

# CISC-810: Research Foundations

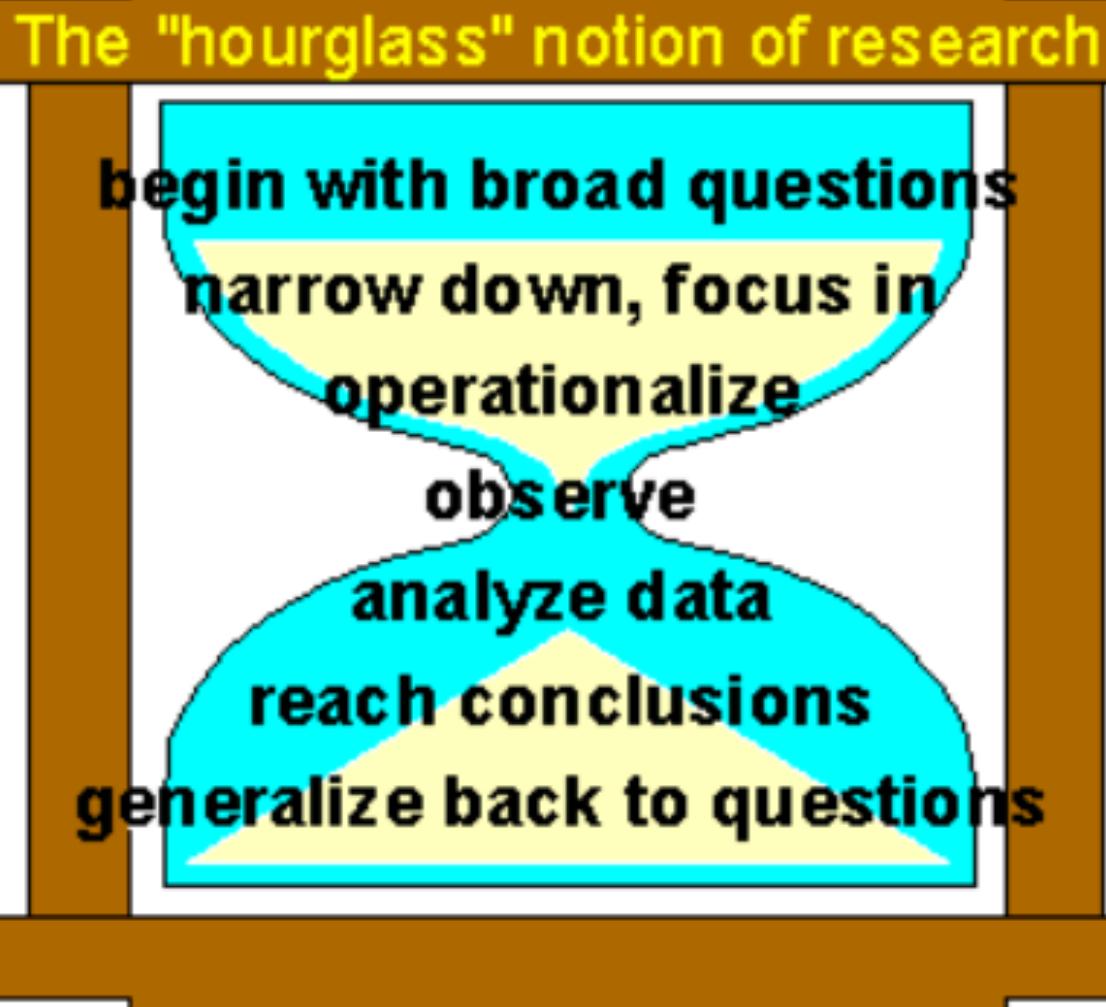
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# Research: a creative process

- Not procedural
- Not linear, although often reported in a linear fashion
- Starts and stops, jumps, intuitions, changes
- **Important:** there is no perfect research process.

## The "hourglass" notion of research



The diagram illustrates the "hourglass" notion of research as a process flow. It features a central white area framed by two thick brown vertical bars. Inside this frame, a blue hourglass shape is centered. The top bulb of the hourglass contains the text "begin with broad questions". The narrow neck of the hourglass contains the text "narrow down, focus in". The bottom bulb of the hourglass contains the text "generalize back to questions". The central vertical axis of the hourglass is labeled with the steps: "operationalize", "observe", and "analyze data", stacked vertically from top to bottom.

**begin with broad questions**

**narrow down, focus in**

**operationalize**

**observe**

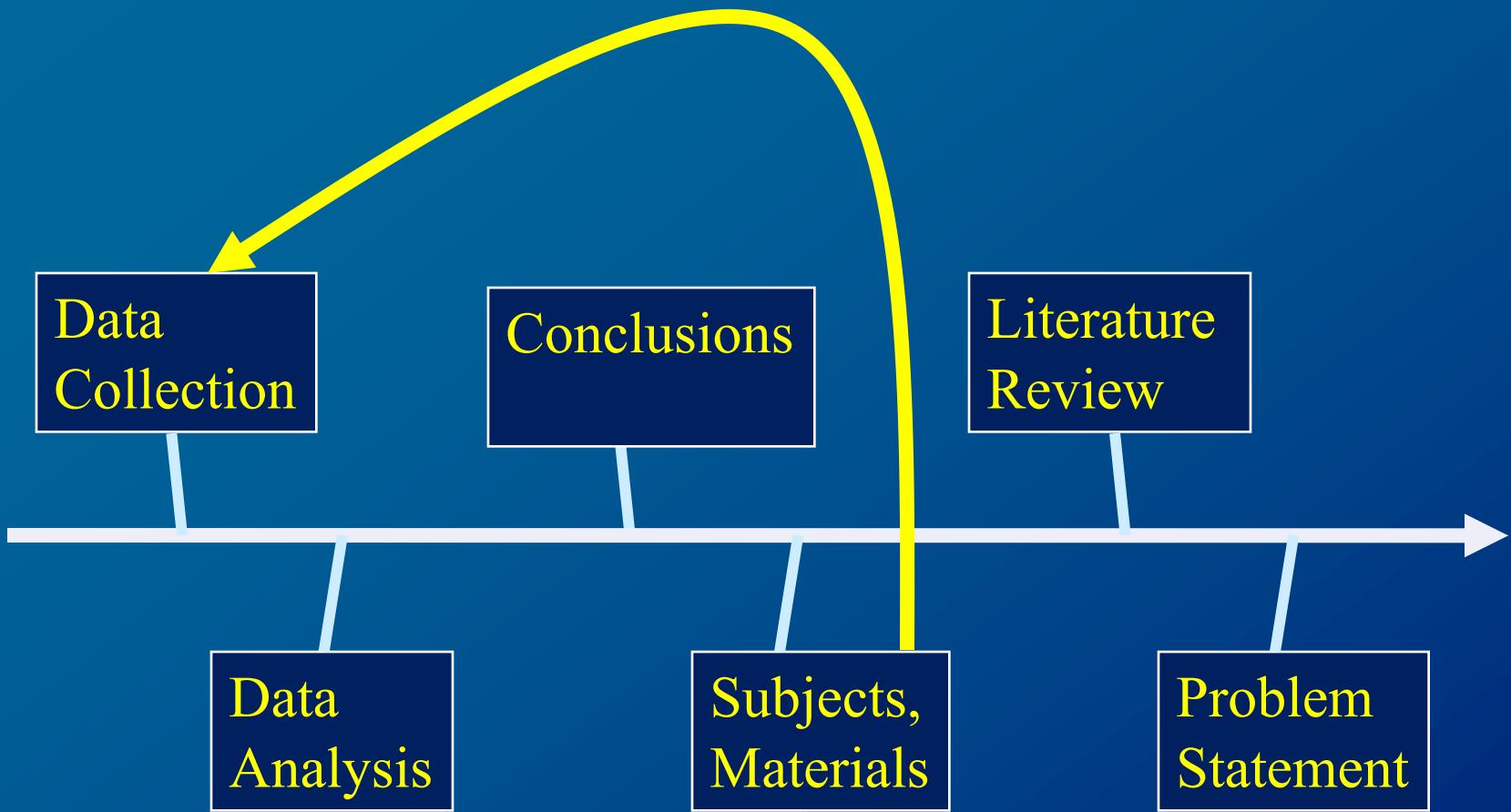
**analyze data**

**reach conclusions**

**generalize back to questions**



The *linear* illusion of research



Other possibilities of being *productively lost*

How do I tie this  
to something  
important

What compromise  
with materials is  
credible  
or possible

What analysis  
is necessary and  
convincing



What has been  
written in this  
journal

How can I get  
the data  
quickly, cheaply,  
within budget?

What do I  
want to  
conclude?

In actual planning, we might very well start from  
the end – *backtracking*!

# Essential Skills

- Analytic/Critical Thinking
- Creative Synthesis: big pictures and small details
- Statistics (maybe sometimes less universally required: *advanced mathematics*): data is the new KING!
- Writing and Presenting: you are what you can communicate
- Project/Time Management

Clarity of thought and precision of expression

# We said...

- Finding, describing, framing to clearly and credibly answer a question (or set of questions)

# Purpose of Research

- Gaining *understanding* of a phenomenon
- Add pieces to the puzzle of:
  - Description: what is happening
  - Explanation: formulate theories, rules
  - Prediction: do they hold, under what circumstances
  - Control: creating mechanisms to dictate a *desirable* outcome

# Usually

- Gathering data in a specific situations (early) with the intent of generalizing to *other or all situations* (later)

***Nomothetic***

*(relating to the study or discovery of general scientific laws)*

- What makes that leap of faith sensible?
  - Logic (what claims can we make)
  - *Statistics* (probabilistic thinking)

# Search for the *Truth*

- Almost always a *relative term*
- Truth is what is currently agreed upon by *experts*
- *Truth* is inevitably wrong to varying degrees
- You can almost always do better ☺

# Consensus on the *Truth*

- A *game* of getting *experts* to agree with you
- Generally, you have to work within the existing system to be credible
- Why would people protect *un-truth*?
  - The age of fake news / alternative facts ☹



# Every Question, Every Field is Different. But ...

- CS, Gaming, IT, Security, SE, ...
- Merging and splitting
- Things come and go out fashion: AI

How to best situate yourself for *your* opportunities regardless your field of interests

# Paradigms

- *The Structure of Scientific Revolutions*  
Thomas Kuhn (1962):
  - Normal science: things move along incrementally
  - Revolutionary science: there are great changes in thinking and the *truth*
- Paradigm shift:
  - new way of seeing things
  - new questions and new approaches

# Paradigm Shift

- Ptolemy – 100 AD, earth centric, but fairly accurate
- Copernicus – 1500, sun centered
- Galileo – early 1600's existence of Jupiter moons, contradicted Ptolemy
- Kepler – ellipsoidal orbits, accurate predictions
- Newton 1600 – physical laws / gravitation

# Perhaps ...

- Computer as a number crunching device
- Computer as a communications (bit-sharing) device
- Computer as a portal to information
- Computer as a ubiquitous component of everything ...

# Homework

- Reading: *Trochim & Donnelly*
  - Foundations:
    - . Ethics in Research

# Homework

- Cooking assignment #2:
  - Just like the last time, cook your favorite dish! However, this time, find a recipe (from anywhere) that is not your own.
  - Materials, recipe, *actual cooking process*
  - How does it taste? Good, bad, potential areas of improvement *according to your taste.*
  - Write it up.
  - Due date: September 1.