EEE499 – Real-Time Embedded System Design
Introduction to the course

Mojtaba Bagherzadeh

Royal Military College (RMC)

mojtaba@cs.queensu.ca

January 8, 2018

Instructor

Mojtaba Bagherzadeh, PhD Student, Queen's University

Office: Room 624, Goodwin Hall, Queen's University

Email.: mojtaba@cs.queensu.ca

Course Website: `https://moji1.github.io/EEE499/`

Hope Page: `http://flux.cs.queensu.ca/mase/member/bagherzadeh`

Office Hours: At any time with appointment

Motivation

Real-Time Systems Are Everywhere.






Motivation

- Provides functionality of almost everything

Motivation

- Provides functionality of almost everything
- Global embedded systems market was valued at USD 159.00 billion in 2015 (100 times PC market size)

Motivation

- Provides functionality of almost everything
- Global embedded systems market was valued at USD 159.00 billion in 2015 (100 times PC market size)
- It is expected to generate revenue of USD 225.34 billion by end of 2021.

Motivation

- Provides functionality of almost everything
- Global embedded systems market was valued at USD 159.00 billion in 2015 (100 times PC market size)
- It is expected to generate revenue of USD 225.34 billion by end of 2021.
- Accounts for 25-40% costs in automotive.

Motivation

- Provides functionality of almost everything
- Global embedded systems market was valued at USD 159.00 billion in 2015 (100 times PC market size)
- It is expected to generate revenue of USD 225.34 billion by end of 2021.
- Accounts for 25-40% costs in automotive.
- Society's critical path

Motivation

- Provides functionality of almost everything
- Global embedded systems market was valued at USD 159.00 billion in 2015 (100 times PC market size)
- It is expected to generate revenue of USD 225.34 billion by end of 2021.
- Accounts for 25-40% costs in automotive.
- Society's critical path
- Must be dependable, but affordable

Motivation

Developing Real-time Embedded systems is challenging

Motivation

Developing Real-time Embedded systems is challenging

- Any failure may cause catastrophic failure. E.g, The Explosion of the Ariane 5

Motivation

Developing Real-time Embedded systems is challenging

- Any failure may cause catastrophic failure. E.g, The Explosion of the Ariane 5
- Real-time response

Motivation

Developing Real-time Embedded systems is challenging

- Any failure may cause catastrophic failure. E.g, The Explosion of the Ariane 5
- Real-time response
- React to unpredictable events

Motivation

Developing Real-time Embedded systems is challenging

- Any failure may cause catastrophic failure. E.g, The Explosion of the Ariane 5
- Real-time response
- React to unpredictable events
- Cope with failures

Motivation

Developing Real-time Embedded systems is challenging

- Any failure may cause catastrophic failure. E.g, The Explosion of the Ariane 5
- Real-time response
- React to unpredictable events
- Cope with failures
- Multidisciplinary
  - Physics (electronics, optics, mechanics, ..)
  - Concurrency
  - Performance
  - Power
  - Dependability

Objective

- An introduction to specifications, analysis, design, and development techniques for real-time software.

Objective

- An introduction to specifications, analysis, design, and development techniques for real-time software.
- A base foundation for the real-time operating system specifically FreeRTOS.

Objective

- An introduction to specifications, analysis, design, and development techniques for real-time software.
- A base foundation for the real-time operating system specifically FreeRTOS.
- A base foundation for modeling and development real-time systems using the UML-RT modeling language.

Objective

- An introduction to specifications, analysis, design, and development techniques for real-time software.
- A base foundation for the real-time operating system specifically FreeRTOS.
- A base foundation for modeling and development real-time systems using the UML-RT modeling language.
- practical experience with a Papyrus-RT, Arduino boards and FreeRTOS.

Objective

- An introduction to specifications, analysis, design, and development techniques for real-time software.
- A base foundation for the real-time operating system specifically FreeRTOS.
- A base foundation for modeling and development real-time systems using the UML-RT modeling language.
- practical experience with a Papyrus-RT, Arduino boards and FreeRTOS.
- An introduction to the theory of scheduling for multitasking systems in a single processor environment.

Plan

- Global perceptive

Plan

- Global perceptive
- Task modeling, task scheduling and schedulability analysis

Plan

- Global perceptive
- Task modeling, task scheduling and schedulability analysis
- Real-Time OS

Plan

- Global perceptive
- Task modeling, task scheduling and schedulability analysis
- Real-Time OS
- Reliability

Plan

- Global perceptive
- Task modeling, task scheduling and schedulability analysis
- Real-Time OS
- Reliability
- Development of real-time system using models

Schedule

- Classes:
  - Monday 9:00-9:50 – S3411
  - Tuesday 13:40-14:30 – S3411
  - Friday 14:40-16:30 – S3412
- Lab:
  Tuesday 14:40-1430 – S5100

Laboratories

4 Labs in total.

- Lab 1,2 (Arduino board , C/C++ within Arduino IDE)

Laboratories

4 Labs in total.

- Lab 1,2 (Arduino board , C/C++ within Arduino IDE)
- Lab 3 (Design a Digital Watch Using FreeRTOS)

Laboratories

4 Labs in total.

- Lab 1,2 (Arduino board , C/C++ within Arduino IDE)
- Lab 3 (Design a Digital Watch Using FreeRTOS)
- Lab4 (Design a Digital Watch Using UML-RT)

Laboratories

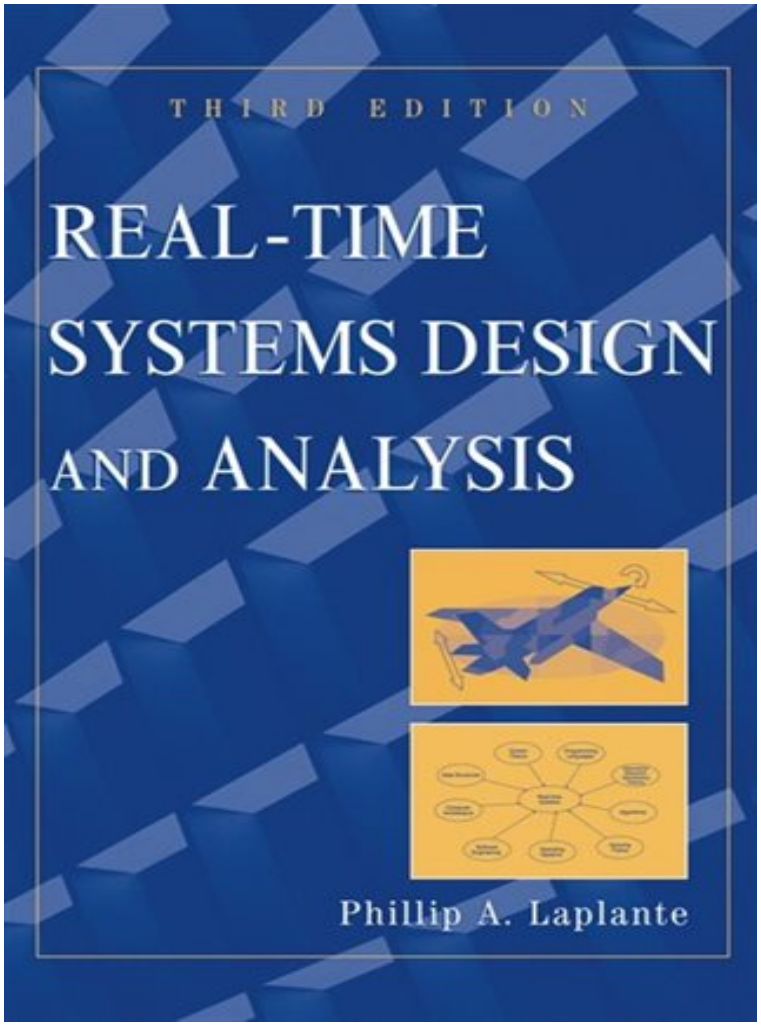
4 Labs in total.

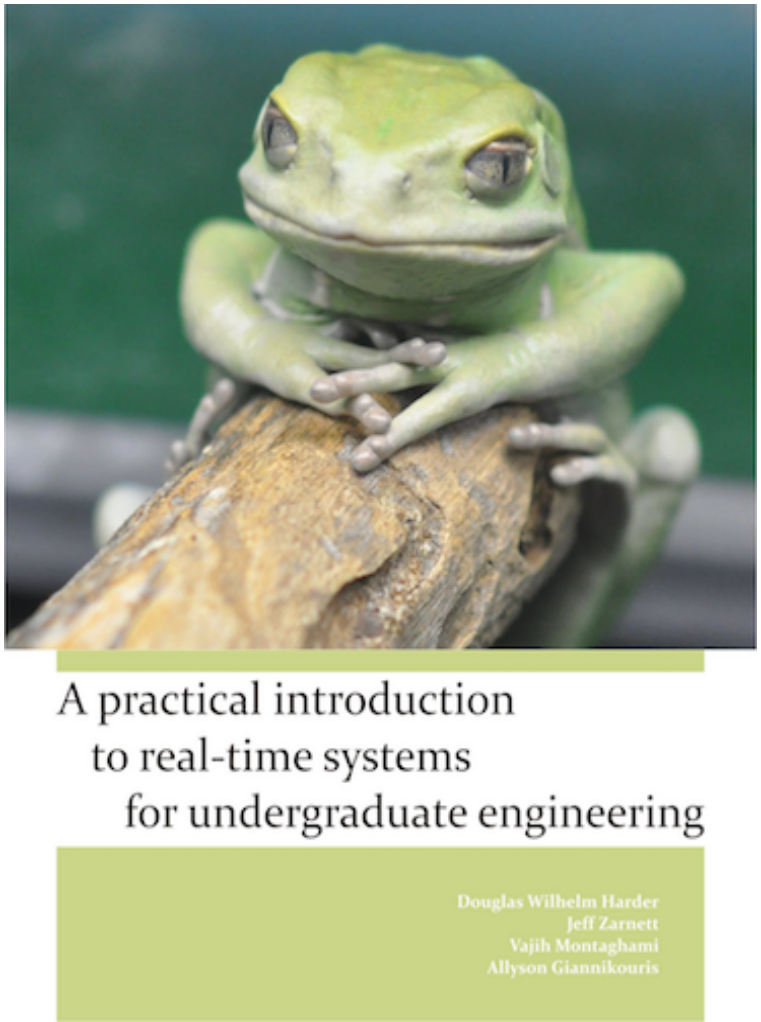
- Laboratories must be completed by teams of two people.
- The labs are to be handed-in before the period of the on the specified date
- Each team must hand-in a quality lab report. The report will be presented in a prescribed format.
- Labs handed in late will receive the mark of 0%
- **All labs are required to be handed-in regardless in order to write the final and pass the course.**

Marking

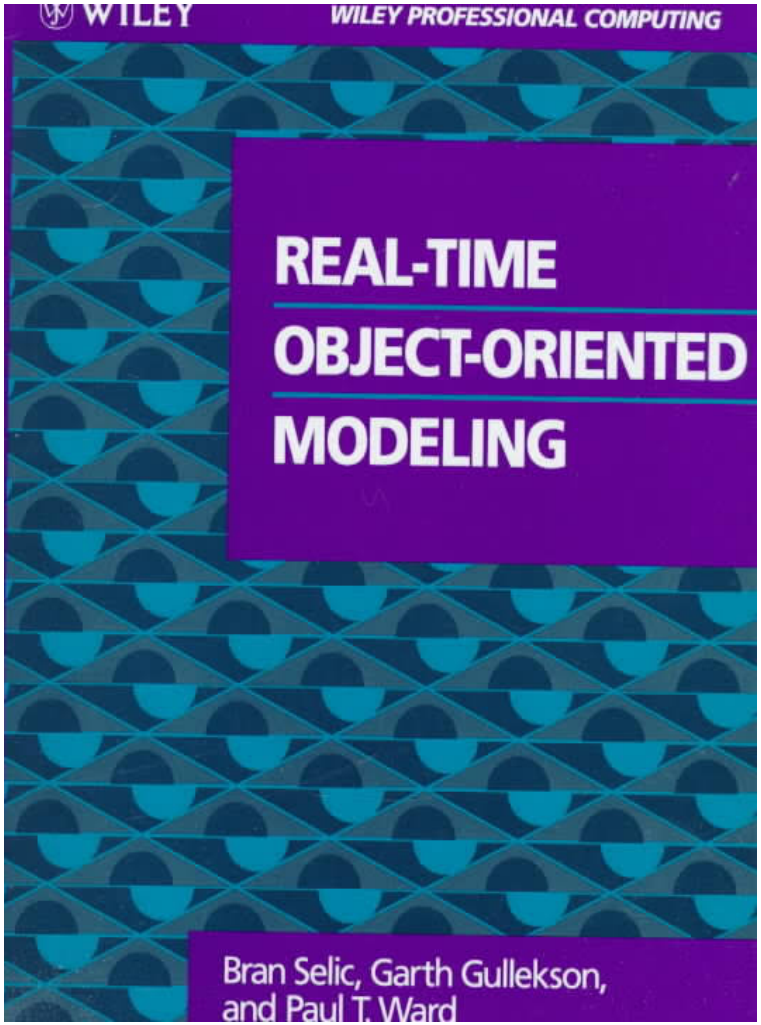
Item	Weight
Laboratories	25% (Each is worth 6.25% of the final mark)
Midterm	20% 6 March
Quizzes	20% (Schedulability: 5% Reliability: 5%)
Final Exam	45% (Some questions will be based on the lab work.)

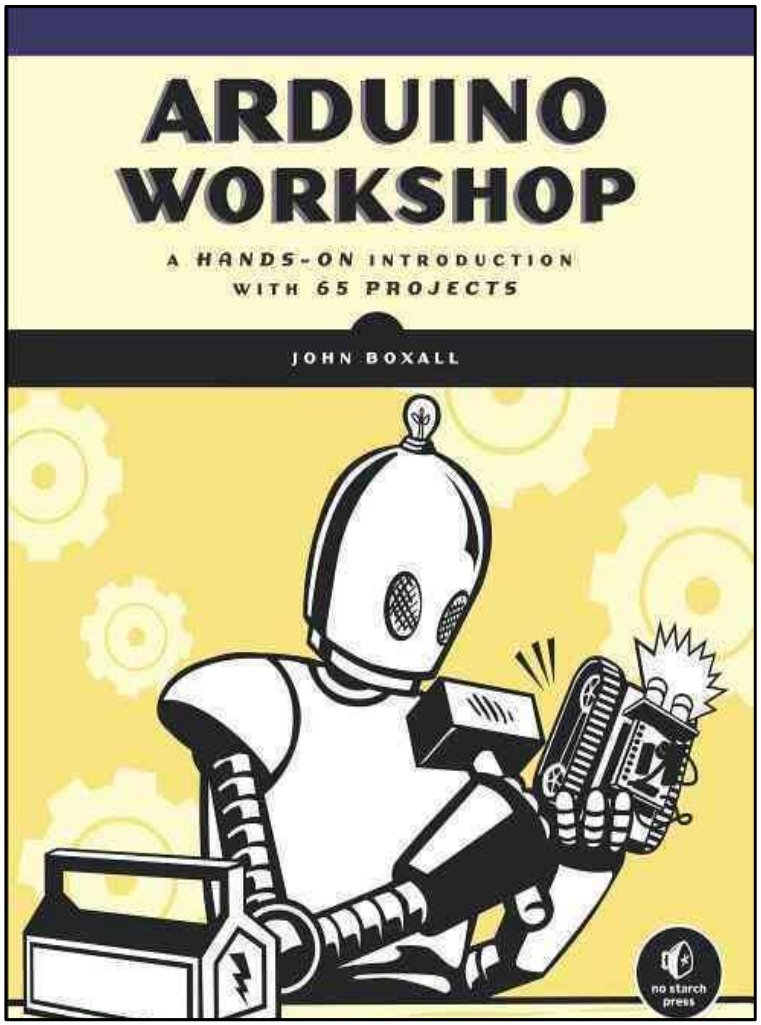
Books


THIRD EDITION
REAL-TIME
SYSTEMS DESIGN
AND ANALYSIS
Phillip A. Laplante

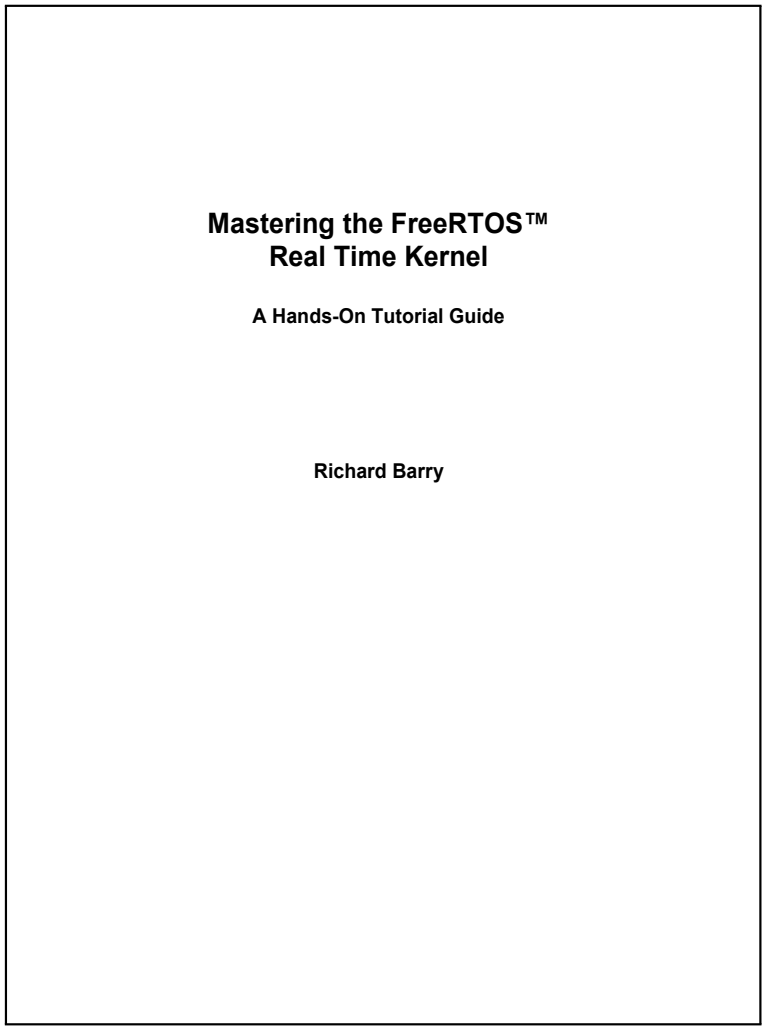

A practical introduction
to real-time systems
for undergraduate engineering
Douglas Wilhelm Harder
Jeff Zarnett
Vajih Montaghami
Allyson Giannikouris

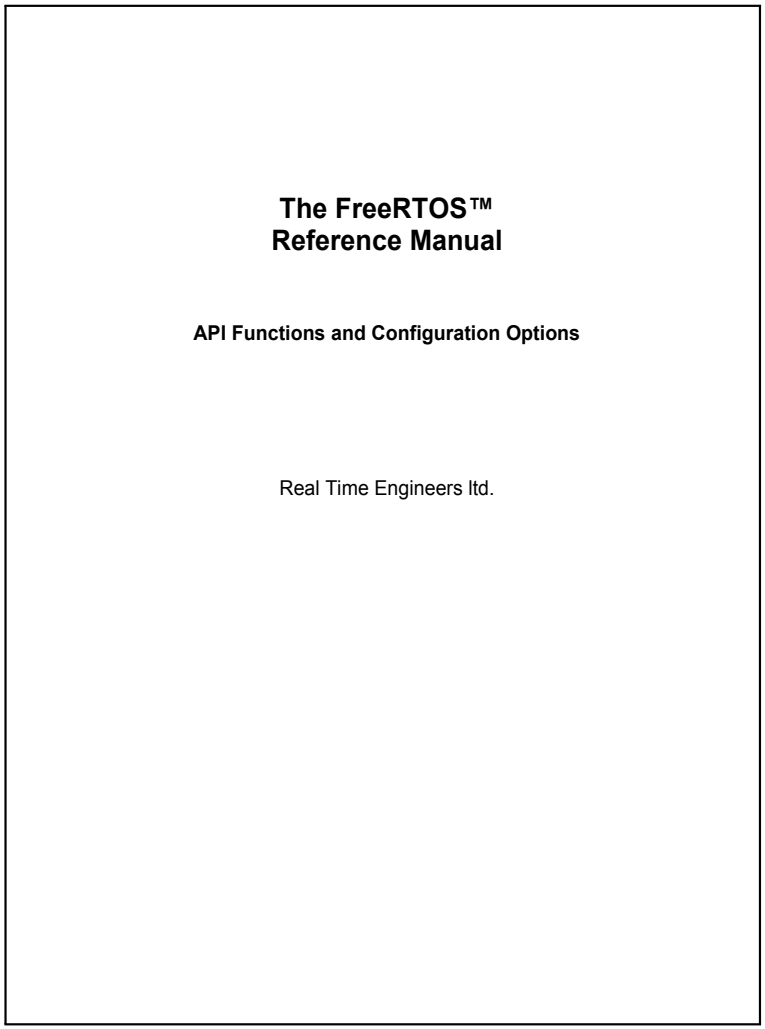
Books


WILEY
WILEY PROFESSIONAL COMPUTING
REAL-TIME
OBJECT-ORIENTED
MODELING
Bran Selic, Garth Gullekson,
and Paul T. Ward


ARDUINO
WORKSHOP
A HANDS-ON INTRODUCTION
WITH 65 PROJECTS
JOHN BOXALL
no starch
press

Books


Mastering the FreeRTOS™
Real Time Kernel
A Hands-On Tutorial Guide
Richard Barry


The FreeRTOS™
Reference Manual
API Functions and Configuration Options
Real Time Engineers ltd.

Academic Missconduct

- Cheating
- Plagiarism
- Any other kinds of university ethics violations can lead to sanctions from a written warning to expulsion from RMC.

  You should familiarize yourself with the rules with respect to academic misconduct available in section 23 of the Undergraduate Calendar.

Question?