**TOPIC SELECTION**

**OUTLINE**
- Stages of research process
- Key for topic selection
- Sources of research topics
- Four types of research topics

**STAGES OF RESEARCH PROCESS**
- Ideal process:
  - Identify field of interest
  - Identify possible topics
  - Create a thesis proposal
  - Undertake pilot study
  - Data collection
  - Data analysis
  - Writing up

- The reality:
  - May visit stages out of order
  - May run into dead ends at any stage
  - May backtrack to an earlier stage in the process and try again
  - May revisit stages in different contexts

**KEY FOR TOPIC SELECTION**
- Three necessary properties of a good research topic:
  - You can do it
  - It hasn't been done
  - It is worth doing

**WHAT YOU CAN DO**
- Need to be answered through self-examination
  - What are your knowledge, experience, strengths, & weaknesses?
  - Math, algorithm, data analysis, theory?
  - What are your interests & passion?
  - Much harder to work on a topic that you feel boring
  - What is your end goal?
  - Complete MSc/PhD, publish journal/conference papers, find academic positions?
  - How much are you willing to commit?
  - Time, effort, financial resources, family sacrifices, etc.

**WHAT HASN'T BEEN DONE**
- Need to be answered through literature review
  - Cannot expect your supervisor knows the state-of-the-art
  - Conducting original research is a central part of MSc/PhD study
  - The reason why plagiarism is so despised in scientific research

- Identify the research gap
  - Conflicting views
  - Ineffective solutions
  - Problem no one exploring
WHAT IS WORTH DOING

• Need to consult your supervisor
• The topic should be non-trivial & has enough impacts/applications
  • No point to present something new but does not work as well as existing approaches
• Questions for your supervisor:
  • Is this topic worth doing?
  • Can it be achieved within a reasonable amount of time?
  • Is it part of his/her research interests?
  • If not, he/she will be unlikely to offer as much helpful advice

• Supervisor selected:
  • Typical for BSc & MSc research
  • Risk depends on how well the supervisor knows the topic & your ability to work on it
  • May not be your own interests
  • Can be completed quickly
  • Good for learning particular methods

• Self-selected:
  • Most typical type of PhD research
  • Riskier, as you need to evaluate originality, importance, & feasibility by yourself
  • Typically time-consuming & somewhat terrifying experience
  • Help you to become an independent researcher

BE OPEN-MINDED, BUT DON’T BE TOO BROAD

• Open mind on research area
  • Many students begin postgraduate study without a clear idea of exactly what they’re interested in studying
  • Try them out by taking courses from different areas
  • PhD breadth requirement is designed to introduce you to different topics

• Open mind on research goal
  • Do not be afraid of changing research goal
  • Be flexible on the approach you take even if you have a clear goal
  • Learn and try different methods
  • Analyze experimental results unbiasedly and follow up on unusual findings

FOUR TYPES OF RESEARCH TOPICS

• Verification/evaluation of existing methods for an existing problem
  • Rerunning an existing method to measure its performance
  • May require reimplementing them, if the original code is not available
  •Verify reproducibility (trustworthiness), which is a core aspect of science
  • Evaluating multiple methods under the same settings
  • Can make significant impacts
  • Involve developing new datasets and/or designing new evaluation metrics
  • Generally low-risk research topics
  • Often require lots of work on implementation/experiments
  • Example: evaluate binocular stereo matching algorithms

• New application of existing method
  • Follow the state-of-the-art technique & apply it to a different problem
  • Understand the merits of the technique and think about where else it can be applied
  • Importance & originality depends on the scope of the application
  • Most common research topics
  • Low- to moderate-risk research topics
  • Chance of success depends on how powerful the new technique is
  • Need to get results quickly as others may doing the same thing
  • Example: apply convolutional neural network to computer vision problems
DEVELOPMENT OF A NEW METHOD

- Design a new algorithm or significantly enhance an existing one
- Originality & importance depend on the advantages & applicability of the method
- Critical to apply it to the same applications that existing methods have been tested
- Show that the new method outperforms existing ones
- Often advance ongoing scientific research and are somewhat rare
- Moderate- to high-risk research topics:
  - Such work can be difficult to do
  - Developed algorithm may not work as well as existing ones
- Example: design the convolutional neural network

DEFINE A NEW RESEARCH DOMAIN

- Define a research problem, conduct pioneer research, & find solutions
- Such topics are typical of major scientific revolutions and hence are very rare
- Such topics are by definition original & important
- Very-high-risk research topics
  - Require deep insights in research in related fields
  - May not be doable or very difficult to do
- Example: text recognition, image understanding

WHERE TO LOOK FOR

- Open questions in existing work
  - What are the limitations of existing approaches?
  - What did authors say about future work?
  - If a topic is truly original, important, & doable, researchers may be reluctant to share
- Combination of elements of existing work
  - Question why/why not when reading papers
  - Discuss your thoughts with others in brainstorming sections
- Reference:
  - How to get a Ph.D.: a handbook for students and their supervisors (Phillips 1994)