

AI Activity: Historical Counting Systems

3.1 AI Historical Detective: Uncovering Counting System Mysteries

Before you begin: Review the "Preparing to Use AI Tools" section in your course materials for guidance on effective prompting, verification, and ethical use of AI. Recommended AI Tools: Use a free AI tool such as ChatGPT, Claude, or Grok for this activity.

In this activity, you'll collaborate with AI to explore historical counting systems by analyzing real-world scenarios using Incan quipu and Roman numerals. You'll practice converting between systems, identify common conversion errors, and strengthen your understanding of how different civilizations developed practical solutions for record-keeping and calculation.

Student Instructions:

1. **Create Your Historical Scenario:** Prompt AI with: "Create a realistic historical scenario involving [choose: Incan empire trade records, Roman construction project, or medieval European monastery] where I need to interpret and convert numbers between different systems. Include specific quantities using the counting methods from that civilization."
2. **Practice System Conversions:** Work through the AI's scenario by converting the given numbers:
 - For Roman numerals: Convert to Hindu-Arabic and explain the additive/subtractive principles
 - For quipu examples: Interpret the knot patterns using single knots, figure-eight knots, and long knots
 - For counting boards: Calculate values using the different compartment multipliers (1x, 2x, 3x, 6x, 12x)
3. **Request Flawed Conversions:** Ask AI: "Now solve this same problem but make 2-3 deliberate errors in converting between these number systems. Don't tell me what the errors are."
4. **Error Analysis Challenge:** Examine AI's incorrect conversions and identify:
 - Which conversion rules were violated?
 - How do these errors reflect common mistakes people make with unfamiliar systems?
 - What aspects of positional vs. non-positional systems cause confusion?
5. **Historical Context Exploration:** Collaborate with AI to discuss: "Why would this civilization have chosen this particular counting method for this type of record-keeping? How do the practical needs of their society connect to their mathematical tools?"
6. **Cross-Cultural Comparison:** Ask AI to show how the same quantities would be represented in two different historical systems, then analyze the advantages and disadvantages of each approach.

Reflection Questions:

- How did working with unfamiliar number systems change your appreciation for the Hindu-Arabic system we use today?
- What patterns did you notice in the types of errors that occur when converting between different counting systems?
- How do the practical needs of a civilization (trade, construction, record-keeping) influence the development of their number systems?
- Which historical counting system seemed most logical to you, and why might that be based on your modern perspective?
- How might understanding these historical systems help you better explain basic number concepts to others?

Optional Extensions:

- Research a counting system not covered in the textbook and create conversion problems with AI
- Design a scenario where multiple historical civilizations interact and must convert between their number systems

Submission Guidelines:

If your instructor requires submission, export or screenshot your AI conversation and include your written responses to the reflection questions. You may submit this through your course's learning management system or as directed by your instructor.

3.2 AI Base System Navigator: Exploring Mathematical Foundations

Before you begin: Review the "Preparing to Use AI Tools" section in your course materials for guidance on effective prompting, verification, and ethical use of AI. Recommended AI Tools: Use a free AI tool such as ChatGPT, Claude, or Grok for this activity.

In this activity, you'll use AI to explore different base systems through personalized scenarios, practice converting between bases, and analyze errors in base conversions. You'll strengthen your understanding of positional notation and place value while connecting these concepts to real-world applications in computing and other fields.

Student Instructions:

1. **Generate Your Base System Scenario:** Prompt AI: "Create a real-world application scenario involving [choose your interest: computer science, archaeology, alien

communication, historical research, or music theory] that requires working with a specific base system other than base-10. Include specific numbers that need conversion and explain why this base makes sense for this application."

2. **Master the Conversions:** Work through the AI's scenario by converting between the given base and base-10:
 - Use the place value method for converting TO base-10
 - Use the division/remainder method for converting FROM base-10
 - Show all your work step-by-step using the procedures from your textbook
3. **Request Error-Filled Solutions:** Ask AI: "Now solve these same conversion problems, but make deliberate mistakes in the conversion process. Include errors in both directions (to base-10 and from base-10) without telling me what the mistakes are."
4. **Debugging Practice:** Analyze AI's flawed solutions and identify:
 - Where in the conversion process each error occurred
 - Whether the error involves place value calculation, division/remainder steps, or basic arithmetic
 - How each error affects the final answer and what the correct process should be
5. **Pattern Recognition:** Work with AI to explore: "Show me how the same number looks in base-2, base-5, base-8, and base-16. Make one error in these representations and help me understand the patterns in how numbers change as we change bases."
6. **Real-World Connections:** Collaborate with AI to discuss: "How does understanding different base systems help explain why computers use binary, or why ancient civilizations might have chosen base-60? What are the practical advantages of different bases for different applications?"

Reflection Questions:

- How did working through conversion errors help you better understand the step-by-step process of base conversion?
- What was most challenging about thinking in a non-decimal base system, and how did this experience change your understanding of place value?
- How do the conversion algorithms (place value expansion vs. division method) help you see the structure of number systems differently?
- In what ways do different base systems reveal the arbitrary nature of our decimal system?
- How might understanding base systems be relevant to your field of study or career interests?

Optional Extensions:

- Explore fractional numbers in different bases (e.g., 0.1 in different bases represents different decimal values)
- Create a scenario involving a base system larger than 10 (like hexadecimal) and practice with letter symbols

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Preparing to Use AI Tools

Understanding AI language models

Artificial intelligence (AI) tools like [ChatGPT](#), [Grok](#), and [Claude](#) are designed to generate human-like text responses. These AI language models can be used to understand and generate natural language, making them highly versatile for math learning, from explaining concepts to assisting with problem-solving. AI's ability to learn from a vast body of text allows it to provide informative, contextually relevant responses across math topics.

You input directions, instructions, or a question and the AI tool generates a response. The input that you give to the AI tool is called a prompt.

Writing Effective Prompts

- **Be Clear and Specific**
 - Too general: Tell me about solving equations.
 - Use more details: Outline three common mistakes when solving quadratic equations and explain how to avoid them in a step-by-step process.
- **Provide context**
 - Too vague: Explain derivatives.
 - Provide context: You are a calculus tutor. I'm struggling with finding the derivative of a composite function in a real-world scenario involving velocity and acceleration. Provide a worked example using the chain rule for the function $v(t) = (3t^2 + 2)^4$, and explain each step.
- **Iterative Approach**
 - Initial prompt: Identify five key steps in graphing a linear function.
 - Follow-up: For the function $y = 2x + 3$, how would you apply these steps, and what adjustments are needed if the slope is negative?

Verifying AI-Generated Information

- **Cross-Check Facts.** Do not assume that AI-generated output is accurate or authentic. AI often makes up fictional responses or incorrect math solutions. Because you cannot be certain of the source of the AI's output, it is important to verify AI responses with credible sources, such as your textbook, class notes, or reliable math websites.
- **Critical Thinking.** While its responses may seem like AI is doing analysis and critical thinking, the AI tool is actually programmed to respond to your prompt based on patterns in language. It is analyzing those language patterns to generate

a response. This is very different from the synthesis of information and critical thinking about math concepts that your human mind does naturally, such as deriving proofs or identifying logical flaws in a solution. You have to review each response and evaluate the plausibility and accuracy of AI responses and whether they logically make sense in a mathematical context.

Acknowledging Use of AI

Your use of AI should be disclosed so that you are not taking credit for work that was not created by you. Use your instructor's preferred method of acknowledgment.