

# Concepts and Software Design for CPS

## Lab 0: Introduction

Chair of Cyber-Physical Systems in Production Engineering  
Technical University of Munich  
Munich, Germany

# Contact Information

Raphael Trumpp

`raphael.trumpp@tum.de`

Binqi Sun

`binqi.sun@tum.de`

Technische Universität München

Lehrstuhl für Cyber-Physical Systems in Production Engineering

Room 5501.02.102a

# Overview (curriculum)

From design to implementation of Cyber-Physical Systems:

- Programming real-time embedded systems with *C*
  - From bit operations to task scheduling and communication
  - Virtual-C IDE and Linux shell
- Cyber-physical modeling and simulation
  - Designing digital filters and controllers
  - Matlab and Simulink

# Overview (organization)

- 12 meetings and 6 assignments
- Assignments are worked on in groups of 3
- Submission via Moodle
  - only one group member submits the groups solution
  - every group member needs to be able to explain the solution
- Due date will be on the Moodle submission page
- Teaching material on Moodle

# Meetings

- Weekly meetings with each team on Zoom
- Two meeting types: *Review* and *Q&A*, held alternately:  
exception for Lab 1 (no Q&A meeting): 28th October: *Review Lab 1*, 4th November: *Q&A Lab 2*, 11 November: *Review Lab 2*, ...
- Review meeting:
  - ▶ students present the solution of their last assignment
  - ▶ we discuss with you the next assignment

(**compulsory attendance**, duration: 20 - 30 min. per team)

- Q&A meeting:
  - ▶ receive help with problems related to the active assignment
  - ▶ ask detail questions about things you learned

As group, write an email with your question/problem until Wednesday/Thursday EOD (the day before the Q&A meeting date).  
(duration: depending on question/problem)

- Next week will be a Review meeting (28th October)

## Schedule (Dates)

Date (d/m/y)	Q/A	Assignment	
		Release	Review
21/10/21	Intro	No. 1	-
28/10/21	-	No. 2	No. 1
04/11/21	No. 2	-	-
11/11/21	-	No. 3	No. 2
18/11/21	No. 3	-	-
25/11/21	-	No. 4	No. 3
09/12/21	No. 4	-	-
16/12/21	-	No. 5	No. 4
23/12/21	No. 5	-	-
13/01/22	-	No. 6	No. 5
20/01/22	No. 6	-	-
27/01/22	-	-	No. 6

Dates might be subject to change

## Schedule (Time slots)

Session 1	10:30 - 13:00
Session 2	13:00 - 14:30
Session 3	14:30 - 16:00

- There are up to 6 groups per session possible
- Groups are formed by up to 3 persons

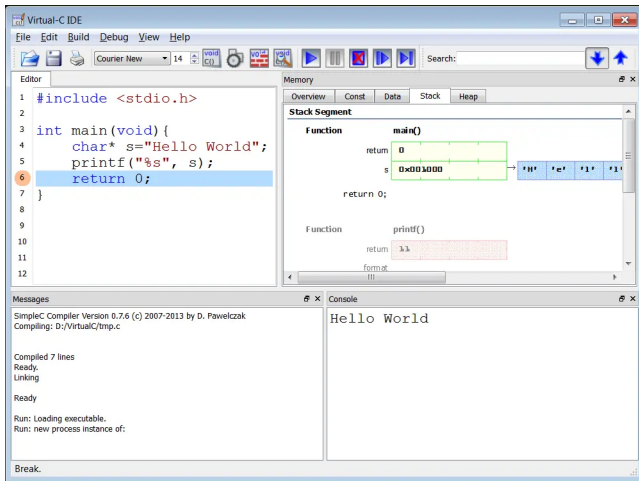
**Please form groups!**



# Software

## Virtual-C IDE

Integrated development environment (IDE) for C with an editor, a compiler, a debugger, and visualization for memory segments.



# Software

## Virtual-C IDE: Installation

To download and install *Virtual-C* follow the instructions from:

<https://sites.google.com/site/virtualcide/>

Supported platforms:

- Microsoft Windows (7, 8, 10) 32/64 Bit
- Mac (OS X 10.7-11)
- Linux (i386, .deb package)  
for other architectures (e.g., amd64) you may need to enable multiarch  
(<https://wiki.debian.org/Multiarch/HOWTO>)  
tested on Ubuntu 16.04 (32 bit), 18.04 (64 bit), Mint 19 (32 & 64 bit)

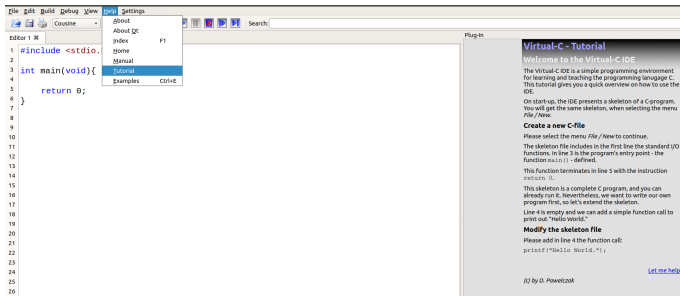
In case of any problems, please read the release notes first:

<https://sites.google.com/site/virtualcide/ReleaseNotes.txt>

# Software

## Virtual-C IDE: First run

After installation please run tutorial ("Hello World!")



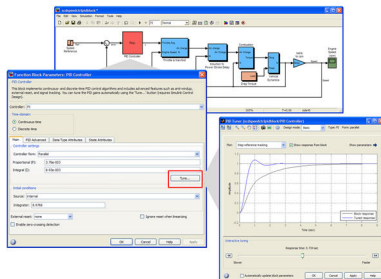
# Software

## Matlab

*MATLAB* is a numerical computing environment and programming language

- matrix manipulations
- plotting of data
- implementation of algorithms

*Simulink* adds graphical simulation and model-based design for dynamic and embedded systems.



To download and install *Matlab* follow the instructions from:

[https://wiki.rbg.tum.de/Informatik/Helpdesk/  
MatlabInstallieren](https://wiki.rbg.tum.de/Informatik/Helpdesk/MatlabInstallieren)

Products to install:

- MATLAB
- Simulink, Simulink Control Design, Control System Toolbox

License Information can be found at: <https://wiki.tum.de/pages/viewpage.action?pageId=43002883>.



# Homework

1: Make sure you can run Virtual-C IDE or another C compiler

2: Run tutorial (“Hello World”) in Virtual-C IDE (see slide 11)

Lab 1 slides are available on Moodle

- Introduction to C
  - ▶ Hello World!
  - ▶ Data Types
  - ▶ Bit Operations
  - ▶ Arrays
  - ▶ Functions