

# Research Methodology in Computer Science

## Finding Research Problems

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# How to find a research problem?

- From large research areas to small ones
  - ▶ What is your interest?
  - ▶ What is others' interest?
  - ▶ Do not waste time in old research fields.
- Read a lot of related papers
- Keep doubt on each statement in the papers
- Think more
- Keep records of all your ideas or questions (Research Notes)
- The research problem reveals

# Two examples

- Traffic Intensity Based Fixed Alternate Routing in All-optical WDM Networks
- Multiple Selfish-Miners in Blockchains

# Traffic Intensity Based Fixed Alternate Routing in All-optical WDM Networks

- **Research Fields:** Optical Networks  $\Rightarrow$  WDM Networks (wavelength continuity constraint)
- **More Specific:** Routing and Wavelength Assignment Problem
  - ▶ Fixed-alternate routing (from short to long) : simple but poor performance (0 papers)
  - ▶ Dynamic-alternate routing (objective function) : complex and better performance (20+ papers)
- **What did most researchers do?** Improve dynamic routing and get better performance.
- **What did I think?** Is there a fixed-alternate routing which can provide performances like dynamic-alternate routing?
  - ▶ Determine the order not by the length of the path
  - ▶ Consider All traffic pattern
  - ▶ 1 conference paper + 1 journal paper + 1 Ph.D. degree + 1 faculty position

# Multiple Selfish-Miners in Blockchains

- **Research Fields:** Blockchain  $\Rightarrow$  Mining algorithms
- **More Specific:** Selfish Mining Attack (Classic paper)
- **What did most researchers do?**
  - ▶ Any other attacks
  - ▶ How to detect selfish mining
  - ▶ Revenue by Selfish Mining
- **What did I think?** How about **multiple** selfish miners?
  - ▶ Previous studies only consider 1 honest miner and 1 selfish miner
  - ▶ How about 1 honest miner and 2 different selfish miners
    - 1 Write Simulation programs (Event-driven Simulation)
    - 2 Revenue by Selfish Mining (Analysis and Modeling by Markov Chain)
    - 3 Game theory (Future works)

# How about you?

- Research Fields:
- More Specific:
- What did most researchers do?
  - ▶ Problem1
  - ▶ Problem2
  - ▶ Problem3
- What did you think?
  - ▶ Problems
  - ▶ Methods
  - ▶ Algorithms

# How about you?

- Research Fields:
- More Specific:
- What did most researchers do?
  - ▶ Problem1
  - ▶ Problem2
  - ▶ Problem3
- What did you think?
  - ▶ Problems
  - ▶ Methods
  - ▶ Algorithms

## Homework #3 (10%)

Please prepare a 15 minute presentation to introduce the research problems you find in this semester. We will determine the presentation order in the next week.