

Research Methods in Engineering

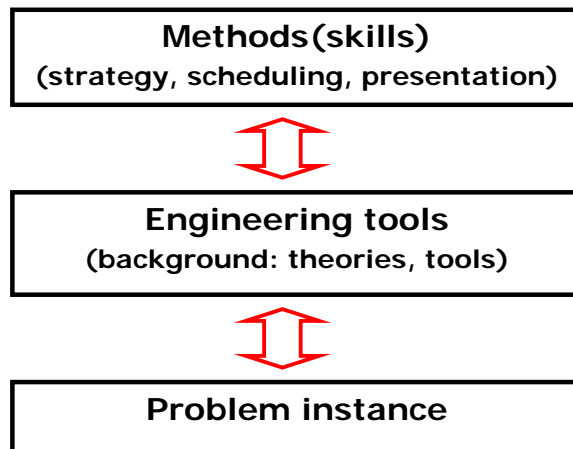
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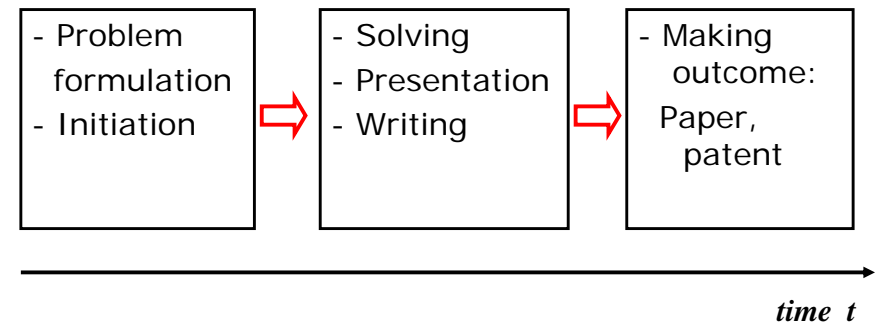
Today's definition of research

- To answer scientific questions
- To solve problems
- To make something new

Research hierarchy



Research progress



What is necessary for research

For example, control engineering

- Background
 - Mathematics, and system and control theories
 - Engineering tools:
software(C++, matlab...) and hardware(cpu, arm, rom...)
- **Methods(skills)**
 - How to think logically
 - How to start to do research
 - How to find qualitative references
 - How to make research plan
 - How to manage the research progress
 - How to present the result: oral presentation and writing
 - How to deal with research result(e.g., legal aspect: patent)

Main purpose of the course

- Main purpose
To develop and practice methods for research in Eng.
- Tasks you will be asked to do
 - Select your own research topic
 - Find qualified stuffs for your own research topic
 - Make a schedule for your research(Management skill)
 - Make oral presentation(communication skill)
 - Write reports(technical writing)
 - (Make outcome(Patent and publication))

Positive participation

I hear and I forget

I see and I remember

I **do** and I **understand**

Confucius 5th century B.C.

Tentative schedule

May 03	Course information
May 10	Introduction to scientific research (HW-#1)
May 17	Information retrieval (HW-#2)
May 24	Oral presentation
May xx	Student presentation 1
May 31	Management of research projects 1(Tilebein)
June 07	Management of research projects 2(Tilebein)
June 14	Technical writing 1 (HW-#3)
June xx	Technical writing 2
June xx	Elements of research ethics (HW-#4)
June 21 or 28	Legal issue in research – patent(Sturm) (HW-#5)
June xx	Student presentation 2
June xx	Final

Two rules: 1. Have at least 1 lecture and not more than 2 a week
2. Finish the course at the end of June

Assignments

Assignment 1	Information retrieval and evaluation
Assignment 2	Oral presentation 1
Assignment 3	Research proposal
Assignment 4	Engineering ethics
Assignment 5	Oral presentation 2

At the beginning of every lecture,
we will have time to discuss the previous assignment.

Possible research topics

- Discrete-time linear MPC
- Continuous-time nonlinear MPC
- Input-constrained control(non-MPC approaches)
- Switching adaptive control(supervisory control)
- Adaptive control
- Nonlinear control theory
- Linear parameter and state estimation
- Systems biology
- Linear output regulation problem
- Nonlinear observer theory

Grading

- Assignments(30%)
- Final(20%)
- Presentation(50%)
 - 50% lecture grade
 - 50% classmate grade
 - Grade will depend on that of others