EMBEDDED SYSTEMS ENGINEERING ROADMAP

Required	Recommended	Possibilities

⚠️ These colors indicate the average importance of each topic. It should be noted that the importance of a topic can vary among different industries and job roles.

START

SOFTWARE

Programming Fundamentals
- Algorithms & Data Structures
- Design Patterns
- State Machines
- Memory Management

Programming Languages
- C
- C++
- Python
- Assembly
- Rust

Operating Systems
- Operating System Fundamentals

Embedded Linux
- Linux Kernel
- Device Drivers
- U-Boot
- Buildroot / Yocto
- Threading / Parallelism
- IPC
- Qt Framework

Real-Time OS
- RTOS Basics
- FreeRTOS
- Zephyr
- QNX
- µC/OS
- RT-Thread

Microcontrollers
- GPIO
- ADC / DAC
- Timers / Counters
- PWM
- Watchdog
- Interrupts
- DMA
- Clock Management
- Power Management
- Bootloader / DFU

SDLC Models
- Agile / SCRUM
- V-Model

Build System
- Compilers / GCC
- Make / CMake
- Bash Scripting
- Docker

Debugging
- JTAG / SWD
- GDB
- OpenOCD

Version Control
- SVN
- Git

Testing
- TDD & Unit Testing
- CI/CD Pipelines
- SIL / HIL Testing
- Standards & Certifications

- Embedded Security
- Embedded GUI
- IoT
- Edge AI
- AUTOSAR

HARDWARE

Interfaces & Protocols

Basic
- UART
- I2C
- SPI

High-Speed
- Ethernet
- USB
- PCIe

Wireless
- Bluetooth
- Wi-Fi
- LoRa
- Zigbee
- Thread
- Matter
- UWB

Industrial
- Modbus
- Profinet
- EtherCAT
- MQTT
- CoAP

Network
- TCP/IP
- UDP

Automotive
- CAN
- LIN
- MOST
- FlexRay

Cellular
- GSM / LTE
- LTE-M / 5G
- NB-IoT

- Memory Technologies & File Systems
- Hardware Simulation / Emulation

- Sensors & Actuators
- Digital Signal Processing
- Control Theory

Electronics
- Basic Math & Calculus
- Principles of Electric Circuits
- Electronics Fundamentals
- Digital Design
- Computer Architecture

Using Test Equipment
- Multimeter
- Logic / Protocol Analyzer
- Oscilloscope

Prototyping Skills
- Breadboarding
- Hardware Design Basics
- PCB Design / EMC
- Soldering / Rework

- FPGA Development

SOFT SKILLS
- Communication Skills
- Problem-Solving Skills & Critical Thinking
- Teamwork & Collaborative Abilities
- Organizational & Time Management Skills
- Being Self-Driven and Independent
- Adaptability & Patience
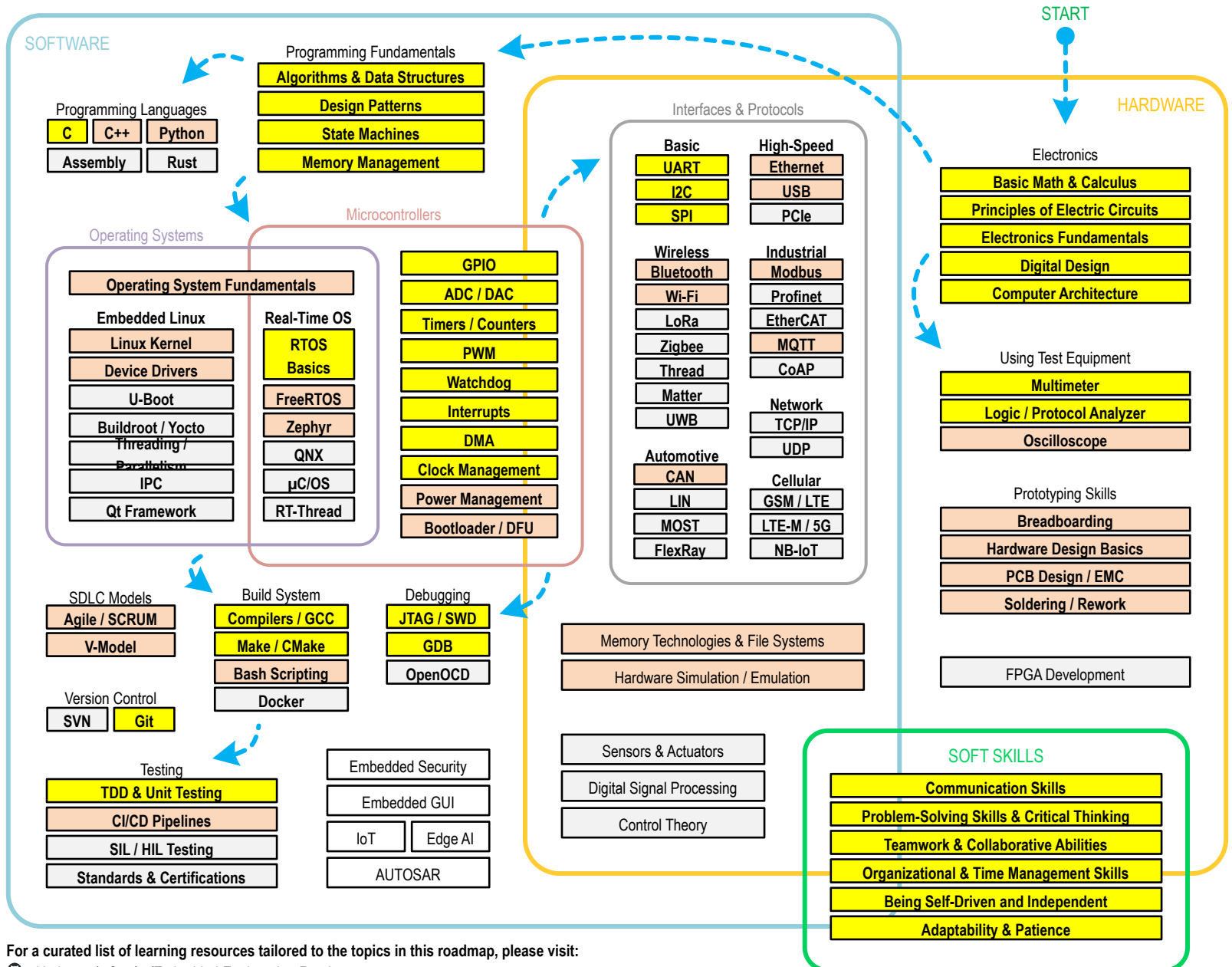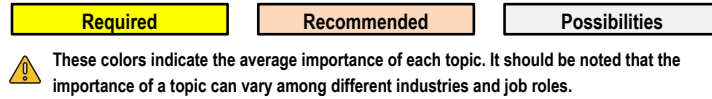
For a curated list of learning resources tailored to the topics in this roadmap, please visit:
github.com/m3y54m/Embedded-Engineering-Roadmap

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