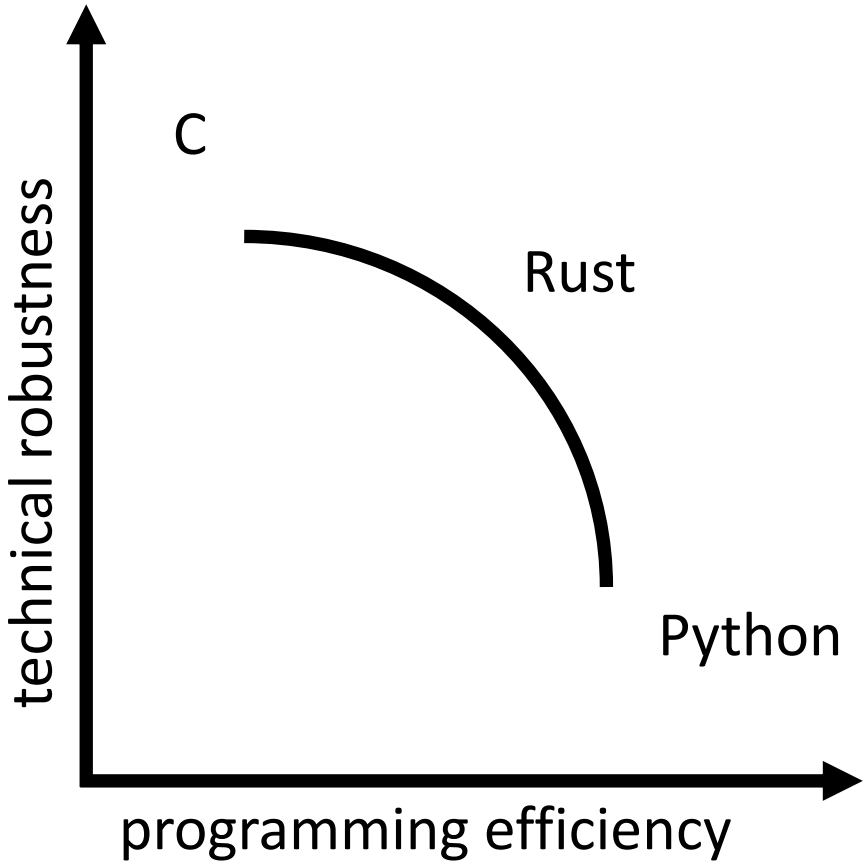
htmaa

sdajani@mit.edu

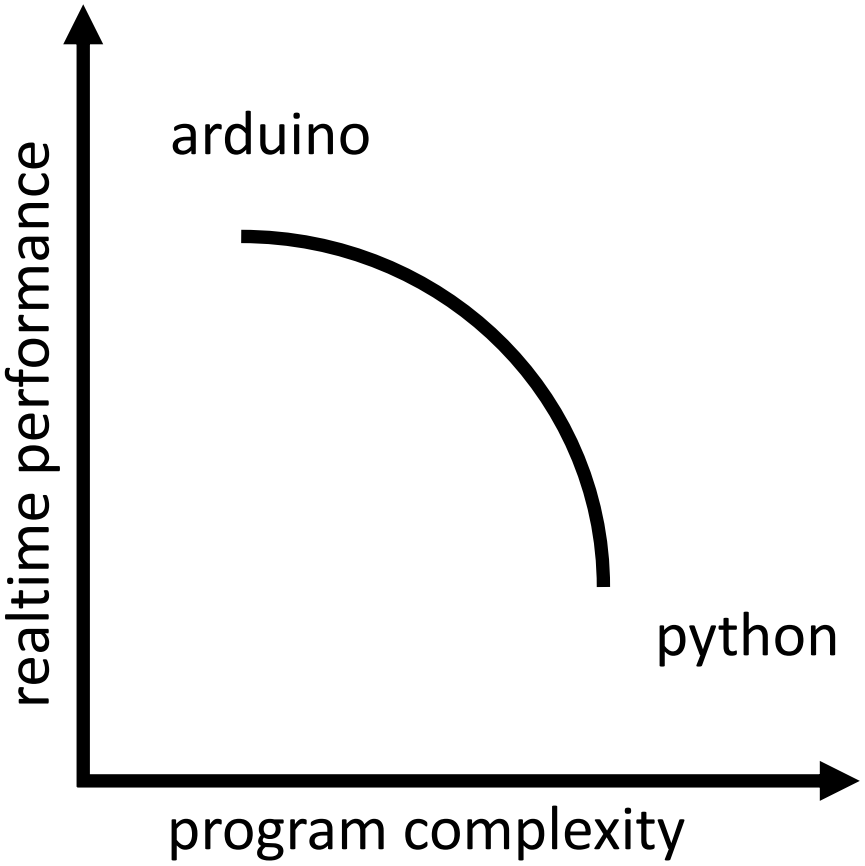
week 2

group assignment

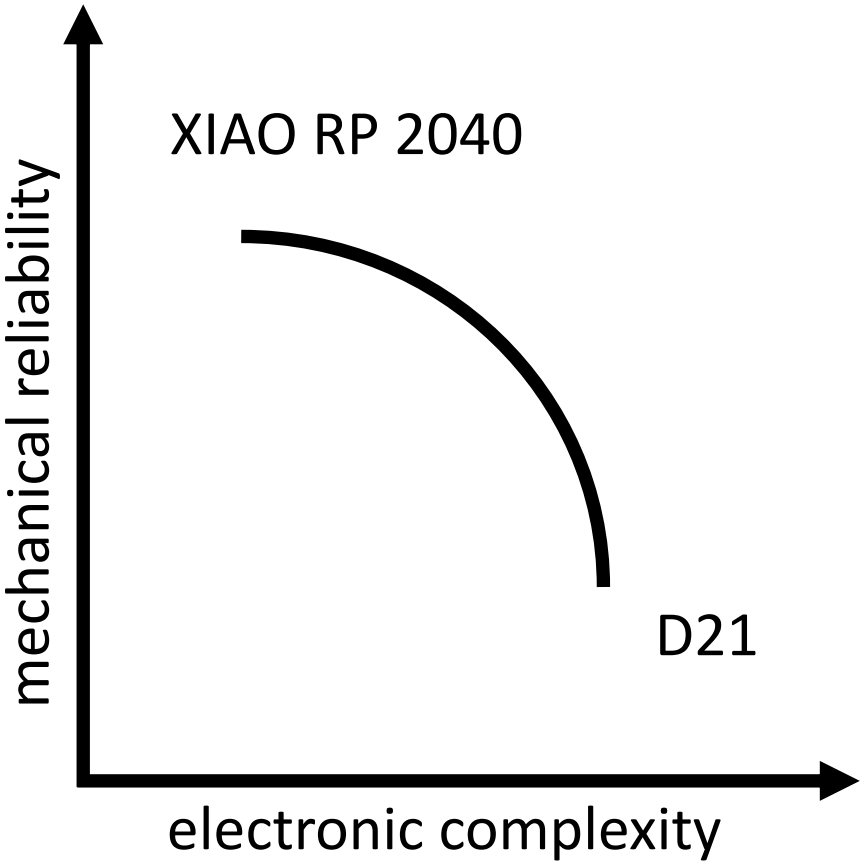
embedded programming language workflow



embedded development workflow



embedded electronics fabrication workflow



Architecture	Example Boards	Toolchain / Workflow	Strengths	Limitations
AVR (8-bit)	ATtiny44, ATmega328 (Arduino Uno)	avr-gcc, avrdude; Arduino IDE for simplified workflow	Mature ecosystem, simple to program, widely taught	Limited memory & speed, not ideal for complex tasks
ARM Cortex-M	SAMD21, STM32, Teensy	arm-none-eabi-gcc, OpenOCD, PlatformIO; Arduino or CircuitPython support	High performance, industry standard, strong debugging tools	Toolchain setup can be complex
RP2040	Raspberry Pi Pico, XIAO RP2040	Pico SDK (C/C++), MicroPython, Arduino IDE; custom PIO assembly for peripherals	Flexible, inexpensive, unique PIO hardware for custom protocols	Requires learning PIO for advanced features
ESP8266 / ESP32	NodeMCU, Sparkfun/Adafruit ESP boards	Espressif SDK/IDF, Arduino IDE, MicroPython	Built-in Wi-Fi/Bluetooth, large community support, IoT-ready	Higher power usage, less deterministic timing
RISC-V	HiFive boards, experimental dev kits	riscv-gnu-toolchain, GDB, newer SDKs	Open-source ISA, growing ecosystem, academic/educational interest	Toolchain less mature, fewer libraries & examples

workflow examples

SAMD21 (ARM Cortex-M)	**RP2040 (Raspberry Pi Pico)**
- write code in C/C++ (arduino ide or platformio). - compile **with arm-none-eabi-gcc**. - upload using **openocd** via usb or swd debugger. - debug with **gdb** or serial monitor.	- write code in C/C++ (pico sdk) or micropython. - compile with **cmake** + **gcc** toolchain. - drag-and-drop **.uf2** file to pico's usb mass storage device. - (optional) use custom **pio** assembly for hardware interfaces.

-> **ARM workflows** emphasize professional-grade debugging, while **RP2040 workflows** emphasize accessibility and flexibility (drag-and-drop + PIO).

references

- lecture notes
- office hours insights
- week 2 course website: https://academy.cba.mit.edu/classes/embedded_programming/index.html
- ai summarization: https://chatgpt.com/share/68d29349-d7ec-8008-91c5-9abf5e087f6f