Research Methods and Paper Writing

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2014/2015

Contact Details

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- Availability Hours:
  - Tuesday: 14:00 – 18:00
  - **by prior arrangement via e-mail**

Section Structure

- **Lectures:** 6 **hours**
- **Homework:** 20 **hours**
- **Timetable:**
  - **Monday** 14:00 – 17:00, Room: POS 1.02
  - **Friday** 9:30 – 12:30, Room: E412
- **Assessment:**
  - Critical presentation of an article – showing that you have considered and evaluated all the analysis' dimensions illustrated in the lecture

Goals

- **Knowledge**
  - Understanding of different research paradigm and in particular the empirical and engineering one
  - Understanding of different research methods
  - Understanding how a scientific article should be written and how it is evaluated
- **Skills**
  - Critical thinking
  - Critical reading and evaluation
  - The ability to present a logical and coherent argument
  - Identification of what a research question is.

In class I

- Initial brainstorming on the key concepts (30 mins)
- Teacher presentation (1 h 30 mins)
  - Research methods and paper structuring
  - Illustration of a PhD research project
  - Critical discussion
- Analysis of a (short) article (1h)
  - Reading
  - Guided discussion on: goals, research method, solution, value
  - Guided discussion of the issues and criticalities of the paper with respect to the points above.

Homework

- Pair with a colleague
- Each student must read and analyze an article written by the other student in the pair – the analysis is following a template (provided by the teacher) with criteria/aspects to assess
- If you are paired with a students that has no "experimental" paper then you will analyze one of my articles ☺
- Prepare a short presentation (15 mins) where you illustrate the article of your partner and evaluate it
- Read selected material that will be provided
  - Material on research methods
  - Example papers.

In class II

- Students presentations of their partner's article
- Discussion for each presentation
- Discussion of the material read during the homework

What a student must do to pass

- Participate to the lectures
- Read the provided material
- Complete the homework

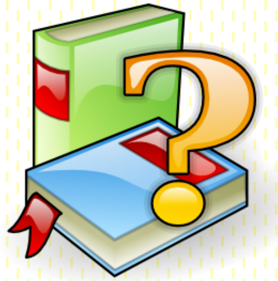
Topics discussed in the lecture

- What is research
- Research methods
- What is computer science
- Research Paradigm in Computer Science
- Experimental computer science (vs. theoretical)
- Basic vs. applied computer science research
- Impact of the research
- Case study (phd project)
- Paper structuring and writing
- Paper evaluation
- Research techniques

Definitions

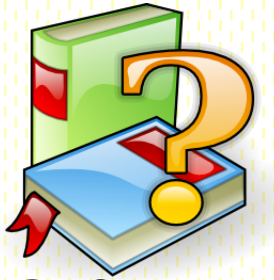
- **Research:** activity of a diligent and systematic inquiry or investigation in an area, with the objective of discovering or revising facts, theories, applications. The goal is to discover and disseminate new knowledge.
- **Research Method:** refers to the manner in which a particular research project is undertaken.
- **Research Technique:** refers to a specific means, approach, or tool-and-its-use, whereby data is gathered and analysed, and inferences are drawn.
- **Research Methodology:** refers to the study of research methods. It does not admit of a plural.

Definitions: Quantitative Methods



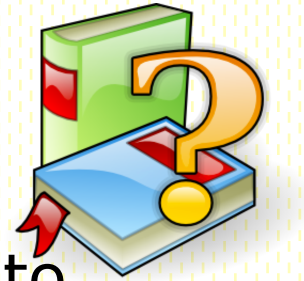
- Origin in the **natural sciences** – scientific method
- The goal is develop **models, theories, and hypotheses** pertaining to natural phenomena (how it works)
- The research is generally driven by hypotheses, which are formulated and tested rigorously, with the goal of showing that the hypothesis is wrong
- Emphasize that **measurement** is fundamental since it gives the connection between observation and the formalization of the model, theory and hypothesis
- **Repeatability** of the experiments and testing of hypotheses are vital to the reliability of the results, since they offer multiple opportunities for scrutinising the findings.

Definitions: Qualitative Methods



- Have their roots in the **social sciences**, and are primarily concerned with increasing our understanding of an area, rather than producing an explanation for it
- Qualitative research is often associated with **fieldwork** and analysis in a limited number of organisational settings
- As humans and organisational conditions change over time, the pre-condition for the study and the analysis of the problem change. Hence, **repeatability** of experiments may **not be possible.**

Definitions



- **Research questions:** state what you want to learn
- **Hypotheses:** are statements of your tentative answers to these questions
- **Pure Research:** to contribute to abstract, theoretical understanding
- **Instrumentalist Research:** to contribute to understanding in order to be able to more effectively act or to 'design interventions' into the environment
- **Empirical Research:** based on the observation of the real word.

Shifting Definition of Computer Science

- *Computer Science is the study of phenomena related to computers*, Newell, Perlis and Simon, 1967.
- *Computer Science is the study and management of complexity*, Dijkstra, 1976.
- *The discipline of Computing is the systematic study of algorithmic processes that describe and transform information: their theory, analysis, design, efficiency, implementation, and application*, Denning, 1985.
- *Computer Science is the mechanization of abstraction*, Aho and Ullman 1992.
- *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*, Mahoney, 2001.

Wegner 1971

*Computer science is in part a **scientific** discipline concerned with the empirical study of a class of phenomena, in part a **mathematical** discipline concerned with the formal properties of certain classes of abstract structures, and in part a **technological** discipline concerned with the cost-effective design and construction of commercially and socially valuable products.*

Top Level of The ACM Computing Classification System (1998)

- A. General Literature
- B. Hardware
- C. Computer Systems Organization
- D. Software
- E. Data
- F. Theory of Computation
- G. Mathematics of Computing
- H. Information Systems
- I. Computing Methodologies
- J. Computer Applications
- K. Computing Milieux

ACM = Association for Computing Machinery

Top Level of The ACM Computing Classification System (2012)

- General and reference
- Hardware
- Computer systems organization
- **Networks**
- **Software and its engineering**
- Theory of computation
- Mathematics of computing
- Information systems
- **Security and privacy**
- **Human-centered computing**
- Computing methodologies
- **Applied computing**
- **Social and professional topics**

Changes in CS: the Role of Technology

- Much of the change that affects computer science comes from advances in technology:
  - The World Wide Web and its applications
  - Networking technologies and distributed systems
  - Graphics and multimedia
  - Embedded systems
  - Ubiquitous computing
  - New types of databases
  - Interoperability and data integration
  - Object-oriented programming
  - Human-computer interaction (new interfaces)
  - Software safety
  - Security and cryptography
  - Application domains

Research Paradigms in CS

- **Empirical:** Computer science is concerned with the study of a class of phenomena
- **Mathematical:** Computer Science is concerned with the study of algorithms and properties of information structures (abstraction from real objects)
- **Engineering:** managing the cost-effective design and construction of complex software-hardware systems (commercially and socially valuable).

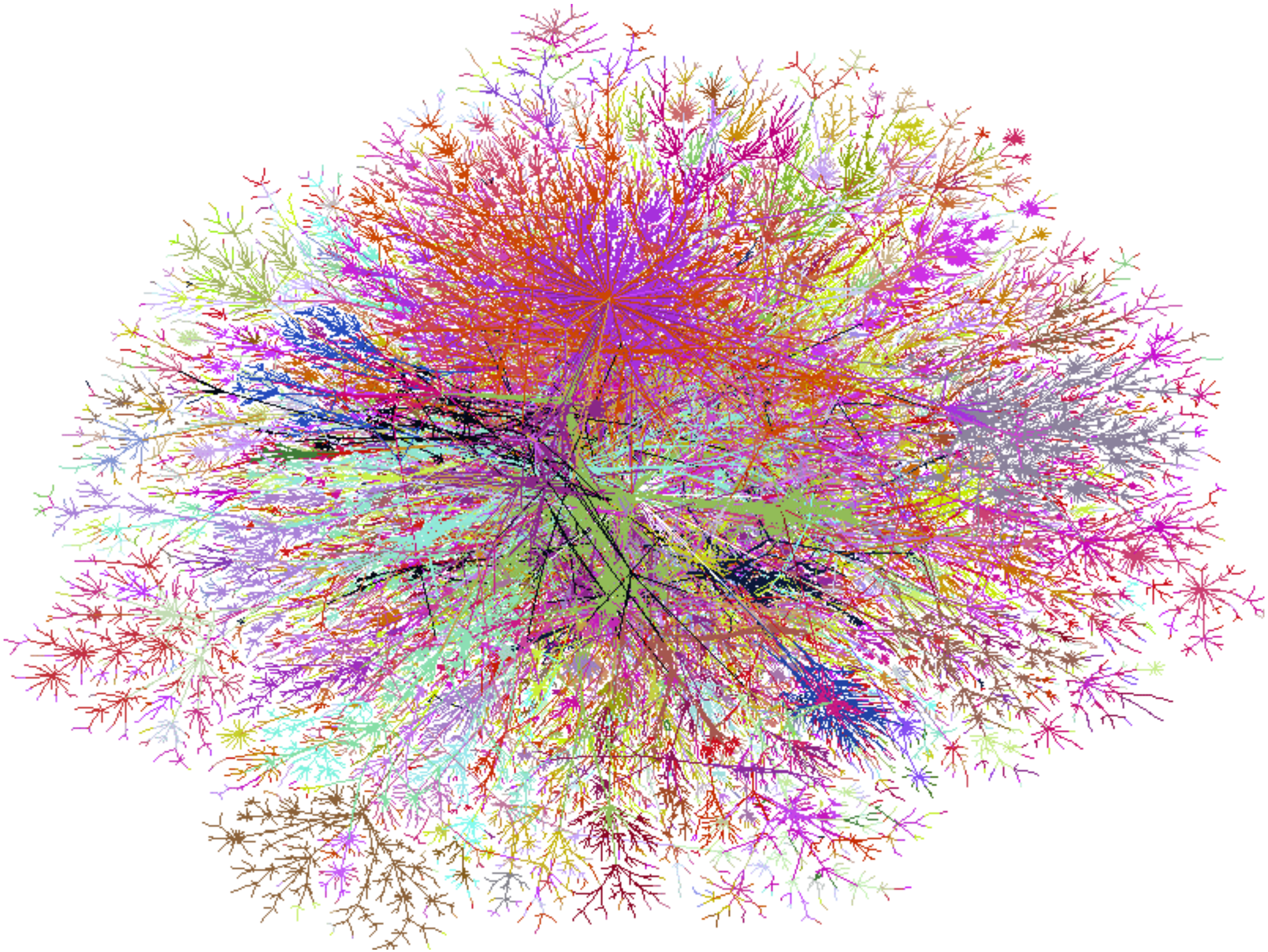
[Wegner, 1976]

Programming Languages
the diachronic perspective

- **1950-1960 The age of empirical discovery:** discovery of basic techniques such as look-up techniques or the stack algorithm for evaluating arithmetic expressions. Prog. Lang. were considered as tools for facilitating the specification of programs.
- **1961-1969 the age of elaboration and abstraction:** theoretical work in formal languages and automata theory with application to parsing and compiling.
- **1970-? The age of technology:** decreasing HW costs & increasing complex SW projects created a "complexity barrier". Development of tools and methodologies for controlling the complexity, cost and reliability of large programs.

[Wegner, 1976]

Empirical



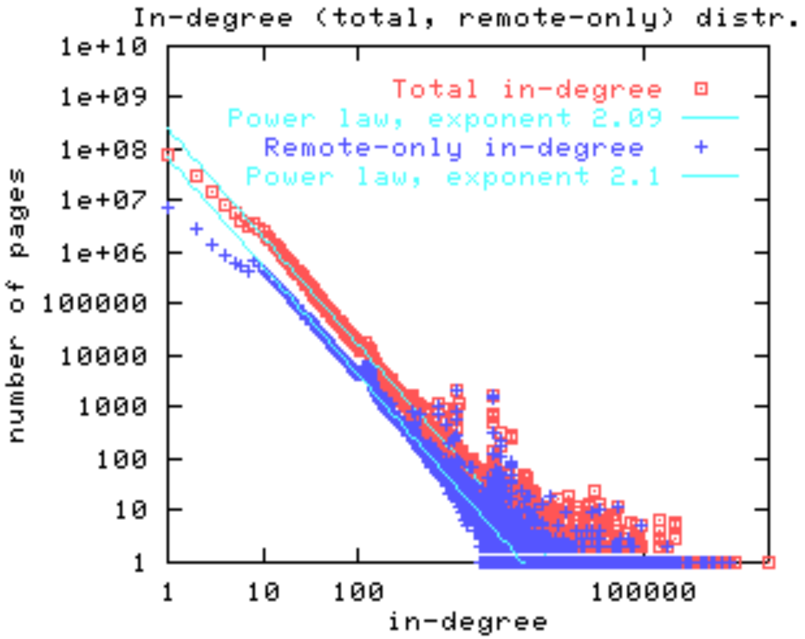
The Structure of the Web

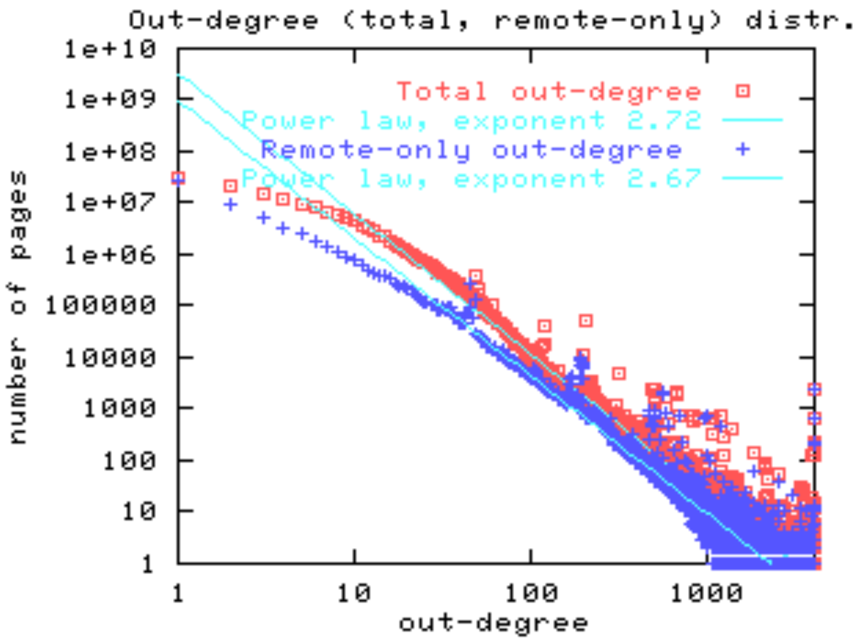
- Web does not have an engineered architecture: billions of pages created by billion of users
- Web contains a large strongly connected core (each page can reach every other)
- The shortest path from one page in the core to another involves 16-20 links (a small world)
- Analysis of web structure lead to better search engines (e.g. Google pagerank method) or content filtering tools.

[Broder et al., 2000]

Distribution Links

- The number of links to and from individual pages is distributed according to a power law: e.g. the fraction of pages with n in-links is roughly $n^{-2.1}$





[Broder et al., 2000]

Mathematical

- Study of algorithms (Knuth)
  - Design and analysis of algorithms (optimal) for particular problems
  - Computational complexity
- Study of representation, transformation and interpretation of information structures
  - Models for characterizing general-purpose tools
  - Mechanism and notations for computing all computable functions.

Mathematical – Example

How to deal with the problem of empty result set for Boolean queries, i.e., queries that contain a set of key-words and fail to return any item

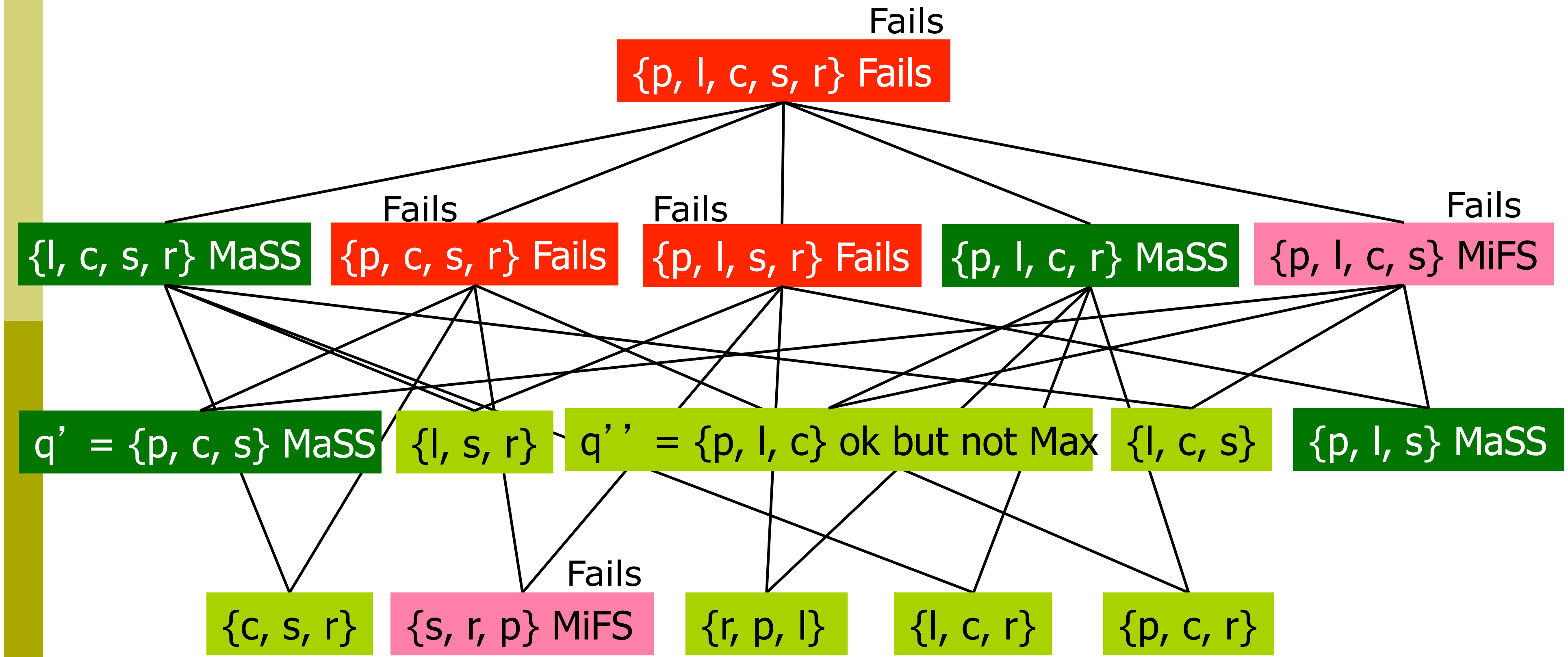
Ex: q ={prolog, language, comparison, survey, rating} fails to retrieve any record (web page)

q'	url1	prolog		comparison	survey	
	url2		language	comparison	survey	rating
	url3	prolog	language		survey	
	url4		language	comparison	survey	
q''	url5	prolog	language	comparison		rating
q'	url6	prolog		comparison	survey	
	url7		language	comparison		
	…	…	…	…	…	…

but there are results for q' ={prolog, comparison, survey}
q'' ={prolog, language, comparison}

Formal Definition of the Problem

- Let q be a query with empty result size.
- **Maximal succeeding subquery problem** q': returns some results, and there is no other succeeding subquery q'' that contains q'
- **Minimal failing subquery** q^*: is a failing subquery of q but any of its subqueries are succeeding



How to use them

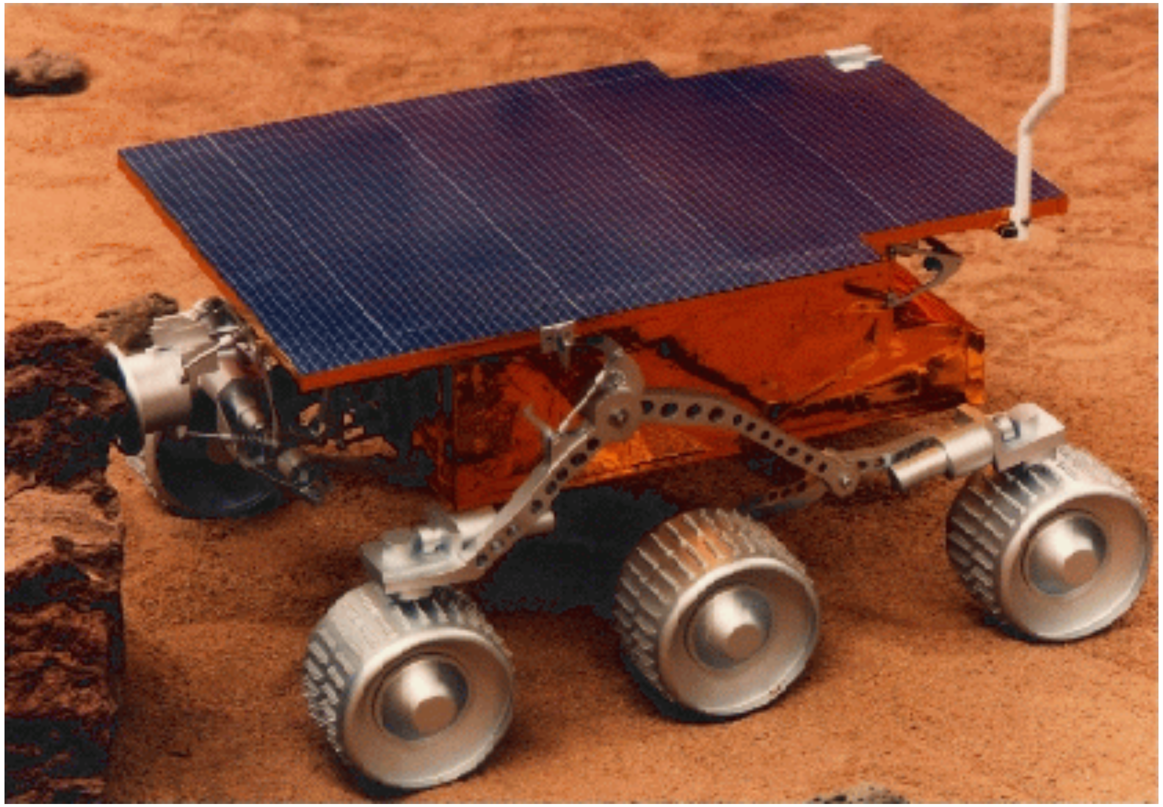
- Minimal failing queries: give a “compact” reason of why the query is failing
  - The user can generate one succeeding subquery **removing one constraint from each minimal failing subquery**
  - Eg: {l, c, s, r} (maximal succeeding subquery) is obtained by removing p from {p, l, c, s} and {s, r, p} (the two minimal failing queries)
  - Still difficult to find the query that relaxes **less constraints as possible** (search for the smallest set of conditions that make satisfiable all the minimal failing subqueries)
- Maximal succeeding subqueries: provide full description of all best relaxations.

Relaxation of Boolean Queries

- Godfrey [1997] studied extensively the problem of empty result set for Boolean queries, i.e., queries that contain a set of keywords and fail to return any item
- **Maximal succeeding subquery problem**
  - **one** of these succeeding subquery can be found in $O(|q|)$,
  - ***two*** in $O(|q|^2)$,
  - **all** makes the problem intractable
- **Minimal failing subquery problem:** similar results as above

Engineering

- Building a robot for the new mission to Mars



- And showing that it works (*better than the previous model*)

My system is better …

My Creation is Better

- Discovering a fact about nature (or about the math world), it is a contribution *per se,* no matter how small
- But [in a synthetic field] anyone can create some new thing
- One must show that the creation is **better**
  - *Solves a problem in less time*
  - *Solves a larger class of problems*
  - *Is more efficient of resources*
  - *Is more expressive by some criterion*
  - *Is more visually appealing*
  - *Presents a totally new capability*
  - *…*
- The "better" property is not simply an observation.

Empirical-Mathematical-Engineering

- Ex: Dealing with failing queries
  - Analyse the failing queries that users generate
  - Define a tractable problem: e.g., find all the maximal succeeding subqueries of q of length |q-1|
  - Design an algorithm that can run in linear time and solve the above problem
  - Design and implement a middleware that get such a query, call a standard SQL-based dbms and returns the found subqueries
  - Empirically test the middleware on a set of real queries (user input) and characterize when such an algorithm is useful (enough powerful to solve the majority of real queries).

[Mirzadeh et al., 2004]

…and apply it to Tourism

… and show that is better

- IQM is the intelligent query management component that suggests query relaxation (and tightening)
- 40 users tried to plan their vacation in Trentino using NutKing
  - Half of them used a system version with IQM – NutKing+
  - The other half used a system version that did not support query relaxation – NutKing-

Objective Measures	**NutKing-**	**NutKing+**
Queries submitted by a user	20 ± 19.2	13.4 ±9.3 *
# of constraints in a query	4.7 ±1.2	4.4 ± 1.1
Avg query result size	42.0 ± 61.2	9.8 ±14.3**
# of times relaxation suggested	n.a.	6.3 ± 3.6
# of times the user accepted a suggested relaxation	n.a.	2.8 ± 2.1

Example: all minimal failing subqueries

ShowMe: Please enter your query:

User: price ≤ 1000, month = august, region = ireland, persons = 2, duration = 14, type = skiing, accom = flat, transport = plane

ShowMe: There are no matches for the following combinations of constraints in your query:

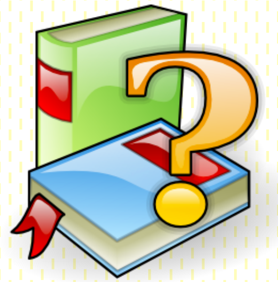
- region: price ≤ 1000, region = ireland
- type: month = august, type = skiing
- region: region = ireland, persons = 2
- region = ireland, type = skiing
- region = ireland, transport = plane
- type = skiing, transport = plane
- transport: accom = flat, transport = plane
- price ≤ 1000, month = august, transport = plane
- price ≤ 1000, persons = 2, transport = plane
- price ≤ 1000, duration = 14, transport = plane
- type: price ≤ 1000, duration = 14, type = skiing, accom = flat

To solve this problem, you need to relax one of the constraints in each of the unmatched combinations

By relaxing *transport* you can eliminate 6 of the unmatched combinations

[McSherry, 2004]

Definitions: Basic vs. Applied



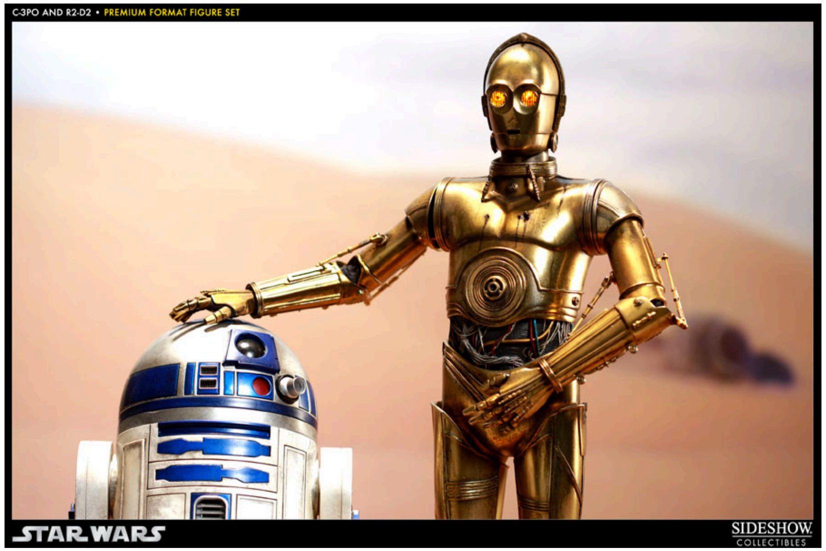
- **Basic (aka *fundamental* or *pure*)** research is driven by a scientist's *curiosity* or interest in a scientific question. The main motivation is to *expand man's knowledge*, not to create or invent something. There is no obvious commercial value to the discoveries that result from basic research.
  - *How did the universe begin?*
  - *What are protons, neutrons, and electrons composed of?*
- **Applied research** is designed to solve *practical problems* of the modern world, rather than to acquire knowledge for knowledge's sake. One might say that the goal of the applied scientist is to *improve the human condition*.
  - *Improve agricultural crop production*
  - *Treat or cure a specific disease*
  - *Help consumer to find best deals.*

Experimental Computer Science

- Experimental computer science and engineering (ECSE) refers to the building of, or the experimentation with or on, nontrivial hardware or software systems
- ECSE is a Synthetic Discipline: the phenomena studied - **artifacts** - have been created by a person rather than being "given" by nature
- Artifacts: computers, chips, compilers, editors, expert systems, protocols, etc.
- Artifacts involve very complex phenomena - total number of constituent parts - overwhelming our ability to understand them by direct analysis
- The interaction of the parts exacerbate the problem of predicting how well a given computational idea will perform on the basis of a purely logical or theoretical analysis
- Consequently, the processes, algorithms, and/or mechanisms **must be implemented so that the behavior of the system and the interaction of the components can be observed in action.** [National Research Council, 1994]

Computing Artifacts Are Universal

- Computers are malleable and versatile: whatever one machine can do, all machines can do (by and large)
- There is no a priori limit on the functionality of computers, which leads to ever-expanding expectations for the capability of artifacts
- In principle the functionality of a previous artifact can always be incorporated into an artifact currently under development – then the expectation is that it must be
- Demands for increasing functionality result in a steady increase in the complexity of new computer systems.



Artifacts' Roles

- **Proof of performance:** an apparatus or test-bed for direct measurement and experimentation (best than an older version)
  - Ex: a speech recognition software; the middleware for query relaxation
- **Proof of Concept:** demonstrates by its behavior that a complex assembly of components can accomplish a particular set of activities, behavior that could not be argued simply by logical reasoning or abstract argument from first principles
  - Ex. : an experimental computer; a recommender system using query relaxation
- **Proof of Existence:** conveys the essence of an entirely new phenomenon
  - Ex: the computer mouse - a verbal description of how a mouse can be used simply does not convey how useful it is as an input device.

ECS and Technology

- The availability of a given technology may well determine the feasibility of a good and innovative idea
- The use of a cutting-edge technology for a project potentially subjects it to the hazards posed by such technologies (e.g., instability, errors, and delays)
- Experimental software artifacts require significant software technology infrastructure (development tools, programming languages, protocols, etc.)
- Not all required software can be created anew - researcher must acquire peripheral software and build interfaces between it and the rest of the system.

Experimental vs. Theoretical CS

- Experimental CS does not depend on a formalized theoretical foundation in the same way that experimental physics can draw on theoretical physics
  - According to theory XXX we must observe this - then experimentally we look for it (if it is not observed the theory is falsified, see. K.Popper)
- Good experimentalists do create models (theories) and test (reject or accept) hypotheses
- "Theory" in CS is very close to mathematics - theoreticians prove theorems
- Experiments are most often conducted to validate some informal thesis derived from a computational model - informed but not rigorously specified by theory - that may have been developed expressly for the experiment
- **The complexity of the systems built in ECS and of the underlying models and theories means that experimental implementation is necessary to evaluate the ideas and the models or theories behind them.**

Experimental **and** Theoretical

- Experimentalists do use theoretical techniques in the conduct of their work
  - Ex: Rough estimates of algorithmic complexity are routinely made, and the recognition that a problem is NP-complete directs experimentalists to examine heuristic solutions.
- Experimental work motivates theoretical work in CS
  - Ex: [Pennock et al., 1999] proved that if the collaborative filtering rating prediction function satisfies certain “natural” properties, then all the users have predicted ratings in the same ordering as a distinguished user (dictatorial).

Theories for Experimentalist

- It is perfectly feasible to create hypotheses directly from a small collection of observations, without any statement of underlying principles and logical derivation of inferences
  - E.g.: *my **totally new** prediction technique has a better accuracy than that "old-technique"*
- But the research can merely refute, or provide conditional support for, those specific hypotheses: **there is no accumulation of knowledge**
- When the hypotheses are derived from a body of theory, the results arising from the research accumulate, and can be used again by other researchers
  - E.g.: *my prediction technique is a "lazy" approach and has a better accuracy than that "old-technique" since in this type of problems the bias component of the error dominates (compared to the variance)*.

Technique- and Problem-Driven

- **Technique-Driven Research**: primarily interested in a technique (e.g. neural networks), look for applications of it.
  - Much computer science is here
  - Tend to “abuse” and push unnecessary techniques not justified by the problem at hand
- **Problem-Driven Research**: Primarily interested in a goal (e.g. support autistic children), use whatever methods are appropriate
  - Tend to be considered as “naïve” and not enough “formal”
- Technique people “learn” about many applications
- Problem-driven people “learn” about many techniques.

Research Traditions in Information Systems

- **Scientific research** – CS Depts. and Business Schools
  - There is a real world, comprising objects and processes. It can be observed. On the basis of observations we form theories as to how it came to be the way it is, and how and why the processes take place.
- **Interpretivist/Qualitative research** – in Business Schools
  - 'Facts' and 'truth' are a chimera, 'objective' observation is impossible, and that the act of observation-and-interpretation is dependent on the perspective adopted by the observer; hence multiple interpretations of the same phenomena must be allowed
- **Engineering research** – CS Depts. and Business Schools
  - the application, testing, stretching and breaking of information technology;
  - the conceptualisation, prototyping, construction, demonstration and application of new technology.

R. Clarke's Quality Characteristics

- **research should reflect the state of knowledge of the domain**, at the time the project is commenced (in order to advance knowledge);
- **research should reflect the state of knowledge of research methodology**, at the time the project is commenced (in order to advance knowledge);
- **research should combine research techniques** in such a manner that the weaknesses of each are complemented by the strengths of the others (in order to contribute to rigour);
- **research should produce data** that reflect the phenomena under study. For scientific research, these need to be subjected to validation testing, and to be submitted to powerful statistical techniques in order to tease out the relationships among the variables (in order to contribute to rigour);
- **research should be practicable** (in order to avoid wastage of resources);
- **research should produce results relevant to the world** (in order to address the interests of organisations which use the data and provide the funding);
- **research should be likely to be publishable** (in order to satisfy the interests of the researcher and their sponsor);
- **research should be ambitious** (in order to drive theory and practice forward).

[Clarke, 2000]

How to do?

The Three Golden Rules

- Raise your quality standards as high as you can live with and always try to work as closely possible at the boundary of your abilities.
- If you can find a topic that is socially relevant and scientifically sound you are lucky: if the two targets are in conflict let the requirement of scientific soundness prevail.
- Never tackle a problem of which you can be pretty sure that it will be tackled by others who are, in relation to that problem, at least as competent and well-equipped as you.

[Dijkstra, 1982]

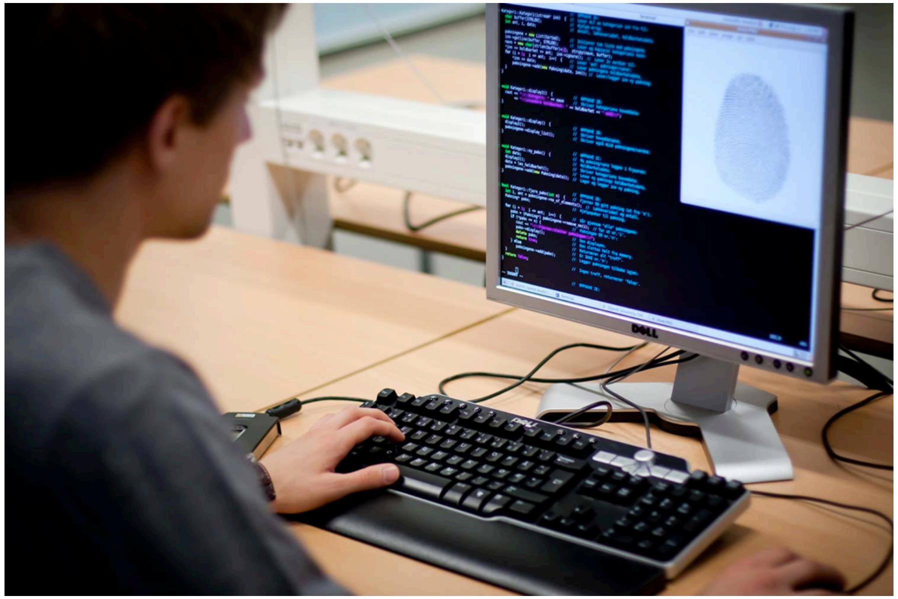
Impact of the research

Impact – the criterion of success

- The fundamental basis for academic achievement is the impact of one's ideas and scholarship on the field
- Dimension of impact:
  - **Who** is affected by a result
  - The **form** of the impact
  - The **magnitude** of the impact
  - The **significance** of the impact

Who is affected

Other researchers



Engineers and Practitioners

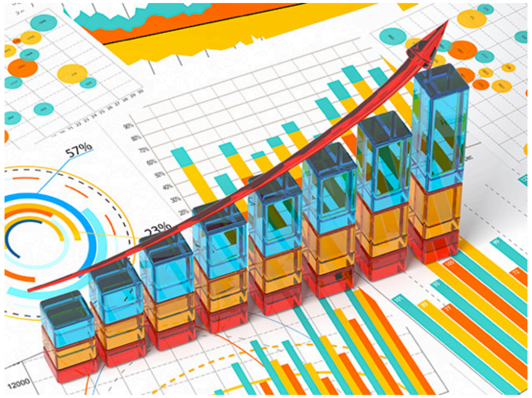
Users

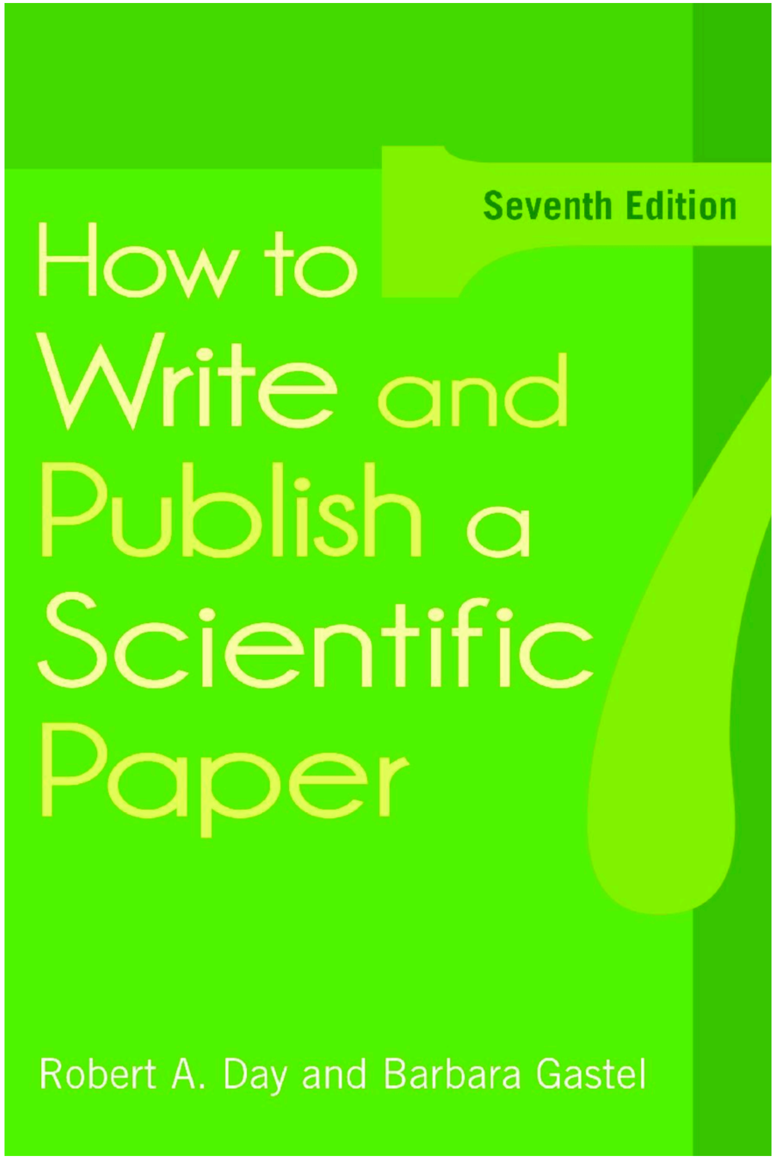
The form of the impact

- The contribution may be used directly or be the foundation for some other artifact
- It may help other to understand better a topic or a question
- It may change how others conduct their research
- It may affect the questions they ask or the topics they choose to study
- It may even indicate the impossibility of certain goals and kill off lines of research.

Magnitude and Significance

- Assessing the magnitude and significance of the impact is done observing "indicators"
  - The number of quotations
  - The quality of the journal/conferences that published the result (acceptance rate – impact factor)
  - The role taken by the researcher in the scientific community (e.g. conference program chair)
  - The patents
  - The amount of money collected by the result (projects, consultancy, products)
  - The quality and quantity of the scientific connections (collaborations)




Seventh Edition
How to Write and Publish a Scientific Paper
Robert A. Day and Barbara Gastel

How to Write a Good Paper

- Ask two questions before starting:
  - What is **new** in your work?
  - What are you going to **write**?
- Emphasize on the **originality** and **significance** of your work
- Organize your thinking and decide the **structure** (outlines) of your paper
- Stick on your **central points** throughout the whole paper and remove all unnecessary discussions.

How to Write a Good Paper II

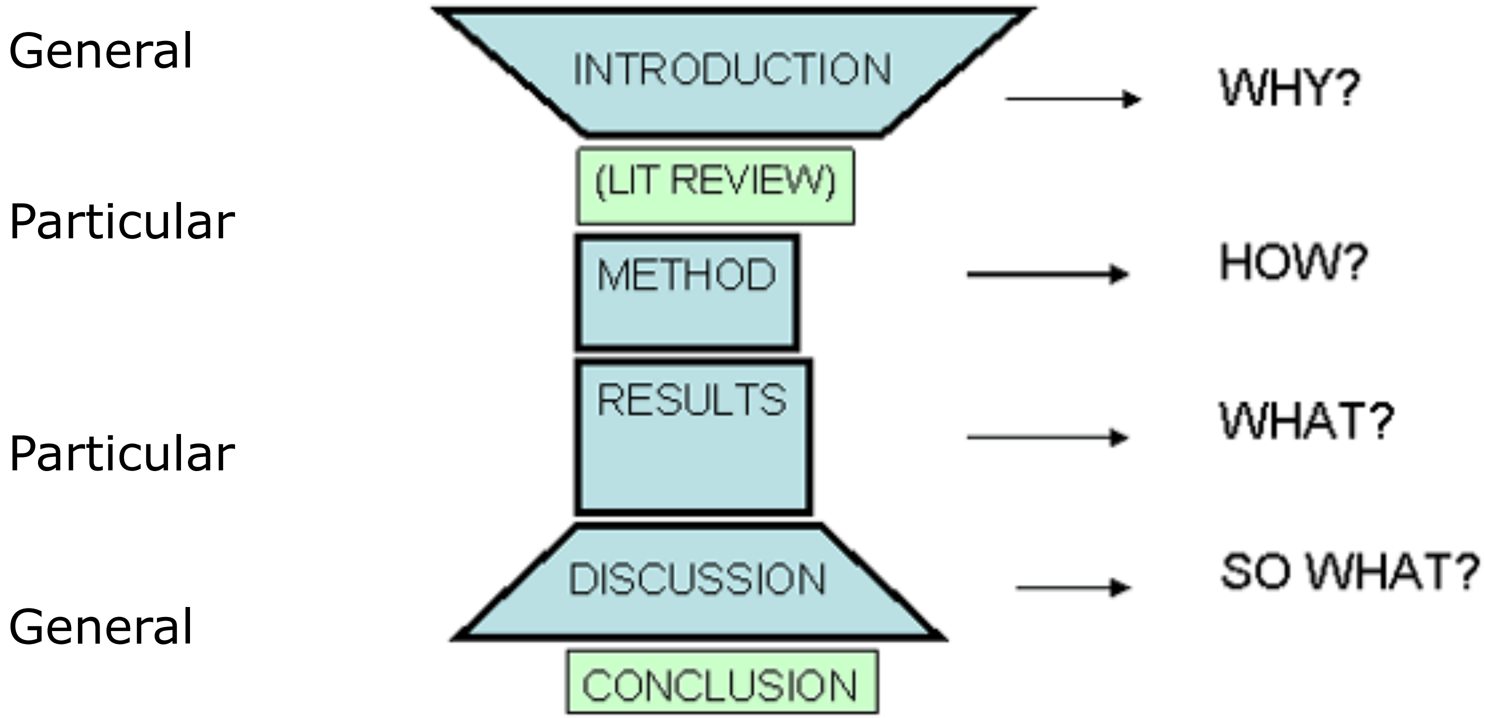
- Start writing the day you start the research and maintain a good bibliographic database (use BibTeX and LaTeX)
- Think about where to submit **early** (the paper must be **adapted** to the venue)
- Don’t try and prove you are smart and avoid the kitchen sink syndrome
- Interrupt the writing process for some days and then resume it – you should be able to read critically your own paper
- Work towards making your paper a **pleasure for the reviewer to read.**

Paper Structure

- **Introduction** – **Techniques** - **Methods** - **Results** – **Discussion** - **Conclusion**
- Highly structured and rigid (*originality in the content not in the form*)
- Question form:
  - What question (problem) was studied ? Answer = Introduction
  - How was the problem studied ? Answer = Techniques and Methods
  - What were the results ? Answer = Results
  - What do the findings mean ? Answer = Discussion and Conclusion

Hourglass Model

- According to the "Hourglass Model", a paper should start from general, and go through particular back to general



Step by Step: Title

- Choose a right title:
  - The title should be very specific, not too broad
  - The title should be substantially different from others – not too short not too long
  - Avoid general titles, e.g., "A new framework for mobile computing"
  - Imagine what words people will use to find your article.

Abstract

- A (concise) abstract should tell:
  - Motivation: Why do we care about the problem and the results?
  - Problem statement: What problem is the paper trying to solve and what is the scope of the work?
  - Approach: What was done to solve the problem?
  - Results: What is the answer to the problem
  - Conclusions: What implications does the answer imply?
- A good hint is **pack each of these part into one sentence**.
- Past tense because refers to work done
- Present tense for the established knowledge
- No references
- Self contained (published by itself).

Paper Organization

- Plan your sections and subsections
- Use a top-down writing method
- Use a sentence to represent the points (paragraphs) in each subsections
- Writing details: expand a sentence in the sketch into a paragraph
- Keep a logical flow from section to section, paragraph to paragraph, and sentence to sentence.

Introduction

- The most difficult part
- I prefer to write it in the final stage and entirely myself
- Should state briefly and clearly your purpose
- Justify why did you choose that subject and why is it important
- From problem to solution (even if some redundancy with Abstract)
- Mention your previously published papers (abstracts, closely related papers, …)
- Avoid mistake: do not keep the reader in suspense (not a detective story).

Introduction II

- 1) **Establish a territory:**
  - bring out the importance of the subject
  - make general statements about the subject
  - present an overview on current research on the subject
- 2) **Establish a niche:**
  - oppose an existing assumption
  - reveal a research gap
  - formulate a research question
  - continue a tradition, or propose a completely new approach
- 3) **Occupy the niche:**
  - sketch the intent of the own work
  - outline important characteristics and results of your own work
  - give a brief outlook on the structure of the paper.

Techniques

- The easiest part!
- Make it clear what is state of the art and what is novel
- Combine intuition with formal definitions and descriptions
- Provide schemas that illustrate the general picture and detailed descriptions (algorithm)
- Be precise and complete
- Stick with the standard terminology and notation
- Avoid details that are not specific to your solutions – refer to the literature.

Materials and Methods Section

- Purpose : describe and justify the experimental design so that the experiments could be repeated by others (peers)
- Reproducibility = basis of Science
- Must give the full details (if not ⇒ rejection by the referee no matter the results)
- Past tense
- Chronological presentation (with sub headings)
- Similar to cookbook recipes : How ? How much?
- Avoid mistake: no mixing some of the results.

Result section = Core of the paper

- Presentation of the data but only representative one
  - *"The fool collects facts, the wise selects them"*
- No more method description
- No references
- Crystal clarity: the whole paper will stand or fall on the basis of the results
- If n variables tested,
  - present in Table or Graphs only those which **affect** the reaction
  - For the others: state you did not find under the experimental conditions
- *Absence of evidence is not evidence of absence*
- Past tense.

Discussion

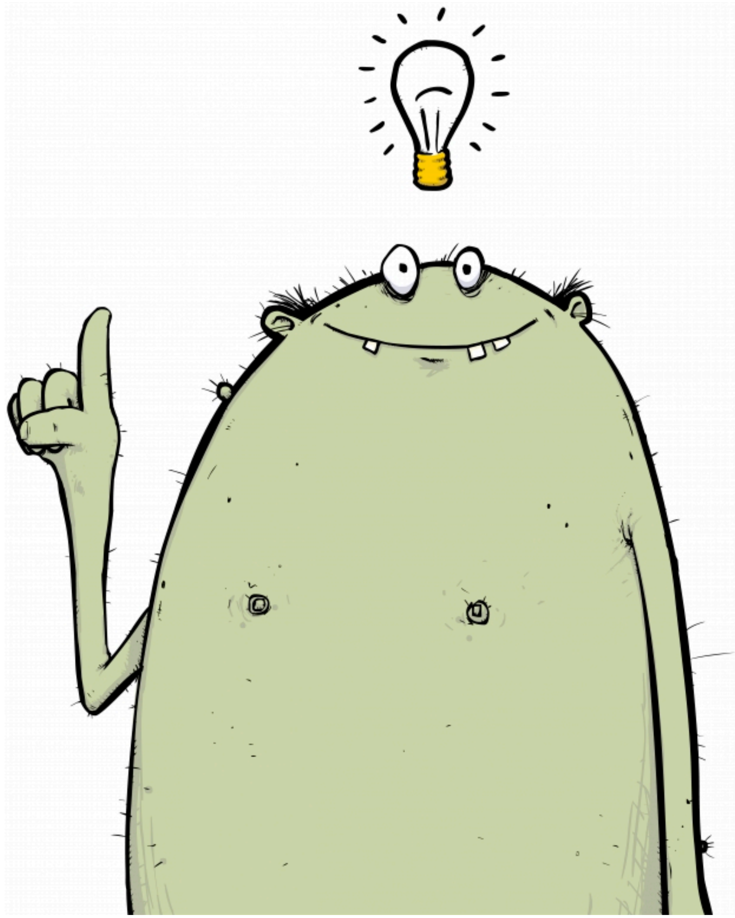
- Harder part to define and to write ← Cause of rejection
- Show the relationships among observed facts
- Try to present the principles, relationships, generalization shown by the results not a recapitulation of the results
- Point out any exceptions or any lack of correlation, define unsettled points
- Show how your results and interpretations agree (or contrast) with previously published work
- Discuss the theoretical implications of your work as well as any possible practical applications
- State your conclusions as clear as possible.

Related Work and list of References

- Use a proper selection of references
- Show your knowledge in the related area
- Give credit to other researchers (reviewers are usually chosen from the references)
- Cite good quality work, particularly when citing your own work, and up to date work
- Related work should be organized to serve your topic
- Emphasize on the significance and originality of your work.

Conclusions

- A research paper should be circular in arguments, i.e., the conclusion should return to the opening, and examine the original purpose in the light of the research presented
- Mention caveats – no solution is perfect
- Emphasis the significance
- Conclusions : 3 times in Abstract, Introduction and Conclusions.



Evaluation Criteria for Articles

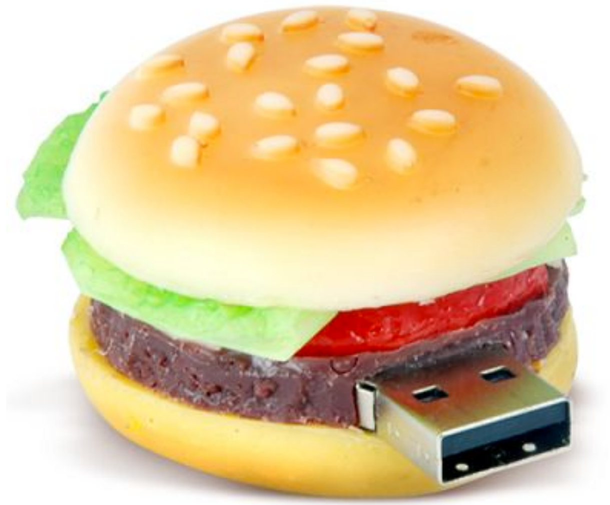
- Significance
- Novelty and Awareness of Related Work
- Technical Soundness and Quality
- Relevance
- Readability and Presentation

Significance

- What is the scientific contribution of this submission? (both in the authors' view and your own, if different)
- Is the problem addressed in this paper well defined and articulated?
- Is the problem addressed interesting enough to warrant publication?
- Does it attack an important and difficult problem or a peripheral and simple problem?
- Does the approach offered advance the state of our scientific knowledge?
- Will the work influence scientific research or lead to innovative commercial developments?
- *A referee should read the paper carefully and with an **open mind** – sometimes this is not true!*
- *A referee should compare the paper with an **appropriate standard** (not your own!)*

Novelty, Awareness of Related Work

- Does this paper present innovative ideas or material?
- Does this paper cite and use appropriate references?
- Detecting plagiarism



Technical Soundness

- Is the information in the paper sound, factual, and accurate?
- Is the used research technique appropriate for the problem addressed/studied?
- Are the paper's algorithms correct?
- Has the author systematically run experiments, provided insightful theoretical analysis, show psychological validity, or otherwise given evidence of generality of the presented approach?
- Are experimental comparisons made to relevant state of the art alternatives (baselines)?
- Were reasonable test beds used?
- Are data unambiguous and properly analyzed?
- Are the results of the research evaluated?
- Are the conclusions supported by the evaluation strategy and result data?
- Have the results been shown to be statistically significant?

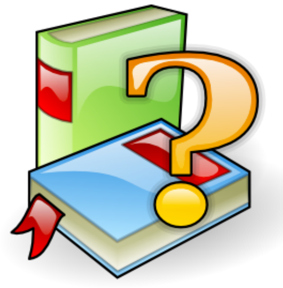
Relevance

- Is the submission relevant to the scope of the journal/conference?
- The article must be adapted to the journal/ conference audience.

Readability and Presentation

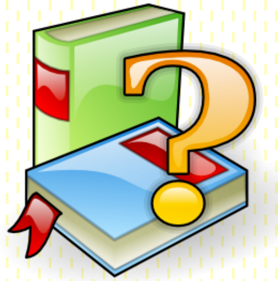
- Does the paper include enough illustrative examples? Are they sufficiently detailed?
- Are the algorithms described in sufficient detail so that readers could replicate the work?
- Is the presentation, organization and length satisfactory?
- Do the authors describe the limitations of their approach in a satisfactory manner?
- Does the title, the key words and abstracts/summary of this paper clearly and sufficiently reflect its contents?
- Is the treatment of the subject complete?
- Can you suggest additions, reductions or amendments or an introductory statement that will increase the value of this paper?
- Are the illustrations and tables necessary and acceptable?
- Are the references adequate and are they all necessary?

Research Techniques



- Non-empirical techniques
- Scientific research techniques
- Interpretivist research techniques
- Research techniques at the scientific/interpretivist boundary
- Engineering research techniques.

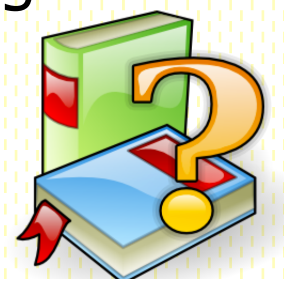
Defs: Non Empirical Techniques



- **Conceptual research:** opinion and speculation, and comprises philosophical or 'armchair' analysis, and argumentative/dialectic analysis;
- **Theorem proof:** applies formal methods to mathematical abstractions, in order to demonstrate that, within a tightly defined model, a specific relationship exists among elements of that model;
- **Futures research, scenario-building, and game- or role-playing:** individuals interact in order to generate new ideas or gather new insights into relationships among variables.
- **Review of existing literature, or 'meta-analysis':** the opinions and speculations of theorists, the research methods adopted by empirical researchers, the reports of the outcomes of empirical research, and materials prepared for purposes other than research.

Defs: Scientific Research Techniques

- **Forecasting:** involves the application of regression and time-series techniques, in order to extrapolate trends from past data;
- **Field experimentation and quasi-experimental designs:** opportunities are sought in the real-world which enable many factors, which would otherwise confound the results, to be isolated, or controlled for;
- **Laboratory experimentation:** this involves the creation of an artificial environment, in order to isolate and control for potentially confounding variables.



Defs: Interpretivist/Qualitative Research Techniques

- **Descriptive/interpretive research:** empirical observation is subjected to limited formal rigor. Controls over the researcher's intuition include self-examination of the researcher's own pre-suppositions and biases, cycles of additional data collection and analysis, and peer review;
- **Focus group research:** gathering of a group of people, commonly members of the public affected by a technology or application, to discuss a topic. Its purpose is to surface aspects, impacts and implications that are of concern.
- **Action research:** the researcher plays an active role in the object of study, e.g. by acting as a change-agent in relation to the process being researched.
- **Ethnographic research:** applies insights from social and cultural anthropology to the direct observation of behaviour.

Defs: Research Techniques at the Scientific/ Interpretivist Boundary

- **Field study:** the object of study is subjected to direct observation by the researcher.
- **Questionnaire-based survey:** involves the collection of written data from interviewees, or the collection of verbal responses to relatively structured questions.
- **Case study:** this involves the collection of considerable detail, from multiple sources, about a particular, contemporary phenomenon within its real-world setting.
- **Secondary research:** this technique analyses the contents of existing documents. Commonly, this is data gathered by one or more prior researchers, and it is re-examined in the light of a different theoretical framework from that previously used.

Defs: Engineering Research Techniques

- **Construction:** this approach involves the conception, design and creation (or 'prototyping') of an information technology artefact and/or technique. The new technology is designed to intervene in some setting, or to enable some function to be performed, or some aim to be realised. The design is usually based upon a body of theory, and the technology is usually subjected to some form of testing, in order to establish the extent to which it achieves its aims;
- **Destruction:** In this case, new information is generated concerning the characteristics of an existing class of technologies. This is typically achieved through testing the technology, or applying it in new ways. The design is usually based upon a body of theory.

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