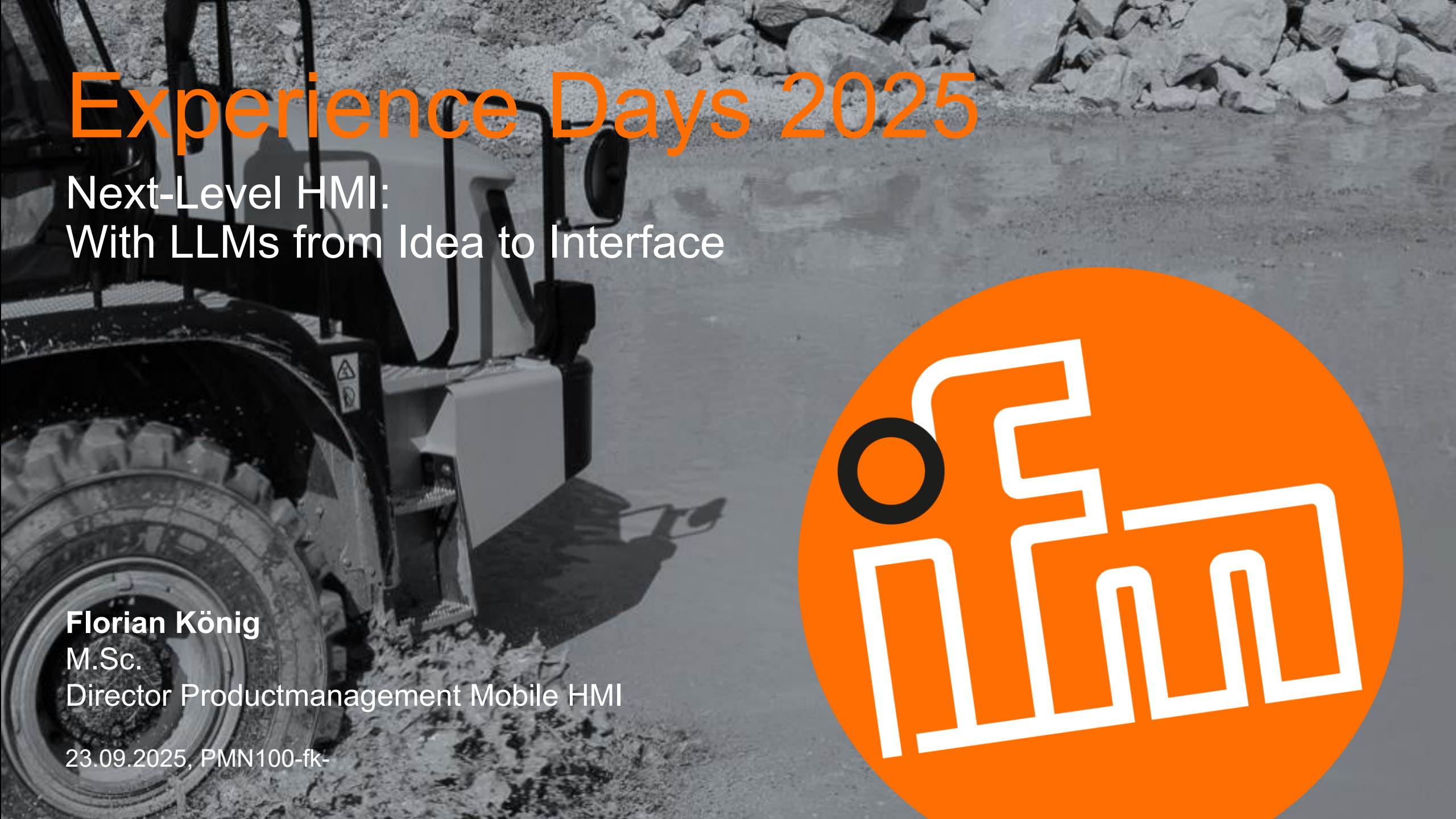
Experience Days 2025

Next-Level HMI:
With LLMs from Idea to Interface



Florian König
M.Sc.
Director Productmanagement Mobile HMI

23.09.2025, PMN100-fk-

Experience Days 2025

Next-Level HMI: With LLMs from Idea to Interface

Goal for today:

- Turn AI into your co-designer: learn practical tips, tricks, and workflows with LLMs (Large Language Models) to create smarter HMIs and simplify your engineering tasks.



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With LLMs from Idea to Interface

Agenda

Facts & HMI Design → LLMs & Methods → Practice & The Engineer’s Role



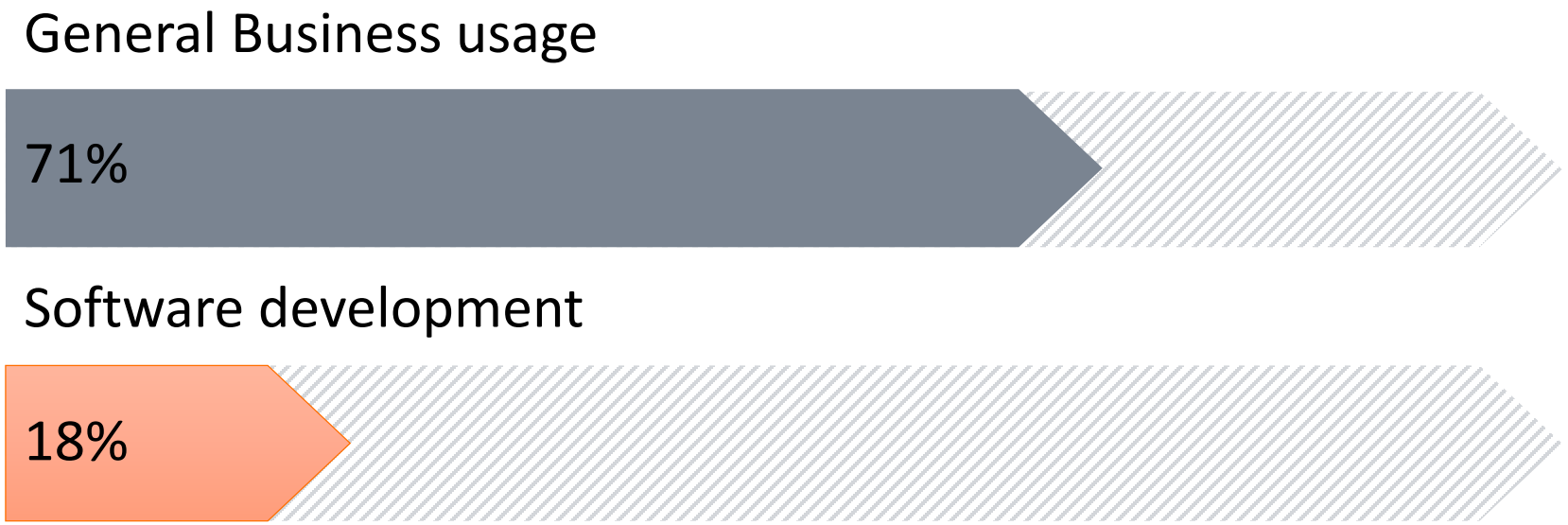
INTERNAL

Facts & Data

Usage of Gen AI in Business

Study: McKinsey, The State of AI, March 2025

- Do you use Generative AI or LLMs in business?



INTERNAL

Facts & Data

Usage of Gen AI in Business

Study, McKinsey, The State of AI, March 2025

- Why only 18% in software development?
  - Developers want to write their own code
  - LLMs are not optimized for Qt / CODESYS
  - Creators are concerned about IP
    (Intellectual Property)







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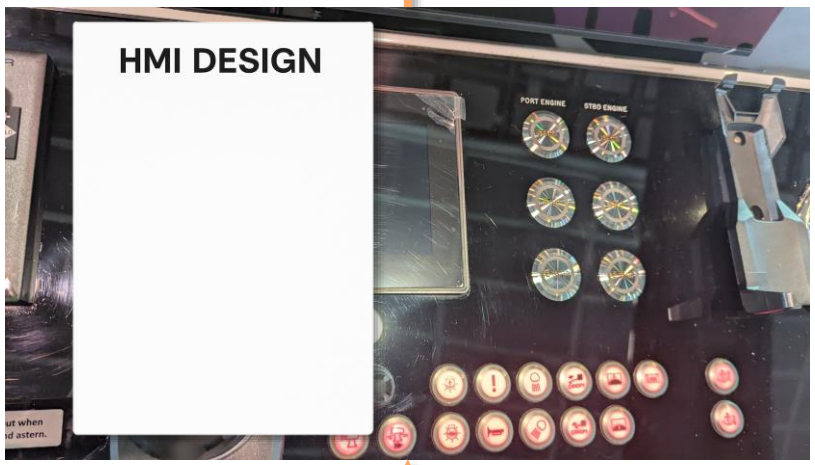
Why AI in HMI Design?

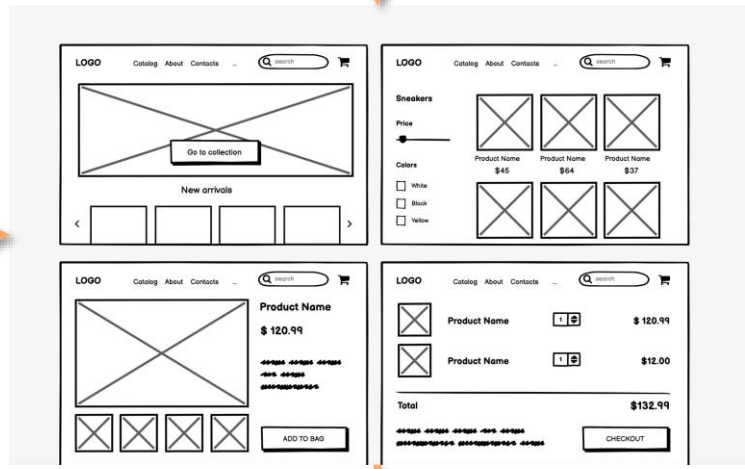
UX & UI Designer

Wireframe design

Requirements for Design

4 Weeks design process





Adjustments

Clickdummy & tests



Integration

Assets creation

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How can LLMs support the HMI design process?

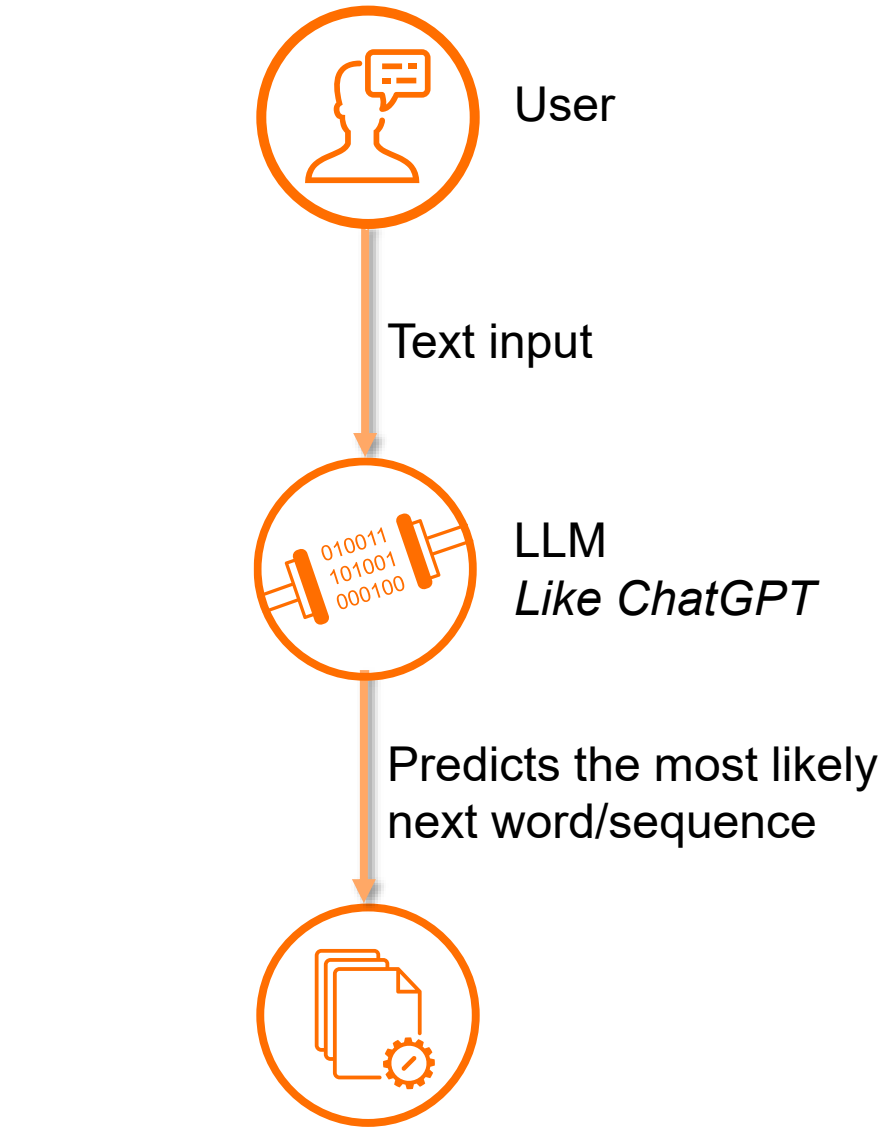
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What are LLMs?

LLMs – Large Language Models

- Neural networks trained on massive text datasets
- Can understand and generate natural language
- Can act as assistants: creating ideas, requirements, code, documents, designs
- LLMs don’t think – they predict patterns in language!

For engineers: assistants that does the boring stuff



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Popular LLMs & Strengths

1 ChatGPT

Versatile generalist

Strong across many domains

OpenAI, USA

2 Claude

Excellent for requirements & structured documentation

Handles very long context well

Anthropic, USA

3 DeepSeek

strong in coding & math

Can parse norms/regulations often restricted in EU/US

China, sometimes blocked

4 Mistral

Lightweight, efficient open models

Privacy-friendly & focused on European compliance

EU, France

Find the model that fits your use case → **Check your Company Policy**

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LLMs & Methods

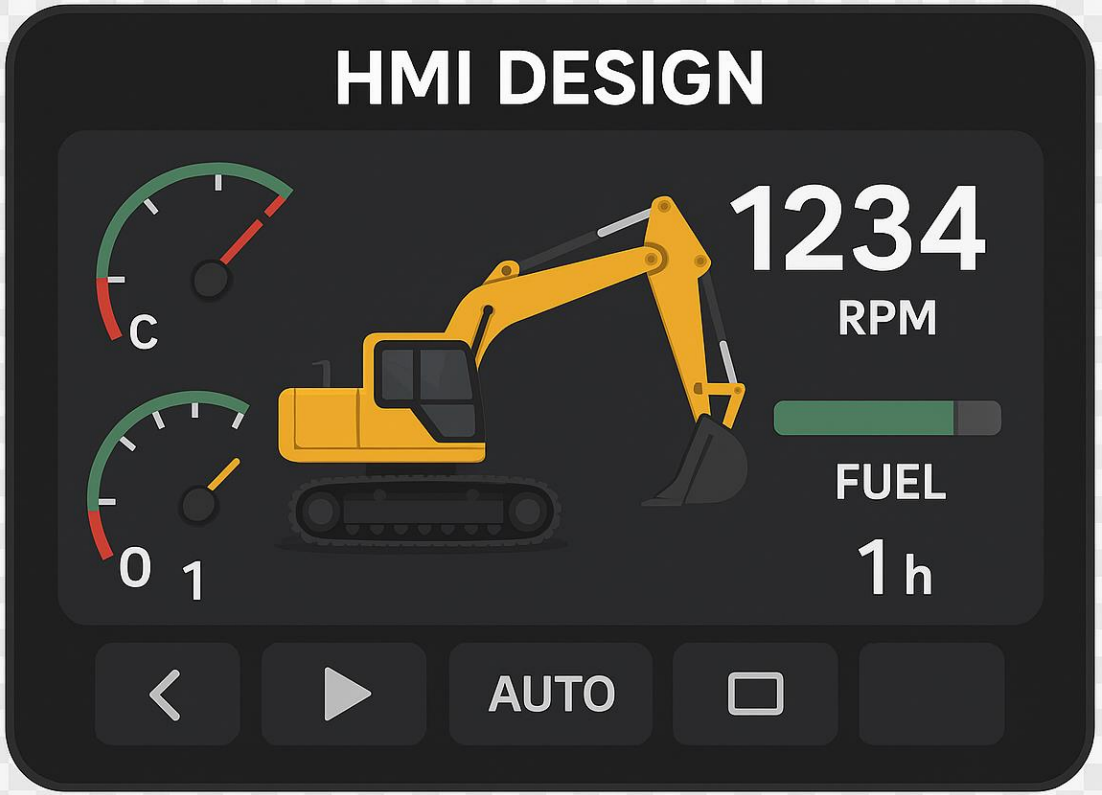
Prompt Engineering

Model:
Copilot

erstelle mir ein HMI für einen Bagger

Zero-Shot Learning

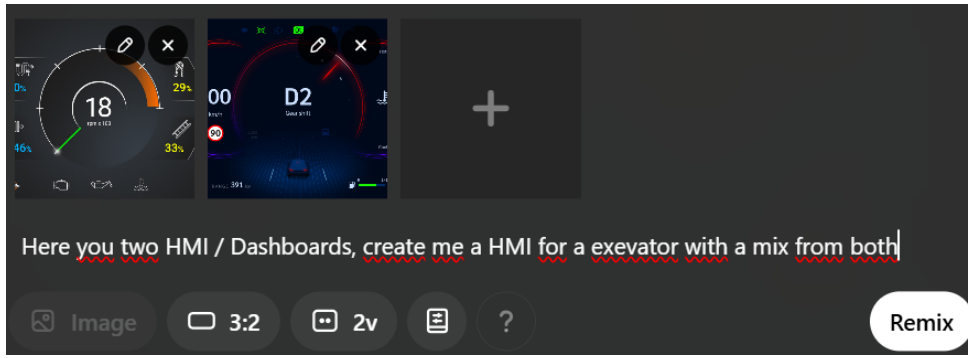
- Just ask → model solves it
- No examples needed
- Fast & flexible



LLMs & Methods

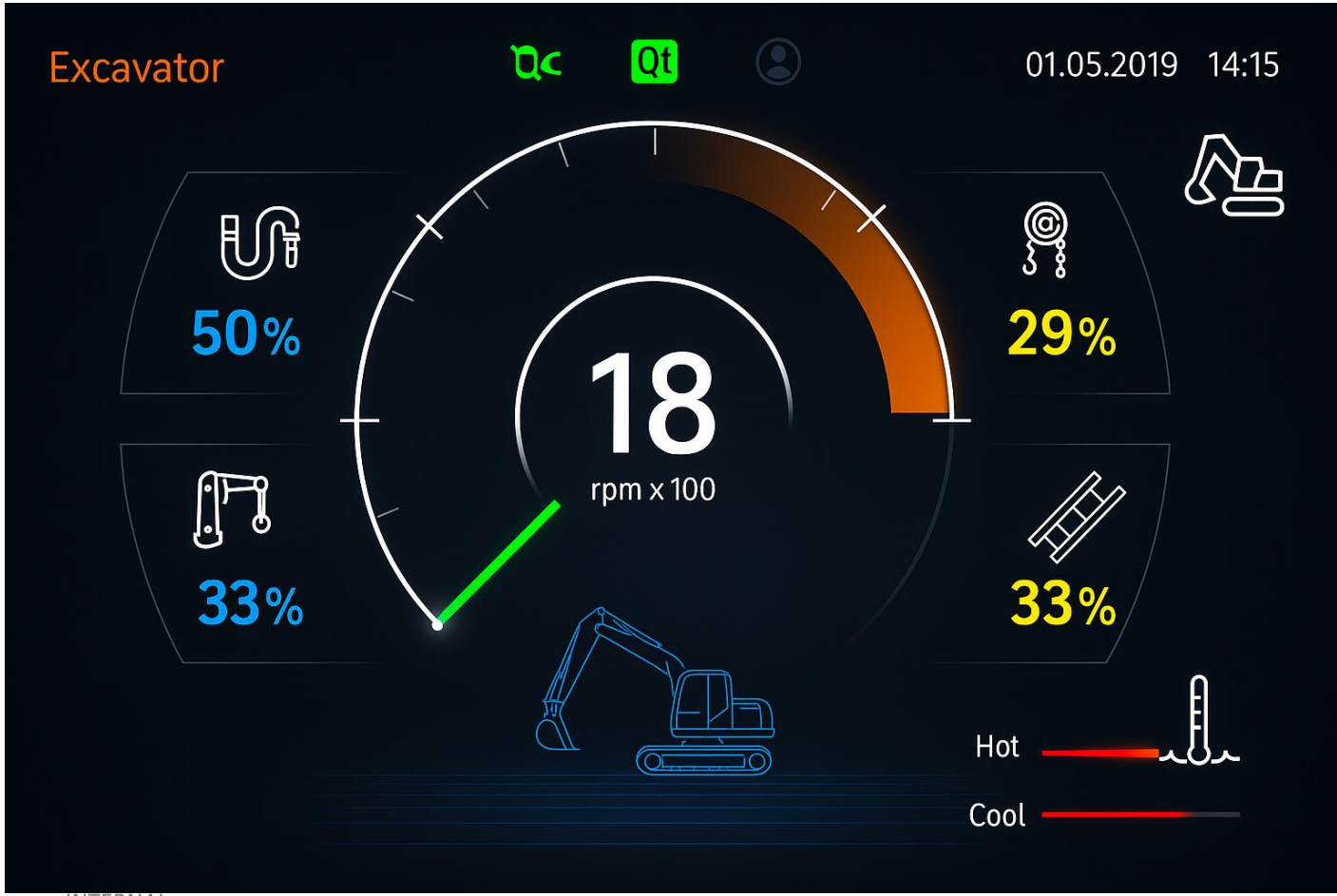
Prompt Engineering

Model: Sora



Few-Shot Learning

- Add a few examples first
- Model imitates style & structure
- More consistent results



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Prompt Engineering

Prompt Priming

- Define role + style + goal upfront
- Example:
  - “You are an HMI UX designer…”
- More aligned output

You are an experienced HMI/UI designer for mobile heavy machinery. Please design a dashboard layout for an Excavator with the resolution 800x480 Pixel. In a cool color sheme.

INTERNAL

LLMs & Methods

Prompt Engineering

Prompt Priming

- Define role + style + goal upfront
- Example:
  - “You are an HMI UX designer…”
- More aligned output

Design a modern Human Machine Interface (HMI) dashboard for a mobile excavator. General requirements: Aspect ratio: 16:10 (800x480 px) → optimized for a 4.3-inch touch display No surrounding frame, show only the UI design itself Highly modern and futuristic style with colorful gradients, transparent glass-like elements, and smooth shading Premium industrial look: robust but stylish, inspired by heavy machinery dashboards Color & Style: Base background: dark anthracite or steel gray Accent colors: strong orange, yellow, with additional highlights in cyan, blue, and white Use vivid neon glows, depth effects, and layered transparency for a futuristic look Buttons and gauges should feel 3D with shading, soft shadows, and subtle lighting Design must remain professional and easy to read outdoors Layout: Top bar (header): Left: machine name → “Excavator 220X” Center: digital clock (time only) Right: battery/engine icon with level indicator Main center area: Large empty circular gauge placeholder (no numbers or values), glowing orange arc, designed for hydraulic/engine data Around the gauge: 4 to 6 circular or square buttons, each with a bold icon: Hydraulics (fluid drop + piston icon) Drive (track/gear icon) Tool (bucket/hammer icon) Errors/alerts (triangle warning icon) [Optional] Camera or Eco/Power mode toggle Bottom bar (footer): Left: Home button (house icon) Center: quick access buttons (e.g., camera, settings) Right: connectivity status (Wi-Fi or CAN bus icon) Interaction style: Buttons should look touch-friendly, large, and glow slightly when active Press effects: subtle color shift or stronger glow Visual atmosphere: Clean and uncluttered layout Strong contrasts for visibility in sunlight Futuristic UI style with transparent overlays, glowing edges, and metallic textures in the background Dynamic, immersive look: feels like a next-gen heavy machinery cockpit interface

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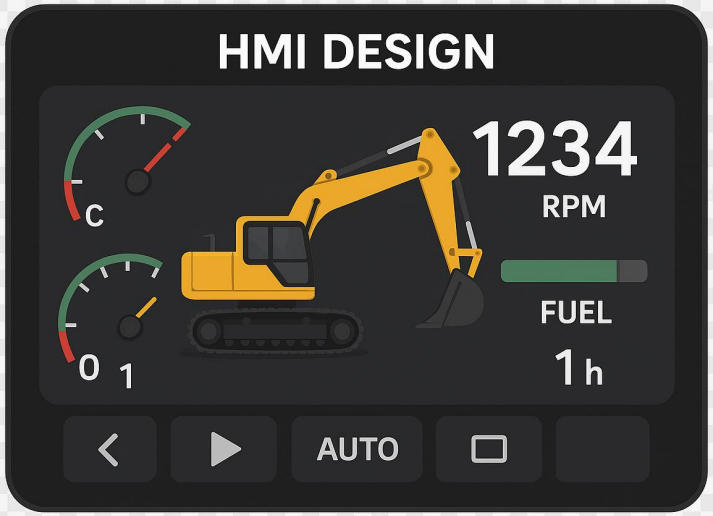
LLMs & Methods

Prompt Engineering

Prompt Priming

- Define role + style + goal upfront
- Example:
  - “You are an HMI UX designer…”
- More aligned output

Model: Copilot



Same command with priming

Model: Copilot

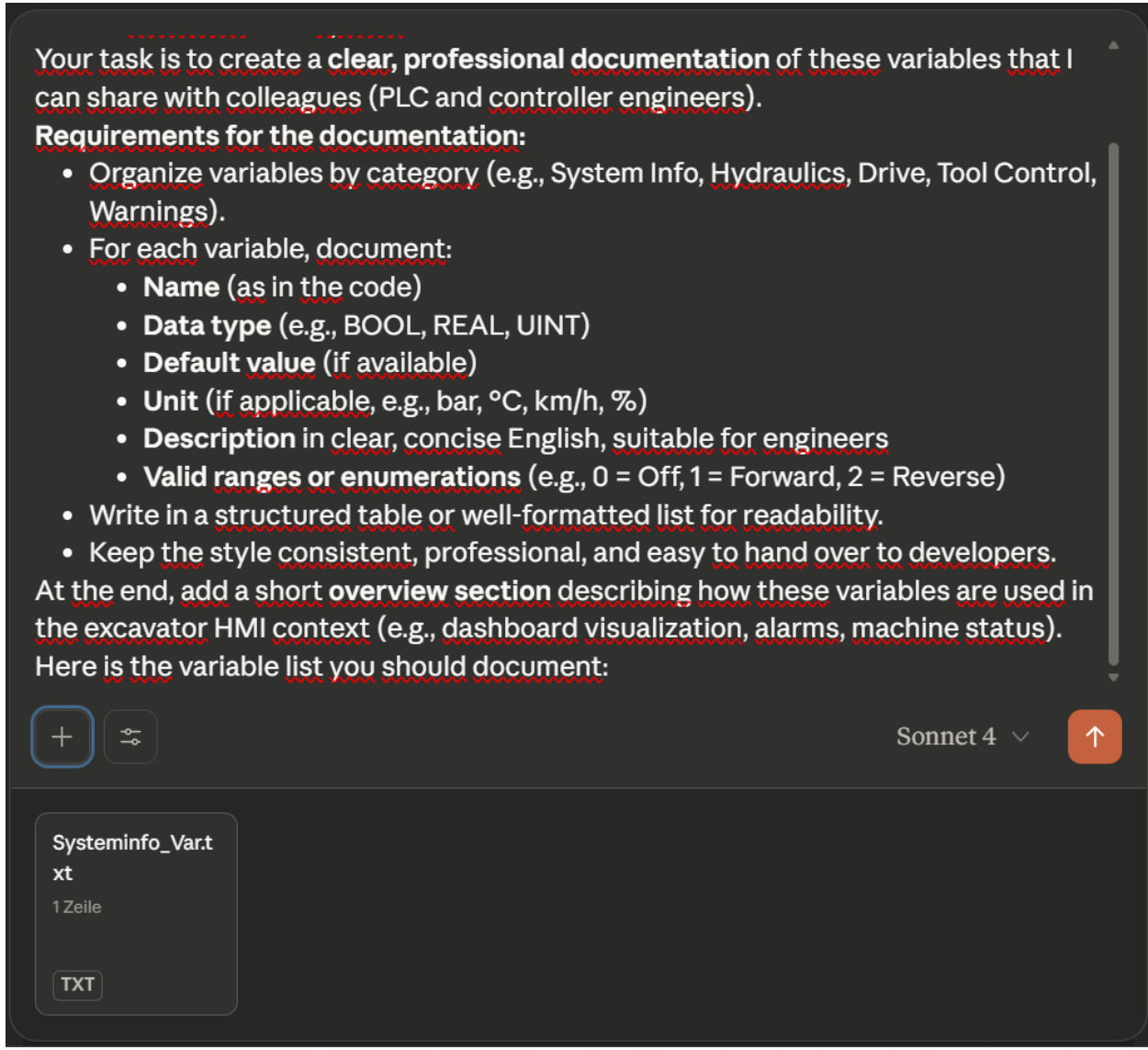


Prompt Engineering

RAG (Retrieval-Augmented Generation)

- Upload manuals, specs, regulations
- System retrieves relevant passages
- Injects into context window
  - (Retrieval-Augmented Generation)

Model:
Claude



INTERNAL

Wie war dein Tag, Florian?

You are an expert technical writer for industrial automation and mobile machinery.
I will provide you with a list of **CODESYS/ST variables** used in a controller for a mobile excavator HMI system.
Your task is to create a **clear, professional documentation** of these variables that I can share with colleagues (PLC and controller engineers).
Requirements for the documentation:

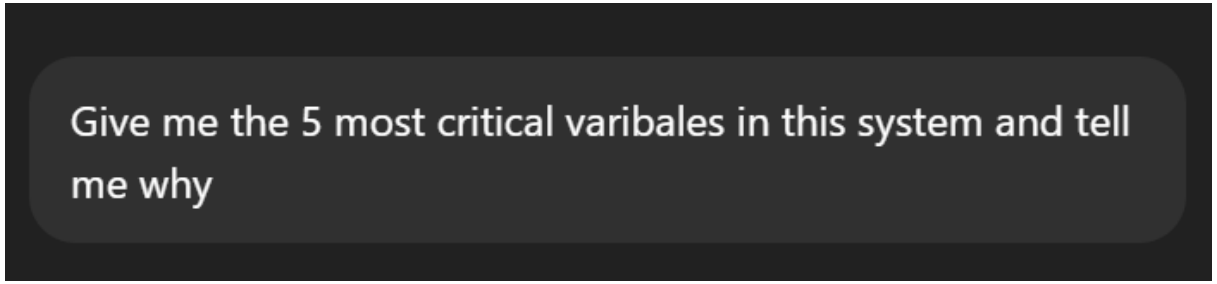
- Organize variables by category (e.g., System Info, Hydraulics, Drive, Tool Control, Warnings).
- For each variable, document:
  - **Name** (as in the code)
  - **Data type** (e.g., BOOL, REAL, UINT)
  - **Default value** (if available)
  - **Unit** (if applicable, e.g., bar, °C, km/h, %)
  - **Description** in clear, concise English, suitable for engineers
  - **Valid ranges or enumerations** (e.g., 0 = Off, 1 = Forward, 2 = Reverse)
- Write in a structured table or well-formatted list for readability.
- Keep the style consistent, professional, and easy to hand over to developers.

Sonnet 4

Systeminfo_Var.txt
1 Zeile

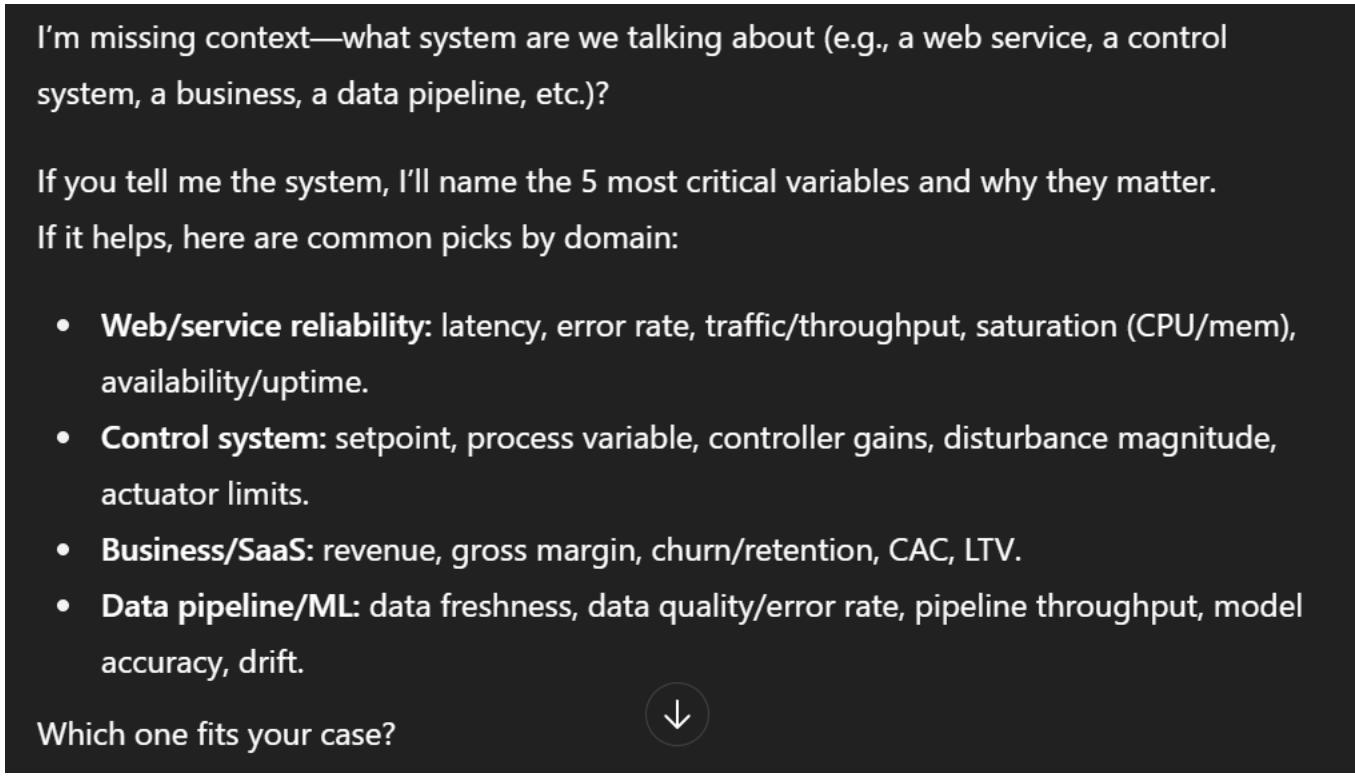
Prompt Engineering

Model: ChatGPT



Context Windows

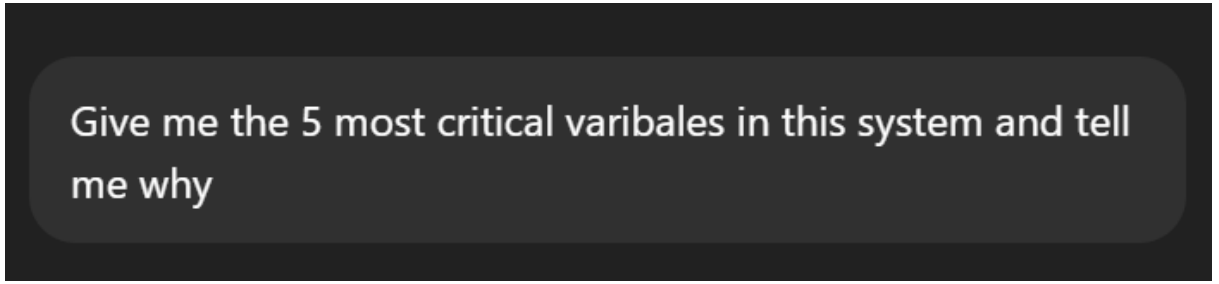
- Model's "memory span"
- Limited size (e.g. 8k–128k tokens)
- If full → oldest info gets cut off
- Analogy: RAM of the LLM



INTERNAL

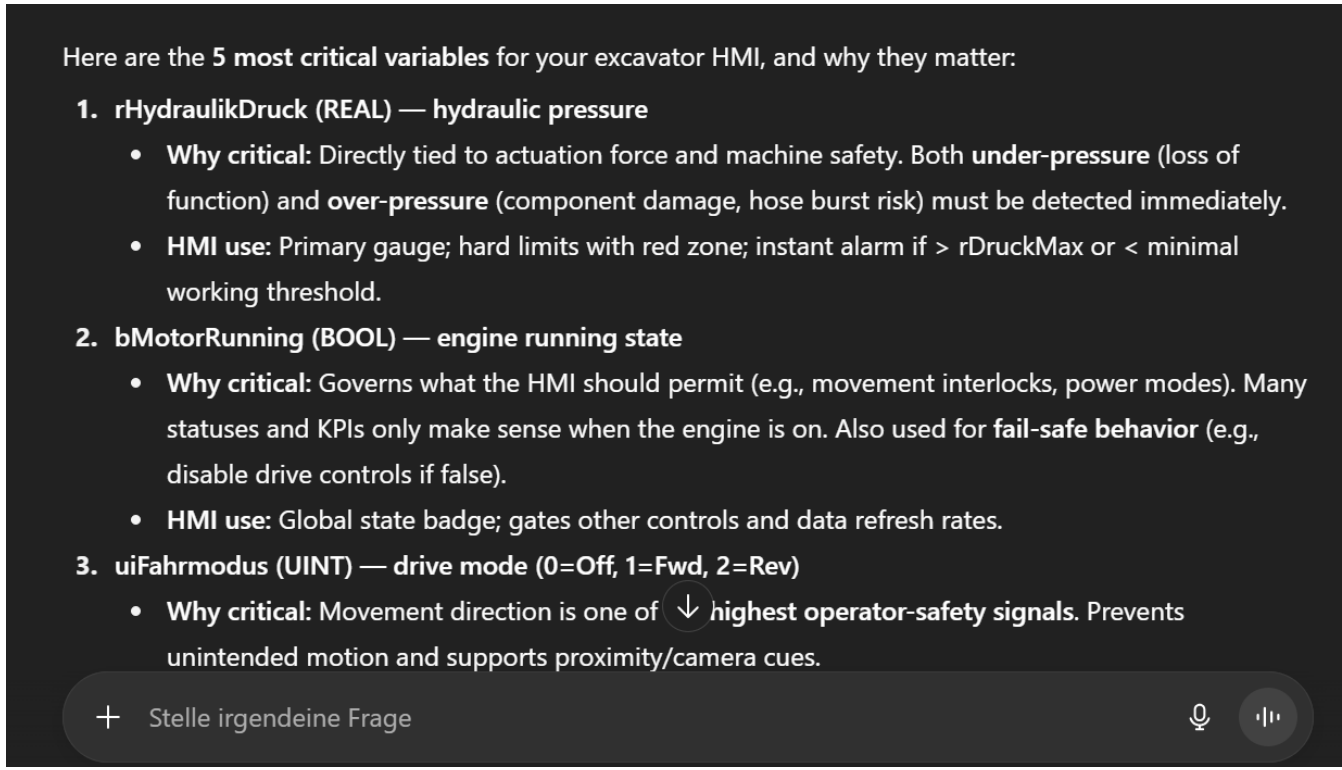
Prompt Engineering

Model: ChatGPT



Context Windows

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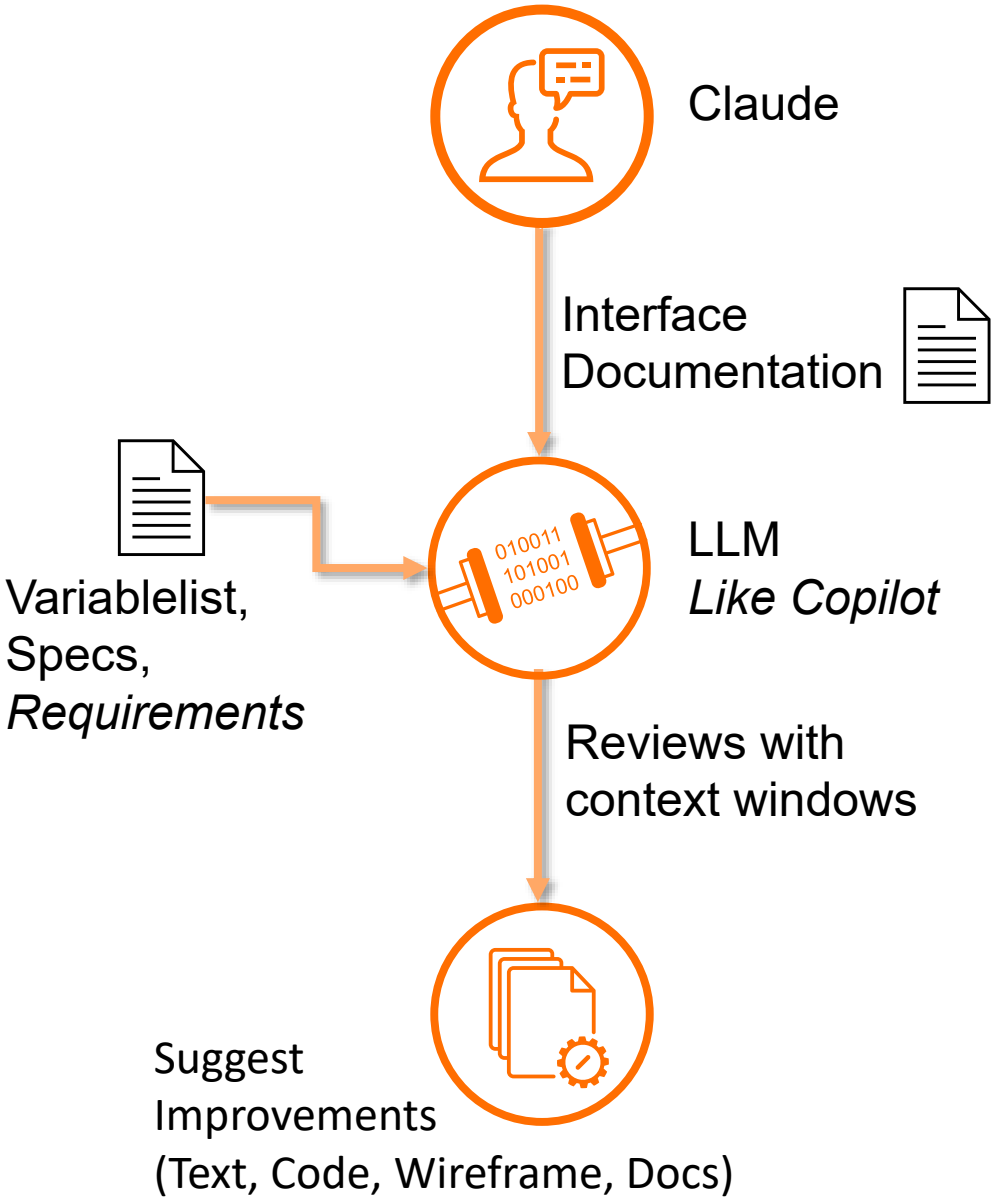
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Prompt Engineering

LLM-as-a-Judge

- Let one LLM review another
  - self-critique = echo chamber
- Ask: “How can this be improved?
  And Why?”
- Fresh perspective = higher quality

“Das haben wir immer schon so gemacht”

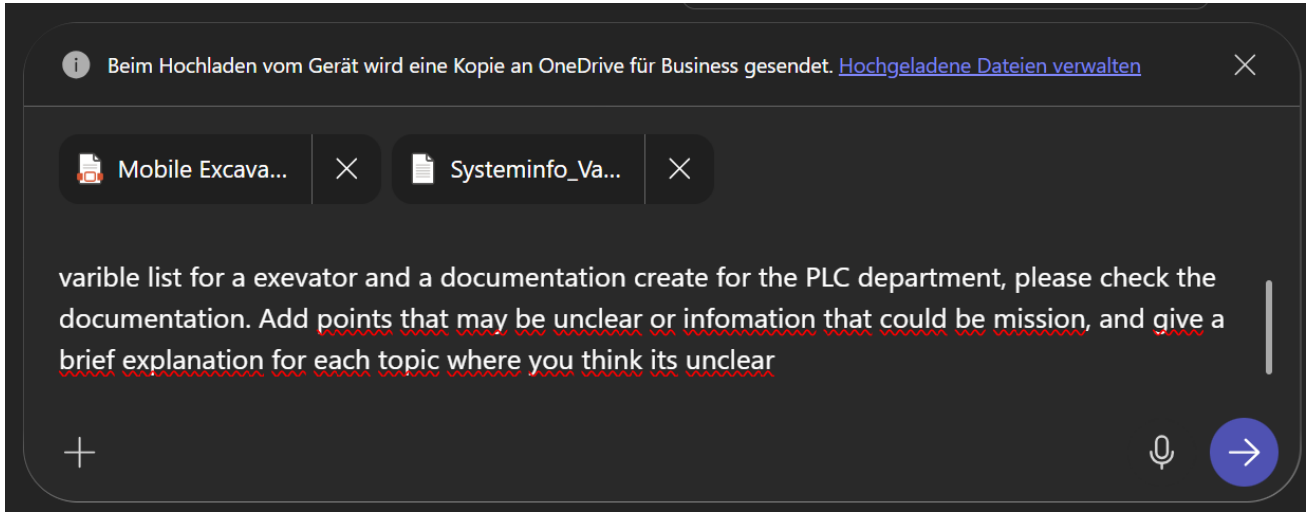


INTERNAL

LLMs & Methods

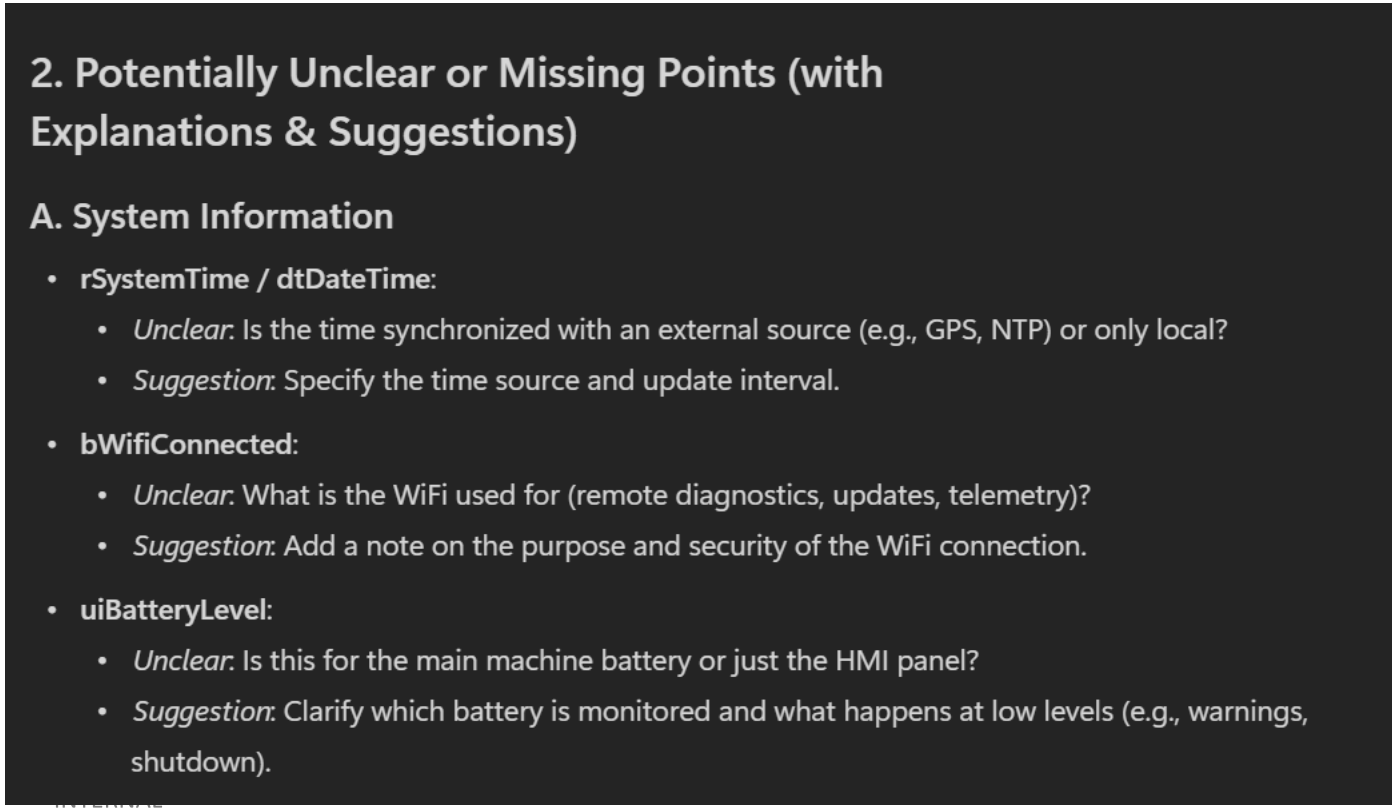
Prompt Engineering

Copilot checks Claude Documentation



LLM-as-a-Judge

- Let one LLM review another
  - self-critique = echo chamber
- Ask: “How can this be improved? And Why?”
- Fresh perspective = higher quality



2. Potentially Unclear or Missing Points (with Explanations & Suggestions)

A. System Information

- **rSystemTime / dtDateTime**:
  - *Unclear*: Is the time synchronized with an external source (e.g., GPS, NTP) or only local?
  - *Suggestion*: Specify the time source and update interval.
- **bWifiConnected**:
  - *Unclear*: What is the WiFi used for (remote diagnostics, updates, telemetry)?
  - *Suggestion*: Add a note on the purpose and security of the WiFi connection.
- **uiBatteryLevel**:
  - *Unclear*: Is this for the main machine battery or just the HMI panel?
  - *Suggestion*: Clarify which battery is monitored and what happens at low levels (e.g., warnings, shutdown).

Prompt Engineering

LLM-as-a-Judge

Claude

Creates Documentation for Systemvariables

Mobile Excavator HMI System - Variable Documentation.pdf

Copilot

Checks document for unclear points with prompt priming or context windows

- **rSystemTime / dtDateTime:**
  - *Unclear*: Is the time synchronized with an external source (e.g., GPS, NTP) or only local?
  - *Suggestion*: Specify the time source and update interval.

Claude

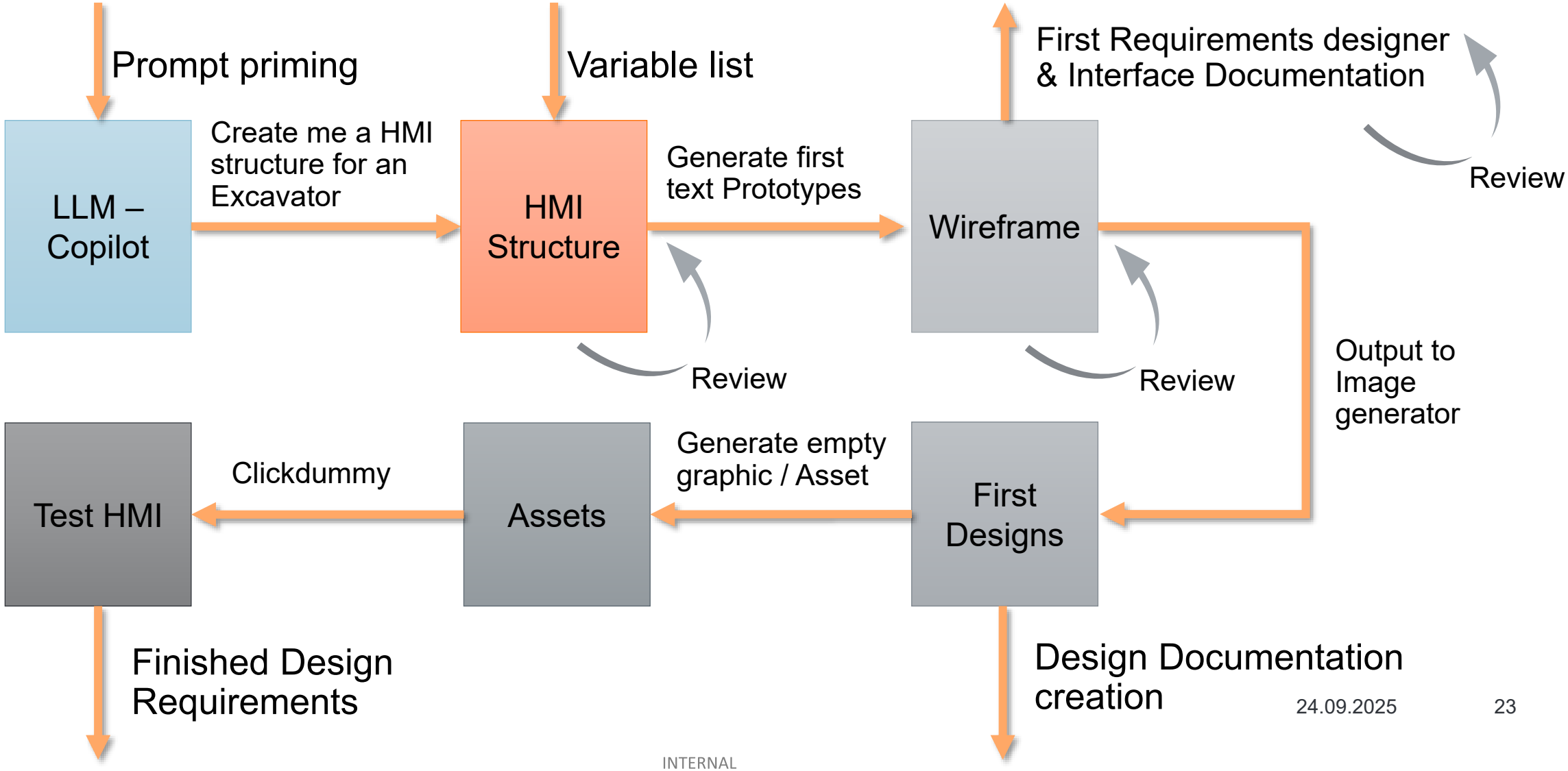
Adds the improvements to the document

Mobile Excavator HMI System - Variable Documentation - Version_2.pdf

Copilot

Checks document again…

Example HMI prototype process

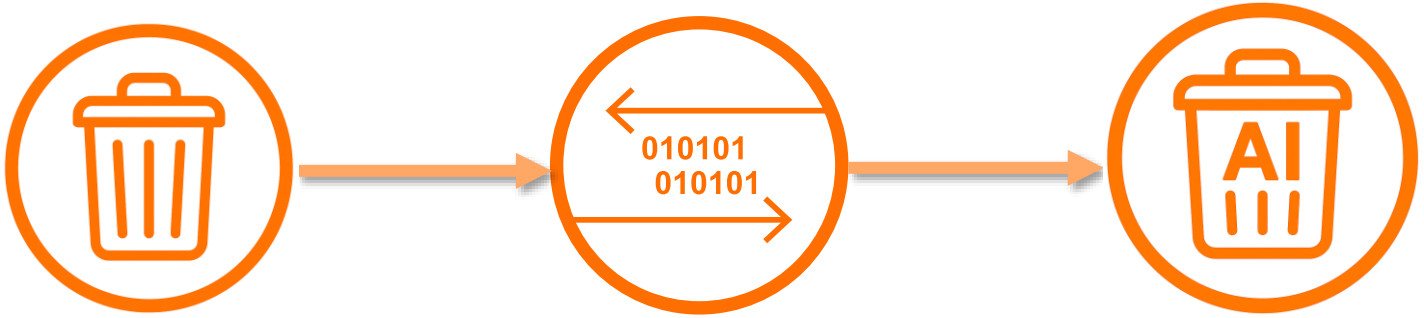


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The Role of the Engineer

Summary

- Different methods & models → pick the right one for your use case
- Engineer = decision-maker & quality gate
- AI = co-designer, **assistants that does the boring stuff**
- AI is only as good as the input (Garbage In → Garbage Out)



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Many thanks



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