PURDUE
UNIVERSITY

January 26, 2011

Dear President Córdova:
Greetings from Computer Science!

Data included here reveals the appalling overlap across the Computer Science and Computer Engineering programs at Purdue. We sincerely request that Purdue urgently consider the following.

Option A: Create a new School of Computer Science and Engineering, in the College of Engineering, by consolidating the Computer Science and Computer Engineering programs.
Option B: Move Computer Science as an independent program in the College of Engineering and create conditions to allow joint degree offerings by Computer Engineering and Computer Science

The addendum articulates how either of the above options will (a) improve **student experience** through reduction in class sizes and a comprehensive set of course offerings (b) achieve significant **cost reduction** through coordinated hiring and consolidation of resources, (c) enrich **research experience** for graduate students, and (d) increase **research awards** through enhanced synergies. We are convinced that the concerned Deans and Department Heads will not take the necessary bold decision without pressure from your office. Hence we request the creation of a high-level committee that, through an open process, will examine the issue and make recommendations that will benefit the students and accrue substantial savings. *Inaction in this matter runs the risk of significant damage to Computer Science.*

Respectfully,

John Rice
Professor Emeritus and Member National Academy of Engineering
Head Department of Computer Science 1983-1996

Ahmed Sameh
Samuel D. Conte Professor of Computer Science
Head Department of Computer Science 1997-2002

Aditya Mathur
Professor of Computer Science
Head Department of Computer Science 2007-2010

Cc: Provost Tim Sands
Addendum: Overlap Between Computer Engineering and Computer Science Programs at Purdue University, West Lafayette Campus

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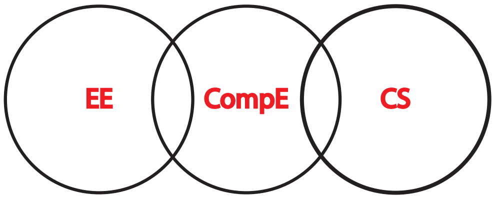
Overlap Between Computer Engineering and Computer Science Programs at Purdue University, West Lafayette Campus

January 26, 2011

Prepared for: President France A. Córdova
Copy to: Provost Tim Sands

> *Purdue has an excellent reputation, is a pride of the State of Indiana, has outstanding faculty, and attracts top students. However, regardless of it's standing, any university must urgently address problems that directly concern student experience, fiscal issues, and research synergies.*

Contents



1. Summary of overlap

Item	Computer Engineering[1]	Computer Science[2]
Faculty	30	43
Faulty with research areas that exist in both programs	28	38
Duplicate courses: Undergraduate	12	
Duplicate courses: Graduate	7	
Overlapping core courses: Undergraduate[3]	5	
Distinct courses that could be offered to students in either programs[4]	6	29
Research areas common to both programs	11	
Areas in need of strengthening in one program, but which exist with significant strength in the other program	Information security Software Engineering	Computer Architecture

[1] Data obtained from https://engineering.purdue.edu/ECE/People/Faculty/Areas/?area_id=2589

Some faculty members in Computer Engineering (CompE) overlap with other areas of research in the School of Electrical and Computer Engineering.

[2] Data obtained from: http://www.cs.purdue.edu/people/faculty/
Courtesy and joint appointments less than or equal to 25% are not included.

[3] The 200-level architecture /digital design courses offered in the two programs are excluded from this count. However, if the two programs were to offer a joint degree then only one of these two courses will be needed.

[4] Some courses included are 490s and 490s that are offered occasionally. Also, not all such courses are included in these counts. In all there are many courses that offered independently by the two programs but that belong to both CS and CompE.

2. Exploiting the overlap and complementary strengths

Student Experiences and Learning: As summarized earlier, there exists a significant overlap between CS and Computer Engineering, there also exist areas of complementary strength. For example, Computer Architecture (hardware) has been a traditional (and appropriate) strength in Computer Engineering. However, School boundaries have made it difficult for CS students to take courses in Computer Architecture. In fact there have been periodic calls from faculty in CS to build a Computer Architecture group within CS. While this would undesirable on all counts, CS students would benefit tremendously from having close access to experts in Computer Architecture within Computer Engineering. Similarly, Engineering students would benefit tremendously from CS' traditional strength in Numerical Methods (a cornerstone of any Engineering Discipline). There are merely a few examples of instances where student experiences and learning would benefit significantly.

Fiscal Efficiencies from Consolidation: Significant cost reductions can be achieved by the proposed move. For example, over the past five years, Computer Science, perceiving a gap in the areas of Data Mining and Machine Learning, hired four Assistant Professors. This completely ignored the presence of an excellent group in Computer Engineering in this area. Computer Science also hired an Assistant Professor in the area of Visualization. Concurrently, the existing group in Computer Engineering also (independently) hired an Assistant Professor in the same area, and is looking to grow this year. Computer Engineering hired in the areas of Compilers and Programming Languages, when a large group exists in Computer Science in this area. Needless to say, had Computer Engineering and CS been able to consolidate hiring, the university would have saved at least seven faculty lines over the past five years. Going forward, as our senior faculty members retire (and others move), these issues will continue to arise. We can choose to ignore expertise existing across Computer Engineering and CS and replace these faculty to guard turf, or bring the two departments closer together to seek efficiencies and explore new areas and synergies.

Research Synergies and Funding: CS faculty has been successful in attracting large federally funded projects. In fact, two large projects, the recently funded Science and Technology Center on the Science of Information (NSF, $25M) and the Department of Energy PSAAP PRISM Center (DoE, $17M), have both been collaborative efforts between CS and various Engineering departments. This kind of synergy does not exist between CS and any other science department. Forthcoming initiatives in Wind Energy (ME, ECE, CS), Embedded Systems (ECE, CS), and active structures (Civil, CS), all involve engineering departments and CS. This has happened largely because a small group of professors have made the effort to reach out across school boundaries to build collaborations. This process can be significantly enhanced through proposed consolidation, resulting in increased funding and participation.

Research Experiences for Graduate Students: Corresponding to the research projects, research experiences for graduate students can be improved through increased collaboration and interaction. Indeed, we argue that computing is an essential aspect of virtually every engineering discipline, and by removing administrative boundaries we will allow engineering and CS students to realize their full research potential.

3. Overlap in Research Programs

Note that not all faculty listed here are **formally** associated with the CE program in ECE, but they are in the ECE department and their areas of interest overlap with those of CS faculty.

Area	**Count***	**Faculty****	
		Computer Engineering	**Computer Science**
Bioinformatics and Computational Biology	9	Ersoy, Ghafoor	Grama, Kihara, Pothen, Qi, Si, Skeel, Szpankowski
Computational Science and Engineering (includes modeling, simulation, and parallel algorithms)	13	Clark, Doerschuk, Eigenmann, Pai, Siskind	Grama, Hoffmann, Pothen, Rego, Sacks, Sameh, Skeel
Databases and Data Mining	11	Allebach, Ghafoor	Aref, Bhargava, Bertino, Clifton, Elmagarmid, Hambrusch, Neville, Prabhakar, Si
Distributed Systems	14	Bagchi, Hu	Bhargava, Eugster, Grama, Hosking, Jagannathan, Killian, Nita-Rotaru, Park, Rego, Xu, Yau
Graphics and Visualization	7	Ebert, Elmqvist	Aliaga, Hoffmann, Popescu, Sacks, Tricoche
Information Security and Assurance	15	Delp, Kak	Atallah, Bertino, Bhargava, Clifton, Fahmy, Nita-Rotaru, N. Li, Nita-Rotaru, Park, Prabhakar, Rego, Spafford, J. Vitek
Machine Learning	9	Gelfand, Givan, Lebanon,	Clifton, Neville, Si, Qi

and Information Retrieval		Lee, Siskind	
Networking and Operating Systems	17	Ersoy, Ghafoor, Hu, Lin, Lu, Pai, Raghunathan, Rao, Zoltowski	Comer, Fahmy, Killian, Kompella, Nita-Rotaru, Park, Xu, Yau
Programming Languages and Compilers	11	Harper, Kulkarni, Midkiff, Eigenmann, Vijaykumar	Eugster, Hosking, Jagannathan, Z. Li, J. Vitek. Zhang
Software Engineering	7	Ghafoor, Kak, Jesiek	Dunsmore, Eugster, Mathur, Zhang
Theory of Computing and Algorithms	5	Siskind	Atallah, Frederickson, Hambrusch, Szpankowski

** Count of CS and ECE faculty in an area; note that one faculty member might appear in more than one area. ** Joint appointments are not included.

Data source: Web sites of Computer Science and Computer Engineering programs and their faculty.

4. Overlap in Course Offerings

Area	ECE Courses	"Nearly Equivalent" CS Courses
Artificial Intelligence	ECE 473 Introduction to Artificial Intelligence ECE 570 Artificial Intelligence	CS 47100 Introduction to Artificial Intelligence
Compilers	ECE 468 Introduction to Compilers and Translation Engineering ECE 573 Optimizing Compilers	CS 35200 Compilers Principles and Practice CS 50200 Compiling and Programming Systems
Graphics and Visualization	EE 495E Computer Graphics EE 595E Visualization	CS 33400 Fundamentals of Computer Graphics CS 53000 Introduction to Scientific
Computer Security	ECE 404 Introduction to Computer Security	CS 42600 Computer Security
Data Structures	ECE 368 Data Structures	CS 25100 Data Structures
Databases	ECE 562 Introduction to Data Management	CS 44800 Introduction to Relational Database Systems
Discrete Mathematics	ECE 369 Discrete Mathematics for Computer Engineering	CS 18200 Foundations of Computer Science
Distributed Systems	ECE 673 Distributed Computing Systems	CS 50500 Distributed Systems
Networking	ECE 463 Introduction to Computer communication Networks ECE 547 Introduction to Computer Communication Networks	CS 42200 Computer Networks CS 53600 Data Communication and Computer Networks
Operating Systems	ECE 469 Operating Systems Engineering	CS 35400 Operating Systems CS 50300 Operating Systems
Parallel Programming	ECE 563 Programming Parallel Machines	CS 52500 Parallel Computing
Programming	ECE 264 Advanced C Programming ECE 435 Object-Oriented Design Using C++ and Java ECE 462 Object Oriented Programming Using C++ and Java	CS 24000 Programming in C CS 18000 Programming I CS 390 JAV Advanced Java Programming CS 390 CPP C++ Programming
Software Engineering	ECE 364 Software Engineering Tools Laboratory ECE 461 Software Engineering	CS 30700 Software Engineering CS 51000 Software Engineering

Data source: Web sites of Computer Science and Computer Engineering programs and their respective faculty.

5. Enrollments in Overlapping Courses

Computer Engineering	Enrollment		Computer Science	Enrollment	
	Fall 2010	Spring 2011		Fall 2010	Spring 2011
ECE 473 Introduction to Artificial Intelligence	NO*	15	CS 47100 Introduction to Artificial Intelligence	36	NO
ECE 570 Artificial Intelligence	12	NO	CS 590 ML0: Statistical machine Learning	NO	18
ECE 468 Introduction to Compilers and Translation Engineering	35	NO	CS 35200 Compilers Principles and Practice	32	30
ECE 573 Compiler and Translator Writing Systems	NO	29	CS 50200 Compiling and Programming Systems	NO	48
EE 495 Fundamentals of Computer Graphics	18	NO	CS 33400 Fundamentals of Computer Graphics	17	NO
EE 595-002 Visualization	9	NO	CS 53000 Introduction to Scientific Computation	27	NO
ECE 404 Introduction to Computer Security	NO	29	CS 42600 Computer Security	44	NO
			CS 526 Information Security	35	43
ECE 368 Data Structures	58	32	CS 25100 Data Structures	64	113
ECE 562 Introduction to Data Management	NO	NO	CS 44800 Introduction to Relational Database Systems	NO	25
ECE 369 Discrete Mathematics for Computer Engineering	76	20	CS 18200 Foundations of Computer Science	123	195
ECE 673 Distributed Computing Systems	12		CS 50500 Distributed Systems	NO	35
ECE 463 Introduction to Computer communication Networks	17	NO	CS 42200 Computer Networks	NO	46
ECE 547 Introduction to Computer Communication Networks	4	NO	CS 53600 Data Communication and Computer Networks	29	31
ECE 469 Operating Systems Engineering	NO	37	CS 35400 Operating Systems	49	33
			CS 50300 Operating Systems	32	30
ECE 563 Programming Parallel Machines	NO	34	CS 52500 Parallel Computing	NO	29

ECE 264 Advanced C Programming	129	90	CS 24000 Programming in C	140	182
ECE 435 Object-Oriented Design Using C++ and Java	NO	NO	CS 18000 Programming I	237	148
ECE 462 Object Oriented Programming Using C++ and Java	49	NO	CS 390 JAV Advanced Java Programming CS 390 CPP C++ Programming	NO NO	30 30
ECE 364 Software Engineering Tools Laboratory	41	64	CS 30700 Software Engineering	NO	91
ECE 461 Software Engineering	NO	NO	CS 51000 Software Engineering	32	NO

*NO: Not offered

Data source: http://mypurdue.purdue.edu

6. Correspondence between Core Computing Courses taken by Computer Science and Computer Engineering majors

Computer Science	Computer Engineering	Comments
CS 182 Foundations of Computer Science	ECE 369 Discrete Mathematics for Computer Engineering	CS 182 is a discrete mathematics course
CS 180 Problem Solving and Object Oriented Programming	ECE 462 Object Oriented Programming Using C++ and Java	CS majors cover C++ in CS 240 and in another 1-credit class.
CS 240 Programming in C	ECE 264 Advanced C Programming	The term “Advanced” in ECE 264 exists because all engineering freshman take a class in basic C programming. CS majors cover the basic and advanced C programming.
CS 251 Data Structures and Algorithms	ECE 368 Data Structures	These two courses are nearly identical and have been so for over a decade.
CS 250 Computer Architecture	ECE 270 Introduction to Digital Systems Design	These two courses perhaps should not be considered as equivalent. However, if there were a joint CS/CompE program, then only one of these courses would be adequate; most likely it would be ECE 270.
CS 252 Systems Programming	No equivalent course	This is a new course in Computer Science. There is no clear equivalent of this in Computer Engineering though Computer Engineering majors in other courses cover several techniques and tools in this course.

Data source: Web sites of Computer Science and Computer Engineering programs.

7. Complementary courses in computing that could be offered to students in either program

Area	Course
Architecture	ECE 270 Intro to Digital Systems Design
	ECE 362 Microprocessor Systems and Interfacing
	ECE 437 Computer Design and Prototyping
	ECE 438 Digital Signal Processing and Applications
	ECE 565 Computer Architecture
	ECE 695 Fault Tolerant Computer Systems Design
Systems and Software (includes programming, compiling, operating systems, security, networks, graphics)	CS 177 Programming with Multimedia Objects
	CS 252 Systems Programming
	CS 314 Numerical Methods
	CS 348 Information Systems
	CS 352 Compilers: Principles and Practice
	CS 354 Operating Systems
	CS 381 Introduction to the analysis of Algorithms
	CS 390 JAV Advanced Java Programming
	CS 390 PYT Python Programming
	CS 390 CPP Python Programming
	CS 448 Introduction to Relational Database Systems
	CS 456 Programming Languages
	CS 490-006 SAN Over UDP Design Analysis
	CS 490-007 Fast Tree Rendering
	CS 490-008 Relational vs OODBMS
	CS 490-009 Robust Computational Geometry
	CS 490-011 Java Persistence Frameworks
	CS 490-012 Image Based Vision Correction
	CS 490-ESO Software For Embedded Systems*
	CS 490-HC0 HCI Issues and Implementation
	CS 490-ST0: Software Testing
	CS 503 Operating Systems
	CS 526 Information Security
	CS 590-024: Security in SOA
	CS 590 CC0 Cyber Conflict in 21st Century
	CS 590 ES0 Embedded Systems
	CS 626 LE1 Advanced Information Assurance
	CS 635 LE2 Capturing and Rendering Real-World Scenes
	CS 661 Formal Compiling Methods

- Offered jointly in Spring 2011

Data source: Web sites of Computer Science and Computer Engineering programs.

8. Computer Science and Computer Engineering: A problem and an appeal

[*A problem*] The signatories feel compelled to alert Purdue administration to a problem that has lingered for years. This problem concerns the proper alignment of two academic programs of vital importance in the 21st century – Computer Science (CS) and Computer Engineering (CompE). The Department of Computer Science at Purdue was established in 1962 when the field was in its infancy. At that time many, at Purdue, strongly believed that Computer Science should be a branch of Applied Mathematics. Since then, the field has evolved significantly into an engineering discipline. A quick survey shows that this fact has been acknowledged not only by Purdue's higher ranked peers such as the University of Michigan, the University of Illinois at Urbana-Champaign, UC- Berkeley, and MIT, but by many other distinguished universities in the U.S. and abroad, in which Computer Science is located in their respective Colleges of Engineering. A thoughtful proposal was made by one of us (A. Mathur), during his tenure as Head of CS, in which he outlined the rationale for relocating CS into its proper engineering environment. Elements of this proposal are included in an addendum to this letter.

[*Overlap among research areas*] Similarly, when the CompE program was established at Purdue around 1995, and included with Electrical Engineering to form ECE, it was mostly a hardware-oriented discipline. Since then it has evolved significantly into one that considerably overlaps with Computer Science. In fact, now at Purdue, the overlap between the CompE and Computer Science programs is astounding, both in duplicating faculty expertise, as well as in duplicating course offerings. Both programs have faculty in the following eleven areas:

1. Algorithms,
2. Artificial Intelligence,
3. Bioinformatics,
4. Compilers,
5. Databases and Data Mining,
6. Computer Graphics and Visualization,
7. High Performance Computing,
8. Information Security,
9. Machine Learning and Information Retrieval,
10. Networking, and
11. Software Engineering.

[*Overlap among course offerings*] Moreover, there are at least 19 courses at the undergraduate and graduate levels that have significant content overlap. *Kindly refer to the tables in this Addendum*. Computer Architecture is the only area in which there is no overlap – Computer Science has no faculty presence in this important area. While some overlap in research and course offerings is inevitable at a large university, Purdue should not allow such extensive duplication of programs to continue *in two different colleges and with two different admission standards*. While Purdue has tolerated this duplication during years of generous state budgets, allowing it to continue during years of fiscal stringency would border on fiscal irresponsibility.

[*Views of students and alumni*] Over the years, new faculty members, graduate and undergraduate students in CS and CompE have often wondered openly as to why Purdue has Computer Engineering and Computer Science in two different colleges. It is also of interest to note that nearly all employers who visit Purdue to interview CompE students also interview Computer Science students for the same jobs, and vice versa. In fact, many Purdue alumni, including a CEO of a large defense company have, in private conversations, wondered why Purdue is reluctant to move Computer Science to the College of Engineering *"where it truly belongs"*. There is also strong support among CS alumni for such a move. Actually, in several annual meetings of the Department's Corporate Partners program (with over 30 members), not a single corporate representative favored the status quo, i.e., Computer Science remaining in the College of Science.

[*CS full professors ignored*] The proposal for relocating CS in the College of Engineering, was first discussed by the CS faculty in the fall of 2008, and further debated at several faculty meetings. Further, the CS faculty and staff completed a survey during the 2008-09 academic year as instructed by the interim Dean of the College of Science. In spite of the fact that the proposal to move CS to Engineering has been supported by a majority of the Full Professors of the Department of Computer Science, the Deans of the Colleges of Engineering and Science, as well as the then University Provost (the Chief Academic Officer) avoided any serious and transparent study of this problem.

On April 8, 2009, a letter signed by 14 Full Professors of the Department of Computer Science was sent to the then Provost supporting the move. Only six Full Professors of the Department were not on the list of signatories that included: all the Department's named and distinguished professors, all university faculty scholars, two of the three former Department Heads closely associated with the department, and one member of the National Academy of Engineering. One Full Professor among the six was on a long leave of absence and hence did not get an opportunity to sign the letter. Rather than favor an academically sound option that promises to bring *tremendous benefits to Purdue's students and save a substantial amount in recurring funds*, unfortunately the then Provost decided to give more credence to self-serving concerns. Thus 14 Full Professors felt totally ignored without a single response from the then Provost.

[*Opposition to moving Computer Science to Engineering*] Few faculty members of Computer Science and Electrical and Computer Engineering (ECE) also oppose the proposed relocation. Apparently, the administration of ECE believes that CompE offers nearly all the courses needed for their students to learn about any subject in Computer Science. Consequently it feels there is no need for the College of Engineering to host another department that offers the same set of courses. Such an attitude clearly attests to the staggering overlap and wasteful spending we emphasized earlier. As the engineering world moves closer and closer to software-driven systems of all kinds, such as automobiles, medical devices, satellites, and smart phones, the College of Engineering (and Purdue) allowed its CompE program *to introduce duplicates of existing Computer Science courses!* Thus, ECE administration's fear of having a strong Computer Science faculty and program in the same College has prevented clear and careful consideration by the College of Engineering of the issue, ignoring the benefits to Purdue, its students, and to the State of Indiana.

A minority of the Computer Science faculty has a variety of reasons for opposing the relocation of Computer Science to the College of Engineering. When asked to generate a proposal as to why Computer Science is not an engineering discipline and that it should remain in the College of Science, the leader of the opposition group declined to present such a case. In fact, to this day, no University administrator, including the Dean of the College of Science, has articulated an academic argument, let alone a fiscally responsible, against the proposed relocation.

[*An ineffective compromise solution*] Most recently, the Interim Department Head of Computer Science has proposed that the department make a case for offering an undergraduate degree in Computer Science to students in the College of Engineering. This is a well-intentioned proposal and might be a good first step resolving issues mentioned here. However, it totally sidesteps the problem of overlap mentioned earlier and ignores the tremendous benefits, e.g., dual degrees and new collaborative programs with other schools in the College of Engineering, that would accrue to Purdue students and faculty by moving Computer Science to the College of Engineering.

[*Response of Purdue's Higher Administration*] Unfortunately, the response of Purdue's higher administration so far gives the impression that Purdue has decided to ignore the various academic and financial benefits of locating the CS and CompE programs in the same College of Engineering.

[*An appeal*] *We appeal to you Madam President to urgently intervene in resolving the issues raised in this letter. It is clear by now, and after nearly three years, that the Deans of Engineering and Science are either reluctant, or unable to address the problem of placing CS in its proper environment.* We urge you, and our University's Chief Academic Officer (Provost) to seriously study the issues raised here, and take steps to shoulder the academic and fiscal responsibilities entrusted to you by the citizens of the State of Indiana. Continuing the duplication of two nationally ranked undergraduate and graduate academic programs in two different colleges *with two different standards of admission* is, in our opinion, inexcusable!