Welcome to our IT Research Strategy Conference

November 17, 2014
## Morning: Graduate education

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>08.45</td>
<td>Registration open</td>
</tr>
<tr>
<td>09.05</td>
<td>Welcome <a href="#">Ewert Bengtsson</a> and <a href="#">Michael Thuné</a></td>
</tr>
<tr>
<td>09.15</td>
<td>Presentations</td>
</tr>
<tr>
<td></td>
<td>- PhD education at IT <a href="#">Wang Yi</a></td>
</tr>
<tr>
<td></td>
<td>- Handling of problematic issues in PhD education <a href="#">Michael Thuné</a></td>
</tr>
<tr>
<td></td>
<td>- <a href="#">Karin Berggren Bremdal</a> Faculty officer (PhD education) at TekNat.</td>
</tr>
<tr>
<td></td>
<td>Rules for graduate education and the upcoming graduate education evaluation</td>
</tr>
<tr>
<td>10.00</td>
<td>REFRESHMENTS</td>
</tr>
<tr>
<td>10.30</td>
<td>Brain storming stations</td>
</tr>
<tr>
<td></td>
<td>- PhD Courses <a href="#">Bengt Jonsson</a></td>
</tr>
<tr>
<td></td>
<td>- Quality Improvement <a href="#">Ingela Nyström</a></td>
</tr>
<tr>
<td></td>
<td>- Goal and Evaluation <a href="#">Thomas Schön</a></td>
</tr>
<tr>
<td></td>
<td>- Problematic Issues <a href="#">Lina von Sydow</a></td>
</tr>
<tr>
<td>11.15</td>
<td>Prioritization</td>
</tr>
<tr>
<td>11.30</td>
<td>LUNCH at <a href="#">Restaurang Feiroz</a>,</td>
</tr>
<tr>
<td>12.30</td>
<td>Summary of graduate education session</td>
</tr>
</tbody>
</table>
# Afternoon: Research strategy

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.00</td>
<td>Presentation of Opportunities and Challenges</td>
</tr>
<tr>
<td></td>
<td>- The process to agree on new initiatives</td>
</tr>
<tr>
<td></td>
<td>Michael Thuné</td>
</tr>
<tr>
<td></td>
<td>- Established department wide research activities:</td>
</tr>
<tr>
<td></td>
<td>UpCERG, UPMARC, e-Science, IoT</td>
</tr>
<tr>
<td></td>
<td>Ewert Bengtsson</td>
</tr>
<tr>
<td></td>
<td>Biomedical information technology: Ewert Bengtsson</td>
</tr>
<tr>
<td></td>
<td>- New research arenas</td>
</tr>
<tr>
<td></td>
<td>Ewert Bengtsson</td>
</tr>
<tr>
<td>13.45</td>
<td>Four brain storming stations</td>
</tr>
<tr>
<td></td>
<td>- Process for strategic planning</td>
</tr>
<tr>
<td></td>
<td>Carolina Wählbly</td>
</tr>
<tr>
<td></td>
<td>- Established department wide research activities</td>
</tr>
<tr>
<td></td>
<td>Edith Ngai</td>
</tr>
<tr>
<td></td>
<td>- Present Arenas</td>
</tr>
<tr>
<td></td>
<td>Lisa Kaati</td>
</tr>
<tr>
<td></td>
<td>- New arenas</td>
</tr>
<tr>
<td></td>
<td>Ginevra Castellano</td>
</tr>
<tr>
<td>14.45</td>
<td>Prioritization</td>
</tr>
<tr>
<td>15.00</td>
<td>REFRESHMENTS</td>
</tr>
<tr>
<td>15.30</td>
<td>Collaboration activities (&quot;Samverkan&quot;)</td>
</tr>
<tr>
<td></td>
<td>Kjell Orsborn</td>
</tr>
<tr>
<td>15.45</td>
<td>Summary of the brain storming</td>
</tr>
<tr>
<td>16.30</td>
<td>The faculty perspective</td>
</tr>
<tr>
<td></td>
<td>Sverker Holmgren</td>
</tr>
<tr>
<td>17.00</td>
<td>Closing remarks</td>
</tr>
<tr>
<td>18.00</td>
<td>Dinner at Riksäpplet</td>
</tr>
</tbody>
</table>
Established department wide research activities:

- **eSSENCE**  E-science
- **UPMARC**  Uppsala Programming for Multicore Architectures Research Center
- **UpCERG**  Uppsala Computing Education Research Group
- **IoT**  Internet of Things
eSSENCE is a strategic collaborative research programme in e-science between Uppsala University, Lund University and Umeå University.

It originated from a governmental initiative to promote high-quality research in areas of strategic societal and industrial importance.

The vision of eSSENCE is to take Swedish e-science to the highest international level and build a creative research environment . . .

. . . where new e-science methods and tools are developed, implemented and applied
. . . where new e-science applications are discovered and developed
. . . where the next generation of e-science researchers is trained in forefront science

eSSENCE strives to create a research environment that enables a strong interplay between e-science research, e-infrastructures, e-education, industry and society.
eSSENCE – supports projects in several areas:

- Materials science
- Human function and environment
- Life science
- Generic e_Science methods and tools

- Participated at 10th IEEE International Conference on e-Science, October 20–24, 2014 | Guarujá, Brazil
Uppsala Programming for Multicore Architectures
Research Center

Bengt Jönsson, director
The Multicore Challenge

Performance of computers
[log]

“Moore’s Law”

Single Core

Multicores

Software must be parallelized

Grand challenge: How support software developers?
UPMARC Mission

Research

Address **fundamental challenges** that will enable **software developers** to **exploit** current and future parallel platforms

Education

Provide future students with skills to **exploit** current and future **parallel platforms**
Fundamental Challenges

Key thematic areas:

- Resource Management
  For performance and predictability
- Programming Languages
  Language constructs programming tools
- Verification
  For correctness
- Application Performance
  Principles for algorithm construction

These challenges need complementary expertise
Uppsala Computing Education Research Group

Arnold Pears
Anders Berglund

Department of Information Technology
Uppsala University
Sweden
Computing education research

- Education Research
- Computing Research
- Teaching and Learning Of Computer Science
- Computer Science Research

Venn diagram showing the intersections of these categories.
Current group structure

Group leader: Arnold Pears
Senior researchers
Anders Berglund Åsa Cajander
Mats Daniels Anna Eckerdal
Aletta Nylén Michael Thuné

Visiting researcher: Neena Thota

PhD student: Anne Peters

Members from 4 Divisions
http://www.it.uu.se/research/group/upcerg
Brief UpCERG history, 1995-2014

• "Grass roots" development since 1995

• Major contributor to international formation of Computing Education Research as a new discipline from late 1990's

• Significant external funding from late 1990's
  - VR/UVK, 2002-2004
  - Center of excellence RHU 2004-2008
  - Contracts with Saudi Arabia 2014-2017

• PhD programme from 2005, *datavetenskap med inriktning mot datavetenskapens didaktik*
Research challenges

- Conduct research which supports sustainable development of higher education to meet the changing needs of learners and society.
- Understanding how students learn complex computing concepts with the intent to improve the quality of the educational experience.
- Leverage cultural diversity in education to enhance the global research and development competences.
UpCERG output, 2005-2014

- 5 PhD theses
- 4 licentiate theses
- 5 book chapters
- 50+ peer reviewed journal articles
- 70+ refereed international conference papers
UpCERG

UpCERG receives over 10 million Swedish Crowns in collaborative research funding.
Internet of Things
a Strategic innovation area

Strategiska innovationsagendor där aktörer inom ett område gemensamt tar fram vision, mål och strategier.

Strategiska innovationsprogram för att förverkliga innovationsagendornas visioner och mål.
Aktörerna sätter agendan utifrån gemensamma behov ...

Stor statlig satsning: 500 miljoner/år plus medfinansiering
Från Agenda till Strategiskt Innovations Program

- Agenda IoT för Sverige startade 2010 som ett IVA projekt
- Samlade stora delar av svensk IoT intresse
- Avslutades 10 april 2012 med en Agenda-dokument och slutkonferens
- Agendan utvecklades vidare genom WS och industriförankring

- Uppsala universitet ansökte och beviljades i juni 2014 det Strategiska innovationprogrammet Internet of Things
- IT-institutionen har beslutat inrätta ett programkontor och har utsett interimsstyrelse 15 sep 2014
Målet med SIP-IoT

Svensk industri och offentlig sektor skall bli bäst i världen 2025 på att utnyttja fördelarna med IoT.

- **Företag**
  - Slutanvändare, IoT-leverantörer, integratörer
  - Stora och små
- **Offentlig sektor**
  - Hälsa och sjukvård
  - Försvar och säkerhet, miljö, infrastruktur och trafik ...

**TRL-nivåer**

- TRL 1
- TRL 2
- TRL 3
- TRL 4
- TRL 5
- TRL 6
- TRL 7
- TRL 8
- TRL 9
Organisationer med Lol-brev och övriga aktörer

<table>
<thead>
<tr>
<th>Number</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ABB</td>
</tr>
<tr>
<td>2</td>
<td>Acreo</td>
</tr>
<tr>
<td>3</td>
<td>Ericsson</td>
</tr>
<tr>
<td>4</td>
<td>HiQ</td>
</tr>
<tr>
<td>5</td>
<td>IQ samhällsbyggnad</td>
</tr>
<tr>
<td>6</td>
<td>Jacobson Agneta</td>
</tr>
<tr>
<td>7</td>
<td>KTH</td>
</tr>
<tr>
<td>8</td>
<td>LKAB</td>
</tr>
<tr>
<td>9</td>
<td>Lund Universitet</td>
</tr>
<tr>
<td>10</td>
<td>Luleå Universitet LTU</td>
</tr>
<tr>
<td>11</td>
<td>Malmö Universitet</td>
</tr>
<tr>
<td>12</td>
<td>SICS</td>
</tr>
<tr>
<td>13</td>
<td>Sigma Connectivity</td>
</tr>
<tr>
<td>14</td>
<td>SMSE</td>
</tr>
<tr>
<td>15</td>
<td>Svensk Elektronik</td>
</tr>
<tr>
<td>16</td>
<td>SP Technical Research Institute of Sweden</td>
</tr>
<tr>
<td>17</td>
<td>Teknikföretagen</td>
</tr>
<tr>
<td>18</td>
<td>Uppsala universitet</td>
</tr>
</tbody>
</table>

Manufacturers and integrators of IoT:
- Ericsson
- Sigma Connectivity
- Telenor
- Telia Sonera
- HiQ
- Brimon
- ABB
- IBM
- Volvo

Trade organisations:
- Svensk Elektronik
- Skogsindustrier
- Teknikföretagen
- Power Circle
- IQ-samhällsbyggnad

Users of IoT:
- LKAB
- Boliden
- Atlas Copco
- Metso
- NCC
- Skanska
- Cementa
- ICA
- HM
- IKEA
- Intensie
- Analyze
- Ore Analyse
- SATS
- WEMEMOVE

Public organizations:
- Trafikverket
- SKL

Academic / research institutes:
- Mälardalens University
- Uppsala University
- Mittuniversitetet
- Luleå Technical University
- ProcessIT
- CDT
- Swedish ICT Research: SICS, Acreo, Interactive Institute, Viktoria
- SP Sveriges Tekniska Forskningsinstitut
- MAPSI
- KTH
- LTH
IoT Organisation

- Styrelse
- Program-kommitté
- Vetenskaplig kommitté
- Program-kontor
- IoT Utbildning
- IoT Innovation & Forskning
- IoT Metoder & Arkitektur
- IoT Kompetens-nätverk
Arenas

- Machine Learning - Michael Ashcroft
- Security - Lisa Kaato
- Energy - (Ewert Bengtsson)
- Biomedical IT - Ewert Bengtsson
The IT-Energy Arena

- **Goal:** to use IT-based methods to increase energy efficiency in the industry and to develop predictive capabilities of novel materials present in future energy-related devices.
  
  - 1. Managing complex systems for energy efficiency (MCSEE)
  - 2. High-fidelity algorithms to predict novel material and device properties for energy production and storage (HAEPS)
Energy efficient treatment of wastewater

Platform: A consortium ("VA-kluster Mälardalen") with 17 members, see also www.va-malardalen.se

Chairman: Bengt Carlsson - IT/UU

Financially support by participating plants and by the Swedish Water and Wastewater Association
Example: "A cruise controller for wastewater treatment plants"

Innovative automatic control strategies applied to wastewater treatment plants may give energy savings around 10-20% with the same effluent quality.

IoT and Cloud is Everywhere

Challenge: “All” devices/ servers are limited by power/ energy today
(Computation and communication would be much faster without this constraint)

- **IoT** (sensors, phones, devices...): Battery life
- **Communication** (3G, 4G, WiFi,..): Communication energy
- **Cloud/ Servers**: Heat, cooling, energy cost (and contributions to CO2)

**IT@UU is well positioned for energy-centric research**

- Research@IT has world-leading low-energy research results [ISCA, MICRO, PACT, ]
- Experience and industrial contacts from WISENET’s and four EU projects
- Have recruited Voigt (sensors) and Kaxiras (energy)

**Future research areas:**

- Computation and communication scheduling for low energy
- Battery scheduling for longer battery life
- New models enabling applications and algorithms research for low energy
- HW/SW co-design for low energy
- New circuits and architectures for low energy
Power efficient computing

- Seminars with invited speakers:
  - Doug Burger, Microsoft Research, who spoke about power efficiency in large scale data centers using specialization (FPGAs).
  - Avinash Sodani, Intel, who spoke about energy-efficiency in HPC.
  - Babak Falsafi, EPFL, who spoke about Big Data and Dark Silicon.

- Discussions for collaboration with Microsoft and

- This year's SICS Multicore Day in Kista with over 200 registrations, organized by Stefanos Kaxiras, was devoted to energy efficiency.

- A new book "Power-Efficient Computer Architecture Techniques: Recent Advances" is being published, with two authors from our department:
Biomedical Information Technology

- internal aspects

- A large fraction of the researchers at the IT-department are involved in research on biomedical applications
  - A recent survey has found 58 researchers
  - Involved in 44 different projects
  - All divisions represented although Vi2 dominates
Biomedical Information Technology
- external aspects

- Medical engineering is a large and growing field, most universities have special departments
- Uppsala has a lot of research but no dedicated department and thus low visibility
- There are ongoing national efforts to create a Strategic Innovation Program in MedTec4Health
- The Engineering Department is proposing a chair in Medical Engineering
- We created an informal interdisciplinary “arena”: Uppsala Forum för Medicinsk Teknik
- Has had three seminars and an open invitation to lectures in a PhD course on medical engineering
Biomedical Information Technology
- the future

- The vice-rectors in tekn-nat and med-farm have appointed a working group to
  - Identify areas with top level competence in medical engineering in Uppsala
  - Identify areas suitable for special strategic efforts
  - Propose how the research and education in medical engineering should be organized at UU
  - Propose a short term and long term strategy for competence supply
  - Create a budget for the strategic effort
  - Present the proposal no later than December 5, 2014
Our strategic budget
The strategic funds in 2015 budget proposal

- We have 8757 kSEK available for strategic efforts.
- Of these the following are already decided (3224 kSEK):
  - 576 kSEK for the staff lounge and other rebuildings
  - 400 kSEK to wireless networks (5 years)
  - 500 kSEK to optimization chair (5 years)
  - 50 kSEK to adjunct professor in Machine Learning (3 years)
  - 1213 kSEK to gender equality efforts
  - 485 kSEK earmarked for graduate courses
- The following new efforts are proposed (1575 kSEK):
  - 200 kSEK economic frame for arena activities
  - 175 kSEK Coordination of Machine Learning with CIM
  - 200 kSEK Promotion/coordination of Biomedical IT
  - 1000 kSEK SPARC-projects in Biomedical IT
- The rest is forwarded to the divisions (3958 kSEK)
New Research Arenas

Use your creativity and imagination in the brainstorming session