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**PART I - THE SCHOOL OF COMPUTATIONAL SCIENCE  
AT FLORIDA STATE UNIVERSITY**

**PART II - SHOULD UNIVERSITIES HAVE TENURE AND DEGREE  
GRANTING DEPARTMENTS OF CSE?**

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## PART II - SHOULD UNIVERSITIES HAVE TENURE AND DEGREE GRANTING DEPARTMENTS OF CSE?

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*To be, or not to be: that is the question:  
Whether 'tis nobler in the mind to suffer  
The slings and arrows of outrageous fortune,  
Or to take arms against a sea of troubles*

⋮

and create a CSE department!

From *Computational Science: Ensuring America's Competitiveness*, Report to the President, President's Information Technology Advisory Committee (PITAC), June, 2005.

Traditional disciplinary boundaries within academia and Federal R&D agencies inhibit the development of effective research and education in computational science. The paucity of incentives for longer-term multidisciplinary, multi-agency, or multi-sector efforts stifles structural innovation.

To confront these issues, universities must significantly change their organizational structures to promote and reward collaborative research that invigorates and advances multidisciplinary science. They must also implement new multidisciplinary structures and organizations that provide rigorous, multifaceted educational preparation for the growing ranks of computational scientists the Nation will need to remain at the forefront of scientific discovery.

(Emphases are mine)

## PRINCIPAL RECOMMENDATION

*Universities and the Federal government's R&D agencies must make coordinated, fundamental, structural changes that affirm the integral role of computational science in addressing the 21st century's most important problems, which are predominantly multidisciplinary, multi-agency, multi-sector, and collaborative. To initiate the required transformation, the Federal government, in partnership with academia and industry, must also create and execute a multi-decade roadmap directed coordinated advances in computational science and its applications in science and engineering disciplines.*

(Emphasis is PITAC's)

## Something that is **not** a good justification for forming a Department of CSE

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- There are certainly many examples of departments being created to solve a real or perceived political problem within a university
  - this is why many applied mathematics departments came into being, e.g.,
    - to resolve conflicts within a mathematics department
    - because a mathematics department ignored the needs of engineering students
- But, creating a department solely to lessen internal conflicts is a mistake
  - one has to have sound reasons that are completely divorced from university politics

## Disciplines and departments

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- It can be argued that the development of a new academic discipline justifies the creation of a new department
  - but, of course, one has to first define “discipline”
  - some universities have separate botany and zoology departments, but are those separate disciplines or are they part of the single discipline that is biology?
  - some universities have separate oceanography and meteorology departments, while others have one department covering both areas
  - certainly, many would argue that statistics is just a branch of mathematics and is no more a separate discipline than are topology, algebra, numerical analysis, etc.
    - yet, many if not most universities have statistics departments that are separate from mathematics

- to a somewhat lesser extent, there exist several applied mathematics departments
  - despite the fact that, by its very name, “applied mathematics” carries the implication that it is a sub-discipline of mathematics
- then there is computer science
  - one can advance the argument that computer science is merely a combination of portions of several other disciplines but is not a discipline in of itself
- What is clear from precedents set at many universities over many years is that although the existence of a discipline can justify the existence of a department, the existence of a department does not require the existence of a discipline
- so, we will not waste any time arguing about whether CSE is or is not a discipline

- We will, however, use the term “discipline” in the tautological sense that something is a discipline if everyone agrees it is one
  - physics, biology, mathematics, history, engineering, chemistry, English are examples of disciplines
  
- So, we pose the following three questions
  - what are the justifications for creating a new department that consists of elements from several disciplines?
  - what are the justifications for creating a new department in a subset of a single discipline?
  - should universities have degree and tenure granting CSE departments?

## What are the justifications for creating a new department that consists of elements from several disciplines?

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- One could argue that uniting faculty from several disciplines but who have a common interest would result in improved training and research
  - new synergies would be created
  - a new department could better respond to a pressing need for interdisciplinary training and research
- These arguments were applied to the case of computer science departments
- Other historical examples exist

- A few decades ago, many universities created nuclear engineering departments; this was during the heyday of nuclear power plant construction

Even before that time, many universities created aeronautics/aerospace engineering departments, again, in response to the need for rapid advances in airplane and rocket design

- faculty were gathered together from two or more existing departments to create the new departments for the reasons advanced above
- we don't build nuclear plants any more and the aeronautics and aerospace industry is not as vibrant as it used to be, so many universities have done away with their aeronautics departments and most universities have done away with their nuclear engineering departments, distributing their faculty to other departments

- despite the lack of staying power of such departments, few would argue against the observations
  - that these departments were very successful at meeting the needs present at the time of their creation
  - that without the existence of those departments, the needs would not have been met as well
- More recent examples are the creation of ethnic studies departments, e.g., African-American, Latino-American, Women's, etc.
  - one can easily believe that there are faculty and students in those departments that would feel at home in history, English, political science, sociology, etc., i.e., in departments tied to traditional disciplines

- The same rationale was used to justify the creation of all these departments, namely
  - that everyone involved had a common interest that overrode the fact that they were trained and had worked in different traditional disciplines
  - that uniting a diverse set of faculty would result in greater benefit to students and to knowledge compared to not doing so
- For computer science it was computers that bound the newly labeled computer scientists together
  - for nuclear engineering it was nuclear reactors
  - for African-American Studies it was interest in the varied aspects of the African-American experience

## What is the justification for creating a new department in a subset of a single discipline?

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- It is perhaps more difficult to come up with justifications for creating a new department in a subset of a single discipline
  - despite the fact that it has been done many times
- One reason is to overcome a civil war within a department
  - many applied mathematics departments started for this reason

- At other times, a new subdisciplinary department is created because the faculty involved, not only locally but nationally, have a sufficiently different outlook on research compared to their colleagues
  - possibly this is why many statistics departments were formed
    - many of the faculty initially involved were very applied and in fact were part of statistical consulting groups at universities
    - they would not have fit in very well in mathematics departments of 50 or more years ago
    - so, when these consulting groups were turned into teaching units, it is not surprising that they did not want to join mathematics departments

## How does computational science fit into the picture?

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- Clearly, it fits into the first picture
  - a CSE department would be one made up of faculty from several traditional disciplines
- Before we discuss justifications for forming CSE departments, we make a few more preparatory remarks

## Are there parallels to the CSE situation?

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- There are probably many parallels to the CSE situation, i.e., several answers to the question:
  - are there faculty who are currently housed in several traditional departments who have a strong common interest and who perhaps should consider forming a new department?
- One example is fluid mechanics
  - fluids is done in almost every engineering department, in geophysics departments (geology, meteorology, and oceanography), in mathematics, and probably some more (but, curiously, it is not done usually done in physics)
    - why not form a Department of Fluid Mechanics?

- Another example is material science
  - there is often faculty doing material science in physics, chemistry, mathematics, engineering, and other departments
    - why not form a Department of Material Sciences?
    - actually, this has been done
- This is not the place to discuss whether or not there should be Departments of Fluid Mechanics and Material Sciences
  - here, we merely observe that, at least a superficial level, the situation computational science finds itself in is apparently not unique

## If we have CSE departments, why not also ESE and TSE departments?

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- If there is justification for forming computational science departments department, why don't we also form a Department of Experimental Science and Engineering and a Department of Theoretical Science and Engineering?
  - perhaps the answer is that the tools and infrastructure used to do experiments and theory in two sciences are too different for such an aggregation to work
  - although it may be wrong to assume so, it seems that the details that one needs to master to do field biology are somewhat different than those needed to use a particle accelerator

## Are CSE departments a totally new idea?

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- Are departments in computational science a totally new idea?
  - there are some in Asia
    - e.g., in China and Japan
  - there are even some in the US
    - e.g., SUNY Brockport, George Mason University

## What about CSE in non-academic environments?

- Are there environments other than universities in which forming a “department” of computational science has led to tangible benefits?
- Funding agencies are one example
  - at the Department of Energy, scientific computing is basically under one umbrella, i.e., a single unit funds engineers, mathematicians, computer scientists, scientists, etc. doing computational science
  - as a result, many believe that the DOE does a good job at fostering interdisciplinary scientific computing at universities and laboratories

- The DOE labs are another example
  - many of them have “departments” of computational science in the form of truly interdisciplinary institutes, centers, groups, etc. devoted to this endeavor
  - these units are very successful and their close-knit interdisciplinary nature is a major contributor to that success
  - although they are not teaching or tenure granting units, they share the same characteristic of not sharing control with other units at the same administrative level

## Why should there be Departments of CSE?

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- Based on the previous discussion, the answer to this question is contained in the answer to the two questions:
  - exactly what is it that CSE people have in common?
  - what benefits could accrue from creating a CSE department?

- Whatever else we have in common, **the one thing that should unite CSE people is their shared interest in algorithms** for solving problems in the sciences and engineering
  - a CSE department should be made up of faculty, students, postdocs, etc., who are primarily interested in creating better algorithms or better algorithmic implementations or better algorithmic analyses
  - these efforts could be focused on specific disciplines or could cut across several disciplines
  - CSE departments should **not** be outgrowths of a single existing discipline or department
    - one should not fall into the trap of thinking that a CSE department should be spawned, e.g., from a math department
    - CSE departments should be an aggregation of people from several existing disciplines and departments

– the question of who would want to be in such a department is then easy to answer

it is those whose interest in developing new and better algorithms,  
even if they are only to be used within a single discipline,  
is above their interest in solving specific problems in that discipline

- What would be gained by forming CSE departments?
  - interdisciplinary interactions among computational scientists would be facilitated
  - such interactions would allow for the easy transfer of information among researchers with seemingly diverse interests
  - allow for new modes of student and postdoc training
  - although these activities could conceivably be carried out in CSE centers, institutes, etc., it is possible most could be gained by doing them in a CSE department

- There are other tangible (political) benefits that could result from forming CSE departments
  - CSE faculty would have **control** over the creation and management of their own degree programs
  - CSE faculty would have **control** over the recruitment and training of their own students
  - CSE faculty would have **control** over the faculty recruitment and tenure processes

## Why should there **not** be Departments of CSE?

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- Some existing departments might become alienated and/or threatened
- Some faculty not invited into the new department could be jealous
- Some faculty will not want to join, not wishing to break ties with their traditional “discipline”

**My own opinion?**

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## My own opinion?

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- Forming CSE departments is an experiment worth trying

- one could fall flat on one's face,

- but

- one could also

- create a model of how computational science and engineering should be done at a university*