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Traditional undergraduate education in science and technology

- ☞ *Little training in the use of computational tools*
- ☞ *Students*
 - *Do not learn to use numerical methods*
 - *Do not learn to write programs*
 - *Do not learn to use computational and data analysis tools, visualization etc*
- ☞ *So far, the curriculum normally not changed to make extensive use of computational tools in teaching*

Undergraduate education

- ☞ Many undergraduates are not well prepared for the needs of modern science/technology research and development in academia and industry*

Traditional PhD education in fields using eScience tools

- *Generally learning by doing*
- *Learn to handle the programs written in the group or to run black box codes*
- *Can not optimize the code used or add/implement new/modern numerical routines*
- *Difficult to introduce computational methods in new fields (biosciences, linguistics,...)*
- *Difficult to get access to suitable graduate courses*

Mission in 1995

- ☞ We need to give graduate students in applied fields a basic knowledge in basic eScience techniques:
 - numerical methods*
 - programming*
 - use of large-scale eScience tools for simulation, data analysis and collaboration**

- ☞ NGSSC was formed to address this issue!*

Formed in 1996 (funding from SSF 1996-2006, 72.6 MSEK)

Goal:

“to increase the competitiveness of research and development in academia and industry in Sweden by increased and improved use of advanced computational techniques”

Some results from the first phase of NGSSC (1996 -2006)

- ☞ 85 students admitted*
- ☞ More than 50 PhD exams within the program*
- ☞ Few drop-outs, some students still active, about 10 left with Licentiate degree*
- ☞ 12 specifically developed courses were developed and given on more than 50 occasions. Topics ranging from numerical methods and programming to computational chemistry, grid computing and visualization*
- ☞ Students/advisors from fields that were not traditional users of eScience tools were specially encouraged to apply*

Affiliations of some NGSSC PhDs after the exam:

- *Princeton (Junior Fellow)*
- *Harward (PostDoc)*
- *Stanford (KAW PostDoc in Bioinf.)*
- *Quantum Technologies, Uppsala (Founder of start-up company)*
- *Sectra AB, Linköping*
- *AgResearch Inc., Dunedin, NZ*
- *BioBridge Computing AB, Malmö*
- *East Sweden Development Agency, Linköping*
- *SMHI (Swedish Met. Office)*
- *Univ. of Melbourne, AUS (+ SSF PostDoc)*
- *Univ. of Queensland, AUS, (KAW PostDoc in Bioinf.)*
- *FOI*
- *Dept. of Math., LiU (Senior researcher)*
- *Rosslin Institute, SC, (KAW PostDoc in Bioinf.)*

*The second phase: Funding from Vetenskapsrådet
2007-2011*

*Produce Ph.D.'s that combines skills in important
applied disciplines with a broad knowledge of
advanced numerical and computational
techniques*

*Encourage interdisciplinary work and spread the
use of computational techniques into new areas
of research and development*

Means

- Provide funding for basic courses in basic eScience techniques tailored to applied sciences
- Provide funding also for more specialized courses
- Provide funding for the students to participate in the courses

The NGSSC concept

- Disciplinary training at home institutions
- Intensive courses provide the computational and mathematical core
- The courses are developed and given by leading experts on different locations within Sweden

NGSSC PhD students

- ➡ In application areas
- ➡ Geographically distributed
- ➡ Very different scientific and educational backgrounds
- ➡ Physics, chemistry, biochemistry, meteorology, geophysics, hydrology, ecology, ...

The NGSSC concept for courses

- The courses were normally organized by two universities, uses local expertise at the university
- NGSSC funds development and giving of the courses
- NGSSC students receive funding for travel and stay to participate in the courses
- The courses are open to other students
- Normally given at the end/beginning of a semester

NGSSC Syllabus

Basic courses

- Numerical Methods in Scientific Computing
- Programming in Science and Technology
- HPC I: Parallel Computers and Programming
- HPC II: Algorithms and Applications
- Data Management and tools

The NGSSC concept for courses

☞ Preparation:

- ☞ Student - teacher interaction via e-mail, etc

☞ Intensive program:

- ☞ Two weeks at organizing universities
- ☞ Individualized modules

☞ Project assignment:

- ☞ At home department
- ☞ Student - teacher interaction via e-mail, etc
- ☞ Preferably connected to the student's own research

NGSSC Syllabus

Advanced courses

- ☞ Specialized subject
- ☞ Each course given once or possibly repeated every second year
- ☞ Given in the NGSSC format or as a summer school
- ☞ May be given in collaboration with research groups or other research schools

NGSSC Syllabus

Advanced courses

- 👉 Finite Element Modelling and Simulation
- 👉 Computational Methods in Statistics with Applications
- 👉 Computational Biophysics/Pharmacology
- 👉 Data analysis in Genetics
- 👉 ...

Experience

- *Local support from supervisor important*
- *Teachers must be able to handle a vast difference in scientific background*
- *Intensive format makes it possible to fit in the courses with other activities*
- *Interdisciplinary interaction mainly between the students*