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Prompt Engineering in AI Tools: The Art & Science of Effective AI Communication

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Introduction

- Three Pillars of Prompt Engineering
- The CRAFT Framework for Prompt Engineering
- Prompt Engineering Techniques
- University Libraries Generative AI-powered Research Tools

Prompting Change: Exploring Prompt Engineering in Large Language Model AI

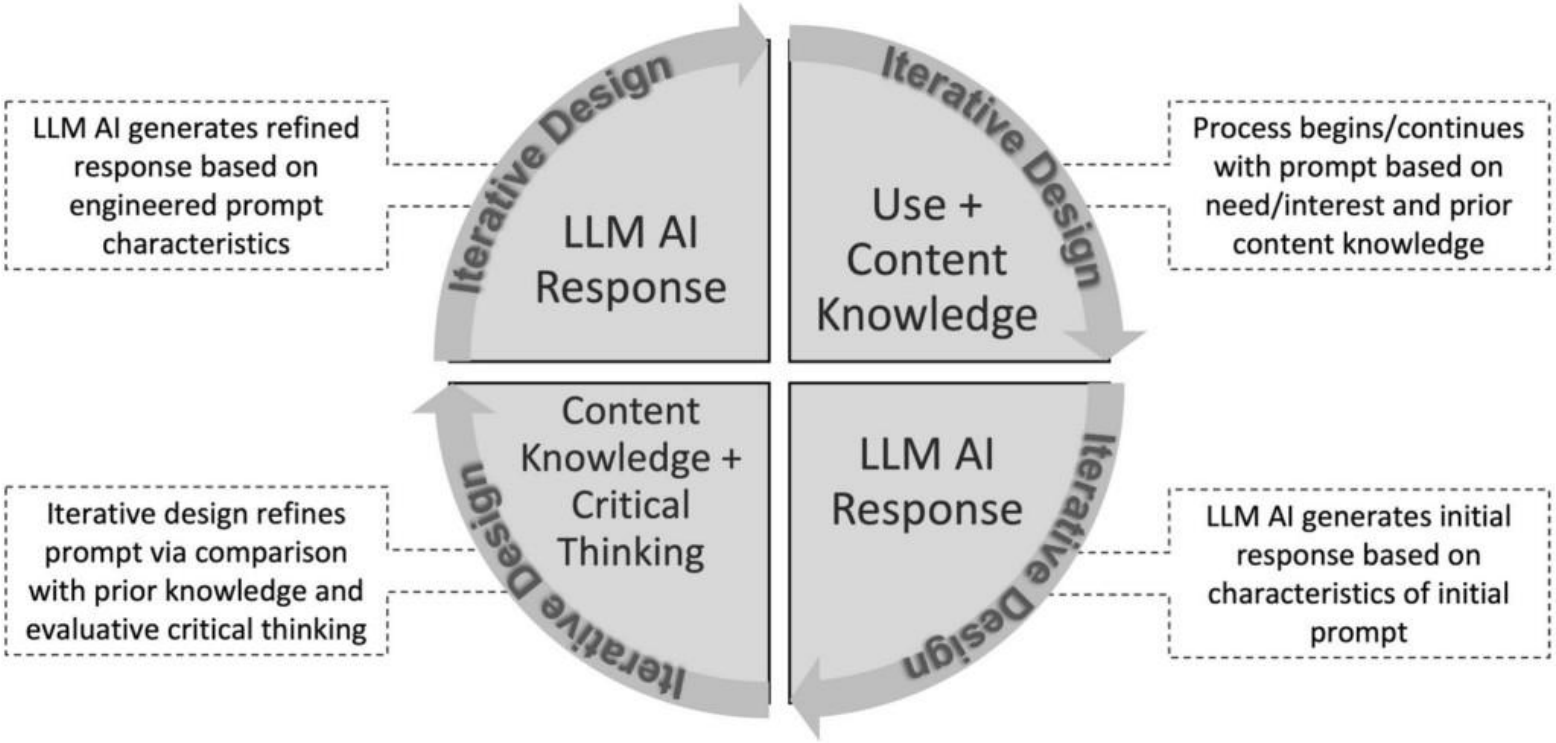

Fig. 1 Prompt engineering process featuring content knowledge, critical thinking, and iterative design

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Discussion Activity: The Three Pillars Analysis

- Format: Think-Pair-Share followed by group discussion
  - Step 1: Individual Reflection (5 minutes)
  - Step 2: Pair Discussion (5 minutes)
  - Step 3: Group Sharing (10 minutes)

Step 1: Individual Reflection (5 minutes)

- Reflect on the three pillars of prompt engineering:
  - Content Knowledge
  - Critical Thinking
  - Iterative Design
- Guiding Questions:
  - Which pillar do you think is most crucial for computational social science research? Why?
  - Can you think of a specific example from your field where all three pillars would interact?
  - What challenges might computational social science scholars face in implementing each pillar?

Step 2: Pair Discussion (5 minutes)

- Partners share their reflections and:
  - Compare their chosen "most crucial" pillar
  - Discuss their examples
  - Identify common challenges

Step 3: Group Sharing (10 minutes)

- Pairs share their most interesting insights
- Create a collaborative list of discipline-specific applications
- Address any contradictions or tensions in perspectives

What is Prompt Engineering?

Prompt Engineering is the iterative process of building and refining prompts for generative AI tools to generate optimal responses.

The CRAFT Framework for Prompt Engineering

- A systematic approach to developing effective prompts for generative AI systems, designed to maximize output quality and reliability.
- Framework Components
  - C - Context
  - R - Role & Responsibility
  - A - Action & Approach
  - F - Format & Function
  - T - Testing & Tuning

C - Context

- Define the background and setting
- Specify relevant constraints
- Establish the knowledge domain
- Set the tone and style
- Example: "For a mixed-methods research project combining survey data (n=2,500) with digital trace data from the same participants' social media accounts..."

R - Role & Responsibility

- Define AI's role
- Specify the intended audience
- Establish interaction parameters
- Set authority levels
- Example: "Act as a methodologist specializing in integrating survey and computational methods for social science research..."

A - Action & Approach

- Specify the required task
- Define methodology
- Outline steps or processes
- Set quality standards
- Example: "Review my approach to aligning self-reported attitudes with observed online behaviors. Suggest statistical techniques for identifying discrepancies and measuring the relationship between stated preferences and digital behaviors..."

F - Format & Function

- Specify output structure
- Define presentation style
- Set length requirements
- Establish formatting rules
- Example: "Present your recommendations in an academic advisory format with: (1) methodological considerations, (2) appropriate statistical tests with R code examples, (3) visualization strategies for multi-modal data, and (4) interpretation caveats..."

T - Testing & Tuning

- Verify output accuracy
- Refine prompt iteratively
- Adjust parameters
- Evaluate effectiveness
- Example: "If the initial analysis approaches don't adequately address measurement validity concerns, please provide additional validation strategies specifically designed for integrated digital/survey datasets."

Prompt Engineering Techniques

- Zero-shot Prompting
  - No examples provided to the model
  - Lower accuracy compared to other methods
- Few-shot Prompting
  - Includes demonstrations/examples
  - Better performance than zero-shot
- Chain-of-Thought Prompting
  - Includes intermediate reasoning steps
  - Higher solve rate than standard prompting
  - Particularly effective for complex problems

Group Activity: Prompt Engineering for Data Visualization

- ICPSR (Inter-university Consortium for Political and Social Research)
- Setup (10 minutes)
  - Form small groups of 3-4 participants
  - Each group should:
    - Select a dataset from the ICPSR repository that interests them
    - Download the dataset and its documentation
    - Identify 2-3 key variables they want to explore visually

Part 1: Initial Prompt Design (10 minutes)

- Groups develop an initial prompt for a generative AI tool (ChatGPT, Claude, etc.) asking it to:
  - Create visualization code for their selected variables
  - Specify the programming language preferred (Python or R)
  - Include information about the dataset structure
- Groups should document:
  - The prompt they created
  - The reasoning behind their prompt structure
  - How they incorporated dataset specifics

Part 2: Evaluate and Iterate (15 minutes)

- Submit the initial prompt to the AI
- Evaluate the response based on:
  - Code functionality
  - Appropriateness of visualization type
  - Clarity of the code
  - Alignment with research question
- Apply critical thinking:
  - Identify any errors, misconceptions, or limitations
  - Document what worked well and what didn't
- Create a revised prompt addressing the limitations
  - Apply more specificity if needed
  - Add constraints or additional parameters
  - Clarify any misunderstandings

Part 3: Refinement and Implementation (20 minutes)

- Submit the refined prompt
- Test the generated code with the actual dataset
- Make necessary adjustments to the code
- Document:
  - How the response improved with the refined prompt
  - Any manual modifications needed
  - Lessons learned about effective prompt engineering

Part 4: Reflection and Sharing (15 minutes)

- Each group briefly presents:
  - Their dataset and research question
  - Their prompt engineering process
  - The final visualization
  - Key insights about effective prompt engineering
- Discuss as a full group:
  - Common challenges faced
  - Strategies that worked well
  - How to apply these skills to other research tasks