

Saarthi: The First Al Formal Verification Engineer

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Saarthi - A Sanskrit word that means someone who guides and leads you to your destination



Agenda



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Agenda



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The US design workforce is estimated to face 35% gap between supply & demand by 2030 creating a shortfall of 23,000 workers





supply by nearly 35% in 2030

Source: BCG Analysis, The Growing Challenge of Semiconductor Design Leadership

Generative AI in hardware design verification has challenges that prevents precise usecase definition



Generative AI is a stochastic process



Non-deterministic output makes it hard to find definite usecase



LLMs suffer ADHD and hallucination – Devin has 18% efficacy



GPT users can get stuck in iterative loops



HW design verification requires precise, deterministic answers

We need to focus on using Generative AI for problem-solving





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Agentic workflows empower AI agents to engage in a more dynamic, iterative and self-reflective process





Non-agentic workflow (zero-shot)



Too much expectation from AI – first time right



Please write me an essay on topic X from start to finish in one go, without using backspace



Agentic workflow (few-shot)

- Write an essay outline on topic X
- Do you need any web research?
- Write a first draft
- Consider what parts need revision or more research
- Revise your draft



Source: Andrew Ng



Human-in-the-Loop AI: My favorite intern



Human-in-the-Loop agentic AI: Continuous feedback from AI agents improves results



Here's the code for intended task{assertion} Please write me SVA code for task{assertion} property fifo not full and empty; 1 |-> \$onehotzero(full,empty); endproperty assert property (fifo not full and empty); Check the code for correctness and give feedback There's a bug on line 2. Fix it by... property fifo_not_full_and_empty v1... It failed to compile in Jasper. Fix it by... property fifo_not_full_and_empty v2... Coder Agent Critic Agent (LLM) (LLM)

Source: Andrew Ng

Agentic reasoning design patterns helps divide problems and concur them





Iterative refinement with self-feedback



Code	Feedback	Refine
<pre>array[i] != array[j];}}</pre>		
if (i != j) {	keyword "unique"	}
<pre>foreach(array[j]) {</pre>	to use the SV	<pre>unique{array};</pre>
<pre>foreach(array[i]) {</pre>	A better approach is	<pre>constraint array_c {</pre>
values in an array	it uses brute force.	
Write constraint for unique	The code is slow as	Code (refined)

Chain-of-thought prompting

Model Input

Q: Roger has 5 tennis balls. He buys 2 more cans of tennis balls. Each can has 3 tennis balls. How many tennis balls does he have now?

A: The answer is 11.

Q: The cafeteria had 23 apples. If they used 20 to make lunch and bought 6 more, how many apples do they have?

Model Output A: The answer is 27. 🗙

Q: Roger has 5 tennis balls. He buys 2 more cans of tennis balls. Each can has 3 tennis balls. How many tennis balls does he have now?

Model Input

A: Roger started with 5 balls. 2 cans of 3 tennis balls each is 6 tennis balls. 5 + 6 = 11. The answer is 11.

Q: The cafeteria had 23 apples. If they used 20 to make lunch and bought 6 more, how many apples do they have?

A: The cafeteria had 23 apples originally. They used 20 to make lunch. So they had 23 - 20 = 3. They bought 6 more apples, so they have 3 + 6 = 9. The answer is 9.

- Chain-of-thought: a series of intermediate reasoning
- Enables LLM models to tackle complex arithmetic, commonsense, and symbolic reasoning tasks

Source: Chain-of-Thought Prompting Elicits Reasoning in Large Language Models

Saarthi: Agentic AI based formal verification using multiagent collaboration





GPT-4o, GPT-4Turbo, Llama etc., Human-in-the-Loop AI

Sampling-and-voting method scales the performance of LLMs with the number of agents instantiated





Source: More Agents Is All You Need



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The set of tasks that AI can do will expand dramatically because of agentic workflows



Ready to use boiler-plate code



Faster ramp-up of junior engineers

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Code faster, with higher quality in small time windows

Agentic AI is a domain-agnostic, generic, and scalable approach



R&D engineer can focus on more complex problems

R&D teams can strive for more ambitious goals

Define your own AI agents and start delegating tasks

Questions & answers



