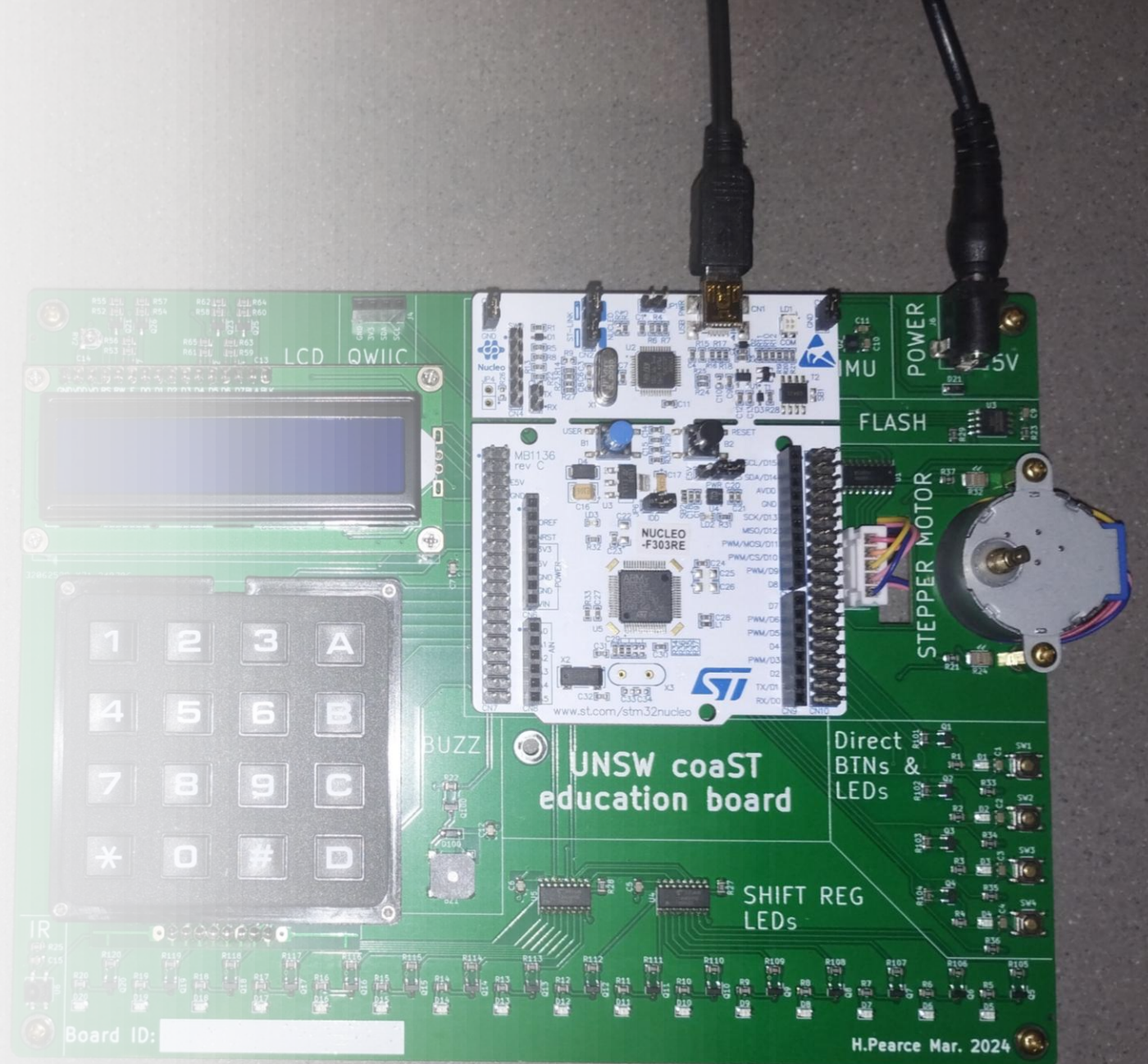


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(Computer Engineering)  
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# Serial Communication- UART

Hasindu Gamaarachchi



# Parallel Communication

- Multiple wires to transfer several bits simultaneously
  - e.g.: LCD interfacing

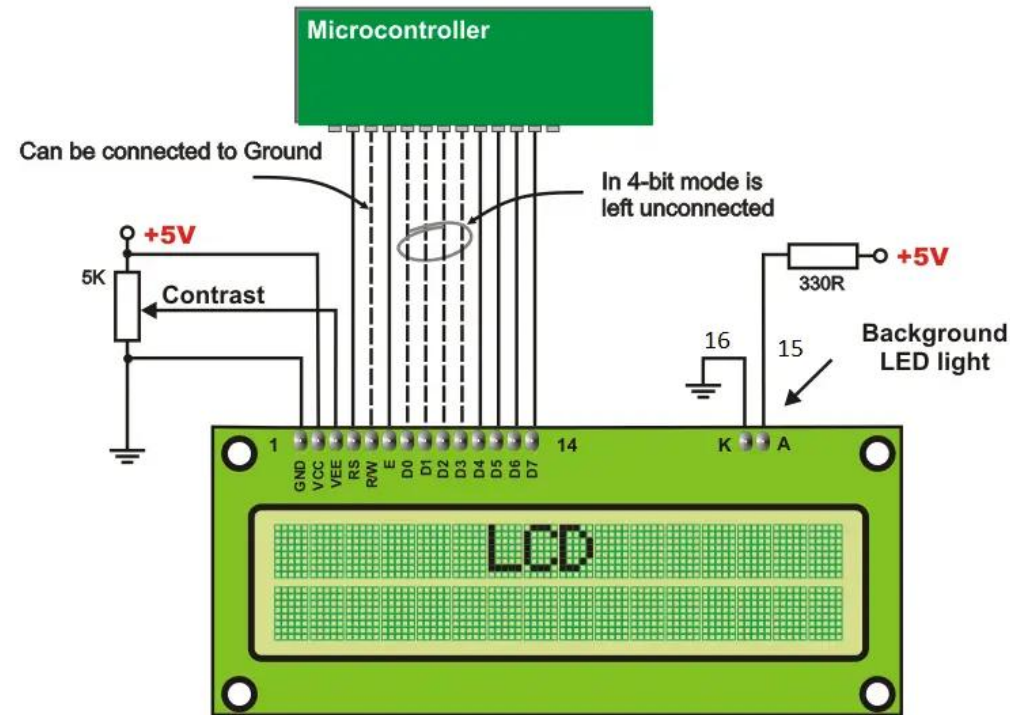


Image from: <https://deepbluembedded.com/stm32-lcd-16x2-tutorial-library-alphanumeric-lcd-16x2-interfacing>

# Serial Communication

- Single wire to transfer one bit at a time
  - Universal Asynchronous Receiver/Transmitter (UART)
  - Serial Peripheral Interface (SPI)
  - Inter-Integrated Circuit (I2C)
  - Universal Serial Bus (USB)

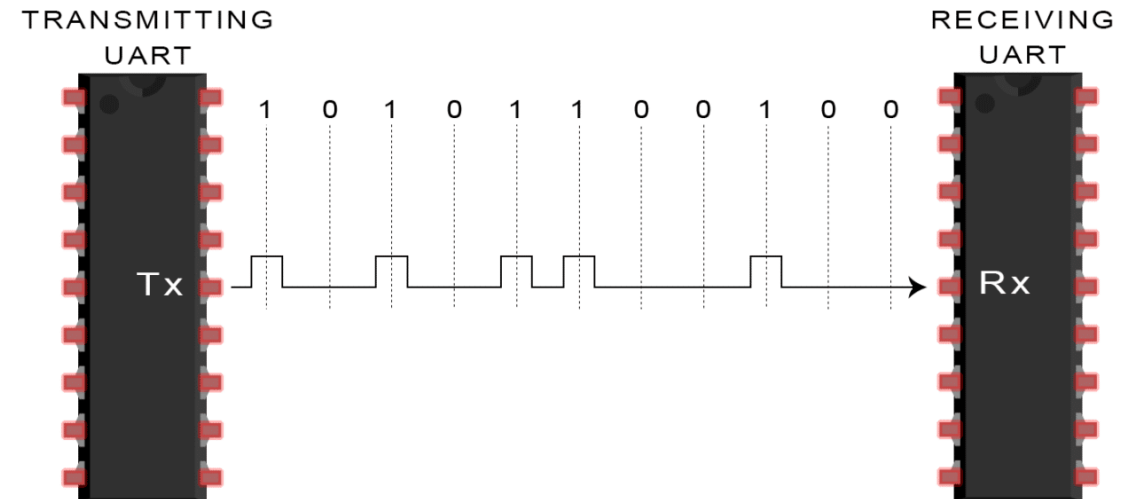
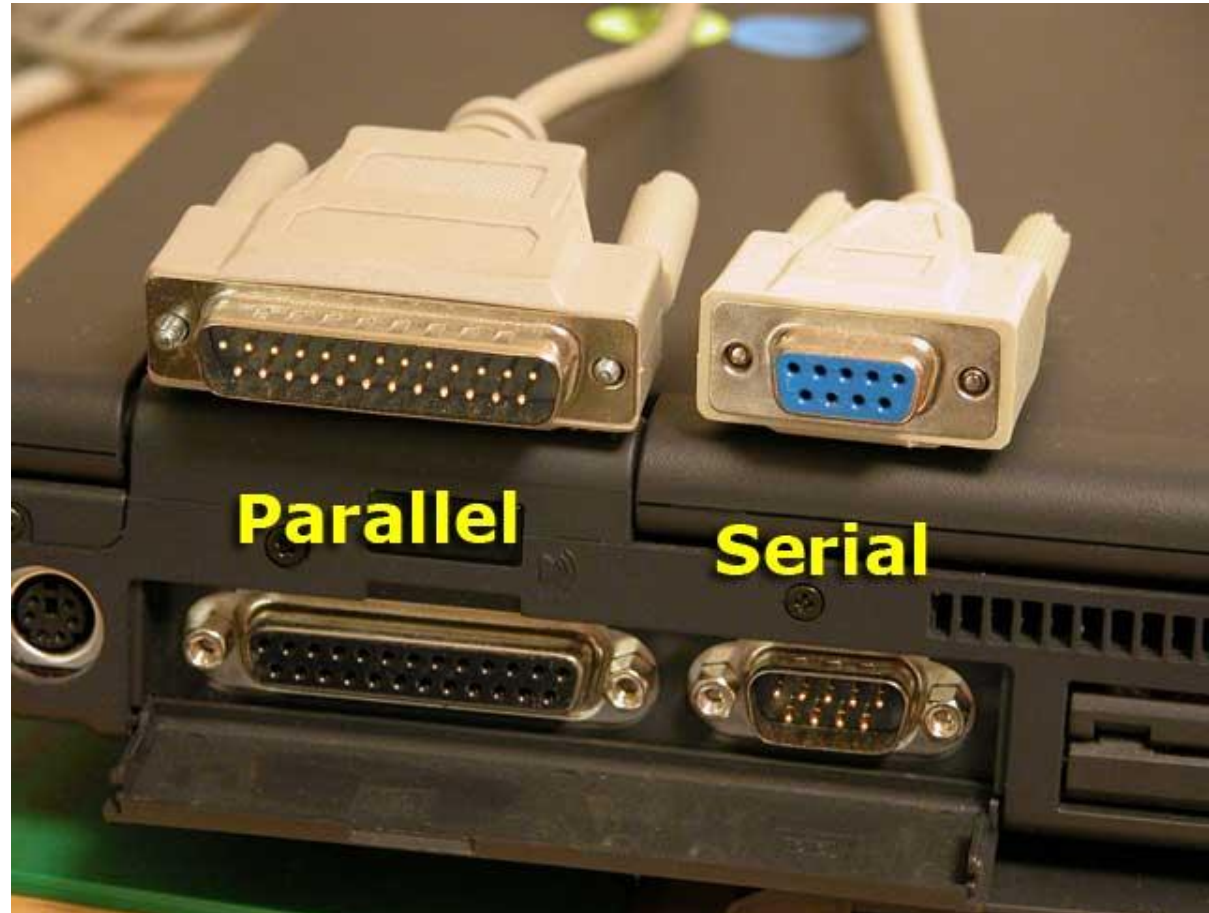


Image from <https://www.circuitbasics.com/basics-uart-communication/>

# Parallel and Serial Communication



<https://www.unm.edu/~tbeach/terms/figures/oldports.html>

# Parallel and Serial Communication



<https://www.flickr.com/photos/126940499@N05/15413982448>

# UART – Microcontroller to Microcontroller

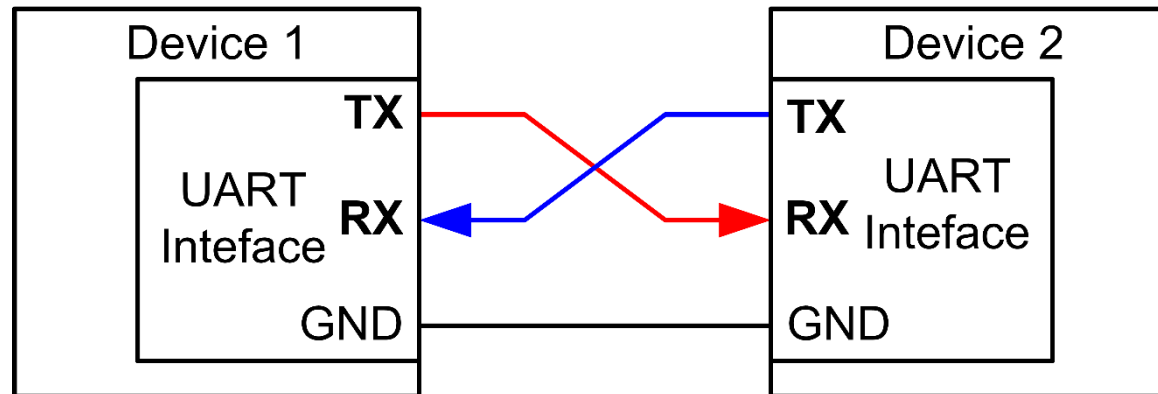
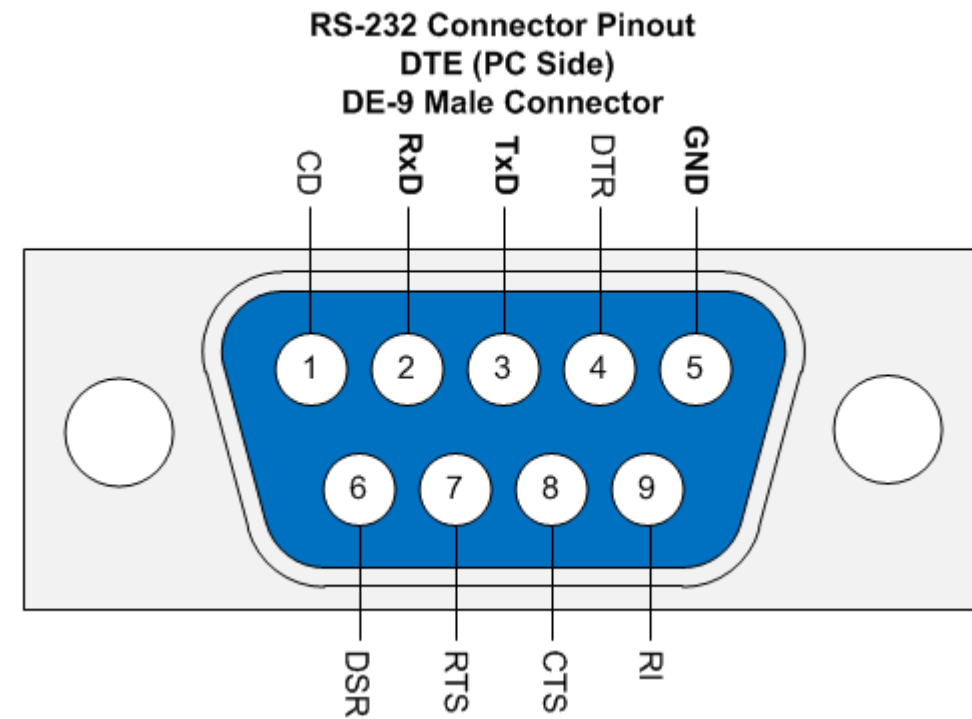


Figure from: Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C (Fourth Edition) – Yifeng Zhu

# UART to PC



[https://commons.wikimedia.org/wiki/File:Serial\\_port\\_%289-pin%29.jpg](https://commons.wikimedia.org/wiki/File:Serial_port_%289-pin%29.jpg)



[https://upload.wikimedia.org/wikipedia/commons/2/29/RS-232\\_DE-9\\_Connector\\_Pinouts.png](https://upload.wikimedia.org/wikipedia/commons/2/29/RS-232_DE-9_Connector_Pinouts.png)





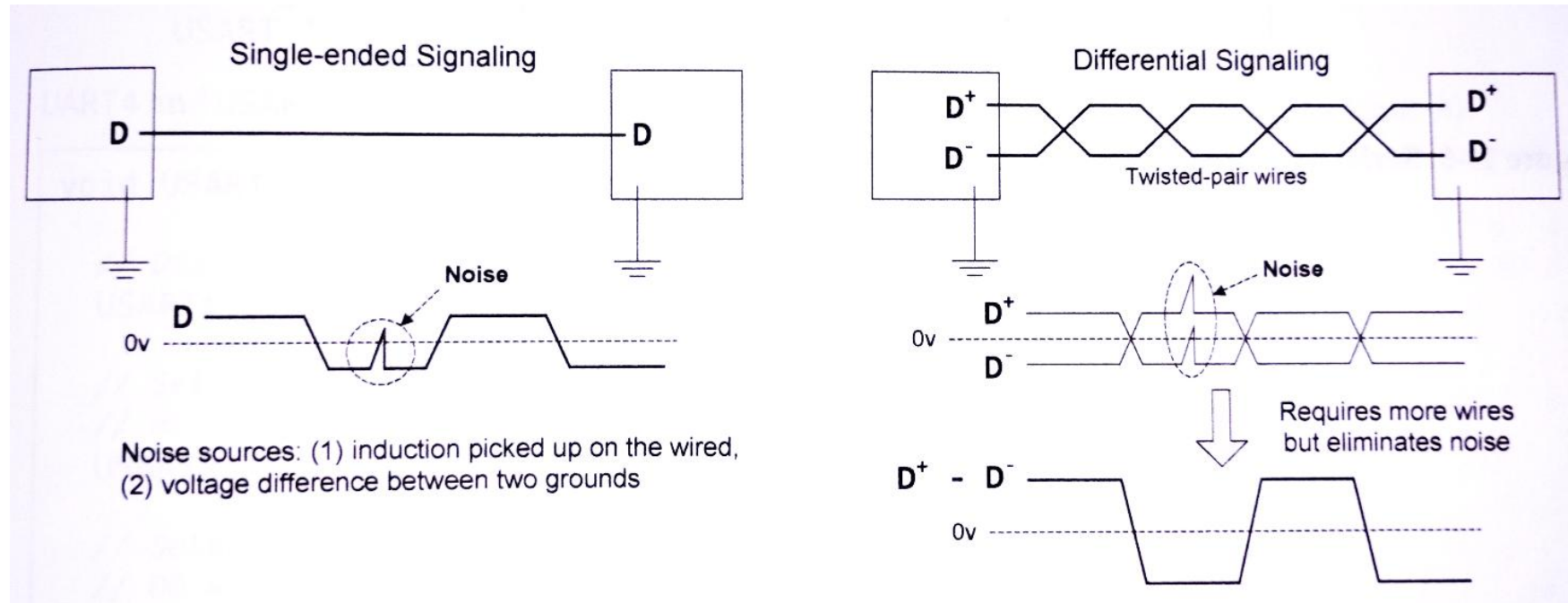
# Voltage Levels

Standard	Voltage signal	Max distance	Max speed	Number of devices supported per port
RS-232	Single end (logic 1: +5 to +15V, logic 0: -5 to -15 V)	30m	115Kbit/s	1 master, 1 receiver
RS-422	Differential (-6V to +6V)	1200m	10Mbit/s	1 master, 10 receivers
RS-485	Differential (-7V to +12V)	1200m	10Mbit/s	32 masters, 32 receivers

RS stands for recommended standards

Slide from Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C (Fourth Edition) – Yifeng Zhu

# Single-ended vs Differential-ended Signaling

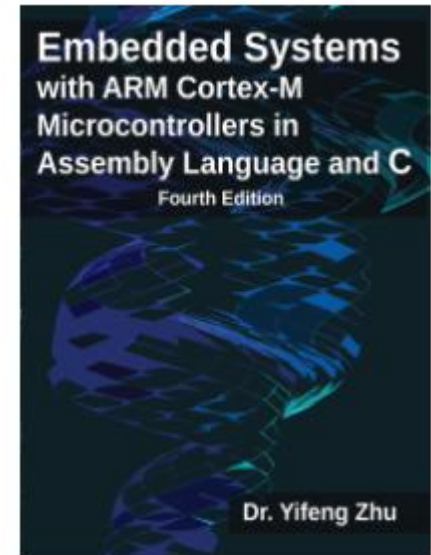


Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C (Fourth Edition) – Yifeng Zhu

# Learning Resources

“Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C (Fourth Edition)” – Yifeng Zhu

- Serial communication protocols- chapter 19



- To the whiteboard and a live demo