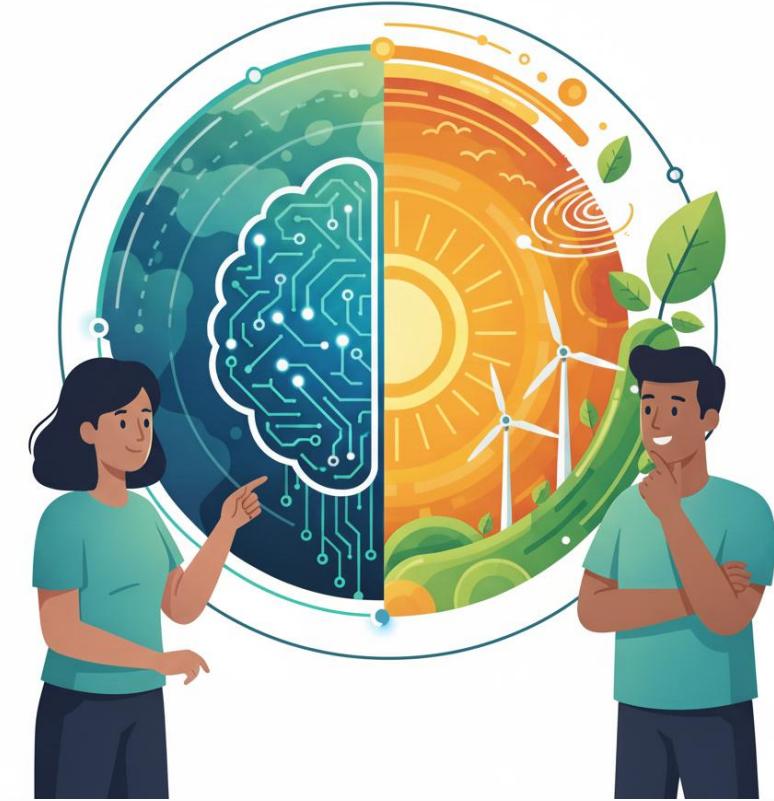


AI Adoption Training

Workshop#4: AI for Advanced Research Techniques

December 2nd, 2025



Today's Agenda

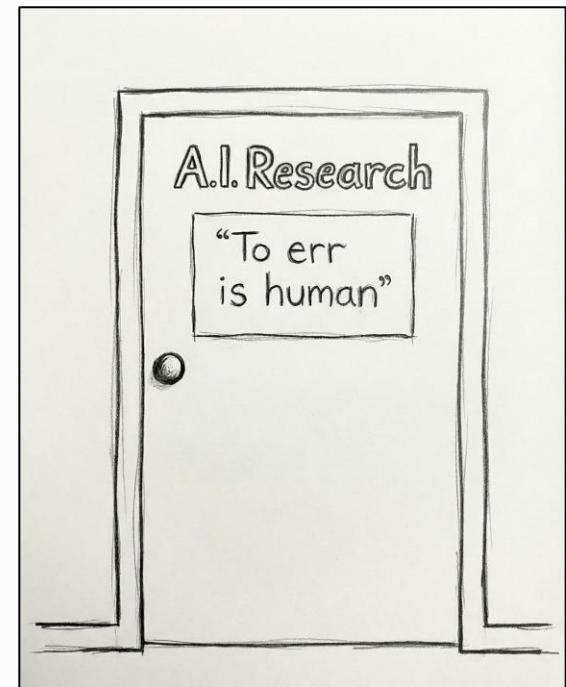
1. **Intro** (5 mins)
2. **Finding Information with LLMs** (10 mins)
3. **Deep Research Features** (15 mins)
4. **Research Tools: NotebookLM and Zotero** (15 minutes)
5. **Research Techniques** (10 mins)
6. **Wrap Up** (5 mins)

Materials are available at: https://github.com/mullinsean/ai_training

From Search to Synthesis to Analysis

Using LLMs to find, organize and review information

- Traditional research: hours of searching, reading, note-taking
- LLM-enhanced research: accelerated discovery and synthesis
- Key question: How do we maintain research quality while increasing productivity?
- Also, LLMs can potentially increase the breadth and depth of research if used properly
 - Next step beyond Google Scholar or other web-based search tools.
- Today's focus: practical techniques that complement (not replace) critical thinking



Web Search & Document Extraction

Basic techniques for information discovery



- LLMs excel at extracting and summarizing information from documents. Equipped with web search, they can be excellent tools for finding and parsing information on the web.
- Best practices include:
 - Prompting matters: Be specific about what you are looking for. Use the guidelines for good prompting
 - Specify recency when it matters (eg: “most recent” or “within last year” if those timelines matter)
 - Request multiple sources (prevents LLMs from stopping searches too early)
 - Ask for source quality indicators (eg: prioritize government sources, peer-reviewed research; avoid blog posts and opinion pieces)
- Essentially, you now have a fully conversational, intelligent interface to web search, instead of just typing in key words.

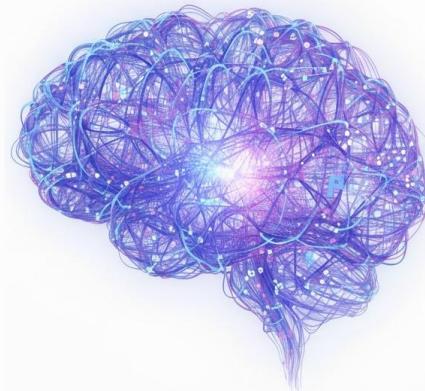
Document Extraction

In addition to asking questions about a document, LLMs can be used to surgically extract specific data or information requests across multiple documents. For example:

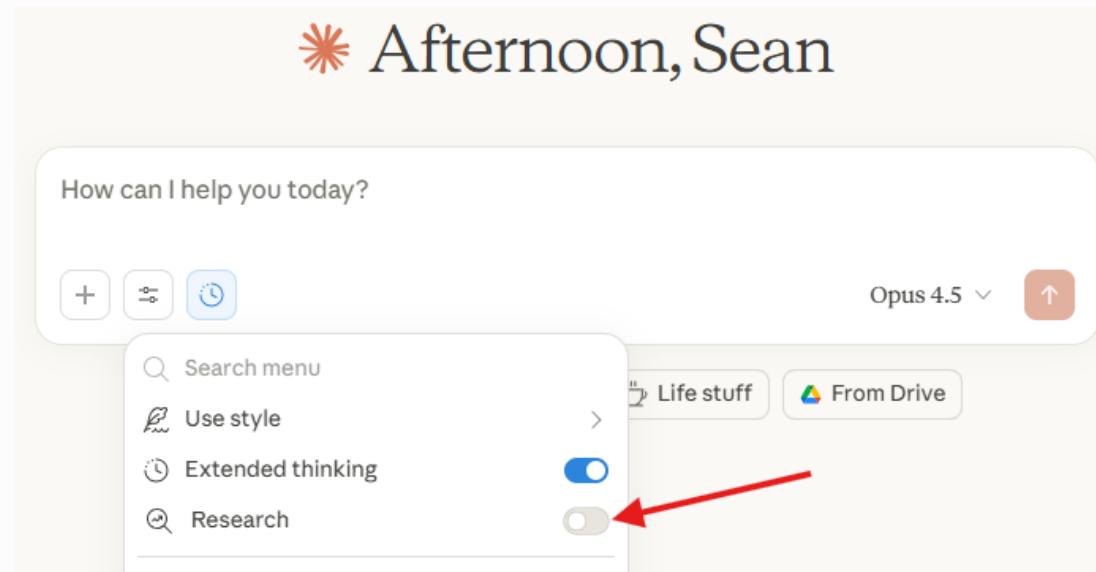
- Extracting all the quantitative findings in a report
- Asking for data in structured forms (eg: creating a table or .csv file)
- Extracting all the references in a document and matching with URLs for source documents.

Deep Research Feature

Advanced “agentic” tool creates sophisticated research reports



- All major commercial LLMs have a “deep research” feature, including ChatGPT, Claude, Gemini and Perplexity.ai
- How it works:
 - LLMs spends 10+ minutes autonomously researching a topic
 - Breaks down the research task into subcomponents, compiles information and then synthesizes into a structured report
 - Includes source references and links back to original documents
- Extremely useful for: literature reviews, background research, policy landscape scans
- Perplexity.ai can specialize in academic papers or financial documents; Gemini can access your Google Drive files, if desired.



Deep Research – Example Applications

Wide variety of use cases

Use Case	Example	Model	Output
General overview of new topic or context	Overview of the geopolitical situation in South Korea	ChatGPT	Transcript: chat Output: pdf
Deep dive into legislative process around a bill.	History of Bill C-27 (Digital Charter Act)	Gemini	Transcript: chat Output: pdf
Summarize and categorize stakeholder reactions	Media and Stakeholder Reception to Budget 2025	Gemini	Transcript: chat Output: pdf
Financial analysis of a sector or a topic	Financial Analysis of Companies in the Nuclear Sector	Perplexity.ai	Transcript: chat Output: pdf

Deep Research – Prompting Techniques

Getting the most out of Deep Research

Prompting for Deep Research:

- Be specific about scope, audience, desired format
- If desired, direct it to particular sources (eg: Hansard transcripts, recent industry whitepapers)
- Review the LLM generated “research plan” and/or answer any clarifying questions before initiating query
- Optional: ask an LLM to create a prompt for your Deep Research query and then paste into new chat session to run it
- Break large research projects into multiple sub-problems and run Deep Research on each of them

Example Prompt:

"Act as a strategic consultant. Conduct a deep research dive into the current state of Solid State Battery manufacturing. I need to know the top 3 bottlenecks preventing mass adoption.

Constraints: Focus only on technical and supply chain hurdles, ignore consumer marketing.

Sources: Prioritize recent (2024-2025) industry whitepapers and patent filings over general news.

Verification: Explicitly state if consensus is lacking on any point.

Output: A structured memo with a 'Technological Readiness Level' assessment for each major player."

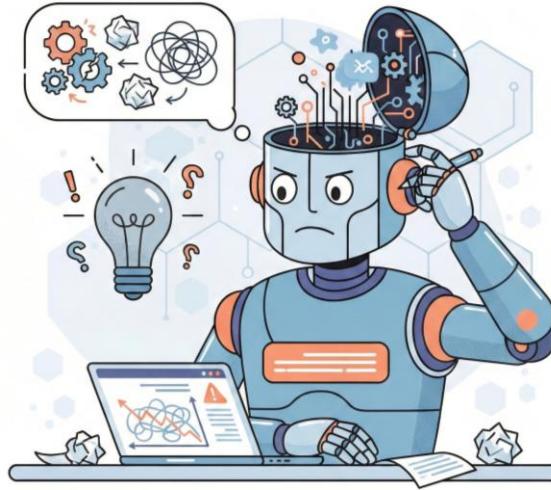
Deep Research features are agentic—they autonomously plan, search multiple sources, browse pages, and synthesize findings. Your prompt needs to act as a **project brief**, not a simple question.

Deep Research – Limitations

Understanding the limits of Deep Research queries

Deep Research features are not without flaws or limitations:

- Only searches what is on the web: will miss academic databases, paywalled content, internal documents
- Not comprehensive: summarizes what shows up in web searches; may miss key sources
- Often follows conventional wisdom: may not surface contrarian or cutting-edge perspectives
- Limited number of uses per month: even for paid plans, the high compute cost of Deep Research queries result in a limited number of queries per month; use sparingly



Think of Deep Research as a smart, very eager second-year undergrad who can tirelessly research any topic in 5-10 minutes.

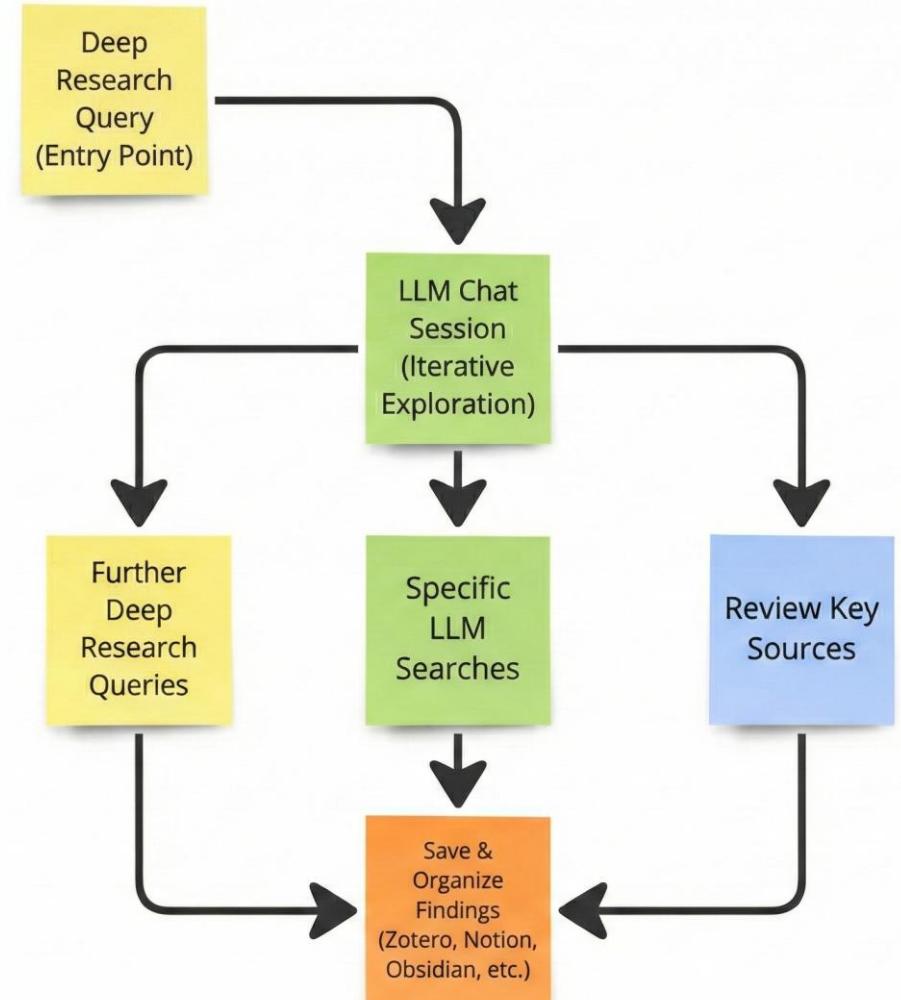
Can be very useful, but assignments should be carefully thought through and output should be reviewed with a critical eye.

Building a Body of Knowledge

Combining Deep Research and iterative LLM conversations

Ultimately, you can build up a body of knowledge by combining iterative LLM conversations with selective Deep Research queries.

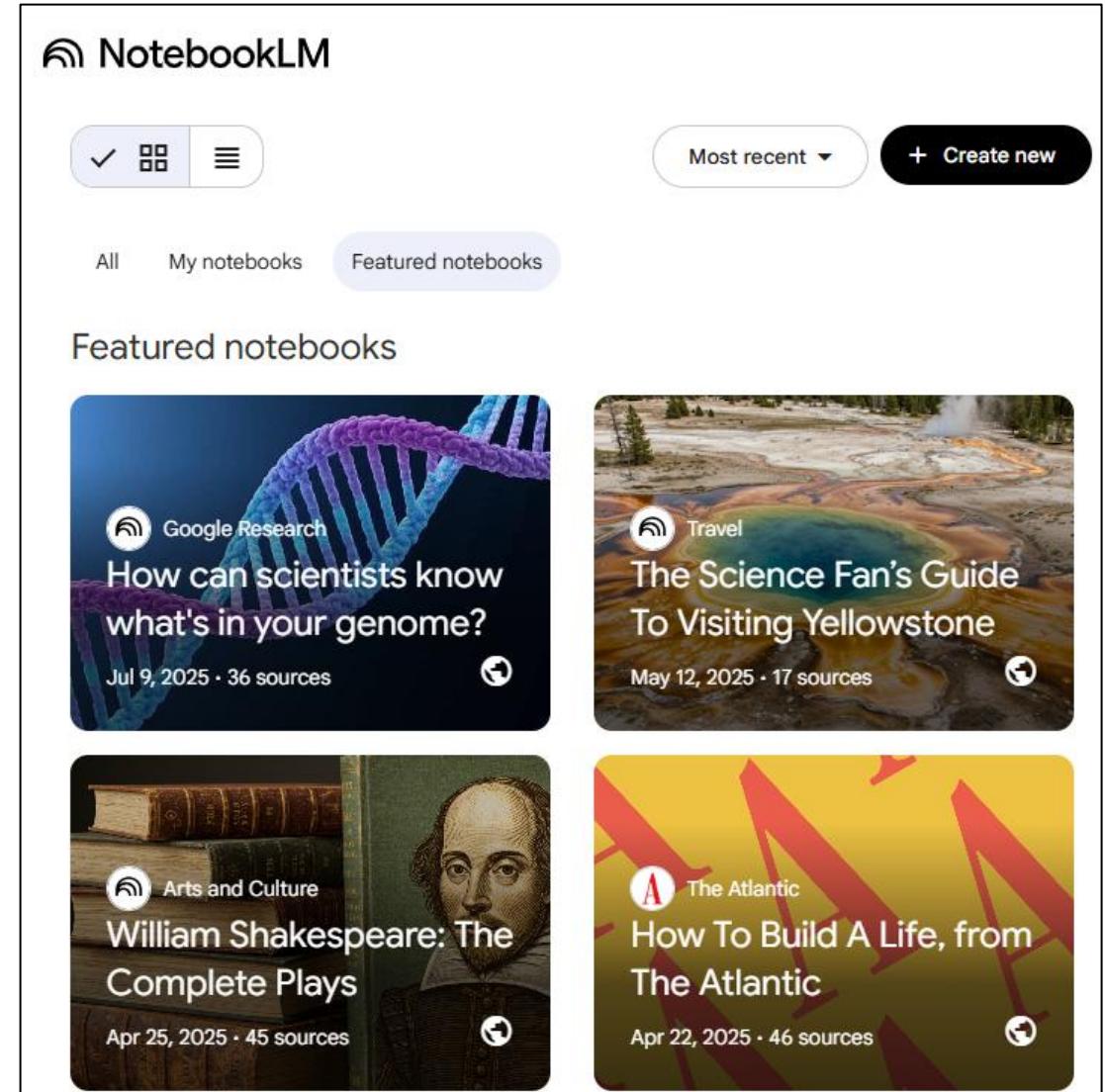
- A Deep Research query can be an entry point into a project; and then can serve as a context document for more in-depth exploration of the topic via a chat session
- These can branch into further Deep Research queries, more specific LLM searches, or reviewing the key sources directly
- Save and organize your findings as you go (notes, documents, chat links):
 - Zotero, Notion, Obsidian or your favourite note organizational tool can be very helpful



Research Tool: NotebookLM

Google's specialized research tool for multi-document analysis

- Google's [NotebookLM](#) free-tier allows you to explore and summarize up to 50 original sources: PDF, text, Word, even audio (podcasts or speeches) or video (Youtube)
- Useful for exploring data sources, surveying across different papers, and for self-education (eg: text books, reference manuals)
- Provides direct citations back to source documents for verification.
- Since last workshop, has now been further enhanced with Gemini Pro 3.0 image generation, allowing the creation of infographics, slide decks and other visual media.

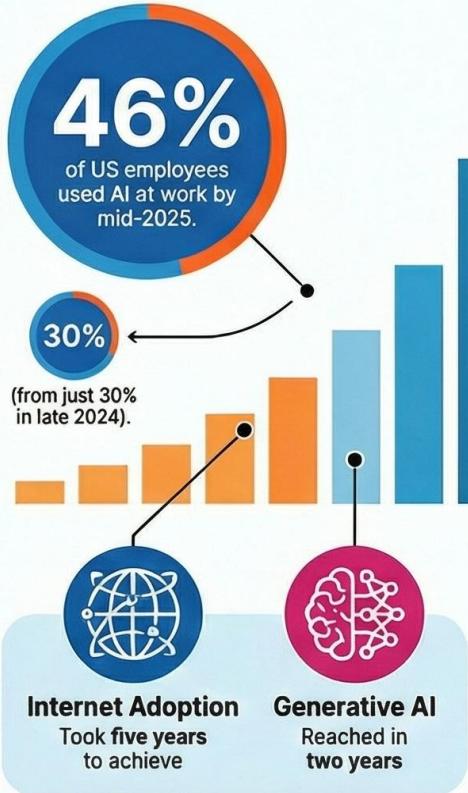


Example of NotebookLM generated infographic:

The AI Revolution at Work: Early Impacts of a New Era

Generative AI adoption is occurring at an unprecedented speed. New research reveals its initial, uneven effects on how people work, who benefits, and which jobs are being reshaped. This infographic summarizes the key patterns emerging from this technological shift.

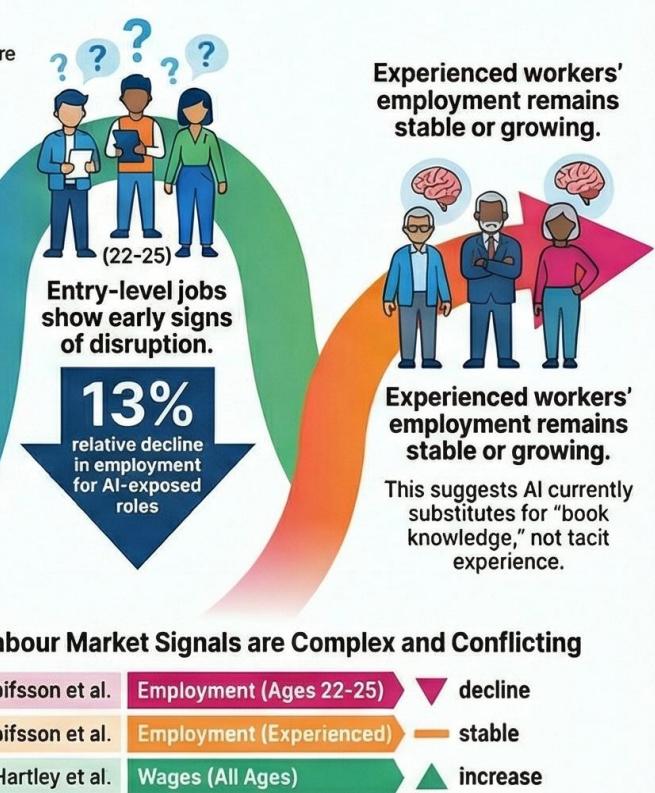
THE AI ADOPTION EXPLOSION



HOW AI IS RESHAPING THE WORKDAY



AN UNEVEN IMPACT ON THE WORKFORCE



Research Tool: Notebook LM

Key Features of NotebookLM

- Summarize and Interrogate: Generate an overview, ask questions across all documents – and save answers as notes.
- Mind Map: Visual representation of the themes and connections across sources
- Audio overview: Generate a “podcast” discussion of your documents
- Infographics and Slide Decks: Still early stage, but initial results are impressive
- Can run regular LLM searches or Deep Research queries inside of Notebook to generate additional sources

The screenshot shows a research summary for the topic "The Rapid Adoption of Generative AI". At the top, there's a small icon of three colored bars (green, yellow, red) followed by the title. Below the title, it says "7 sources". The main text summary discusses the rapid adoption and usage patterns of generative AI tools like ChatGPT, Claude, and Copilot across various demographics and professional settings. It highlights that AI adoption is fast and globally widespread, but highly concentrated geographically in high-income countries and disproportionately used for tasks in computer, mathematical, and writing-intensive fields. The text also mentions a split between enterprise users focusing on automation and consumer users seeking augmentation, with evidence suggesting high per-capita usage countries shift toward augmentation over time. It notes that Copilot users highlight firm-specific factors as powerful predictors of AI use, leading to measurable changes in work habits like reduced time spent on emails and faster document completion.

Save to note

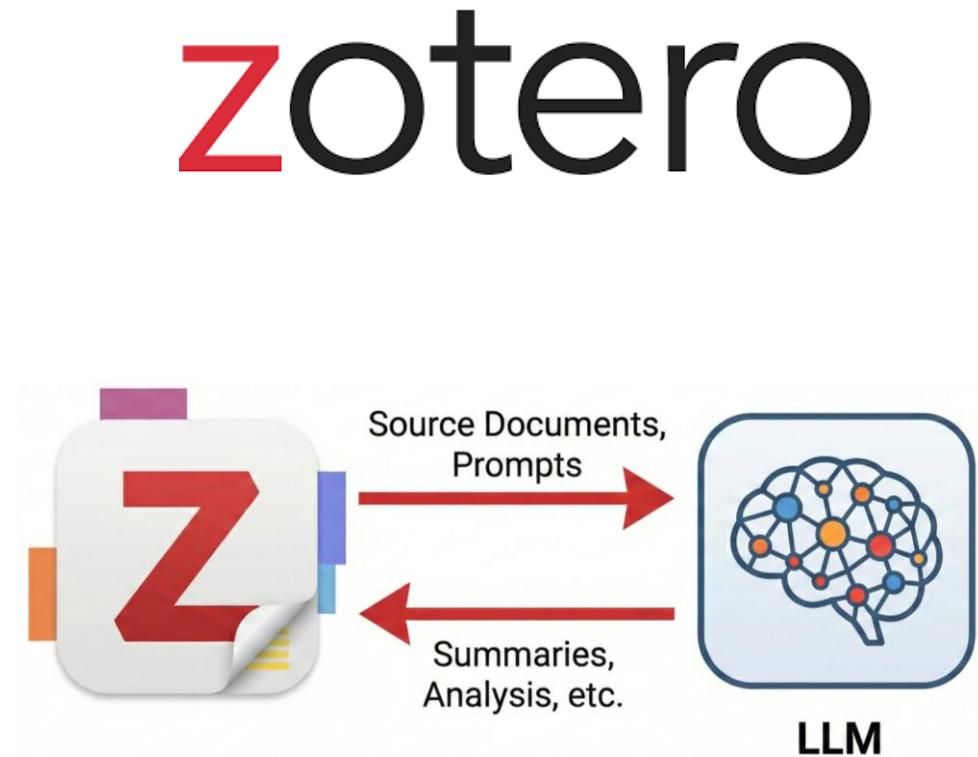
Video Overview Audio Overview Mind Map

(example)

Research Tool: Zotero + LLMs

Leveraging open-source research tool for LLM use

- [Zotero](#) is a free, open-source research tool for organizing primary research sources.
 - Not an AI-tool directly, but can be very useful for LLM-assisted workflows
- Build collections of sources (PDFs, webpages, videos, interview transcripts) for different projects
 - Can also include Deep Research query results
- Easy to drag PDFs from Zotero into LLMs or NotebookLM for analysis
- Save LLM-generated notes and summaries back to Zotero
- Maintains a “source of truth” for your research outside of chat session
- Zotero can also save project-specific LLM prompts for key tasks (eg: “summarize these documents with respect to X”)



Research Tool: Zotero + LLMs

Example Zotero library integration with LLMs

Z File Edit View Tools Help

GenAI Adoption Shifting Work Patterns with...

My Library Group Libraries Generative AI Research GenAI Adoption LLM Prompts Duplicate Items Unfiled Items Trash Sovereign AI Cloud Paper

Everything

Title	Creator	Item T...	Year
The Labor Market Effects of Generative Artificial...	Hartley et ...	Preprint	2024
Which Economic Tasks are Performed with AI? E...	Handa et al.	Preprint	2025
Shifting Work Patterns with Generative AI	Dillon et al.	Preprint	2025
How People Use ChatGPT	Chatterji et...	Journa...	
Canaries in the Coal Mine? Six Facts about the ...	Brynjolfsson...	Journa...	
Summary: "Canaries in the Coal Mine? Six Fa...		Note	

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Summary: "Canaries in the Coal Mine? Six Facts about the Recent Employment Effects of Artificial Intelligence"

<https://claude.ai/chat/e802dd0e-cca3-45b7-a2b4-f38ceff2033e>

Authors: Erik Brynjolfsson, Bharat Chandar, Ruyu Chen (Stanford University) **Date:** August 26, 2025 **Source:** Stanford Digital Economy Lab

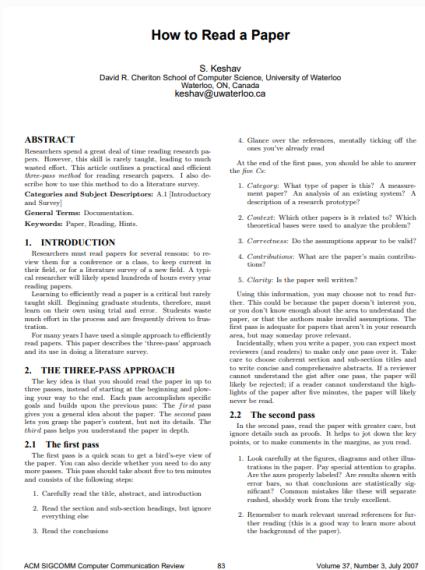
Overview

This paper uses high-frequency administrative payroll data from ADP (the largest US payroll processor, covering 25+ million workers) to examine how generative AI adoption is affecting employment across occupations. The analysis

Reading and Reviewing Papers with LLMs

An LLM-assisted update to the “three-pass framework” for reading papers

- Keshav (2007) articulates a helpful, “three-pass” framework for reading academic papers.



“How to Read a Paper”, Keshav (2007),
<http://ccr.sigcomm.org/online/files/p83-keshavA.pdf>

Pass	Regular Framework	LLM-aided Framework
First Pass – Quick Review	Quick scan: focus on title, abstract, introduction, type of paper, section and sub-section headings and conclusions 5-10 minutes total	Generate an audio overview or structured LLM summary focused on key areas of interest
Second Pass – Understanding of Paper	Carefully read paper to understand core arguments and key findings; go section by section, pausing to absorb data and findings Using this information, you may choose not to read further. This could be because the paper doesn't interest you, or you don't know enough about the area to understand the paper well enough to make sense of it. The first pass is adequate for papers that aren't in your research interests. Incidentally, when you write a paper, you can expect most reviewers to read it to make sure the paper is suitable to choose subjects and sub-section titles and to write concise and comprehensive abstracts. If a reviewer asks for a revision, it's likely that the paper will be rejected; if a reader cannot understand the highlights of a paper after five minutes, the paper will likely never be read. 2.2 The second pass In the second pass, read the paper with greater care, but ignore the details. You may take notes, highlight key points, or make comments in the margin, as you read.	READ CAREFULLY – no shortcuts! :)
Third Pass – Deep Understanding of Methodology and/or Peer Review	Virtually recreate the paper, including redoing proofs, rerunning data analysis or reviewing code	Use LLMs to verify proofs, inspect data, review code, check calculations

Advanced Techniques: Beyond Summaries

Sophisticated methods for extracting insights from documents

- **Comparison Matrix:** Build comparison tables across multiple documents (e.g., "Create a comparison matrix with three reports as columns. Compare: cost projections, deployment timeline, infrastructure barriers")
- **Red Teaming:** Ask the LLM to adopt a critical persona (e.g., "Skeptical Finance Minister") to critique your findings
- **Gap Analysis:** "Based on these documents, what perspectives or data points are missing?"
- **Formatting:** eg: Convert documents to LaTeX; format references in APA style
- **Data Cleaning:** clean and organize datasets (either directly or by writing code)
- **Reviewing Proofs or Code:** Paste proofs or code into LLMs for careful verification

Example Conversation:

Using Gemini to compare four papers, build a comparison chart, provide critiques and identify missing gaps.

Finally, summarize conversation and save as a note in Zotero.

([chat](#))

Additional Reading: AI for Research

Prof. Anton Korinek's work on LLMs for (economics) research

- [Anton Korinek](#) (UVA, Brookings): Leading researcher on AI applications in economics
- "[AI Agents for Economic Research](#)" (August 2025): Guide to using agentic AI tools for research tasks
- "[Generative AI for Economic Research: Use Cases and Implications](#)" (December 2024): Comprehensive overview of LLM applications
- Although focused on the economics profession, many of the techniques generalize to other academic and applied research fields.

Table 1
PRIMARY USEFULNESS OF LLM MODEL TYPES FOR RESEARCH TASKS

Research Category	Traditional LLMs	Reasoning Models	Agentic Chatbots
Ideation & Feedback	Good for initial brainstorming.	Best for structured feedback and identifying logical flaws.	Actively scans literature for novelty and grounding.
Writing	Excellent for drafting, summarizing, and rephrasing existing text.	Ensures logical flow in complex arguments.	Incorporates real-time web information.
Background Research	<i>Shortcoming: No live web access.</i>	Synthesizes info from provided texts.	Best for live web searches and up-to-date literature reviews.
Coding	Generates basic code snippets.	Excellent for writing and debugging complex algorithms.	Executes code, tests hypotheses, and interacts with data files.
Data Analysis	<i>Shortcoming: Cannot execute code.</i>	Helps interpret data and suggest approaches.	Best for end-to-end analysis: data cleaning, coding, visualization.
Math	<i>Shortcoming: Unreliable for complex math.</i>	Solves multi-step problems and formal proofs at PhD level.	Can leverage external computational tools to ensure accuracy.
Promoting Research	Drafts initial promotional content.	Tailors summaries for specific audiences.	Automates creating summaries and posts for multiple platforms.

Note: The most useful model type in each research category is bolded.

Korinek (2025)

Thank You!



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