Course Overview:

Understanding basic RTOS principles is easy but applying those techniques and reaching an advanced understanding of the concepts is difficult. This workshop propels developers into advanced RTOS application design techniques that are rarely covered in traditional RTOS courses but are critical to the practicing engineer. In this course we will examine practical examples and techniques that will accelerate development activities and improve the robustness of RTOS based designs. We will be using Percepio's Tracealyzer to not only visualize our applications but also spot common RTOS issues such as priority inversions and dead-lock.

Who Should Attend?

Attendees are engineers who are interested in or will be designing applications using a Real-time Operating System. The course covers advanced techniques that are rarely discussed in courses or online literature, making the course immediately applicable to the real world. The course is appropriate for engineers with a basic RTOS understanding or experienced engineers looking for new techniques and skills. Attendees should understand the fundamentals of the C programming language. Advanced concepts are reviewed as they apply.

Key Take-a-ways:

- Hands-on experience developing RTOS based applications
- How to identify and resolve common RTOS application issues
- The techniques available to developers designing applications using an RTOS
- Design patterns and when to use them
- How to use the microcontroller hardware to debug in real-time
- Advanced debugging techniques such as Deep Insight Analysis
- How to optimize an RTOS application
- Techniques for securing an RTOS based application and kernel
- Example code and test hardware platform
- Best practices for RTOS based applications

Course Format:

This course is offered live online, as a self-paced course. Public and on-site courses are available on request.

Cost:

Single Regular: $1000   USD
Group Rates: Contact jacob@beningo.com

Contact Information:

Jacob Beningo
jacob@beningo.com
P.O. Box 400
Linden, Mi 48451

Sessions Overview:

Session 1 – Synchronization Patterns

- Unilateral rendezvous
- Credit tracking
- Bilateral rendezvous
- Client server
- Synchronizing multiple tasks
- Selecting the right synchronization method
- Best Practices

Session 2 – RTOS Pitfalls and Issues

- Complexity
- Issues – Task Jitter
- Issues – Thread Starvation
- Issues – Priority Inversion
- Issues – Deadlock
- Solutions
- Best Practices

Session 3 – Debugging RTOS Applications

- Printf
- ITM
- ASSERT
- SWD
- OS-Aware Debugging
- Real-time Tracing
- Debugging tools
- Deep Insight Analysis
- Error trapping
- Best Practices

Session 4 – RTOS Application Design Patterns

- Designing an IoT Sensor Node Overview
- UART command processing
- ensor Sampling Strategies
- Command Processing
- User interactions
- TCP/IP Integration
- System Testing
- Best Practices

Session 5 – Optimizing RTOS Applications

- RTOS Configuration
- Memory
- Performance
- Energy
- Trade-offs

- Best Practices

Session 6 – Securing an RTOS Application

- Using the MPU with Tasks
- Defining trusted and untrusted code
- Using Trustzone with a RTOS
- Thinking like a hacker
- Best Practices

Session 7 – RTOS Application Best Practices

- Best Practices

Note: Each lecture has an associated lab.

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Frequently Asked Questions (FAQ):

How long do I have access to the course materials for?

Attendees have access to the materials indefinitely. Attendees not only get to keep the materials and recordings but may also attend any online live runs of the class at any point in the future and will also get access to any updates to the course.

What hardware and toolchain does the course use?

Amazon FreeRTOS is supported by several different silicon vendors and the list is growing every day. The course is designed to work with any of these boards. You choose your board at:

https://aws.amazon.com/freertos/getting-started/

You can then order the board from your favorite electronics distributor.

What format is the course offered in?

The courses are offered in three different formats:
- Live Online w/ access to recording (self-paced materials)
- Self-paced online
- Public
- *Company* On-site courses

Is there a discount for multiple people to attend?

Yes. There is a discount for 3+ attendees. Please contact us for details.

How are the online live sessions hosted?

Live sessions are hosted through GoTo Webinar. After sign-up, you will receive the link to registered for the online sessions about a week before they start. If you miss an online session, the recording is usually posted to the course site within 24 hours.

How do I access the course materials?

Course materials are hosted at https://beningo.mykajabi.com/library. After ordering, you will receive a username and login to access the materials.

If I attend a live course, do I still get access to the online course?

Yes. If you attend a course live online or in person, you will get access to the self-paced recordings and materials that you can then reference and access at a later date.

Lecturer Background

Jacob Beningo is a Certified Software Development Professional (CSDP), chair of the IEEE South Eastern Michigan Consultants Affinity Group, an independent consultant and lecturer who specializes in the design of embedded software for resource constrained and low energy mobile devices. He has successfully completed projects across a number of industries including automotive, defense, medical and space. He enjoys developing and teaching real-time and reusable software development techniques using the latest methods and tools. He blogs for EDN.com about embedded system design techniques and challenges. Jacob holds *bachelor's* degrees in Electrical Engineering, Physics and Mathematics from Central Michigan University and a Master's degree in Space Systems Engineering from the University of Michigan.

Additional resources, templates and Jacob's monthly embedded software newsletter can be found at www.beningo.com . Check out his other workshops at http://www.beningo.com/services/workshops/

Click the social media link below to follow Jacob and get more tips and tricks:

Blogs can be found at the following sites by clicking the image:

Testimonials

"I would like to express my gratitude to Mr. Beningo for putting together this bootloader class. His excellent teaching skills made the training very enjoyable. The videos and material provided, including the laboratories, contributed to my success in understanding that topic. It was also very comforting to know that whenever I had a question he was always available. I cannot wait to put this knowledge into practice! I recommend this class to anyone serious about embedded system design and engineering."

-- Michel Bédard

"Thank you for the extra materials and the course – I now understand better some issues specific for embedded systems, I also learned few things I didn't know yet. It definitely influences my performance in daily work (IP and its driver prototyping in embedded system) and already allowed me to successfully debug some strange behavior"

-- Arek Golec

"In addition to having an extremely high level of expertise with regard to architecting and implementing embedded software and real-time embedded systems, Jacob has a rare talent for communication. His cheerful disposition, enthusiasm, and depth of knowledge make Jacob one of the most popular presenters at the Embedded Systems Conference (ESC). Jacob's sessions are always well-attended (often standing room only) and well-received by the attendees."

-- Clive "Max" Maxfield, Editorial Director, Embedded.com, and Technical Content Director, ESC

 "Jacob Beningo conducted a 5-session hands-on class on the fundamentals of microcontrollers for EETimes University, that was sponsored by STMicroelectronics. While the "fundamentals" approach was familiar, we added the unique hands-on wrinkle and Jacob proved to be an excellent instructor. He adapted seminar material we supplied and patiently walked the on-line class through lessons while contributed to their learning about the valuable features of the provided STM32 microcontroller and Discovery Kit. His success in leading the class was amply demonstrated in the outstanding participant engagement during the sessions and in their comments and feedback afterwards."

-- Michael Markowitz, Director Technical Media Relations, STMicroelectronics