RESEARCH METHODOLOGY

Made Easy

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Personal account

- BSc in Mech Engineering, Union College, NY 12308, USA, 1989.
- PhD in Mechanical Engineering, SUNY at Buffalo, NY, USA, 2001.
- Various Grant Proposals
- PG supervisors, examiners.
Questions...

- WHY do you do research?
- WHY do you choose your research area?
- WHAT will you become after you are done?
- WHY Research Methodology?
Course Learning Outcomes

At the end of this course you should have:

- Increased awareness of the nature and value of research in system development.
- Enhanced practical understanding of the fundamental concepts and skills required in a complete research cycle.
- Applied relevant concepts and skills in the development and evaluation of a research proposal.
- Carefully prepared a systematic and comprehensive action schedule to carry out the research plan within a defined period.
This Course...

- Learning by doing
- Practical Workshop
- Guide you to prepare your research proposal
What is research?

- The ultimate discovery of truth
  - Its purpose is to learn what has never been known before
  - To ask a significant question for which no conclusive answer has previously been found; and
  - Collecting and interpreting relevant data, to find an answer to that question

Development of Research Skills

- Learning how to conduct good research:
  - New skills *(that many people do not have)*
  - Better understanding and interpretation of the literature
  - Recognize new questions that need investigation

- Objectivity is the key element of research
Search for Truth

Five sources of evidence in the pursuit of truth:

1. Custom and tradition
2. Authority
3. Personal experience
4. Deductive reasoning
5. Scientific inquiry
Deductive Reasoning

A.k.a., Logic.

✓ In deductive reasoning, thinking proceeds from general assumption to specific application

✓ GENERAL → SPECIFIC

✓ Aristotle and other early philosophers
  o Drawing conclusions through categorical syllogism.
  o All philosophers are moral. Socrates is a philosopher. Therefore, Socrates is moral.
  o Resistance training makes one big and bulky by increasing body mass. Sandi is resistance training. Therefore, Sandi will become big and bulky.

✓ Not sufficient as a source of new truth
Conclusions about events (general) are based on information generated through many individual and direct observations (specific).

- SPECIFIC $\rightarrow$ GENERAL
- Researchers observe an individual or group of individuals from a larger population $\rightarrow$ based on these observations, generalizations are made back to the larger population.
Two kinds of induction:

- **Perfect**
  - Conclusions based on observations made from ALL members of a group or population

- **Imperfect**
  - Conclusions based on observations made from a random sample of members of a population
Deductive vs. Inductive Reasoning

- **Deductive:**
  - Every mammal has lungs. All rabbits are mammals. Therefore, every rabbit has lungs.

- **Inductive:**
  - Every rabbit that has been observed has lungs. Therefore, every rabbit has lungs.
The Scientific Method

- Systematic; cyclic; series of logical steps.
  - Identifying the problem
  - Formulating a hypothesis
  - Developing the research plan
  - Collecting and analyzing the data
  - Interpreting results and forming conclusions

- Example...
RESEARCH PROCESS

Research Area Identification

Problem Identification

Theoretical Framework

Methodology
Research Design

Data Collection & Analysis

Conclusions
PhD & Master

- PhD Research – contribution to KNOWLEDGE
- Master Research – contribution to LEARNING
Graduate Research Program Types

**Type A**
- Coursework
- Qualifying Exam
- Research Proposal
- Research
- Defence/Viva

**Type B**
- Coursework
- Research Proposal
- Research
- Defence/Viva

**Type C**
- Research Proposal
- Research
- Defence/Viva
Course Outline

- Philosophy and Overview of Research
- Identifying Research Area
- Research Problem Definition
- Research Framework & Design
- Data Collection & Analysis
- Proposal Writing
- Proposal Presentation
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Grading

PASS/FAIL:

- 80% attendance
- Completing your assignment & Research proposal with minimum grade of B-