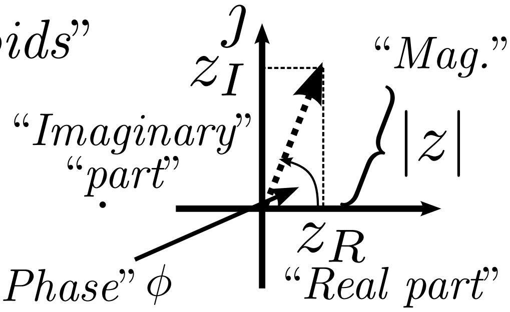
	Time	“*Relationships*” ⟷	Frequency
Must know	“*Decomposition*” $x[n]=\sum_{k=<N>} a_k e^{j(\frac{2\pi k}{N})n}$	“*Get Freq. coefs.*”	$a_k = \frac{1}{N}\sum_{n=<N>} x[n]\, e^{-j(\frac{2\pi k}{N})n}$
	$x[n]$ has N samples /periodic in N	“periodic in N”	$a_k = a_{k+N}$
	$x_1[n] + x_2[n]$	“*Linear*”	$a_k = b_k + c_k$ $x_1[n] \leftrightarrow b_k,\ x_2[n] \leftrightarrow c_k$
	$\alpha \cdot x[n]$	“*Linear*”	$\alpha \cdot a_k$
Properties	$x[n]$ is real	“*Conjugate Sym.*”	$a_k = a^*_{-k}$
	$x[n]$ real and $x[n]=x[-n]$		a_k's are real
	$x[n-\alpha]$	“*Time Shift*”	$a_k \cdot e^{-j(\frac{2\pi k}{N})\alpha}$
	$x[n] \cdot e^{j(\frac{2\pi\alpha}{N})n}$	“*Freq. Shift*”	$a_{k-\alpha}$
Examples	$x[n] = 1$	“*DC-constant*”	$a_k = \delta[k]$
	$x[n] = \delta[n]$	“*unit sample*”	$a_k = \frac{1}{N}$
	$x[n] = \cos\left((\frac{2\pi\ell}{N})n\right)$		$a_k = \frac{1}{2}\delta[\ell] + \frac{1}{2}\delta[-\ell]$
	$x[n] = \sin\left((\frac{2\pi\ell}{N})n\right)$		$a_k = \frac{1}{2j}\delta[\ell] - \frac{1}{2j}\delta[-\ell]$

$$e^{j\underbrace{(\frac{2\pi k}{N})}_{\text{“Freq.” (fraction of } 2\pi)}n} = \cos\left((\frac{2\pi k}{N})n\right) + j\sin\left((\frac{2\pi k}{N})n\right)$$ “*Euler's*”

“*discrete-time sinusoids*”

“*A complex number has 4 parts*”

$$z = \underbrace{z_R}_{|z|\cos(\phi)} + j\underbrace{z_I}_{|z|\sin(\phi)} = |z|e^{j\phi}$$



$\lvert z\rvert^2 = z_R^2 + z_I^2$	$\phi = \tan^{-1}(\frac{z_I}{z_R})$

“*Conjugation*”

$$z^* = z_R - jz_I = |z|e^{-j\phi}$$