Serial–Parallel Data Conversion

Agenda (for next 2 lectures)

- In The News: Developments in multitasking; Power constraints
- Reminder of Midterm dates: **Thu Feb 9** (next week), Tue Mar 27
- Take up any questions from previous lectures;
  review 7-segment LED displays, Series and Parallel circuits
- New material:
  - Review of devices to date: analog vs digital operation
  - Functioning of a potentiometer
  - Serial-Parallel data conversion
  - Operation of shift register, ie. 74HC595

Assignment

- Read “Chapter 6: Binary counters” in Beginning Arduino

In The News

You might be interested to check out the number of educational institutions (ranging from primary to post-secondary) that are banning laptops in the classroom:

Feb 1st: http://news.err.ee/education/672d316a-bb60-4ac2-b40b-98c2d380d2d1

Why do we care about power? It's not only because we want to be mobile:

> "*That expected increase in processing performance is at an end," said DARPA Director Regina Dugan in a statement. "Clock speeds are being limited by power constraints. Power efficiency has become the Achilles Heel of increased computational capability.*"

hardware.slashdot.org/story/12/01/29/183238/darpa-targets-computings-achilles-heel-power

Potentiometer

A potentiometer is a three terminal, variable resistor. We will see how it is wired internally and how it can be used as a simple variable resistor or as a voltage divider. In order to easily understand its operation, you will need to have a solid understanding of series circuits and Ohm’s law.

Analog and Digital

As a useful review of the concept of analog and digital signals, consider a chart of the devices we have seen to date. Are they analog or digital devices? Consider also starting columns for additional characteristics (ie. As listed in the course outline!): linear vs non-linear; active vs passive; resistive, capacitive, or inductive; sensor, actuator or both.

Device	Analog / Digital	Linear / non-linear	Active / Passive	R / C / L	Sensor / Actuator	Other
Arduino						
Resistor						
LED						
Switch						
Potentiometer						
Shift register						
(more to come)						

Serial-Parallel Data Conversion

To make the best use of available connections, or to minimize the amount of wiring, modern systems are increasingly transferring data serially (think USB, Firewire, SATA, Thunderbolt, and all forms of wireless devices). Serial data transfer means that single bits are transferred one at a time, one after another.

At the same time, to gain maximum processing speed, processors are increasing the width of their data path: going from 16-bit, to 32-bit, and now 64-bits. Since more than a single bit is transferred at one time, these represent parallel data transfer circuits.

Somewhere in the middle, there needs to be conversion circuits which convert from a parallel data stream to serial, and then from serial to parallel.
We will study at an example circuit: the 74HC595 8-bit serial shift register which can serve as a serial-parallel converter. We'll start with the data sheet, to identify:

- voltage requirements
- maximum current output levels
- key control signals
- general operating principles

We will look at the control signals in detail and required timing to achieve the desired serial-parallel mode of operation. Most of this work will be done on the whiteboard.

The next lab is an exercise in controlling an output (LED) with a shift register.