

AI in Electronics Design



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Will the electronics designer become electronic?

Richard van der Werf



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Woensdag 19 april 2023
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AI in electronics design

- ✦ What is Artificial Intelligence?
- ✦ AI in current tools
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AI is everywhere now

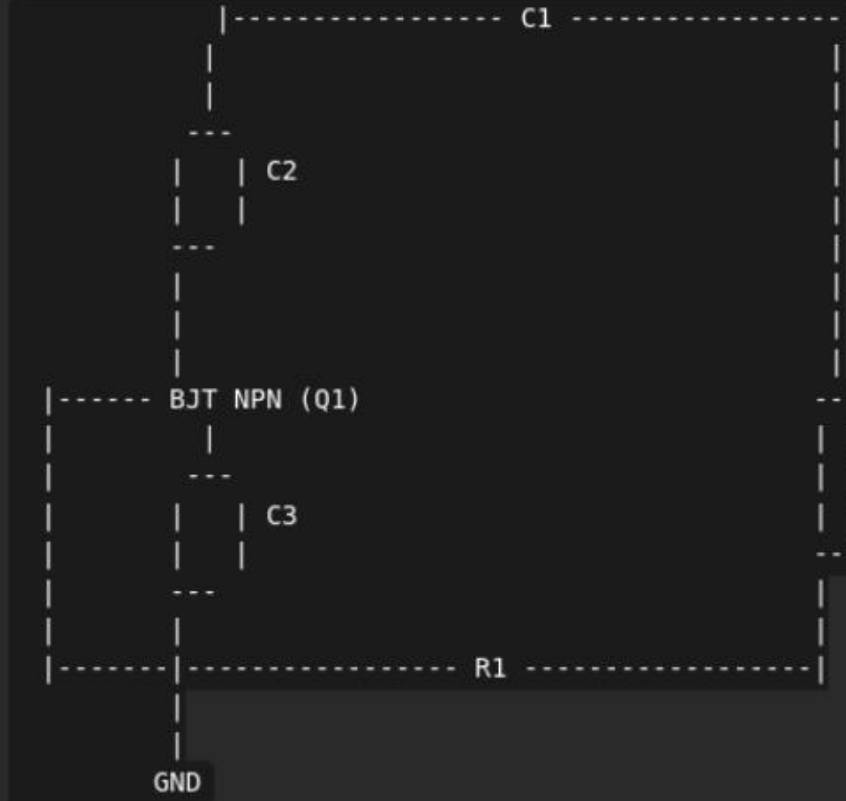
Ask ChatGPT, Bard or Copilot on simple things, and it will come up with an answer.





copilot

Sure, a simple type of oscillator which uses only NPN transistors is a Colpitts oscillator. Here is a basic Colpitts oscillator schematic:



Components:

- Q1: An NPN transistor. For instance, a 2N3904 could be used.
- C1, C2, C3: Capacitors. Values will depend on the desired frequency
- L1: An inductor. Its value will depend on the desired frequency.
- R1: A resistor to control the base current of the transistor.

Note: The values of C1, C2, C3, and L1 should be selected to resonate at the frequency you want the oscillator to work at. The resonant frequency can be calculated as:

$$[f = \frac{1}{2 \pi \sqrt{LC}}]$$

Can you please suggest a buck converter IC. It should take 12V in and output 5V. I need efficiency larger than 70 percent, and 5A output current.

View other drafts

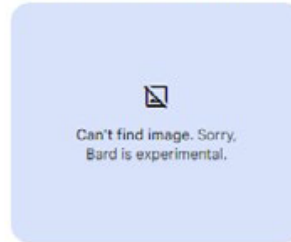
Sure, here are a few buck converter ICs that meet your requirements:

- TPS79733-Q1 from Texas Instruments is a highly efficient buck converter IC with an efficiency of up to 96%. It can output up to 5A of current and has a wide input voltage range of 4.5V to 36V.



TPS79733-Q1 buck converter IC from Tex...

- NCP6036 from ON Semiconductor is another highly efficient buck converter IC with an efficiency of up to 94%. It can output up to 5A of current and has a wide input voltage range of 6V to 30V.



- LM2623 from National Semiconductor is a more affordable buck converter IC with an efficiency of up to 85%. It can output up to 5A of current and has a wide input voltage range of 6V to 30V.



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Artificial Intelligence

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What is Artificial Intelligence?



Artificial intelligence (AI) refers to computer systems capable of performing complex tasks that historically only a human could do, such as reasoning, making decisions, or solving problems.



AI encompasses a wide variety of technologies, including machine learning, deep learning, and natural language processing



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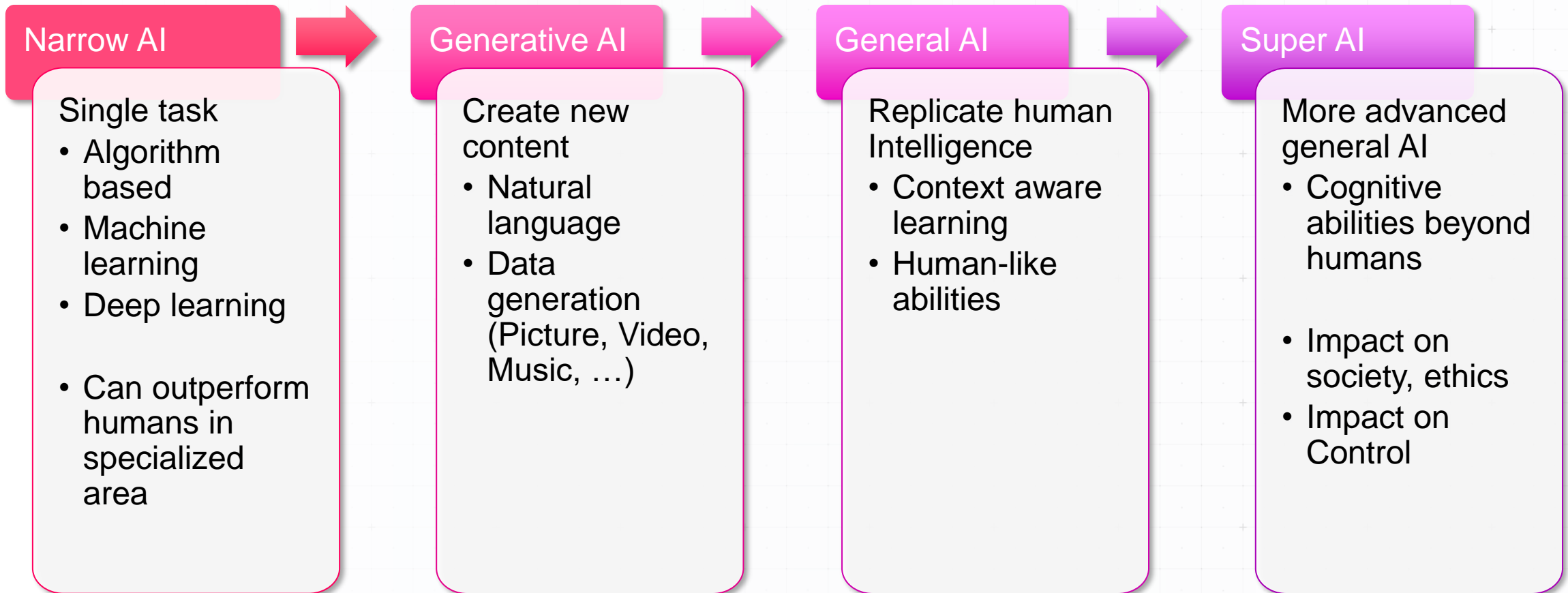
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AI evolution

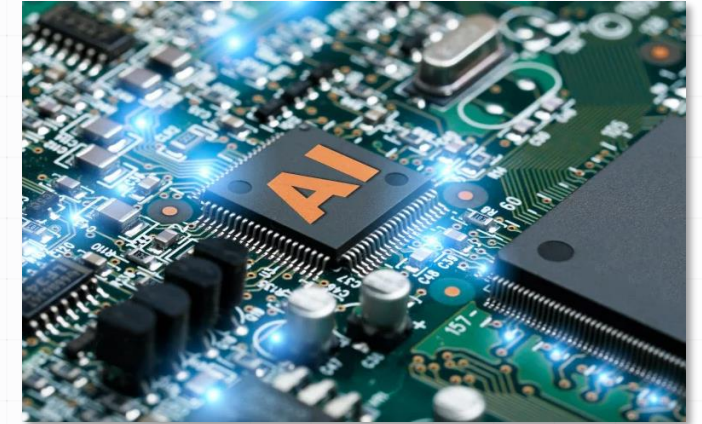





What is AI now

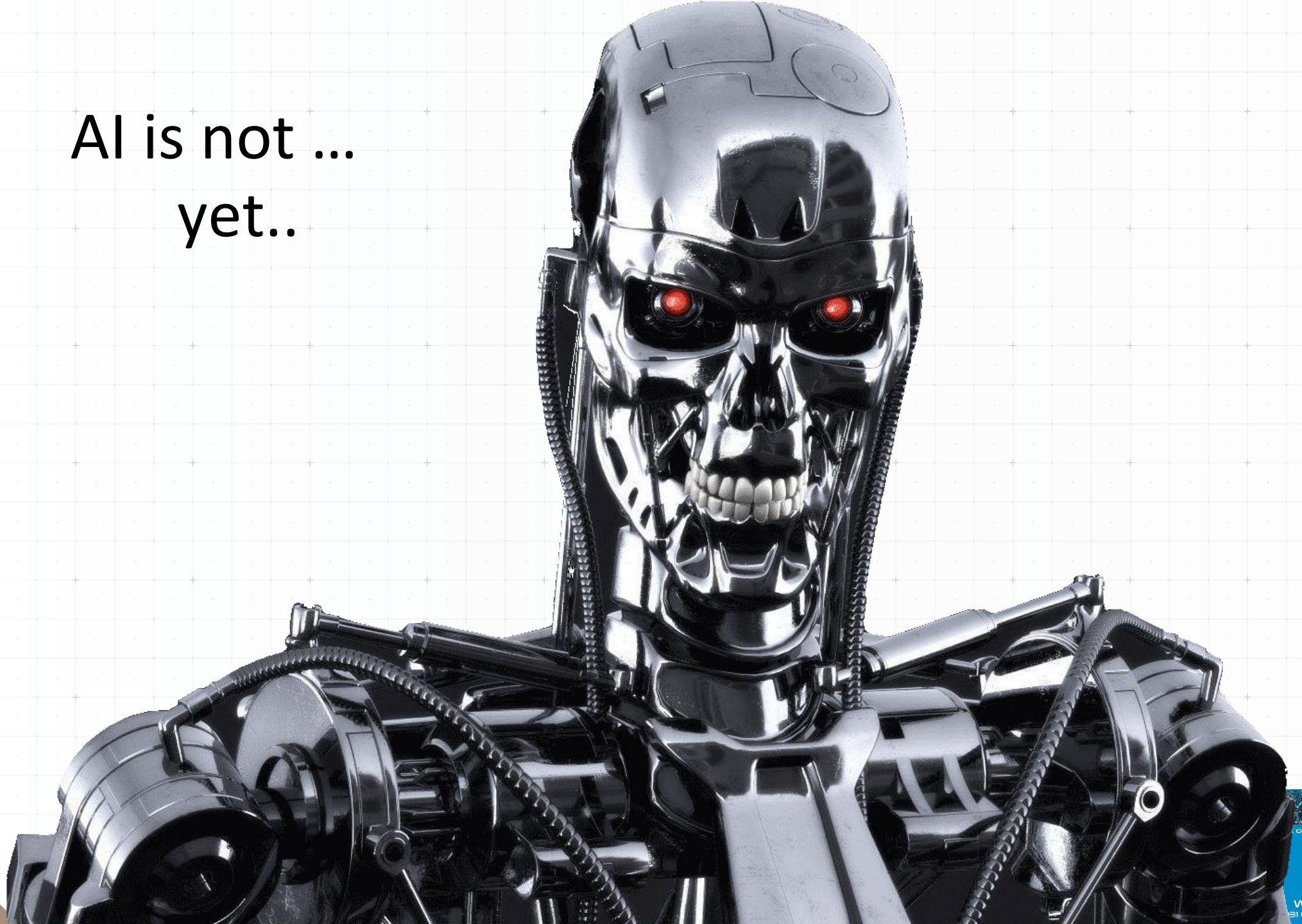
AI usually presents itself as:

- ✦ Systems that analyze information, like image detection systems.
- ✦ Systems that solve a problem, like find an optimal routing (without using brute force) or play chess.
- ✦ Systems with natural language interfaces that help find information.
- ✦ Systems that generate content like images, music, ...





AI is not ...
yet..

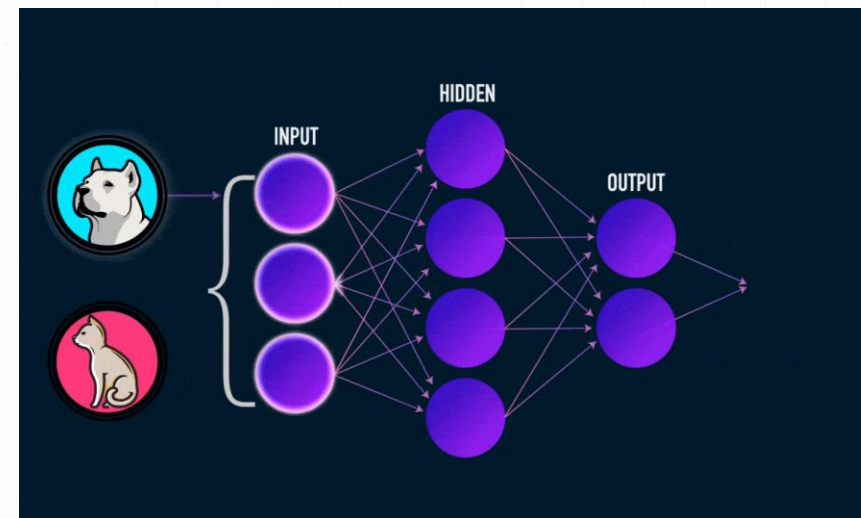




How does AI work?

Machine learning is concerned statistical algorithms that can learn from data and generalize to unseen data, and thus perform tasks without explicit instructions.

Deep learning is a form of machine learning which uses artificial neural networks to process information and thus find inferences or results.

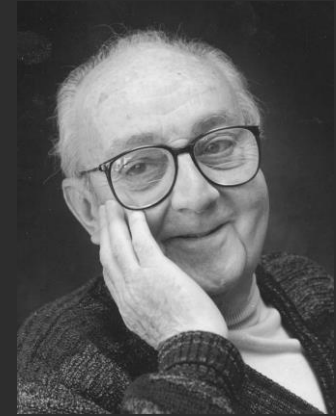




Issues with AI

"All models are wrong, but some are useful"

- *George Box, 1976*



- Data quality
- Traceability of the information
- Are you at the edge of the model?



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Summary

AI strives to mimic human intelligence.

AI uses data to learn.



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AI in EDA tools

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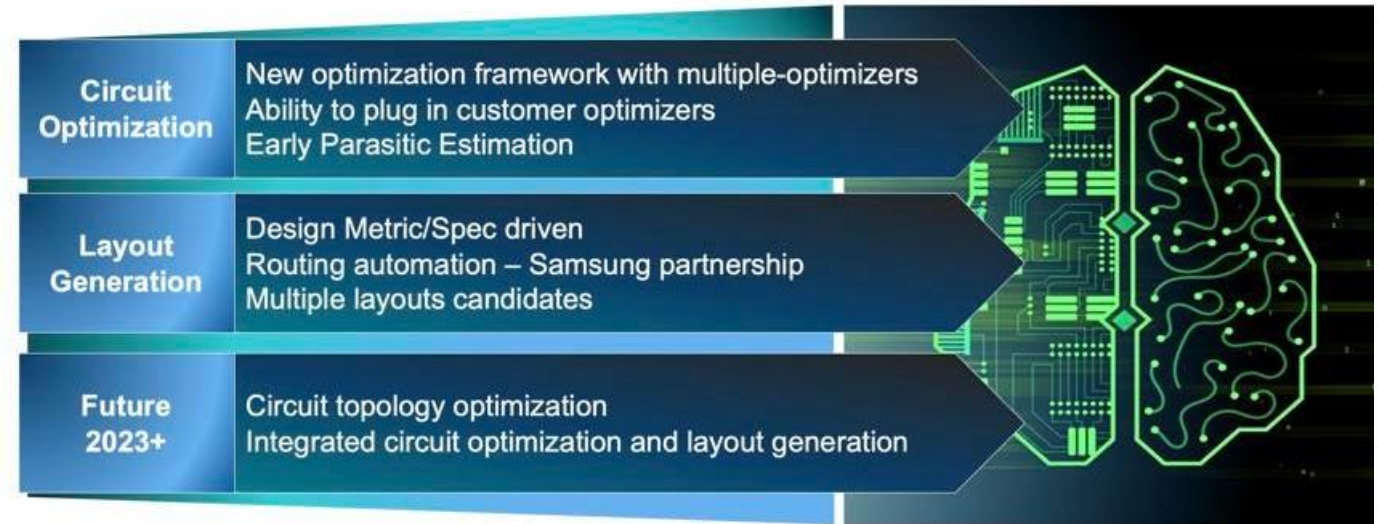
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Areas where AI is already applied

- ✦ Design optimization,
- ✦ Verification,
- ✦ Synthesis,
- ✦ Component selection,
- ✦ Component placement,
- ✦ Calculating optimal values,
- ✦ Reducing power consumption, performance and/or area
- ✦ Predicting complex circuit behaviour
- ✦ Identify design errors
- ✦ ...



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Current forms

Assist	Chat-based tools with a natural language interface, that can assist in operating the tool, in giving ideas, point to the right information (datasheets), suggest components, etc.
Generation	Generate testbenches. Design retargeting. Optimize for power, performance, area, etc. Generate powerplanes, component placement. Testpattern generation
Analyse	Identify issues, e.g. through waveform analysis, DRCs etc

AI in current EDA tools

PCB design

- **Flux AI** – Adds Copilot to the design tool. Helps in selecting parts, getting information on the parts, determine values, how to connect.

The screenshot displays a chat interface with a dark background and purple accents. It features several chat bubbles and a central diagram. The chat bubbles include a user question about building a USB 3.2 USB-C hub, an AI response with a list of ideas and a link to a datasheet, a user question about connecting an ATTINY85 to an OLED, an AI response explaining pin 32 on an ESP1, and a user compliment. The central diagram shows a pin header with labels: 5 AREF/PB0, 6 PB1, 7 PB2, 2 XTAL1/PB3, 3 XTAL2/PB4, and 1 ~RESET~/PB5. A purple box labeled 'copilot' is connected to the header, with lines indicating connections to SDA, SCL, and GND. A mouse cursor is pointing at the GND connection.

@copilot I'd like to build a USB 3.2 USB-C hub. How would you approach this?

For a USB 3.2 USB-C hub, I have some ideas:

1. You'll need a USB-C hub controller: For USB 3.2 (20 Gbps), consider the TI TPS65983B ([datasheet](#))... Show more

Great Scott! You're a genius!

@copilot connect this ATTINY85 to the OLED

You got it...

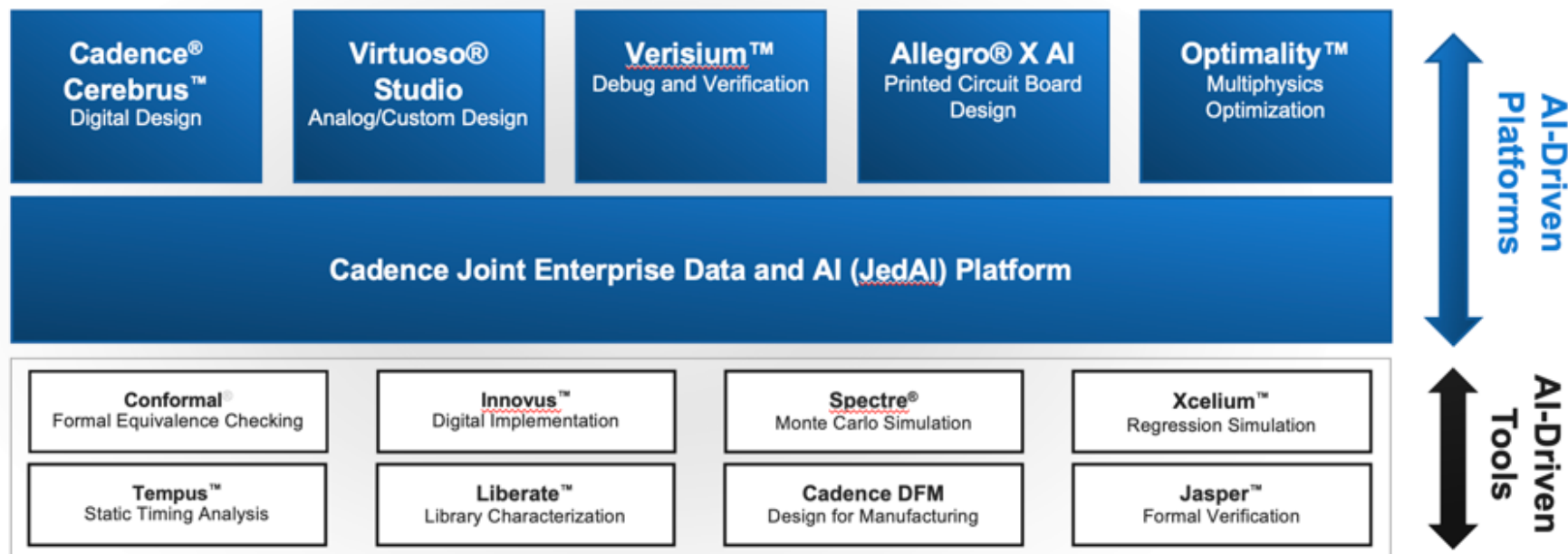
@copilot, what does pin 32 do on this microcontroller?

According to the datasheet^[1], Pin 32 on ESP1 is an IO pin named "IO32". It's a general-purpose input/output pin that can be used for various functions such as digital input, digital output, analog input, or as an interface for peripherals like I2C, SPI, and UART... Show more

AI in current EDA tools

PCB design

- **Cadence Allegro X AI** - Automates component placement, power plane creation, and routing critical nets.





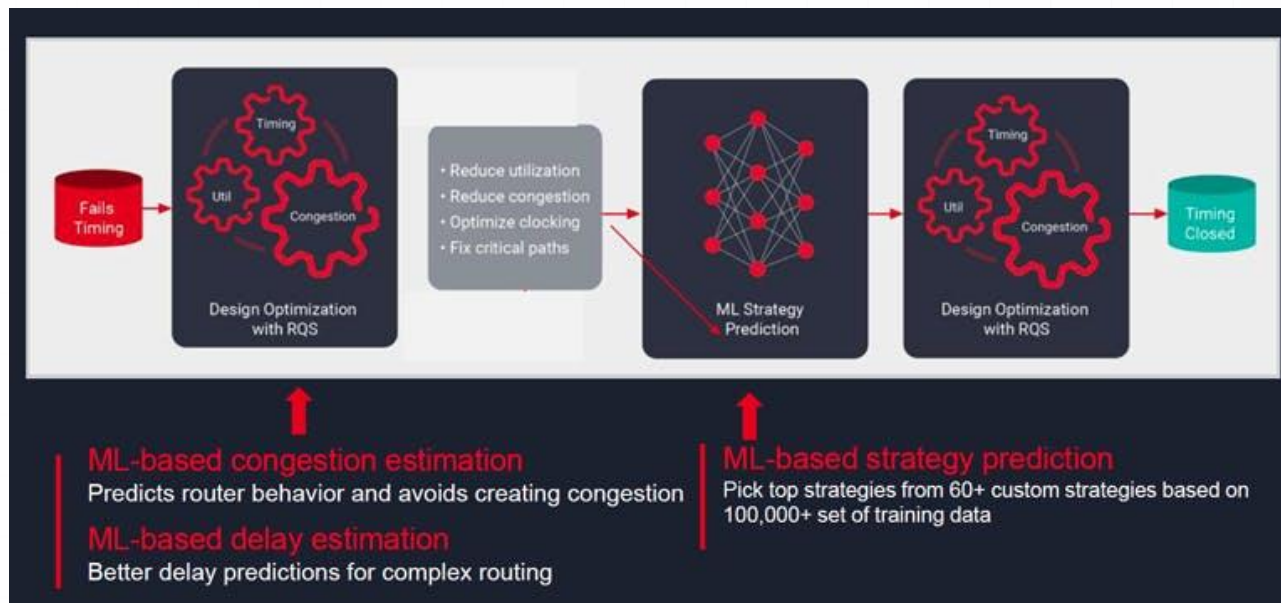
AI in current EDA Tools Chip design

- ***Synopsys.ai Copilot*** – Chat-like assistant that can work as an experienced co-worker. Explanations, advice, etc.
- ***Siemens Solido*** – IC verification. Promises to accelerate IC verification. It promises to do a complete verification without doing full-force
- ***Synopsys DSO.ai*** – Autonomous optimization of power, performance and area
- ***Cadence Cerebrus*** – optimization methods for power, performance and area.
- ***The Cadence Verisium Verification Platform*** – Uses algorithms that leverage big data and generative AI across multiple runs of multiple engines The Verisium platform optimizes verification workloads, boosts coverage, and accelerates root cause analysis of bugs.



AI in current EDA tools FPGA design

- ***Xilinx Vivado ML*** – Uses AI to Optimize/Route. E.g. Intelligent design runs to improve timing closure.



Mainly the FPGA tools are helping to reduce the effort to create AI powered designs (e.g. *Intel FPGA AI*).



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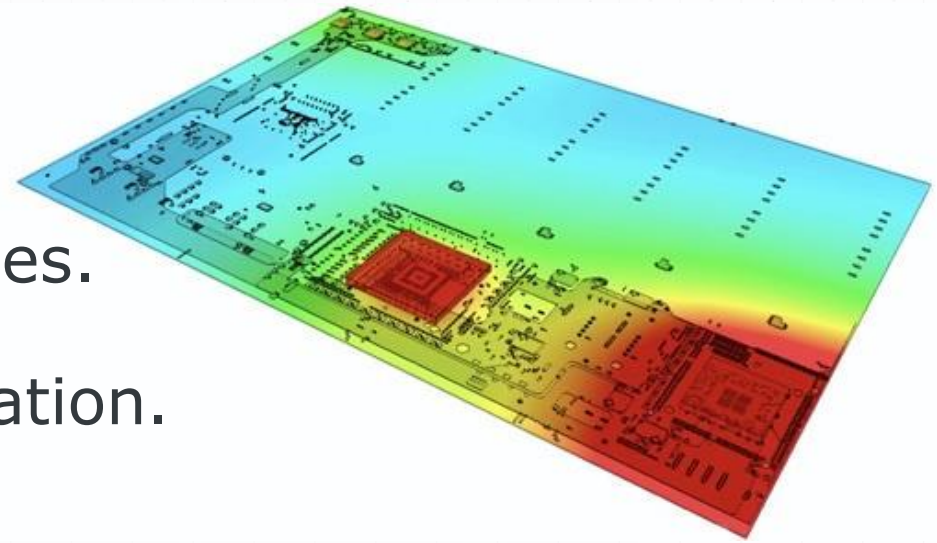
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AI in current EDA tools

Multiphysics

Uses AI to

- Help in setting up simulations
- Optimize simulation approaches.
- Optimize design space exploration.



E.g.

- ***Cadence Celsius***
- ***Ansys AI+, Ansys ChatGPT***



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What does it mean for CAD environment

AI usually means ... lots of data to process

- More memory
- More compute power needed
- Continuous connection to the internet





What does it mean for CAD environment

- Not just on a single machine. Usually, larger server installations needed.

(Unless PCs get more AI processing capabilities on board)

- Tools will need a connection to cloud computing, or move to the cloud altogether.

- Complex environments.
- What happens to your data?



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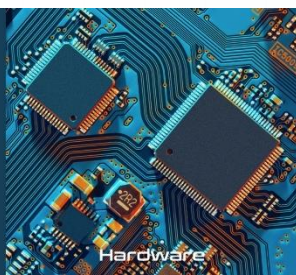
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Will it become really creative?

The really creative part like the circuit design is much more challenging.

One reason is that the data is probably the Achilles heel. IP protection is blocking this:

Who will deliver the high-grade designs to get it trained on?





Data is an issue

On Dec. 27, 2023, The New York Times filed a lawsuit against OpenAI alleging that the company committed willful copyright infringement through its generative AI tool ChatGPT.

“One key obstacle in applying AI to PCB inspection is the dependence on large, labeled datasets for training AI systems. Collating these datasets can be resource-intensive, especially because images of component defects—what’s sometimes termed “negative data”—can be difficult to obtain. What’s more, not all manufacturers possess the required hardware imaging capabilities to collect data in a format that’s suitable for AI applications.”



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Future developments

More and more generative capabilities will emerge;
more design tasks can be automated.

This leads to higher level of design.

=> The actual tasks the designer will change, so we
can probably handle larger designs.



So “Will the Electronics Designer be Electronic?”



No. It will change, but electronics designers will not become obsolete

“AI will never take over the design process, but it has become a critical capability that helps design teams get the job done and focus on higher-value functions that help their employer succeed in the market.”

Karl Freund Jun 13, 2023



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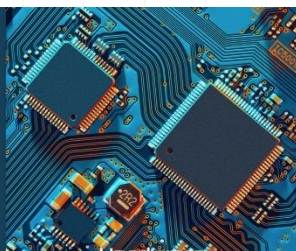
Connecting your Design Flow

- ✦ Support
- ✦ Consultancy
- ✦ Design
- ✦ Training

Stand nr. 3

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