Lecture 2, Sep 13, 2021

- Two foundational models: modelling Engineering Design and Argument

Models

1. No model is perfect; they're all simplifications that are intended to be **useful**
   - Models are interpretations and simplifications of a broader system and are inherently limited
2. Models are **lenses**; they allow you to see the same situation differently
3. **Some** models are predictive, others are explanatory
   - Not all models are predictive

Model of Engineering

- At its core, engineering happens in reality: 1. The world as it is, 2. The world as I/we create it
  - This is the "trial-and-error" space: e.g. if you want to test a building, you would build it and load it until it breaks
  - Early research and impractical in today's world
  - "Technology"
- In the "theory" space: 1. The world as I/we perceive it, 2. The world as I/we dream it
  - Using science and math, we model the world as it is to form the world as we perceive it
  - When we build the world as we dream it, we turn it into the world we create
  - "Science and math"
- The goal of this course is to iterate between perception and dream, so when we finally build it, we have a tried-and-true solution
- The process starts with the world as it is, models it, produces the design, and the build it
  - There is a back and forth between the model and the design that Praxis focuses on

Arguments

- At our core, engineers **make decisions** and **recommend designs**; to push our designs and decisions, we need arguments
- Toulmin's Structure of Argument
  - Any argument starts with a ground: the reason why we make the argument
  - From the ground, a claim is made; in an ideal world, this directly leads to acceptance
  - Any nontrivial claim requires support: bring in justification and evidence to support the claim, qualifiers to limit the claim
  - Example:
    * Ground: technology exists
    * Claim: technology is not applied science
    * Justification: sometimes technology precedes the science that explains it, so science is not necessary prior to technology (claim could be **challenged and questioned**)
    * Evidence: the Wright brothers were flying before aerodynamics; stream engines came before thermodynamics (argument based on historical example; can be **fact-checked**)
    * Qualifier: the "sometimes"; even though our faculty is "Applied Science and Engineering"
  - The order is not set; e.g. an argument can start with a justification, evidence, etc; but the pieces must exist
  - Next lecture: counterclaims
    * Argument by example is vulnerable to counterexamples
- Spectrum of claims: Ground →Analytical Claim →Interpretive Claim →Speculative Claim →Crazy Idea
  - The further a claim is from the ground, the more evidence and justification it requires to be acceptable
  - Analytical →"what?", interpretive →"so what?", speculative →"what could be?"
- Ways to support claims:

1. Research for facts, for previous designs, codes, standards and guidelines, for approaches and processes, for cognate (similar) concepts and theories
2. Testing, calculating, modelling
3. Sketching, low-fidelity prototyping, proofs of concept