but I disagree with Professor XXX's judgment. Instead I would like Purdue faculty, especially in engineering and science to consider including AP CS in the list of Lab Science courses alongside biology, chemistry, physics, anatomy, physiology, earth/space science. Or, as an alternate, consider adding a new program named Computing.

Any decision regarding the replacement of a Math course in high school is too important a topic to be left to a handful of faculty or university administrators. Faculty in different colleges must be given an opportunity to discuss this topic at length and make a recommendation to their respective units. Your letter gives the Deans August 15, 2010 as the deadline for their response. This simply does not offer enough time for discussion among faculty. I therefore request that you postpone any decision on changing the already announced Math requirement until after faculty has had a chance to discuss this issue.

Given that Purdue's new Math requirement is intended to improve the overall quality of incoming students and consequently retention as well as Purdue's overall ranking, it is important that we not change this requirement unless there is strong evidence otherwise.

Finally, my sincere apologies for this rather long response to your memo to the Deans. My intense involvement in CS, Mathematics, and Engineering since 1968 has led me to understand the relative importance of these disciplines and this forced me to offer you my rather passionately worded rationale and concerns.

Best regards.

Aditya Mathur
Head, Computer Science

CC: XXXX

High School Course Expectations for 2011 Enrollment

Proposed alternates to Dean Pam Horn's proposal to replace "4-year Math requirement" by "3-year math + an optional AP CS to replace the fourth Math course."

Alternate A: Add AP CS to the list of Lab Science Course.

College/School/Program	High School Semesters or Equivalent				
	Math (1)	**Lab Science (2)**	English (3)	Foreign Language (4)	Social Studies
Agriculture	8	6	8	4	6
Consumer and Family Sciences	8	6	8	4	6
Education	8	6	8	4	6
Engineering	8	6 (2 must be chemistry)	8	4	6
Health Sciences	8	6	8	4	6
Liberal Arts	8	6	8	4	6
Management	8	6	8	4	6
Nursing	8	6 (2 must be biology and 2 chemistry)	8	4	6
Pre-pharmacy	8	6 (2 must be biology and 2 chemistry)	8	4	6
Science	8	6	8	4	6
Technology	8	6	8	4	6
Undergraduate Studies Program	8	6	8	4	6
Veterinary Technology (Bachelor's)	8	6 (2 must be biology and 2 chemistry	8		6
Veterinary Technology (Associate)	6	2 biology, 2 chemistry	8		6

1 Beginning with students who apply for 2011 enrollment, Purdue requires 8 semesters of college-preparatory math. View a list of college-prep math courses that Purdue can and cannot accept toward this requirement.

2 Lab science includes biology, chemistry, **computer science,** physics, anatomy, physiology, earth/space science, etc.

3 English includes grammar, composition, literature, speech, and vocabulary, but not journalism, newspaper, yearbook, or theatre arts.

4 Students do not have to take four semesters of the same foreign language. American Sign Language counts if it is part of a secondary school's curriculum.

Alternate B: Add Computer Science as a new program.

College/School/Program	High School Semesters or Equivalent					
	Math (1)	Lab Science (2)	English (3)	Foreign Language (4)	Social Studies	**Computer Science (5)**
Agriculture	8	6	8	4	6	**2**
Consumer and Family Sciences	8	6	8	4	6	**2**
Education	8	6	8	4	6	**2**
Engineering	8	6 (2 must be chemistry)	8	4	6	**2**
Health Sciences	8	6	8	4	6	**2**
Liberal Arts	8	6	8	4	6	**2**
Management	8	6	8	4	6	**2**
Nursing	8	6 (2 must be biology and 2 chemistry)	8	4	6	**2**
Pre-pharmacy	8	6 (2 must be biology and 2 chemistry)	8	4	6	**2**
Science	8	6	8	4	6	**2**
Technology	8	6	8	4	6	**2**
Undergraduate Studies Program	8	6	8	4	6	**2**
Veterinary Technology (Bachelor's)	8	6 (2 must be biology and 2 chemistry	8		6	**2**
Veterinary Technology (Associate)	6	2 biology, 2 chemistry	8		6	**0**

1 Beginning with students who apply for 2011 enrollment, Purdue requires 8 semesters of college-preparatory math. View a list of college-prep math courses that Purdue can and cannot accept toward this requirement.

2 Lab science includes biology, chemistry, physics, anatomy, physiology, earth/space science, etc.

3 English includes grammar, composition, literature, speech, and vocabulary, but not journalism, newspaper, yearbook, or theatre arts.

4 Students do not have to take four semesters of the same foreign language. American Sign

Language counts if it is part of a secondary school's curriculum.
5. Students who take AP Computer Science may reduce the Lab Science credit requirement by 2 while retaining the listed course constraints.