C1. Intro to Embedded

Embedded Essentials
BACKBONE

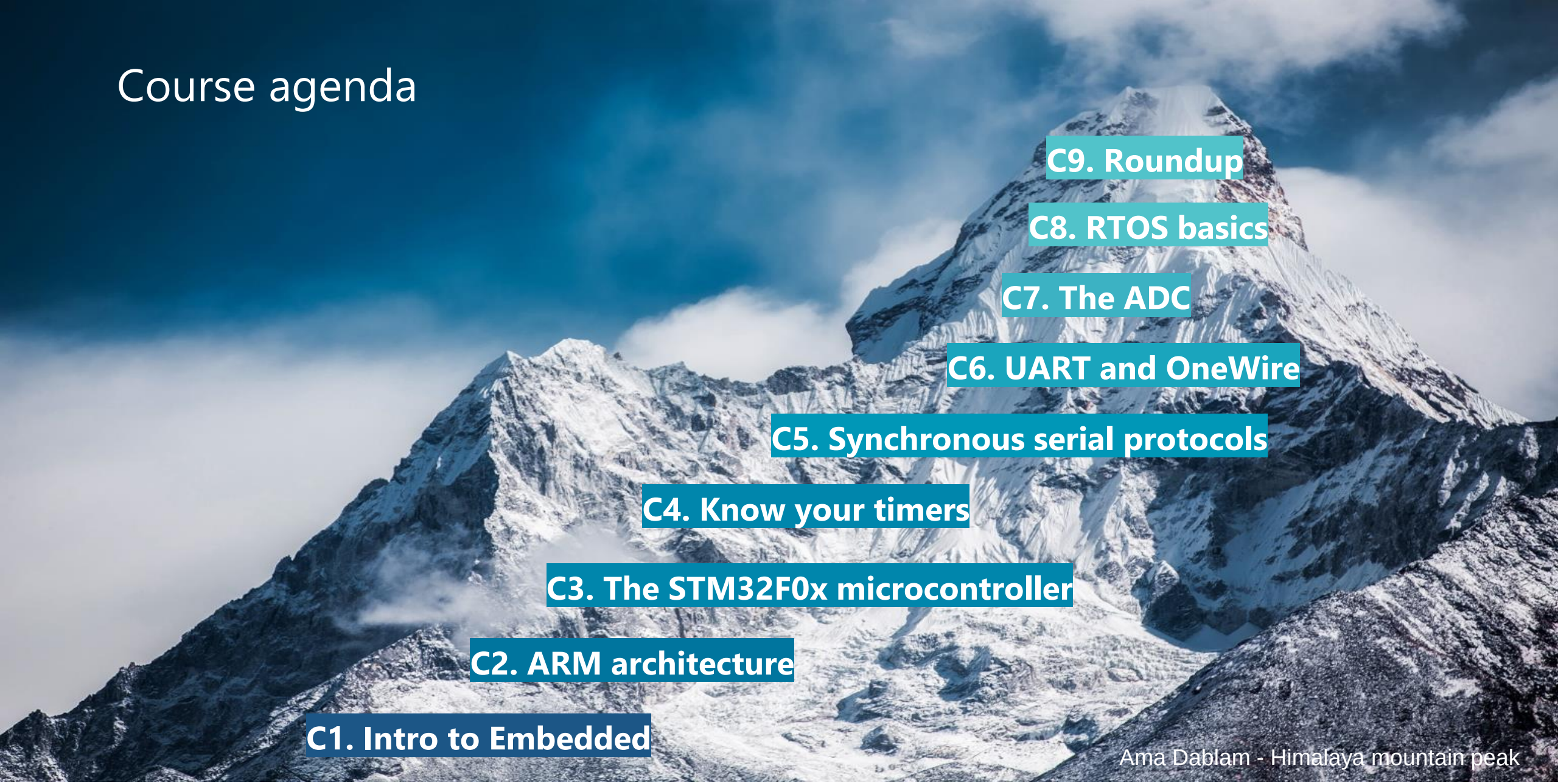
Let’s meet

George Serea

Course Introduction

- **What you will learn**
  - Define components of an embedded system
  - Design and write code for ARM based microcontrollers
  - Work in a team-aware environment
  - Make use of bug report tools
  - Make use of versioning control
- **What you should already know**
  - C programming
  - Basic electrical engineering concepts
  - Basic computer architecture and digital circuits

Course agenda



Ama Dablam - Himalaya mountain peak

Today’s agenda

1. Setup course ground rules
1. Software development
1. Anatomy of an embedded system
1. Setup the work environment
1. C language refresher
1. Basic hardware concepts - A & D
1. The microcontroller architecture

Course ground rules

- Course schedule
- How much to wait before starting the course?
- Course structure: breaks, standup, theory, practice, mini-contest
- Homework
- Laptop usage during presentation
- Q&A anytime during class

➡ Further reading [GroundRules]

Software Development Life Cycle

Design

- Customer needs
- Concept study
- Requirements
- Product design

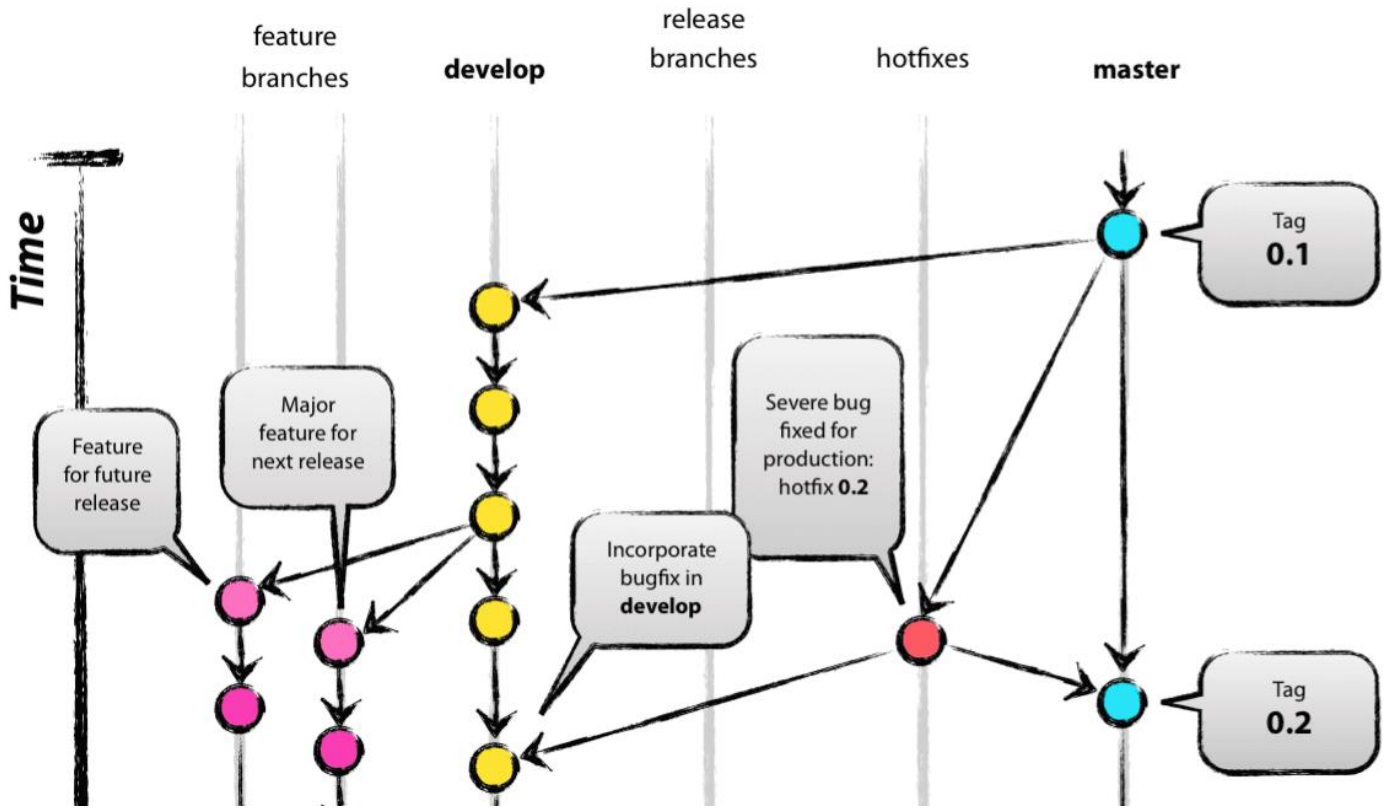
Develop

- Code development
- Bug solving
- Incremental releases
- Integration & testing

Operate

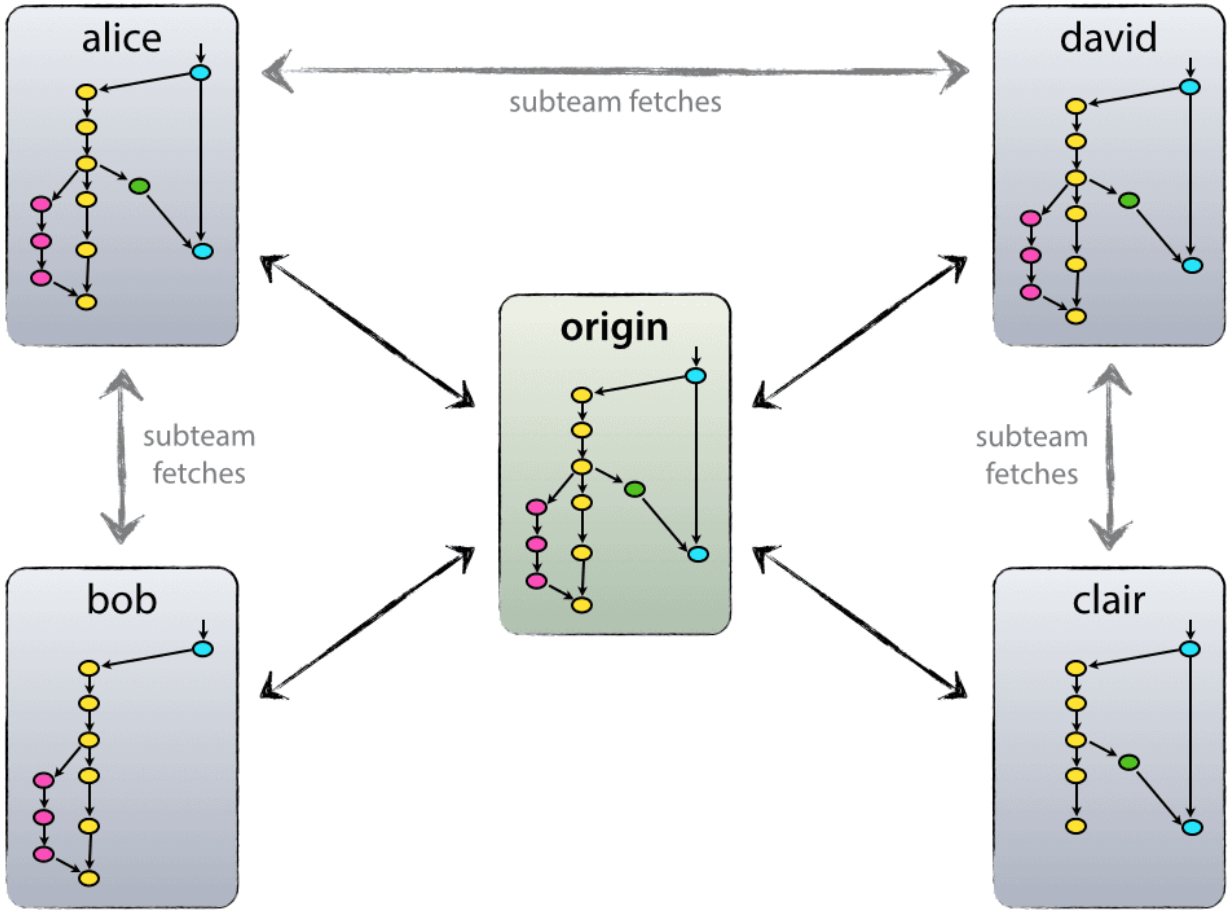
- Market releases
- Maintenance
- Client support
- Product phase-out

Software Versioning



➡ Further reading [Git Branching]

Software Versioning



Software Development Domains

01	General purpose	• Web development • Computer graphics • Other PC & mobile apps • Operating systems & tools
02	Business	• Business intelligence • Financial apps • CRMs and ERPs
03	Science	• Scientific R&D • Big data • Machine learning and A.I.

Software Development Domains

04 Embedded systems

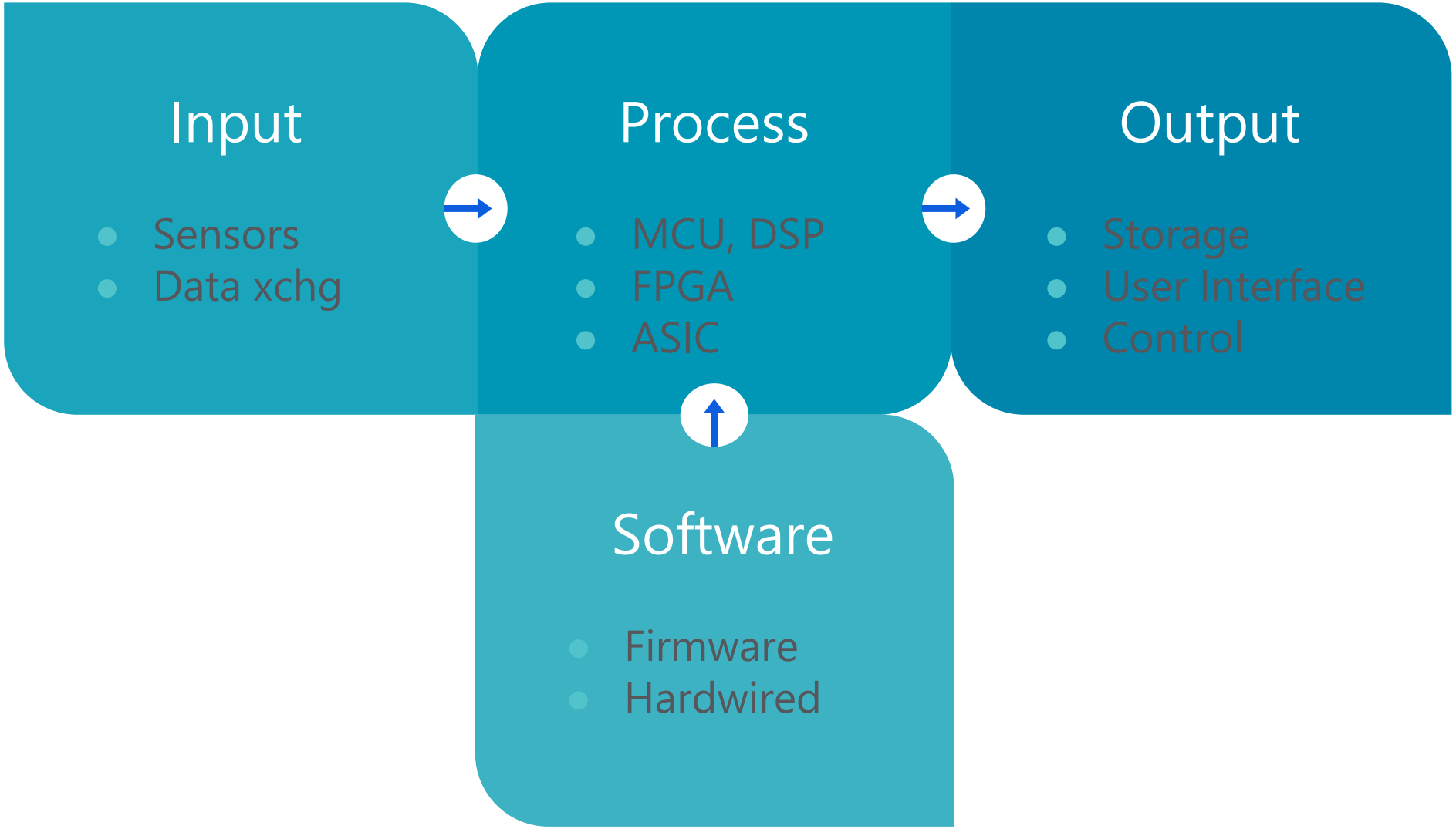
- Automotive and transportation
- Medical devices
- Networking & telecom
- Mass market: IoT, camera, printer
- Energy production & distribution
- Space & Military devices
- Data collection and science R&D

Anatomy of an Embedded System

Further reading [EmbeddedSystemCourse]

Embedded System

Anatomy of an Embedded System



Some architecture choices

01	Cost	• Just the resources needed
02	Reliability	• Simple solution => few bugs
03	Time to market	• Choose popular, easy to use & well supported solutions
04	Availability	• Manufacturer can supply needed number for life-span duration of product

Design an embedded system

Customer needs

Describe what is the task the product needs to perform.

Features

Describes what characteristics the product needs to possess to do the task.

Components

Describes what actual components need to be present in the product to offer the needed capabilities (features).

Customer needs

Greenhouse monitor

I need a device that

- Measures temperature in my greenhouse
- Displays average temperature
- Lets me set a threshold temperature
- Gives alarm if temperature drops below threshold
- Monitors and shows total hours of sunlight

Home automation

I need a device that

- Displays the room temperature
- Lets me set desired temperature
- Starts the heater or AC when temperature goes below or above threshold
- Turns on a light after sunset when I enter the front door

Features

Greenhouse monitor

- Measure temperature
- Display various data
- Allows setting parameters
- Measure light intensity
- Gives an alarm (visual? audio?)

Home automation

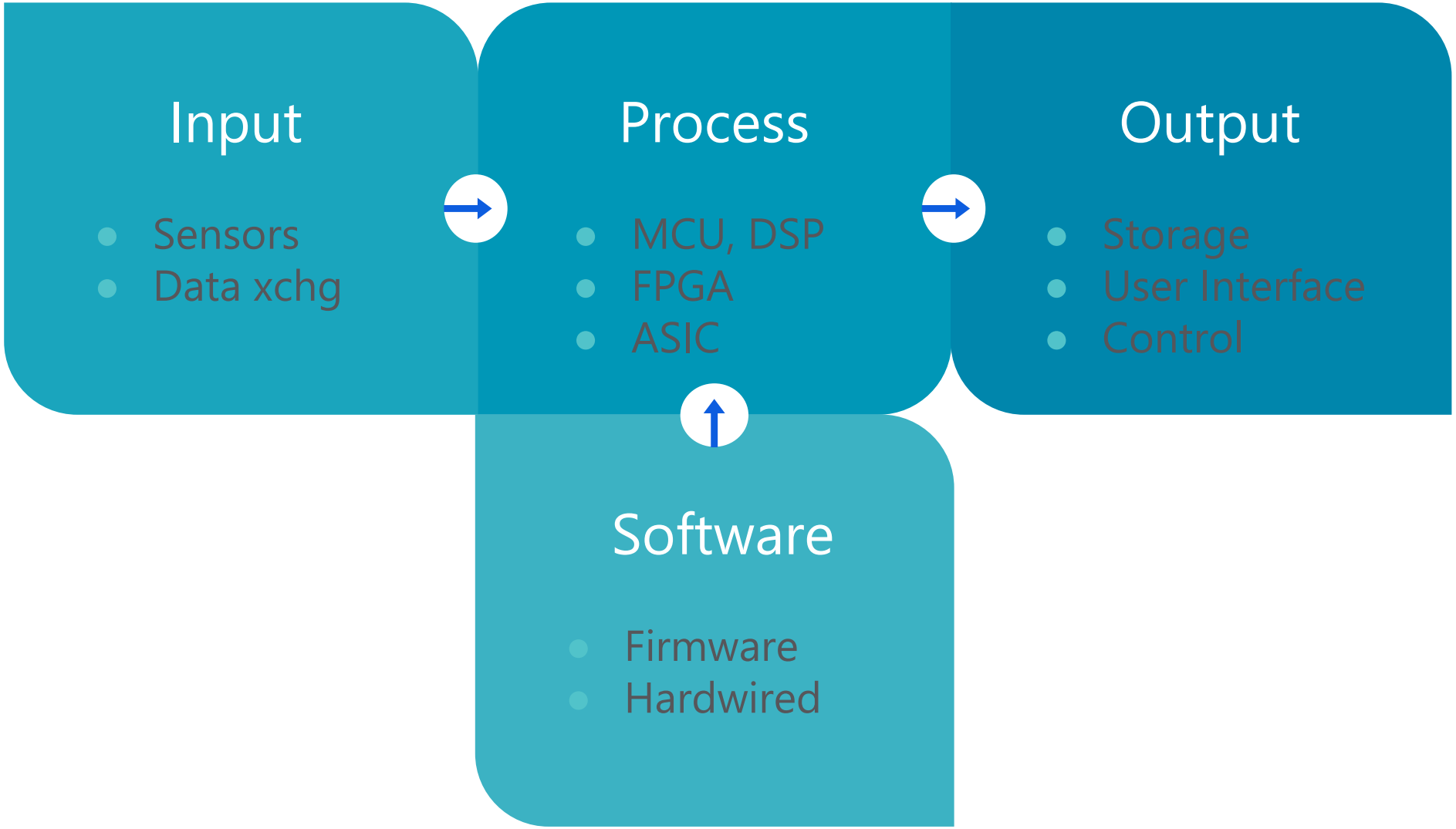
- Measure temperature
- Display various data
- Allows setting parameters
- Measure light intensity
- Control AC, heater, light

Components

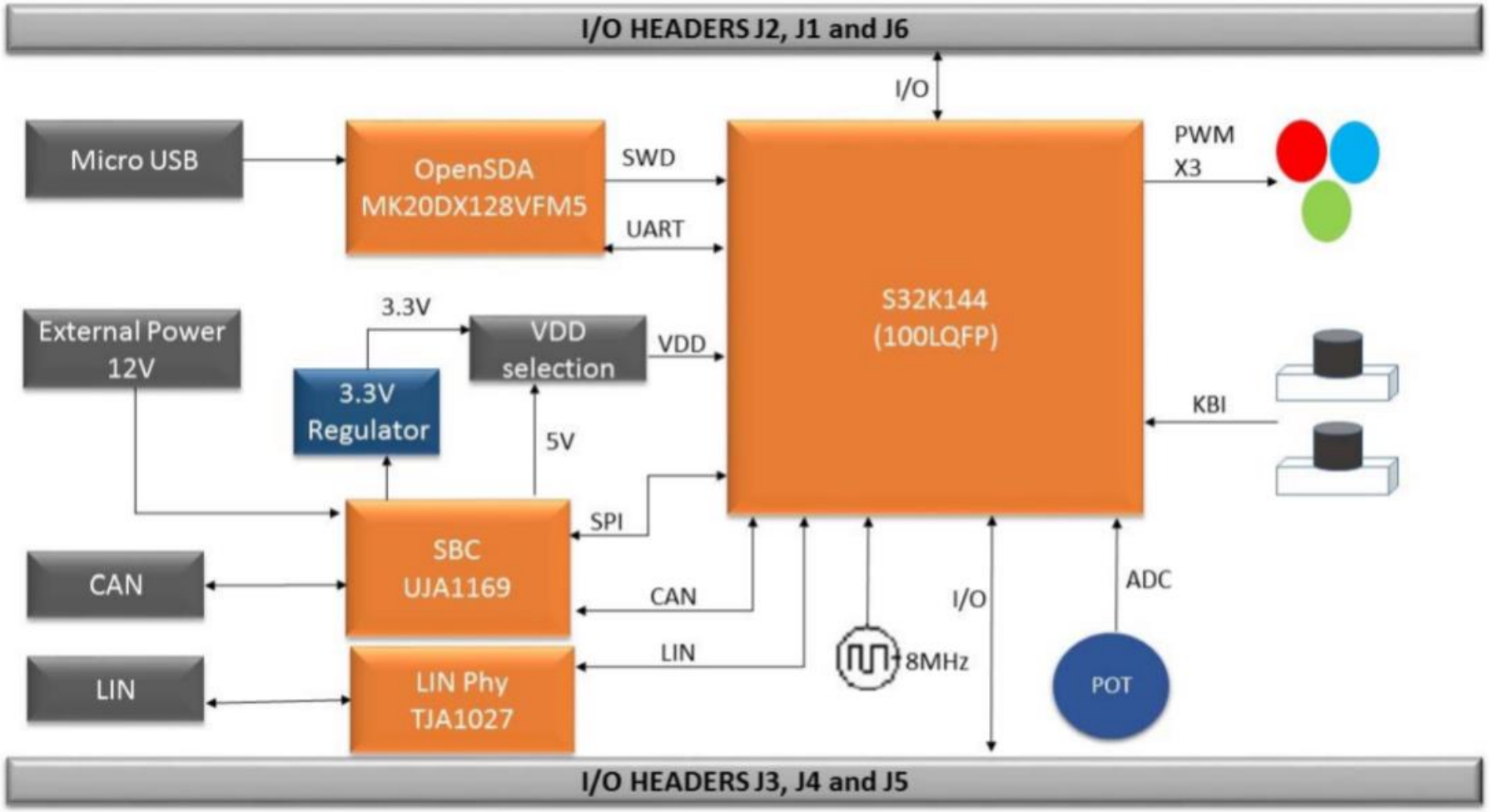
01	Measure Temperature	Temperature Sensor
02	Display Data	Display (user interface)
03	Change Parameters	Buttons (user interface)
04	Measure Light Intensity	Light Sensor
05	Control light, heater, AC	Relays

Embedded System

Anatomy of an Embedded System

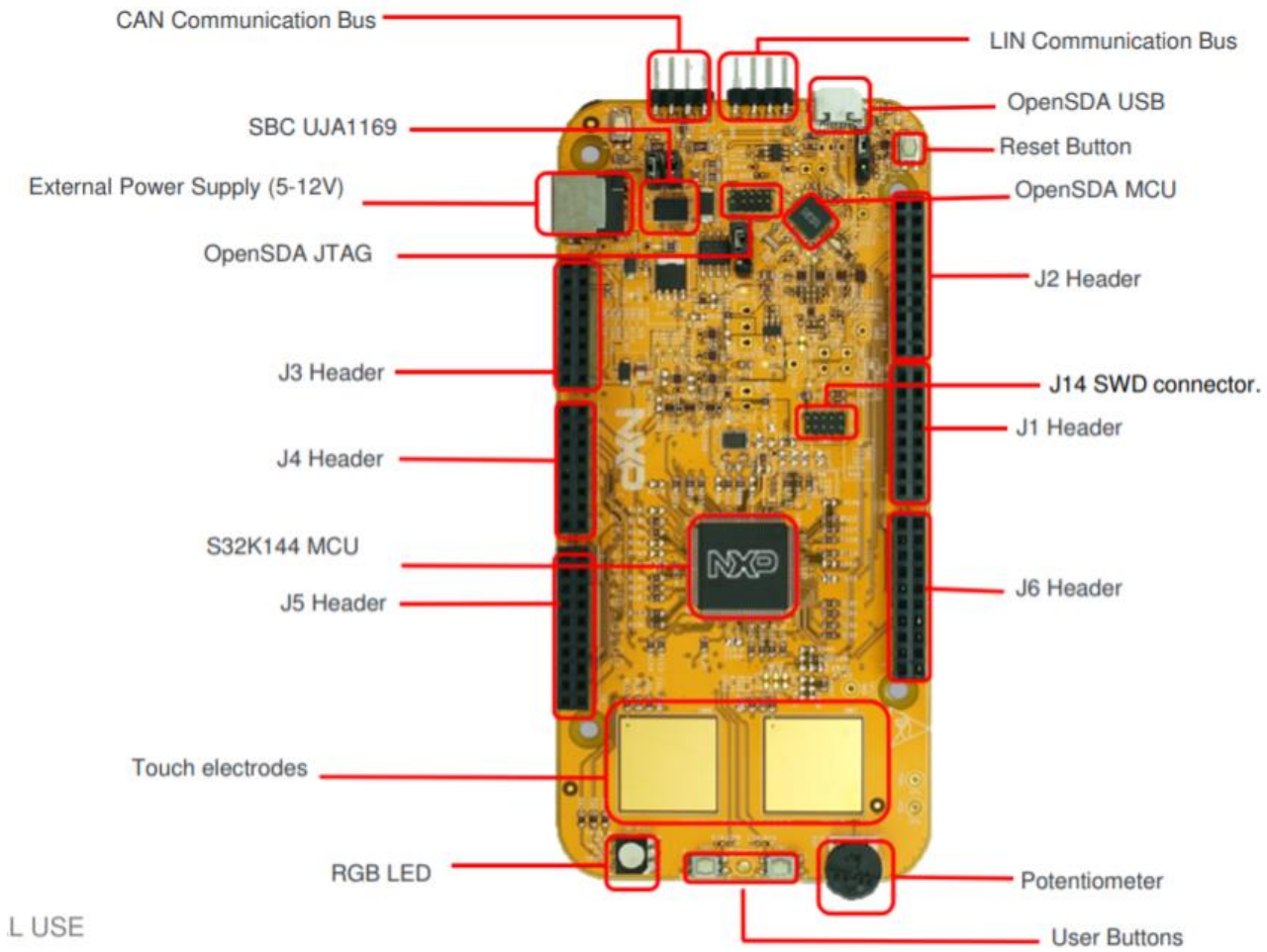


Our Embedded System



Our Embedded System

Anatomy of an Embedded System



L USE

nine TECH

Environment: Windows

Please install S32 Design Studio from NXP’s website

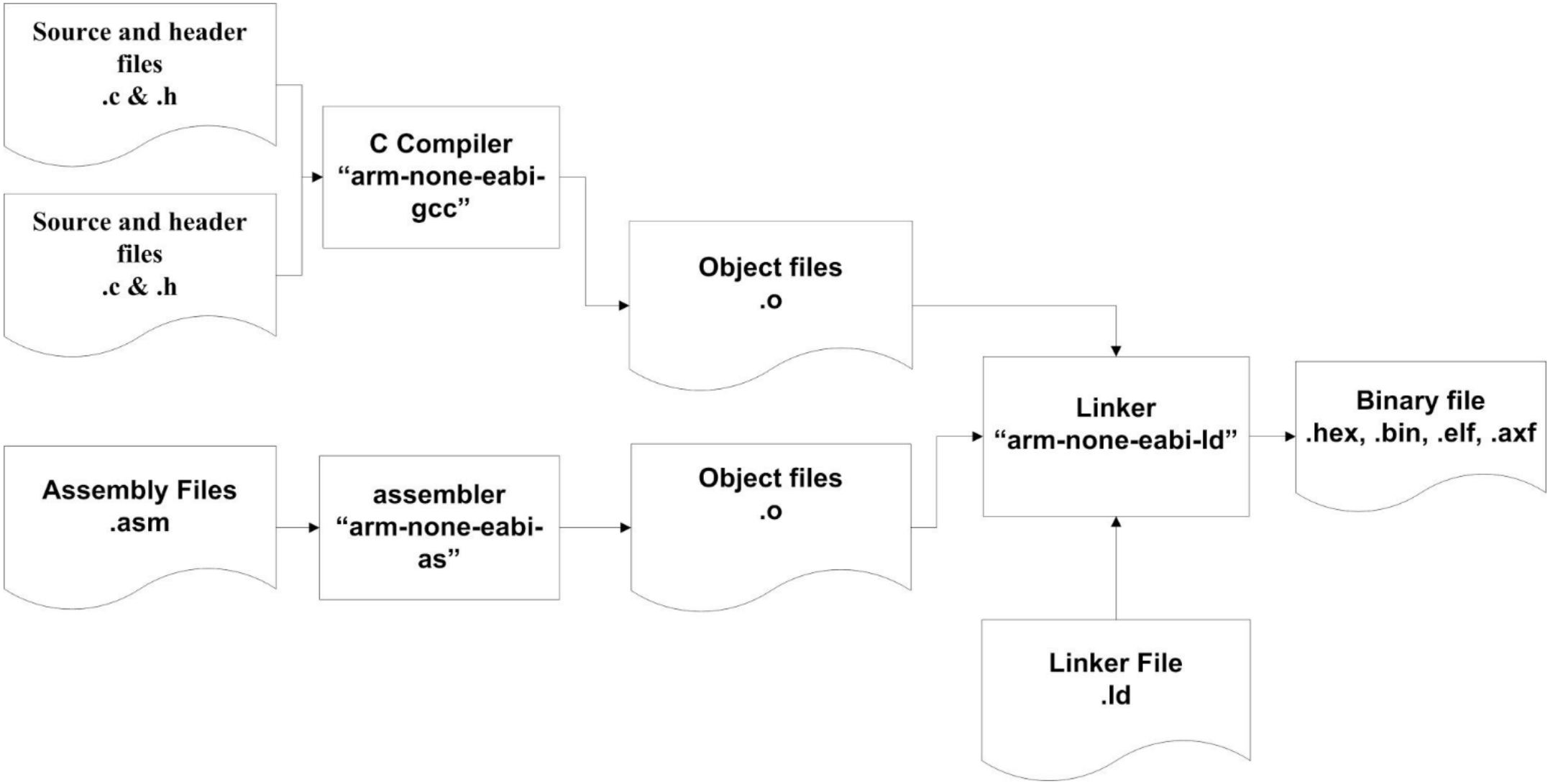
How to work as a team

- Git usage – TO DECIDE NAME
- Redmine usage
- Fill in the Input document
- How/if we do homework

C language

- Some C important concepts
- Memory mapping

C toolchain



- Meet the microcontroller datasheet

Conclusion

- Our selected project
- Microcontroller architecture
- Next steps, homework
- Q & A

Thank You!

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