Research Foundations in Computer Science

Unit VI

Identifying Potential Research Methods

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

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 8 :
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 above as an e-mail attachment to
<mashaygan2005@yahoo.com>

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 … . Does it work for us, too?

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?**

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 some task?**
  - **What are the best parameters for running a particular program?**

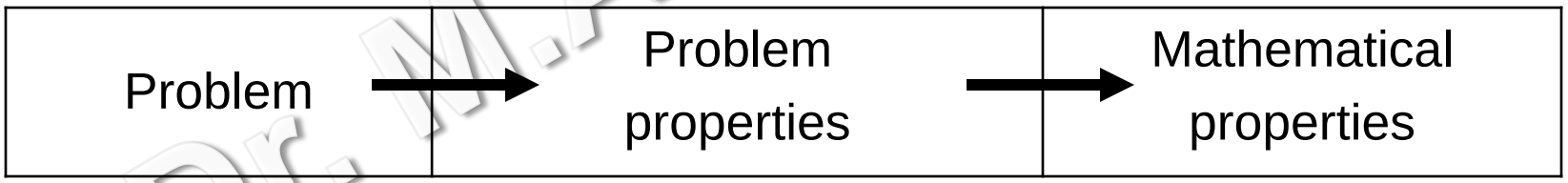
- **Experimental studies are valuable because we can control almost all experimental conditions.**
- **Running another experiment is relatively cheap, just need cycles and time.**

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) …

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**

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 9 :
To write the Research Methodology section

Objective:

To Write section 3 of your research (research methodology part).

Approach:

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

Submit the above as an e-mail attachment by Wednesday ……. 1394 to <mashaygan2005@yahoo.com>