Signals, Systems, and Complex Numbers

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- What is a System?
  - From electrical engineering perspective, a system is device or a group device or a set-up that takes an input signal x and manipulates it to generate a signal y
  - Add another layer of abstraction over circuit (or other) models
  - Can allow us to think about, analyze, and design circuits while paying attention only to what is important in a particular setting and ignoring lots of other details
- Complex Numbers
  - The imaginary numbers consist of all numbers bi, where b is a real number and i is the imaginary unit, with the property that $i^2 = -1$
  - The first four powers of i establish an important pattern and should be memorized:

$$\boxed{i^1 = i \qquad i^2 = -1 \qquad i^3 = -i \qquad i^4 = 1}$$

  - The complex numbers consist of all sums $a + bi$, where a and b are real numbers and i is the imaginary unit. The real part is a, and the imaginary part is bi
  - Conjugates
    - The conjugate of $a + bi$ is $a - bi$
    - The conjugate of $a - bi$ is $a + bi$
- Systems
  - Physical System
    - Defining a system involves drawing a boundary around some part of the world (or conceptually, inside a computational device) so that quantities external to those boundaries may influence what happens inside the boundaries (the "inputs" to the system)
  - Mathematical System