CSCE482: Senior Capstone Design
Today…

• Give us some information from which to form teams.
• Start to think about projects you can propose to your teammates.
• For Monday: “The Five Dysfunctions of a Team: A Leadership Fable”
• What is Engineering Design, What is a Team, etc.
What is Engineering Design?

• Engineering design is the process of devising a system, component, or process to meet the desired needs.

• Engineering design is a decision-making process in which the basic sciences and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective.

• Engineering design is a methodical approach to solving a particular class of large complex problems.
A team is...

A *small* group of people with *complementary* skills who are equally committed to:

- a common *purpose*,
- performance *objectives*,
- and working *approach*,

for which they hold themselves mutually *accountable*.
This is a team
Heilmeier's Catechism

George Heilmeier worked on LCDs, Became CTO of TI, president and CEO of Bellcore, SAIC

When Heilmeier was the director of ARPA in the mid 1970s, he had a standard set of questions he expected every proposal for a new research program to answer. These have been called the Heilmeier Catechism.
Heilmeier's Catechism

1. What is the problem, why is it hard?
2. How is it solved today?
3. What is the new technical idea; why can we succeed now?
4. What is the impact if successful?
5. How will the program be organized?
6. How will intermediate results be generated?
7. How will you measure progress?
8. What will it cost?

Of course, if you are proposing a small effort, some of these questions should be adapted and modified (e.g., #5).
Science vs. Engineering

In his book *The Tower and the Bridge* David Billington says: "There is a fundamental difference between science and technology. Engineering or Technology is the making of things that did not previously exist, whereas Science is the discovery of things that have long existed."


There can be a lag of many years between Science and Engineering. E.g., Newton’s theories suffice for aspects of rocket flight, but fuels, launchers, etc. needed to be developed.

Let’s look at an Engineering Science Problem

Mathematics, Science, or Engineering Science

- A simply supported steel beam with 3” diameter circular cross-section is loaded as shown in the figure. Determine maximum stress and deflection on the beam.

- Find $x$ if $x^2 - 8x + 15 = 0$

- The force of the wind on a flat surface varies directly with the area of the surface and the square of the velocity of the wind. When the wind is blowing 16 miles per hour, the force on an area of 4 square feet is 5 pounds. What is the force on a square yard when the wind is blowing 12 miles for hour?

What are the common features of these problems?
Donald A. Schon Cartoon

Solid Ground of Engineering Science

Design Swamp

Contemplating Engineering Design
Typical Engineering Student with Science and Mathematics Background

Solid Ground of Engineering Science

Design Swamp
Possible Logo for Engineering Design

This is meant to convey the notion that, unlike engineering science, much of engineering design does not depend on universally applicable laws of nature.
Nine Step Model of Design Process

1. Recognizing the need
2. Defining the problem
3. Planning the project
4. Gathering information
5. Conceptualizing alternatives
6. Evaluating the alternatives
7. Selecting the preferred alternative
8. Communicating the design
9. Implementing the preferred design
Cost of Making Changes During Different Phases of the Design Life Cycle

- preliminary design
- detailed design
- production
- consumption

cost of change, $
Summary of the methodology

Identify the Need

Goal Statement

Objectives

Constraints

Design Criteria