Strategic Plan

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New Strategic Plan

- Since the development of the 2003 hiring plan, many internal and external constraints have changed:
  - Political priorities (on the national, regional, local and university level).
  - New research opportunities/trends.
  - Loss of academic staff (and thus expertise in certain areas).

- There is still a need for a significant increase of the permanent academic staff.

- The growth should be based on strategic considerations and on building existing as well as new areas of research strength.

Strategic Importance and Relevance

- Computers pervade all parts of human activities and they are indispensable in our modern society.

- New research areas such as pervasive computing, networks, new kinds of interfaces, massive data, etc.

- Interdisciplinary and multidisciplinary.

- National level:
  Research and higher education are considered to be key areas in the development of international competitiveness.

- Regional level:
  Initiatives within food, energy/environment, and healthcare.

- Local level:
  Development of the IT City Katrinebjerg.

University Development Contract (1)

- The multidisciplinary aspects have been reinforced by the recent fusions with e.g.:
    - Aarhus School of Business (Handelshøjskolen),
    - Danish National Environmental Research Institute (Danmarks Miljøundersøgelser)
    - Danish Institute of Agricultural Sciences (Danmarks JordbrugsForskning).

- Strong collaboration with the Engineering College of Aarhus (Ingeniørhøjskolen) around the new Aarhus School of Engineering (ASE).

- Theoretical natural sciences are among the six focus research areas identified in the contract with the Ministry of Science. The department is involved in many of these activities.

University Development Contract (2)

- The university has the ambitious goal to double the number of PhD students.

- This is likely to imply that the number of PhD students in science (and also in computer science) will be more than doubled.

- Broader use of university research, e.g. through patents, licensing agreements and spin-off companies, as well as collaboration with industry and local government.

- The IT-City Katrinebjerg and the Alexandra Institute are specifically mentioned as a unique environment for establishing close collaboration between researchers, the private industry and other organisations.

- A significant expansion of the IT-education on the bachelor and master level is one of the university's main educational priorities.

- It is expected that a good deal of the new admissions will be within the Department of Computer Science (e.g. IT-bachelor).

Department of Computer Science

- Computer science started at the University of Aarhus in 1971 as a part of the Department of Mathematical Sciences.

- In the period 1993-1998, computer science went through a very rapid growth increasing the total staff from 80 to 160 people – primarily due to a dramatic increase in the amount of external funding.

- An independent Department of Computer Science was created in January 1998.

- Over the next 5-6 years, the department gradually moved to new buildings as a part of the university's plan to concentrate the ITC activities in the IT-City Katrinebjerg.

- There is a close collaboration with other organisations in Katrinebjerg, in particular with the Department of Information and Media Sciences and the Alexandra Institute.
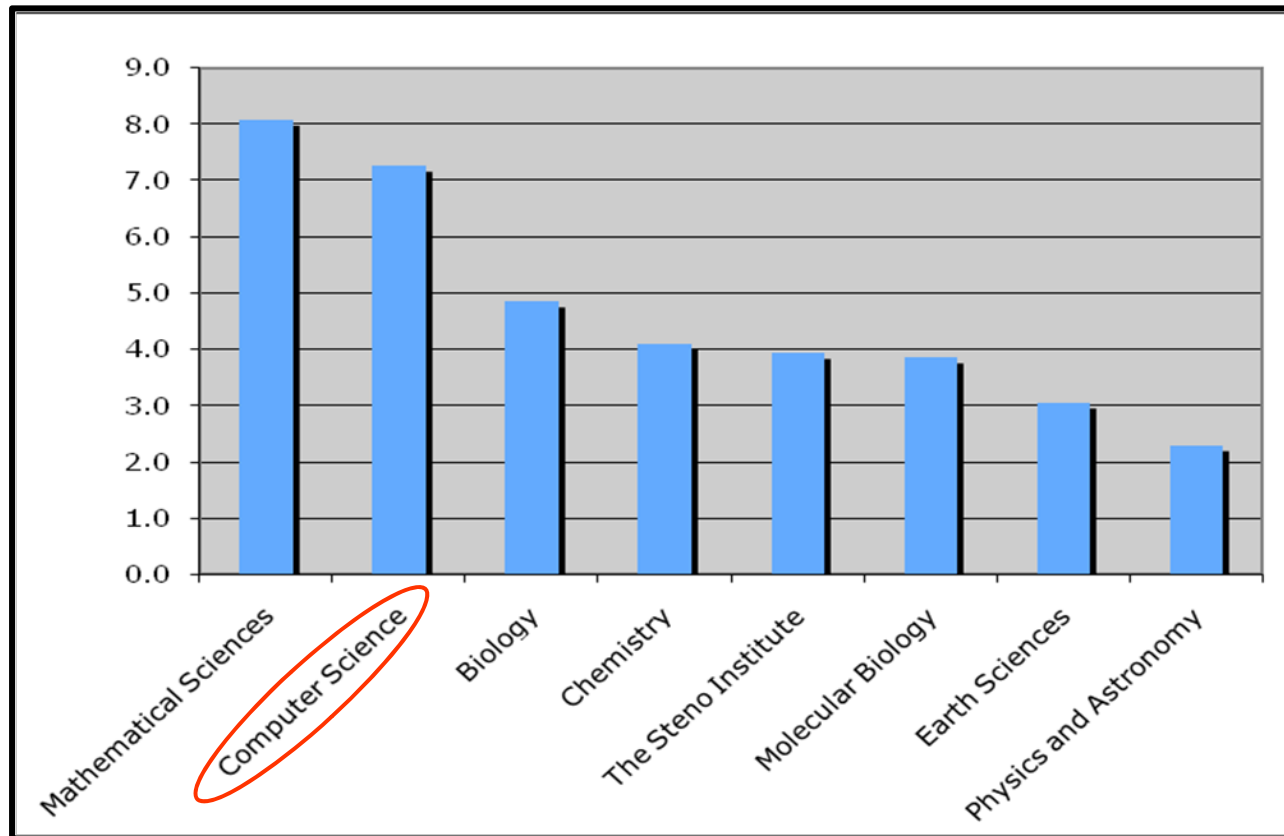
Development in Permanent Academic Staff

- The permanent academic staff has been rather stable over the last 20 years and has not increased proportional to the growth in total staff.
- From 1989 to 2003 there were around 20 members of the permanent academic staff. Then the number was increased to 27.
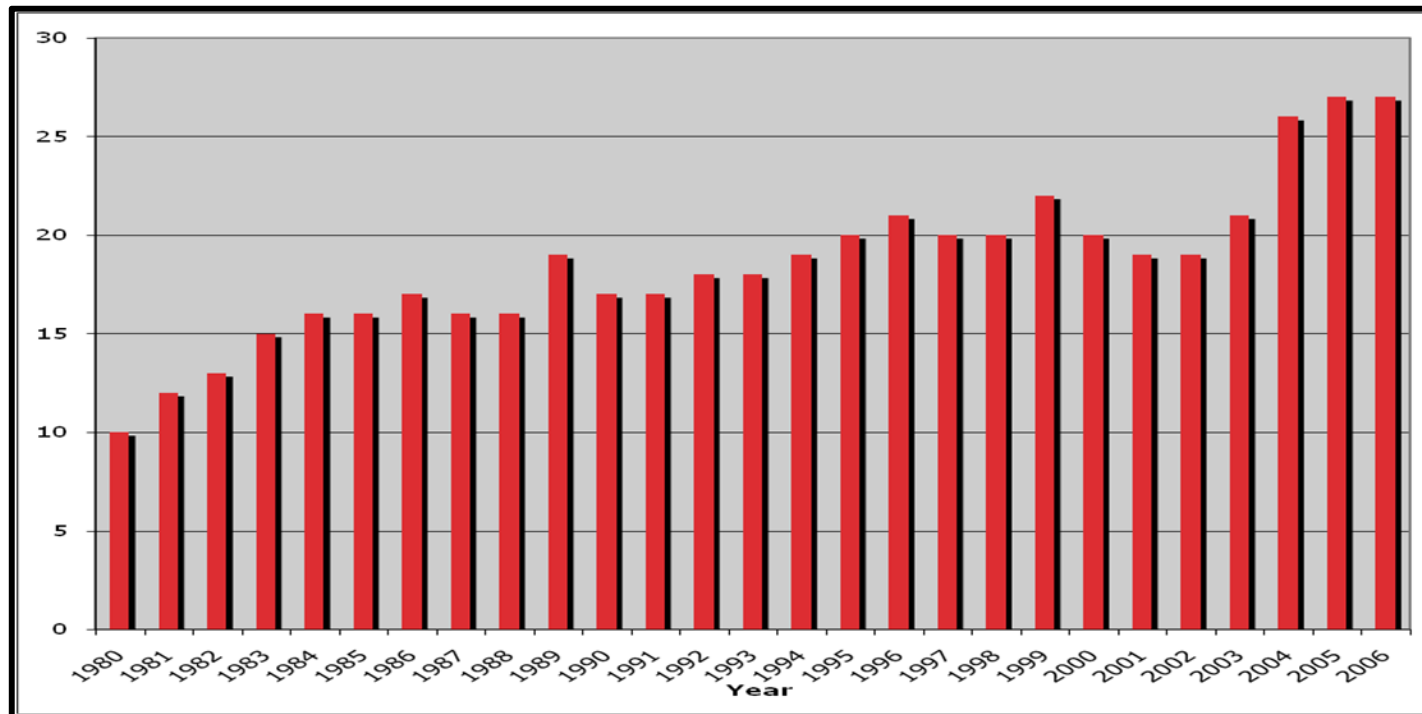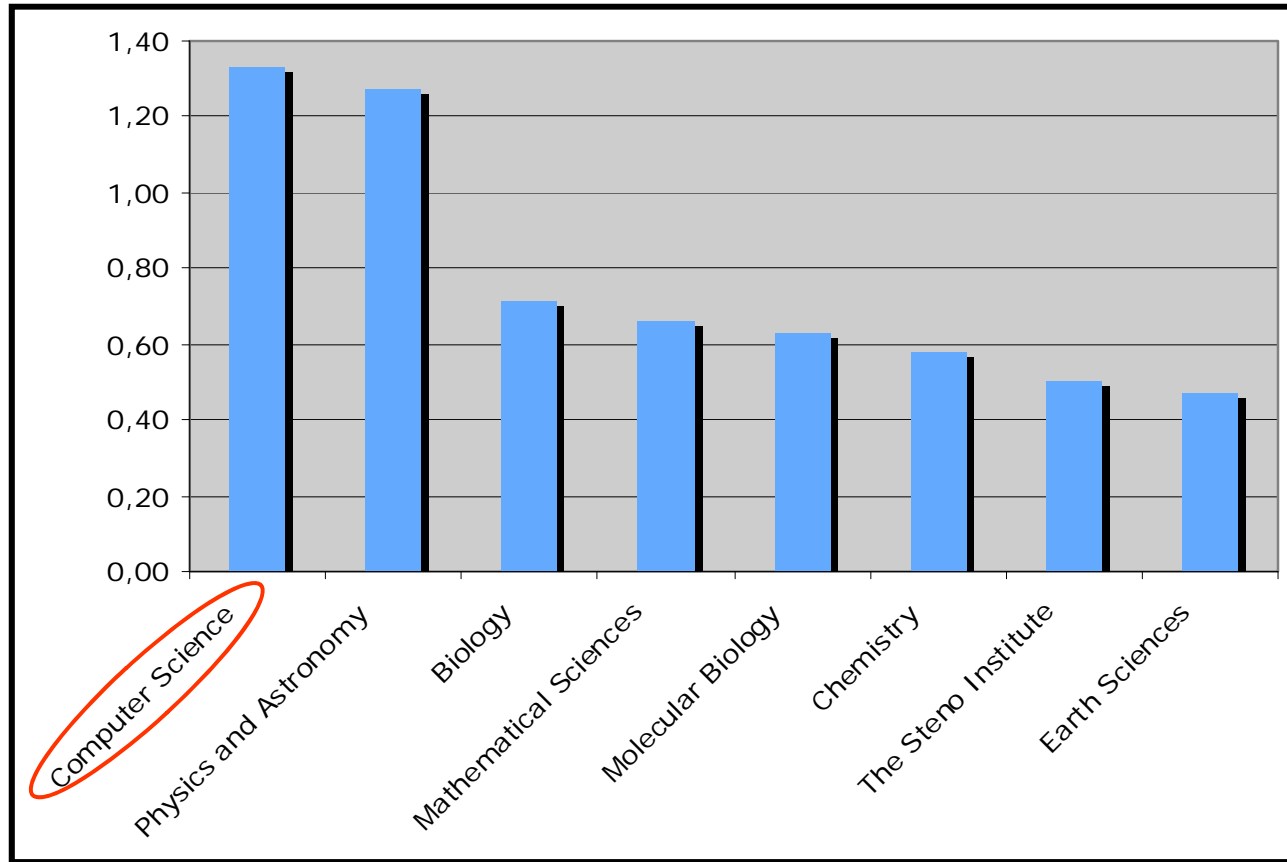
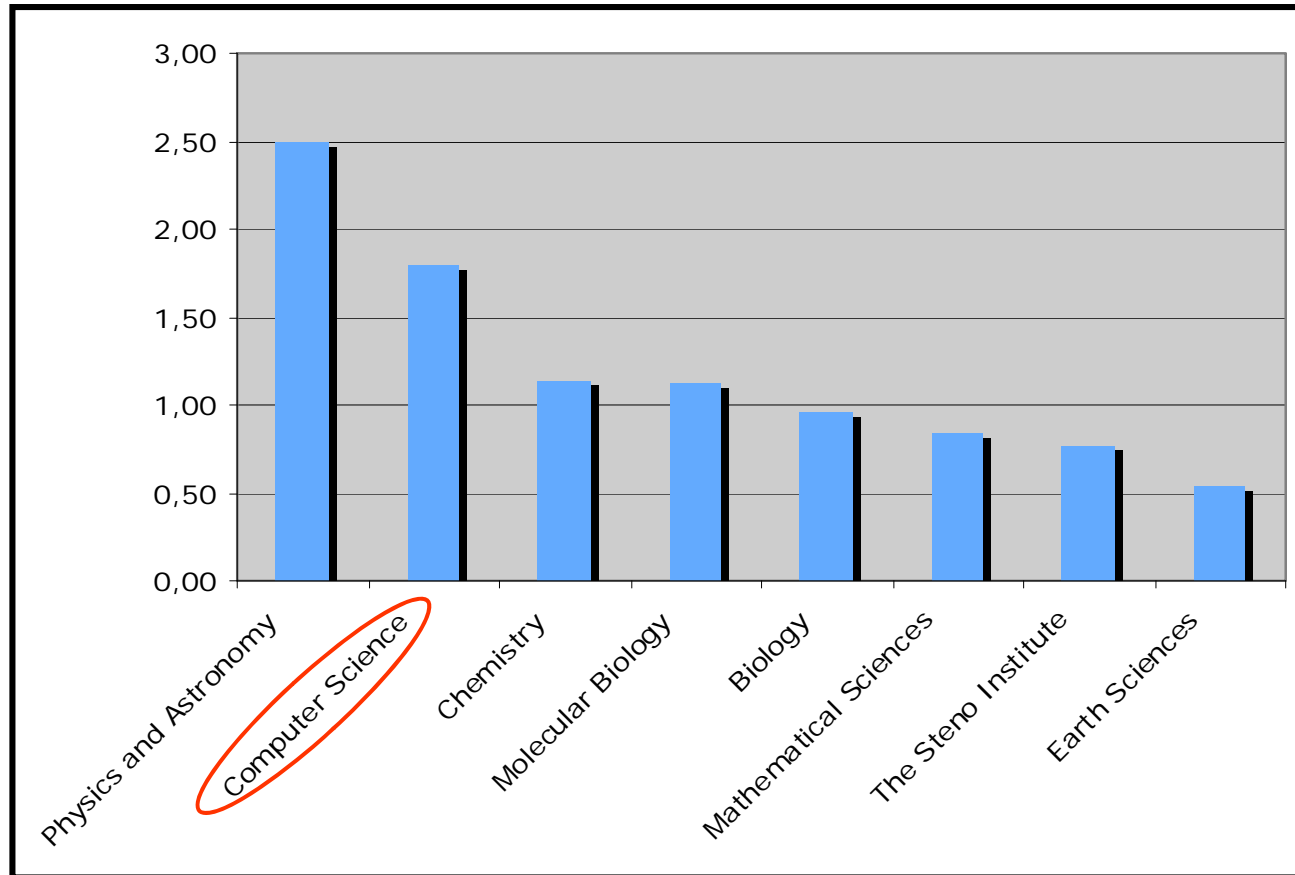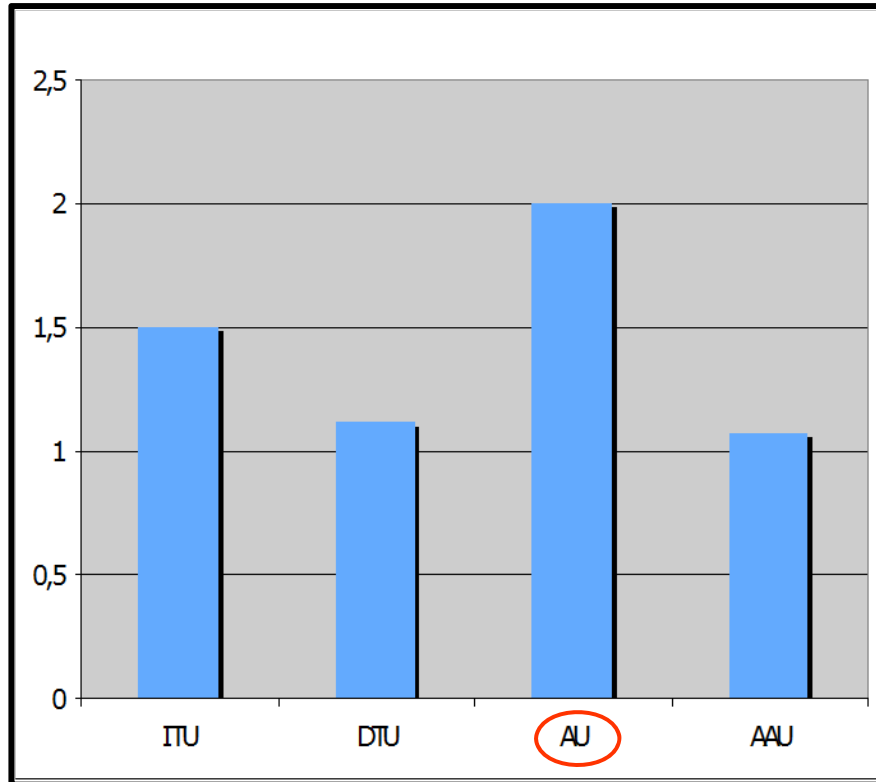# Student-Year Production (STÅ) relative to Total Academic Staff

Number of PhD Students relative to Total Academic Staff

Number of PhD Students relative to Permanent Academic Staff

Number of PhD Students relative to Permanent Academic Staff

- Numbers are from a joint benchmarking project with the following participants:
- IT University of Copenhagen (ITU).
- Institute for Mathematical Modelling at the Danish Technical University, Lyngby (IMM).
- Department of Computer Science at the University of Aarhus (AU).
- Department of Computer Science at the Aalborg University (AAU).

Number of Refereed Publications relative to Total Academic Staff
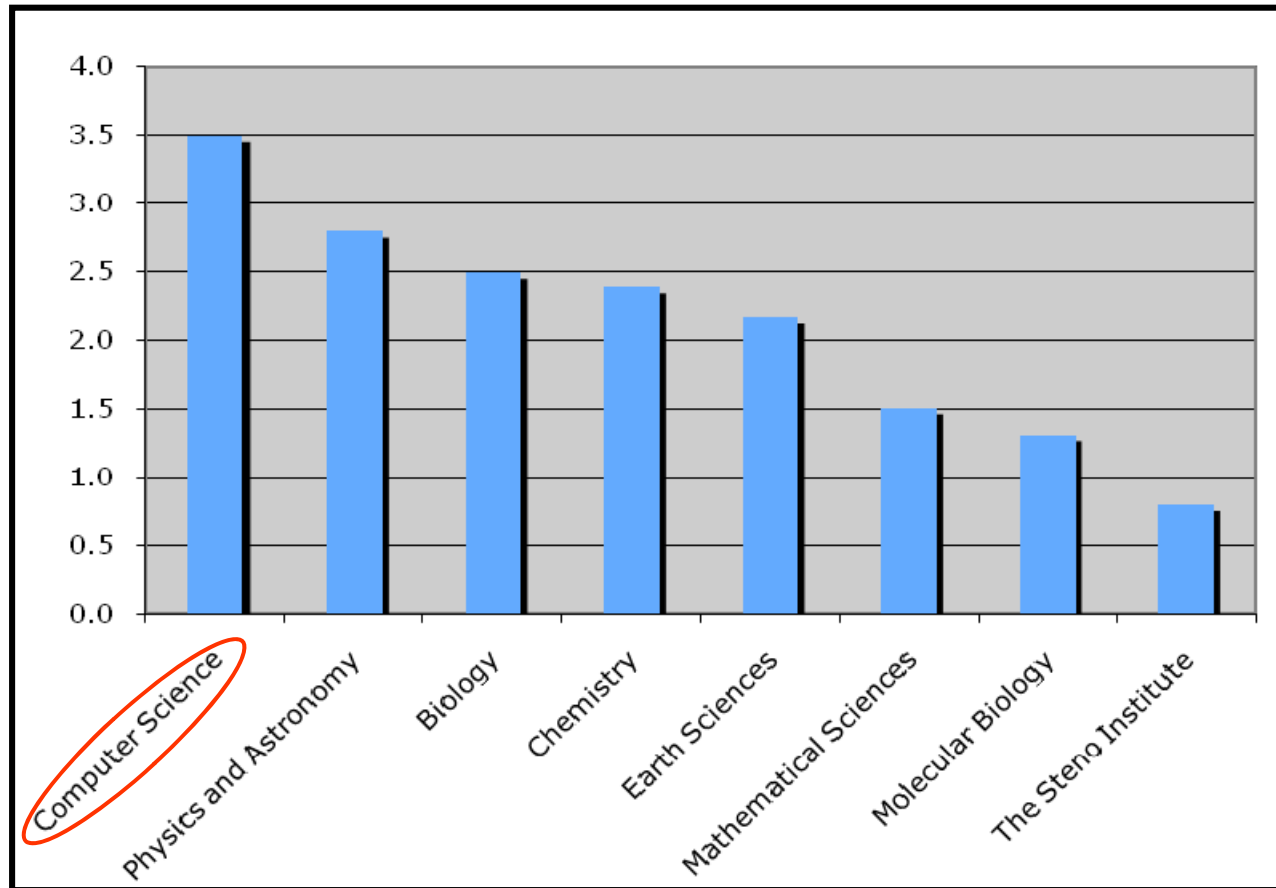
Number of Refereed Publications and Books relative to Total Academic Staff
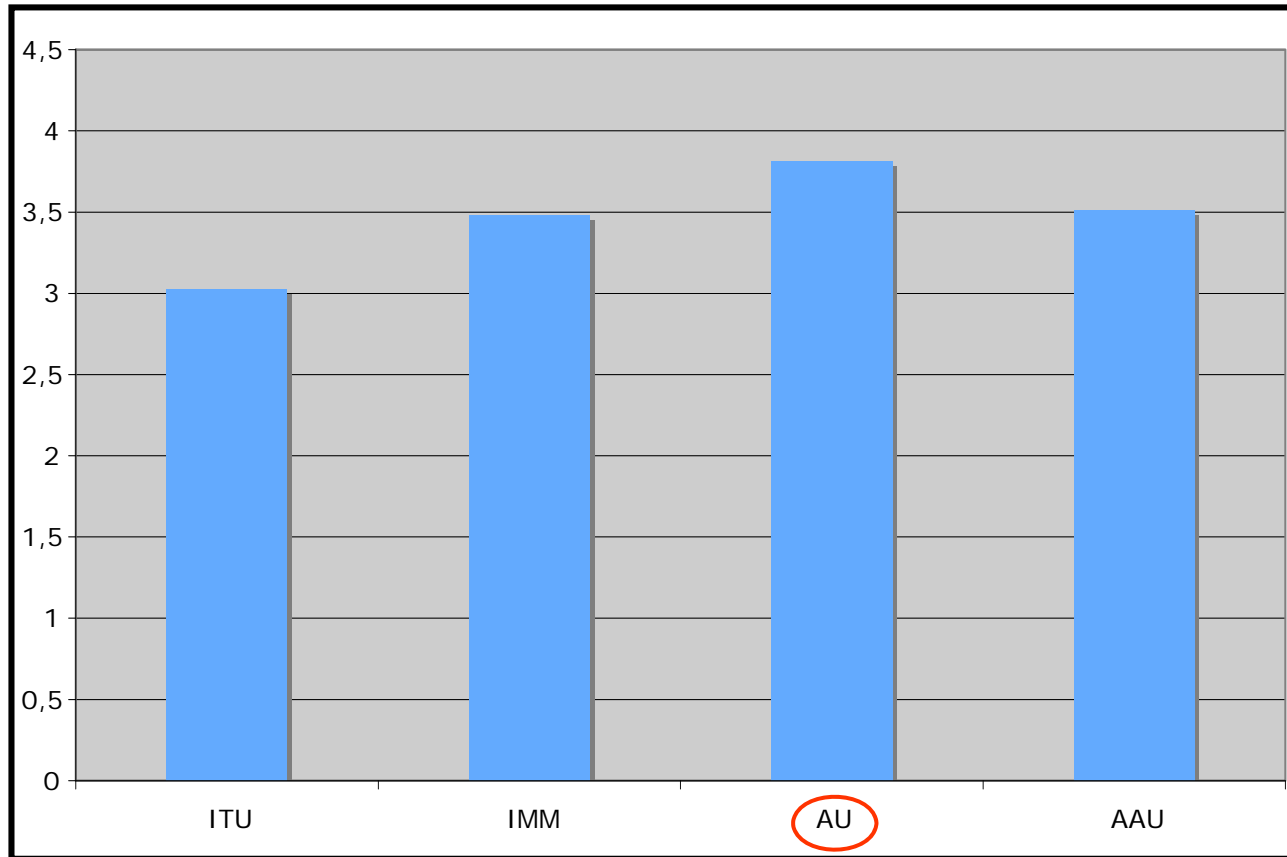
Percentage of Permanent Academic Staff with H-index above 5, 10 and 20.
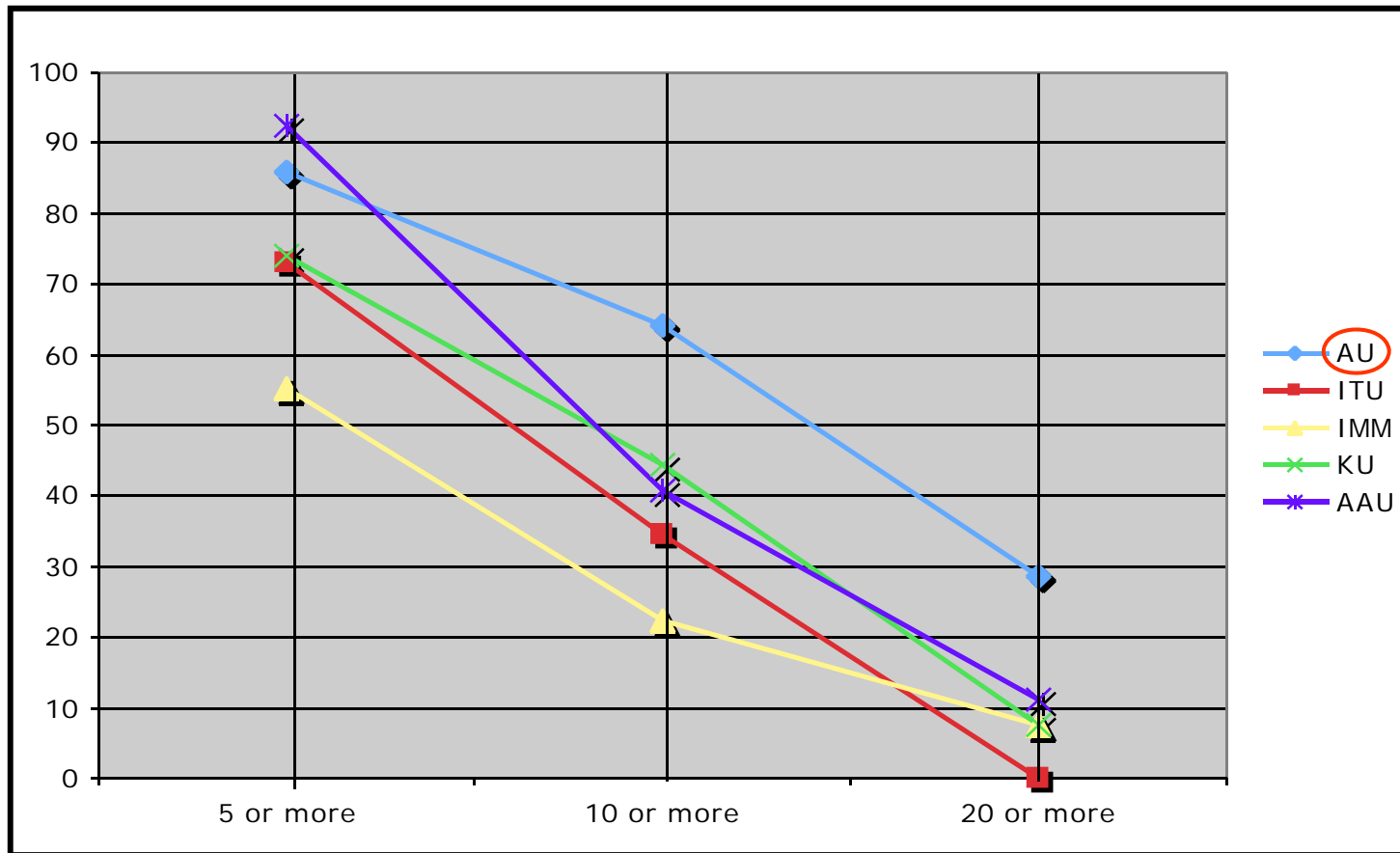
Research Groups (1)

- <u>Algorithms and Data Structures</u>:
  Lars Arge, Gerth Stølting Brodal.

- <u>Bioinformatics</u>:
  Christian Nørgaard Storm Pedersen.

- <u>Complexity Theory</u>:
  Gudmund Frandsen, Peter Bro Miltersen.

- <u>Computer Graphics and Scientific Computing</u>:
  Ole Østerby, Peter Møller-Nielsen, (Ken Museth, adjunct prof).

- <u>Cryptography and Security</u>:
  Ivan Bjerre Damgård.

Research Groups (2)

- <u>Human-Computer Interaction</u>:
  Olav Wedege Bertelsen, Susanne Bødker, Kaj Grønbæk,
  Morten Kyng, Preben Holst Mogensen.

- <u>Modelling and Validation of Distributed Systems</u>:
  Søren Christensen (half-time), (Kurt Jensen).

- <u>Object-Oriented Software Systems</u>:
  (Michael Caspersen), Henrik Bærbak Christensen,
  Klaus Marius Hansen.

- <u>Programming Languages and Formal Models</u>:
  Olivier Danvy, Erik Ernst, Anders Møller, Klaus Ostermann,
  Michael I. Schwartzbach.

- <u>Outside groups</u>:
  Ole Caprani.

Strategic Opportunities

- The challenges computer scientists are facing can no longer be overcome by using expertise from only one part of computer science.

- Interdisciplinary and multidisciplinary research is a key to progress, and this calls for collaboration between different parts of computer science as well as collaboration with other sciences.

- At the same time, political priorities on national and regional levels put computer science in a central position, thus creating a potential which the department should be ready to exploit.

- On the next slides we will look at opportunities:
  - within the department.
  - within the Faculty of Science.
  - with other institutions.

Opportunities within the Department

- The department already hosts a number of joint research projects where some of our existing groups work together, e.g.:
  - Secure Information Management and Processing (SIMAP),
  - Palpable Computing (PALCOM), and
  - IT Security for Citizens (ITSCI).

- Thus, the department has proved to be capable of exploiting opportunities for synergies between existing groups, and we believe the same can be done between existing groups and new related areas which we wish to develop.

- Such a strategy seems much more feasible than attempts at developing completely new groups: it will in general be easier to attract highly qualified people when they can relate to researchers already in the department.

Synergies within the Department (1)

- Efficient algorithms for handling massive amounts of data is an increasingly important research area with strong connections to, e.g., pervasive computing.
    - In addition to the importance as a core area, it also offers excellent possibilities for multidisciplinary collaboration.
    - As an example, the area of databases acts as a catalyst between algorithms and data structures on one side and programming languages and formal models on the other side.

- The algorithmics and complexity community has recently taken an interest in game theory, resulting in the development of algorithmic game theory.
    - This is very much in line with the trend towards widespread use of computers, which naturally implies that we think of computers, not as stand-alone, but as entities that interact with others who may, however, have conflicting interests.

Synergies within the Department (2)

- More widespread use of computers means that IT-security becomes an even more important issue.
    - Specifying and designing secure systems requires ability to express desired security goals and analyse whether they have been achieved. Therefore, the border area between programming languages and formal methods and cryptography and security is very promising.

- In practice, security of a system depends, not only on technical soundness, but also on its usability.
    - If users fail to understand relevant security aspects of a system, they will make bad decisions and security may be lost, and hence security in practice is to a large extent a border area between cryptography and security and human-computer interaction.

Synergies within the Department (3)

- Pervasive computing has long been a focus area for our department.
  - The success of pervasive systems depends crucially on their user interfaces, the software architecture, their efficiency and the networks/protocols by which computers may dynamically utilise resources available at other computers.
  - In addition, the reliability of such systems is a crucial factor, and hence being able to validate and verify a system before deployment is an important goal.

- Finally, computer graphics is an area in which the department wants to build a new group. Also this is an area with strong connections to other activities and groups in the department.

Opportunities within the Faculty of Science

- Our department has been quite successful in discovering and exploiting opportunities for joint research ventures with other areas within the faculty, e.g.:
    - Algorithm and data structures with bio-sciences (within the Bioinformatics Research Center).
    - Cryptography and security with physics (producing joint research projects in quantum cryptography).
    - Algorithm and data structures with earth sciences and biology (developing frameworks for applications of GIS-systems).
    - Complexity theory and algorithm and data structures with mathematics (investigating opportunities for joint research within scientific computing).

- We think that such multidisciplinary initiatives are very important. However, they should be planned and coordinated at the faculty level, and hence they are not directly reflected in our hiring plan.

Opportunities with Other Institutions

- We are expanding our activities within pervasive healthcare with the University Hospital, the Institute of Experimental Clinical Research and the County. The Engineering College of Aarhus is also involved.

- We cooperate with the Aarhus School of Architecture within the joint Centre for Interactive Spaces.

- We also cooperate with some of the partners which have recently fusioned with the University, in particular:
  - Faculty of Agricultural Sciences (around massive terrain processing and more broadly GIS-systems.
  - National Environmental Research Institute (about climate change and GIS-systems).
  - Aarhus School of Business (about business development).

Opportunities with Other Institutions within Education

- The department also collaborates with a number of other institutions about education, e.g.:
    - Information and Media Sciences (the multimedia education and the BRICS2 PhD School).
    - Engineering College of Aarhus (graduate program in computer engineering).
    - Aarhus School of Architecture (the product design branch of the new IT-bachelor education).
    - Aarhus School of Business (the business branch of the new IT-bachelor education).

Refocusing Resources

- Loss of permanent staff members has significantly reduced some of our groups. We do not propose that such areas should invariably be re-staffed. Rather, we view this as an opportunity to refocus our resources.
    - As an early example, the department used to have significant expertise in VLSI design and development.
    - In more recent times, an active research group within complex systems and artificial intelligence has been completely depopulated.
    - At present, the activities within semantics and logic have suffered a similar loss, and we will refocus and consolidate our resources in the related areas of programming languages and mobile computing.
    - A similar refocusing has already taken place for the area of systems development, where our resources have been consolidated within the areas of human-computer interaction and pervasive computing.

Gender Issue

- The department has, similarly to many other computer science departments world wide, serious problems in recruiting female students and, in turn, female researchers.

    - The department tries to recruit more female students by running IT-camps for girls every fall.

    - We want to make it attractive for female students to enter PhD studies, and develop an employment policy that balances the evaluation of research merits with e.g. maternity leave periods.

    - We may consider hiring an "extra" female applicant when a female applicant for a position has got excellent evaluations without being the one chosen for the position.

    - We may establish search committees to locate appropriate female researchers.

International Staff

- Over the years, the department has had a large number of non-Danish members of its permanent academic staff.
    - This has been extremely fruitful and has significantly contributed to the success of the department.
    - Unfortunately, there is a higher turn-over rate for this group and most of them have left (primarily for family reasons or because they have won attractive professorships there).

- The department wants to increase the number of non-Danish academic staff members, which has now become rather low due to the reasons mentioned above.
    - To do we use search committees and our network to attract top-qualified staff from abroad (and from other Danish computer science departments).

More Permanent Staff is needed

- The shortage of permanent academic staff at the professor and associate professor level is increasingly becoming a serious bottleneck for further expansion of our activities.

- The department has a much smaller percentage of permanent academic staff than other comparable departments within Denmark and abroad.

- This means that the permanent academic staff uses a very substantial part of their time for project applications, project administration, and project leadership. This obviously decreases the incitement and possibilities to start new projects.

- Hence, the department proposes to increase the permanent academic staff from the present 25 people to 35 people in 2018.

- This is consistent with the vision of the department which says: "Over a period of 10 years the number of permanent academic members of staff should increase by 10, at least, half of them preferably from other institutions."

Permanent Staff are leaving

- Since 1995 the department has lost 15 members of its permanent staff.

- Most of these have won professorships at other universities in Denmark and abroad (or joined the management of our faculty). This is a clear witness of the excellent qualifications of our staff.

- There is no reason to believe that this trend will change over the next years.

- Moreover, there will be at least two retirements due to age within the next few years: Ole Østerby (born 1939) and Peter Møller-Nielsen (born 1942).

Detailed Hiring Plan

- We propose 16 new positions for the coming 5 year period.

- It is our experience from the previous plans that some of these positions will be postponed or cancelled for different reasons.

- On the other hand, there may also be situations in which we want to add a new position to the plan, e.g. if we loose existing staff with competences in critical areas or if we get the possibility to attract top-quality researchers within other interesting areas.

- We believe that the proposed plan is likely to result in an actual net growth of approximately one person per year over the five year period covered in this plan. If the actual net growth turns out to be significantly larger, the plan should be reconsidered.

Detailed Hiring Plan (2007-2009)

<u>2007</u>:

- Software architecture for distributed embedded systems (search committee; ongoing negotiations with appropriate candidate).

<u>2008</u>:

- Computer graphics (ongoing negotiations with very good candidate).
- Databases (delayed; search committee to be established soon).
- Interaction design (to be filled soon, 7 applicants).

<u>2009</u>:

- Complexity theory.
- Cryptographic protocols.
- Massive data algorithms.
- Software architecture for mobile computing.

Detailed Hiring Plan (2010-2012)

2010:

- Computer graphics.
- Databases.
- Massive data algorithms.
- Modern computer networks.

2011 and 2012:

- Context awareness and multi-sensory systems.
- Model checking.
- Programming languages and security.
- Security.

Questions/comments