



Leveraging AI to Accelerate Embedded Software Development

# DAY 1: The Rise of AI in Embedded Software

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## THE SPEAKER



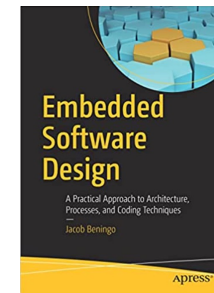
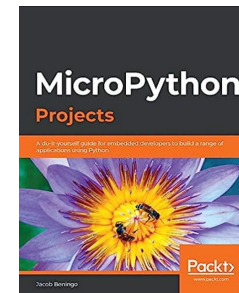
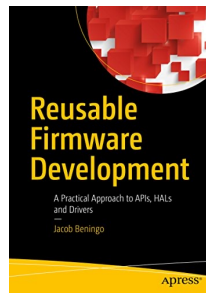
# Jacob Beningo

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## Beningo Embedded Group - President

Focus: Embedded Software Consulting and Training

Specializes in *creating and promoting* embedded software excellence in businesses around the world.



Blogs for:

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01

# Introduction

# Welcome!

from the artificial intelligence . . .

## Example uses of AI:

- Medical Diagnosis
- Finance and Banking
- Autonomous Vehicles
- Virtual Assistants
- Business Development
- Marketing
- Brainstorming
- Image Analysis
- etc

JA You

Can you give me a 100 - 150 word introductory paragraph for a presentation on AI and ML entitled "Leveraging AI to Accelerate Embedded Software Development"?

ChatGPT

Certainly! Here's an introductory paragraph for your presentation on "Leveraging AI to Accelerate Embedded Software Development":

"In today's rapidly evolving technological landscape, the integration of Artificial Intelligence (AI) and Machine Learning (ML) into embedded software development is not just an innovation, but a necessity. The title of our presentation, 'Leveraging AI to Accelerate Embedded Software Development,' encapsulates a transformative approach where AI and ML are not merely tools, but pivotal allies in the development process. This integration promises to revolutionize how we design, develop, and deploy embedded software, drastically reducing development time while enhancing efficiency and reliability. By harnessing the power of AI algorithms and ML models, developers can anticipate and solve complex challenges, automate mundane tasks, and optimize code in ways previously unimagined. Our journey today will explore the cutting-edge methodologies, real-world applications, and the future potential of AI and ML in transforming embedded software development. This convergence of AI and embedded systems is not just the future; it is the present, and it is reshaping the landscape of software development as we know it."



# Non-technical Examples

AI Show Notes

## Summary

In this episode, Jacob discusses trends in the embedded software industry and provides techniques and practices for staying relevant and successful. The trends include leveraging AI to develop embedded systems, improving CI/CD processes, phasing out C for C++ or Rust in 32-bit applications, adopting developer-centric workflows, moving to higher levels of abstraction, and using POSIX APIs in real-time operating systems. The techniques covered are model-based design, containerizing and virtualizing development processes, and adopting DevOps and CI/CD.

## Takeaways

- Leveraging AI can improve efficiency, code generation, debugging, and code reviews in embedded software development.
- Improving CI/CD processes can enhance automation, reliability, and deployment of embedded software.
- Phasing out C for C++ or Rust in 32-bit applications can provide more modern and scalable development options.
- Adopting developer-centric workflows allows for customization and efficiency in the development process.
- Moving to higher levels of abstraction enables hardware independence and scalability in embedded software development.
- Using POSIX APIs in real-time operating systems provides flexibility and portability in application code.
- Model-based design, containerization, and virtualization are effective techniques for efficient and scalable development processes.
- Adopting DevOps and CI/CD improves collaboration, automation, and efficiency in embedded software development.

## Chapters

- 00:00 Introduction and Reflection on the Embedded Software Industry
- 02:14 Trend 1: Leveraging AI to Develop Embedded Systems
- 11:53 Trend 2: Improving CI/CD Processes
- 16:44 Trend 3: Phasing out C for C++ or Rust in 32-bit Applications



Hello And Welcome To The Embedded Frontier Podcast. I'm Your Host, Jacob Benigno. And Today We Are Going To Be Talking About Trends In The Embedded Software Industry. Tha... [View Transcript](#)

37:42

# Non-technical Examples

 **New Course**

## Course Details

We'll use your title and description to generate a sample course outline:

Title

Machine Learning in Embedded Systems

Brief description

Example: Learn the skills required to ...

Use this info to generate content and additional resources

[Learn more](#)

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 AI Assistant **New**

 **Zoom AI Companion**

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## Audience POLL Question

Are you currently using AI outside of embedded software? If so, in the chat, list some areas where you are currently using it.

- Yes
- No



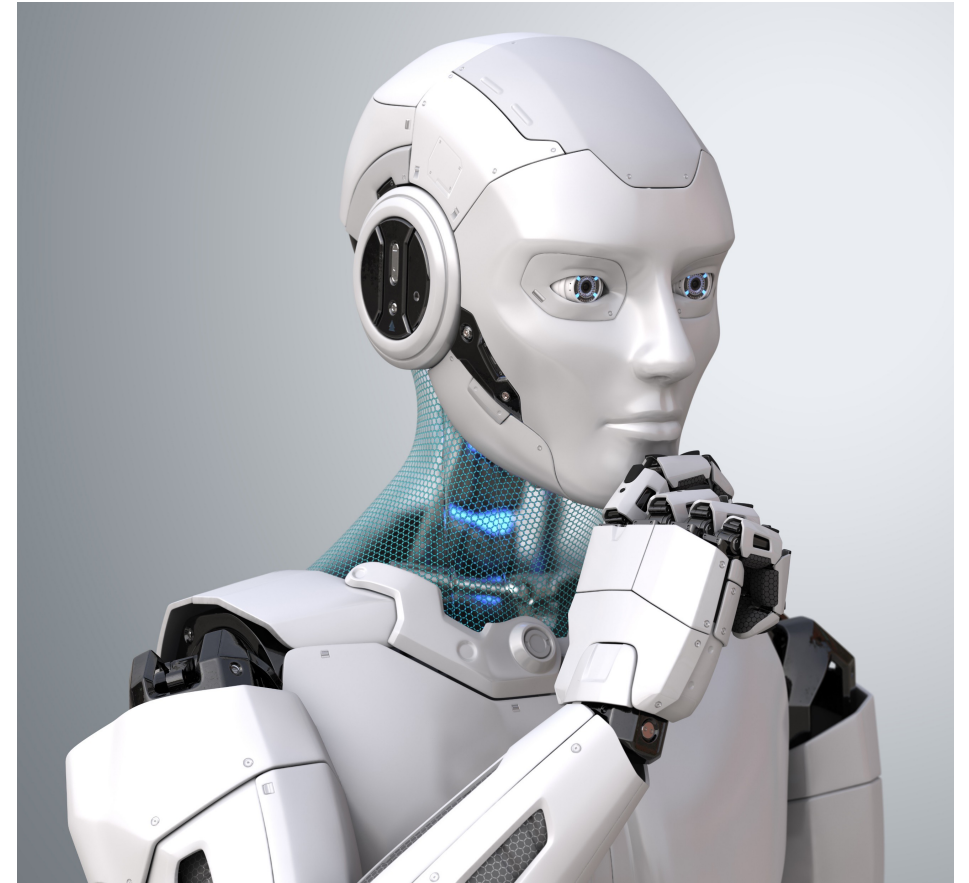


02

# Artificial Intelligence and Machine Learning

## What is artificial intelligence?

"Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition and machine vision."



# What is machine learning?

“Machine learning is a field of computer science that often uses statistical techniques to give computers the ability to ‘learn’ with data, without being explicitly programmed”

- Wikipedia



## The Rise of AI / ML

- Artificial Intelligence
  - Cloud-based
  - Generative AI
    - Write code
    - Debug code
    - Code suggestions
    - Datasheet to code converter
    - etc
- Machine Learning
  - On-chip
  - Resource constrained
  - Wide range of applications
    - Sensors
    - Classifications,
    - etc

## Audience POLL Question

Are you currently using AI / ML in or to develop your embedded applications?

- Yes, AI to develop and ML in my application
- Yes, AI to develop only, no ML
- Yes, no AI, but using ML in my application
- No, but within the next 6 months
- No, the distant future





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# AI Technologies for Embedded Developers

# AI Tools for Embedded Software

```
int main() {
    if (wiringPiSetup() == -1) {
        fprintf(stderr, "Failed to initialize wiringPi.\n");
        return 1;
    }

    pinMode(LED_PIN, OUTPUT);

    while (1) {
        digitalWrite(LED_PIN, HIGH);
        delay(BLINK_DELAY_MS);
        digitalWrite(LED_PIN, LOW);
        delay(BLINK_DELAY_MS);

        printf("Hello, world!\n");
    }

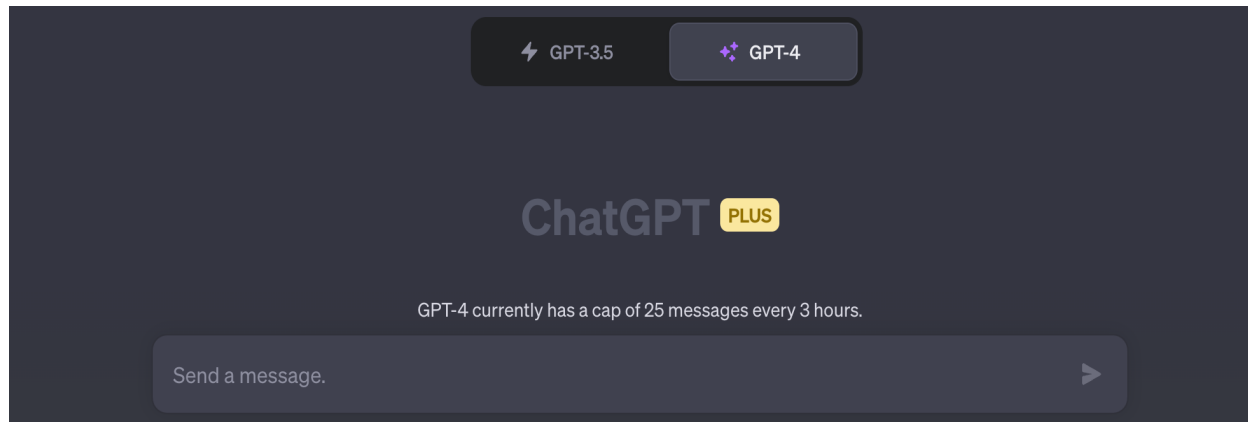
    return 0;
}
```

## Github Copilot

- Powered by OpenAI Codex
  - Generative pretrained model
- Suggests code to the developer
- Emulates pair programming with AI
- 26% - 40% percent of code suggestions are accepted

<https://github.com/features/copilot>

# AI Tools for Embedded Software



## ChatGPT

- GPT-3.5 or GPT-4 LLM
- ChatGPT is an AI language model by OpenAI.
- It creates human-like text from given prompts.
- GPT-4 architecture enables context understanding and response generation.
- Trained on diverse internet text, specifics are unknown.
- No access to personal data unless explicitly provided.
- Versatile: drafts emails, writes, tutors, translates, simulates, codes.
- Despite sophistication, ChatGPT has limitations.
- It doesn't understand like humans, may err.
- Aim is to continuously refine and improve it.

# AI Tools for Embedded Software

AI Tools can help embedded developers in several ways:

- Debugging code by suggesting potential causes and solutions.
- Writing embedded software documentation for specific hardware components.
- Providing code snippets for common embedded system tasks.
- Assisting in real-time troubleshooting of embedded systems issues.
- Offering guidance on best practices in embedded software development.
- Generating skeleton code for communication protocols (SPI, I2C, UART).
- Reviewing existing code and suggesting improvements or refactoring.
- Simulating responses from different hardware components for testing.
- Tutoring in advanced embedded systems concepts and programming languages.
- Assisting in project management tasks for embedded systems development.

## Audience POLL Question

What are you most interested in using AI for?

- a) Providing code snippets for common embedded system tasks.
- b) Assisting in real-time troubleshooting of embedded systems issues.
- c) Reviewing existing code and suggesting improvements or refactoring.
- d) Assisting in project management tasks for embedded systems development.
- e) other



●● Next Steps

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## Additional Resources

Please consider the resources below:

- [Jacob's AI Blogs](#)
- [Jacob's CEC courses](#)
- [Jacob's ML Blogs](#)
- Embedded Bytes Newsletter
  - <http://bit.ly/1BAHYXm>

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Consulting

Coaching

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## Next Steps



The Rise of AI in Embedded Software

Writing Better Prompts for Code Generation

Optimizing your Build System with AI

Abstracting your Hardware with an AI-Generated HAL

Managing AI and ML Code



Thank You

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