

The Art of Doing a PhD

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Technical University
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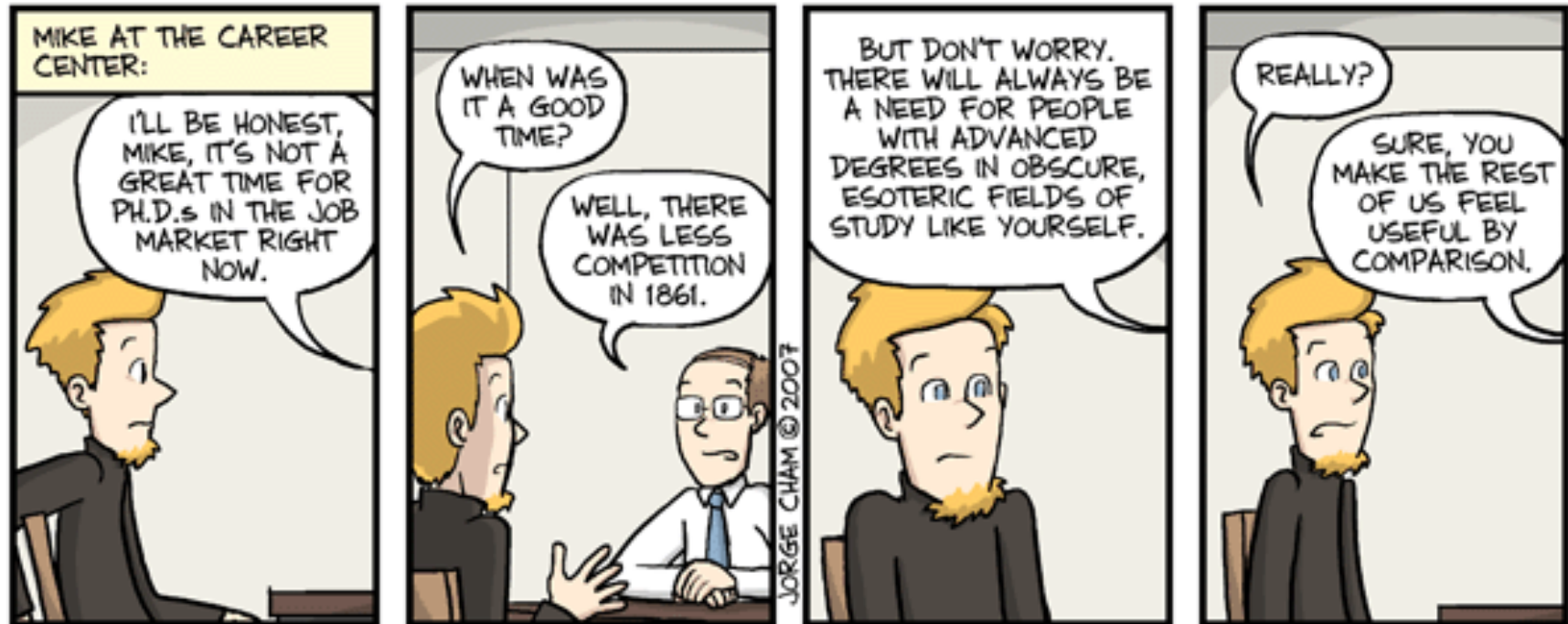
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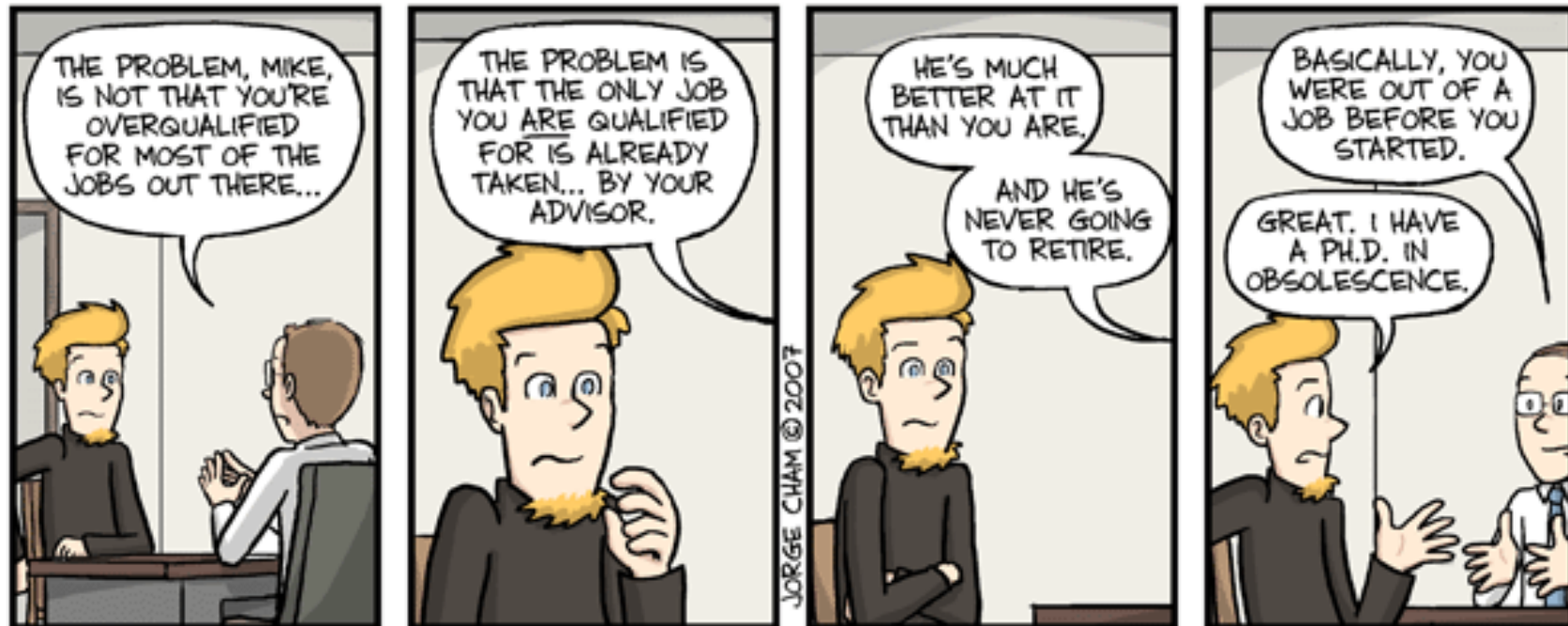
How hard can it be?

- The *Feynman Problem Solving Algorithm*
 - 1) Write down the problem.
 - 2) Think very hard.
 - 3) Write down the solution.
- Getting a PhD
 - “*It's like teaching swimming by tossing students into the deep end of the pool and seeing who makes it to the other end alive and who drowns.*” [Ronald T. Azuma]

Agenda

- Motivation & Compensation
 - Do you really want to be a PhD?
 - Where will it take you?
- The “Fish” Model
 - Overall approach
 - Important milestones
- Where do good ideas come from?
 - ... and what is a “good idea” anyway?
 - ... and what is “plagiarism” by the way?
- Literature review
- How to write a thesis
- How to prepare your “elevator pitch”
- How to referee
- ... and a list of thing that there is no time to cover this time

Why get at PhD?



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Why get a PhD degree?

- Getting a PhD is hard work – really hard work!
 - Normally 4-6 years hard work
 - Very fast 2-3 years



Why get a PhD degree?

- Getting a PhD is hard work – really hard work!
 - Normally 4-6 years hard work in the US, DE, ...
 - Very fast 3 years in DK & UK
- So why?
 - Money?
 - Social status?
 - Fame?
 - Becoming a better person – wife, husband, mother, father, ...
- Well – why?
 - Doing research – now and later
 - Devoted to pursue your own ideas
 - Dedication
 - Freedom
 - Future (research) position – being “on the edge”
 - International / Global scene
 - And yes – potential fame within your community.

Why are we here?

- Universities are places of knowledge
 - contribute to knowledge by research
 - disseminate knowledge by publications & education
- Thus, our job is
 - doing research and publish it
 - teaching
- Face it, you are a researcher now!
 - (somehow sounds cool – doesn't it?)

Source: Builds upon Christian Becker's PhD intro slides to his students

THE two main concepts in Research

- In Danish (and German) “research” is called “videnskab” (or “wissenschaft”)

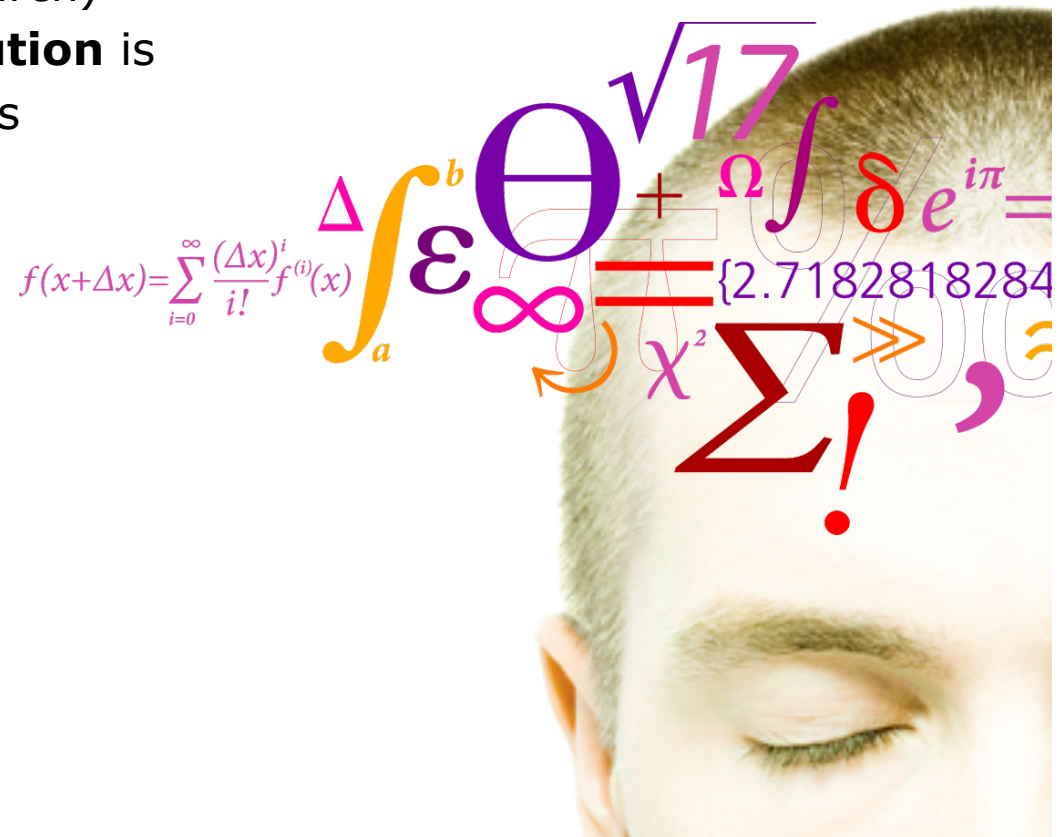
THEREFORE – whenever you do anything (research that is), you should always ask yourself the following two questions:

- - is this new?
 - can I publish this?
- - hence, this is the reason why dissemination is core to research

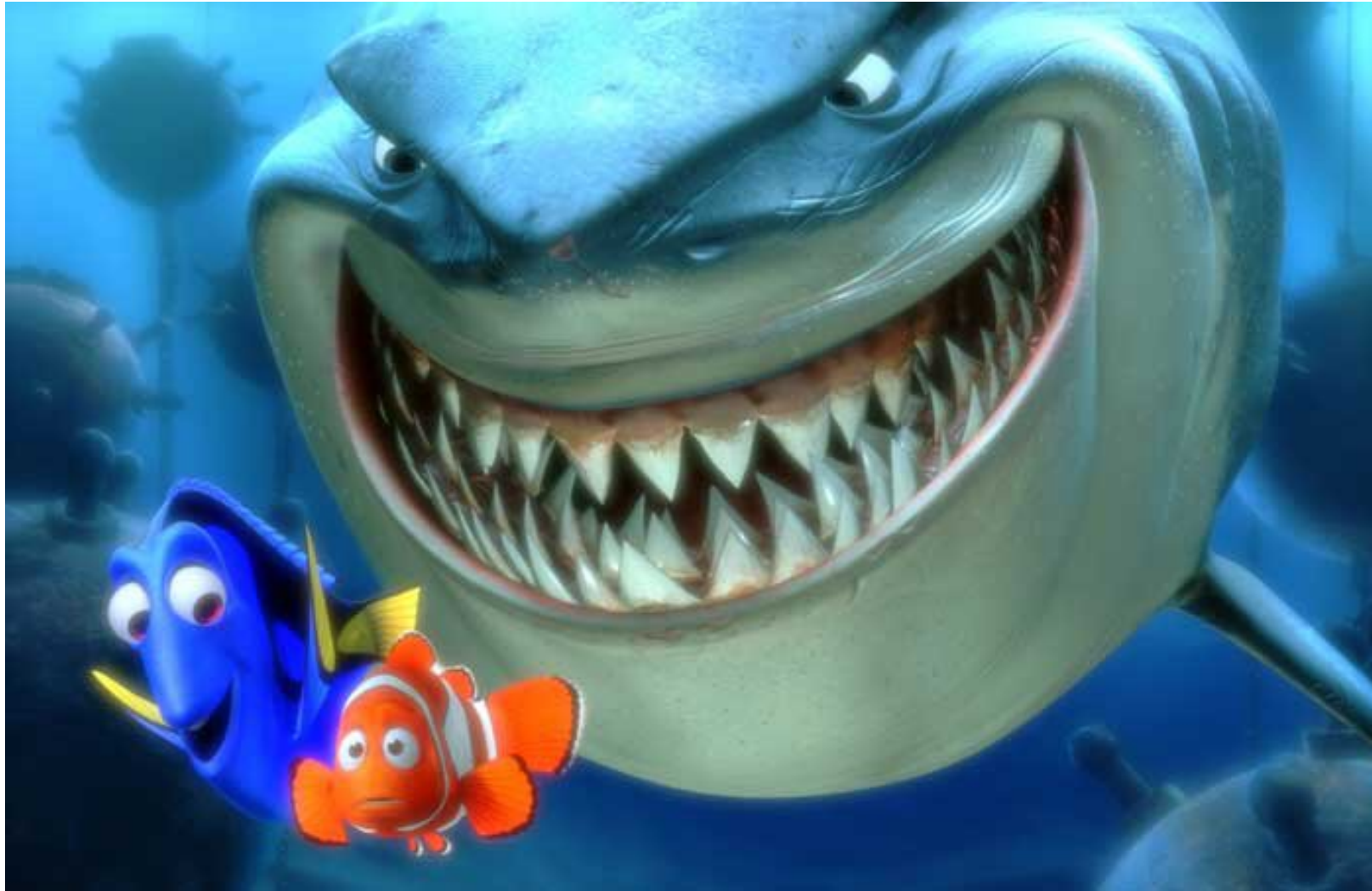
Small exercise

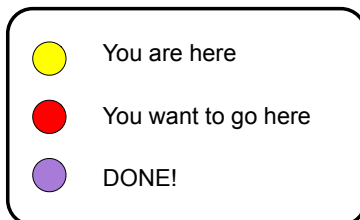
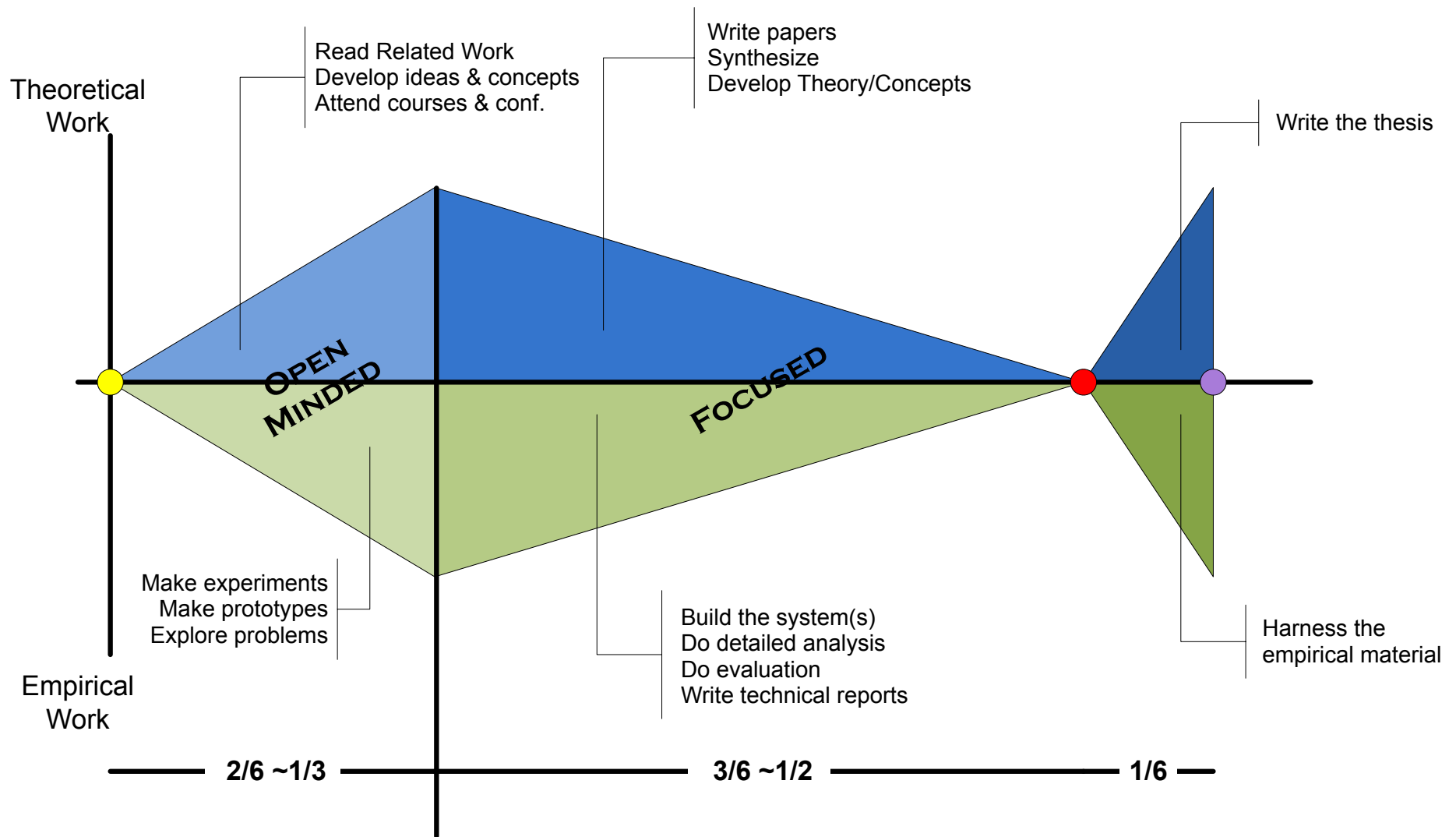
In pairs – each give the “elevator pitch” of your PhD topic and explain

- **why** you are here (doing research)
- what your (indented) **contribution** is
- where you want to **publish** this



The Fish Model





Deliverables:

- related work
- detailed design
- plan
- methods
- hypothesis
- goals
- contributions

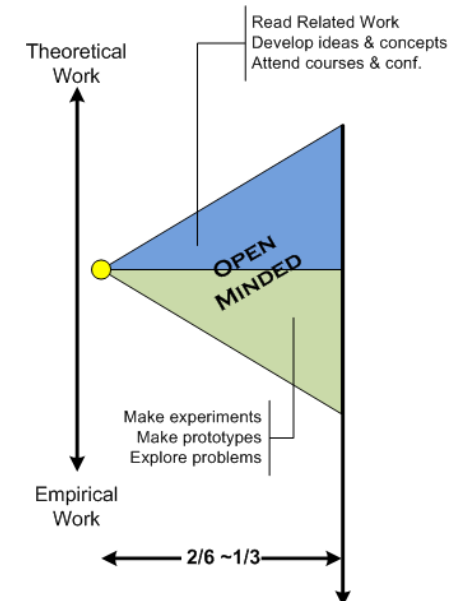
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Important Milestone in a PhD

- Admission
 - celebrate
- 1/3 – exploring
 - know your related work and people
 - know your thesis, goals, plans, methods, and
 - expected contributions, and
 - how you want to demonstrate it
- 5/6 – researching
 - just do it!
 - look out for spin-offs (paper potentials)
 - keep focused!
- 6/6
 - turn in the thesis
 - prepare for life after the PhD
 - look for job

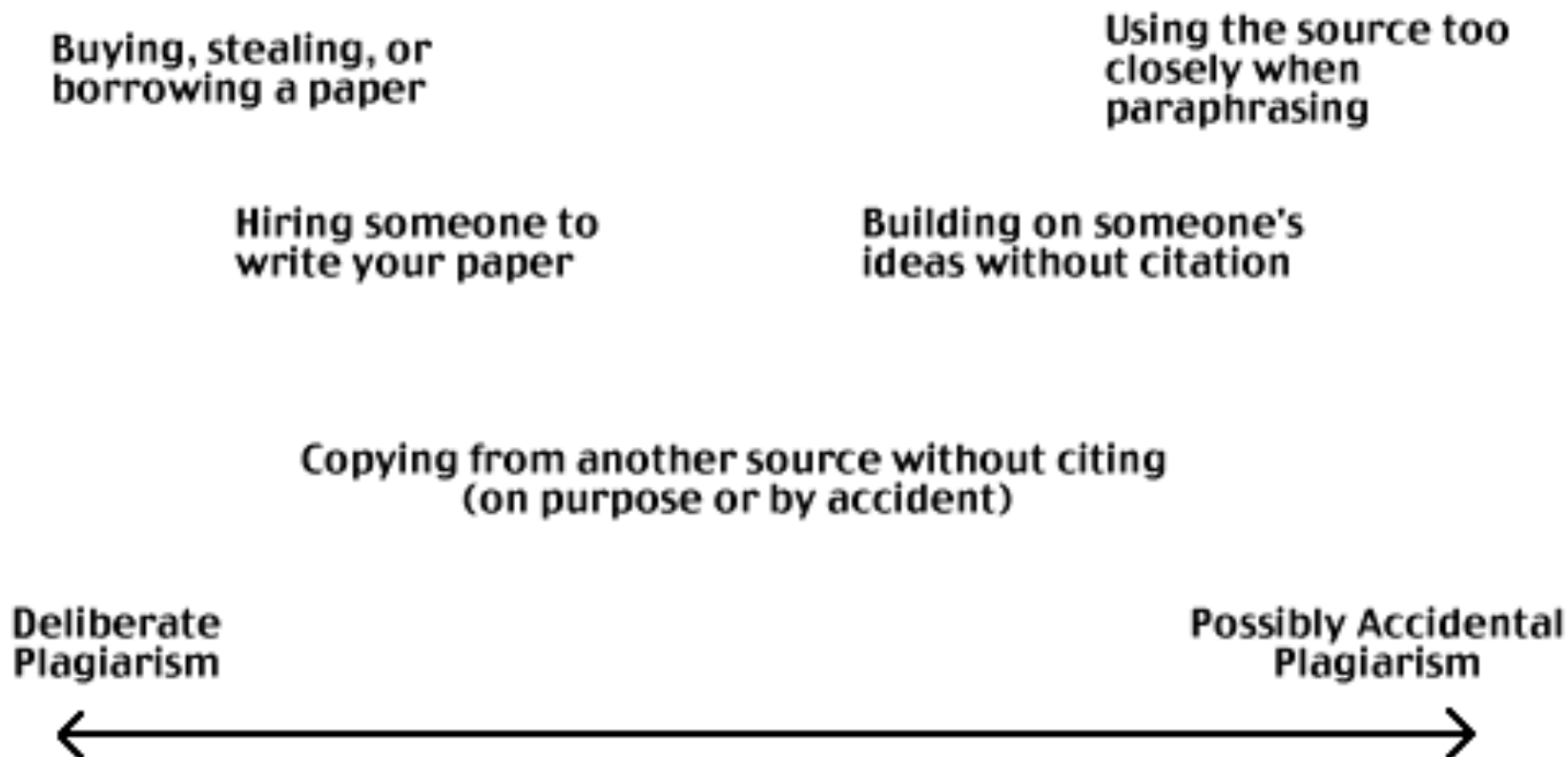
The “Head” – How to get good ideas?

- Theoretically – “Top-Down”
 - start with research area
 - read, read, read, read, read
 - talk, see, hear, survey, ...
 - courses, summer schools, conferences, ...
 - (ask your professor)
- Empirically – “Bottom-Up”
 - find a (real) problem – maybe even for a real person
 - study, visit, interview, try, experiment, ...
 - download, compile, run, test, stress, ...
 - replicate someone else’s work (verify)
 - try to generalize and rephrase the problem



... a word on plagiarism

- “The act of passing off as one's own the ideas or writings of another”
[GeorgiaTown Honors Council]



*Copied from Owl online writing lab,
owl.english.purdue.edu/handouts/research/r_plagiar.html*

How to avoid plagiarism

- Giving Credit
 - ideas, inspiration, unique phrases, figures, conversations
- Use accurate citations
 - cite
 - quote literal copies
 - cite paraphrased text
 - cite copied images
- Record Keeping
 - in time you forget where (your) ideas come from
 - keep track!
 - use a lab book

Source: Saul Greenberg's presentation on plagiarism, "Plag.ppt" from his homepage.

Literature Review

- “A good literature review adds value. It is not just a catalog of papers you have read” [Greenberg]
- A literature review:
 - Show you know the literature – you must be selective
 - Gives your readers background to understand your work
 - Gives a historical perspective shows how ideas arose and evolved over time
 - Leads into the problem you wish to tackle in your thesis
 - Describes related work
 - Explains why your idea or perspective is new
 - Gives a new view of the problem / solution space

Types of literature reviews

- Annotated Bibliographies
 - a list of papers ordered by some means (perhaps alphabetically or by topic), where each paper is represented as a reference plus a summary paragraph.
 - very useful and straightforward to do while reading
 - however, does not add value
- Project summaries
 - useful in systems-oriented research
 - good at describing current state of the art if its fairly new
 - however, quickly become overwhelming
- By ideas
 - typically abstractions that *you* may have made after reading many papers / project descriptions, and so on.
 - this is what you should strive for!
 - however, require some thinking and work!
- Historically
 - useful if you wish to show the evolution of ideas over time.
 - however, only works if this evolution really does lead into your research problem

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The “Related Work Matrix”

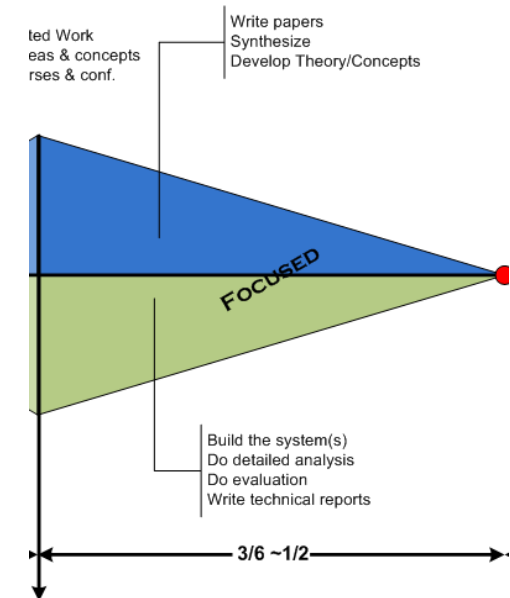
Table 1. Current location sensing technologies.

Technology	Technique	Physical	Symbolic	Absolute	Relative	LLC	Recognition	Accuracy and precision if available	Scale	Cost	Limitations
GPS	Radio time-of-flight lateration	•		•		✓		1-5 meters (95-99 percent)	24 satellites worldwide	Expensive infrastructure \$100 receivers	Not indoors
Active Badges	Diffuse infrared cellular proximity		•	•			✓	Room size	1 base per room, badge per base per 10 sec	Administration costs, cheap tags and bases	Sunlight and fluorescent light interfere with infrared
Active Bats	Ultrasound time-of-flight lateration	•		•			✓	9 cm (95 percent)	1 base per 10 square meters, 25 computations per room per sec	Administration costs, cheap tags and sensors	Required ceiling sensor grid
MotionStar	Scene analysis, lateration	•		•			✓	1 mm, 1 ms, 0.1° (nearly 100 percent)	Controller per scene, 108 sensors per scene	Controlled scenes, expensive hardware	Control unit tether, precise installation
VHF Omini-directional Ranging	Angulation	•		•		✓		1° radial (= 100 percent)	Several transmitters per metropolitan area	Expensive infrastructure, inexpensive aircraft receivers	30-140 nautical miles, line of sight
Cricket	Proximity, lateration		•	•	•	✓		4 × 4 ft. regions (= 100 percent)	≈ 1 beacon per 16 square ft.	\$10 beacons and receivers	No central management receiver computation
MSR RADAR	802.11 RF scene analysis and triangulation	•		•			✓	3-4.3 m (50 percent)	3 bases per floor	802.11 network installation, ≈ \$100 wireless NICs	Wireless NICs required
PinPoint 3D-ID	RF lateration	•		•			✓	1-3 m	Several bases per building	Infrastructure installation.	Proprietary, 802.11
Avalanche	Radio signal	•			•			Variable,	1 transceiver		

J. Hightower & G. Borriello. Location Systems for Ubiquitous Computing. *IEEE Computer*, Aug. 2001

The “Body” – Scientific Contribution

- Adds to “knowledge”
 - thus it must be a **written** contribution
 - and not only something you did
- Typically addresses a clear stated problem
 - and explains well, what is new
 - the „delta” to existing work
- Relevance of a scientific contribution - some metrics
 - relates to the relevance of the problem
 - relates to the #citations
 - relates to the publication
 - the kind (workshop, conference, journal)
 - the ranking of the conference/journal
 - relates to *your* impression of the problem’s relevance

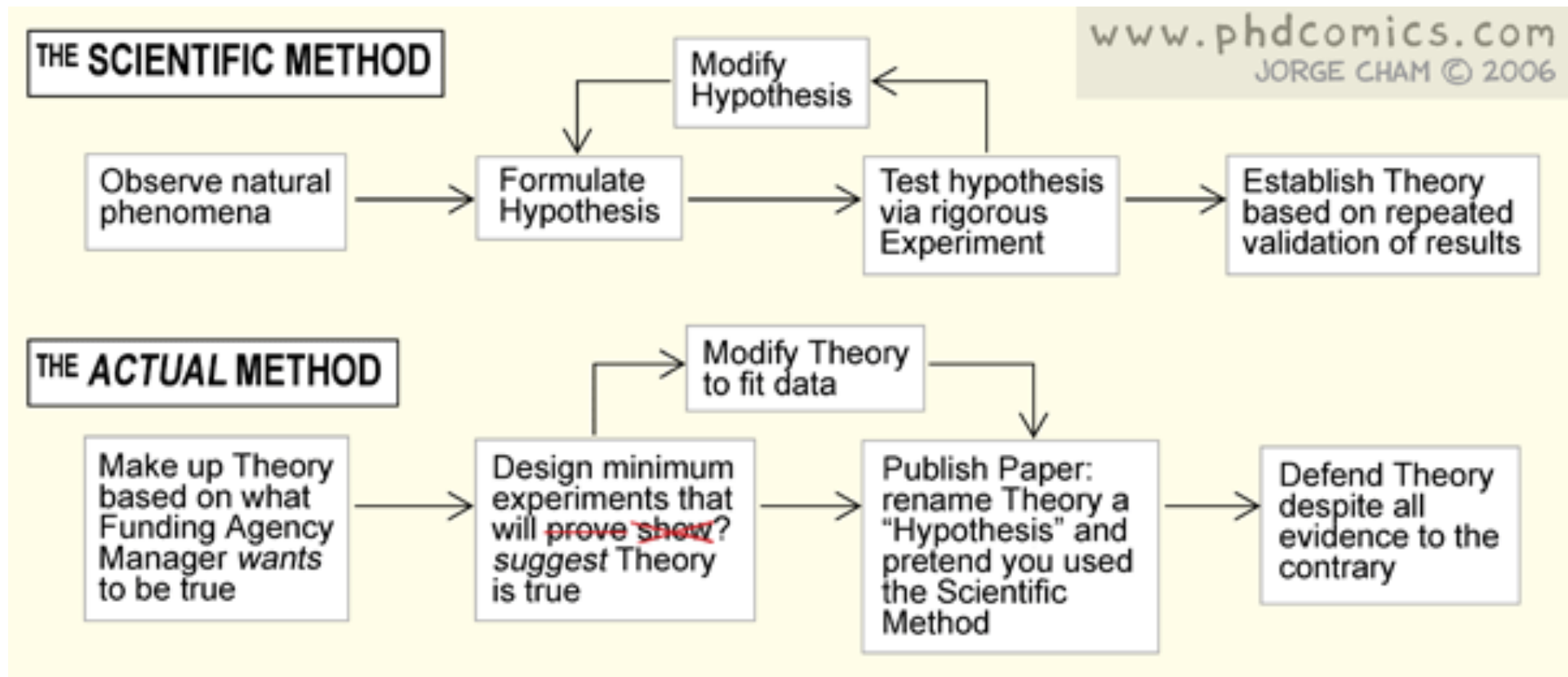


Source: Christian Becker’s PhD intro slides to his students

A Scientific Contribution II

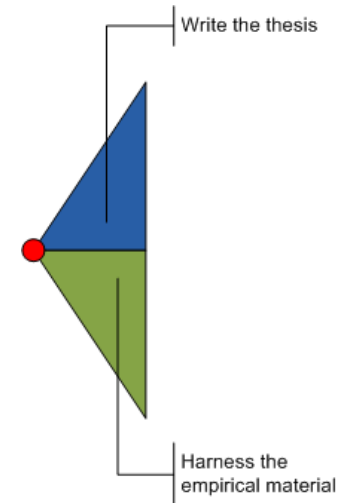
- More specific, theory of science deals about
 - scientific contributions – what is a scientific proposition
 - a number of such theories exist for a variety of domains
- Some rough examples
 - Constructionism (“engineering”) proof by construction
 - Falsification (“science”, K. Popper) no proof possible, but instead a scientific proposition must allow for showing that it is wrong
- Also: contributing to the scientific community
 - reviewing papers and proposals
 - organizing conferences and workshops
 - editorial boards, program committees, etc.

Science?



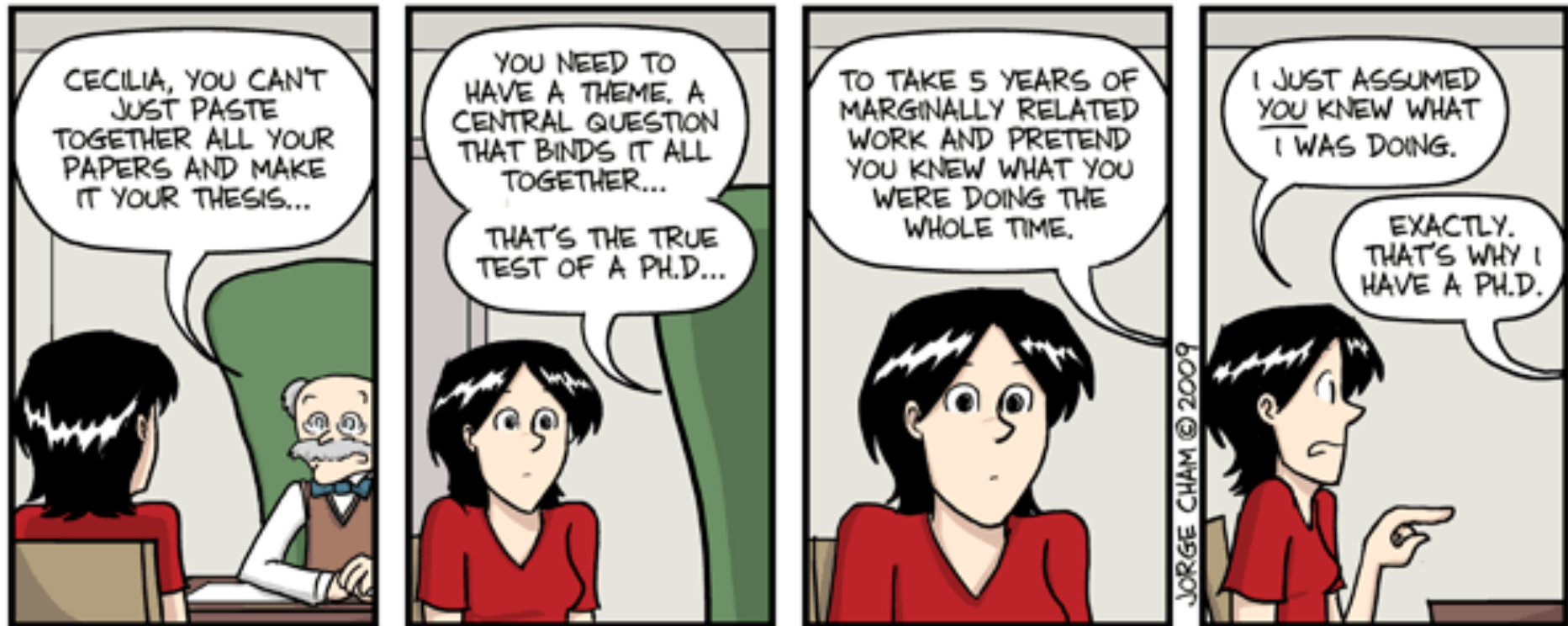
The “Tail” – Writing Chapter 1

- Context and Motivation
 - Research field / area
 - Is it a real problem
 - Why would anyone care if I solved it?
- Background
 - Small Literature review / Related Work (full version is in chapter 2)
 - What is the research context?
 - What is the state-of-art?
- Hypothesis
 - Thesis or Problem statement
- Goals and methods
 - What are the *operational* goals you want to achieve?
 - And how will you do it?
- Results
 - Contributions
- Thesis overview
 - Outline of the thesis



Source: Saul Greenberg's homepage.

A word of warning on the “Danish Thesis Model”



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Exercise

Try to outline the introduction of a thesis describing the invention of the paper clip



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The Elevator Pitch

- You should always have your PhD Elevator Pitch ready
 - 1 min | 5 min | 10 min | 20 min
 - both with and without slides
- Outline (do you recognize this?)
 - **background** - what is the community, problem, and motivation
 - **prior work** - what is the state of art and what research / technologies / studies exists
 - **gab** - the "however" sentence; what is missing, what is your research statement/question
 - **what** – the “therefore” sentence: what you (plan to) do
 - **methods & plans** - how will (did) you do this?
 - **contribution** - reflecting back to the background and introduction, what does your research contribute to the overall research question and community

Shared platform for mHealth data

- In the area of mobile sensing and mobile health there is a growing research interesting in collection of behavioral and health data from mobile and wearable technology
- A number of platforms are available for supporting this, including the AWARE platform, Open mHealth, Open DataKit, and previously also the funf framework.
- HOWEVER – except for Open mHealth none of these platform allow for standardization of data and none of them allow for cross-study analysis and data sharing.
- THEREFORE – by building on the work done primarily in Open mHealth (but also others), the goal of my (PhD) project is to create an open mHealth platform where data can be shared and analyzed across studies.
- My scientific method is to experimental. This mean that I will design and build an extended Open mHealth platform for data sharing and analysis. Then I will test it in two specific cases; one addressing mental health the other diabetes. I also plan to work with other research to have them use and donate data to the platform.
- When successful, this platform will be a huge asset in the further design and development of mHealth applications and for data sharing in the scientific community.

Shared platform for mHealth data

- In the area of **mobile sensing** and **mobile health** there is a growing research interesting in collection of behavioral and health data from **mobile and wearable technology**
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- My scientific method is to **experimental**. This mean that I will **design** and **build** an extended Open mHealth platform for data sharing and analysis. Then I will **test** it in two specific cases; one addressing mental health the other diabetes. I also plan to **work** with other research to have them use and donate data to the platform.
- When successful, this platform will be a huge **asset** in the further design and development of mHealth applications and for data sharing in the **scientific community**.

Becoming part of the scientific community



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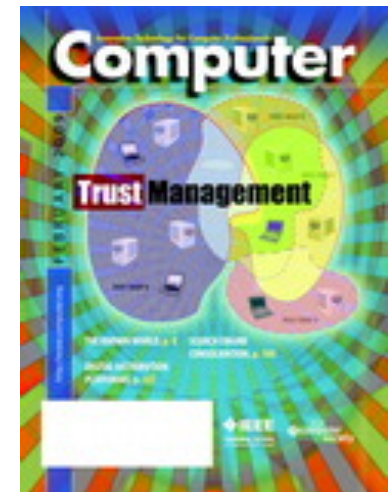
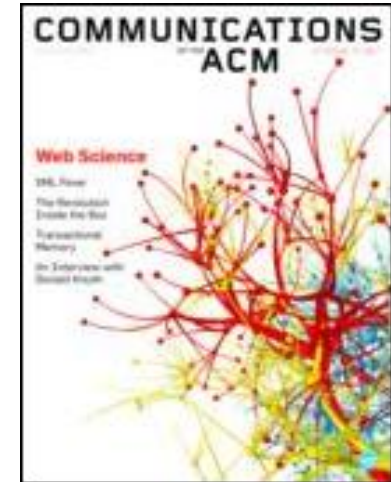


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Professional Associations

- ACM – Association for Computing Machinery
 - acm.org
 - focus on computer science
 - hugely influential
- IEEE – Institute of Electrical and Electronics Engineers
 - ieee.org
 - 125 years old
 - focus on engineering
- European / National
 - IFIP
 - Dansk Selskab for Datalogi (DIKU)
 - Datalogforeningen (AU/Daimi)
 - ...



Refereeing

- Just overhead?
 - your professor hands you all his papers...
- Refereeing is excellent practice for
 - developing critical appraisal skills
 - understanding how good (and bad) papers are written
- Fairness
 - all your papers will be refereed
 - expected duty of all researchers/academics
- Other upsides
 - enhance reputation
 - expedites processing of your own papers
 - get on editorial board or program committee
 - 'previews' to the state of the art

Source: Saul Greenberg's presentation on refereeing, "HowToReferee.ppt" from his homepage.

A Template for Reviewing

- Meta information
 - paper title, author (if not ann.), manuscript id, ...
- The review
 - brief summary (2-3 lines)
 - “If you can’t, there is probably something wrong with the paper” [ACM CHI FAQ]
 - Contribution
 - what is new? is it significant? (novelty/contribution)
 - would it stimulate further work? (impact)
 - how relevant is it to the community? (relevance)
 - Quality of the *research*
 - how sound is the work?
 - how appropriate/reliable are the methods used?
 - how reasonable are the interpretations?
 - how does it relate to existing work?
 - can an experienced practitioner in the field duplicate the results?
 - Quality of the *writing*
 - outline, language, spelling, grammar, figures, ...
 - Recommend acceptance / rejection

Receiving reviews

ADDRESSING REVIEWER COMMENTS

BAD REVIEWS ON YOUR PAPER? FOLLOW THESE GUIDELINES AND YOU MAY YET GET IT PAST THE EDITOR:

<p>Reviewer comment:</p> <p>"The method/device/paradigm the authors propose is clearly wrong."</p> <p>How NOT to respond:</p> <p>✗ "Yes, we know. We thought we could still get a paper out of it. Sorry."</p> <p>Correct response:</p> <p>✓ "The reviewer raises an interesting concern. However, as the focus of this work is exploratory and not performance-based, validation was not found to be of critical importance to the contribution of the paper."</p>	<p>Reviewer comment:</p> <p>"The authors fail to reference the work of Smith et al., who solved the same problem 20 years ago."</p> <p>How NOT to respond:</p> <p>✗ "Huh. We didn't think anybody had read that. Actually, their solution is better than ours."</p> <p>Correct response:</p> <p>✓ "The reviewer raises an interesting concern. However, our work is based on completely different first principles (we use different variable names), and has a much more attractive graphical user interface."</p>	<p>Reviewer comment:</p> <p>"This paper is poorly written and scientifically unsound. I do not recommend it for publication."</p> <p>How NOT to respond:</p> <p>✗ "You #&@*% reviewer! I know who you are! I'm gonna get you when it's my turn to review!"</p> <p>Correct response:</p> <p>✓ "The reviewer raises an interesting concern. However, we feel the reviewer did not fully comprehend the scope of the work, and misjudged the results based on incorrect assumptions."</p>
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www.phdcomics.com

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Practical advices

- Have a 30 sec, 2 min, 5 min summary of your research ready when people ask
 - have a standard presentation
 - have a “favorite” paper (of your own)
 - say, what are you currently working on
- You’re part of a team and university
 - your success is the team’s success
 - we speak and act as one (cool :) team to the outside
 - everybody adds to the visibility and reputation
- Everybody helps to the teaching load
- Everybody helps to the review load
- Everybody should help raise funds

Important final points

- Academia is business
 - fundraising, TA, RA, ...
 - a very competitive market
 - you (as a PhD student) is a vital resource in this game
 - be sure what commitments are tied to your scholarship
- Academia is a social activity
 - (start) networking!
 - find fellow PhD students – they are your brothers in arms and may become your friends for life
 - attend conferences – as a SV – summer schools
 - present your work everywhere – also in the elevator
- Academia requires strict time management
 - “Kill your TV” [Randy Pausch, CMU]
 - Planning and organization

Other just as important issues...

- The Art of Scientific Writing
- Attending Conferences
- Taking classes, summer schools, etc.
- Doing TA or RA jobs
- How to give presentations
- The Life Cycle Of A Graduate Student
- The Thesis Oral Defense
- Seeking jobs and giving interviews
- ...

Resources

- This presentation and other resources are available at my homepage
 - <http://people.compute.dtu.dk/jakba/pmwiki/pmwiki.php/Main/ArtPhD>
- Saul Greenberg's homepage
 - <http://pages.cpsc.ucalgary.ca/~saul>
- "So long, and thanks for the Ph.D.!"
 - a.k.a "Everything I wanted to know about C.S. graduate school at the beginning but didn't learn until later."
 - Ronald T. Azuma, UNC, 1997, 2003
- <http://www.phdcomics.com/>
- ... and a lot of other resources!

Seminar BINGO!

To play, simply print out this bingo sheet and attend a departmental seminar.

Mark over each square that occurs throughout the course of the lecture.

The first one to form a straight line (or all four corners) must yell out **BINGO!!** to win!



SEMINAR B I N G O

Speaker bashes previous work	Repeated use of "um..."	Speaker sucks up to host professor	Host Professor falls asleep	Speaker wastes 5 minutes explaining outline
Laptop malfunction	Work ties in to Cancer/HIV or War on Terror	"...et al."	You're the only one in your lab that bothered to show up	Blatant typo
Entire slide filled with equations	"The data <i>clearly</i> shows..."	FREE Speaker runs out of time	Use of Powerpoint template with blue background	References Advisor (past or present)
There's a Grad Student wearing same clothes as yesterday	Bitter Post-doc asks question	"That's an interesting question"	"Beyond the scope of this work"	Master's student bobs head fighting sleep
Speaker forgets to thank collaborators	Cell phone goes off	You've no idea what's going on	"Future work will..."	Results conveniently show improvement

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