Mansoura University
Faculty of Computers and Information
Department of Information Technology

Research Methodology

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COURSE SYLLABUS

Chapter 1: What Is Research?

Chapter 2: How to Select Research Topics?

Chapter 3: Literature Review and Formulating a Problem

Chapter 4: How to Generate Research Ideas?

Chapter 5: How to Design Algorithms?

Chapter 6: How to Do Experiments?

Chapter 7: How to Write a Paper?

Chapter 8: Paper Submission and Publication

Chapter 9: Reference and Research Impact

Chapter 10: Resource, Advisor, and Time Management

CLASSROOM RULES

- ***Be on-time***.
- Enter the classroom in an ***orderly way*** and go straight to your seat and set according to the ***sticks*** on the seat.
- Put your ***mobile phone*** on silent mode during the class.
- No ***speaking*** without permission. Raise your ***hand*** if you have a question.
- No ***liquids or food*** in the classroom.
- ***Respect*** the teacher, classroom, and other students.

GRADING

- ***Semester work*** 25 (Midterm, participation, assignments…)
- ***Final:*** 75

Chapter 1

What Is Research?

DEFINITION

- There are different definitions to the term “research” which include:

> Creative and systematic work undertaken to increase the stock of knowledge

- The definition contains four key terms: ***creative,*** ***systematic,*** ***increase*** and ***stock of knowledge***.

DEFINITION --- CREATIVE

- Being "creative" refers to that:
  - The successful research must provide results that were not previously achieved via previous study.
  - Or, that the effort to be unique in a previously unexplored area.
- In the fields of science and engineering, there are three kinds of originalities that may be found:
  1. **New tools, approaches, or procedures should be implemented that have not been used before.**

     Here: To demonstrate why and how the suggested method is appropriate, evidence must be provided.
  2. **Investigate new fields.**

     A new method to addressing issues that have not been successfully handled or addressed by previous study.
  3. **Studying unexpected issues.**

     This originality allows researchers to investigate an established research subject using a novel method of investigation.

DEFINITION --- CREATIVE

- For project's outcomes, creativity and originality will be judged based on the *findings* and any unique by-products.
- Examples include:
  - ***Novel results of new products, theories, concepts, or techniques.***
  - ***Also, learning why a certain experiment failed or why a specific method did not work in a new setting is still considered innovative by-product.***

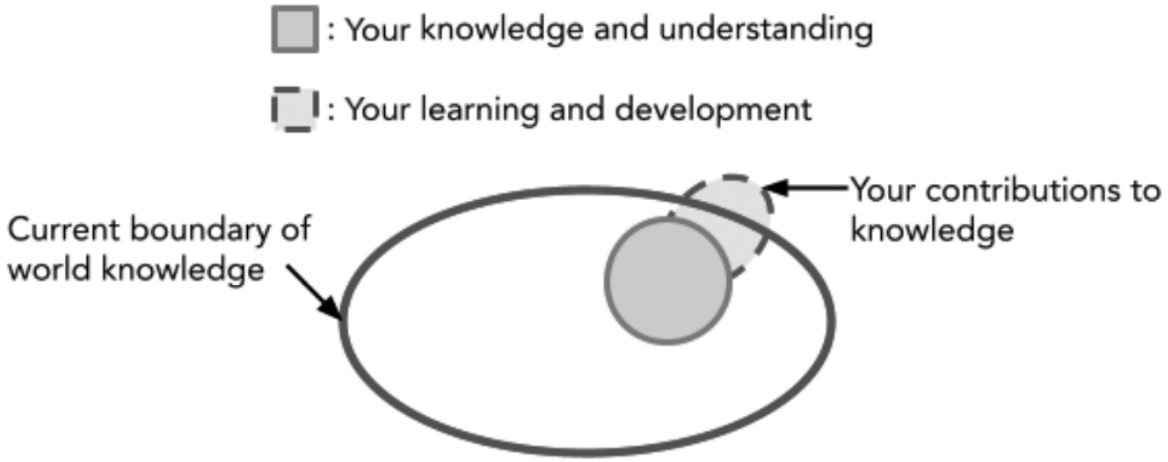
DEFINITION --- SYSTEMATIC

- Research must be a *deliberate activity* that adheres to a *well-established set of steps and procedures*.
- Following a systematic process for doing research may then directly:
  - *Transfer the creativity and knowledge into works* that have the potential to impact others, and
  - Are simple to follow for others to *replicate*.
- There, the typical studying steps in the science and engineering fields are:
  1. *Reviewing* the literature and *surveying* on a particular area/issue.
  2. Using your knowledge and actual data for *developing your own hypothesis*.
  3. *Testing the theory* (empirically or theoretically) with a comprehensive experimentation/implementation.
  4. *Reflecting on and integrating the resulting information* of your observations and *considering how your findings may affect others* in the domain.

DEFINITION --- INCREASE

- The phrase "increase" in the definition of research can be interpreted as "*contributing to knowledge*."
- Therefore, unless you communicate the information that you obtained from your studying/learning with others, the findings of your study are essentially pointless.
- Accordingly, the word "contribute" mean that the research should contribute to global knowledge so that it is available to everyone, rather than just the researchers themselves.

DEFINITION --- INCREASE (CONT.)



- The figure shows the world's body of knowledge and the many ways in which contributions may be made to it.
  - According to the figure, your own knowledge, which is represented by the dark area, is absorbed inside this domain.
  - When you learn things that others already know, this allows you to broaden your own knowledge, as shown by the bright area inside the bounding box.
  - Then, your study may result in contributions to global knowledge, in the form of inventions, new theories, and other innovations, This causes bright area to extend beyond the border through adding to the global body of knowledge.

DEFINITION --- THE STOCK OF KNOWLEDGE

- Discussing the meaning of the stock of knowledge can be represented in terms of a hierarchy consisting of *data, information, knowledge, and wisdom* where they are:

1. **Data**: the factual components that describe things or events that take place under particular conditions.

Ex: you may be required to gather pictures of cats from various sources online in your research work where the information you gathered may have originated from a variety of sources, including various breeds and images of varied sizes. Here, the raw pictures that, in their current state, signify practically nothing.

DEFINITION --- THE STOCK OF KNOWLEDGE (CONT.)

- Discussing the meaning of the stock of knowledge can be represented in terms of a hierarchy consisting of *data, information, knowledge, and wisdom* where they are:

2. **Information:** represents data that has been processed in order to give some insight into the significance of it (i.e., preprocessing the data, examining it, summarizing it, and otherwise processing it into a more intelligible and usable manner).

Ex: Returning to the cat example, processing the pictures into something useful may lead to the identification of various cat kinds and patterns, the identification of the most significant differences between each cat species, etc.

DEFINITION --- THE STOCK OF KNOWLEDGE (CONT.)

- Discussing the meaning of the stock of knowledge can be represented in terms of a hierarchy consisting of *data, information, knowledge, and wisdom* where they are:

3. **Knowledge:** represents more in-depth knowledge of a subject or situation.

   While information provides you with a grasp of the "what" (i.e., what is occurring), knowledge reflects your comprehension of the "why."

   Knowledge is the interpretation of what you learn through information in the form of rules, patterns, etc.

Ex: In the cat example, your knowledge about them will provide you a general idea of what you're getting at with your comprehension. For example, why the samples of each breed of cat collected are of different sizes, etc.

DEFINITION --- THE STOCK OF KNOWLEDGE (CONT.)

- Discussing the meaning of the stock of knowledge can be represented in terms of a hierarchy consisting of *data, information, knowledge, and wisdom* where they are:

4. **Wisdom:** represents the capacity to use your abilities and experiences in new ways to generate new knowledge and adapt to new circumstances.

Ex: In the cat example, wisdom can reflect your capacity to extend your investigations to other objects such as dog classification models, among other things.

DEFINITION --- THE STOCK OF KNOWLEDGE (CONT.)

- Notes:
  - The act of *collecting data and information* on one's own is referred to as "*intelligence gathering*."
    - Such collection can help in answering issues such as *what is going on in the world*, *what we don't know*, and *what we can find out,* etc.
  - On the other hand, *research* must go beyond just collecting data and must also *explain what you observe* (e.g., using explanations, connections, analogies, generalizations, and hypotheses, etc.).
    - It is required to *make an addition to the existing body of knowledge*.
  - Therefore, while facts and information may only answer the question "what?", knowledge and insight can answer the question "why?

REFERENCES

- Meikang Qiu, Han Qiu, Yi Zeng. Research and Technical Writing for Science and Engineering. CRC Press, 2022.

Thank you ☺