

Review Slides Answers

What units do ADC's return?

→ They return bins within a range of 0 to $2^{\text{bit-depth}}$ bins.

Say I have ~~an~~ a 4 bit ADC reading with input voltage ranging from 0-5V. How would I convert an ADC reading to voltage?

→ reading (in bins) | 5 volts

 2^4 bins

* multiply 5 V
 divide 2^4 bins

I have a difference equation $y[n] = y[n-1] + x[n] + 3x[n-1]$. Given $a[n]$ and $b[n]$, which one has a higher normalized cross correlation with $y[n]$ when $x[n] = [1, 1, 1, 0]$?
 $a[n] = [2, 10, 18, 18]$
 $b[n] = [0.1, 0.5, 0.9, 1.2]$

step 1 solve for $y[n]$

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

$$3x[n-1] = [0, 3, 3, 3]$$

$$y[n-1] = [0, 1, 5, 9]$$

$$y[n] = [1, 5, 9, 12]$$

step 2 plug $y[n]$ and $a[n]$ into normalized cross correlation formula (should be ~ 0.918)

$$\sum_i \frac{(x[i] - \bar{x})(y[i] - \bar{y})}{\sqrt{\sum_i (x[i] - \bar{x})^2 \sum_i (y[i] - \bar{y})^2}}$$

step 3 do the same for $y[n]$ and $b[n]$ (should be ~ 1.0) * might not be 1 because of rounding

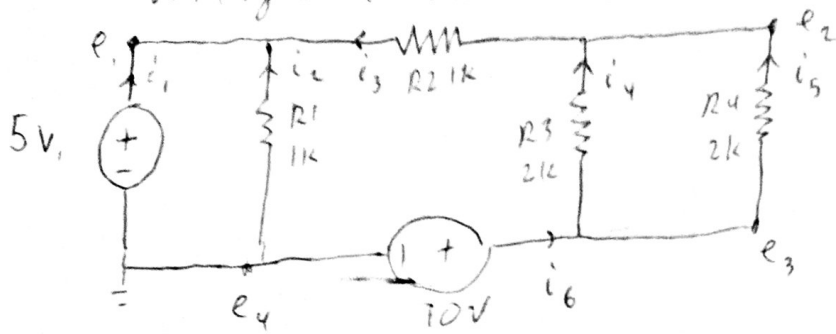
so $b[n]$ has higher correlation.

What does PWM do? What are the benefits?

- It ~~can~~ is a periodic signal where the signal is HIGH for some fraction of the period (duty cycle) and off the rest of the time. ~~By~~ Adjusting the duty cycle changes the average voltage of the signal.
- PWM can deliver power very efficiently and is cheap to implement.

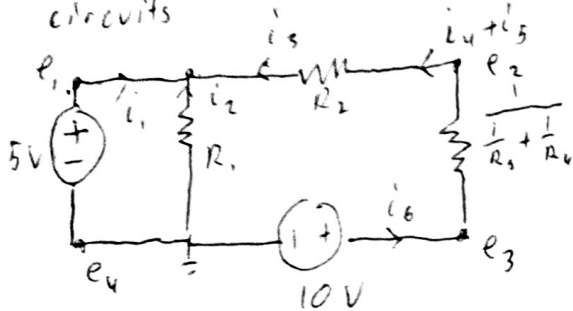
Find currents flowing through each branch

Find voltages at each node

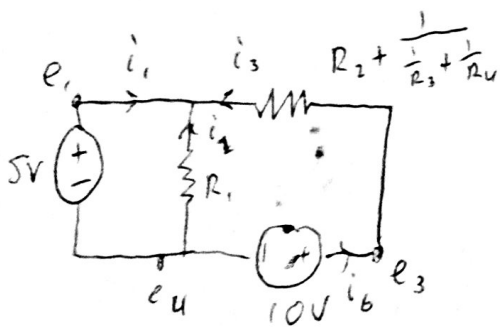


$$\begin{aligned} e_1 &= 5V \\ e_2 &= 7.5V \\ e_3 &= 10V \\ e_4 &= 0V \end{aligned}$$

equivalent circuits



$$\begin{aligned} i_1 &= 2.5 \text{ mA} \\ i_2 &= -5 \text{ mA} \\ i_3 &= 2.5 \text{ mA} \\ i_4 &= 1.25 \text{ mA} \\ i_5 &= 1.25 \text{ mA} \\ i_6 &= 2.5 \text{ mA} \end{aligned}$$



How much power consumed by each resistor?

$$R_1 \Rightarrow 5V \cdot 5 \text{ mA} \Rightarrow 25 \text{ mW}$$

$$R_2 \Rightarrow (7.5V - 5V)(2.5 \text{ mA}) \Rightarrow 6.25 \text{ mW}$$

$$R_3 \Rightarrow (10V - 7.5V)(1.25 \text{ mA}) \Rightarrow 3.125 \text{ mW}$$

$$R_4 \Rightarrow (10V - 7.5V)(1.25 \text{ mA}) \Rightarrow 3.125 \text{ mW}$$

How much power is sourced by V1? V2?

$$V_1 \Rightarrow 5 \cdot 2.5 \text{ mA} \Rightarrow 12.5 \text{ mW}$$

$$V_2 \Rightarrow 10 \cdot 2.5 \text{ mA} \Rightarrow 25 \text{ mW}$$

* Note that sum of sourced power and consumed power is equal.

I read 1.3 volts on an 8-bit ADC and store the value in a char `i`. What happens if I print `i`?

Assuming voltage range is 0-3.3V,

$$\frac{1.3}{3.3} \cdot 2^8 = 100.848... = 100 \text{ ADC readings can't be decimal numbers}$$

chars are 1 byte \Rightarrow 8 bit so this ADC reading fits in a char data type.

If I print char it will be ASCII of 100 \Rightarrow 'd'

Main point of this problem is to exercise some data manipulation.

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

\rightarrow `pointer[1] = 'h'`; is writing to unallocated memory which may cause an error.

The first two operations on pointer are equivalent.

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

\rightarrow We see no declaration of a variable called `data`.
so it doesn't exist (also valid to say we can't tell)

I'm trying to store `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?

\rightarrow key idea \Rightarrow header specifying post with URL to script and `x, y` coordinate in the body

Last question

\rightarrow `counter = 0`

because it is reset on each request
and my last request is a GET which doesn't increment the counter.