High-Performance ARM Architectures: Cortex-M4

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	Topic	Lecture	References	Demo Code (Content\Demos)	Lab Code (Content\Labs\)
Introduction	Introductions and Course Overview	• Slides			
	Cortex-M4F Overview		• Cortex-M for Beginners Whitepaper • Cortex-M4 Device Generic User Guide, Chapter 1		
	Platform: NXP FRDM-K64F		• User Guide • Schematic	Blinky	Installing and Using the Toolchain: Toolchain, Instructions, Keil App Note 287
Key Architecture Concepts	ARMv7-M Programmer's and Memory Models ARM Cortex-M4 Core	• Slides	• Programmer's Model: ARMv7-M Architecture Reference Manual, Chapter A2, B1 • Cortex-M4 Device Generic User Guide Section 2.1 and 2.2 • Memory Model: ARMv7-M Architecture Reference Manual, Chapter A3, B2		
	Thumb-2 Instruction Set	• Slides	• ARMv7-M Instruction Set: ARMv7-M Architecture Reference Manual, Chapter A4 • Thumb instruction set encoding: ARMv7-M Architecture Reference Manual, Chapter A5 • Yiu Appendix 1 • Memory Barrier Instruction Programming Guide • Cortex-M4 Device Generic User Guide Chapter 3 • Cortex-M4 Technical Reference Manual Section 3.3	What did the compiler give us? Base_Timing_UART	
	Exceptions and Interrupts	• Slides	• Cortex-M4 Device Generic User Guide Section 2.3, 4.2 • Cortex-M4 Technical Reference Manual Section 3.9 • Yiu Appendix 4	Evaluating Interrupt Responsiveness input_interrupt	
	Basic Performance		• Cortex-M4 Device Generic User	How fast does that code	

	Analysis		Guide Section 4.4	really go? Base_Timing_UART	
	Cortex-M4 DSP and SIMD Support	• Slides	• DSP Capabilities White Paper • Yiu Appendix 2 • ARM C Language Extensions • Cortex-M4 Device Generic User Guide Chapter 3	SIMD Demo Code	Using the DSP and SIMD Instructions: Using CMSIS-DSP, Applying SIMD instructions
	Floating Point Unit		• Cortex-M4 Device Generic User Guide Section 3.11, 4.6 • Cortex-M4 Technical Reference Manual Chapter 7	Demo of FPU speed: floats, doubles, trig approximations. ecompass	
Memory System	Memory Protection Unit		• Cortex-M4 Device Generic User Guide Section 4.5 • Cortex-M4 Technical Reference Manual, Chapter 5		Applying the MPU - sysmpu
Software Design & Development	How C Code is Really Implemented	• Slides	• ARMCC User Guide • ARMASM User Guide		
	Helping the Compiler do a Good Job on the M4F	• Slides	• Yiu, Section 20.6, 20.7	How well does the compiler optimize this code? bubble	What did the optimizer miss? ecompass
	Using Low-Power Modes	• Slides	• Cortex-M4 Device Generic User Guide Section 2.5 • K64 MCU Datasheet	How much power does the system use? power_mode_switch	
Debug Support	Invasive and Non-Invasive Debug		• Debug Architecture: ARMv7-M Architecture Reference Manual, Chapter C1	Live debugging and data graphing with SWV and J-Link Keil App Note 287 DSP	
SoC Design	SoC Architecture and Hardware Implementation		• Designing a System-on-Chip (SoC) with an ARM Cortex-M processor • AMBA 3 AHB-Lite Protocol v1.0 • AMBA 3 APB Protocol v1.0		

Biographical Information

Dr. Alexander Dean is an associate professor in the ECE Department at North Carolina State University. Since 2001 he has performed nearly 100 in-depth embedded system software design reviews and tutorials for the Emerson Software Center of Excellence.
He has developed four embedded systems courses and taught them over fifteen years. Based on these courses he has created the teaching materials for the university programs of Renesas Electronics, ARM Ltd., Imagination Technologies and Microchip.
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