



TRAINING IN REAL-TIME
EMBEDDED DEVELOPMENT

Course C++-503: C++ for non-C Programmers

Course Description:

This course introduces the C++ language for use on real-time and embedded applications. It assumes no prior experience of C programming, and is suited to engineers with existing experience of other high-level languages (e.g. Ada).

Attendees perform hands on embedded programming, on target hardware, during course practicals. Approximately 50% of the course is given over to practical work.

Overview:

An intensive five day course covering C++ in the context of real-time embedded application development.

Course Objectives:

- To provide an understanding of the essentials of the C++ programming language.
- To give you practical experience of writing C++ for real-time systems.
- To demonstrate the traps and pitfalls of the language when used in a real-time system.
- To give you the confidence to apply these new concepts to your next real-time project.

Delegates will learn:

- The core C++ syntax and semantics
- How to access hardware in C++
- About memory and performance issues associated with C++
- How Real-time Operating Systems affect the use of the language

Pre-requisites

- Experience of high-level programming, e.g. Ada
- Prior knowledge of C is not assumed

Who Should Attend:

The course is designed for engineers who are embarking on a project using C++ for the first time, but have little or no experience of C. It assumes they have previous high-level language experience (e.g. Ada).

Duration:

Five days

Course Materials:

- Delegate Handbook

Related Courses:

- OO-503 Real-Time Systems Design with UML 2.0
- AC++-401 Advanced C++
- RTOS-201 Fundamentals of Real-Time Operating Systems

Course Workshop:

The course makes use of target hardware during the real-time practical exercises. The board targeted is an IAR Kickstart development board (NXP LPC2129 ARM7-based microcontroller). An application board is controlled via the LPC2129 to give attendees a real sense of embedded application development

Course Outline:

Background to C++

Introduction to C++ Programming

Types and Operators

- C base types
- Precedence & associativity

Control Flow

- Logical expressions and operations
- Decision Making
- Loops

Functions

- The Function as a logical program unit
- How parameters are passed

Arrays and Pointers

- Arrays as circular buffers
- Relationship between pointers & arrays

Introduction to Object Oriented (OO)

Principles

- Key characteristics of OO development
- OO techniques and the real-time software development process

Introduction to Classes

- Classes & class instances
- Methods
- Constructors & destructors

More on Classes

- Inlining member functions
- const member functions
- static class members and functions

Inheritance

- Building class hierarchies
- Dynamic binding for class methods, virtual functions
- Polymorphism

Multiple inheritance (MI)

- MI and interfaces

Functions and Operators

- Class defined conversions
- Overloading and function selection
- Overloading operators

Exception Handling

- What are exceptions?
- Throwing and catching an exception

Templates

- Introduce parameterised types and functions
- Function and class templates

The Standard Library

- Introducing the Standard Template Library

Software Structuring

- Structuring large scale software systems
- Namespaces

Real-Time Specifics

- Low level facilities of C++ including:
- Accessing hardware
- Manipulating information at the bit level
- Polling
- Interrupts

Portability Considerations:

- Language features affecting portability;
- Non-standard C++ language features;

Concurrency:

- Concurrency;
- Sharing resources in multi-tasking systems;
- Synchronizing tasks;
- Transferring data between tasks.

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