RTS Lab Kick Off - Q2 2024/25

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TU Delft

Zephyr®

The TA Team

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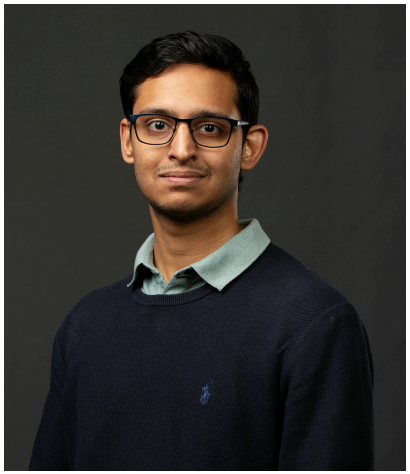

Shashwath Suresh

MSc. CESE 2nd Year
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Contacting Us

- For questions related to theory contact G.Iosifidis@tudelft.nl
- For questions related to labs you can contact us at rts-ewi@tudelft.nl
- Please mention your group number in any communication with us
- We prefer you use the course email to contact us
- You are welcome to come and talk to us during the lab

Contents

Practical Matters

Prerequisites

Proficient in C and C++

Basics of Real Time Operating Systems

Git

LaTeX

Reading software documentation

Operating System and IDE

Operating System

- You can use Linux, Mac or Windows.
- You cannot use WSL (flashing the board is not possible)
- We strongly recommend you to use **Linux**

IDE

- We recommend using CLion for doing these assignments
- VSCode can also be used
- VIM, Emacs etc. are also fine, but you may need to debug using the command line and the support you will get in the labs may be limited, if any

Working on assignments

- Assignments to be performed in pairs
- Enroll in a group on Brightspace if you haven't already!
- Each group on brightspace will be given a GitLab repository
  - If you don't have a repository, inform us when collecting your hardware
- Lab setup and assignment details are published on the course website
  cese.pages.ewi.tudelft.nl/real-time-systems
- If you have troubles with your lab partner, report this ASAP, do not wait until week 10!

Report

- Both assignments require a report
- Only a .pdf file typset in **Latex** will be accepted
- A **Latex** template is provided for each lab on the website, you **must** follow the template!
- **Do not exceed the page limits**
- References do not count towards the page limit

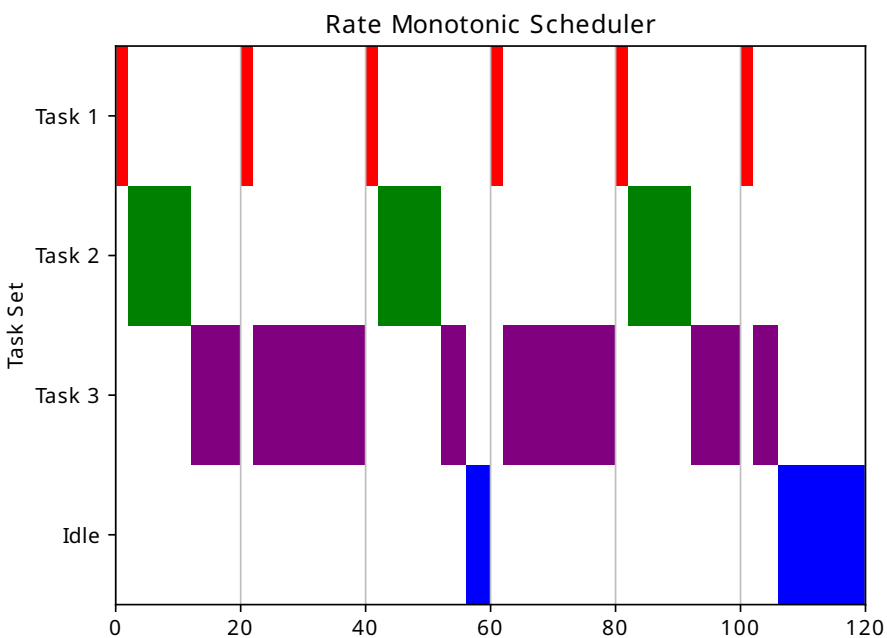
Submitting assignments

- Each group has a GitLab repository
- Last commit on `main` **before** the deadline is your submission
  - Report must be on GitLab by the deadline
    - **Root** of your repository
    - Name **must** follow the **convention given on the website**
  - Code **must** pass CI checks
- Our Advice - As soon as you have something, push to main so you don’t lose progress

The Assignments

Assignment A

Coding Schedulers



Assignment B

The Synthesizer

Schedule

Week	Lab	Delivery
Week 1		
Week 2	Assignment A	
Week 3	Assignment A	
Week 4	Assignment A	7th Dec
Week 5	Assignment B	
Week 6	Assignment B	
Christmas		
Week 7	Assignment B	
Week 8	Assignment B	18th Jan
Week 9		
Week 10		Final Exam

Grading

2 Lab assignments account for 40% of the final grade

Assignment	% Lab Grade	% Total Grade
Assignment A	40%	16%
Assignment B	60%	24%

Table 1: Weight of each assignment on the lab and final grades

Feedback Group

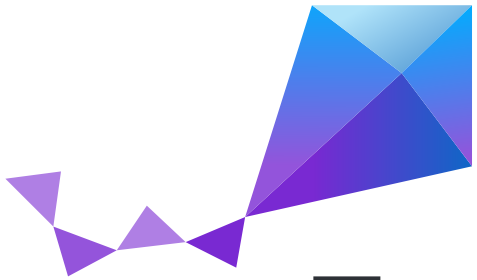
Group of 5-6 volunteers that will provide feedback about the assignments, more information after the hardware delivery.

Volunteers?

Please come talk to us after the hardware handout

Tools and Hardware

Why Zephyr

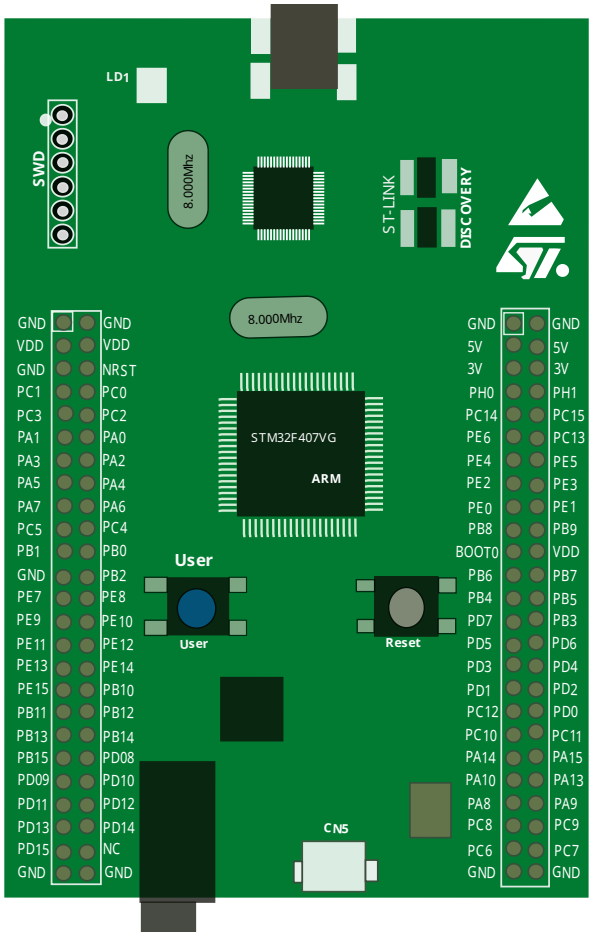


Zephyr®

- Multiple Scheduling Algorithms
- Highly configurable / Modular for flexibility
- Cross Architecture
- Memory Protection
- Compile-time resource definition
- Devicetree Support
- Native Linux, macOS, and Windows Development
- User friendly and full-featured Shell interface
- Great documentation
- And much more![1]

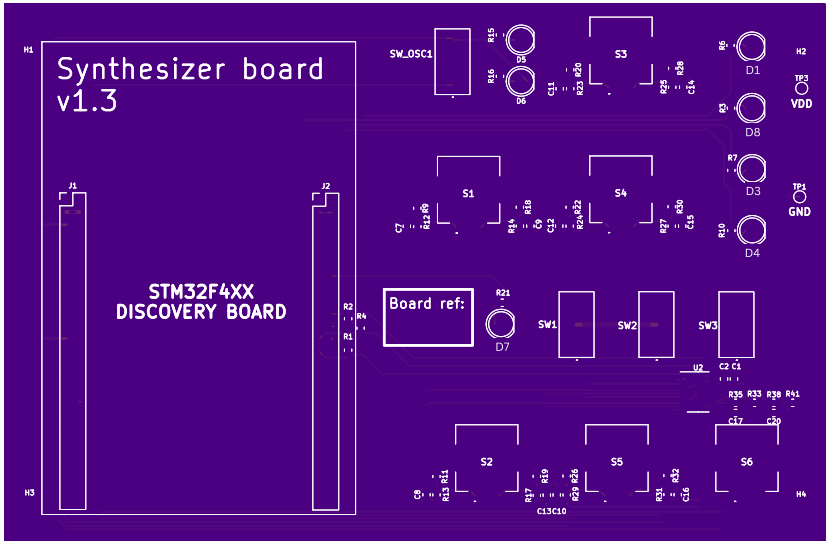
[1] https://docs.zephyrproject.org/latest/introduction/index.html#distinguishing-features

The Development Board: STM32F407-DISCO



- STM32f407 Arm Cortex-M4 with Floating Point Unit at 168 MHz max, 8 MHz on the board
- On-board ST-link programmer
- Class-D audio amplifier and minijack connector
- 4 controllable LEDs
- USB port
- Extension connectors

Custom Daughter Board



- A custom IO extension board
- 5 GPIO LEDs (D1/D3/D4/D7/D8)
- 6 Rotary Encoders (S1/S2/S3/S4/S5/S6)
- 3 Single Pole Double Throw (SPDT) Toggle Switches (SW1/SW2/SW3)
- 1 SPDT Toggle Switch with LEDs (SW_OSC1 & D5/D6)
- LEDs & Toggle switches connect to STM GPIOs
- Rotary encoders connected to IO expander IC (PCA9555PW)
  - IO expander connected to STM using I2C

Questions?

Assignment A

The Assignment

In groups of 2, implement 2 scheduling algorithms for periodic preemptible task sets and 2 fixed-priority servers for aperiodic tasks on the STM32 Dev board.

Periodic Scheduling algorithms

- **Rate Monotonic (RM)** - Smaller period -> Higher Priority
- **Earliest Deadline First (EDF)** - Earliest absolute deadline -> Higher Priority

Aperiodic Scheduling algorithms

- **Background Scheduling** - Aperiodic Task priority < Periodic Task priority
- **Schedule it Immediately** - Aperiodic Task priority > Periodic Task priority

Checking the template...

Grading and Deadline

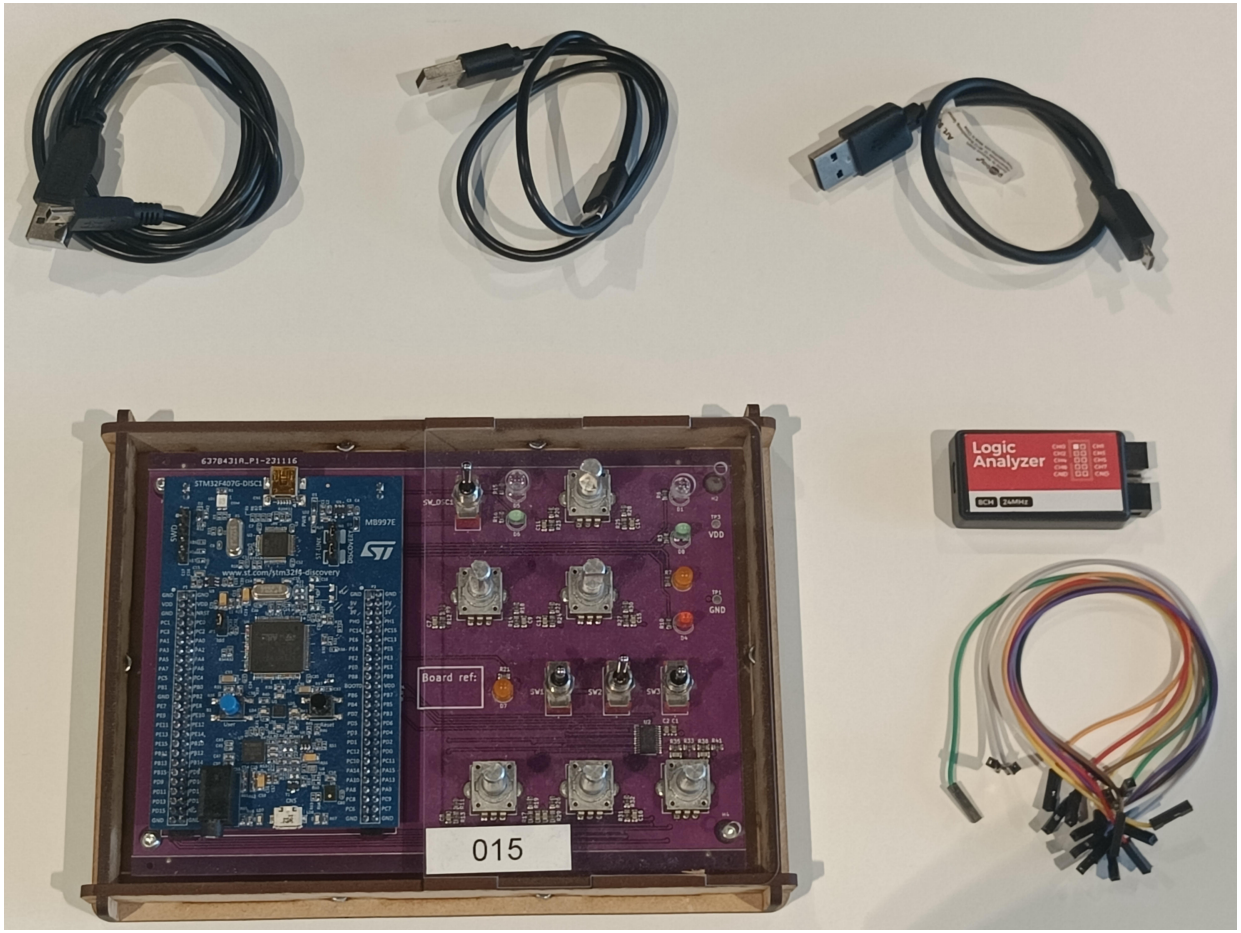
- Assignment A is **40%** of the lab grade
- Deadline: **Saturday 7th of December at 23:59 (week 4)**

Questions?

How to get your Hardware

- We scan your campus card and register your group
- You pay €50 by card
- A development kit is assigned to you and handed over
- Ensure that all the components are present in the box you receive
- If you haven’t received a GitLab repo inform the TAs

NOTE: ONLY ONE BOARD PER GROUP



Enjoy the Lab!