UNIVERSITY OF WATERLOO
FACULTY OF ENGINEERING

SE 350 RTX LAB 0

Introduction to the Project and Tools

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Department of Electrical and Computer Engineering

General Information

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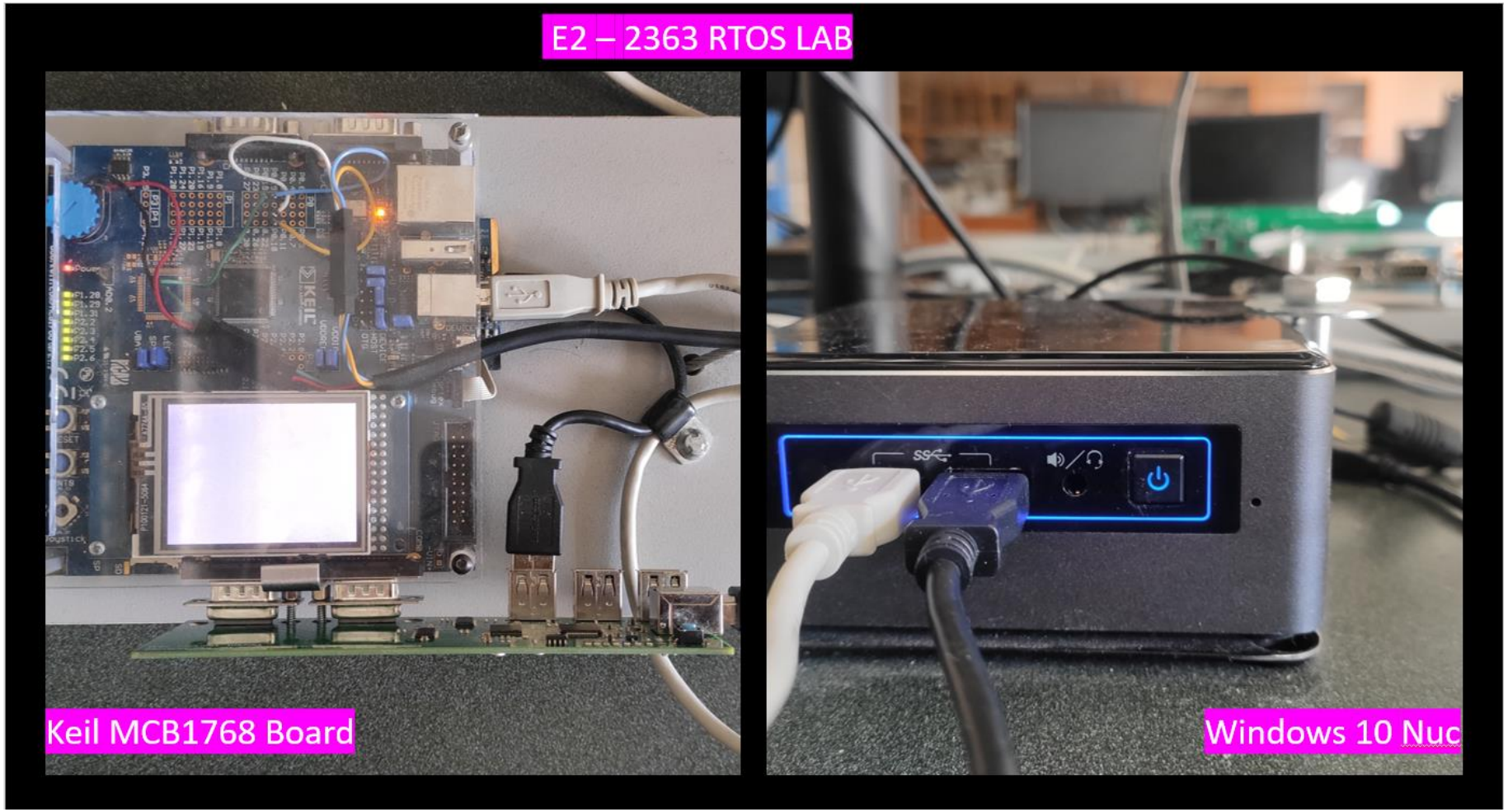
RTOS LAB

(Image Courtesy of Eric Praetzel)

Board and Host Connection



RTX Project

Proj	Requirements	Deadlines
P1	A: Fixed Size Memory Pool B: Processes Management	Week 5 Tue Feb. 1st 08:30 EST
P2	A: Message Passing B: Timing Service	Week 8 Tue Mar. 1st 08:30 EST
P3	A: Console I/O B: Stress Testing	Week 12 Tue Mar. 29 08:59 EST

- **3 grace days for the term without penalty, no submission accepted after 3 days.**
- **15% per day late submission penalty afterwards**
- **15% penalty if only functions inside the simulator**

Lab Sessions

- Help Lab sessions: TWTh 8:30 – 11:30 EST, weeks 3, and 10
  - 8:30 – 10:00: Drop-in
  - 10:00 – 11:30: 15 minutes time slot for booking in Jan.
    - Drop-in when we return in-person
  - Each time slot has two lab staff available
  - You may reserve up to two consecutive slots
  - Attendance is not mandatory for help sessions
- Demo Lab sessions: TWTh 8:30 – 11:30 EST, weeks 5, 8 and 12
  - Attendance is mandatory for demo sessions, requires booking
  - Specify your Group ID in the message/note when booking
- Extra Drop-in help sessions upon requests
  - Let class representative contact us if the class need them

Seeking Extra Help

- Piazza
  - Target response time: one business day
  - Do not wait till the last minute to ask questions
- LAB Office Hours: TWTh 10:30 – 11:30 EST, weeks 2, 4, 6, 9, and 11
  - 10:30 – 11:30: 15 minutes time slot for booking in Jan.
  - TBD when we return in person
- Individual appointment
  - By email
  - Subject line needs to start with [SE350-LAB Group<gid>]
- Extra Drop-in help sessions upon requests
  - Let class representative contact us if the class need them

SE 350 W22 LAB Calendar

Wk	Mo	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	Jan	3 New Year	4	5 Classes begin	6	7	8	9
2	Jan	10	11 P0 Due	12 15:30 T - P1A	13 10:30 - 11:30 O IH	14	15	16
3	Jan	17	18 08:30 - 11:30 H	19 08:30 - 11:30 H 15:30 T - P1B	20 08:30 - 11:30 H	21	22	23
4	Jan	24	25 10:30 - 11:30 O IH	26 10:30 - 11:30 O KE 15:30 T-P1A	27 10:30 - 11:30 O IH	28	29	30
5	Jan	31	1 08:30 - 11:30 D P1 Due	2 08:30 - 11:30 D 15:30 T - P2A	3 08:30 - 11:30 D	4	5	6
6	Feb	7	8 TBD O	9 TBD O 15:30 T - P2B	10 TBD O	11	12	13
7	Feb	14	15 TBD O	16 TBD O	17 TBD O	18	19 READ	20 READ
7	Feb	21 Family Day	22 READ	23 READ	24 READ	25 READ	26 READ	27 READ
8	Feb	28	1 08:30 - 11:30 D P2 Due	2 08:30 - 11:30 D 15:30 T - P3A	3 08:30 - 11:30 D	4	5	6
9	Mar	7	8 TBD O	9 TBD O 15:30 T - P3B	10 TBD O	11	12	13
10	Mar	14	15 08:30 - 11:30 H	16 08:30 - 11:30 H	17 08:30 - 11:30 H	18	19	20
11	Mar	21	22 TBD O	23 TBD O	24 TBD O	25	26	27
12	Mar	28	29 08:30 - 11:30 D P3 Due	30 08:30 - 11:30 D	31 08:30 - 11:30 D	1	2	3
13	Apr	4	5 Classes end	6	7	8 Final Exam	9	10

Mo	Week	Topics	Weight
Jan	1	P0 Group Signup and Git Activation	
Jan	2	P0 Keil IDE practice	3
Jan	3	P1-A Memory Mgmt P1 Help Session	
Jan	4	P1-B Process Mgmt	33
Feb	5	P1 Demo	
Feb		P2-A IPC	
Feb	6	P2-B Timing timer iproc	
Feb	7		
Mar	8	P2 Demo (midterm week in ECE)	32
Mar	9	P3-A Console I/O (UART iproc, KCD, CRT)	
Mar	10	P3-A WCLCK, set_proi proc P3 Help Session	
Mar	11	P3-B Stress testing procs	
Apr	12	P3 Demo	32
Apr	13		

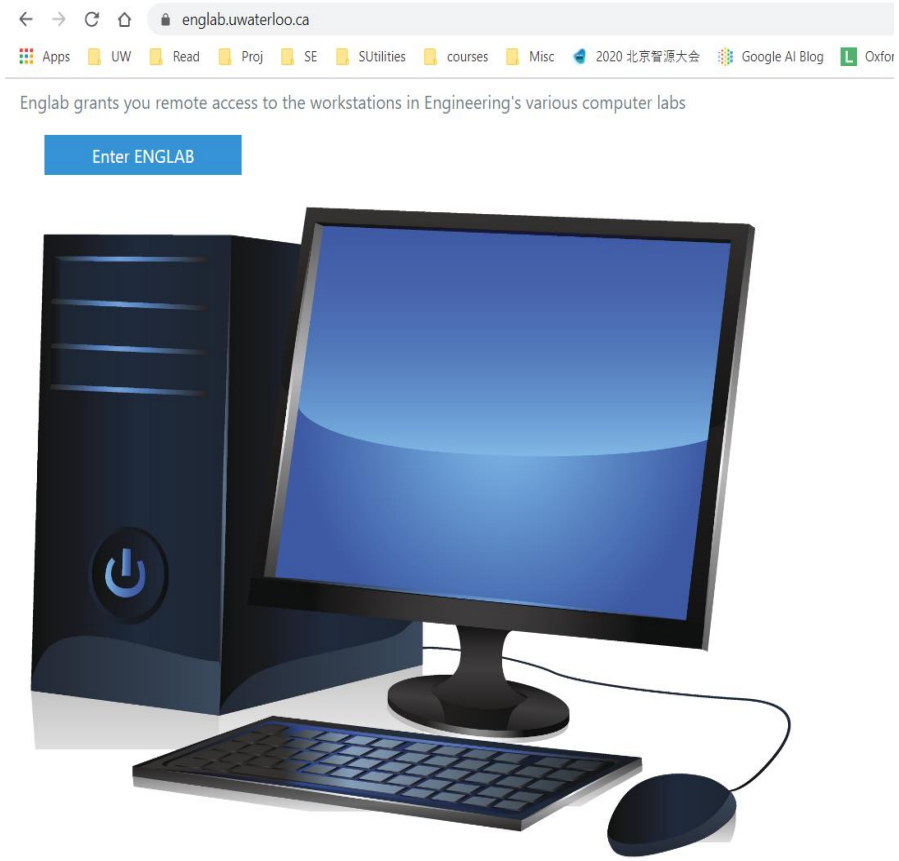
IH Irene Huang **SS** Sulav Shrestha **KE** Karim W. A. Elhammady

Lab Office Hours - O	First/Last Day of Lecture
Lab Help Sessions - H*	No Teaching Activites
Lab Demo Session - D	Lab Tutorials - T

* For online offerings, 8:30 - 10:00 are drop-in and 10:00 - 11:30 requires booking

Remote Access of ece-rtos*

- You need campus VPN
- englab.uwterloo.ca
- ECE → ece-rtos
- 27 machines
- Support multiple monitors.
- Please close all running programs before you logout and disconnect.



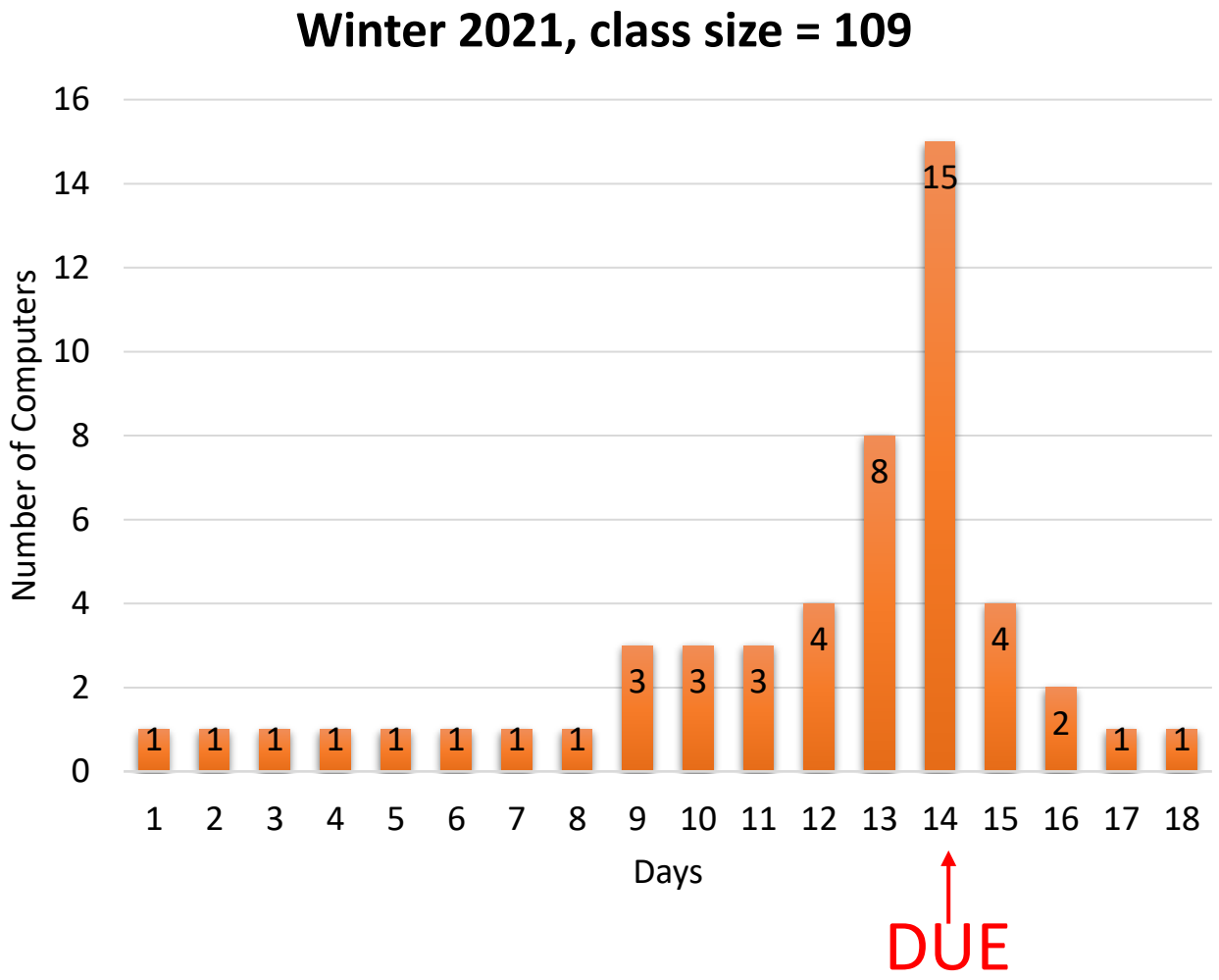
Room Usage

- We have 118 students
- Are there enough computers?

YES

conditioned on

- DO NOT WAIT TILL THE LAST MINUTE
- USE SIMULATOR ON YOUR OWN MACHINE
- USE LAB MACHINE TO TEST CODE ON BOARD



HelloWorld

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Reading the Lab Manual

Chapter	Topics	How to Read
1.1	Summary of RTX Requirements	Skim
7	Remote Desktop	Study
8	Keil IDE	Study
6.6	FAQ – Keil IDE	Skim
9.3 – 9.3.1	CMSIS and its file structure	Study
10.1	MCB1700 Board	Skim

- Lab manual and starter code: https://github.com/yqh/SE350

ARM TOOLCHAIN

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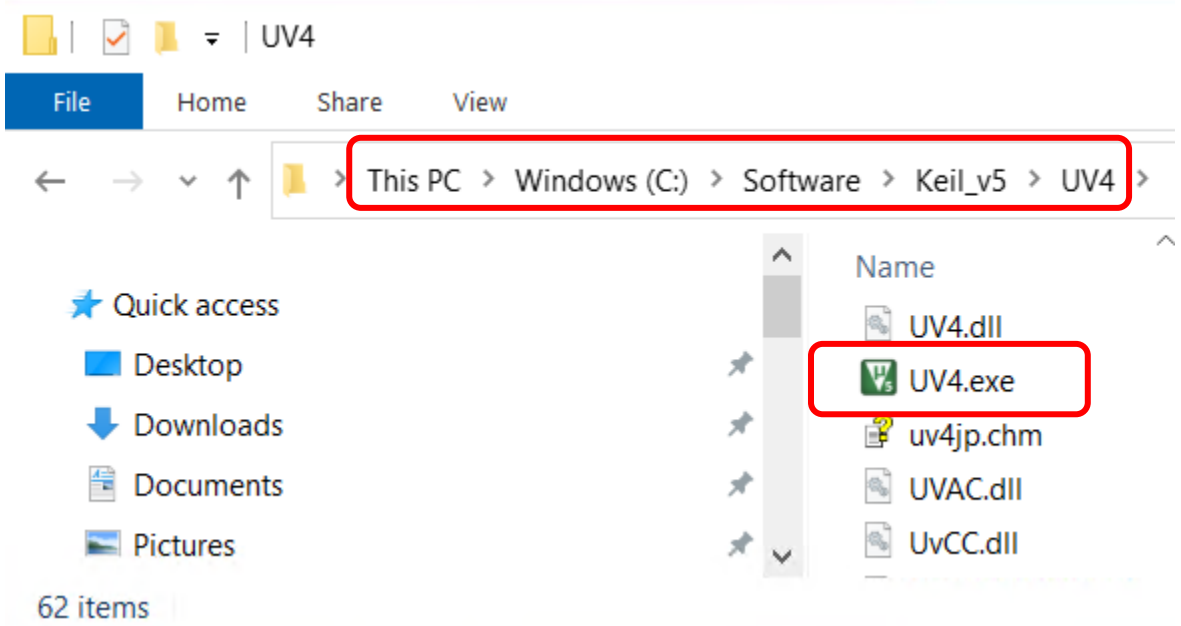
Keil MDK5

- The ece-rtos* machine



- Install on you own windows PC
  1. MDK Core

     Keil MDK Version 5.35
     Link

  2. Device Family Pack
     - NXP->LPC1768

  3. MDK V4 Legacy support

     MDK V4 Legacy Support
     Link

MAC and Linux

- Windows Virtual machine
  - Virtualbox: https://www.virtualbox.org/
- Not a fan of Virtual machines?
  - MAC
    - $$$ Parallels: https://www.parallels.com/ca/
    - $$ Crossover: https://www.codeweavers.com/crossover
  - Linux
    - Wine: https://www.winehq.org/

Pitfalls

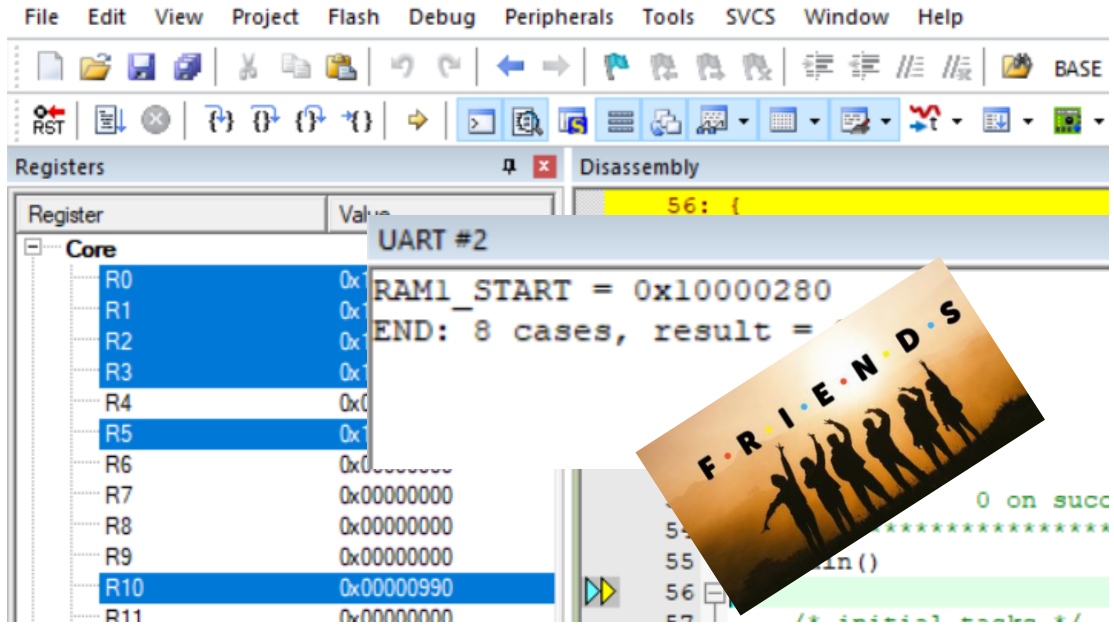
- Do not leave spaces in your directory name
- Simulator is good about 85% of time.
- You should always test the code on the board!
  - Simulator initializes certain memory regions.
  - The hardware does not initialize those memory regions
  - Simulator does not require proper serial port initialization setting
  - The hardware does require proper the serial port initialization
  - Simulator runs one to two orders of magnitude slower than the real time

Does this mean we should avoid the simulator?

NO

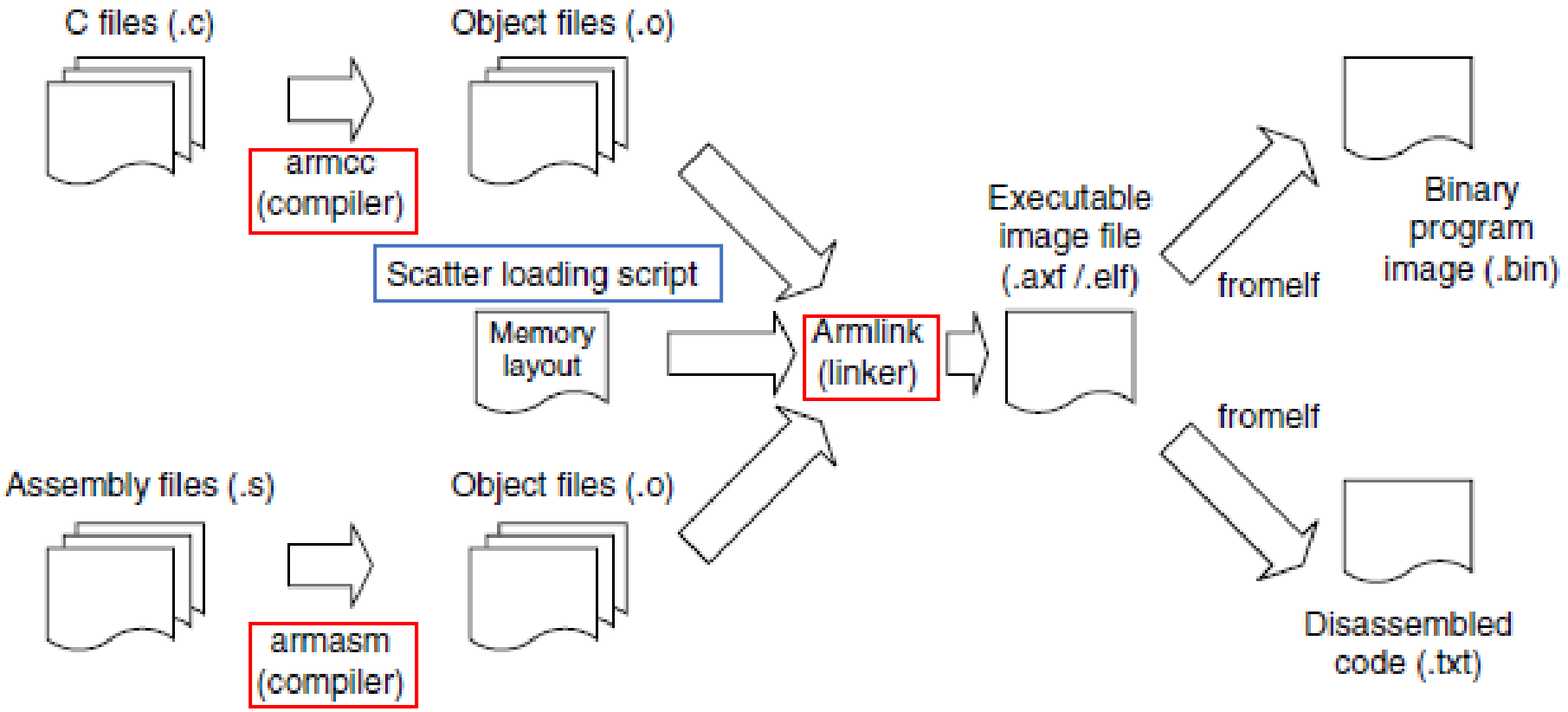
Simulator is Your Friend

- Divide and Conquer
- Develop and test on simulator
- Test each small milestone on board
- Using simulator is a common practice in real world



A tool is a good one when you know its limitations and use it correctly.

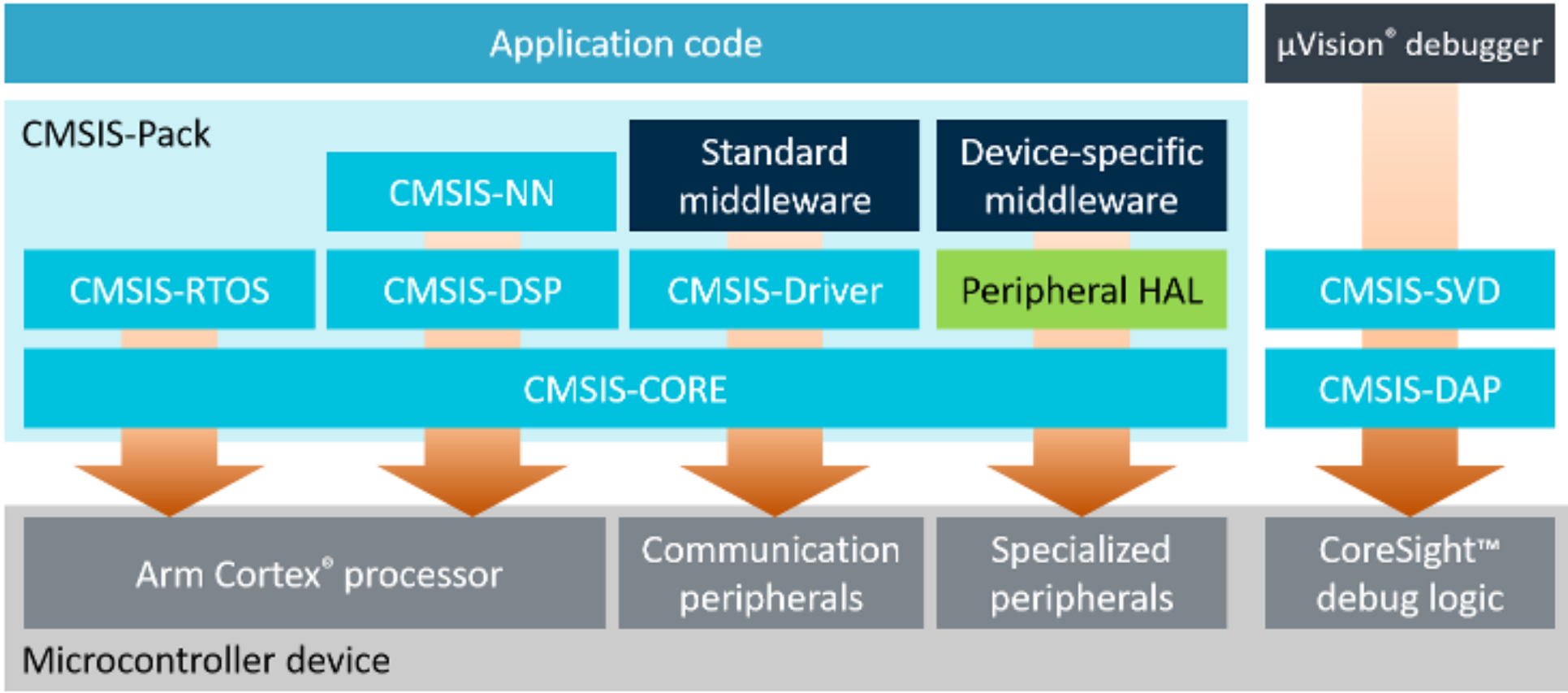
Example Flow Using ARM Development Tools



(Image Courtesy of [1])

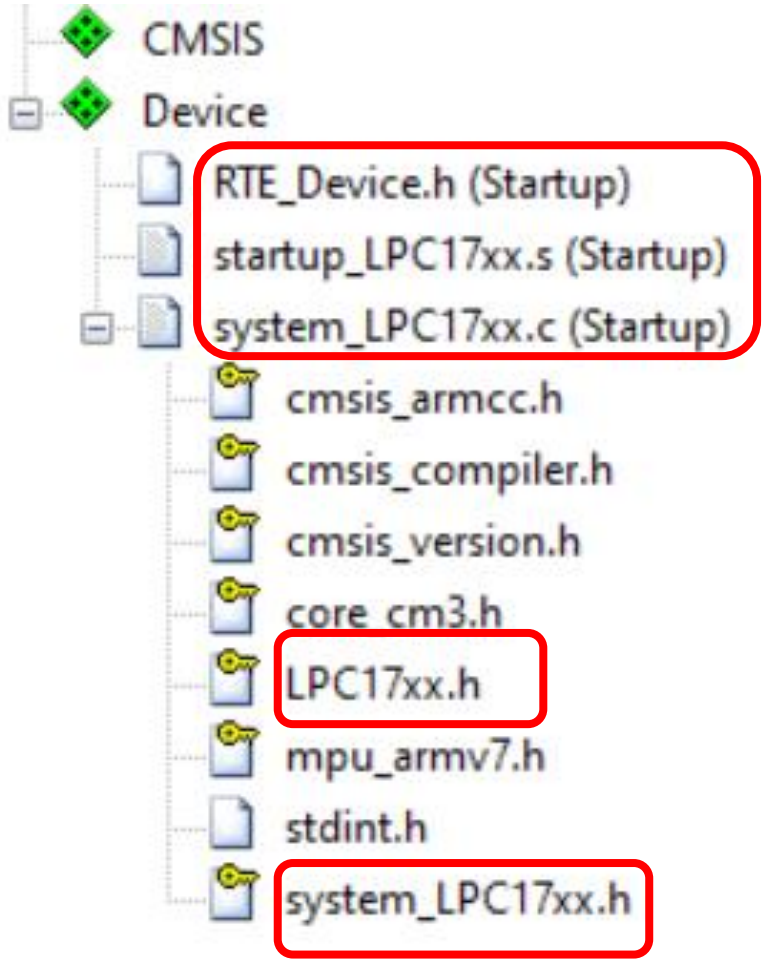
CMSIS Structure

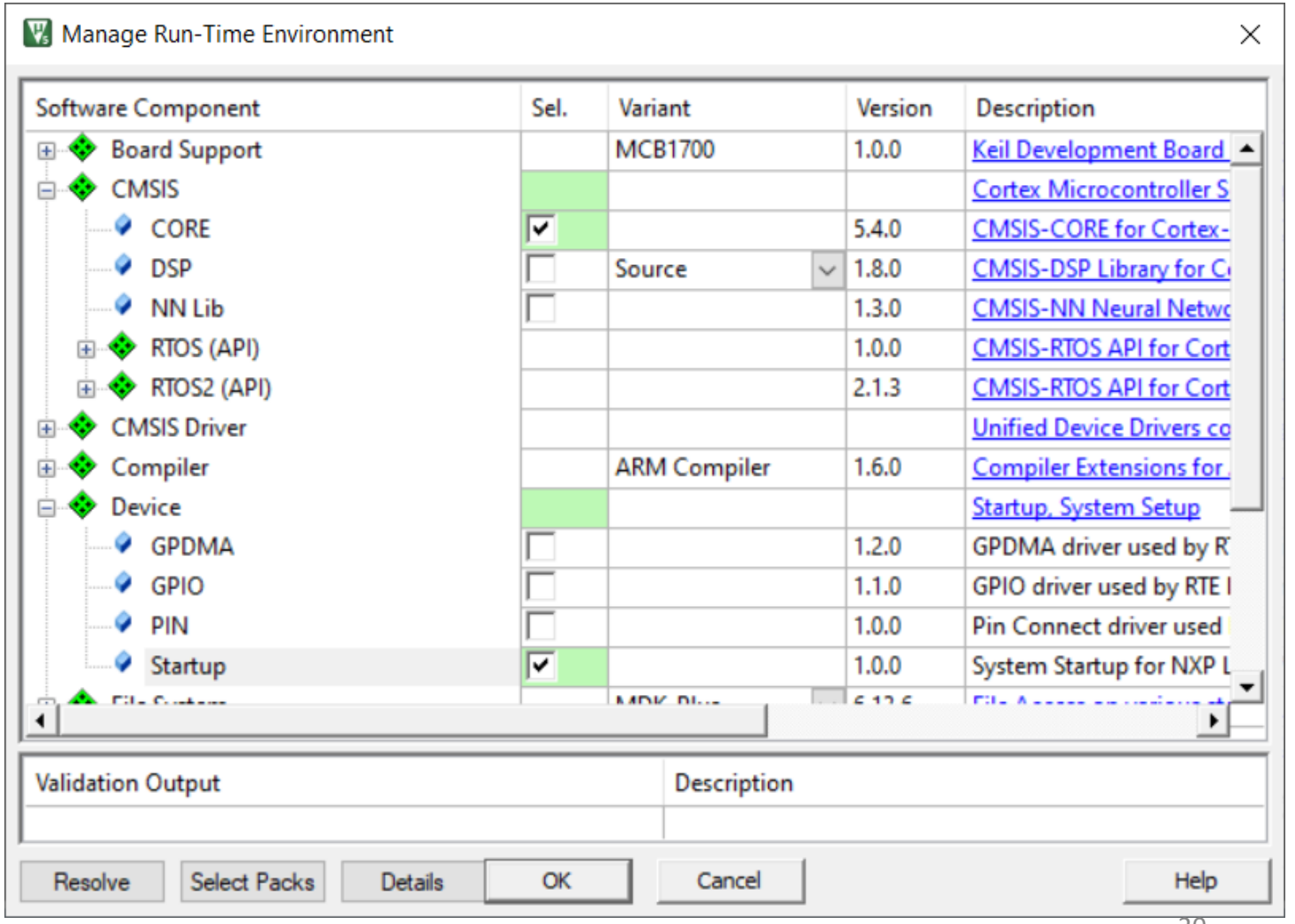
Cortex Microcontroller Software Interface Standard



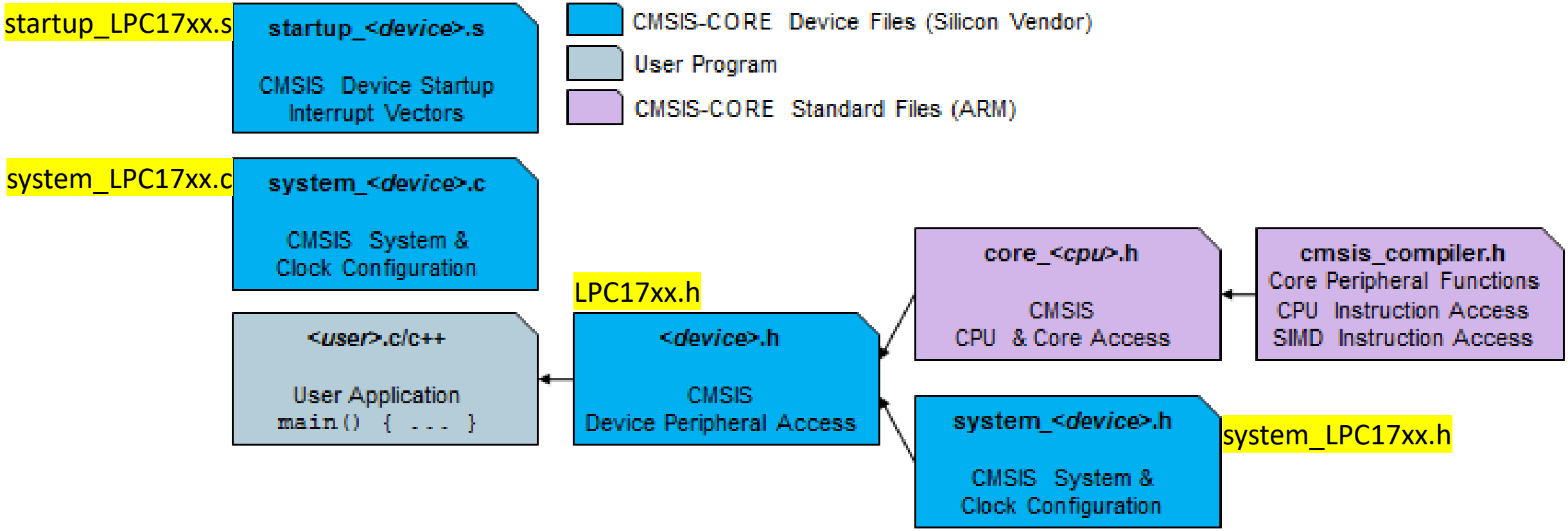
(Image Courtesy of Keil.com CMSIS-Core (Cortex-M) documentation)

Run-Time Environment





CMSIS-Core File Structure



(Image Courtesy of Keil.com CMSIS-Core (Cortex-M) documentation)

The main.c

```
int main() {

    /* CMSIS system initialization */
    SystemInit();

    /* uart by polling */
    uart0_init();
    uart1_init();
    ……
}
```

CMSIS System Initialization Reference

Summary

- Install Keil IDE on your own computer
- Create your own HelloWorld Application
  - Run it on the simulator
  - Run it on the board by remote desktop

References

1. Yiu, Joseph, *The Definite Guide to the ARM Cortex-M3*, 2009
2. *ARM Compilation Tools Version 5.0 Developer Guide*
3. *ARM Software Development Toolkit Version 2.50 Reference Guide*
4. *LPC17xx User's Manual*
5. *Software Interface Standard for Arm Cortex-based Microcontrollers, CMSIS Version 5.7.0*

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Thank you!

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