I KEEP six honest serving-men
(They taught me all I knew);
Their names are What and Why and When
And How and Where and Who.
I send them over land and sea,
I send them east and west;
But after they have worked for me,
I give them all a rest.

The Elephant's Child

Computer scier research and how to communicate it

Arkady Zaslavsky

IEL, CSIRO COMPUTATIONAL INFORMATICS
www.csiro.au

Outline

Communicating research

- Research proposals
- Writing style
- The thesis
- University-Student-Supervisor relationships and expectations
- Publication strategy and plans
- Writing papers
- Presenting at conferences and seminars
- Where to look for resources & references
- Use Case – Context Spaces

Why is Marco Polo famous?

Was he the first European to visit China?

No!

Was he the first person to write about it?

Yes!

The moral?

Publish or perish!

Ground Rule

"If a project does not result in a high quality journal publication then you may as well climb a high mountain and shout your results into the wind"

Source: http://www.chamex.com/adventure/ski-mont-blanc

Publish or perish

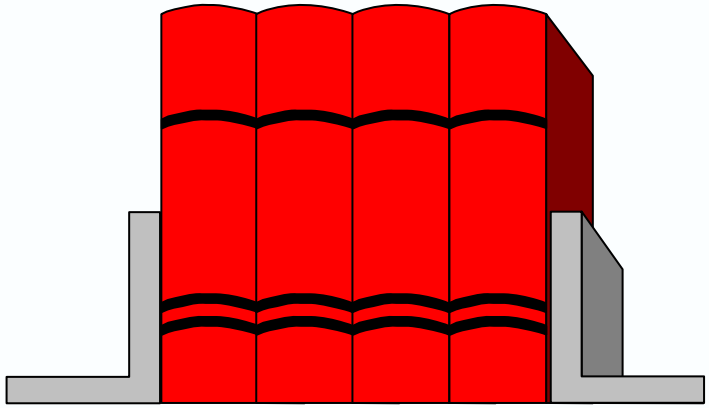
Publish your work as you go!!

Where to publish?

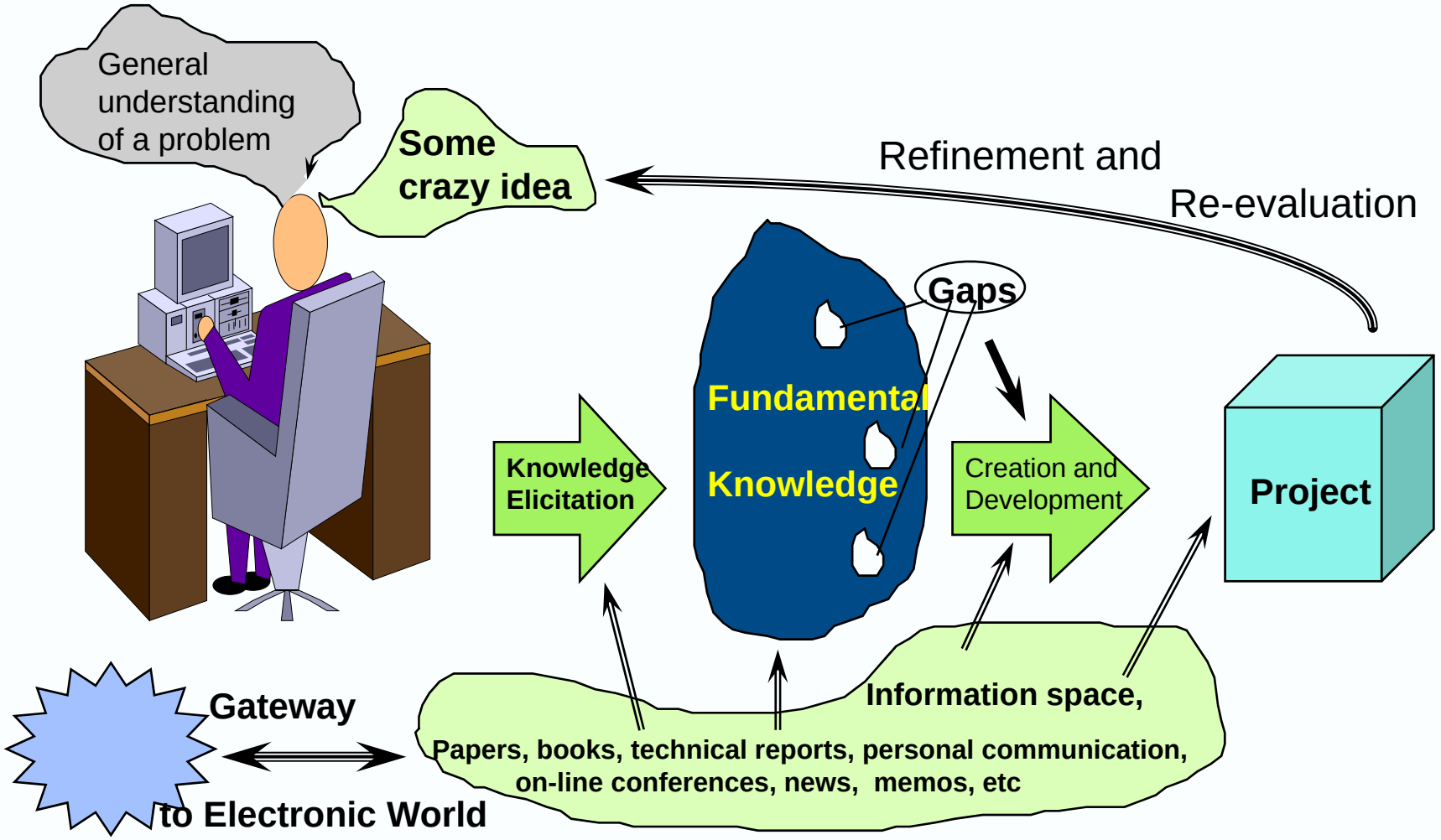
- Location, location, location!!!!
- It is better to be rejected by the best journal (at least you get some feedback) than publish in a “wrong” location

What to publish?

- “horses for courses” – conference/journal
- Quality, not quantity
- Get feedback
- Polish!

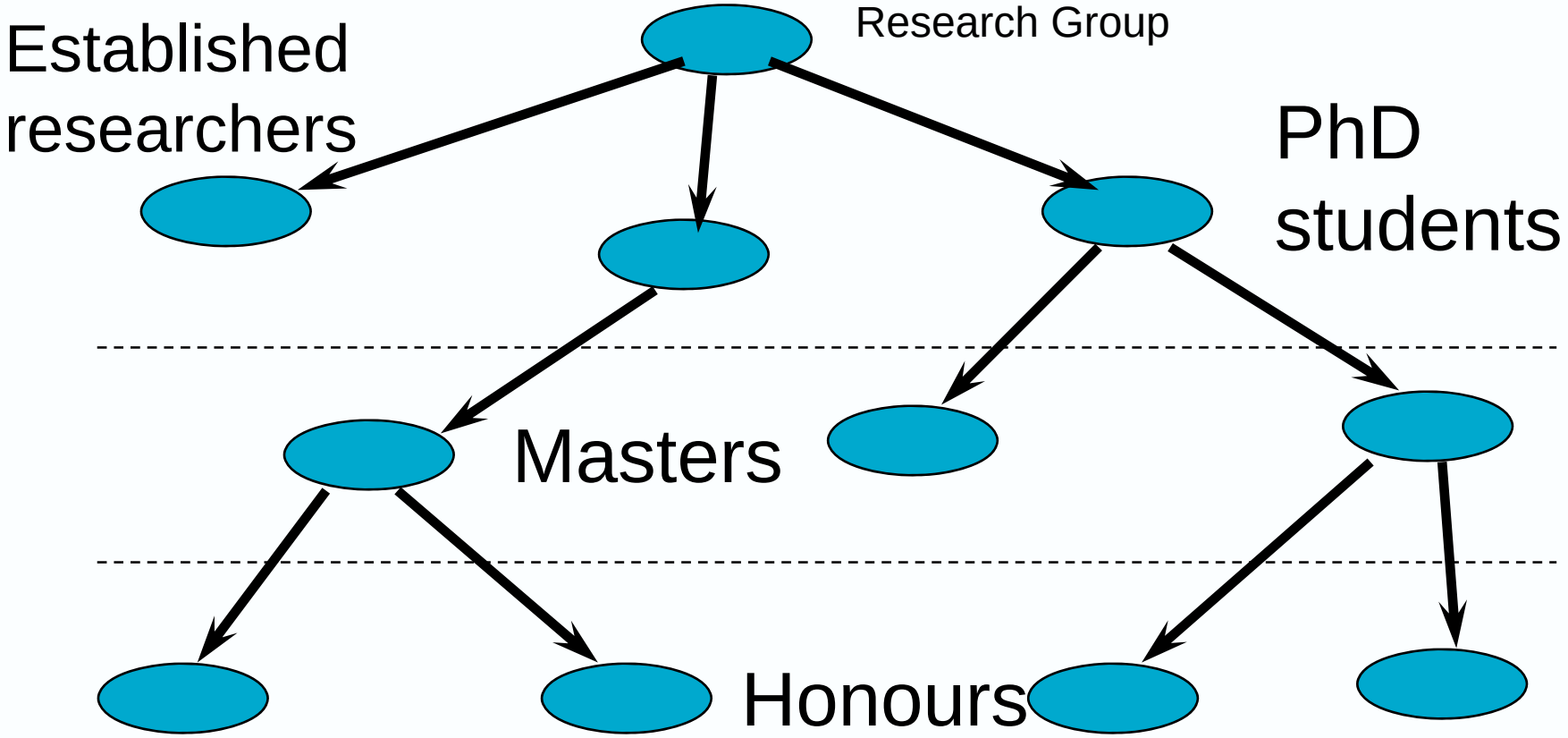


Research and Access to Information



Research Philosophy

Project Tree: strong roots - strong branches



Discovery vs. invention

- There are two main ways of practicing science : discovery vs. invention
- Biologists, physicists, chemists, researchers in psychology… are discoverers
- Computer scientists, researchers in nanotech, researchers in process engineering or in industrial engineering… are inventors
- Mathematicians… are mathematicians :-)

Lionel Brunie
LIRIS lab
National Institute of Applied Sciences (INSA)
Lyon, France

Inventing

- Software Engineering & Computer Science produces *inventions*
- Computers do not exist by themselves. They have been created by human beings => there is nothing to *discover* in a computer or in a software
- The objective of research in CS is “just” to make computers and computer networks more efficient more easy to use, more reliable, more powerful… i.e. more useable/useful
- As a consequence, a research result in CS has no (real) intrinsic value. It has only the value that the research community and/or the society gives to it. A useless invention has no value !

Computer “Science”

some people argue that computer science is not a science in the same sense that biology and chemistry are

- the interdisciplinary nature of computer science has made it hard to classify

computer science is the study of *computation* (more than just machinery)

- it involves all aspects of problem solving, including
  - the design and analysis of algorithms
  - the formalization of algorithms as programs
  - the development of computational devices for executing programs
  - the theoretical study of the power and limitations of computing

whether this constitutes a "science" is a matter of interpretation

- certainly, computer science represents a rigorous approach to understanding complex phenomena and problem solving

Common kinds of scientific writing

Proposals

- Submissions (argue a case)
- Research proposals (e.g. thesis proposal)
- Grant applications (to apply for funding)
- Position paper (set out a case, points for discussion)

Research articles

- Present results of a research project
- Reviews (overview and interpret research in a field)
- Reports (set out project findings, eg. consultancy)

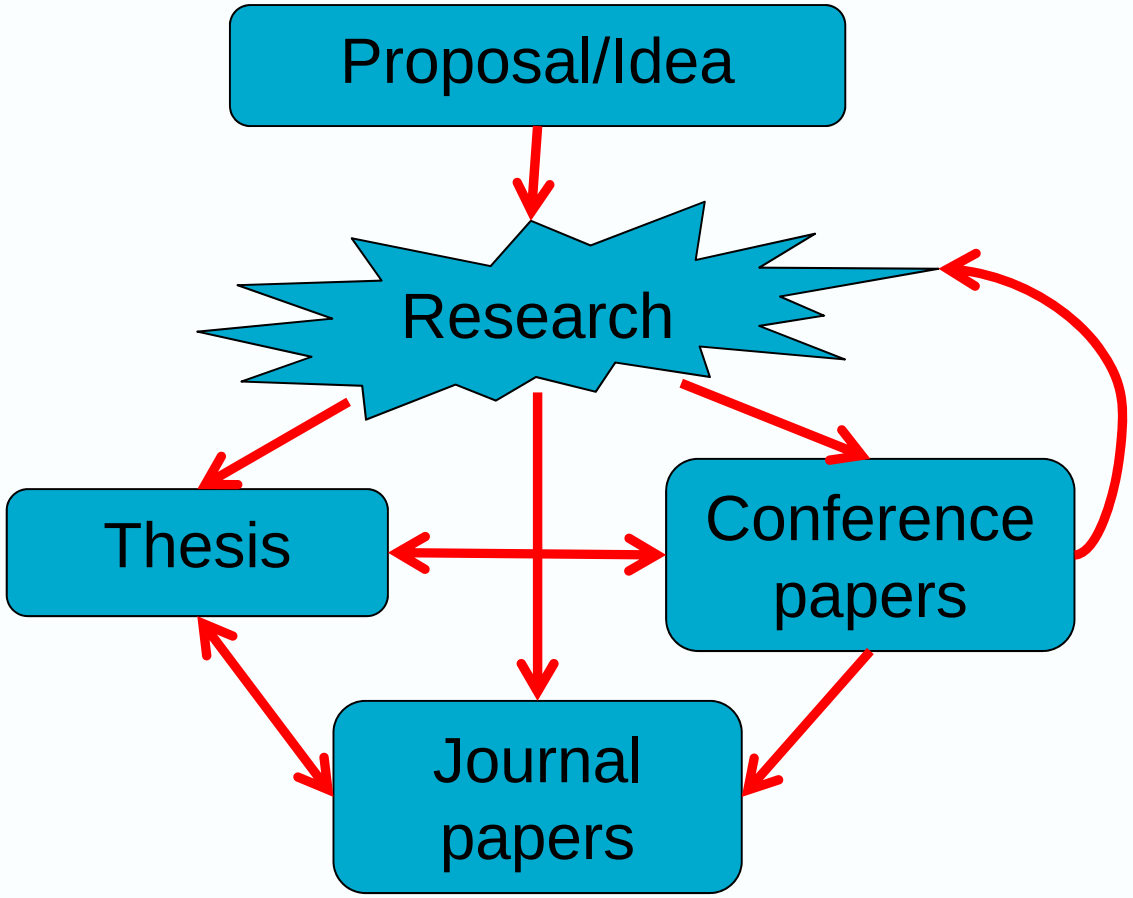
Popular articles

- Explain research ideas to the public

Books and monographs

- Substantial accounts of entire fields

How do you get to that journal paper?



Practices are very discipline specific

- Some computer scientists rarely publish in journals, considering first rank conferences to be as valuable
  - Google Scholar is more popular in CS than ISI
- Many disciplines do not publish in conferences at all, eg, consider medicine, physics, librarianship

Research Proposals

Usually the first research communication you will write

Keep writing them throughout your career

- Grant applications
- Conference papers
  - Discipline dependent

Show the world what you're going to do

- Sell your ideas

Early confirmation or refutation

Who are you writing for?

Supervisors

Scholarship committee

Confirmation panel

Other colleagues

Standard elements of a proposal

Title

Abstract

Introduction

Literature review

The topic, problem, questions

Theoretical framework

Research method

- How you will collect and analyse data

Timeline to completion

References

Other possible elements

Resources required

- Funding sources
- Travel, accommodation
- Equipment
- Personnel

Ethics strategy

Risks and mitigation strategy

Novelty

Significance

Writing Style (for all research communication)

Key things that set the tone

- English
- Referencing
- Presentation

English

- Spelling & grammar checks
- Proofread

- That also requires learning how to reason in English, not to translate from another language, if your first language isn't English

English Writing Style

Personal pronouns

- I have found that ……..
- We believe that ……..
- The findings of this project are ……

Default

- Don’t use personal pronouns for your project, especially first person singular
  - I, me, my

English Writing Style 2

Active vs Passive voice

- Use active where possible
  - "The project will investigate fast internet protocols" rather than "Fast internet protocols will be investigated."
- Word can help sort it out

Tense

- Be consistent
- Default
  - Past tense for lit review
    - "Liu (1981) found that …" rather than "Liu (1981) finds that …"
  - Past tense to describe results
    - "*The speed of transmission **was** …*" rather than "*the speed of transmission **is** …*"
  - Present tense to discuss results and present conclusions
    - "*The new protocol **is** an exciting advance on the state-of-the-art*." rather than "*The new protocol **was** an exciting advance on the state-of-the-art*."

Tone

Formal and succinct

- Distance from subject matter like an outside observer
  - Suggests objectivity
- Professional and serious

Personal and informal

- Journalistic
- Entertaining

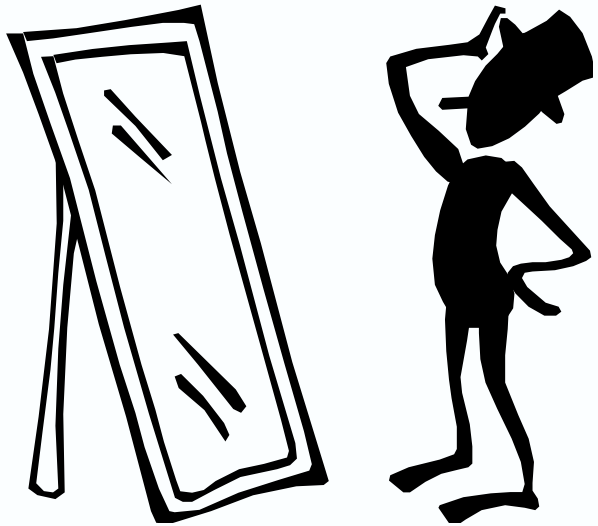
More on Writing Style

Coherence of the manuscript

- Ideas tied together logically
- Repetition of variable names
- Use consistent terms & acronyms
- Connecting sentences & paragraphs

Simple sentences

Polish, polish, polish...



Increase your global impact

How many people will see your paper?

Conference	100
Journal	1000
Web	10000+

Online publishing

Instant world-wide availability

Hypermedia features of the Web

Eliminating distribution costs

Low production costs

- *No need to print "hard copy*"

Potential world-wide audience

“Niche"/special interest publishing is viable

Copyright is an issue!

Other kinds of research outputs

Software

Patents

Datasets

Online websites & portals

Creative works and exhibitions

Translations

Popular reports and articles

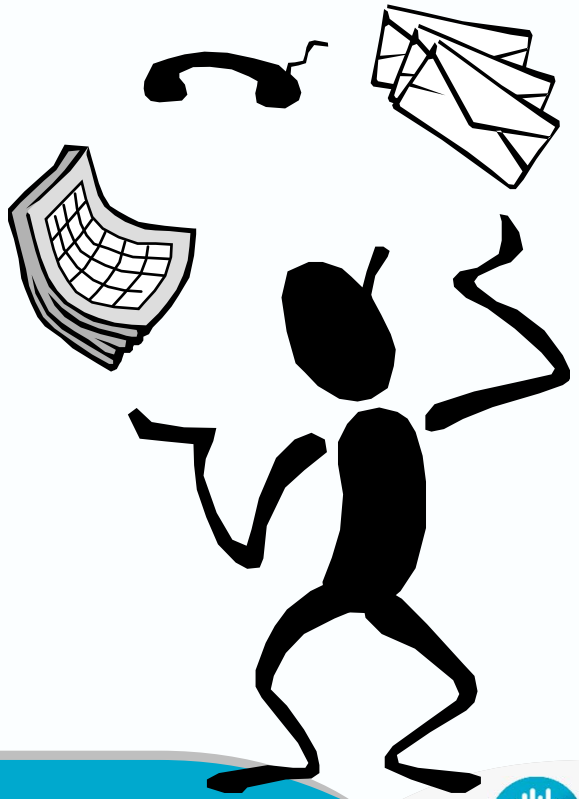
Media documentaries

Reports to government

Some words of warning

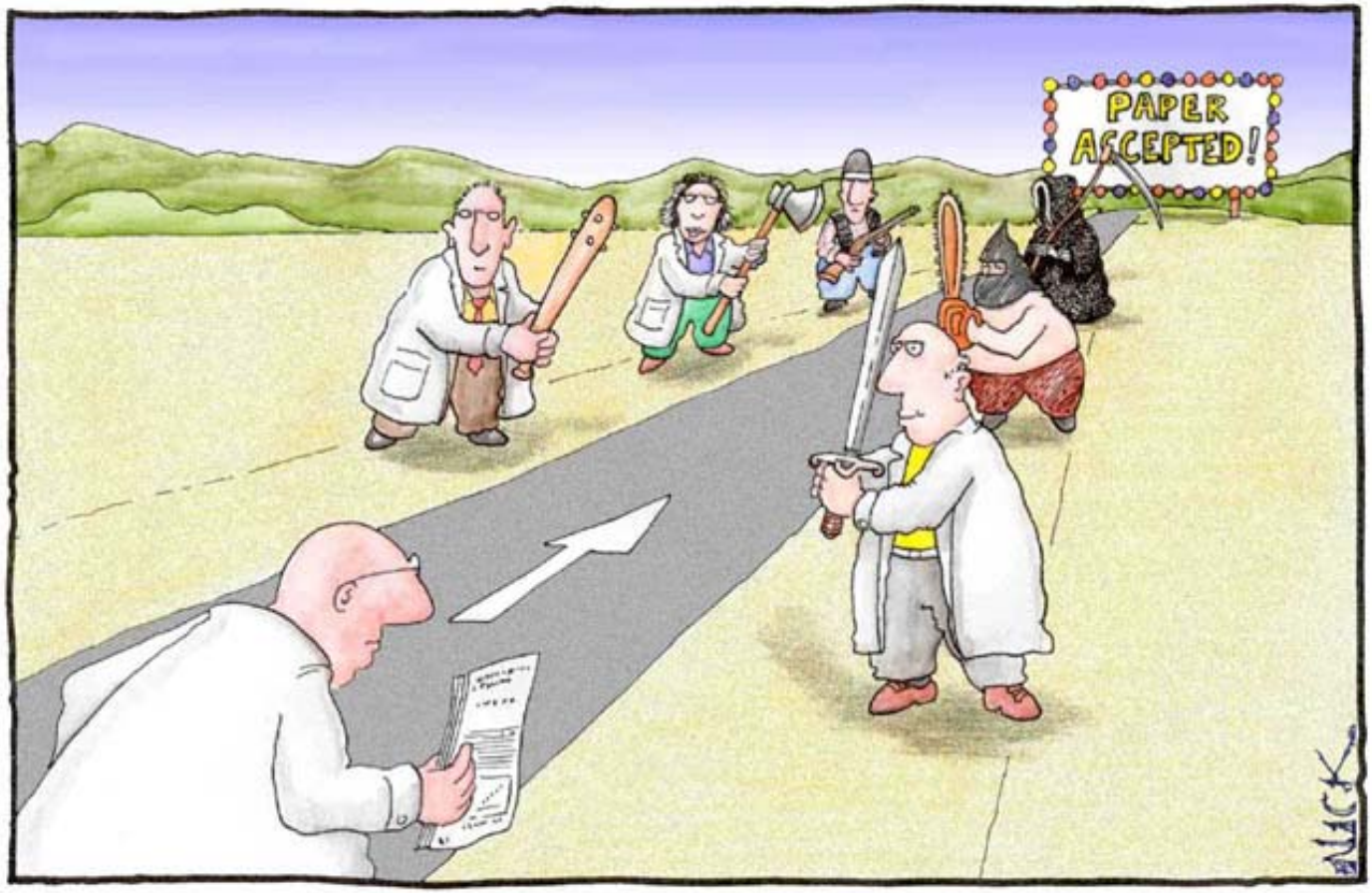
Be aware of these issues ...

- Contracts
- Copyright and permissions
- Defamation and libel
- Liability
- Plagiarism



- Scientists get asked to referee work of others.
- Ask yourself these questions:
  - Are the question and design clear?
  - Are the methods valid?
  - Are the results justified?
- Checking work of others helps you see good and bad points in your own work
- Avoid the temptation to show off at the author's expense. It may rebound on you!

Beware of Rambo reviewers!!!



Most scientists regarded the new streamlined peer-review process as 'quite an improvement.'

PhD?

PhD Definition

- Philosophiae Doctor (Doctor of Philosophy)
  - "degree granted by a university to a learned individual who had achieved the approval of his peers and who had demonstrated a long and productive career in the field of philosophy"
  - "degree to be granted to someone who had undertaken original research in the sciences or humanities "

Doctoral Seminar
Nayda G. Santiago
November 3, 2004

Philosophy?

Definitions

- Love and pursuit of wisdom by intellectual means and moral self-discipline
- Investigation of the nature, causes, or principles of reality, knowledge, or values, based on logical reasoning rather than empirical methods.
- The critical analysis of fundamental assumptions of beliefs.
- A set of ideas or beliefs relating to a particular field or activity; an underlying theory.
- General laws or principles under which all the subordinate phenomena or facts relating to that subject are comprehended.

What Research is not

Research isn’t information gathering:

- Gathering information from resources such books or magazines isn’t research.
- No contribution to new knowledge.

Research isn’t the transportation of facts:

- Merely transporting facts from one resource to another doesn’t constitute research.
- No contribution to new knowledge although this might make existing knowledge more accessible.

What Research Is

"…the systematic process of collecting and analyzing information (data) in order to increase our understanding of the phenomenon about which we are concerned or interested."[1]

1. Leedy P. D. and Ormrod J. E., Practical Research: Planning and Design, 7th Edition. 2001.

Research Characteristics

1. Originates with a question or problem.
2. Requires clear articulation of a goal.
3. Follows a specific plan or procedure.
4. Often divides main problem into subproblems.
5. Guided by specific problem, question, or hypothesis.
6. Accepts certain critical assumptions.
7. Requires collection and interpretation of data.

Scientific Method

Hypothesis

Sequence of **experiments**

- Randomization
- Repetition

Change one parameter/experiment

Prove/Disprove Hypothesis

Document for others to reproduce results

Taken from "How to have a bad carreer in research/academia" by David Patterson, Feb 2002.

Research Projects

Research begins with a problem.

- This problem need not be Earth-shaking.

Identifying this problem can actually be the hardest part of research.

In general, good research projects should:

- Address an important question.
  - original and significant
- Advance knowledge.

Incorrect Choice - Research Projects

The following kinds of projects usually don't make for good research:

- Comparing data sets.
- Correlating data sets.
- Problems with yes / no answers.

High-Quality Research

Good research requires:

- The scope and limitations of the work to be clearly defined.
- The process to be clearly explained so that it can be **reproduced** and **verified** by other researchers.
- A thoroughly planned design that is as **objective** as possible.

High-Quality Research (cont.)

Good research requires:

- Highly ethical standards be applied.
- All limitations be documented.
- Data be **adequately analyzed** and explained.
- All findings be presented **unambiguously** and all conclusions be justified by sufficient evidence.
  - Vocabulary - definition

Research Process

Research is an extremely cyclic process.

- Later stages might necessitate a review of earlier work.

This isn't a weakness of the process but is part of the built-in error correction machinery.

Because of the cyclic nature of research, it can be difficult to determine where to start and when to stop.

Step 1: A Question Is Raised

A question occurs to or is posed to the researcher for which that researcher has no answer.

- This doesn't mean that someone else doesn't already have an answer.

The question needs to be converted to an appropriate problem statement like that documented in a research proposal.

Step 2: Suggest Hypotheses

The researcher generates intermediate hypotheses to describe a solution to the problem.

- This is at best a temporary solution since there is as yet no evidence to support either the acceptance or rejection of these hypotheses.

Step 3: Literature Review

The available literature is reviewed to determine if there is already a solution to the problem.

- Existing solutions do not always explain new observations.
- The existing solution might require some revision or even be discarded.

Step 4: Literature Evaluation

It’s possible that the literature review has yielded a solution to the proposed problem.

- This means that you haven’t really done research.

On the other hand, if the literature review turns up nothing, then additional research activities are justified.

Step 5: Acquire Data

The researcher now begins to gather data relating to the research problem.

- The means of data acquisition will often change based on the type of the research problem.
- This might entail only data gathering, but it could also require the creation of new measurement instruments.

Step 6: Data Analysis

The data that were gathered in the previous step are analyzed as a first step in ascertaining their meaning.

As before, the analysis of the data does not constitute research.

- This is basic number crunching.

Step 7: Data Interpretation

The researcher interprets the newly analyzed data and suggests a conclusion.

- This can be difficult.
- Keep in mind that data analysis that suggests a correlation between two variables can’t automatically be interpreted as suggesting causality between those variables.

Step 8: Hypothesis Support

The data will either support the hypotheses or they won't.

- This may lead the researcher to cycle back to an earlier step in the process and begin again with a new hypothesis.
- This is one of the self-correcting mechanisms associated with the scientific method.

Common Methodologies

Methodologies are high-level approaches to conducting research.

- The individual steps within the methodology might vary based on the research being performed.

Two commonly used research methodologies:

- Quantitative.
- Qualitative.

Methodology Comparison

Quantitative	Qualitative
Explanation, prediction	Explanation, description
Test theories	Build theories
Known variables	Unknown variables
Large sample	Small sample
Standardized instruments	Observations, interviews
Deductive	Inductive

The Thesis

Often the largest piece of writing you do

Structure depends on method

Size depends on method

Be guided by your supervisor

Look at theses in departmental libraries

Who are you writing for?

Examiners

Thesis Survival Tips

Start writing as soon as the proposal is accepted

- Start with the Literature Review

Keep writing

- Must be a daily activity
  - even a couple of sentences or paragraphs a day
- Avoid binge writing

Workshop each chapter with your research group colleagues

Use a bibliographic tool such as Endnote

Use a proof-reader

Responsibilities of a University

- ensuring access to resources and people
- protection of intellectual property rights
- standards and requirements are adhered to
- annual reports
- grievance procedures
- appeals procedures
- clear guidelines for examiners

Responsibilities of a School/Department

- appropriately qualified for admission
- has the capacity
- appropriate research project
- project is feasible
- enough expertise and interest on supervisor's side
- sufficient workload & supervision

Responsibilities of a Supervisor

- give guidance
- ensure productive use of candidate's time
- advice on time scheduling & management
- request written reports
- appropriately instructed on safety
- arrange seminars, meetings, conferences
- oversee the candidate's work

Responsibilities of a Candidate

- be familiar with regulations
- utilize resources, facilities and opportunities
- adhere to safety regulations and ethical practices
- take the initiative
- maintain the progress
- prepare the THESIS

Supervisor expectations

- student independence
- produce legible written work
- seek advice and comments from others
- meeting regularly
- be honest on reporting the progress
- follow the advice
- be enthusiastic
- enjoy the project

Student Expectations

- work to be read
- supervisors to be available
- be friendly, open and supportive
- constructively critical
- have a good knowledge of the research area
- exchange of ideas
- courteous
- be enthusiastic and involved in student success

Research: Success Factors

- Focus
- Support & infrastructure
- Critical mass
- Continuity
- Academic excellence
- International recognition
- Collaboration & links

Writing a Paper

Size determined by journal or conference

- Journal typically 8,000 words
- Conference typically 4,000 words

A micro writing plan

1. Title?
2. Purpose?
3. Authors?
4. Audience?
5. Method?
6. Publication Outlet?
7. Theoretical Contribution?
8. Practical Contribution?

A micro writing plan 1

1. **Title**
   - What is the title of the paper?
2. **Purpose**
   - Why am I writing this?
   - How does this fit into my development plan?
3. **Authors**
   - Who are the authors?
   - What is their intended contribution?
   - Have a written agreement

A micro writing plan 2

4. Audience

- Who do you want to read it?
- Professional vs Academic?

5. Method

- What am planning to use?

6. Publication Outlet

- Which conference or journal?
- What level (A*, A, B, C)?
- CORE list
  - http://core.edu.au/index.php/categories/conference%20rankings
  - http://core.edu.au/index.php/categories/journals

So, where?

Conferences

- Choose a community & consistently engage

Journals

- Match method
- Match to project quality

Be careful with choice

- Don’t waste
- Don’t over reach

A micro writing plan 3

Theoretical Contribution?

- You must make a clear and useful contribution to knowledge

Practical Contribution?

- Optional
- Important for applied IT fields

Alternative writing plan

1. What is the story and who is the audience?
2. What is the significance?
3. How best to communicate the story and significance to the intended audience?

Structure of a Scientific Paper

- Title
- Abstract
- Introduction
- Background & Rationale (includes Literature Review)
- Method
- Results
- Discussion
- Conclusion
- Acknowledgements
- References
- Appendices

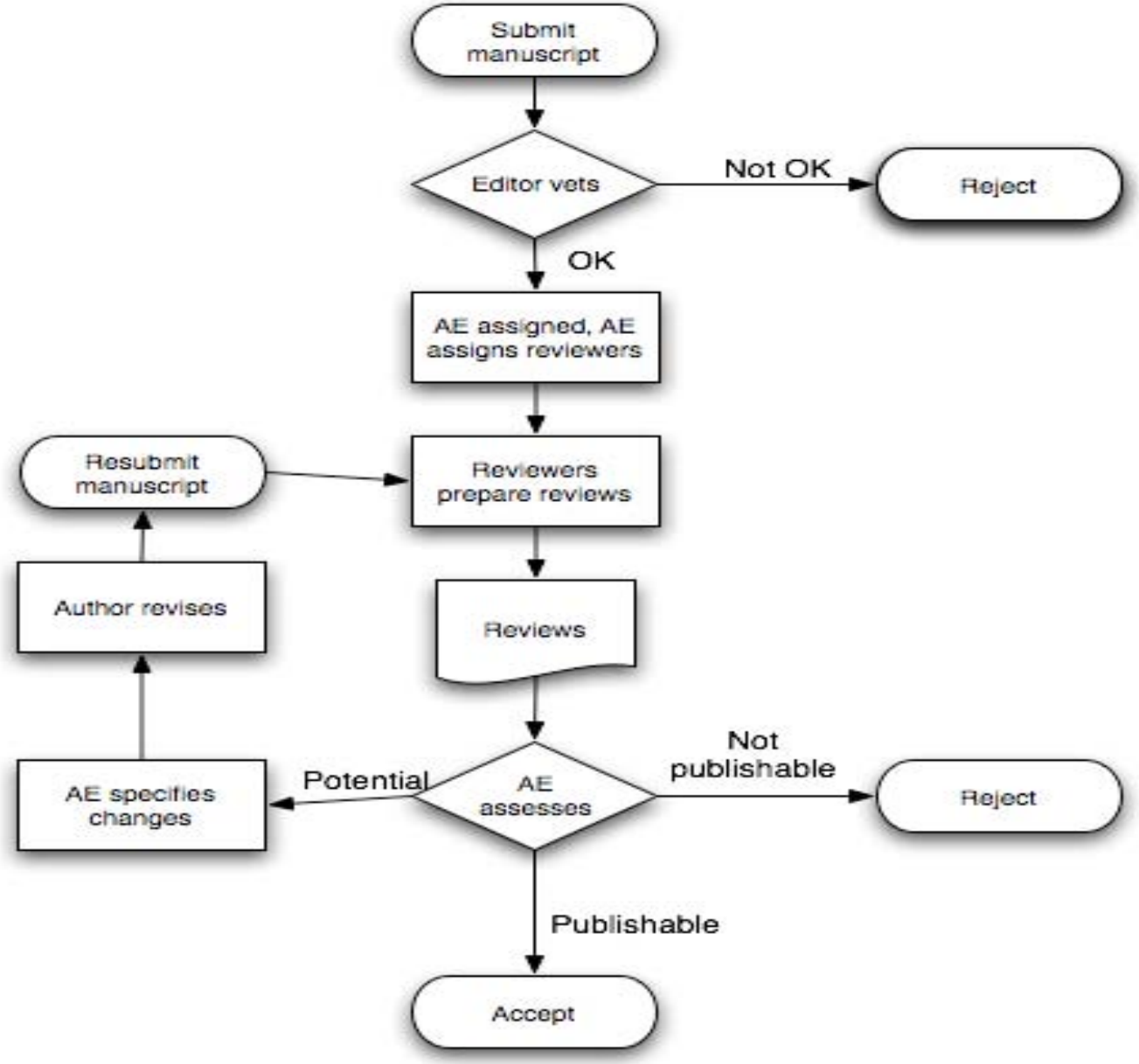
Who are you writing for?

Editors

Reviewers

And if accepted, researchers

Journal refereeing



Reviewing

Smith, A.J. (1990). The task of the referee. *IEEE Computer, 23 (4), 65-73.*

What is the purpose of the paper?

Is the paper appropriate?

Is the goal significant?

Is the method or approach valid?

Is the actual execution of the research valid?

Are the correct conclusions drawn from the results?

Is the presentation satisfactory?

What did you learn?

More Advice (for those aiming at academe)

Every academic needs a mentor

- Start writing with a well published

Be part of a group

Organize effort around a small number of major projects

Develop and maintain a publishing plan

Occasionally publish by yourself

Presenting your research

Conference/seminar presentations important for many reasons

- Getting your research noticed
- Building collaborations
- Jobs

Write a plan

- What is the purpose of the talk?
- Who is the audience?
- What is the ‘take away’ message?

Presentation 101

Introduction -> Body -> Conclusion

Simple slides

White space

Simple & clear graphics

10/20/30 rule

- 10 slides
- 20 minutes
- 30 point

Presenting tips

Practice, practice, practice

- must be within time
- if the material rolls off your tongue then you are less likely to be nervous

Arrive early to setup

Multiple backup strategies

Prepare flash cards if nervous

Speak loudly and clearly

Be open with your body language

Observe your audience

Talk to your audience

Today's Main Takeaways

Know who you're writing for

Attend to basics

- English & referencing

Three Ps

- Polish, polish, polish
- Practice, practice, practice

Write plans

- Macro, micro, presentation

Write early and often

The worst thing you can do!

Slide #1

The Role of Translocation and Selection in the Emergence of Genetic Clusters and Modules

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Abstract Biomolecular studies point increasingly to the importance of modularity in the organization of the genome. Processes such as the maintenance of metabolism are controlled by suites of genes that act as distinct, self-contained units, or *modules*. One effect is to promote stability of inherited characters. Despite the obvious importance of genetic modules, the mechanisms by which they form and persist are not understood. One clue is that functionally related genes tend to cluster together. Here we show that genetic translocation, recombination, and natural selection play a central role in this process. We distill the question of emerging genetic modularity into three simulation experiments that show: (1) a tendency, under natural selection, for essential genes to co-locate on the same chromosome and to settle in fixed loci; (2) that genes associated with a particular function tend to form functional clusters; and (3) that genes within a functional cluster tend to become arranged in transcription order. The results also imply that high proportions of junk DNA are essential to the process.

Keywords
Genetic modularity, self-organization, feedback, translocation, clustering

NEVER use the text of your paper as slides!!!!

Readings and resources

Purdue University Writing Lab (1999).

- http://owl.english.purdue.edu/

G.D. Gopen and J.A. Swan (1990). The Science of Scientific Writing. *American Scientist* 78, 550-558.

- http://www.americanscientist.org/issues/feature/the-science-of-scientific-writing/9

Margaret Procter (2007). *Advice on Academic Writing*. University of Toronto. http://www.utoronto.ca/writing/advise.html

Marc E. Tischler (2007). *Scientific Writing Booklet*. University of Arizona

- http://www.biochem.arizona.edu/marc/Sci-Writing.pdf

Monash University Library: Citing, referencing and plagiarism:

- Quiz: http://lib.monash.edu/tutorials/citing/citing-quiz/quiz.html
- Tutorial: http://lib.monash.edu/tutorials/citing/

Literature Review

A literature review is a necessity.

- Without this step, you won't know if your problem has been solved or what related research is already underway.

When performing the review:

- Start searching professional journals.
- Begin with the most recent articles you can find.
- Keep track of relevant articles in a bibliography.
- Don't be discouraged if work on the topic is already underway.

Literature Review Pitfalls

Be very careful to check your sources when doing your literature review.

Many trade magazines are not peer reviewed.

- Professional conferences and journals often have each article reviewed by multiple people before it is even recommended for publication.
- The IEEE and ACM digital libraries are good places to start looking for legitimate research.

Literature Review Pitfalls (cont.)

The Internet can be a good source of information. It is also full of pseudo-science and poor research.

Make sure you verify the claims of any documentation that has not been peer reviewed by other professionals in the computing industry.

Digital Libraries

- ACM DL: www.acm.org/dl/
- IEEE Xplore http://ieeexplore.ieee.org/Xplore/home.jsp
- Elsevier: http://www.elsevier.com/
- Springer: http://www.springer.com/?SGWID=5-102-0-0-0
- Wikipedia: http://en.wikipedia.org/wiki/Main_Page
- The DBLP Computer Science Bibliography: http://www.informatik.uni-trier.de/~ley/db/
- arXiv.org: http://arxiv.org/

Personal Bibliographical Databases

What one could expect from the Personal Bibliographical Database ?

Desirable features:

- Manage personal bibliographical records
- Provide fast search by keywords, phrases, date, author, publisher, title, boolean expressions with all of above, wild characters
- Powerful import/export facility in order to intercommunicate with widespread bibliographical software packages and word-processors

Personal Bibliographical Databases

- Flexible output capability, allowing to produce the list of references in required format and order
- Convenient way of including additional entries
- Good editor and formatter as well as the option to invoke the external editor or wordprocessor
- Both single-user and network version
- Several levels of protection
- Combination of public bibliographical database with the option of private databases

Examples of PDB

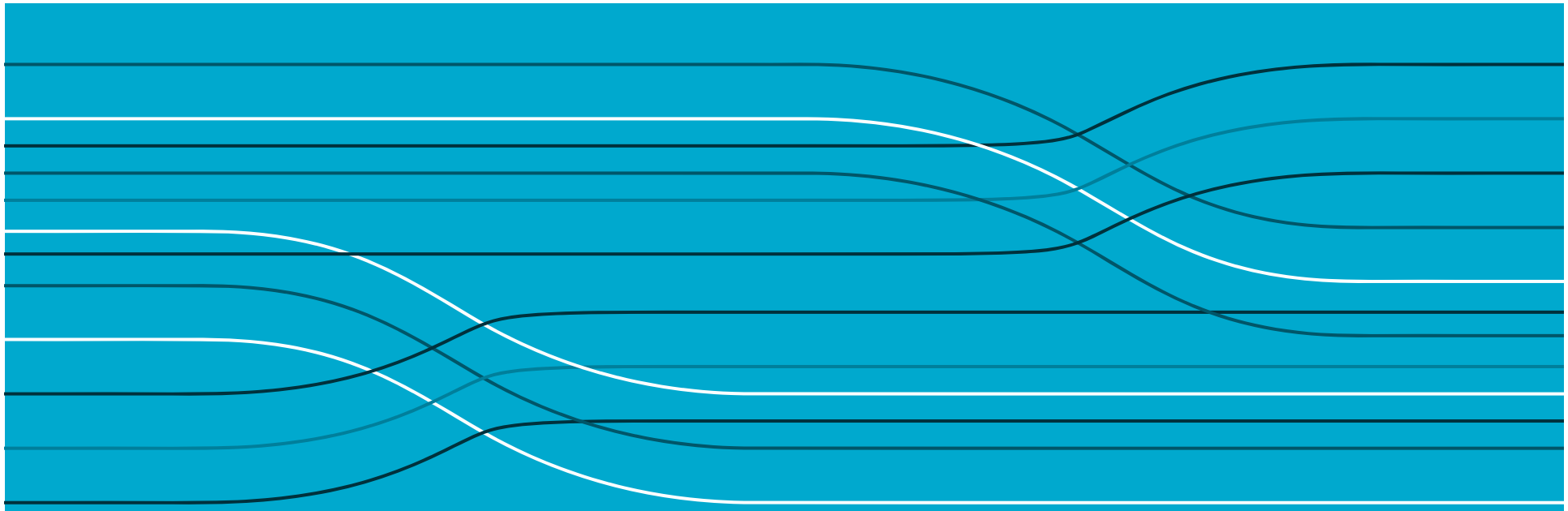
Endnote

a commercial reference management software package, used to manage bibliographies and references when writing essays and articles. It is produced by Thomson Reuters. [http://en.wikipedia.org/wiki/EndNote]

BibDB / WinBibDB

Reference Manager

a commercial reference management software package sold by Thomson Reuters. RM is most commonly used by people who want to share a central database of references and need to have multiple users adding and editing records at the same time.
[http://en.wikipedia.org/wiki/Reference_Manager]



Use Case: Context Spaces – representing context and reasoning about situations in pervasive computing

www.csiro.au

CSIRO

Context Spaces – foundation for context representation, reasoning, validation, prediction

Context Spaces leads towards a general context model to aid reasoning about and describing context, and to design operations for manipulating and utilizing context

- Geometrical spaces metaphors
- The state-space model [Ogata, 67]
- Control theory

Application space - UoD

Situation spaces – subsets/subspaces of application spaces

Context state – current sensor readings

Recent PhD research related to ContextSpaces

- Amir Padovitz “Context Management and Reasoning about Situations in Pervasive Computing”, 2006
- Pari Delir Haghighi, “Situation and Resource-Aware Adaptation for Ubiquitous Data Stream Mining”, 2009
- Ruwini Kodikara Edirisinghe, “Context Aware Cross-layer Architecture for Real-time Wireless Local Area Networking”, 2009
- Prem Prakash Jayaraman, “Cost-Efficient Collection and Delivery of Sensor Data using Mobile Devices”, 2010
- Waskitho Wibisono, “A Distributed Framework of Context Management and Situation Reasoning in Mobile Peer-to-Peer Environments for Ubiquitous Applications”, 2012
- Saguna, “Complex Activity Recognition and Context Validation within Social Interaction Tools”, 2013
- Karan Mitra, “Quality of Experience Measurement, Prediction and Provisioning in Heterogeneous Access Networks”, 2013
- Andrey Boytsov, “Situation Awareness in Pervasive Computing Systems: Reasoning, Verification, Prediction”, 2013

Publications (books and chapters in books)

Burstein, Frada; Brézillon, Patrick; Zaslavsky, Arkady (Eds.), “Supporting Real Time Decision-Making. The Role of Context in Decision Support on the Move”, Series: Annals of Information Systems, Vol. 13, 1st Edition., 2011, XXX, 320 p. 68 illus., Softcover, ISBN: 978-1-4419-7405-1

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Mohamed Medhat Gaber, Arkady Zaslavsky and Shonali Krishnaswamy, “Data Stream Mining”, Data Mining and Knowledge Discovery Handbook, 2010, Part 6, 759-787, DOI:10.1007/978-0-387-09823-4_39

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Potential PhD projects in Internet of Things

- Semantic annotation of captured sensor data
- Discovery of sensors
- Sensor data marketplace
- Spatial, temporal, utility metrics for large-scale sensor experiments
- Efficient validation of sensor data /sources
- Capturing context of sensor data
- Situational awareness of sensing-as-a-service experiments
- Tools for planning, management and optimisation of large scale sensor experiments
- Sensor data provenance
- Proactive adaptation of IoT applications
- Context & situation prediction in IoT

Thank you !

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