DESN2000 (Computer Engineering) 2025 T2

Introduction to STM32 ARM and GPIO

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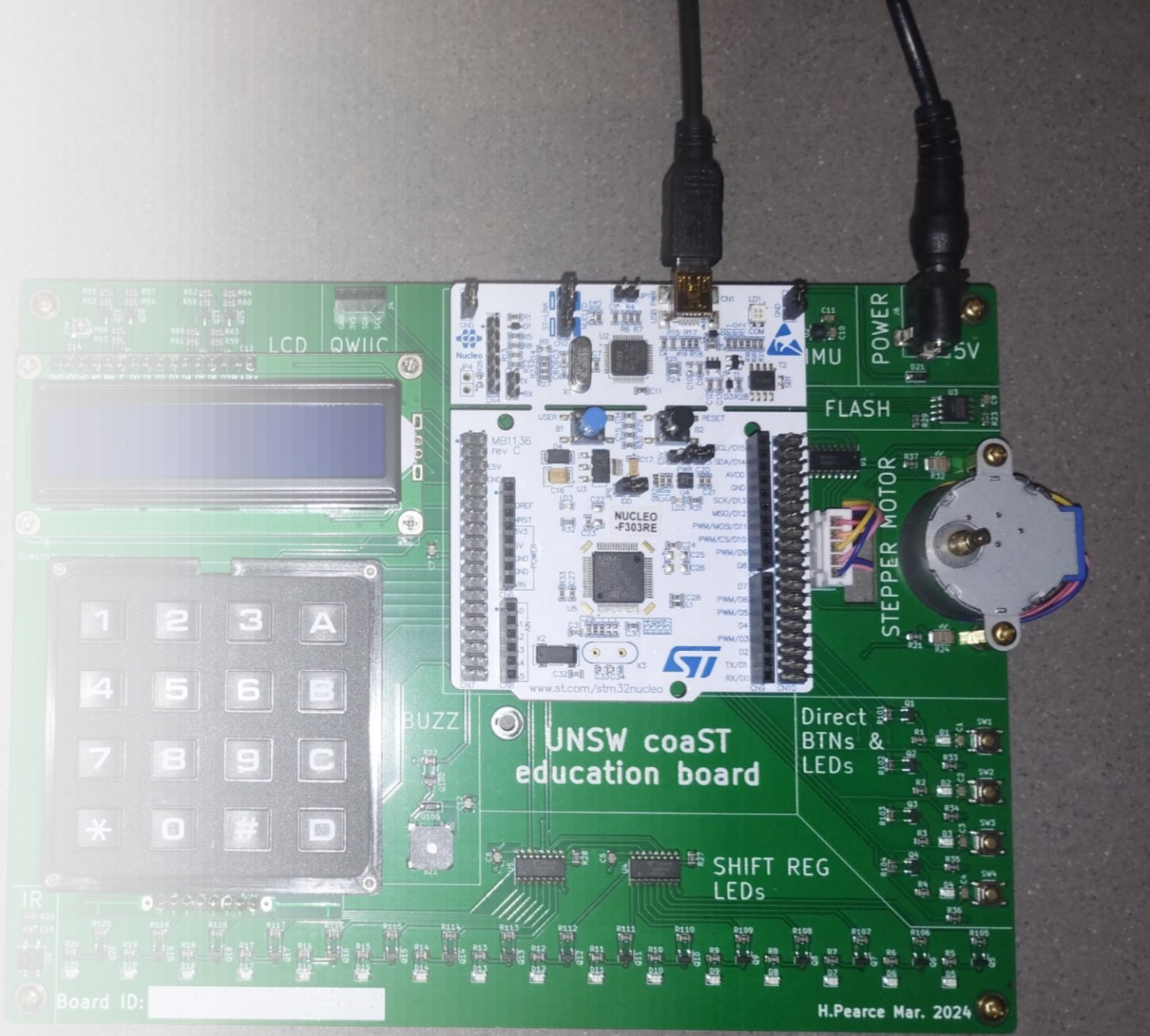
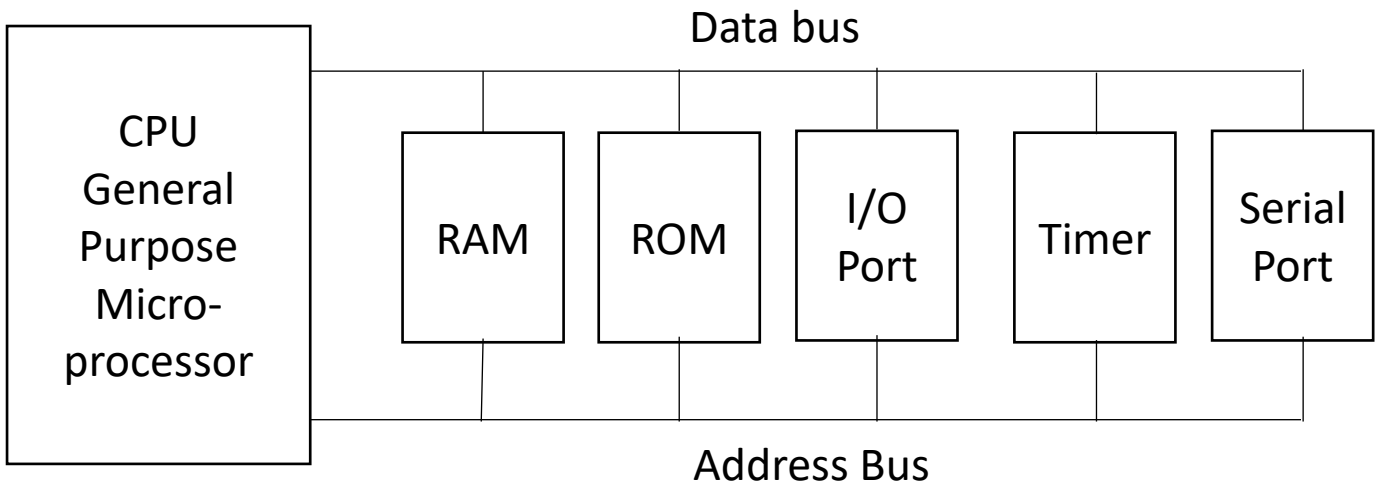


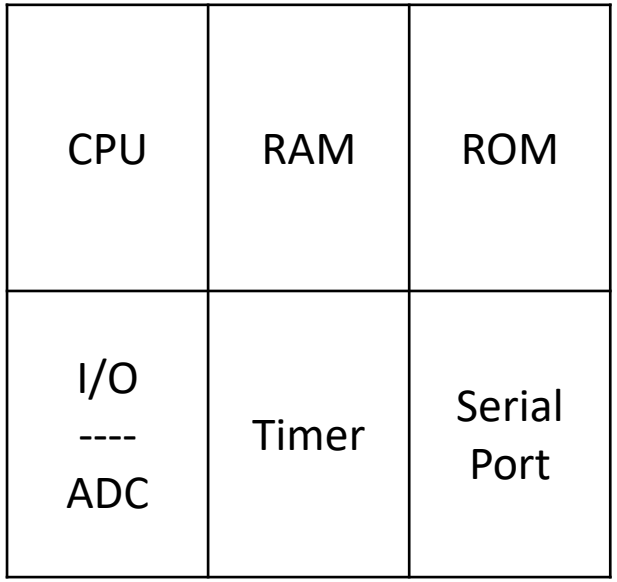
What are embedded systems?

- A system composed of computer processor, computer memory, and input/output peripheral devices
- Embedded as part of a complete device often including electrical or electronic hardware and mechanical parts
- Dedicated function within a larger mechanical or electronic system
- e.g.: calculators, printers, Microwave ovens, treadmills ...

Microprocessors vs Microcontrollers



General Purpose Microprocessor System



Microcontroller

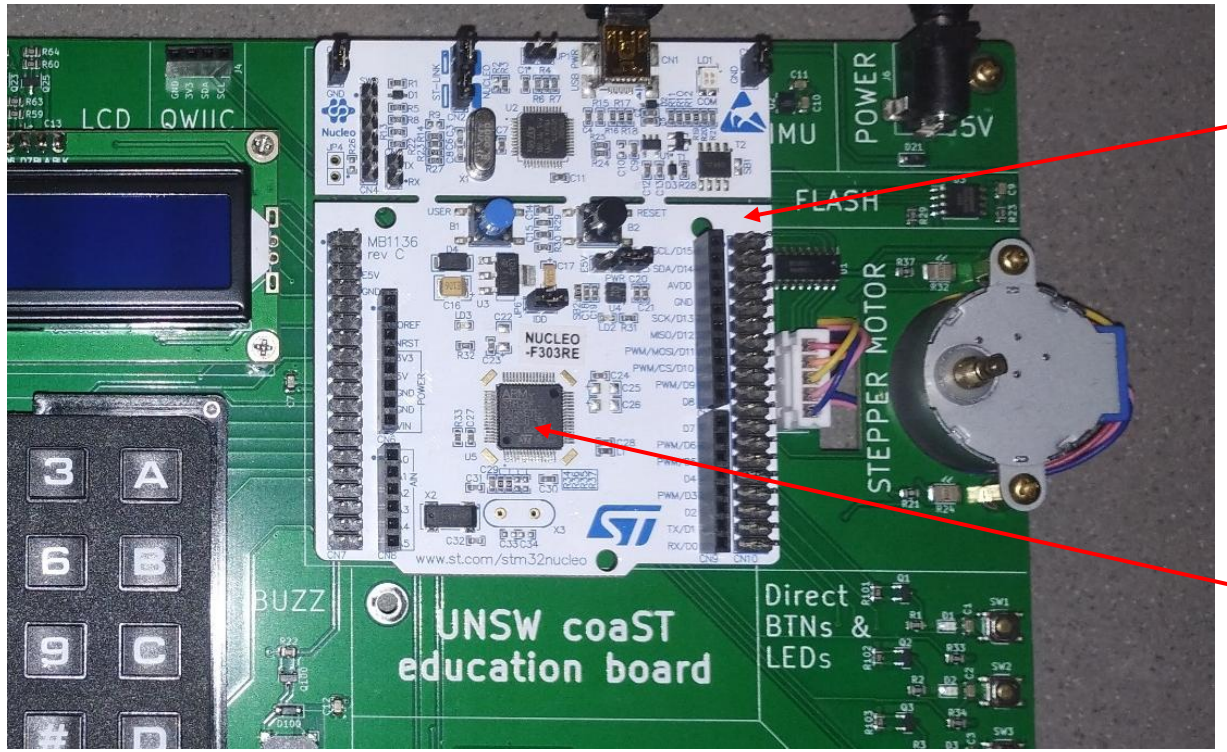
Different Microcontrollers

- Microchip PIC
- Atmel AVR (Now under Microchip)
- Espressif Systems (ESP8266 and ESP32)

- ARM-based microcontrollers
  - STMicroelectronics STM32  What we learn
  - NXP Freescale
  - Texas Instruments LM4F, TM4C …
  - ….

STM32F303RE

- We will focus on STM32F303RE, which is the microcontroller found in the NUCLEO-F303RE Board

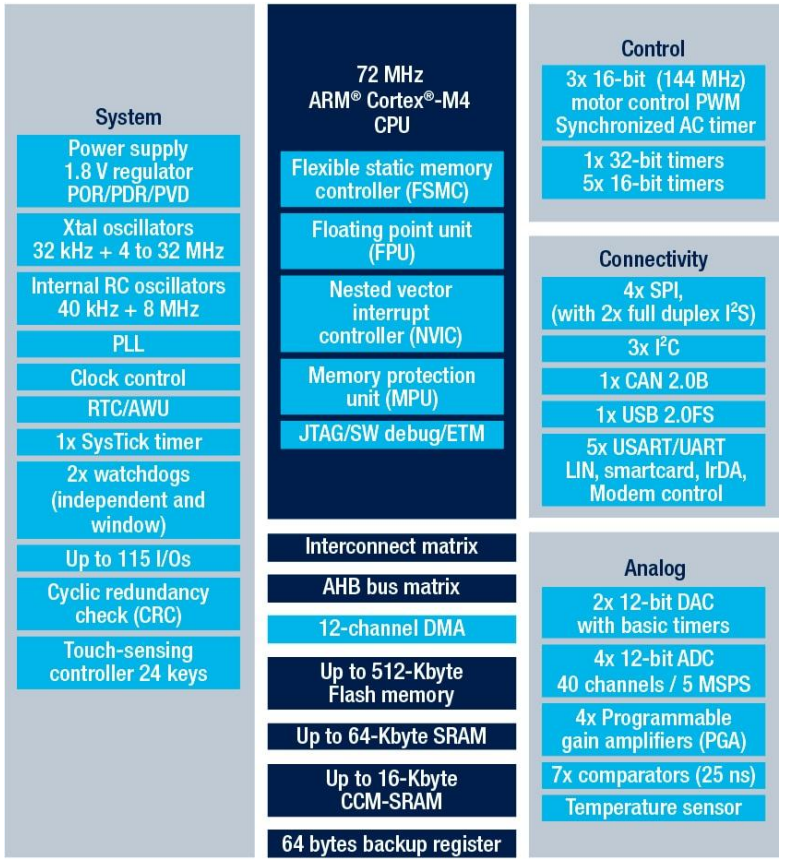


NUCLEO-F303RE Board

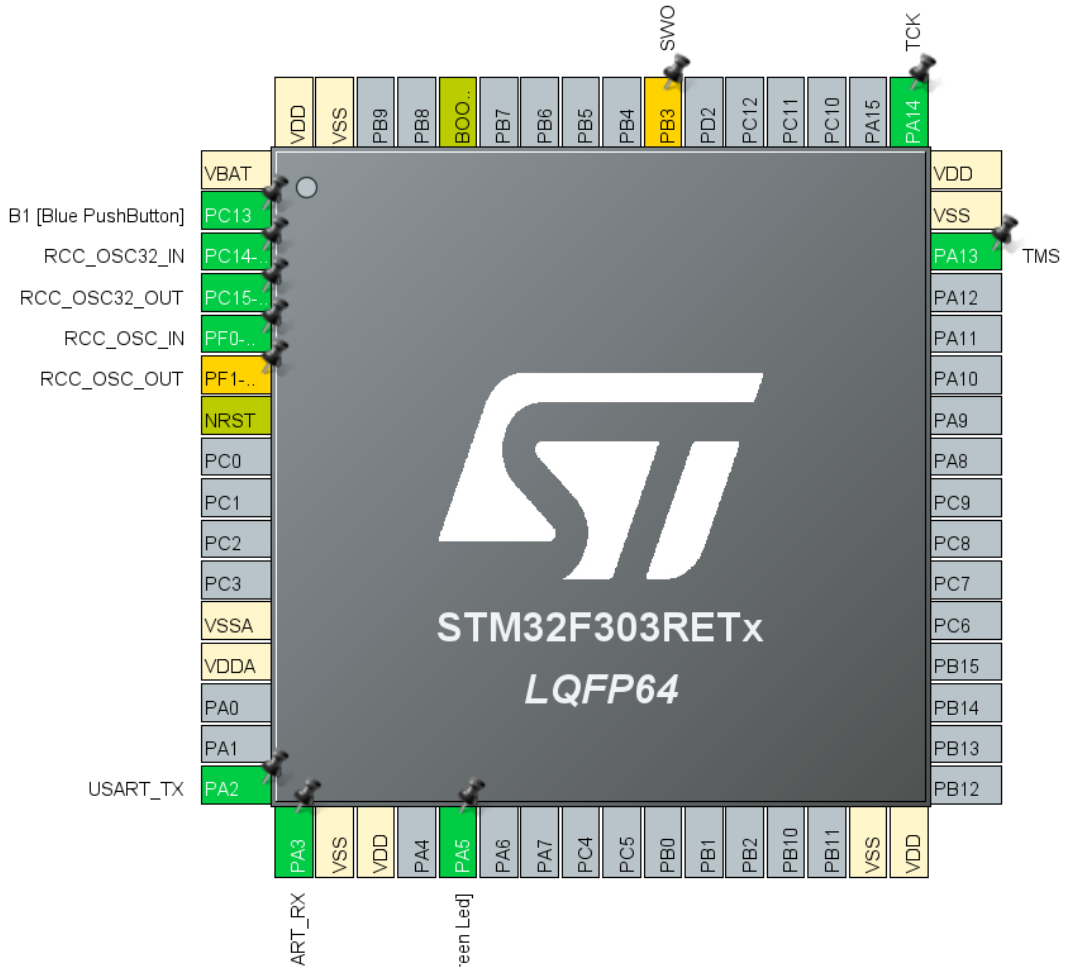
STM32F303RE ARM microcontroller

STM32F303RE Specification

- ARM Cortex-M4 32-bit CPU
- 64 Kbytes of SRAM
- Operating voltage - 2.0 V to 3.6 V
- Peripherals such as
  - Digital I/O
  - Analogue to Digital Converters (ADC)
  - Timers
  - Serial communication interfaces
- More info:
  - https://www.st.com/en/microcontrollers-microprocessors/stm32f303re.html
- Datasheet:
  - https://www.st.com/resource/en/datasheet/stm32f303re.pdf



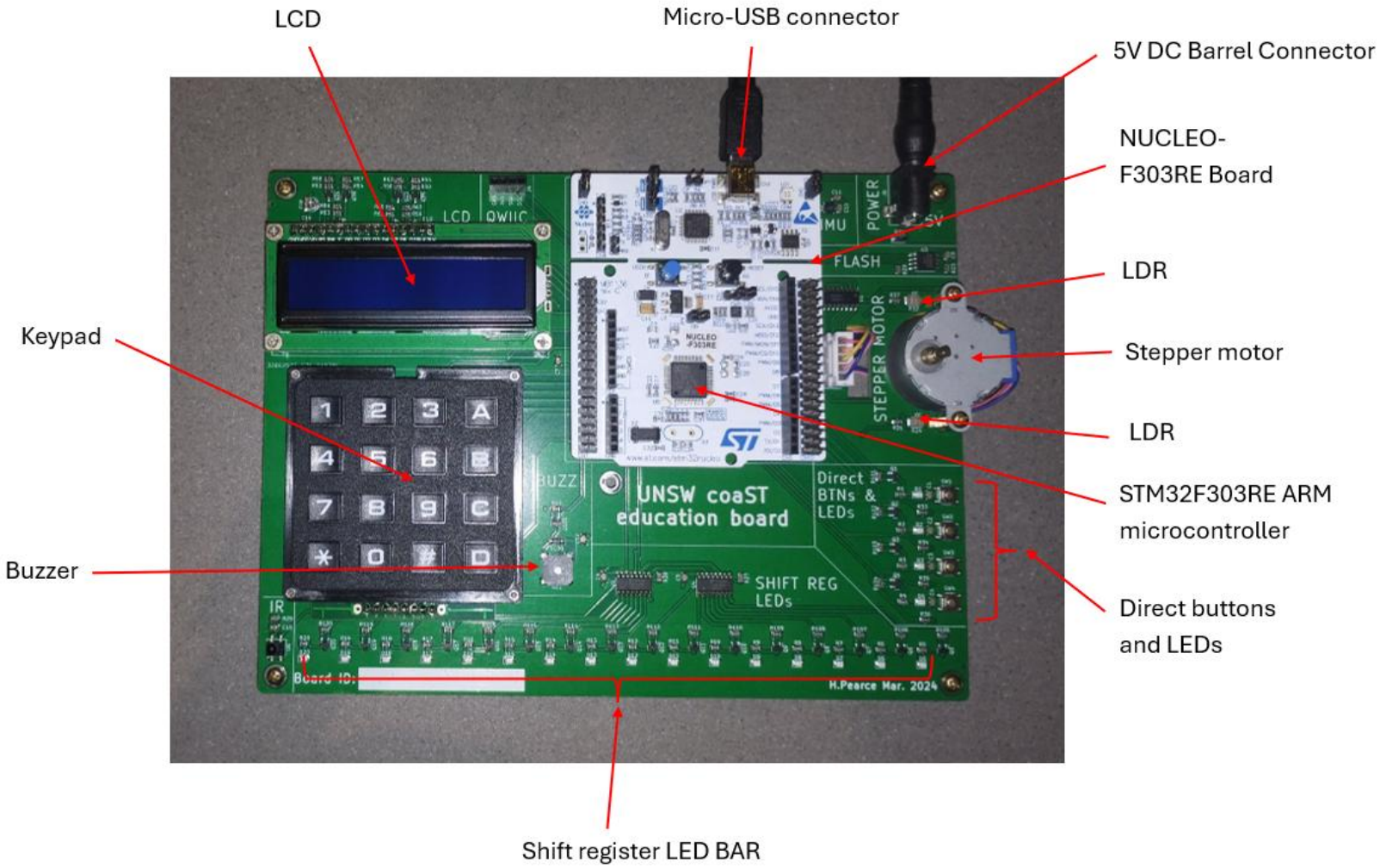
STM32F303RE LQFP64 Pins



<u>General Purpose I/O Pins</u>

- Limited pins on a microcontroller
- GIPO pins can be configured by software to do different functions like
  - Digital I/O
  - Analogue I/O
  - Communication, interrupts, timer capture etc.

coaST board components

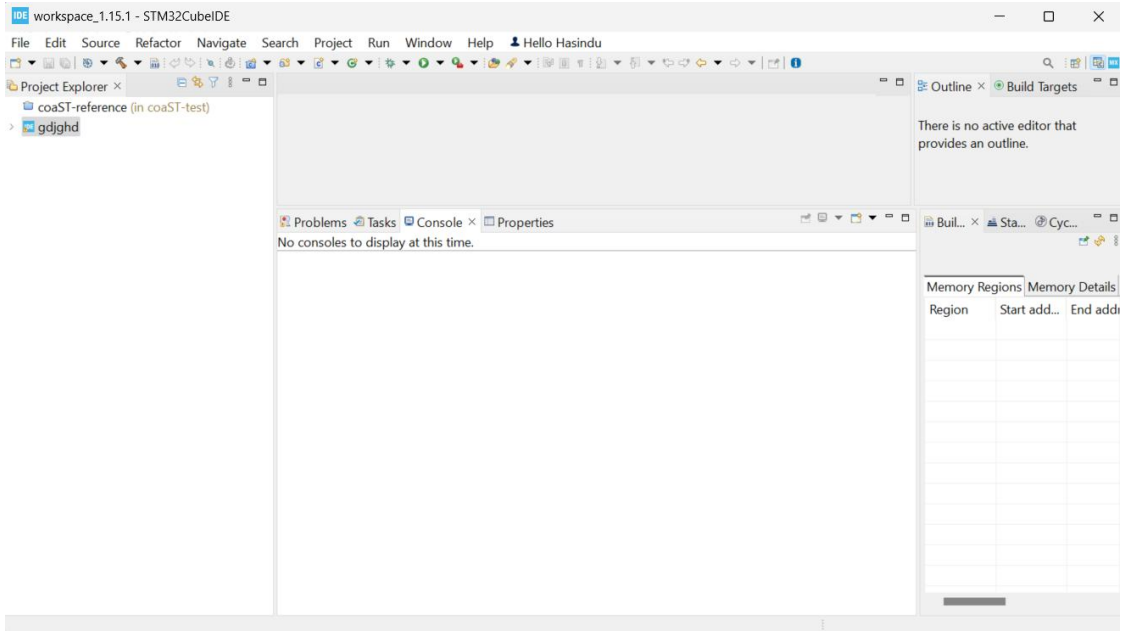


Board components:
https://webcms3.cse.unsw.edu.au/DESN2000/25T2/resources/112035

Board pin connection:
https://webcms3.cse.unsw.edu.au/DESN2000/25T2/resources/112036

STM32 cubeIDE

- STM's integrated development environment (IDE)
  - Code Editor
  - Compiler
  - Drivers
  - Debugger
  - Flasher/programmer
- Getting started with cubeIDE
  - https://webcms3.cse.unsw.edu.au/DESN2000/25T2/resources/112038



Reading Material

- Zhu, Yifeng, Embedded systems with ARM Cortex-M microcontrollers in assembly language and C
  - Available in the UNSW library
  - Chapter on GPIO (Chapter 15 in 4th edition)

End of Slides

Let us move on to the whiteboard and
some live coding

- Getting started with STM cubeIDE
- Digital I/O
  - Output: direct LEDs
  - Input: direct buttons