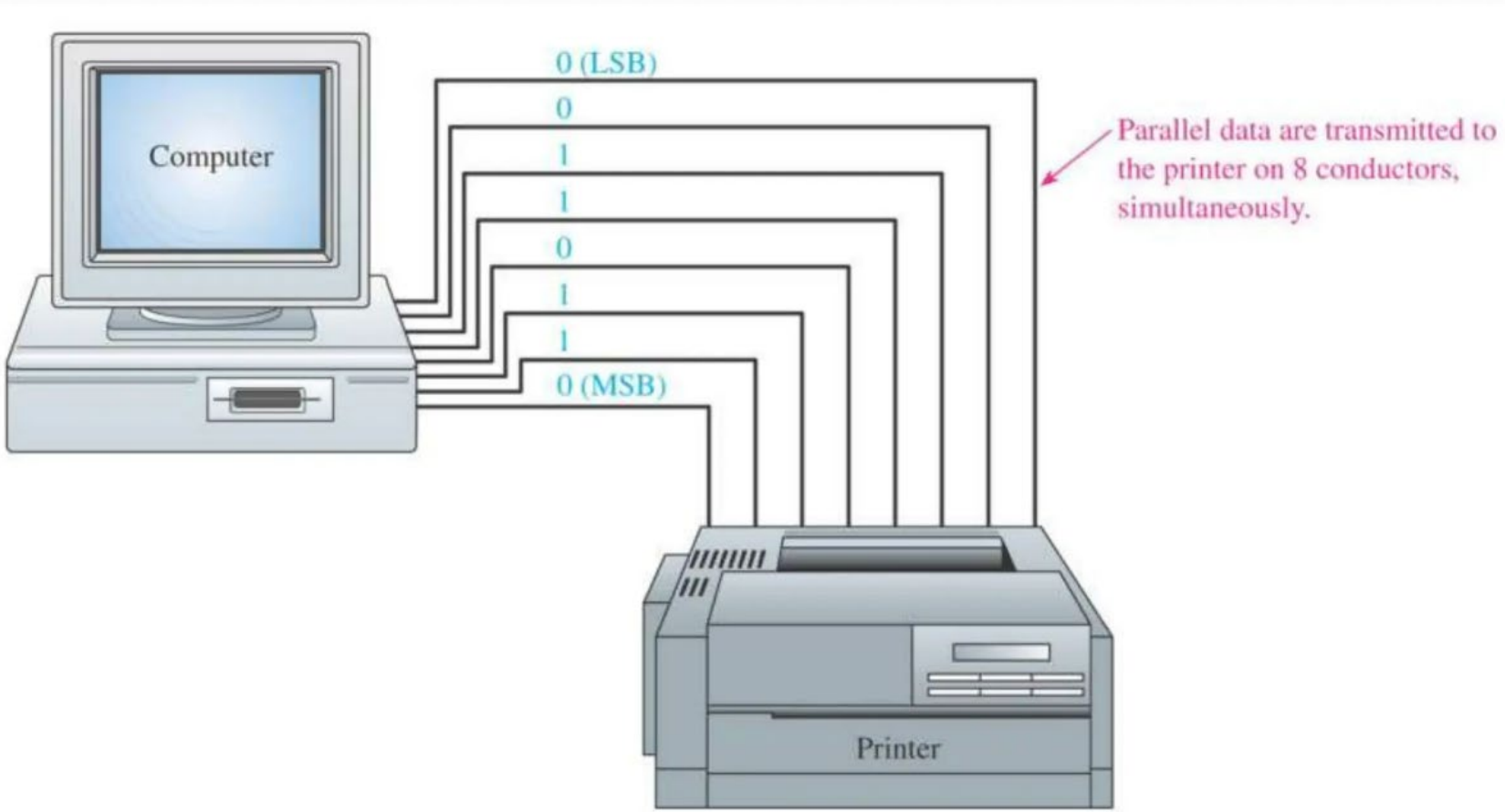
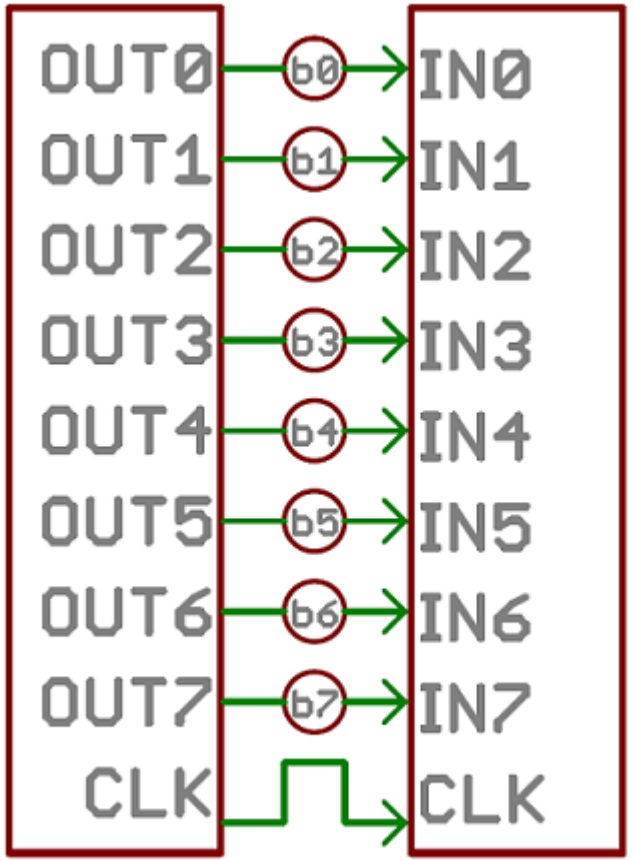
# P524: Survey of Instrumentation and Laboratory Techniques

# Week 5.5: Serial Communications, Oscilloscope

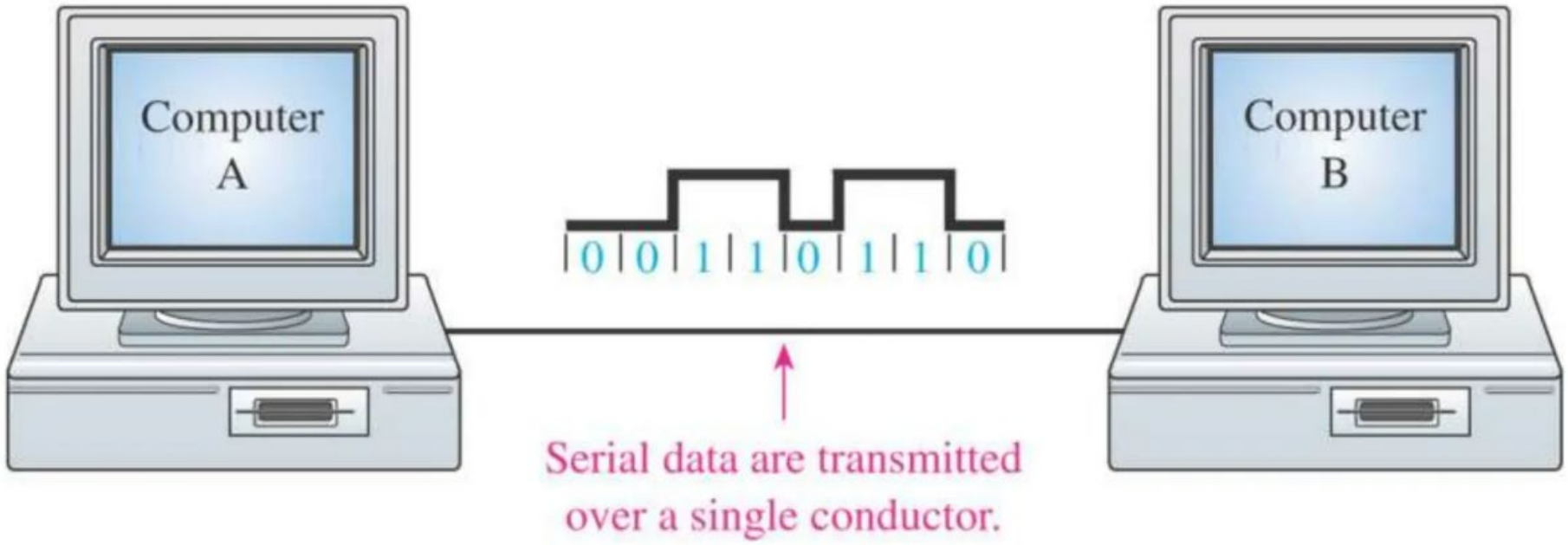
9/25/2024

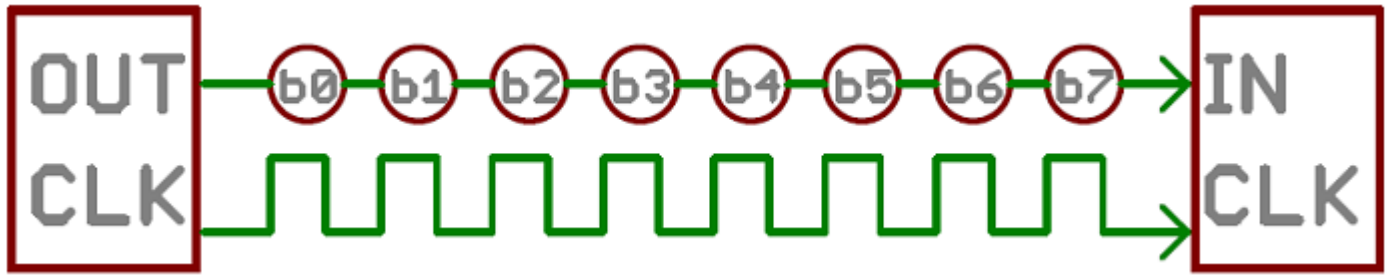
# Parallel communication between a computer and a printer



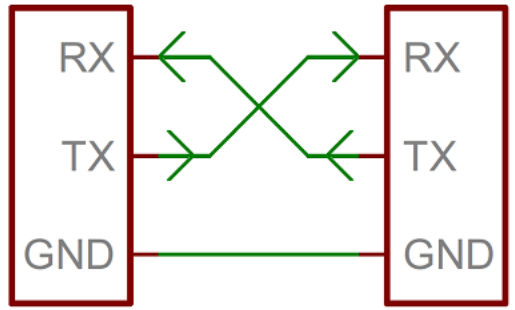



# Serial communication between computers



# Asynchronous serial protocol




Hardware wiring:
E.g.: Ultimate GPS, Bluetooth, serial LCD

- Baud Rate (bits-per-second): Baud rates can be just about any value within reason. The only requirement is that both devices operate at the same rate. **9600 bps, or 960 bytes per second** for non-critical applications. Other "standard" baud are 1200, 2400, 4800, 19200, 38400, 57600, and 115200.

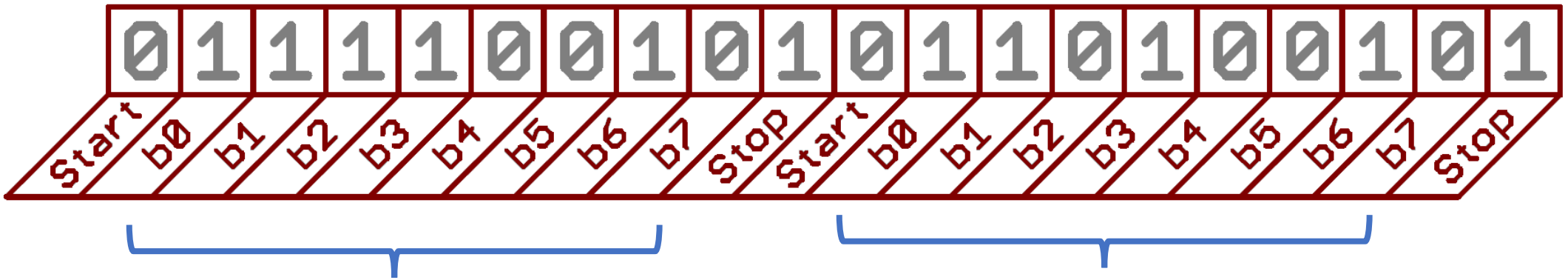
- Framing the data: Each block (usually a byte) of data transmitted is sent in a packet of frame of bits:


- Synchronization bits: The start and stop bits mark the beginning and end of a packet.
- Parity bit: sum 5-9 bits of data byte: even/odd for error checking

# 9600 8N1 Protocol: 9600 baud, 8 data bits, no parity, and 1 stop bit

one of the most commonly used serial protocols.

A device transmitting the ASCII characters 'O' and 'K' would have to create two packets of data:



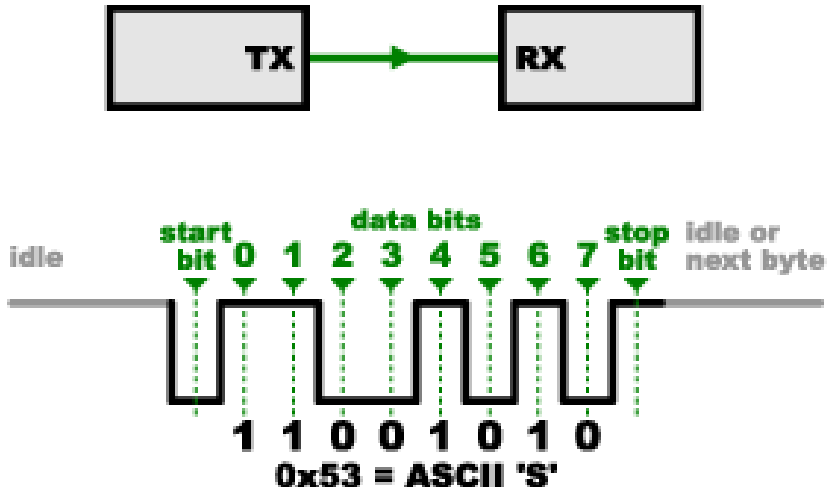

The ASCII value of *O* (that's uppercase) is 79, which breaks down into an 8-bit binary value of `01001111`.

*K*'s binary value is 75, or binary: `01001011`.

**Endianness**: Is data sent most-significant bit (msb) to least, or vice-versa? If it's not otherwise stated, you can usually assume that data is transferred **least-significant bit (lsb) first**.

# Asynchronous vs Synchronous serial protocols

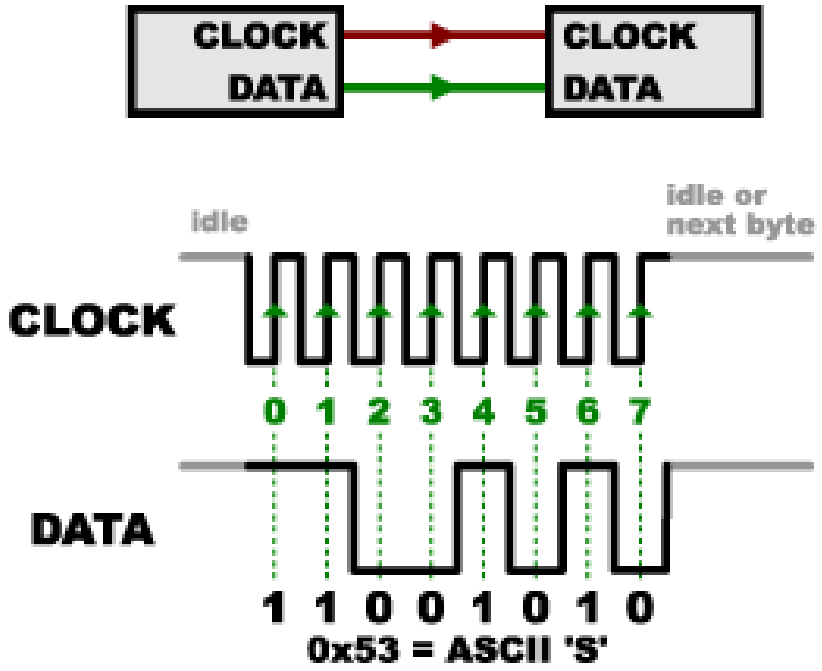
**Asynchronous:**




The start bit is always indicated by an idle data line going from 1 to 0, while the stop bit(s) will transition back to the idle state by holding the line at 1.

Complex hardware to strip data bits

**Synchronous:**




- Because the clock is sent along with the data, specifying the speed isn't important
- Save the start and stop bits; simple hardware converts to parallel

# In-class assignment and Homework (due 9/30)

- 1. Please read all three SparkFun tutorials listed near the start of unit 2 writeup.

- 2. SPI and I2C BME: Wire up and demonstrate 2 BME sensors, one with I2C interface (original), the other with SPI

*Reminder - Homework (due 10/2/2025):*

*Design a box lid that slides into place instead of just sitting on top of the box. When you're finished with your design, email me both the STL file and the gcode file. Then print and show me the box.*