
DON'T
PANIC

THE HITCHHIKER'S GUIDE TO THE PhD

Andrian (Andi) Marcus

seers group

www.andrianmarcus.net

1995
B.S. Computer Science

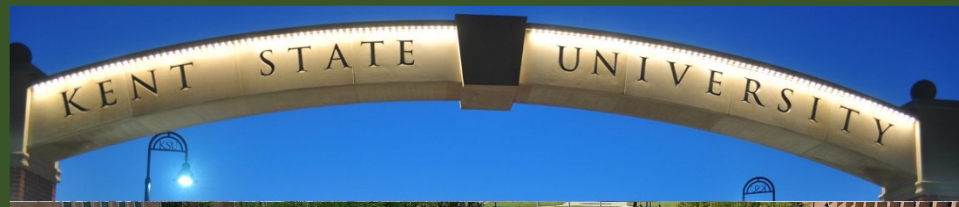
1997
MS European Studies

2005-06
Visiting Prof.

1997-1998
Fulbright Scholar

2001
MS Computer Science

2003
PhD Computer Science



2003-2014
Assistant/Associate Professor

2014-2023
Associate/Fool Professor

2023 – GEORGE MASON UNIVERSITY

WHAT IS MY WORK ABOUT?

"Focus on the students, since graduating great students means you'll produce great research, while focusing on the research may or may not produce great students."

Nico Habermann (1932-1993)

BEFORE WE BEGIN

These are my opinions – albeit not all original

Others may (strongly) disagree – listen to them!

There are many ways to do research and often it is highly personal – remember what Peggy talked about

Feel free to interrupt and ask questions or comment

WHY ATTEND A SUMMER SCHOOL?

VISSOFT 2005

Budapest, Hungary


VISSOFT 2005
Budapest, Hungary

MY FIRST SUMMER SCHOOL

ICSM 2010

Timisoara, Romania

ICSM 2010
Timisoara, Romania

ASE 2010
Antwerp, Belgium


WCRE 2010
Boston, MA, USA

Vadim Zaytsev @grammarware · Feb 5, 2014

The best “best paper award” talk by Andi Marcus ever. Exposes the whole life cycle of rejections of the paper!
#csmrwcre #saner

GETTING A PH.D.

WHY PURSUE A PH.D.?

Career choice

- Academia – research and/or teaching
- Industry – R&D

Personality

- Problem solver
- Like independent work
- Dislike routine work

WHY PURSUE A PH.D.?

Career choice

Industry – programmer/developer

Personal

Prestige – I want to be called Dr. X

Everyone in my family has a graduate degree

Pathway to legal immigration

GOALS OF THE PH.D. PROGRAM

Training (acquiring skills)

- Research
- Organization
- Teaching and mentoring
  - How to do research
  - About your research
  - In your field

Research work

- Advance knowledge in the field
- Can be done in several ways

Expertise

- At graduation you will be the worlds' foremost expert in your research topic

WHAT DO YOU NEED BEFORE STARTING YOUR PH.D.?

Motivation and patience

- It is an investment in your future

Communication skills

- Orthogonal to language
- If YOU cannot explain what you are doing, then nobody can

Stamina

- Not a 40 hours/week job
- Research does not stop at 5pm

Ability to learn

- New things
- From failures and successes

WHAT DO YOU NEED BEFORE STARTING YOUR PH.D.?

Background

- Technical skills
- Broader background, beyond CS/SE, is a plus

Language

- English

Personality

- Curiosity
- Ability to work with others
- Humility
- Self confidence

CHALLENGES DURING THE PH.D.

Research topic

Advisor

Pressure and coping

- Constant judging - papers, grants, presentations, classroom
- Repeated failures
- Deadlines
- Balance work-life
- Finances – most students are poor

WHAT IS YOUR PH.D. ALL ABOUT?

Independent research

Expertise

you will be the worlds' foremost expert in your research topic

Until that happens, remember that

"Your advisor is always right!"

Jonathan Maletic

"When you manage to prove your advisor wrong, you are ready to graduate"

Andrian Marcus

WHAT IS YOUR PH.D. ALL ABOUT?

Benefits

Exciting, sense of purpose, work with others, unparalleled satisfaction, it is work for you, it is the beginning of other things

Cost

Hard work, frustration, high failure rate

Warning!

May lead to nowhere, not for everyone, you often need to give up independence to achieve independence, it can go really wrong

Not the end of the world if you never finish your Ph.D.

WHAT IS YOUR DISSERTATION ABOUT?

The end results of years of work, sweat, and struggles

- Some say you should even publish it as a book

Byproduct of your research training and work, on the way to build a career and long term research agenda

- Many places accept dissertations as a collection of (some) of your papers

CHOOSING YOUR RESEARCH TOPIC

Listen to your advisor

- You need their help and expertise, especially as you start your research
- Do not go too far away from their area of expertise, yet
  do not stay too close either
- The most valuable help you can get is not technical in nature
  - Publication venues, research techniques, past experience, connections, etc.

CHOOSING YOUR RESEARCH TOPIC

Be brave

"Boldly go where no one has gone before"

Be prepared

It may lead to nowhere, so you need to come back to square one

Beware of "rabbit holes"

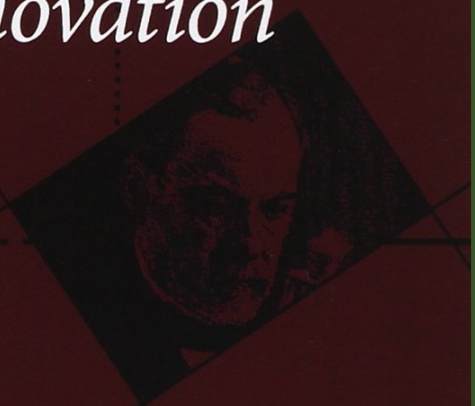
You need to sell it and protect it

Be mindful about return on investment

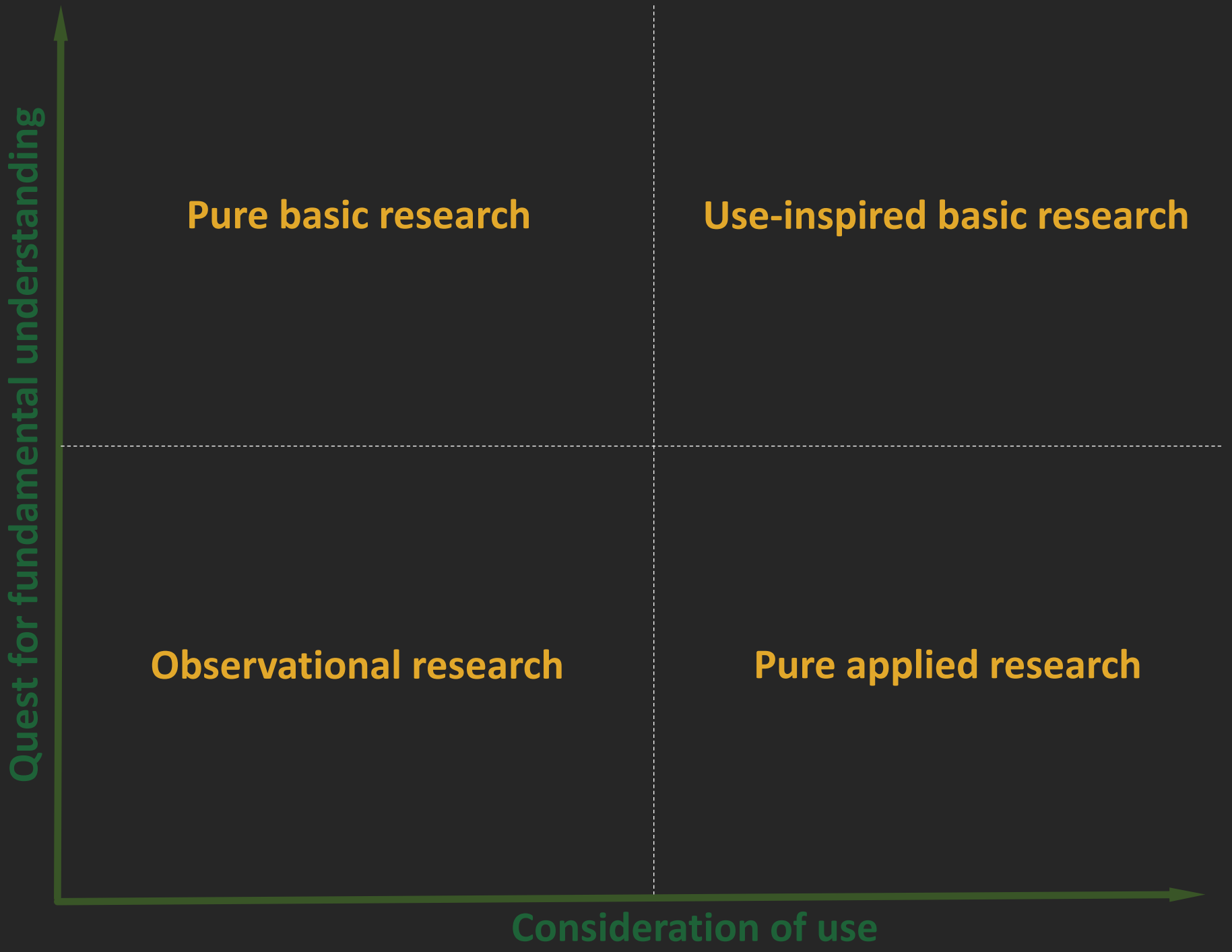
WHAT KIND OF RESEARCH DO YOU WANT TO DO?

PASTEUR'S QUADRANT

Basic Science and Technological Innovation



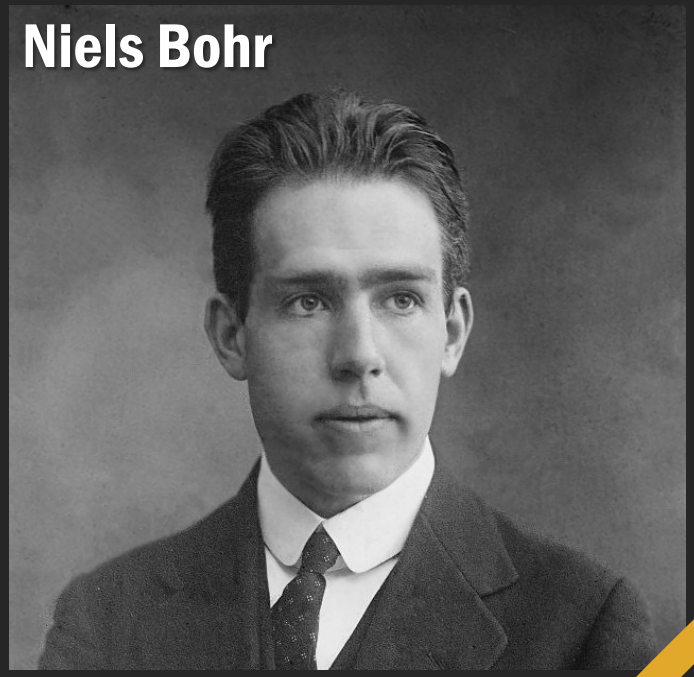
Donald E. Stokes


Pure basic research
Use-inspired basic research
Observational research
Pure applied research
Quest for fundamental understanding
Consideration of use

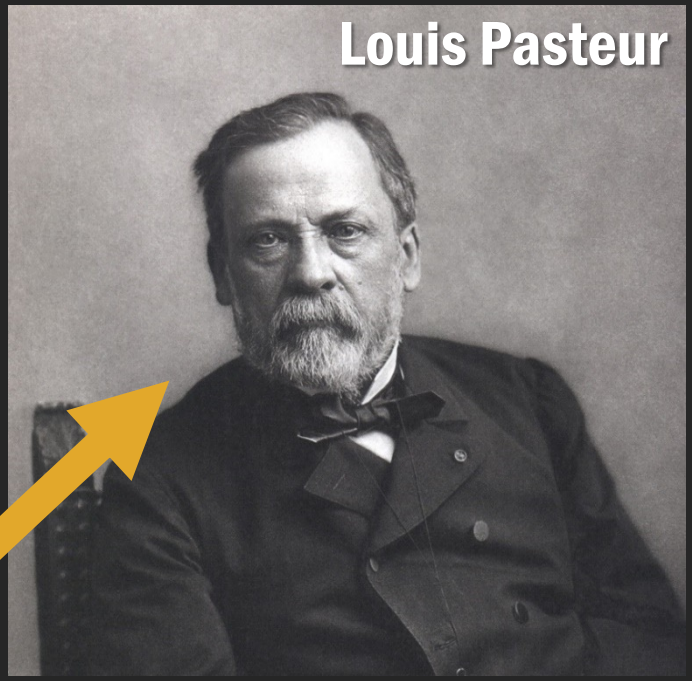
Quest for fundamental understanding

Pure basic research

Niels Bohr



Louis Pasteur

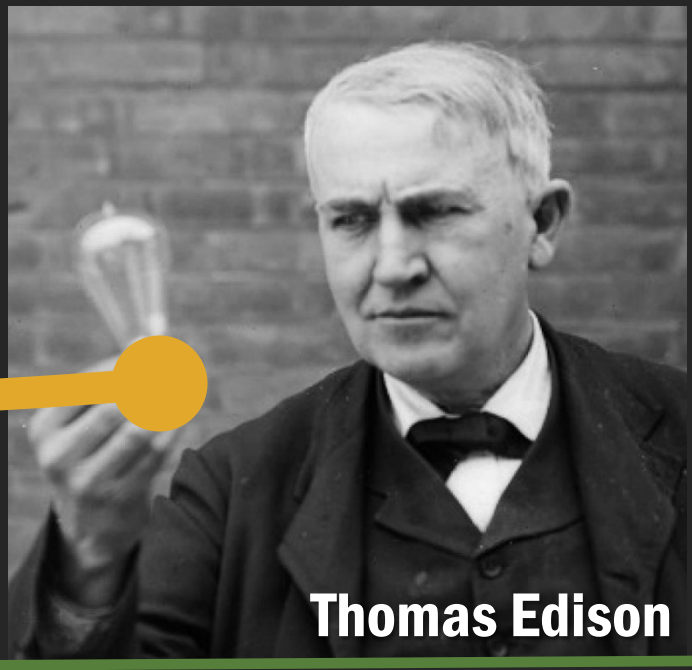


Use-inspired basic research

Observational research

Birdwatchers

Pure applied research



Thomas Edison

Consideration of use

RESEARCH IN SOFTWARE ENGINEERING

UNDERSTANDING HOW TO AND HELPING

produce software cheaper

- increase productivity
- process improvement
- tool support:
  IDEs, programming languages, algorithms, libraries, etc.
- usability
- communication
- information management
- cognition
- human factors

produce better software

- software quality analysis and measurement
- software testing
- process improvement
- tool support:
  IDEs, programming languages, algorithms, libraries, etc.
- usability
- communication
- information management
- cognition
- human factors

RESEARCH AREAS IN SOFTWARE ENGINEERING

Process improvement is difficult and long-term

- Done in academia during the 1980s
- Academic environment inappropriate for such research
- Mostly grassroot movement since 1990s (e.g., agile community)

Productivity improvement research is tricky

- Needs industrial environment
- Requires research methods from other disciplines, such as, anthropology, social science, management, HCI, etc.
- Driven by trial and error, e.g., unusual work environments
- Hated by developers, loved by managers
- Needs high-quality process data
- Serious ethical issues

DEFINING YOUR RESEARCH AGENDA

What?

Why?

How?

WHAT?

What is the problem you are researching?

The most **common** question you will have to answer in your career

WHY?

Why is this important?

The most **important** question you will have to answer in your career

HOW? – CONDUCTING YOUR RESEARCH

The good news

- There is no one way (or best way) to do research

The bad news

- There are bad ways to do research

HOW DO WE LEARN TO DO RESEARCH?

LEARN FROM THE EXPERTS

Embarking On a Journey to Conduct Disruptive Research in Software Engineering: *Who, What, How*

Together, we will take a deep dive and follow a less traveled path through the landscape of research methods in software engineering research. We will explore *who* our research aims to impact, *what* kinds of contributions we can expect from our research, and *how* we can use innovative research methods. Some of the topics we will dive into include **design science** as a frame for software engineering research, the benefits and challenges of using **mixed methods** in software engineering, and how to uncover the potential but not always obvious or positive **disruptive impacts of novel technologies** (such as generative AI and VR) on software engineering practice. After this talk, you should feel more empowered to pursue ambitious and impactful research using innovative research methods.


Jonathan Maletic
@KSU
ICPC '08
Amsterdam, NL


Václav Rajlich
@WSU
ICSM'05
Philadelphia, PA

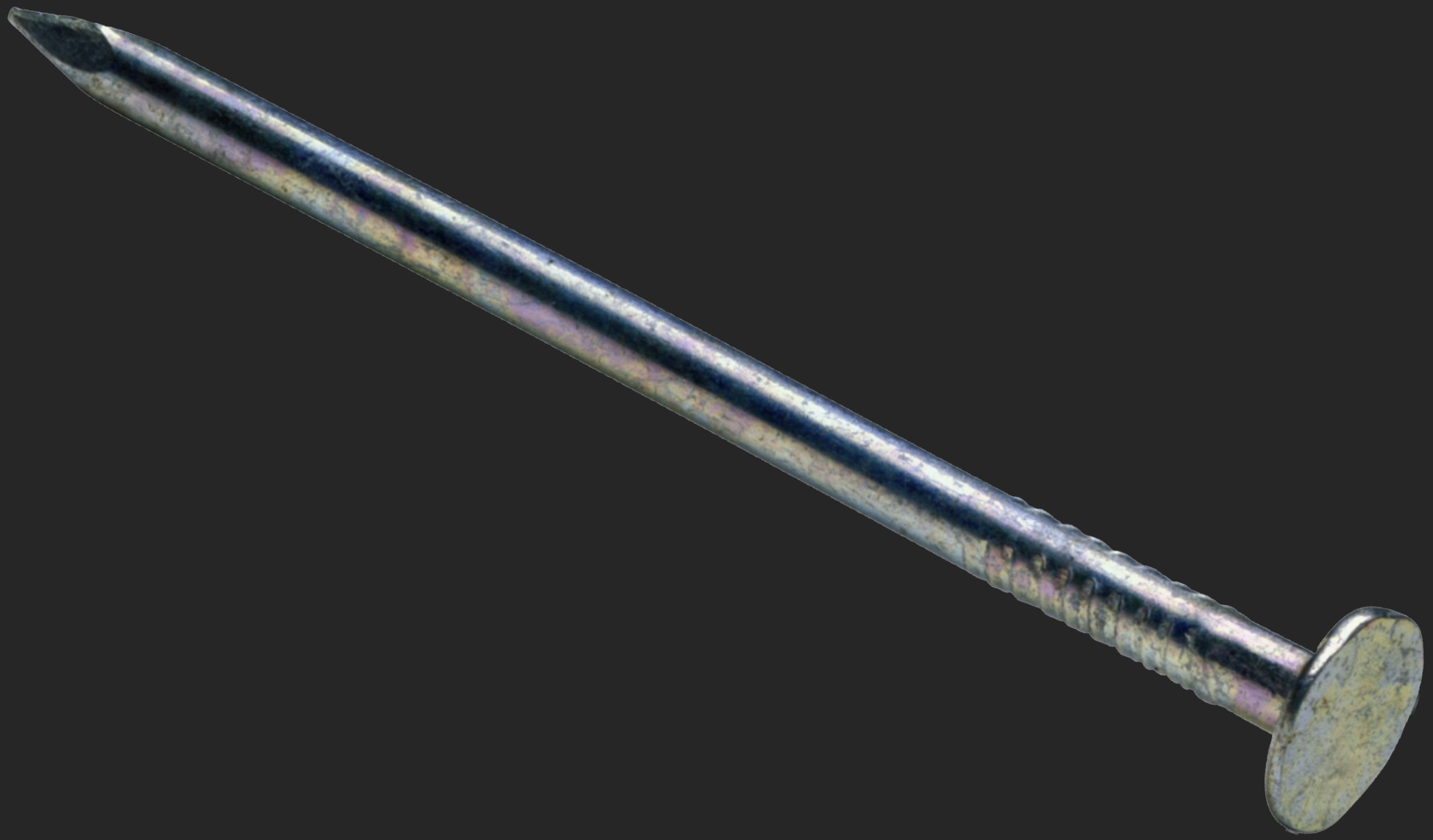
Max Di Penta
@Uni Sannio

ASE'17
Singapore

"If all you have is a hammer, everything looks like a nail." – **Abraham Maslow**

STUDY AND UNDERSTAND THE PROBLEM

IDENTIFY SPECIFIC INSTANCES YOU CAN SOLVE



FIND THE BEST SOLUTION

RESEARCH IN THE SEERS group AND CO.

Need driven research

(as opposed to hypothesis driven)

Empirical research

(as opposed to theoretical)

1. Identify an existing problem
2. Document the problem
3. Study and understand the problem

   Add to the knowledge in the field

   Transfer knowledge to other problems – future research
4. Formulate a solution
5. Implement the solution
6. Evaluate the solution empirically
7. Publish the results

8. Can we generalize the solution?
9. Can we adapt the solution to other similar problems?

BREADTH VS. DEPTH

How far should you explore a problem?

- Novelty wears off quickly
- Being the first or one of the many
- Learning takes time – expertise has costs
- Adoption and impact take years (sometimes decades)
- Focusing on one problem will leave room for others to take on the others

REINVENTING THE WHEEL

Very common

It starts with new terminology

- Often needed
- Often an excuse to ignore previous work
- Buzzwords

Start with a survey

- Place your work in the proper context and make the differences clear

COLLABORATIONS VS. SOLO WORK

- Nobody's perfect
  - Others can help us
  - We can help others
- Do a lot of small jobs with many people
- Do fewer bigger jobs with few people
- Issues
  - Intellectual property, funding, students, jobs, etc.
  - Cost
  - Working with senior collaborators

PRESENTING YOUR RESEARCH

Publishing

- What?
- When?
- Where?

Branding

LEAST PUBLISHABLE UNIT (LPU)

Avoid LPUs!

Focus on quality over quantity

- Do not ignore the world we live in (e.g., “the number game” in academia)

Graduation and tenure pressures lead to LPUs

Incremental research vs. LPU

NOW OR LATER?

Workshops are today what conferences used to be two decades ago

- Fast dissemination of research
- Rapid feedback from the community
- Mark your territory
- arXiv

HOME SWEET HOME

Find your home venue, where *everybody knows your name*

- Higher chance of relevant reviews
- Reviewers more likely to know your work (helps avoiding LPUs)

Cultivate your presence there and maintain it for the long term

- Invest in your home – make it better

Aim for the high impact venues (ICSE, ASE, FSE, TSE, TOSEM), but beware that they are everyone's home

BUILDING A BRAND NAME

Are you an expert in the problem or in the solution?

Example: using LLMs in software engineering

Solutions are applicable across fields

Problems are within (sub)fields

Who (persons or venues) are sensible to the problem and can appreciate your solution?

ETHICS AND RESPONSIBILITIES

Everybody talks and knows about it

We do not know or talk enough about it

Largely self controlled!

Poor community infrastructure for control

YOU, YOUR ADVISOR, AND YOUR RESEARCH

Your Ph.D. research should be long term

Where does their work ends and yours starts?

Split/share the world after your graduation

Will you be competitors or collaborators after your graduation?

Who has the IP of your dissertation work?

CAREERS IN ACADEMIA

WHY SHOULD YOU WORK IN ACADEMIA?

Not an easy sell

Alternatives are often more glamorous or lucrative

You probably heard your advisor complain about academia every day for the last x years

WHAT I LIKE ABOUT IT?

More than a job

"Choose a job you love, and you will never have to work a day in your life."
- unknown – popularized by Harvey Mackay

Five jobs into one

Educator; researcher; mentor; administrator; promoter

Independence

Academic freedom - tenure

Unique perks

Work with young and smart people

World wide collaborations + travel

Flexibility time-wise and work-wise

Sabbatical

WHAT I LIKE ABOUT IT?

Stability

Tenure + Good salaries

Consulting + start-ups

Research impact

Publications - citations

Consulting - industry

People impact

"If you think in terms of a year, plant a seed; if in terms of ten years, plant trees; if in terms of 100 years, teach the people." *– Confucius*

Legacy

Students – careers

Mentees – school of thought

MYTHS ABOUT WORKING IN ACADEMIA

I have to teach a lot

- Most research active faculty will teach 2 courses a year

I will not make money

- True in some countries
- Can have research income, consulting, business

Research is too hard

- There are teaching based positions
- Can migrate towards administrative positions

Research is not practical

- It can be

LEGACY

ICSME'11

Williamsburg, VA


LEGACY
ICSME'16
Raleigh, NC


LEGACY
ICSME'16
Raleigh, NC