Signals: Voltages or currents that varies with time.
Examples: **Audio** signals include speech and music.
Musical notes (middle C is a 254 Hz sinusoid), octaves.

Periodic: $x(t)$ has *period* $T \leftrightarrow x(t) = x(t+T)$ repeats every T.
Examples: Musical tones; EKGs (heart); 60 Hz wall sockets.
Then: Periodic signals can be decomposed into sinusoids:

Periodic signal=sum of sinusoids at frequencies which are
integer multiples of the *fundamental frequency*=$\frac{1}{T}$ Hz$\sim$*prism.*
Have **frequency content.** See Fourier series handout for details.

Circuits: Components connected together in a network.
Components: Resistors, inductors, capacitors, sources.
Examples: Op-amps modelled using dependent sources.

Systems: Use of a circuit to *process* signals to do something.
Filters: Circuits that affect the frequency content of a signal.
EX #1: Low-pass filters to reduce noise in sensor signals;
EX #2: Bass and treble controls or graphic equalizers;
EX #3: Dolby noise reduction; preemphasis and deemphasis.

Sinusoid: Signal having form $x(t) = A\cos(\omega t + \theta)$ where:
Amplitude: A=(usual) amplitude; 2A=*peak-to-peak* amplitude A_{pp};
Amplitude: $\frac{A}{\sqrt{2}} \approx 0.707A$=*rms* amplitude A_{rms}; $20\log_{10} A_{rms}$=dBV.
Why? A_{pp} easy to measure on scope; A_{rms} for AC power (see later).
$A_{rms} = \sqrt{\frac{1}{T}\int_0^T A^2\cos^2(\omega t+\theta)dt} = \frac{A}{\sqrt{2}}$ if $\omega \neq 0$. $\omega = 0 \rightarrow$DC value.

Frequency: ω=circular frequency in $\frac{radians}{second}$;
Frequency: $\omega = 2\pi f$ where f=frequency in Hertz ($\frac{cycles}{second}$).
Period: $T = \frac{1}{f} = \frac{2\pi}{\omega}$. Sinusoid repeats every T: $x(t) = x(t+T)$.
Phase: θ=phase (shift) in radians or degrees. 1 radian=$\frac{180}{\pi} \approx 57.3^o$.

Example: Voltage in wall socket: $v(t) = 170\cos(377t + \theta)$ for some θ.
Amplitude: A_{usual}=170 volts; A_{pp}=340 volts; A_{rms}=120 volts.
Frequency: $T = \frac{1}{60}$ seconds; f=60 Hz; $\omega = 377\ \frac{radians}{second}$.
where: Approximating $170 \approx 120\sqrt{2}$ and $377 \approx 2\pi 60$ (quite close).