Design Technology Center
National Tsing Hua University

成功的學術研究之道

吳誠文、吳中浩、張世杰、黃錫瑜
What is Graduate Study for?

- **Undergraduate study**
  - To learn existing knowledge
  - To broaden your view of the world

- **Graduate study**
  - To investigate and explore the unknown world
  - To learn *research* skills and methodologies
  - To intensify your vision of the future
  - To learn that you have to keep learning to stay competitive
What is Research?

- Research: careful, systematic, patient study and investigation in some field of knowledge, undertaken to discover or establish facts or principles [Webster’s New World Dictionary]
  - To learn/study known or existing facts or principles
  - To discover/establish unknown or new facts or principles
Panelists

張世杰教授
• What are the most important factors in successful research?

黃錫瑜教授
• What are the proper research skills?

吳中浩教授
• What is an advisor for? How do I learn from my advisor?
成功的學術研究之道

清華大學資訊工程學系
張世杰

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Good research (topic)

- Address important issues
- A real problem (not a toy)
- Solid theoretical work
  - $E=mc^2$
- Good empirical results
Good research (topic)

- Push the frontier of “knowledge” – not just “data”
  - Data: facts resulting from an experiment
    - parameters in simulated annealing.
  - Knowledge: facts analyzed, condensed, or combined with facts from other experiments to produce useful information
Research Topics

Interesting  Useful  Novel
Finding a good topic

- Narrow and well defined topic → may not be exciting

- A new direction → difficult to define and to evaluate. (Need an advisor.)

- Out of ordinary → be sure that people are actually interested
How to Find a Good Problem?

- Ask your advisor?
- Ask your friends?
- Look for “Future Work” in the literature?
- ??
Searching research topics

- Today’s racing between Turtle and hare
- Fighting in a narrow lane
Some pitfalls during research

- Selecting a research topic and **Invent a new field & stick to it?**
  - No! Do ``Real Stuff'': solve problem that someone cares about
  - No! Use separate, short projects
  - Long effort in fast changing field???
  - If going to fail, better to know soon
  - Match the strengths and weaknesses of local environment
  - Prototypes are exciting
Find a good research problem?

- It’s a process – don’t rush!!

- Have to know/master the current state-of-the-art before you can clearly define the problem, and before you can advance state-of-the-art
Do NOT worry too much

- Stay focus and motivated.
- Organize activities
- Manage your time to do something useful every day.
- Regularly meet with advisors
- Attending seminars.
如何做好學術研究工作

清華大學電機系  黃錫瑜

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A Constant Search Process

➢ Re-search

• “再一次”地尋找，重新尋找，不斷地尋找

Every Problem Has Its Own Soul Mate!
Most people live their lives
• With only 20% of their creativity
You will be very fine
• If you can exploit your other 80%
Two elements of Intelligence
- Knowledge Base
- Inference Engine

What is your Knowledge Base?
- Spaghetti
- Spider Web
- Tree Structure
- Special Graph (Tree-Like With Symbolic Links)
Classification

Peak Power Estimation

Static Approaches
- iMax
- ILP
  - Signal Correlation Based

Dynamic Approaches
- Functional
  - Gate-Level
  - Transistor Level
- Vector Generation
  - Timed ATPG
  - Probability
  - Genetic Algorithm

Mixed-Level
A Typical Research Flow

1. Start
2. Find A Good Topic
3. Survey Papers
4. Brain Storming
5. Propose Solutions
6. Feasibility Study
7. Implementation & Tuning
8. Finish
Examples of High-Impact Works

(1) Milestone Work
- Binary Decision Diagram (BDD)
- R. Bryant, 1987

(2) First Results For Unsolved Problems
- Equivalence Checking
- D. Brand, 1993

(3) Incremental Works
- Improvements over existing algorithms
Presentation Tips

- Overall Mindset
  - It’s your show!
  - Know your audience
  - Get across the key messages, not every detail
  - Define your problems and terminology clearly
  - Practice to make it perfect

- Technical Details
  - Use picture, flow chart, graph, whenever possible
  - Use right fonts and colors
  - One minute per slide in conference presentation
Writing Tips (1)

- Paper Organization
  - Essay, not prose or novel
  - (1) Abstract: short and sweet
  - (2) Introduction:
    - classification and comparison, motivation
  - (3) Experimental results: information, not data
  - (4) Conclusions: “show them the $”
Writing Tips (2)

Details About Writing

• Always check your spellings
• Define your terminology before using it
• Use short sentences
• A picture saves thousand words
• Itemize long descriptions
• Watch your references, …
結語

科學是一種直覺
需要兩大元素，Knowledge and Inference
新思維，新方法，創新永不止息 ...

It’s not just research
it is your competitiveness!
The Relationship and Roles between Advisor & Students
指導教授和學生的角色及互動關係

吳中浩

8/10/2004

Design Technology Center
National Tsing Hua University
角色

指導教授
➢ 提供Financial support
➢ 提供生涯規劃建議
➢ 研究指導
➢ 畢業後升學/就業建議與輔導

學生
➢ 讀書與研究
➢ 交友
➢ 生涯規劃
互動關係

- Matching（尋求適合的指導教授/學生）
- 雙向溝通（嚴師型，亦師亦友型）
- 研究態度
  - 自動自發（self motivate）
  - 不懼挫折
  - 了解自己的長短處，發揮自己的專長
  - 做自己有興趣的究研