Panel 1

Lowest OSI Level is Physical Level
⇒ defines bits and handles their transmission.

Bits are digital signals: discrete range
as opposed to analog signals: continuous range between 2 values

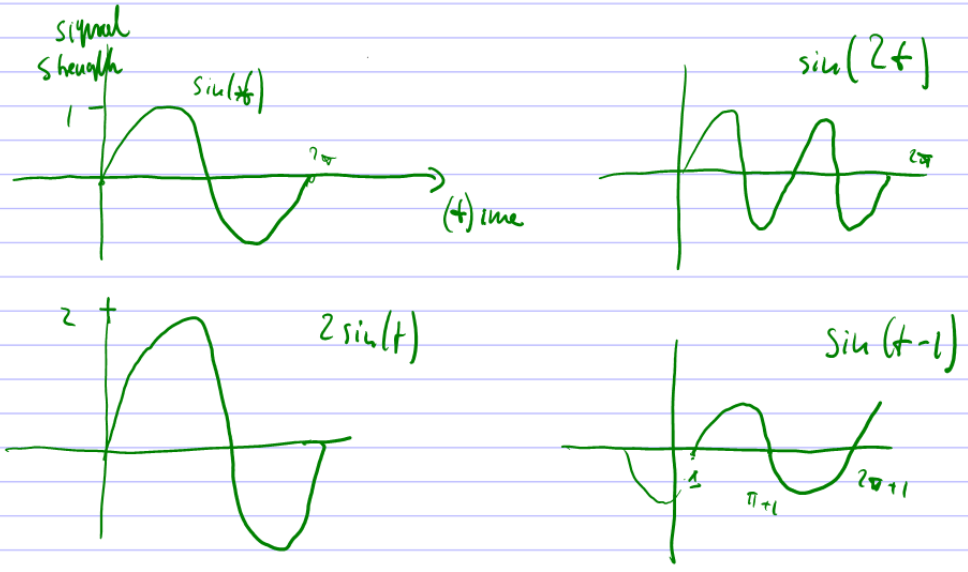
Start looking at analog signals

1

Panel 2

Analog Signals

Def: An analog signal is a continuously varying signal



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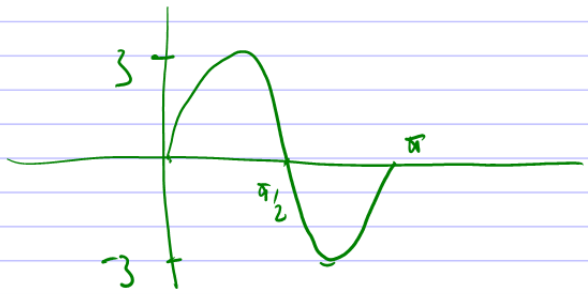
Panel 3

Analog Signals

Def: An analog signal is a continuously varying signal

$f = 1/\text{period} = (1/s \quad Hz)$



$3\sin(2t)$ (0 ... 2π)

Frequency = $1/\pi$

Period : π seconds

Amplitude : 3

3

Panel 4

Period: time it takes for a signal to repeat

Frequency: # of times a signal oscillates per second

$$f(t) = a_0 + \sum_{j=1}^{\infty} \left(a_j \cos\left(\frac{2\pi j t}{P}\right) + b_j \sin\left(\frac{2\pi j t}{P}\right) \right)$$

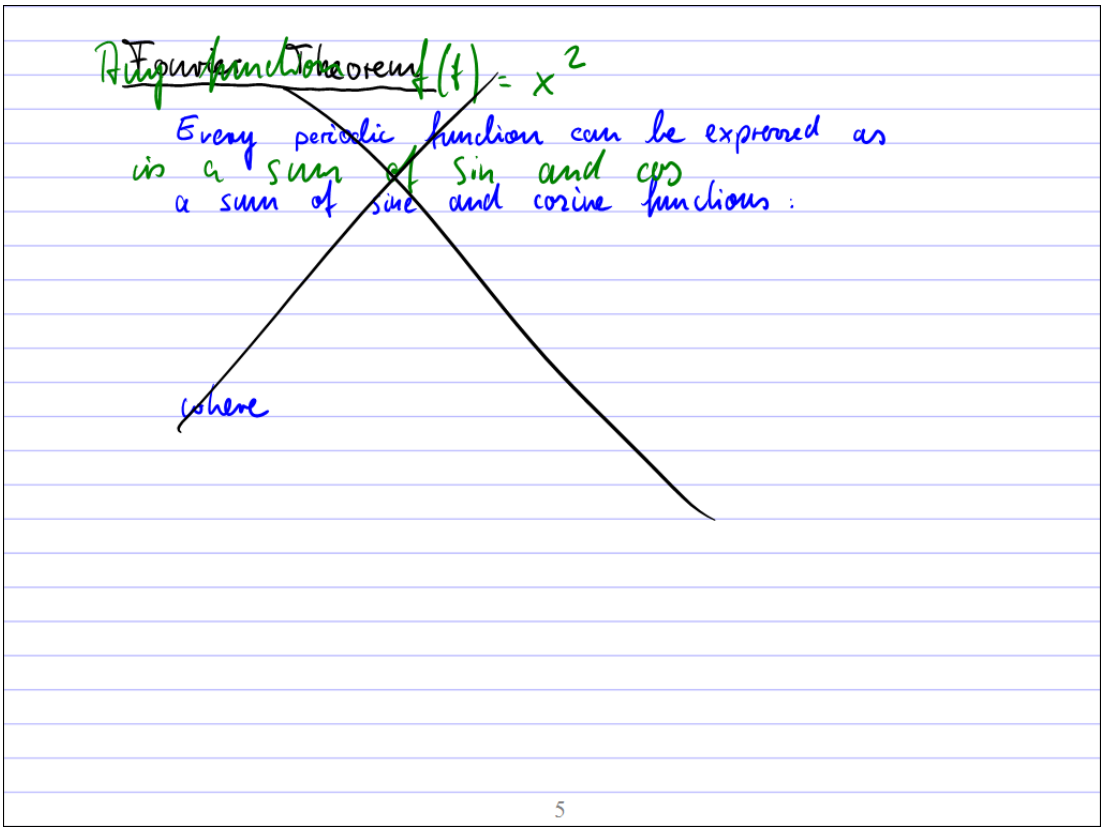
Amplitude: largest and smallest value of pattern

$$a_j = \frac{1}{P} \int_{-P/2}^{P/2} f(t) \cos\left(\frac{2\pi j t}{P}\right) dt$$

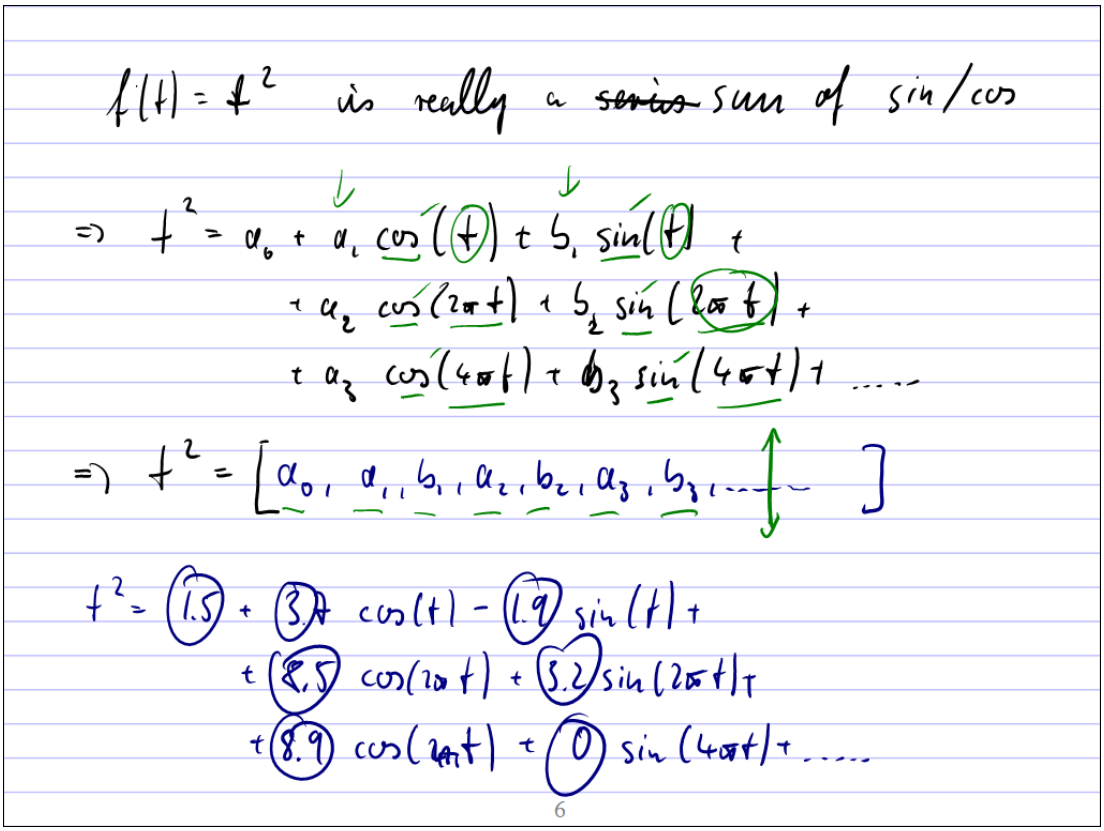
$$b_j = \frac{1}{P} \int_{-P/2}^{P/2} f(t) \sin\left(\frac{2\pi j t}{P}\right) dt$$

4

Panel 5



Panel 6



Panel 7

Period: time it takes for a pattern to repeat

Frequency: # of times a signal oscillates per second

Amplitude: largest and smallest value of pattern

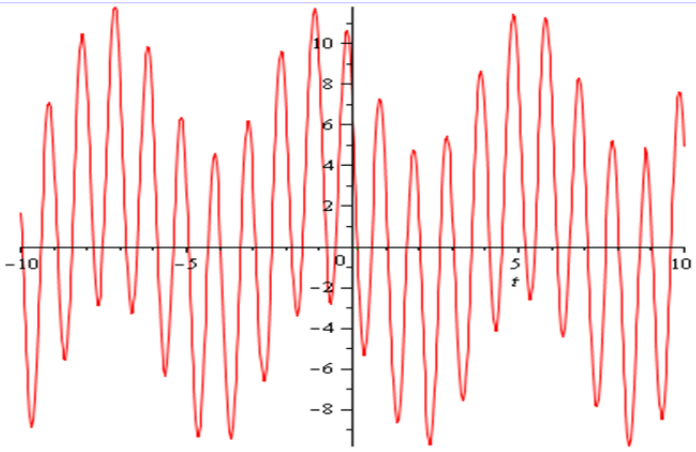
7

Panel 8

Ex. What is the function

[1, 2, -3, 4, -6, 0, 0, 0] =

$f(t) = 1 + 2\cos(t) - 3\sin(t) + 4\cos(2\pi t) - 6\sin(2\pi t)$



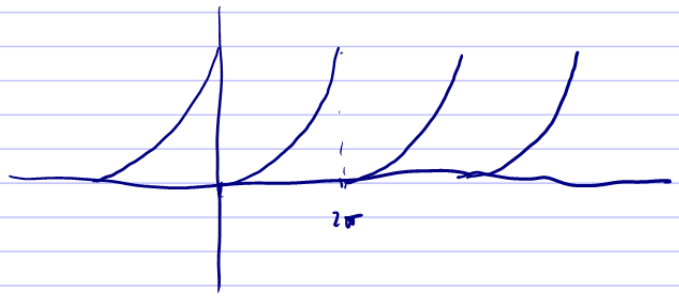
8

Panel 9

Other way: What is

$f(t) = t^2$? $= [a_0, a_1, b_1, a_2, b_2, a_3, b_3 \ldots]$

$a_0 + a_1 \cos(t) + b_1 \sin(t) + a_2 \cos(2t) + b_2 \sin(2t)$



9

Panel 10

To compute these Fourier Coefficients, you could numerically integrate

$a_j = \int f(t) \cos(jt)\, dt$, $b_j = \int f(t) \sin(jt)\, dt$

but that's too slow!

FFT algorithms to compute a_j, b_j quickly!

↳ Fast Fourier Transform

10