Literature Reviews and Selling Ideas
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The CMU centers for:
Informed DEmocracy And Social cyber-security
Computational Analysis of Social and Organizational Systems

Literature Review for a Scientific Paper

- Sets the ground work for what is critical and new in presenting your new scientific work.
- This is typically short 2-4 pages
- In CS often have 10 or so studies, many more in some fields
- But literature is used throughout paper
Importance of Lit Review in Paper

- Demonstrates your understanding/mastery
  - Outlines important research trends
  - Assesses the strengths and weaknesses of existing research
  - Identifies potential gaps in knowledge
- Establishes a need for current and/or future research projects
- Locates your work or agenda within the literature

Importance of Citing Others Outside of Lit Review

- INTRO
  - Establishes potential impact of this research
  - Why is this important to the general public
- DATA or METHODS
  - Gives credit to others for data, algorithms, theory
  - Comparison with your data or algorithm
- Summary or Future Directions
  - Why your work confirms x’s work
  - Confirmation that next step is critical
High Level Guide

- Introduce the literature review by describing the major research topic
- Identify the broad problem area in a meaningful way (not too broad, not too specific)
- Describe why audience should care about this topic
- Don’t try to cover everything written on your topic
- Select the research most relevant to the topic of the paper
- You will use the studies in your literature review as “evidence” that your research is important and your findings relevant

The Scientific Paper (home for the lit review)

- Closes gaps in the research;
- Tests an aspect of a theory;
- Replicates an important study;
- Retests a hypothesis with a new or improved methodology;
- Resolves conflicts in the field;
- Creates original research (this is rare).

- Your lit review should be oriented to support the type of paper
Core Idea

- Core statement goes here.
- Describe the area that your project is addressing.
  - Briefly describe the connection to improving an area
  - Briefly describe what is not known - the open question that needs resolving.

Core Idea Cont.

- Core Statement Example: “We will put a man on the moon and return him safely by the end of the decade”
  - This may be the hardest part of this briefing
  - Keep this to one or two sentences as illustrated by the example above (perhaps with a graphic).
    - Straightforward and simple
    - Concrete: actions, behaviors, artifacts
    - Self testing
    - Tell a story
  - Recommended reading: “Made to Stick: Why Some Ideas Survive and Others Die” by Chip Heath & Dan Heath
Describe the Area

- Describing the area – what is the newness of your approach
- Whether you are discovering new information or developing a new widget, it needs to be improving how some operation is done today.
  - Here is where you get to introduce that connection.
  - Use single short narrative statements.

What are you trying to improve

- How does the operational or institutional element that you are addressing get it done today?
- Who does it?
- What are the limitations & problems of the present approaches?
- This is further setup for describing the newness of your approach and is key to evaluation by reviewers
What is new

- What recent changes in the scientific or technological environment are enabling the field to successfully address this problem now?
- How has the field advantage of that recently developed information, technology, theory, integration to address the limitations and problems of the present approaches?
- Upon whose shoulders are you and the field standing? What is enabling the field to move to the next level?

Novelty Claims example

- Example:
  - Recent advances in agent-based models will allow us to model known individual cognitive processes into software agents.
  - Executing these agents in a simulation model will generate more realistic group behavior.
  - This will allow us to forecast group behavior more accurately in response to an influence message.
  - A wide range of messages can be tested against a wide range of plausible agent characteristics
Evidence that concepts have been appropriately synthesized

- Major theoretical concept underlying this review
  - A plain language description of the theoretical concept
  - Reference refereed publications of concept
  - Concrete example(s) of how you have implemented this construct in your model or process
- Next major theoretical concept ...

Evidence that concepts and constructs are appropriately applied to a domain

- What are is the field trying to model or process?
- Concrete examples of how real world information, entities, actions are being translated into computational parameters and values {Subject Matter Experts, Statistics, other …}
  - How is a translation being verified
- Concrete examples of how results from the model or process will affect outcomes or analysis procedures
Gaps

- When all is said and done
  - What is critical that has not been done
  - Why should this be done? What are the payoffs
- 5/10 year plan
  - What is likely or should happen in next few years

Literature Reviews are Arguments

- All sources cited in the literature review should be listed in the references
- A literature review should include introduction, summary and critique of journal articles and books, justifications for your research project and the hypothesis for your research project
- After reviewing the literature, summarize what has been done, what has not been done, and what needs to be done
- Remember you are arguing why your study is important!
- Note: any formal research question or hypothesis needs to be clearly linked to your literature review
Do Literature Reviews with A Purpose

- Start with a good outline.
- Have at least:
  - An introduction that establishes the importance of the topic, the scope of the review, and the organization of the paper;
  - The major section headers and sub-sections that follow the same organization as the organization established in the introduction;
  - Summary of findings, implications of findings, and discussion.

How Far Back to Search

- Depends on field
- Depends on type of review – type 1 more recent articles, type 2 include more historical articles
- For articles found consider:
  - Is it current?
  - Have the claims, evidence, or arguments been superseded
  - Is it a citation classic or critical for historical background
Four Analysis Tasks in the Literature Review

- Summarize
- Synthesize
- Critique
- Compare

Summarize & Synthesize

In your own words, summarize and/or synthesize the key findings relevant to your study.

- What do we know about the immediate area?
- What are the key arguments, key characteristics, key concepts or key figures?
- What are the existing debates/theories?
- What common methodologies are used?
- What are common assumptions about data? Model parameters? …
Illustrative phrases

- has demonstrated, failed to demonstrate
- is concerned with, deals with, describes
- compared to, contrasting
- the first one to
- later approach, extended, altered, changed, revised

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Compare & Critique

- Evaluates the strength and weaknesses of the work:
  - What specific claims are made?
  - What specific conclusions are drawn?
  - Are they warranted by the evidence?
  - How does this article, argument, theory, etc., relate to other work?
  - Are they stated clearly?
  - What support is given for those claims?
    - What evidence, and what type is offered?
  - Is the evidence relevant? Sufficient?
    - What is the source of the evidence or other information?
    - The author’s own experiments, surveys, etc.? Government documents?
    - How reliable are the sources?
Compare & Critique Cont.

- What arguments are given?
- Does the author take into account contrary or conflicting evidence and arguments?
- How does the author address disagreements with other researchers?
- What assumptions are made and are they warranted?
- How do the different studies relate? What is new, different, or controversial?
- What views need further testing?
- What evidence is lacking, inconclusive, contradicting, or too limited?
- What research designs or methods seem unsatisfactory?

Adjectives to use in Comparison and Critique

- Unusual
- Small, Large
- Simple
- Exploratory, Comprehensive
- Limited
- Restricted
- Flawed
- Complex
- Competent
- Important
- Innovative
- Impressive
- Useful
- Careful
Analysis

- Consider whether the literature:
  - Demonstrate the topic’s chronological development.
  - Show different approaches to the problem.
  - Show an ongoing debate.
  - Center on a “seminal” study or studies.
  - Demonstrate a “paradigm shift.”

Analysis

- By the end of the review you should be able to answer
  - What do we know
  - What do we not know
  - What needs to be done
  - How your research will contribute
Common Errors

- Not logically organized
- Not focused on most important facets of the study
- Doesn’t relate literature to the study
- Too few references or outdated references cited
- Recent references are omitted
- Leaves out a major author or paper
- Doesn’t demonstrate why this topic fits in this venue
- Not written in author’s own words and style
- Reads like a series of disjointed summaries
- Doesn’t argue a point

Extended Literature Reviews
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Practicum

The CMU centers for:
Informed DEmocracy And Social cyber-security
Computational Analysis of Social and Organizational Systems
The Invisible College

- The invisible college is a small group that controls the perspective on the issue
  - What constitutes good work
  - What the challenges are
- The members of the invisible college
  - may not agree with each other
  - collectively recognize each other’s expertise
  - Using their knowledge you can
    - identify the central members of the group
    - Identify the knowledge boundaries of the problem
The Window of Influence

Disciplinary Coherence

- The extent to which science is “carved up into a host of detailed studies that have no link with one another” is a question of network cohesion.
  - A fractured discipline will be dominated by tight clusters based on specific research problems
  - An integrated discipline will have strong connections bridging research problems
Understanding Scientific Coherence

- Normal Science, accumulation & revolution
  - Science is problem driven & evidence based
  - Consensus emerges through a competition of ideas against data
    - (though lab ethnography repeatedly shows that consensus is often more socially constructed than evidentiary)
  - Scientific “Star” systems reward prior success, and stars shape research agendas

- Boundary Specification & Science as a profession
  - Motivated by prestige & competition for resources
  - Competition will lead to both vanquishing and niche filling
  - Disciplinary identity & coherence become a key issue
  - Contested fields lead to “chaotic” outcomes (Abbott 2001)

- Invisible Colleges
  - Informal communities create acceptable scientific standards
  - Boundaries are defined socially through interaction

- Scientific (social) Movements
  - Combination of many of these ideas under a social movement frame
  - Coherence becomes a framing & “grievance” issue used to shape resource allocation

Methods to Understanding Scientific Coherence

Networks of Interest:

- Citation networks – a direct trace of scientific recognition & production
- Topic networks – clusters of scientific products speaking about the same subject
- Collaboration networks – “invisible communities” of social interaction that produces scientific products
- Research Communities – People linked through common research topics (merger of 2 & 3)
Types of Links

- Type
  - Direct
    - A cites B
  - Co-occurrence
    - A and B co-author
    - Bibliographic coupling
  - Co-citation
    - B & C both cited by A

Level
- Document
- Author
- Journal

Co-Citation

- Co-Citation is a similarity measure used to establish a subject similarity between two items
- If A and B are both cited by C, they may be said to be related to one another, even though they don't directly reference each other
  - If A and B are both cited by many other items, they have a stronger relationship
  - The more items they are cited by, the stronger their relationship is
  - Undirected, Unweighted
- Proposed in the fields of citation analysis and bibliometrics as a fundamental metric to characterize the similarity between documents
Co-Citation

- **Document Co-Citation Network (DCA)**
  - Logical opposite of bibliographic coupling
  - The co-citation frequency equals the number of times two papers are cited together, i.e., appear together in a reference list

- **Author Co-Citation Network (ACA)**
  - Authors of works that repeatedly appear together in lists of references are assumed to be related.
  - Clusters in ACA networks often reveal shared schools of thought or methodology, common subjects of study, collaborative and student-mentor relationships, ties of nationality, etc.
  - Scientific areas differ in the density of the ACA

- **Journal Co-Citation Network (JCA)**
  - JCA networks offer wide-angle views of scholarly disciplines
  - Over time analysis reveals the evolution of disciplinary similarity.

Science Citation Index

**Association-of-ideas index**
- cited article
- cited article
- cited article
- article
- citing article
- citing article
- citing article
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Co-citation analysis

Articles that cite the same article are likely to both be of interest to the reader of the cited article.

Co-citation Philosophy

- all articles published between 1993 and 2013 in Nous, the Journal of Philosophy, the Philosophical Review, and Mind.
- chosen because they are high-impact, high-prestige, and self-consciously "generalist" journals.
- Articles 2,262
- Citations 34,000
- 520 most cited items (as at 500 not natural break).
Collaboration Network

- Girvin-Newman Algorithm was applied to a collaboration network of scientists at the Santa Fe Institute
  - an interdisciplinary research center
  - The 271 nodes in this network represent scientists during the calendar year 1999 or 2000 and their collaborators
- An edge is drawn between a pair of scientists if they coauthored one or more articles during the same time period
- The network includes all journal and book publications, papers by the scientists involved

Scientist Collaboration Diagram

- Largest component of the Santa Fe Institute collaboration network, with the primary divisions detected by Girvin-Newman algorithm indicated by different node shapes
### Key Challenges

- **Rate of Change:**
  - cyber-technologies, legal and policy constraints, and global information flow

- **Technical, policy and economic issues impact**
  - what science can be done,
  - what science needs to be done,
  - how science can be done,
  - what is required for those who can do that science
Data Control & Management

- Data is often only a sample
  - Biases are often not known nor accounted for
- Data is not free and open
  - Providers dictate who can do what kind of science
- Data is not necessarily preserved
  - Replication is difficult if not impossible
- Policies are out-of-sync with technology & science
  - Often not possible to collect the data needed to answer the policy question

Social Cyber-Security – Time Line
Why the Disconnect?

Co-Authorship Network of Social Cyber-Security
Central Core of Social Cyber-Security
Recommended Reading


For More Information

- Director Kathleen M. Carley - kathleen.carley@cs.cmu.edu
- IDeaS website - https://www.cmu.edu/ideas-social-cybersecurity/
- CASOS website - http://www.casos.cs.cmu.edu/
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