

Real-Time & Embedded Systems

Uwe R. Zimmer - The Australian National University

Organization & ToC

who could be interested in this?

anybody who ...

- ... would like to see **immediate real-world involvement** in his/her work
- ... would like to **learn how to create predictable and fault-tolerant, complex systems**.
- ... would like to **know more about the usage of >95% of all processors**.

© 2019 Uwe R. Zimmer, The Australian National University page 4 of 96 | Page 1: Organization & ToC up to page 10

Organization & ToC

Textbooks (sort of ...)

[Burns2009]
 Alan Burns and Andy Wellings
Real-Time Systems and Programming Languages
 Addison Wesley, fourth edition, 2009

[Burns2007]
 Alan Burns & Andy Wellings
Concurrent and Real-Time Programming in Ada
 Cambridge University Press, 2007

[McComick11]
 McComick, J. W., Singhoff, E., & Huges, J.
Building Parallel, Embedded, and Real-Time Applications with Ada.
 Cambridge University Press, 2011.

... plus specific references for each topic (all on the course site).

© 2019 Uwe R. Zimmer, The Australian National University page 7 of 96 | Page 1: Organization & ToC up to page 10

Real-Time & Embedded Systems 2019



Organization & ToC


Uwe R. Zimmer - The Australian National University

Organization & ToC


who are these people? – introduction

This course will be given by


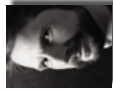
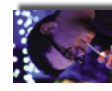
Uwe R. Zimmer
 Tutoring and labs by



Calum Snowdon & Michael Bennett
 Electronics design by



Mark Turner

© 2019 Uwe R. Zimmer, The Australian National University page 5 of 96 | Page 1: Organization & ToC up to page 10

Organization & ToC

Topics

1. Introduction & Real-time languages
2. Physical coupling
3. Interfaces
4. Time & Embodiment
5. Asynchronism
6. Synchronisation
7. Scheduling
8. Resource control
9. Reliability & Fault-tolerance


© 2019 Uwe R. Zimmer, The Australian National University page 8 of 96 | Page 1: Organization & ToC up to page 10

Organization & ToC

what is offered here?

Overview, Perspectives, Paths, Methods, Implementations and open questions
 of/fmto/four/about

Real-Time & Embedded Systems



© 2019 Uwe R. Zimmer, The Australian National University page 3 of 96 | Page 1: Organization & ToC up to page 10

Organization & ToC

how will this all be done?

Lectures:

- 2 x 1.5h lectures per week ... all the nice stuff
 Monday: 15:00 (Engineering Theatre) and Thursday 09:00 (Forestry Theatre)

Laboratories:

- 2 hours per week ... all the rough stuff
 times-slots on our web-site—all in CSIT laboratories
 -enrolment: <https://cs.anu.edu.au/streams/>

RESOURCES:

- Introduced in the lectures and collected on the course page:
<https://cs.anu.edu.au/courses/comp4330/> ... as well as schedules, slides, sources, link to forums, etc. pp. ... keep an eye on this page!

Assessment:

- Exam at the end of the course (70%) plus one assignments (30%)
 - both are tested in oral exams (unless enrolment numbers require otherwise).

© 2019 Uwe R. Zimmer, The Australian National University page 6 of 96 | Page 1: Organization & ToC up to page 10

Organization & ToC

Topics

1. Introduction & Real-time languages
 - 1.1. Staking out the field
 - 1.2. Features (and non-features) of a real-time system
 - 1.3. Components of a real-time system
 - 1.4. Real-time languages
 - Ada
 - Esterel
 - Pearl
 - VHDL
 - Timed CSP
 - Real-Time JAVA
 - POSIX
2. Physical coupling
3. Interfaces
4. Time & Embodiment
5. Asynchronism
6. Synchronisation
7. Scheduling
8. Resource control
9. Reliability & Fault-tolerance

© 2019 Uwe R. Zimmer, The Australian National University page 9 of 96 | Page 1: Organization & ToC up to page 10

Organization & ToC

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

5. Asynchronism

6. Synchronisation

7. Scheduling

8. Resource control

9. Reliability & Fault-tolerance

© 2019 Dawid Zimmer, The Australian National University PAGE 17 of 961 (Page 1) "Organization & ToC" up to PAGE 18

Organization & ToC

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

5. Asynchronism

6. Synchronisation

7. Scheduling

8. Resource control

9. Reliability & Fault-tolerance

© 2019 Dawid Zimmer, The Australian National University PAGE 17 of 961 (Page 1) "Organization & ToC" up to PAGE 18

Organization & ToC

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

Topics

4.1. What is time? / What is embodiment?

4.2. Time: notion, delays, time-out

4.3. Interfacing with time

4.4. Specifying timing requirements

4.5. Satisfying timing requirements

© 2019 Dawid Zimmer, The Australian National University PAGE 17 of 961 (Page 1) "Organization & ToC" up to PAGE 18

Organization & ToC

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

5. Asynchronism

Topics

5.1. Interrupts, signals, exceptions

5.2. Atomic Actions

5.3. Asynchronous transfer of control

© 2019 Dawid Zimmer, The Australian National University PAGE 17 of 961 (Page 1) "Organization & ToC" up to PAGE 18

Organization & ToC

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

5. Asynchronism

6. Synchronisation

Topics

6.1. Variable-based synchronization

6.2. Message-based synchronization

© 2019 Dawid Zimmer, The Australian National University PAGE 17 of 961 (Page 1) "Organization & ToC" up to PAGE 18

Organization & ToC

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

5. Asynchronism

6. Synchronisation

7. Scheduling

Topics

7.1. Basic real-time scheduling

7.2. Real-world extensions

7.3. Language support

© 2019 Dawid Zimmer, The Australian National University PAGE 17 of 961 (Page 1) "Organization & ToC" up to PAGE 18

Organization & ToC

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

5. Asynchronism

6. Synchronisation

7. Scheduling

8. Resource control

Topics

8.1. Resource synchronization primitives

8.2. Resource reclaiming schemes

8.3. Real-time resource control

© 2019 Dawid Zimmer, The Australian National University PAGE 17 of 961 (Page 1) "Organization & ToC" up to PAGE 18

Organization & ToC

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

5. Asynchronism

6. Synchronisation

7. Scheduling

8. Resource control

9. Reliability & Fault-tolerance

Topics

9.1. Terminology

9.2. Faults

9.3. Redundancy

9.4. Reduce & Formalise

© 2019 Dawid Zimmer, The Australian National University PAGE 17 of 961 (Page 1) "Organization & ToC" up to PAGE 18

Organization & ToC

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

5. Asynchronism

6. Synchronisation

7. Scheduling

8. Resource control

9. Reliability & Fault-tolerance

Table of Contents

1. Introduction & Real-time languages

2. Physical coupling

3. Interfaces

4. Time & Embodiment

5. Asynchronism

6. Synchronisation

7. Scheduling

8. Resource control

9. Reliability & Fault-tolerance

© 2019 Dawid Zimmer, The Australian National University PAGE 17 of 961 (Page 1) "Organization & ToC" up to PAGE 18