

# Research Foundations in Computer Science

Unit VI

## Identifying Potential Research Methods

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# Review of Previous Weeks

- The concept of research
- Importance of research
- Finding previous research
- Finding current research
- Reviewing the literature
- Identifying a research problem
- Developing research objectives

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# Where you should be

- ✓ Identified an area of research
- ✓ Compiled a preliminary bibliography of published materials related to your research area
- ✓ Identified people, laboratories and/or departments involved with research in your area
- ✓ Analyzed the literature on your area of research
- ✓ Uncertainly identified a research problem to be addressed
- ✓ Set preliminary objectives for your research project

# Assignment 7 :

## Objectives of Proposed Research

### Objective:

To write at least two objectives for the proposed research project

### Approach:

1. Examine the objectives of studies used in the Review of Literature
2. Based on your Statement of Problems, develop 2 - 5 objectives for your proposed research project
3. The objectives must
  - a. Be related to the problem
  - b. Be realistic and attainable
  - c. Use action verbs

Submit the result of this assignment as a printed hard copy to me, till on next session (next week).

# Outline for Today

- Identifying research methods

**1 ) Research methods**

**2 ) Research methodologies**

**3 ) Factors to consider in selecting research methods**

# 1 ) Research Methods

**Procedures, algorithms, process and etc.,  
used in a research.**

– **Methods help us to collect samples and data, and find a solution to a problem .**

➤ **e.g. questionnaires, interviews, experiments, etc.**

# 1 ) Research Methods (Cont.)

- 1 ) Feasibility studies (Is it possible?)
- 2 ) Case studies (Is it appropriate?)
- 3 ) Experimental (comparative) studies (Is it better ?)
- 4 ) Formal model (What is?)
- 5 ) Simulation (What if?)
- 6 ) Literature survey (What is known/unknown?)
- 7 ) ...

# 1 ) Research Methods (Cont.)

## 1 – 1 ) Feasibility studies

**Here is a new idea. Is it possible ...?**

- **Is it possible to solve a specific problem effectively?**
  - From computer science perspective?
  - From engineering perspective?
  - From economic perspective?
  - ...
- **Is the technique new / novel / original?**



## 1 ) Research Methods (Cont.)

### **1 – 2 ) Case studies**

**Here is a new idea that works for problem A.  
Does it work for problem B, too?**

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# 1 ) Research Methods (Cont.)

## 1 – 3 ) Experimental studies

– Here are two techniques. Which one is better?

- What are criteria for 'better'?
- What are the differences?
- What are the trade-offs, when one is better?

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## 1 ) Research Methods (Cont.)

# 1 – 3 ) Experimental studies (Cont.)

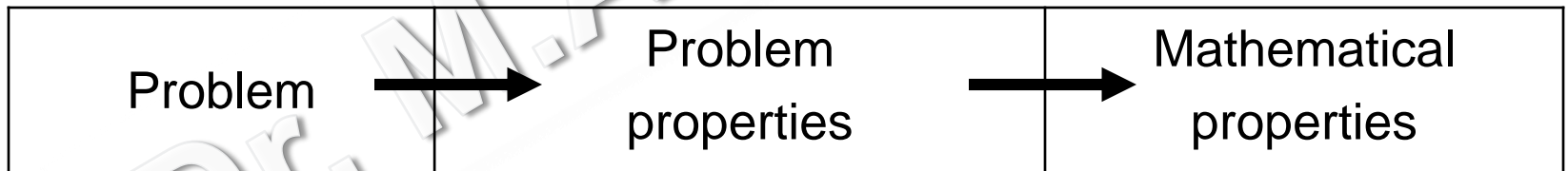
- Experimental studies (comparative studies) aim to answer questions like these:
  - Is program A really more *efficient* than program B, in practice?
  - Does A's runtime *vary* more widely than B's on different inputs?
  - Is program A really more *accurate* than program B, when applied to same task?
  - What are the best parameters for running a particular program?
- Experimental studies are valuable because we can control almost all experimental conditions.
- Running another experiment is relatively cheap, just need cycles and time.

## 1 ) Research Methods (Cont.)

### 1 – 4 ) Formal models

– How can we explain to the world about ...?

- Make a mathematical model of a problem
- Identify properties of a problem
- Show some important characteristics of the model



# 1 ) Research Methods (Cont.)

## 1 – 5 ) Simulation

### – What would happen if ...?

- Study phenomena in detail
- Make suggestions on what would happen if ...
- Test using simulated situation
- Extrapolate to real world

## 2 ) Research Methodologies

**A systematic way to solve a problem**

- The approaches by which researchers use to describing, explaining and predicting phenomena
- e.g. qualitative, quantitative, mixed method

## **2 ) Research Methodologies (Cont.)**

- 1 ) Implementation driven**
- 2 ) Mathematical proofs**
- 3 ) Experimentation**
- 4 ) Observational**
- 5 ) ...**

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## 2 ) Research Methodologies (Cont.)

### 2 – 1 ) Implementation driven

- To develop a better system / approach
- But system may fail, because of :
  - a) wrong idea
  - b) wrong approach
  - c) wrong evaluation
- May not be able to generalize from one system to other systems



## 2 ) Research Methodologies (Cont.)

### 2 – 2 ) Mathematical proofs

- Formal proofs to reason about the validity of a hypothesis given some evidences.  
e.g. mathematical reasoning can be used to demonstrate that an algorithm can cover all possible input cases
- May work in theory but not in practice

## 2 ) Research Methodologies (Cont.)

### 2 – 3 ) Experimentation

- Clear sequence of steps:  
**hypothesis → methods → results → conclusion.**
- Statistical measures determine whether an experiment actually supports a hypothesis, but environment must be carefully controlled if the results of an evaluation are to be trusted

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## 2 ) Research Methodologies (Cont.)

### 2 – 4 ) Observational

- Analyzing the usefulness of a system in its eventual context of use, but depends on subjects.

e.g. success or failure of a new programming language in a real project

### 3 ) Factors to Consider in Selecting Research Methods

- Validity
  - Are there other factors that may affect the results?
- Reliability
  - To what extent is the data and analysis dependent on the researcher? the instruments? Can the results be replicated?
- Generalizability/Transferability
  - Can the findings be used in another situation?

# Assignment 8:

## To write the Research Methodology section

### Objective:

To write research methodology part of your research.

### Approach:

Combine information from earlier assignments, and adding and updating where necessary, to form methodology section of research proposal.

Submit the required task as a printed hard copy to me, till on next session (next week).