# A Framework for Research

CS 7123, Spring 2025

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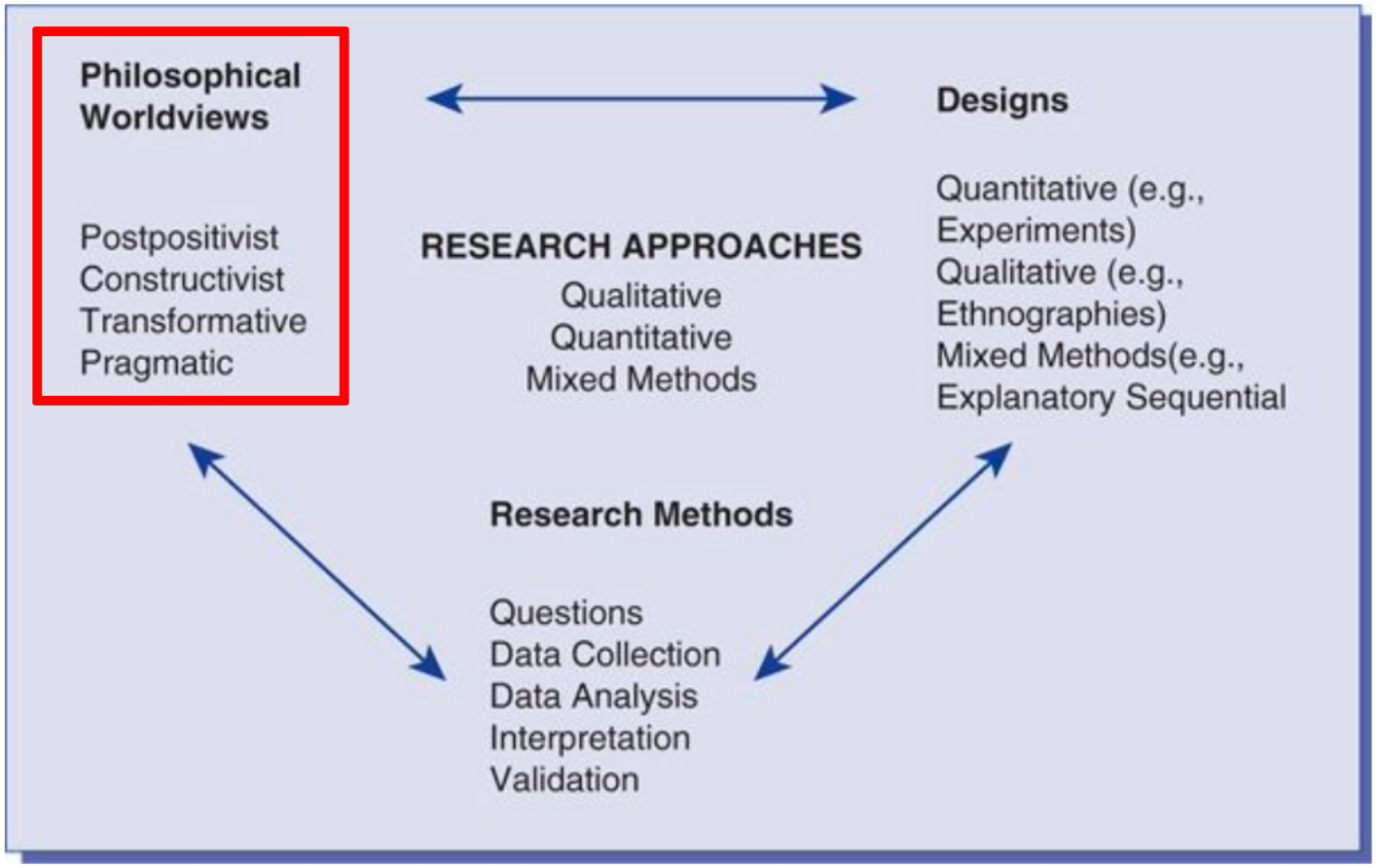
Used/adopted materials from Slides of the “Research Design: Interdisciplinary Research Methods for Information Sciences and Technology” course, taught by Prof. Dongwon Lee, at Pennsylvania State University

# Agenda

- A Framework for Research
- Course Report

# A framework for Research




Source: Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, by John W. Creswell and J. David Creswell

# Orienting with research worldviews

**Post-positivism**
- Determination
- Reductionism
- Empirical work
- Theory testing

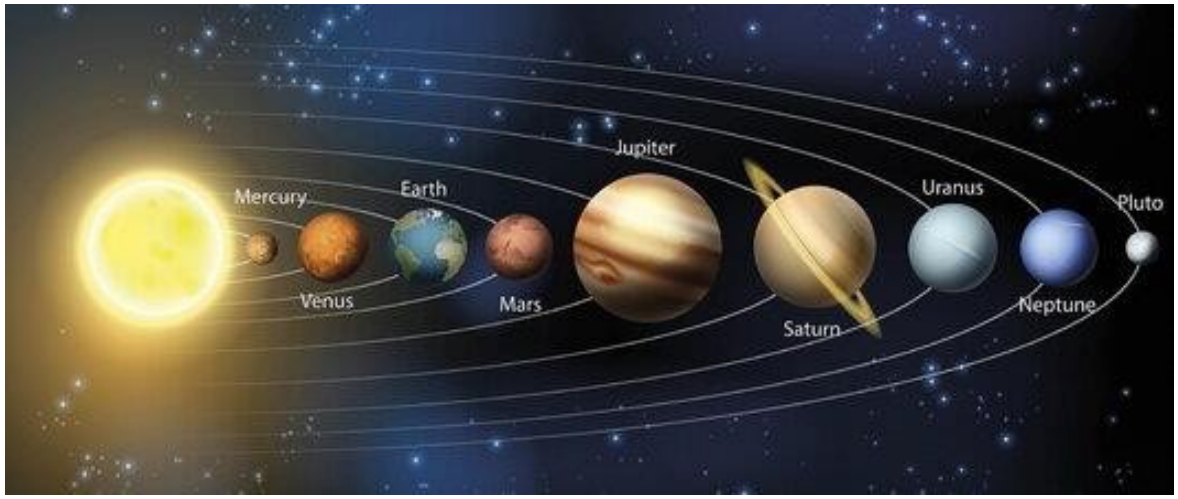
**Constructivism**
- Understanding
- Multiple meanings
- Social/historical
- Theory generation

**Transformative**
- Political
- Power and justice
- Collaborative
- Change oriented

**Pragmatic**
- Consequences matter
- Problem is focus
- Multiple groundings
- Real-world practices

*Adapted from the book* Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, by John W. Creswell and J. David Creswell

# 1) Post-positivism




- Positivism: I can observe and experiment to fully understand and create knowledge about the Solar system (inductive process)

- Post-positivism: Through observation and experimentation, it is highly likely that I can gain knowledge about the Solar system. However, in future, my knowledge can be falsified through further research

  (deductive process)

# 1) Post-positivism

- Conventional view, often referred to as *scientific method*
  - Conventional in that theory testing is the guiding star
- Experimental design is fundamental: cause ➔ effect
  - What you learn is only as solid as the methods you define for collecting and analyzing data (operationalization of concepts)
- Theory + experimental design produce testable hypotheses
  - Often don't "prove" hypotheses; rather reject null hypothesis
  - Empirical results refine theory or create new theory

# Post-positivism grounded on normal science

*(c.f. Thomas Kuhn and his followers)*

- Scientific communities develop from shared belief structures
  - Scientific "knowledge" is fully mediated by the sociology and psychology of the academic world
  - Highly regarded academic researchers serve as thought leaders
  - Sharing of science values, methods, language, activities: *paradigms*
  - These commitments are passed on to students, who follow same paths
- Mature science is "normal science" for puzzle-solving
  - Kuhn notes that scientists mostly apply theories to think about new problems, rather than throwing theories out
- But emergent crises ➔ paradigm shift (scientific revolution)
  - E.g., multiple credible datasets that do not fit, in similar ways

# 2) Constructivism

- Meaning and understanding is subjective, constructed by individuals as they interact with objects and other people
  - Goal of the researcher is to evoke these varied understandings
- Grasping the real world, historical and social context of a research setting is essential
  - Contrast to "controlling" the context via experimental design
  - Explicit acknowledgement of researcher's own interpretive context
- Theories may be held, but they are not tested
  - Instead, they are emergent and used for explanatory purposes
  - Emphasis always on *making sense* of research participants' understandings and interactions (member checking is common)

# 2) Constructivism

- Positivism: knowledge exists outside of the self, and can only be derived through observation and prediction

- Constructivism: knowledge exists within the self and is constructed by individuals as they interact with themselves and with their environment
  - Many realities depending on the contexts ➔ Relativistic

# 3) Transformative approach

- Builds on interpretivist methods, but goes further, seeking to change the status quo
  - May also use a critical theory lens to propose and guide change
  - Research participants often are those who have been ignored
- The research framing includes an *agenda for change*
  - Start with recognized problem, interpret using theory or empirical findings, intervene and study the process
- Role of theory is to explain current problematic setting and to make sense of useful interventions

# 4) The pragmatic worldview

- Focus shifts from theories or accepted methods to desired outcomes or action – "applied" science
  - Eclectic, in that a given project may draw from different theories or models, guided by overarching goal to solve the problem
  - Mixed methods are the norm, with emphasis is on how the different sources of data complement each other
  - Continued focus is on producing the desired outcome

- Goal is for less concern about "what is truth" in favor of more concern for "what makes sense now"

# 4) The pragmatic worldview

- Pragmatic theory of knowledge

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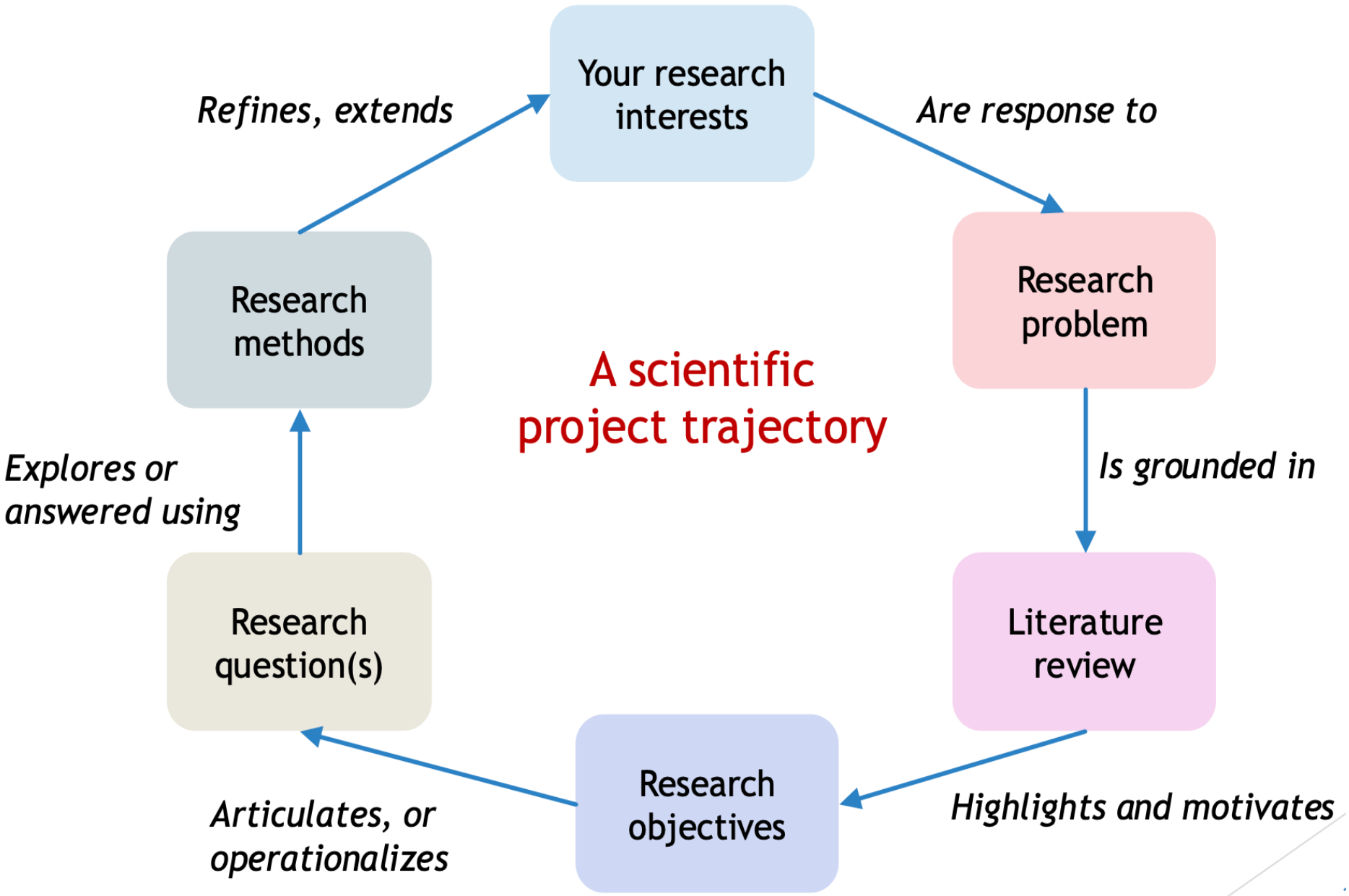
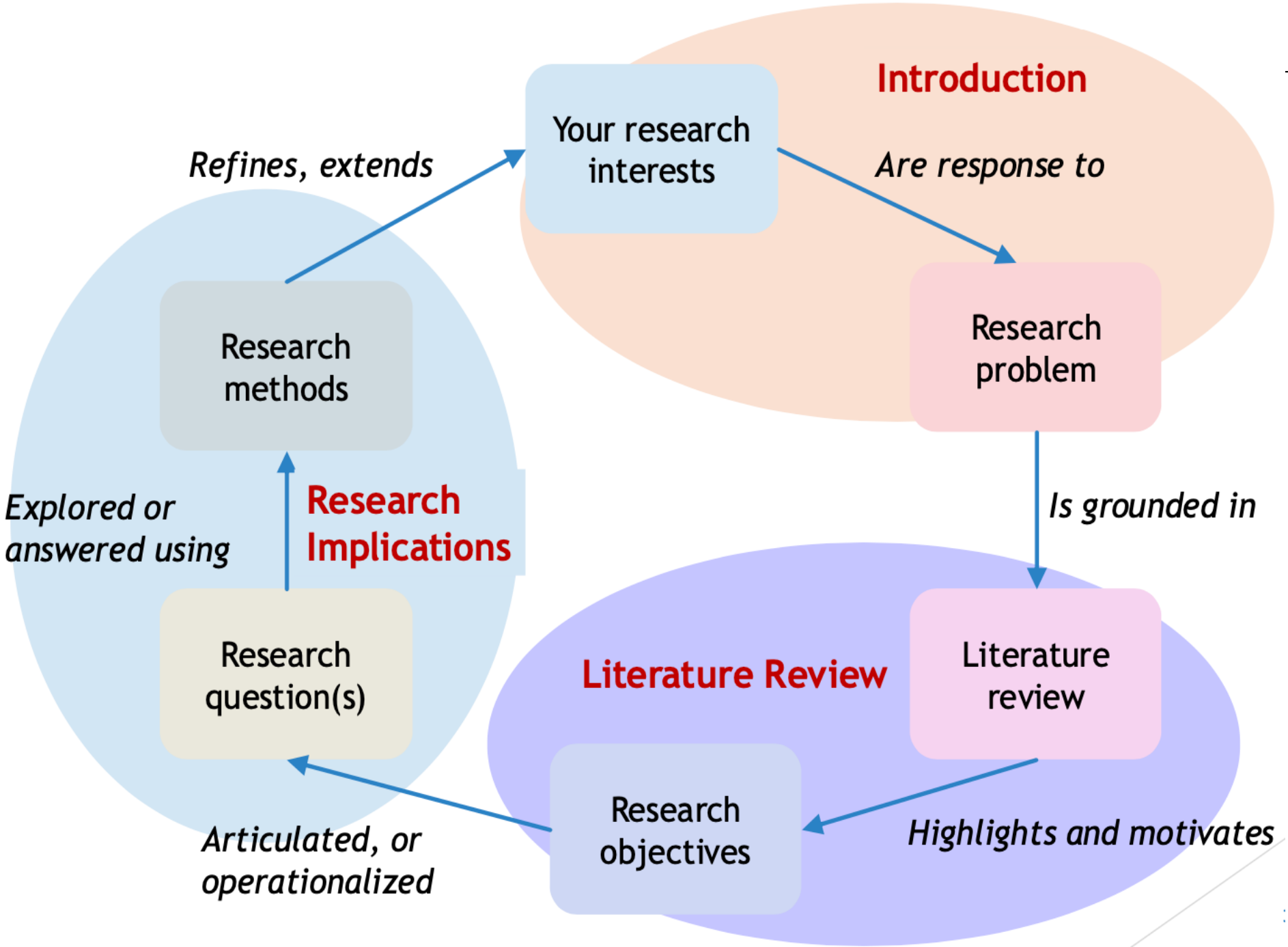

A scientific project trajectory
Your research interests
Are response to
Research problem
Is grounded in
Literature review
Highlights and motivates
Research objectives
Articulates, or operationalizes
Research question(s)
Explores or answered using
Research methods
Refines, extends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# How to choose a topic?

*For those of you who are still wondering…*

- Try asking yourself a question about your interest
  - What do you want to study? "My research is about…"
- Then, find out how it (or related stuff) has been studied before
  - Skim a bunch of related papers, approaches: how might you go beyond what has been done?
- Consider carefully not just whether a project *could* be done on the topic, but whether it *should*
  - Will it contribute to the literature? Will anyone care?
  - This may not become obvious until later in the process!
- Draft a title, summary of ideas to make ideas more concrete
  - Keep it brief, eliminate unnecessary overhead

# Synthesizing relevant literature

***For course report, minimum of 15 published/peer-reviewed papers (no arxiv preprints)***

- What is your favorite way to find more relevant literature?
  - Ask your advisor
  - Look at the reference of your favorite article
  - What else?

# Synthesizing relevant literature

- Use search tool for systematic retrieval (eg, lib tool, Google Scholar, Microsoft Academic, DBLP)
  - Prior literature review may help to organize, but just as a start
  - Find gaps and inconsistencies, *judgement* of important papers
  - Iterate: as you learn more, go back and expand terms
- Find key papers in the field and see who cites them
- Try to identify most important authors/labs, see what they post as current work
  - Eg, Are you aware of the authors/labs at forefront of the research problem you are interested in?

# Report components

- Title Page
- Abstract (will evolve from plan ➔ summary)
- Introduction
- Literature Review
  - Subsections with **meaningful headings** chosen to highlight core issues
  - Final subsection should summarize conclusions from review
- Research Proposal/Methods/Implications/etc
  - Research questions, hypotheses (if appropriate), research methods to use
- Expected Contributions
- References

*No specific formatting requirements, but strongly recommend using UTSA Thesis template*

# Incremental development

- Draft a title, a planning abstract
- Find the literature and work out an argument: Draft a compelling Introduction, and Bibliography
- Fill in the rest: Complete first draft
- Respond to feedback, refine: Final report

# Abstract

- Note that in the first assignment, the abstract is used as a planning aid, not as a summary
  - Emphasis on problem, its importance, and how you will be developing the course report

- As part of your first draft, revise the Abstract to fit:
  - State the problem and why it is important
  - Briefly summarize state-of-the art in the areas you have covered in the Literature Review section
  - Briefly summarize your research objectives and the methods proposed in the Research Implications section
  - Conclude with a brief statement of the possible impacts described in your Expected Contributions section

# Introduction

- Start with a compelling call to action
  - May follow prior work, but may also be a societal issue
- Briefly summarize state of current relevant knowledge
  - Use inline definitions of technical terms
  - May also reference state-of-the-art technology
- Draw conclusions from the brief review
  - Are there gaps or critical flaws?
  - Opportunities for novel directions? Refinements?
  - Emphasize significance of your conclusions
- Finish with concise statement of research needed
  - This is a preview or advance organizer for what is ahead

# Literature Review

- Should have headings, subheadings that show your “logic”
- May want preliminary subsection with definitions if jargon used
  - Always spell out acronyms on first use, unless in common use
- Avoid the simplistic approach of summarizing
  - Build *on top of* related work; your job is to push on the boundaries
  - The best reports will include visual aids, e.g., conceptual map or table
- End review with Research Objectives subsection
  - Explain how your objectives build on top of the literature

# Research Implications

- Introductory paragraph reminding the reader about your research objectives and presenting research questions
- Transition to set up the rest of the section – the types of methods you are about to propose
- Separate subsections for different types of methods, including subsubsections as needed for more details
  - Be sure to give rationale for choice of methods
  - Feel free to use additional references that have introduced, defined, or applied these methods

# Expected Contributions

- Begin with introductory paragraph summarizing your research objectives and general approach

- Then, follow the NSF proposal expectations:
  - One subsection that discusses the Scientific Merit of the work you propose to do: how/what will it contribute to published research?
  - A second that discusses the Broader Impacts: how/what will it contribute to society (e.g., economy, education, social justice, policy, government, and so on)?

# References

- Include any paper you cite in the report
- All references must be complete (author(s), date, title, venue, etc.)
- References must be listed (and cited in text) following APA style guidelines
  - Please both alphabetize and number them in the listing, but use APA convention for referring in the text

# References

- In-reference style example
  - Duckworth, A. L., Quirk, A., Gallop, R., Hoyle, R. H., Kelly, D. R., & Matthews, M. D. (2019). Cognitive and noncognitive predictors of success. *Proceedings of the National Academy of Sciences, USA*, *116*(47), 23499–23504.
  - "(Duckworth et al., 2019) first proposed …"
- Use bibliography tool
- Eg, LaTeX package
  - \usepackage{apacite} ...
  - \cite{} …
  - \bibliographystyle{apacite}
  - \bibliography{mybib.bib}
- https://apastyle.apa.org/style-grammar-guidelines/paper-format/sample-papers