

6.08 Review Session 2019

TA -> Mark



Exam Info

Tuesday April 9

7:30pm

Last Names: A through L in 10-250, M through Z in 32-123 (Stata)

Calculators allowed

3 pages front back cheat sheet

Special Accommodations email Joe: jodalyst@mit.edu

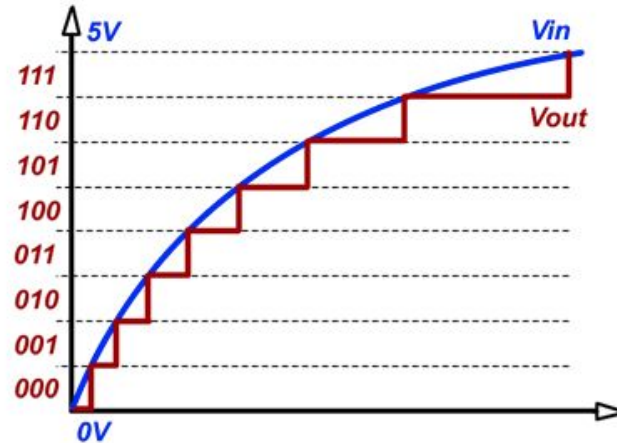
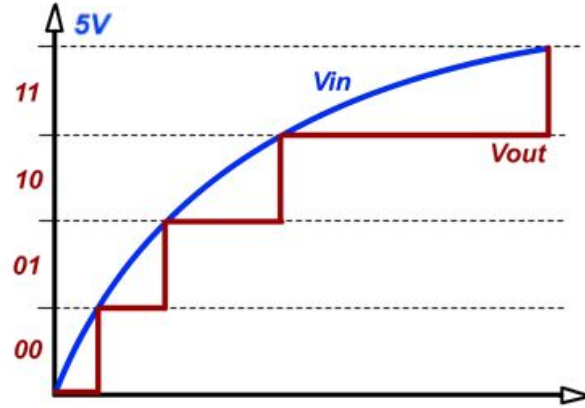
General Questions?

Review Outline

1. ADC conversions
2. Signals
3. Node Analysis
4. Power
5. FSM
6. Memory Pointer stuff
7. Wifi stuff
8. Crypto

ADC Conversion

- What are bins?
- What is bit depth?
- Keep track of units
- sampling/quantization



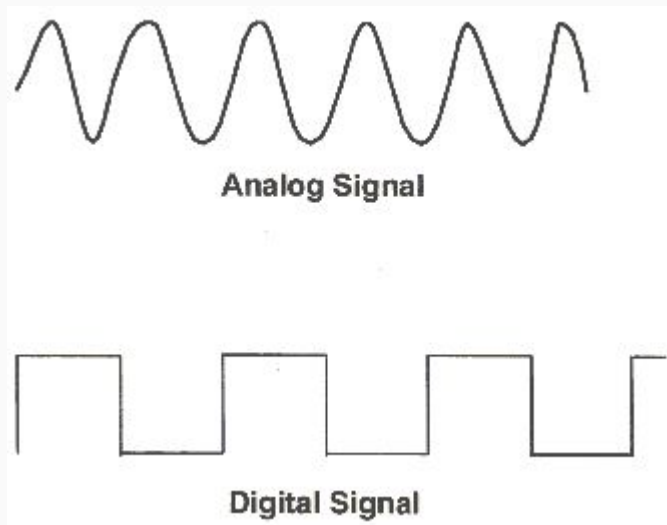
Example Problem

What units do ADC's return?

Say I have an 4 bit ADC reading a voltage that can range from 0-5V. How would I convert an ADC reading to voltage?

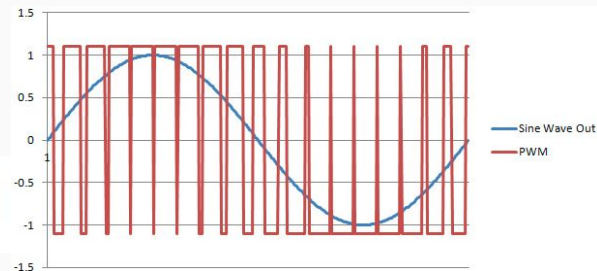
Signals

- Analog
- Digital
- Filtering



$$y[n] = \sum_{p=0}^m \frac{1}{1+m} x[n-p]$$

$$y[n] = \alpha y[n-1] + (1-\alpha) x[n]$$



$$x[n] \star y[n] = \sum_i \frac{(x[i] - \bar{x})(y[i] - \bar{y})}{\sqrt{\sum_j (x[j] - \bar{x})^2} \sqrt{\sum_j (y[j] - \bar{y})^2}}$$

Example Problem

I have a difference equation $y[n] = y[n-1] + x[n] + 3*x[n-1]$. Given two data sets, which plot has the higher *normalized* cross correlation.

$$x[n] = [1, 1, 1, 0]$$

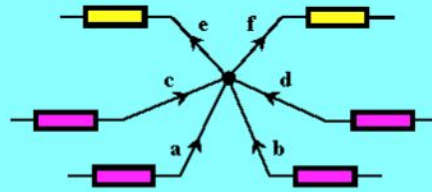
$$a[n] = [2, 10, 18, 18]$$

$$b[n] = [.1, .5, .9, 1.2]$$

What does PWM do? What are the benefits?

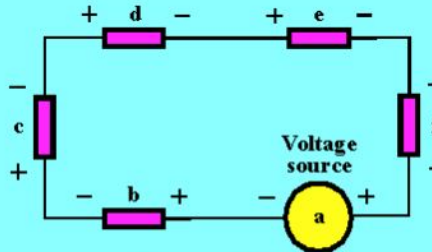
Node Analysis

- KCL
- KVL
- Resistors
- Units!!!



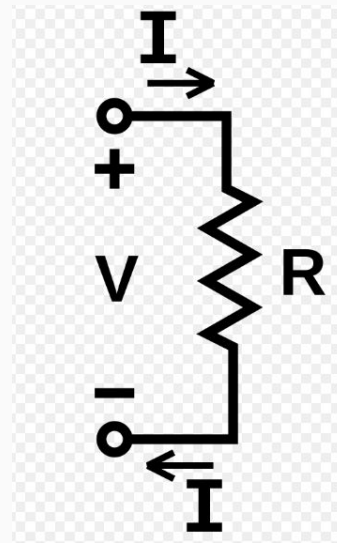
First Law

$$a + b + c + d = e + f$$



Second Law

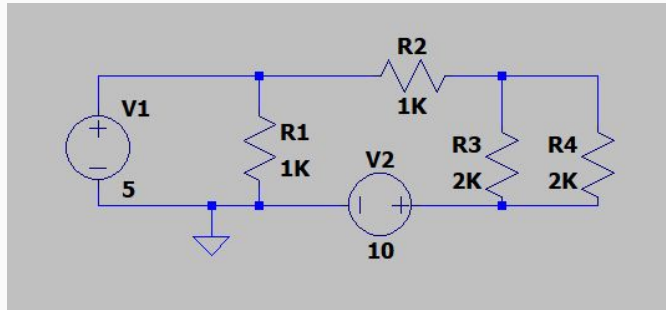
$$a + b + c + d + e + f = 0$$



Example Problem

Find the currents flowing through each branch

Find voltages at each node.



Power

- Sign Convention
- Efficiency
- Source vs Non-Source
- Avg power calculation
- Units!!!

Efficiency = (Power to useful stuff) / (Total power)

$$P = I \cdot V$$

Capacity units = mAh \Rightarrow [A][s]

Time = Capacity/Current \Rightarrow [A][s]/[A] \rightarrow [s]

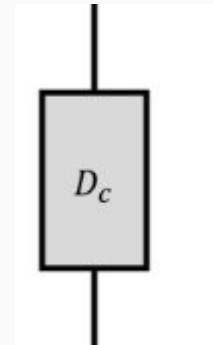
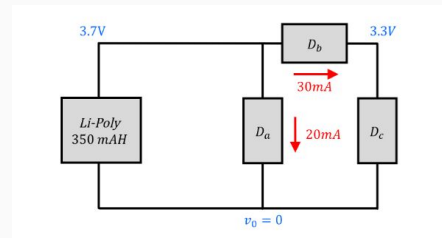
Pay attention to UNITS!!!!!!

$P_{in} = P_{out}$ by conservation of energy

$I \cdot V$ of all sources = $I \cdot V$ of all other components

\rightarrow remember the trick for avg power/current

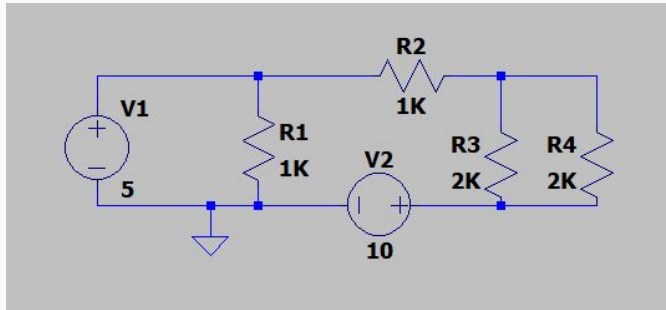
- 1) Determine periodic pattern
- 2) Sum time weighted currents and divide by period for average current over the period
- 3) Apply equation to find time



Example Problem

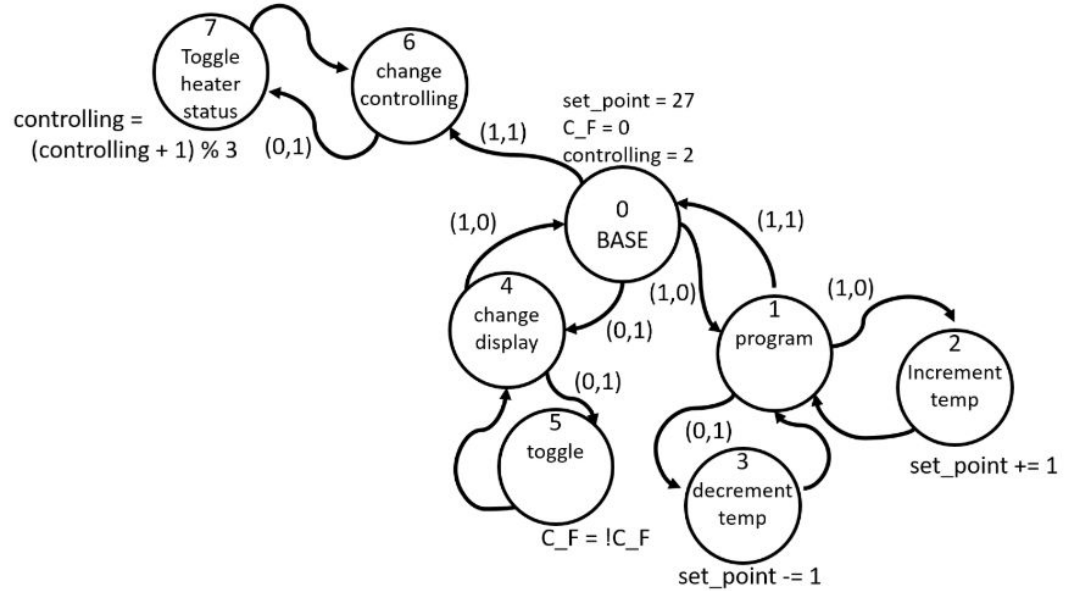
How much power is consumed in each resistor

How much power is sourced by V1? V2?



FSM

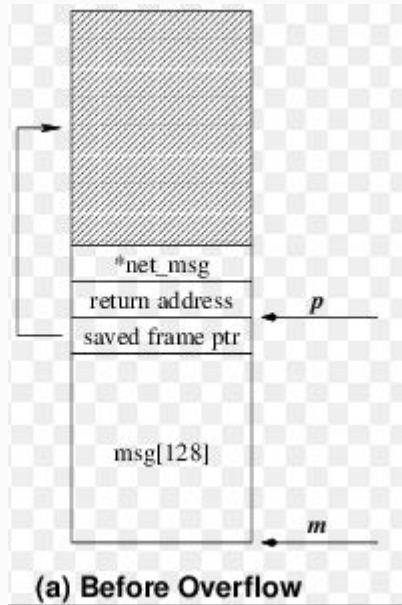
- Transitions
- Well Defined graphs



Memory

- Pointers
- String/array manipulation

Strings are NULL terminated
Pass by reference
Data types



Example Problem

I read 1.3 volts on a 8-bit ADC reading and store the value in a *char i* what happens if I print *i*?

I have variables *char* pointer* and *char arr[100]*. Which of the following has undefined behavior?

**pointer = 'h', pointer[0] = 'h', pointer[1] = 'h', *arr = 'h', arr[0] = 'h', arr[1] = 'h'*

HTTP

- GET vs POST
- Client vs Server
- JSON
- APIs

```
GET /search?q=cat HTTP/1.1
Host: google.com
```

```
POST /folder/spot HTTP/1.1
Host: internet.com
Content-Type: application/x-www-form-urlencoded
Content-Length: 22

thing1=value&thing2=89
```

APIs

- use access tokens.
- request to API server
- follow the formats

```
{
  "firstName": "John",
  "lastName": "Smith",
  "isAlive": true,
  "age": 27,
  "address": {
    "streetAddress": "21 2nd Street",
    "city": "New York",
    "state": "NY",
    "postalCode": "10021-3100"
  },
  "phoneNumbers": [
    {
      "type": "home",
      "number": "212 555-1234"
    },
    {
      "type": "office",
      "number": "646 555-4567"
    },
    {
      "type": "mobile",
      "number": "123 456-7890"
    }
  ],
  "children": [],
  "spouse": null
}
```


Example Problem

I have a variable `char request[100] = "GET /resource?data=10 HTTP/1.1\r\nHost: Server\r\n\r\n"` does the variable data exist?

I'm trying to store an x, y coordinate in a database on my server using a script stored at www.myserver.com/script.py. What should my request look like?

I have a variable `counter` in my server-side script. I set it to 0 at the top of the script and I increment it every time there is a POST. What should the value of `counter` be after 5 POSTs and one GET?

Crypto

- Caesar
- Vigenere
- Modular arithmetic

Caesar => single shift for each character in string
Vigenere => shift by letters in keyword offsets

Modular Arithmetic

- Mod operator is '%' in python and C++
- Different ways to think of mods
 - 1 -> gives remainder of a division
 - 2 -> groups/sets the values of numbers between 0 and (n-1) where n is the number you are modding by.
- Some equations that were described

$$(x \cdot y) \bmod p = (x \bmod p) (y \bmod p) \bmod p$$

$$(m^a) \bmod p = (m \bmod p)^a \bmod p$$

$$(m^a \bmod p)^b \bmod p = (m^b \bmod p)^a \bmod p$$

*m should be primitive root modulo p