



# Research Methodology

Asad W. Malik

[Asad.malik@seecs.edu.pk](mailto:Asad.malik@seecs.edu.pk)

Department of Information Systems

Faculty of Computer Science & Information Technology

University of Malaya

Office Location: B-2-15



# Group-I

Master by Coursework only

- ✓ **WQC** - Master of Information Technology Management
- ✓ **WQD** - Master of Data Science



# Marks distribution

- ✓ Assignment –I (Individual Presentation & submission) – 20%
- ✓ Assignment –II (Group Presentation & submission) – 25%
- ✓ Assignment –III (Group Presentation & submission) – 40%
- ✓ Class test 15%



## TEXT/ Ref.Book

- ✓ John W. Creswell, Research Design – Qualitative, Quantitative and Mixed Methods Approaches, 4<sup>th</sup> Edition – SAGE Publishers



## W1: Research Paper

- ✓ Osman, Ahmed M. Shahat. "A novel big data analytics framework for smart cities." *Future Generation Computer Systems* 91 (2019): 620-633.



# Course Learning Outcomes

- ❖ Explain the concepts and roles of research in computer science
- ❖ Differentiate the approaches and steps involved in conducting research in computer science
- ❖ Describe the principal methods of research used in computer science and related areas
- ❖ Provide a proposal for a research project, and make an oral presentation of the research proposal



# Outline

- Introduction to Research Methodology
- Research Objective/scope
- Problem formulation
- Formulate research questions
- Academic Research
- Introduction to Literature review
- Critical review
- Plagiarism and how to avoid/ Similarity Index
- Research approaches (Qualitative and Quantitative)
- Getting started with Scientific writing using Latex
- How to write scientific papers
- Discussion on research proposal & thesis writing



# Research Methodology

- ✓ What is research?
- ✓ Why do we research?





# Research Methodology

- ✓ What is research?
  - ❖ Search of knowledge
  - ❖ Systematic investigation and study in order to establish facts and reach new conclusions” – (Oxford dictionary)
- ✓ Why do we research?
  - ❖ Want to know the answers to our questions



# Research Methodology

- ❖ Almost all professions affirm the need of research
  - ✓ Advancement of business – Restaurant example
    - ❖ How many customers do I treat daily
    - ❖ Which are the most served dishes on weekends
  - ✓ Enlightenment of knowledge
    - ❖ How the mobile network works



# Research Methodology

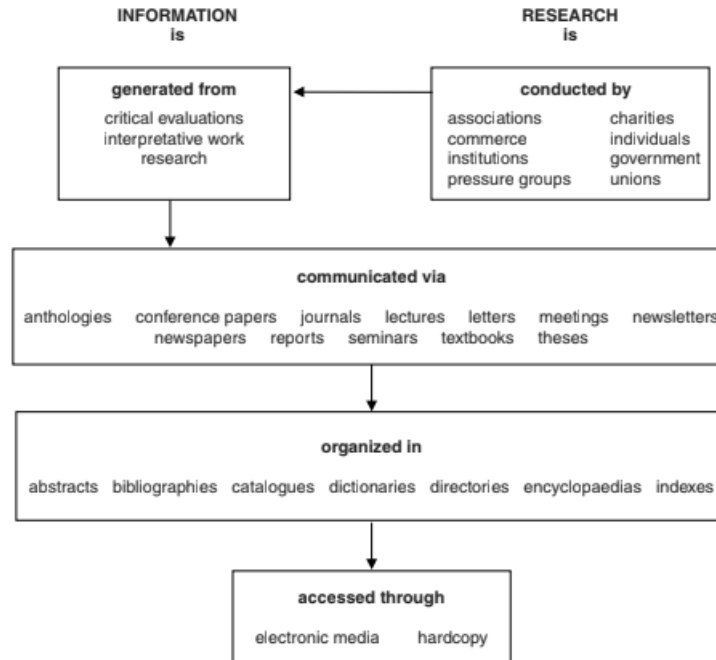
- **Research Methods**

- ✓ Research methods are the methods by which you conduct research into a subject or a topic
- ✓ Research **methods** involves **conduct** of **experiments, tests**, surveys and etc.
- ✓ Research methods aim at finding solution to research problem

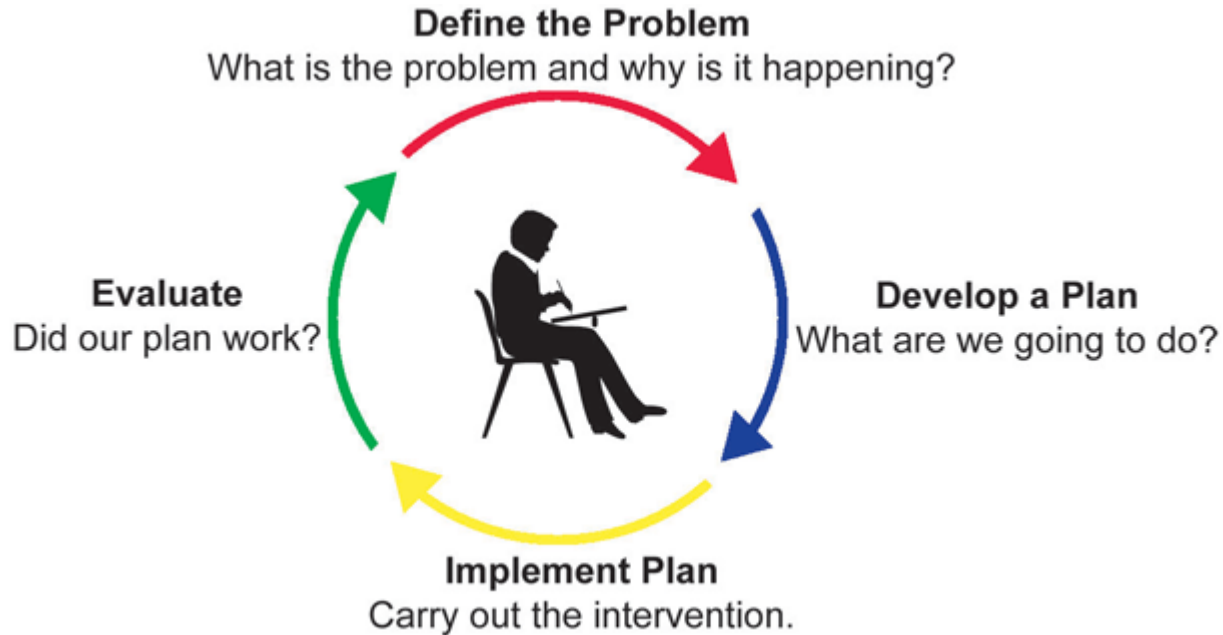
- **Research Methodology**

- ✓ Research methodology explains the method by which you may proceed with you research
- ✓ Research methodology involves the learning of the various techniques that can be used in the conduct of research, tests, experiments surveys and etc.
- ✓ **Research methodology aims at employment of the correct procedures to find out the solution**

# Generation and Communication of Research Knowledge



# Typical Problem Solving Loop





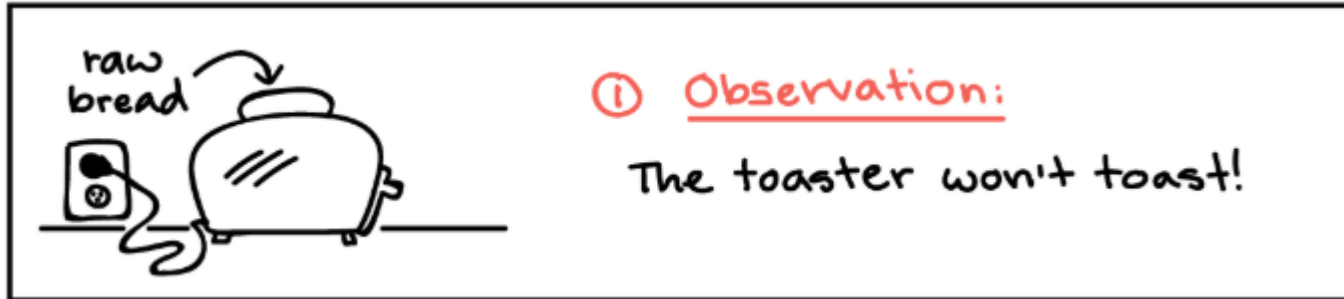
# The scientific method

The *scientific method* has **five basic steps**, plus one **feedback** step:

- ✓ Make an **observation**.
- ✓ Ask a **question**.
- ✓ Form a **hypothesis**, or testable explanation.
- ✓ **Make** a prediction based on the hypothesis.
- ✓ **Test** the prediction.
- ✓ **Iterate**: use the results to make new hypotheses or predictions.

# Scientific method example: Failure to toast

- I. Make an **observation** - Let's suppose that you get two slices of bread, put them into the toaster, and press the button. However, your bread does not toast.



# Scientific method example: Failure to toast

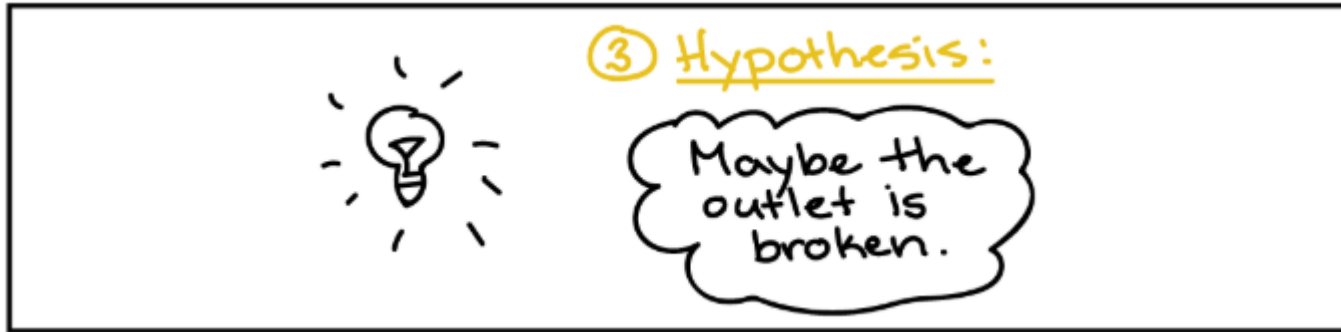
- II. Ask a **question** - Why didn't my bread get toasted?





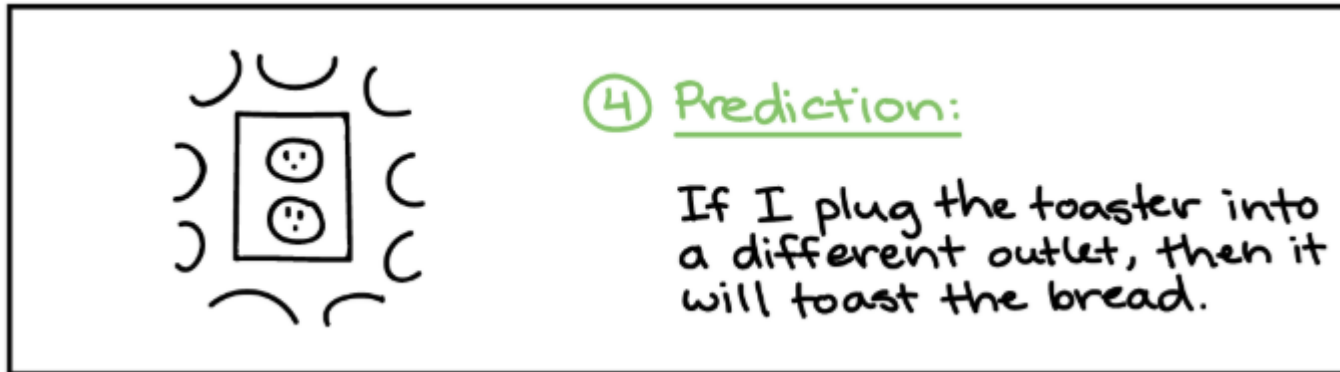
## Scientific method example: Failure to toast

III. Propose a **hypothesis** - A *hypothesis* is a potential answer to the question, one that can somehow be tested. For example, our hypothesis in this case could be that **the toast didn't toast because the electrical outlet is broken.**



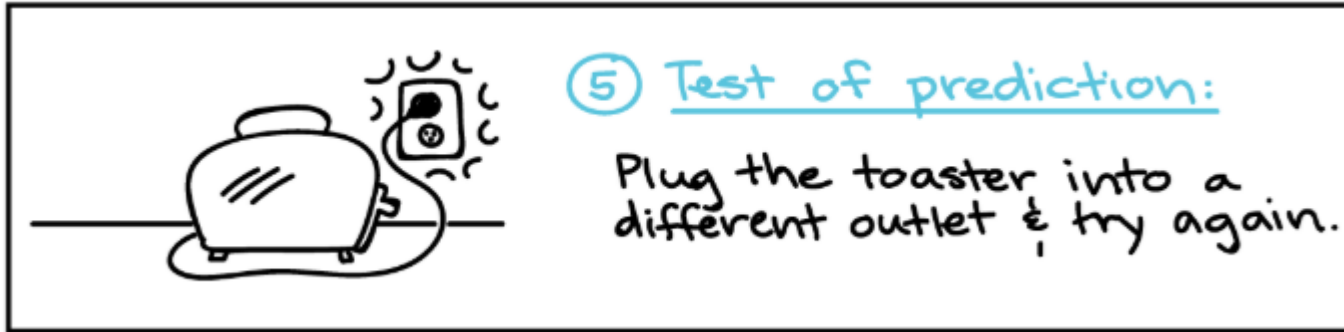
## Scientific method example: Failure to toast

IV. Make **predictions** - A prediction is an outcome we'd expect to see if the hypothesis is correct. In this case, we might predict that if the electrical outlet is broken, then plugging the toaster into a different outlet should fix the problem.



## Scientific method example: Failure to toast

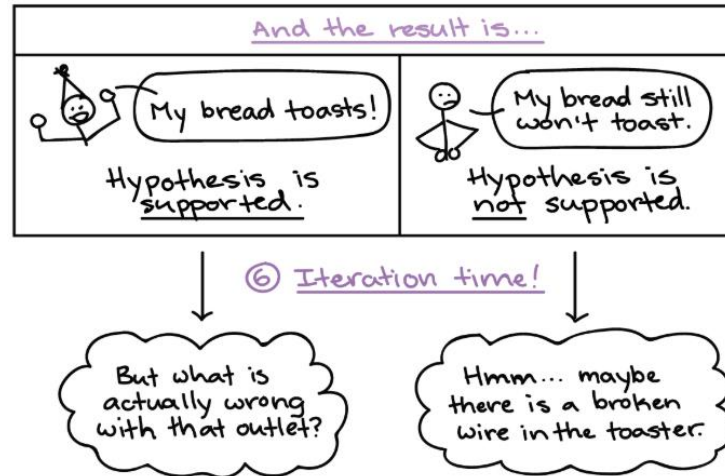
- V. Test the **predictions** - To test the hypothesis, we need to make an observation or perform an experiment associated with the prediction. For instance, in this case, we would plug the toaster into a different outlet and see if it toasts.



- ✓ If the toaster **does toast**, then the hypothesis is supported—likely correct.
- ✓ If the toaster **doesn't toast**, then the hypothesis is not supported—likely wrong.

# Scientific method example: Failure to toast

- VI. **Iterate** - The last step of the scientific method is to reflect on our results and use them to guide our next steps.



- ✓ In most cases, the scientific method is an **iterative process**. In other words, it's a cycle rather than a straight line. The result of **one go-round becomes feedback that improves the next round of questions**.



# RESEARCH

- ❖ Research involves many steps

- ❖ Problem definition
- ❖ Literature review
- ❖ Research Method
- ❖ Data collection
- ❖ Analysis
- ❖ Drawing inference – making hypothesis
- ❖ Arriving at the solution



Research Plan



## But First, Set Your Research Objectives

- ❖ It is very important to set your goals in your research specifies the objectives
- ❖ Objective should be **realistic, brief** and feasible to **achieve**
- ❖ First you should determine your primary research objective – **What you want to find out.**
  - ✓ **‘To explore the buyers’ journey when choosing a new service provider’**
- ❖ **Primary objectives are generic ones**
- ❖ You should then define several specific research objectives. These indicate research plans to investigate to achieve the primary objective
  - ✓ **To identify what factors are important for the providers**
- ❖ Sample statements
  - ✓ **To find the relationships between events, and factors that can influence the study under focus....!**



# SCOPE OF RESEARCH

- ❖ Define the scope of your research
- ❖ Define the **limitation** of your work in terms of constraints such as **time**, **budget** and etc.
- ❖ Sometimes, it also **includes** the **deliverable**
- ❖ This will help you to **prioritize** the **tasks**, and even can **avoid** some **issues** that are likely to **consume** much of your **time**

*Bottom-line: A streamlined investigation with well-defined boundaries will better serve you in the accomplishment of this goal than a study that is too broad or overly ambitious*



## Identify research problem

- I. Find the area of your interest
  - ✓ If you don't narrow down your initial research area of interest, you'll end up wanting to research everything
  - ✓ **Ask your advisors and other faculty** about possible topics or issues within your research area of interest
- II. Explore literature
  - ✓ **Read through a lot of research articles** in your research area – especially, the Conclusion and Future work section
  - ✓ Map out the Literature: Try to categorized your read, will help in article writing

**Note:** **choose issues because you find them deeply interesting**, not just because your advisor recommended them





## Problem Statement

Your problem statement must answer the 5W's and 1H.

1. Who?      Who has the problem?
2. What?     What is the problem?
3. When?     When does the problem occur?
4. Where?    Where does the problem occur?
5. Why?      Why does the problem occur?
6. How?      How does the problem occur?



## Problem Statement

Your problem statement must answer the 5W's and H.

1. Who? Who has the problem? (Content Provider)
2. What? What is the problem? (Congestion inside data center)
3. When? When does the problem occur? (Random Intervals)
4. Where? Where does the problem occur? (Entire data center)
5. Why? Why does the problem occur? (Large number of requests)
6. How? How does the problem occur? (Users generated multiple requests)

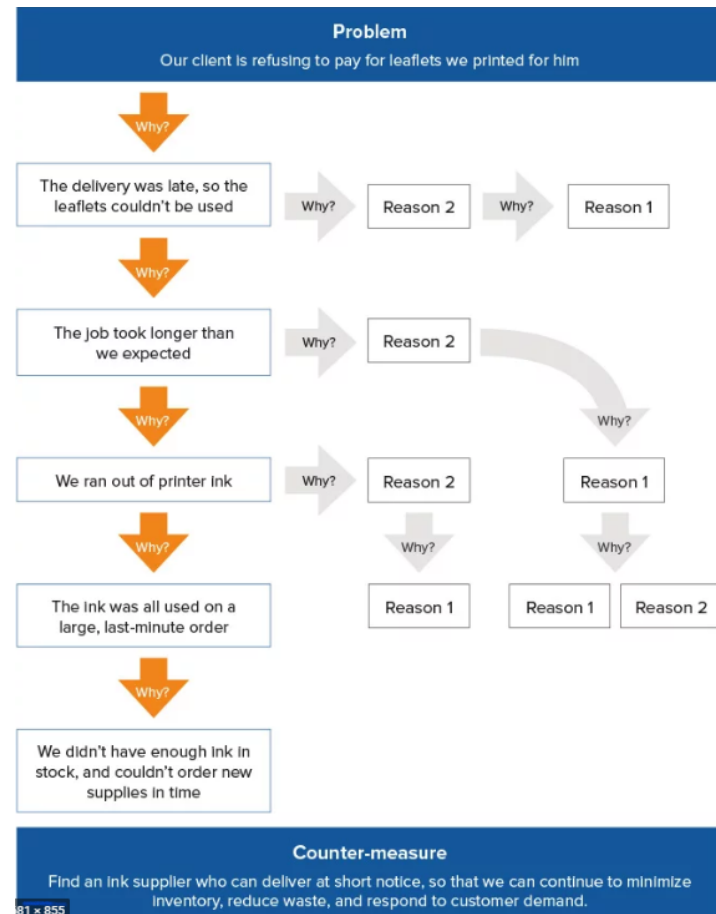
# Problem definition

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5. Why? Why does the problem occur?
6. How? How does the problem occur?

❖ At this stage write your problem statement.



# Problem definition

## Problem Scope



# Sample -1 (student)



## Problem statement

- Healthcare Data sets.
- Data Mining in Healthcare.
- Disease Prediction/Diagnosis/Treatment.
- Filtering and formatting.
- Filtering efficiency.


# Sample -2 (student)



## Problem statement

- Create a dataset of face images
- Extract face embeddings for each face in the image(again, using OpenCV)
- Train a model on top of the face embeddings
- Utilize OpenCV to recognize faces in images and video streams

# Sample -3 (student)



## Problem statement

- IoT is an emerging technology. In most of the industries are using IoT vastly due to its advantages. To improve performance in healthcare industry are also using IoMT. IoMT collect patient informations, processes it and distribute its to doctor, patients and other authorities on real time. Patients information is very attractive for the hackers.To prevent unauthorised access, all IoMT process have to be safe and secure. As people's lives are hanging on the line.



## Sample Problem statement

- Parallel discrete event simulation frameworks have been widely used to analyze the performance of traditional applications under different scenarios. The existing frameworks are designed to work on a cluster and cloud-based computing environments. With the current advances in the internet of things, there is a strong need to revamp such traditional frameworks and make use of the smart connected-devices as an underlying infrastructure to perform simulations.

M. Haseeb, Asad Waqar Malik, A. U. Rahman and M. M. Hamayun, "Towards Distributed Heterogeneous Simulation using Internet of Things," in *IEEE Internet of Things Journal*.





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- |    |        |   |
|----|--------|---|
| 1. | Who?   | Parallel discrete event simulation community                          |
| 2. | What?  | Traditional frameworks are designed for cluster and cloud environment |
| 3. | When?  | Adoption of Internet of Things (IoTs)                                 |
| 4. | Where? | For all simulation frameworks   |
| 5. | Why?   | To utilize the smart connected-devices for simulation                 |
| 6. | How?   | Due to diverse architecture   |



## Sample Problem statement

- Parallel discrete event simulation frameworks have been widely used to analyze the performance of traditional applications under different scenarios. The existing frameworks are designed to work on a cluster and cloud-based computing environments. With the current advances in the internet of things, there is a strong need to revamp such traditional frameworks and make use of the smart connected-devices as an underlying infrastructure to perform simulations (Angelo et al. 2018).