Introduction to Research in Computing

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Workshop on research

CIIC 8996
February 23, 2011
10:30am to 12:00, S229
Present yourself

- Name
- Short bio
  - Where are you from
  - Degree/degrees
  - Area of research
- What do you expect from CIIC 8996
Objective

- Students will understand the fundamental concepts and competencies required for computing research.
- Students will understand the scope of their own individual research project.
Genius?

- “You don't have to be a genius to do well in graduate school. You must be reasonably intelligent, but after a certain point, I think other traits become more important in determining success.”

"Everything I wanted to know about C.S. graduate school at the beginning but didn't learn until later." by Ronald T. Azuma, v. 1.08, 2003
Which traits?

- **Traits**
  - Mental toughness
  - Self-reliance
  - Desire to excel
  - Commitment to scholarship

- The successful graduate student is one who possesses both the intellectual abilities and the necessary personal characteristics.
"In sum, graduate work takes initiative, independence, perseverance, acceptance of responsibility, and a general freedom from emotional conflict and anxiety. The benefits of going to graduate school, especially a top-ranked school, are enormous, but they demand a high price in sweat and anxiety...Succeeding in graduate school requires years of single-minded dedication, much energy, individual initiative, and responsible independent study. We wish you well!" (Fretz and Stang, 1980).
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Do you have those traits?

- Yes
  - Great! You are going to finish in no time.
Do you have those traits?

- Yes
  - Great! You are going to finish in no time.
- No
  - Did you truly believe those who said yes?
Essential Features in Research

- Read scientific literature
- Work independently
- Use of careful and reproducible techniques
- Oral communication
- Written communication
- Meaningful and focused research question
  - Strive to produce a significant finding
- State of the art environment
- Professional meetings

Lopatto, March 03
Two aspects

- **Technical**
  - Understanding scientific method
  - In depth knowledge on the topic
    - Understanding of the issues
  - State of the art
  - Lab skills

- **Soft skills**
  - Time management abilities
    - Courses vs research
  - Good communication skills
    - Oral
    - Written
  - Problem solving
  - Working under pressure
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How do you know things?

- You know
  - The world is round.
  - It is cold on the dark side of the moon.
  - Vitamin C prevents colds.
- How do you know things?
  - At some point everybody knew that the world was “flat”.
Example
Example

Maguey worm: are two varieties of edible caterpillars that infest maguey and Agave tequilana plants. .... They are also considered delicious deep fried or braised, seasoned with a spicy sauce and served in a tortilla.
Questions

- Are worms “really” good or bad to eat?
  - How do you know what is really true?
- Looking for reality
  - Tricky business
  - Epistemology or theory of knowledge is the branch of philosophy that studies the nature, methods, limitations, and validity of knowledge and belief.
Preposition

Truth

Knowledge

Beliefs
Knowledge = justified true belief

See Edmund Gettier for another definition
The four canons of science

- **Determinism**
  - The universe is orderly
  - All events have meaningful, systematic causes

- **Empiricism**
  - The best way to find out how the world works is to make observations.

- **Parsimony**
  - Facing with two competing theories that do an equally good job of handling a set of empirical observations, we should prefer the simpler one.

- **Testability**
  - Theories can be tested.
    - Confirmable or disconfirmable using current available research techniques.

Pelham & Blanton, 2003
Knowing about the world

- Authority
- Intuition
- Logic
- Observation

How would you know if eating worms is good for you?
How do we find out?

- **Scientific Discovery**
  - **Law**
    - Universal statement of the nature of things that allows reliable predictions of future events
  - **Theories**
    - General statement about the relation of two or more variables
  - **Hypotheses**
    - Predictions about specific events that are derived from one or more theories.
Hypotheses

- A prediction, stemming from a theory, stated in a way that allows it to be tested.
  - Help to test the validity of theories
  - Question
    - What is the best way to study for a test?
      - Cramming the night before the exam
      - Study over several nights
  - How are questions answered?
    - Research
Research

- Systematic inquiry aimed at the discovery of new knowledge.
  - Operationalization
    - The process of translating a hypothesis into specific testable procedures that can be measured and observed.
Scientific Method

- The approach used to systematically acquire knowledge and understanding about the phenomena of interest

Identify questions of interest

Formulate an explanation
- Specify a theory
- Develop a hypothesis

Carry out research
- Operationalize hypothesis
- Select a research method
- Collect the data
- Analyze the data
The Research Process

Conceptualization
Specify the meaning of the concepts and variables to be studied

Choice of Research Method
Experiments
Case Study
Correlational, etc.

Sampling
What system are we studying?
What will be observed?
How many instances?

Operationalization
How will we actually measure the variables under study?

Observations
Collecting data for analysis and interpretation

Data Processing
Transforming the data collected into a form appropriate for manipulation and analysis

Analysis
Analyzing the data and drawing conclusions

Application
Report Results and assess implications

From E. Babble
Conceptualization

- A **concept** is an *abstract idea* or a mental symbol, typically associated with a corresponding representation in and *language* or *symbology*, that denotes all of the objects in a given *category* or *class* of entities, *interactions*, *phenomena*, or relationships between them.

- Conceptualization – the process of coming to an agreement of the meaning of a term

- Creating a conceptual order
  - Cognitive map
Cognitive maps are a method we use to structure and store spatial knowledge, allowing the "mind's eye" to visualize images in order to reduce cognitive load, and enhance recall and learning of information.

- Cognitive maps can be represented and assessed on paper through a concept map, or any variety of spatial representation.
Exercise

- In a piece of paper
- Write the title of your research
- Write the question of interest associated to your research
- Draw a concept map or visual map of the concepts associated to your research work
References

- Richard St. John, Stupid, Ugly, Unlucky and RICH: What really leads to success
- Research Concepts by Chris Jones and Xiaoping Jia, presentation
- Time Management by Kathleen Riepe, presentation
- Seely, John, Oxford Guide to Effective Writing and Speaking, Oxford University Press, 2005
References

- First Things First, Steven Covey. Simon/ Schuster. 1994
- Everything I wanted to know about C.S. graduate school at the beginning but didn’t learn until later. by Ronald T. Azuma, v. 1.08, 2003
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Questions?

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