PURDUE UNIVERSITY®

CS 240: Programming in C

Lecture 26: Interfacing with Hardware

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Announcements

- Course Evaluations Available
- Homework 13 Extra Credit
- Lecture Wednesday will wrap up networking and include final exam review and discussion
  - Last lecture

Final Exam

- Thursday, May 8
- 10:30am – 12:30pm
- ELLT 116 (Main Auditorium)

Final Grade Computation

- Grade cutoffs may be adjusted at the end of the semester, depending on distribution
  - Will not raise them (90/80/70/60 A/B/C/D) is guaranteed
  - Often lower the C cutoff
- Grade computation
  - 50% HW/Quiz/Style
    - Sum all points for hw/quiz/style and divide by points possible
    - Don’t forget HW13 is extra credit, HW0 is 25 points
  - 14% Midterm 1
  - 14% Midterm 2
  - 22% Final

Grade Determination

Hwk/Quiz Avg		Test Avg		Course Avg	Grade
>= 85%	and	>= 85%	and	>= 90%	A
>= 75%	and	>= 75%	and	>= 80%	B
>= 65%	and	>= 65%	and	>= 70%	C*
>= 55%	and	>= 55%	and	>= 60%	D
< 55%	or	< 55%	or	< 60%	F

* C threshold may be lowered

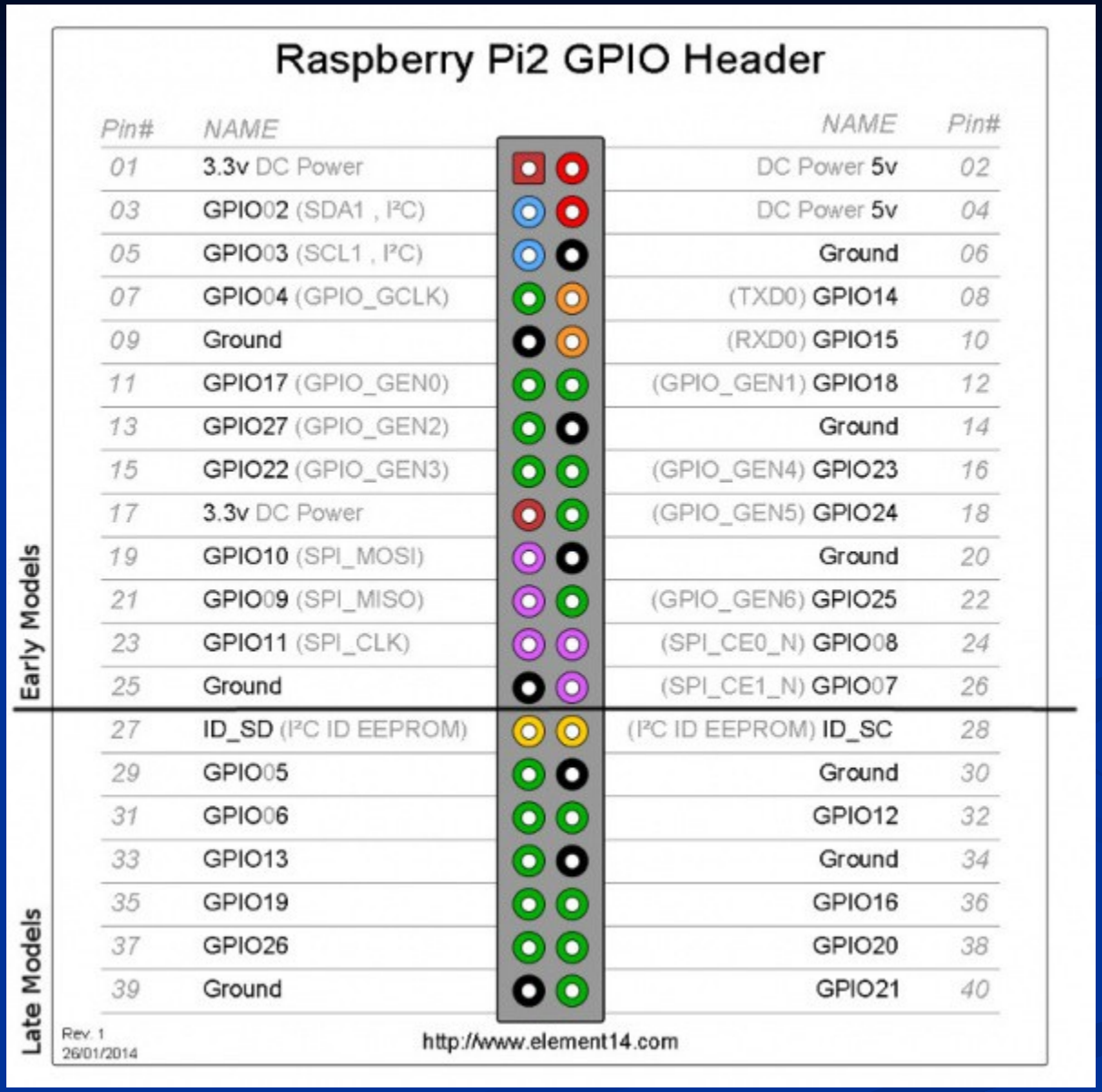
The Final Frontier: Interfacing to hardware

Ports

- Computers used to have things like serial and parallel ports
  - Great for (slow) communication, easy to interface
  - Rarely exist now
- Other ports are available...
  - Ethernet port – need the ethernet protocols
  - USB port – difficult due to transmission speed
  - Firewire port – more difficult than USB port
- Look in /dev on Linux

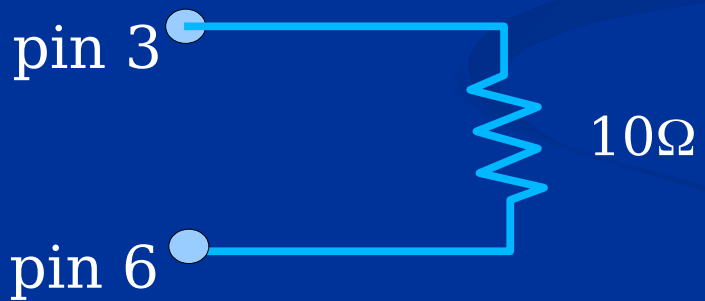
Raspberry Pi

- Embedded systems are cheap
- Lots of Systems on a Chip (SoCs) out there
- Often with exposed pins
  - Easy to interface
- Many can run a full-fledged OS


Raspberry Pi2 GPIO Header
Pin# NAME NAME Pin#
01 3.3v DC Power DC Power 5v 02
03 GPIO02 (SDA1 , I²C) DC Power 5v 04
05 GPIO03 (SCL1 , I²C) Ground 06
07 GPIO04 (GPIO_GCLK) (TXD0) GPIO14 08
09 Ground (RXD0) GPIO15 10
11 GPIO17 (GPIO_GEN0) (GPIO_GEN1) GPIO18 12
13 GPIO27 (GPIO_GEN2) Ground 14
15 GPIO22 (GPIO_GEN3) (GPIO_GEN4) GPIO23 16
17 3.3v DC Power (GPIO_GEN5) GPIO24 18
19 GPIO10 (SPI_MOSI) Ground 20
21 GPIO09 (SPI_MISO) (GPIO_GEN6) GPIO25 22
23 GPIO11 (SPI_CLK) (SPI_CE0_N) GPIO08 24
25 Ground (SPI_CE1_N) GPIO07 26
Early Models
27 ID_SD (I²C ID EEPROM) (I²C ID EEPROM) ID_SC 28
29 GPIO05 Ground 30
31 GPIO06 GPIO12 32
33 GPIO13 Ground 34
35 GPIO19 GPIO16 36
37 GPIO26 GPIO20 38
39 Ground GPIO21 40
Late Models
Rev. 1
26/01/2014
http://www.element14.com

We can access those pins from a program…

- 3.3V
- Maximum 16mA (8mA default) per pin
- Maximum of 50mA total
- Don’t do this:



- Hint: you’ll lose more than electrons.

Datasheet

- Sometimes called “spec sheet”
- Details technical characteristics of a component
  - Can be hardware or software
- Often includes…
  - Functional descriptions
  - Pin diagram
  - Voltage ratings and specs
  - Power consumption
  - I/O waveforms
  - Timing
  - Physical dimensions
  - etc

BCM2835

- First generation Raspberry Pis use a 700MHz ARM11 processor (BCM2835)
- Newer Pis use BCM2836 (v2 1.1), then BCM2837 (v2 1.2, v3)

Raspberry Pi GPIO access

- RPI.h
- pins.c
- pins.h
- traffic.h
- traffic.c

Boiler Up!