Research Methods in Computing

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Presentation for Trinity CS post-grads,
April 2009, Dublin

A note on this series of lectures

This course is designed for post-graduate students in computing science and has three interlinked objective:

1. First, to describe the distinctive nature of research in computing, a subject with substantive application and significant intellectual challenge.

2. Second, to introduce the students to the emerging discipline of knowledge management so that the student can appreciate how knowledge flows in organisations and in the society at large – causing the frequent paradigm shifts in computing.

3. Third, issues related to the governance and laws related to the Internet will be discussed.

The students will be able to discuss the matters outlined above with speakers, drawn from academia and industry, during seminars given by the speakers. The speakers will refer to their own career choices in computing.
Some definitions

RESEARCH: A systematic search for facts; scientific investigation

You think; you reflect; you write; you revise; you communicate; you receive feedback; you think; you reflect.....
Useful stuff?

RESEARCH:
You think; you reflect; you write; you revise; you communicate; you receive feedback; you think; you reflect......

Many books on how to write: Check this one out

Course Outline

Introduction
- Research in Computing
- Paradigm Shifts
- How to Write a Research Proposal

Knowledge Management
- Knowledge of People and Organizations
- Corporate Learning
- Knowledge Creation Crew

Internet Law
- Basis of the Law Governing the Internet
- Passing of
- Your idea or mine?
- Patent

Biographical Lectures
- Lectures by CS Staff – what did I do to become what I am?
Coursework

Project: How to write a Research Proposal
Objective: To write a proposal for a research funding agency
Work Mode: Team work (2-4 per team)
- Group Presentation
- Individual reports
Evaluation: 40% marks on Group Presentation
- 40% marks for Individual Report
Deadlines: Report Submission: 1st June 2009
- Presentation: 5 June 2009 onwards (TBC)
Class Tests: On topics in paradigm shifts, knowledge transfer and Internet Law → 20% marks

Useful stuff?

RESEARCH:
You think; you reflect; you write; you revise; you communicate; you receive feedback; you think; you reflect.....

Many websites on how to write a CS thesis:
A quirky one is by my good friend Professor Aaron Sloman:
http://www.cs.bham.ac.uk/research/projects/poplog/teach/theses
Useful stuff?

RESEARCH:
You think; you reflect; you **write**; you revise; you communicate; you receive feedback; you think; you reflect.....

Good communication is extremely important –

**WHAT IS YOUR RESEARCH QUESTION?**
(Takes about 6-12 months to define and you have to refine the question over the next 24-36 months)

ALWAYS BE SURE TO ACKNOWLEDGE OTHERS

---

Useful stuff?

RESEARCH:
You think; you reflect; you **write**; you revise; you communicate; you receive feedback; you think; you reflect.....

Good communication is extremely important –
Motivate the reader
Structure the thesis
- Introduction → Birdseye view of your work and its context
- Literature Review → What motivated you? Set the scene/produce a critique
- Method → How will you do what you have to do?
- Experiments & Evaluation → Does your method work?
- Afterword → What happened? Wins and Losses?

ALWAYS BE SURE TO ACKNOWLEDGE OTHERS
Useful stuff?

RESEARCH:
You think; you reflect; you write; you revise; you communicate; you receive feedback; you think; you reflect.....

Good communication is extremely important –
Motivate the reader
Structure the thesis – Make it look like a fish
  Introduction → Fat
  Literature Review → Fatish
  Method → Fat
  Experiments & Evaluation → Fatish
  Afterword → Thin

ALWAYS BE SURE TO ACKNOWLEDGE OTHERS
Good communication is extremely important –
Motivate the reader
Structure the thesis – Make it look like a fish

Introduction → Thin
Literature Review → Fat
Method → Fat
Experiments & Evaluation → Thin
Afterword → Sprawling

ALWAYS BE SURE TO ACKNOWLEDGE OTHERS
Useful Stuff?

RESEARCH:
You think; you reflect; you write; you revise; you communicate; you receive feedback; you think; you reflect…..

Many websites on how to write a CS proposal:

Useful Stuff?

<table>
<thead>
<tr>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>The object under study was displaced horizontally</td>
<td>The ball moved sideways</td>
</tr>
<tr>
<td>On an annual basis</td>
<td>Yearly</td>
</tr>
<tr>
<td>Endeavour to ascertain</td>
<td>Find out</td>
</tr>
<tr>
<td>It could be considered that the speed of storage reclamation left something to be desired</td>
<td>The garbage collector was really slow</td>
</tr>
</tbody>
</table>
Useful Stuff?

Resource Overbooking and Application Profiling in a Shared Internet Hosting Platform

BHUVAN URGAOCHNAR
The Penn State University
PRASHANT SHENOY
University of Massachusetts
and
TIMOTHY ROSCOEO
ETH Zürich

In this article, we present techniques for provisioning CPU and network resources to shared Internet hosting platforms running potentially antagonistic third-party applications. The primary contribution of our work is to demonstrate the feasibility and benefits of overbooking resources in shared Internet platforms. Since an accurate estimate of an application's resource needs is necessary when overbooking resources, we present techniques to profile applications on dedicated nodes, possibly while in service, and use these profiles to guide the placement of application components onto shared nodes. We then propose techniques to overbook cluster resources in a controlled fashion. We outline an empirical approach to determine the degree of overbooking that allows a platform to achieve improvements in revenue while providing performance guarantees to Internet applications. We show how our techniques can be combined with commodity and QoS-aware allocation mechanisms to provide application isolation and performance guarantees at run-time. We implement our techniques in a Linux cluster and evaluate them using common server applications. We find that the efficiency (and consequently revenue) benefits from controlled overbooking of resources can be dramatic. Specifically, we find that overbooking resources by as little as 1% we can increase the utilization of the cluster by a factor of two, and a 5% overbooking yields a 100-600% improvement, while still providing useful resource guarantees to applications.

Bhuvan Urgaonkar, Prashant Shenoy, Timothy Roscoe (2009). Resource overbooking and application profiling in a shared Internet hosting platform. ACM Transactions on Internet Technology (TOIT) Volume 9 , Issue 1 (February 2009)
Useful Stuff?

Useful Stuff?

DriveDefence

Report for Text


Text analysed on Mon, 30 Mar 2009 18:46:36 GMT.

Reporting:

- all sentences (highlighted with |sentence word count| in purple italic text)

Summary

- Total sentences with 20 or more words= 6.
- Longest sentence has 43 words.
- Total words=213.
- Total sentences=6.
[Average sentence length = 44.22 words].

Details

[10] In this article, we present techniques for provisioning CPU and network resources in shared Internet hosting platforms running potentially antagonistic third-party applications. The primary contribution of our work is to demonstrate the feasibility and benefits of overbooking resources in shared Internet platforms. Since an accurate estimate of an application’s resource needs is necessary when overbooking resources, we present techniques to profile applications on dedicated nodes, possibly while in service, and use these profiles to guide the placement of application components onto shared nodes. We then propose techniques to overbooking cluster resources in a controlled fashion.

[11] Since an accurate estimate of an application’s resource needs is necessary when overbooking resources, we present techniques to profile applications on dedicated nodes, possibly while in service, and use these profiles to guide the placement of application components onto shared nodes.

[12] We then propose techniques to overbook cluster resources in a controlled fashion.

[13] We outline an empirical approach to determine the degree of overbooking that allows a platform to achieve improvements in revenue while providing performance guarantees to Internet applications.

[14] We outline how our techniques can be combined with commonly used QoS resource allocation mechanisms to provide application isolation and performance guarantees at run time.
Useful Stuff?

Some definitions

RESEARCH:
You think; you reflect; you write; you revise; you communicate; you receive feedback; you think; you reflect.....

The American way: You publish or you perish

The European way: Some will publish to help others survive
Some definitions

RESEARCH:

You think; you reflect; you write; you revise; you communicate; you receive feedback; you think; you reflect.....

- I would like to briefly (!) describe my favourite description of what I understand research in computer science is.
- I would like to talk about good and ‘bad’ research papers in CS – and David Gregg will talk about this topic and I hope to follow up
- I would like to talk to you about how to write a research proposal; slotted time is limited so perhaps we can do some group-work?

Computing a professional discipline criss-crossing many subjects?

Many of the modern sciences are of interdisciplinary, “eclectic” type. It is a trend for new sciences to search their methods and even questions in very broad areas. It can be seen as a result of the fact that the communications across the borders of different scientific fields are nowadays much easier and more intense than before.

Computing?

- **Computing** is the action of calculating or counting; the activity or operation of a computer; the action or practice of using a computer, esp. as a professional or expert.


Computing?

- Computing ‘is decidedly a new kind of discipline one in which, for example, theory is not concerned with explaining extant (physical) phenomena, and experimentation is not necessarily concerned with testing whether theory predicts reality.’

  International Review of Research in Computer Science in the UK (2001)
Alan Turing and his Legacy

**ALAN MATHISON TURING** (born London, 23 June 1912, died Manchester, 7 June 1954)

Mathematician, cryptanalyst, **pioneering** theoretical computer scientist and **first** of the computer professionals, amongst the **founders** of computational biology. And an amateur athlete (Walton Athletic Club, Surrey).

All in a brief life of 41 years, 11 months and approximately 15 days.

www.turing.net
Computing: a Professional Discipline

- Computing is a professional subject much like medicine, the law, or accountancy:
  - The intellectual challenge in a professional subject is always there and inextricably linked with the application.
  - Only in dead subjects there is only theory and no application.
  - Only in mundane branches of human endeavour there is only application and no theory.

Computing: Research in an interdisciplinary enterprise

The diversity of research paradigms within Computer Science may be responsible for the divergences of opinion concerning the nature of Computer Science research.

The fundamental question underlying all computing is:

What can be (efficiently) automated?
Computing: a Professional Discipline

- Computing is a professional subject much like medicine, the law, or accountancy:
  - There are theoretical advances in a professional subject (theory of infection in medicine, equality of all before the law, or the concept of limited company);
  - There are experimentations that help the profession to progress (micro-surgery, electronic tagging and ‘war crimes’, compliance schemes)

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Computing: a Professional Discipline

- Computing is a professional subject much like medicine, the law, or accountancy:
  - There are theoretical advances in a professional subject (assemblers, compilers);
  - There are experimentations that help the profession to progress (the personal computer, the Internet, the Grid, programming paradigms)
Computing: Research in an interdisciplinary enterprise

Science Foundation Ireland suggests that research in computing is ‘Bold research in numerous disciplines continues to transform the potential of information and communications technologies. Fields that have already contributed to ICT’s evolution include the fundamental sciences, the engineering of complex systems and software, low-cost manufacturing technologies, and end-user applications.’

http://www.sfi.ie/home

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Two SFI Projects in the Department – CTVR under Donal O’Mahony and Metropolis under Carol O’Sullivan, are amongst the best examples of interdisciplinary research in Computing.

http://www.sfi.ie/home
Computing – the new metaphor

We should, by the way, be prepared for some radical, and perhaps surprising, transformations of the disciplinary structure of science (technology included) as information processing pervades it.

Allen Newell, Artificial Intelligence 25 (1985) 3

Computing – the new metaphor

Initially, c. 1940, Computer Science was net recipient of intellectual input from mathematics, logic, electronics, psychology, organisation theory and human factors (sociology) and (neuro-)biology;

Now, c. 2000, Computer Science is providing intellectual input to other disciplines, notably communications engineering, neuro-biology, molecular genetics, economics and econometrics
Computing – the new metaphor

- Current classics in science and technology – one paper by two computer scientists

- Article Title: MODELTEST: testing the model of DNA substitution
  Authors: Posada, D; Crandall, KA
  Journal: BIOINFORMATICS
  Volume: 14
  Issue: 9
  Page: 817-818
  Year: 1998

http://www.in-cites.com/currentclassics/august2006.html

Research in Computer Science

The discipline of Computing is the systematic study of algorithmic processes that describe and transform information: their theory, analysis, design, efficiency, implementation, and application
The discipline of Computing is the systematic study of algorithmic processes that describe and transform information: their theory, analysis, design, efficiency, implementation, and application.

1. **Computer Science is the study of phenomena related to computers.**

2. **Computer Science is the study of information structures**

3. **Computer Science is the study and management of complexity.**

4. **Computer Science is the mechanization of abstraction**

5. **Computer Science is a field of study that is concerned with theoretical and applied disciplines in the development and use of computers for information storage and processing, mathematics, logic, science, and many other areas.**
Computing: a Professional Discipline

- Computing is a professional subject much like medicine, the law, or accountancy:
- The intellectual challenge in a professional subject is always there and inextricably linked with the application.
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- Only in mundane branches of human endeavour there is only application and no theory.

Computer Science and shifts in meaning

It is interesting to note that the British/American/Irish term "Computer Science" has an empirical orientation, while the corresponding German and French terms “Informatics” have an abstract orientation.

Computer Science: Key Areas

What can be (efficiently) automated?

Three broad areas of inquiry:
Experimental Computer Science;
Theoretical Computer Science;
Simulation and Modeling

Computing: a Professional Discipline

- **Theoretical research in computer science concerns the power, limits, and costs of computation independent of hardware systems.**

- A theorem might, for example, characterise a class of problems that cannot be computed by a digital computer, thereby making a statement not only about present-day hardware but also about any digital computing device that might ever be built or conceived.

- Theoreticians also derive bounds on the time or memory required by any program that solves problems from a given class (such as searching, sorting, or scheduling).
Sometimes the cost or intractability of a problem is reason for dismay; sometimes not --- the premise of modern cryptography is that reversing certain methods of encryption would be intractable.

Much of the work in theoretical computer science is mathematical in character. And formal logic is central. By definition, each step in a formal proof must be mechanisable, creating an intimate connection between proof and computation.

The study of programming languages, like the study of logic, is concerned with the expressive power of formal notations, with correspondences between syntax (programs) and semantics (what they mean), and with the means by which texts in a formal language can be analysed (automatically or manually) in order to extract truths.

Experimental work plays a very different role in computer science research from the part it plays in the natural sciences.

- Rather than attempting to understand an existing reality, experiments in computer science are often intended to explore new approaches or abstractions.
- Here, a research prototype might be built, instrumented, deployed, and measured in order to evaluate the strengths and weaknesses of something that the prototype embodies.
Experiments are pivotal in the natural sciences when they demonstrate aspects of reality that depart from what current theory predicts and thus defy our understanding; in computer science, it is prototypes that launch paradigm shifts.

- Building a prototype might expose implicit assumptions,
- prevent key sub-problems from being ignored by its builders,
- or allow its users to discover synergies and unanticipated uses issues that would not be addressed if analytical techniques were applied to a paper design.

Timeshared computing, the personal computer (with all its productivity-enhancing software), and the Internet itself, all started as experimental prototypes.
Computing: a Professional Discipline

The PageRank Citation Ranking: Bringing Order to the Web

January 29, 1998

Abstract

The importance of a Web page is an inherently subjective matter, which depends on the readers interests, knowledge and attitudes. But there is still much that can be said objectively about the relative importance of Web pages. This paper describes PageRank, a method for rating Web pages objectively and mechanically, effectively measuring the human interest and attention devoted to them.

We compare PageRank to an idealized random Web surfer. We show how to efficiently compute PageRank for large numbers of pages. And, we show how to apply PageRank to search and to user navigation.

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### ‘Measuring’ Research Performance in Computer Science?

#### The Most-Cited Institutions in Computer Science, 1995-2005

<table>
<thead>
<tr>
<th>Rank</th>
<th>Institution</th>
<th>No. of papers</th>
<th>Cited</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AT&amp;T</td>
<td>2351</td>
<td>20479</td>
<td>wireless communications, quantum computing, on-line learning, and statistical analysis for Ethernet LAN traffic</td>
</tr>
<tr>
<td>2</td>
<td>IBM</td>
<td>3316</td>
<td>19417</td>
<td>organic thin-film transistors, all-optical networks, and chip interconnections</td>
</tr>
<tr>
<td>3</td>
<td>UC Berkley</td>
<td>1586</td>
<td>12408</td>
<td>including oligonucleotide array data and global DNA sequence alignments</td>
</tr>
<tr>
<td>4</td>
<td>MIT</td>
<td>1986</td>
<td>12259</td>
<td>Integrated services networks, data hiding, the semantic Web, and organic thin-film transistors</td>
</tr>
<tr>
<td>5</td>
<td>Stanford</td>
<td>1612</td>
<td>11457</td>
<td>genome-wide expression data processing, large-scale hypertextual Web search engines, de-noising, and multiscale phenomena</td>
</tr>
<tr>
<td>9</td>
<td>ETH Zurich</td>
<td>962</td>
<td>6452</td>
<td>MOLMOL, generalized privacy amplification, and public key encryption</td>
</tr>
</tbody>
</table>

#### Most cited articles in Computer Science 1990-2006

<table>
<thead>
<tr>
<th>Rank</th>
<th>Title</th>
<th>Authors</th>
<th>Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Introduction to algorithms. (1991)</td>
<td>Cormen et al</td>
<td>3803</td>
</tr>
<tr>
<td>3</td>
<td>Communicating Sequential Processes (1985)</td>
<td>Hoare</td>
<td>2697</td>
</tr>
<tr>
<td>4</td>
<td>Maximum Likelihood from Incomplete Data via the EM Algorithm. J. Royal Stats. Soc</td>
<td>Dempster, Laird, Rubin</td>
<td>2321</td>
</tr>
<tr>
<td>5</td>
<td>Elements of Information Theory (1991)</td>
<td>Cover &amp; Thomas</td>
<td>2220</td>
</tr>
</tbody>
</table>

[http://citeseer.ist.psu.edu/articles.html]
### Wireless/Mobile Networks top 5 cited papers 2004-2005

<table>
<thead>
<tr>
<th>Journal</th>
<th>Title</th>
<th>Authors</th>
<th>Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE SIGNAL PROC MAG, Vol 14, pp 49-83, 1997</td>
<td>Space-time processing for wireless communications - Improving capacity, coverage, and quality in wireless networks by exploiting the spatial dimension</td>
<td>Paulraj &amp; Papadis</td>
<td>173</td>
</tr>
<tr>
<td>IEEE/ACM Trans of Networks, Vol 5, pp 3879</td>
<td>A resource estimation and call admission algorithm for wireless multimedia using shadow clusters</td>
<td>Levine et al</td>
<td>113</td>
</tr>
</tbody>
</table>


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### ‘Measuring’ Research Performance in Computer Science?

#### Interview with one of the authors of the 2nd most cited paper, Dr. Kumar

- **Your most-cited paper is on the capacity of wireless networks. How did you approach the problem of capacity, and what made it interesting to you?**

  The excitement of wireless, obviously, is that you can dispense with all these wires. You don’t need them to communicate. If you have a laptop and some kind of wireless modem, you can open up your laptop and spontaneously, at any given time, form a network with maybe 1,000 people on your campus or 100 people in your office building. This is what’s called an ad hoc wireless network. There’s no prior infrastructure. What makes them interesting is that they need to be very adaptive. For instance, in the morning there may only be 50 people in this building; in the afternoon, 100. So the number of nodes may change. The position of the nodes changes. But the network itself has to keep functioning.

[http://www.esi-topics.com/wireless/interviews/PRKumar.html](http://www.esi-topics.com/wireless/interviews/PRKumar.html)
## Computer Science: Key Areas

**What can be (efficiently) automated?**

<table>
<thead>
<tr>
<th>Theoretical CS</th>
<th>Logic + Mathematics: limits of computation and the power of computational paradigms; formal/conceptual models</th>
</tr>
</thead>
</table>
| Experimental CS: Experiments are: | (a) Used both for theory testing and for exploration  
(b) Used for testing theoretical predictions against reality.  
(c) Designed to test the presence of bugs in a theory; not their absence  
(d) The basis of in search, automatic theorem proving, planning, NP-complete problems, natural language, vision, games, neural nets/connectionism, and machine learning.  
(e) Conducted to simulate the human brain (neural networks), but were initially rejected on theoretical grounds, but the theory under-reported the salience of NN |
| Simulation/Modelling | Applied Maths/Numerical Analysis & input from application discipline. Key areas here include artificial life, virtual reality, computer games with ‘built-in’ physics, chaos and non-linear dynamical systems |

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**A commonly used research model in CS: Hypothetico-deductive method**

1. **Existing theories and observations**
2. **Hypothesis**  
   Hypothesis must be thoroughly redefined
3. **Predictions**  
   Hypothesis must be adjusted
4. **Tests and new observations**  
   Consistency achieved
5. **Old theory confirmed (within a new context) or new theory proposed**
6. **Selection among competing theories**

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**Gordana DODIG-CRNKOVIC (2005). Scientific Methods in Computer Science;  
www.idt.mdh.se/personal/work/cs_method.pdf**
Computing – the new metaphor

We should, by the way, be prepared for some radical, and perhaps surprising, transformations of the disciplinary structure of science (technology included) as information processing pervades it.

In particular, as we become more aware of the detailed information processes that go on in doing science, the sciences will find themselves increasingly taking a meta-position, in which doing science (observing, experimenting, theorizing, testing, archiving,) will involve understanding these information processes, and building systems that do the object-level science.
Computing – the new metaphor

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Then the boundaries between the enterprise of science as a whole (the acquisition and organization of knowledge of the world) and [Soft Computing] AI (the understanding of how knowledge is acquired and organized) will become increasingly fuzzy.

Allen Newell, Artificial Intelligence 25 (1985) 3

Paradigm Shifts in Computing:
Corporate Learning in the computing industry?

Can organisations learn? Feedback and Control

single loop learning:

Step 1
Sense, scan, monitor environment

Step 2
Compare info. against operating norms

Step 3
Initiate appropriate action
Paradigm Shifts in Computing: Corporate Learning in the computing industry?

**Can organisations learn? Feedback and Control**

**Double loop learning:**
- Sense, scan, monitor environment
- Initiate appropriate action
- Compare info. against operating norms
- Question whether the operating norms are appropriate
- Step 1
- Step 2
- Step 3
- Step 2a

**Single loop learning in computing industry**
- Sell or lease faster & bigger computers
- Initiate R& D and marketing strategy
- Institutional ownership & operation
- Step 1
- Step 2
- Step 3
Can organisations learn? Feedback and Control

Single loop learning in computing industry

- Step 1: Sell or lease faster & bigger computers
- Step 2: Initiate R&D and marketing strategy
- Step 3: Institutional ownership & operation

Double loop learning in computing industry

- Step 1: Sell or lease faster & bigger computers
- Step 2: Institutional ownership & operation
- Step 3: Why institutional ownership & control?
Paradigm Shifts in Computing: Corporate Learning in the computing industry?

Can organisations learn? Feedback and Control

Double loop learning: In computing industry

Sell or lease faster & bigger computers

Initiate R&D and marketing strategy

Institutional ownership & operation

Allow individual ownership & control

SELL cheaper & faster computers

Initiate R&D and marketing strategy

Individual ownership & operation

Can organisations learn? Feedback and Control

Double loop learning in computing industry
Paradigm Shifts in Computing:
Corporate Learning in the computing industry?

Can organisations learn? Feedback and Control

Single loop learning: Apple’s contribution

- SELL cheaper & faster computers
- All software development must be in house

Step 1

Step 2

Step 3

- Initiate R&D and marketing strategy

Paradigm Shifts in Computing:
Corporate Learning in the computing industry?

Can organisations learn? Feedback and Control

Double loop learning in computing

- SELL cheaper & faster computers
- All software development must be in house

Step 1

Step 2

Step 3

- Should we allow others to develop software for our PC?
Paradigm Shifts in Computing:
Corporate Learning in the computing industry?

Can organisations learn? Feedback and Control
Double loop learning: IBM contribution

We should allow others to develop software for our PC.

Can organisations learn? Feedback and Control
Double loop learning:

Double-loop learning is like a thermostat which can ask the question: Why have you set my operating norms as X°C for hot and Y°C for cold? Although the thermostat questions it still goes on controlling the environment.
Writing a Research Proposal

- **Writing a Research Proposal**
  - A research proposal is similar in a number of ways to a project proposal; however, a research proposal addresses a particular project: academic or scientific research.

http://www2.smumn.edu/deptpages/~tcwritingcenter/Forms_of_Writing/ResearchProposal.htm
Research Proposal

- What is the question that this proposal addresses?
- Why is this problem significant?
- How will the question be addressed?
- What is your recent record of accomplishment in research that would suggest you can achieve success in addressing this problem?
- What is the value of this research to the people of Ireland?

Research Proposal

- Date of Ph.D. (or equivalent)
- Date of faculty appointment
- List of previous positions in chronological order, including appropriate details and starting with current appointment
- List of up to 5 most relevant/significant publications, including author(s), title of article, name of publication, date of publication, and details (such as volume, pages)
- List of patents, granted or pending, including application number, title, year, and assigned inventors
- List of grant funding, current or pending, including title, funding body, duration, amount, % commitment, role (PI, co-PI or collaborator). Any possible overlap with the current project MUST be clarified.
- Brief grant support history
- List of awards and honours
Writing a Research Proposal

INSIGHT: Video Analysis and Selective Zooming using Semantic Models of Human Presence and Activity (c. 0.5 Million Sterling)

INSIGHT is a project funded by EPSRC and [the UK Ministry of Defence] under the EPSRC Technologies for Crime Prevention and Detection Programme. INSIGHT aims to advance techniques for semantic content analysis of CCTV recordings for automatic semantic video tagging, search and pro-active sampling by:

1. Developing models for fully automated semantic-tagging of CCTV recordings based on holistic human presence detection and abnormal event/activity recognition, e.g. monitoring unmanned sites and buildings and to significantly reduce the false alarms triggered by existing Video Motion Detection systems.

2. Developing models for event and activity based visual topic spotting and scene change detection for semantic decomposition and automatic sorting of CCTV recordings over time, e.g. automatically detecting in video aggressive human behaviour on buses, trains or in front of buildings.

3. Developing models for automated selective zooming and super-resolution in CCTV recordings with variable levels of details, e.g. to synthesize in arbitrary virtual views good-quality close-up images of a face or vehicle number-plate in order to improve the accuracy of automatic face-recognition and ANPR (Automatic Number Plate Recognition), and to increase the value of imagery evidence captured in low-resolution by CCTV cameras.
**Writing a Research Proposal: A research ‘grid’**

<table>
<thead>
<tr>
<th>DEVELOP</th>
<th>GENERIC APPLICATION</th>
<th>ELABORATION</th>
<th>SPECIFIC APPLICATION</th>
<th>IMPROVEMENT TO EXISTING PRODUCTS/SERVICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODELS</td>
<td></td>
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<tr>
<td>ALGORITHMS</td>
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</table>

http://www2.smumn.edu/deptpages/~tcwritingcenter/Forms_of_Writing/ResearchProposal.htm

**Writing a Research Proposal**

<table>
<thead>
<tr>
<th>DEVELOP</th>
<th>GENERIC APPLICATION</th>
<th>ELABORATION</th>
<th>SPECIFIC APPLICATION</th>
<th>IMPROVEMENT TO EXISTING PRODUCTS/SERVICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODELS</td>
<td>fully automated semantic-tagging of CCTV recordings</td>
<td>based on holistic human presence detection and abnormal event / activity recognition,</td>
<td>e.g. monitoring unmanned sites and buildings</td>
<td>and to significantly reduce the false alarms triggered by existing Video Motion Detection systems.</td>
</tr>
</tbody>
</table>

http://www2.smumn.edu/deptpages/~tcwritingcenter/Forms_of_Writing/ResearchProposal.htm
The purpose of your research proposal is not...

To describe the WizWoz system

- Your reader does not have a WizWoz
- She is primarily interested in re-usable brain-stuff, not executable artefacts

Contributions should be refutable

<table>
<thead>
<tr>
<th>NO!</th>
<th>YES!</th>
</tr>
</thead>
<tbody>
<tr>
<td>We describe the WizWoz system. It is really cool.</td>
<td>We give the syntax and semantics of a language that supports concurrent processes (Section 3). Its innovative features are...</td>
</tr>
<tr>
<td>We study its properties</td>
<td>We prove that the type system is sound, and that type checking is decidable (Section 4)</td>
</tr>
<tr>
<td>We have used WizWoz in practice</td>
<td>We have built a GUI toolkit in WizWoz, and used it to implement a text editor (Section 5). The result is half the length of the Java version.</td>
</tr>
</tbody>
</table>

Simon Peyton Jones, Microsoft Research, Cambridge
Writing a Research Proposal

The truth: credit is not like money

Giving credit to others does not diminish the credit you get from your paper

- Warmly acknowledge people who have helped you
- Be generous to the competition. "In his inspiring paper [Foo98] Foogle shows... We develop his foundation in the following ways..."
- Acknowledge weaknesses in your approach

Simon Peyton Jones, Microsoft Research, Cambridge

Credit is not like money

Failing to give credit to others can kill your paper

If you imply that an idea is yours, and the referee knows it is not, then either

- You don’t know that it’s an old idea (bad)
- You do know, but are pretending it’s yours (very bad)

Simon Peyton Jones, Microsoft Research, Cambridge
Research Proposal

<table>
<thead>
<tr>
<th>Cost items</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Staff</td>
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<tr>
<td>Equipment</td>
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<tr>
<td>Materials/Miscellaneous</td>
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<tr>
<td>Travel</td>
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<tr>
<td><strong>Total, €</strong></td>
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</tbody>
</table>

**REVIEW PROCESS**

- The applicant is asked to designate the panel in which he/she wishes the proposal to be reviewed. Descriptions of the RFP review panels are available on the SFI website. All proposals will be reviewed by international panels of reviewers selected by SFI staff. The reviewers will be sent a number of proposals to review and will submit their written reviews to SFI prior to the panel meeting. The reviewers will then convene as a panel to discuss the merits of all the proposals in their research area, taking into account the reviews already submitted by the panel members. A rapporteur for each proposal will be assigned from among the panel members and he/she will provide a written summary of the panel discussion. This summary and the overall recommendation will reflect the consensus of the panel and will be provided to SFI before the end of the panel meeting, SFI will use these recommendations to make funding decisions.
Computing: a Professional Discipline

- The moral of the story:
  - Computing is an expanding discipline; all pervasive and hence with diffuse boundaries;
  - Computing can be viewed as a science or a branch of engineering, but this would be saying that medicine is medical science or the law is a social science;
  - Computing is a professional subject where there challenges theoretical and practical alike