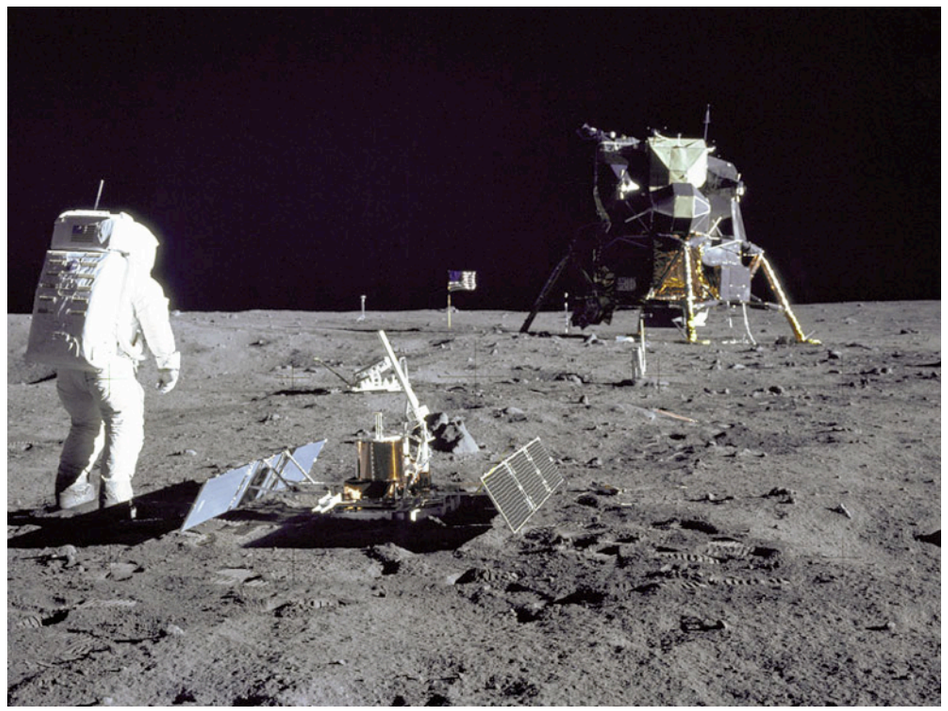
Normal ⟷

A Spectrum of Engineering Design

Normal ⟷ **Radical**

A Spectrum of Engineering Design

Normal ⟷ **Radical**



Characterizing the Spectrum

Normal

- ?

Radical

- ?

Characterizing the Spectrum

Normal

- expect to work in a wide variety of well-understood cases

Radical

- hope it works in 3 cases

Characterizing the Spectrum

Normal

- reduced risk
- reduced cost
- easier communication
- easier maintenance
- shorter development time

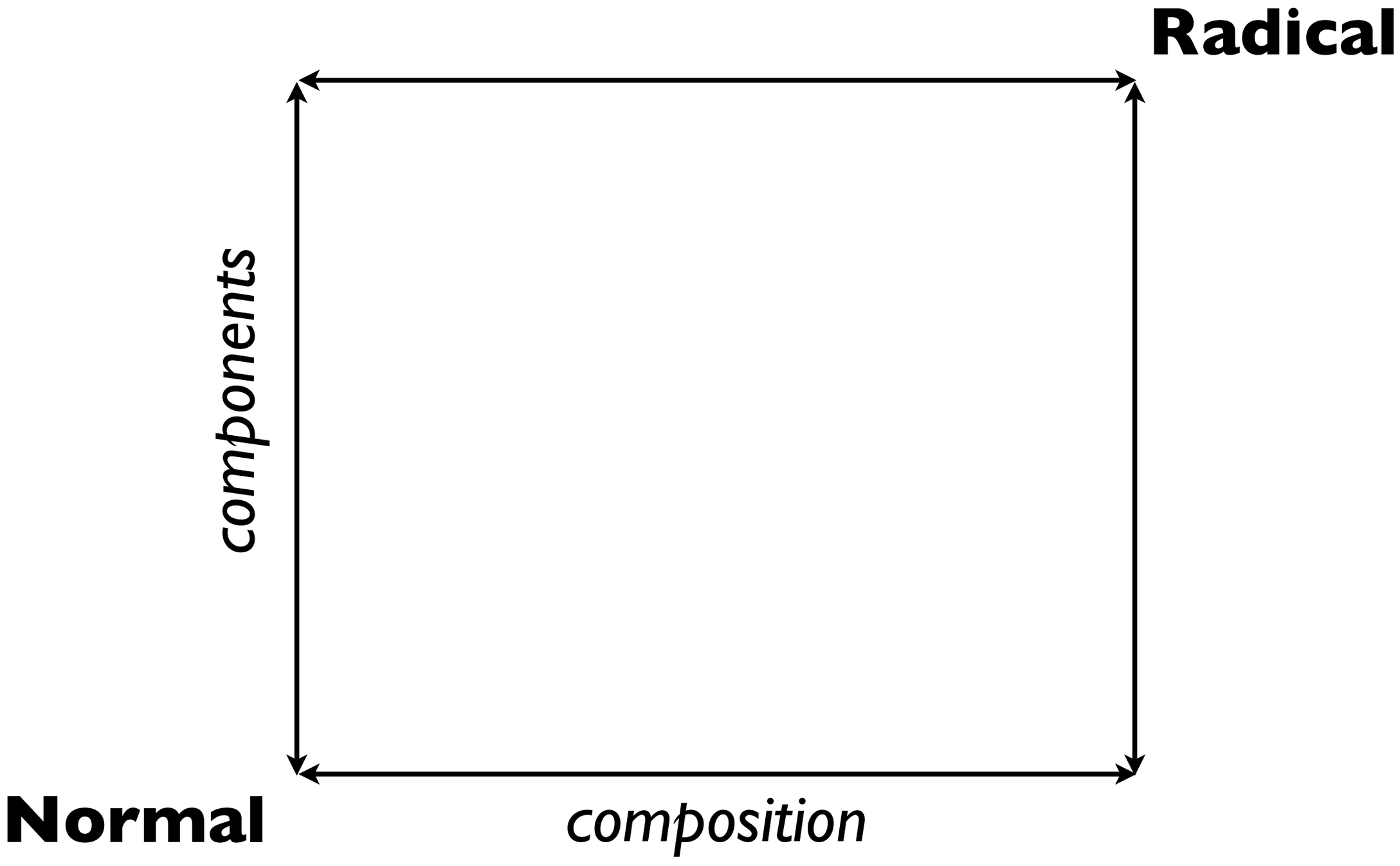
Radical

- innovation is expensive and time consuming
- harder requirements elicitation
- harder verification

Sez who?

- Michael A. Jackson
  The Name & Nature of Software Engineering
- Walter G. Vincenti
  What Engineers Know and How They Know It
- Edward W. Constant
  The Origins of The TurboJet Revolution

A Space of Engineering Design



SE2 is about normal modes of composition.

Most of the other courses that you've taken so far have been about normal components: e.g., databases, compilers, operating systems, etc. (or basic skills, e.g. math)

There are two ways of constructing a software design.

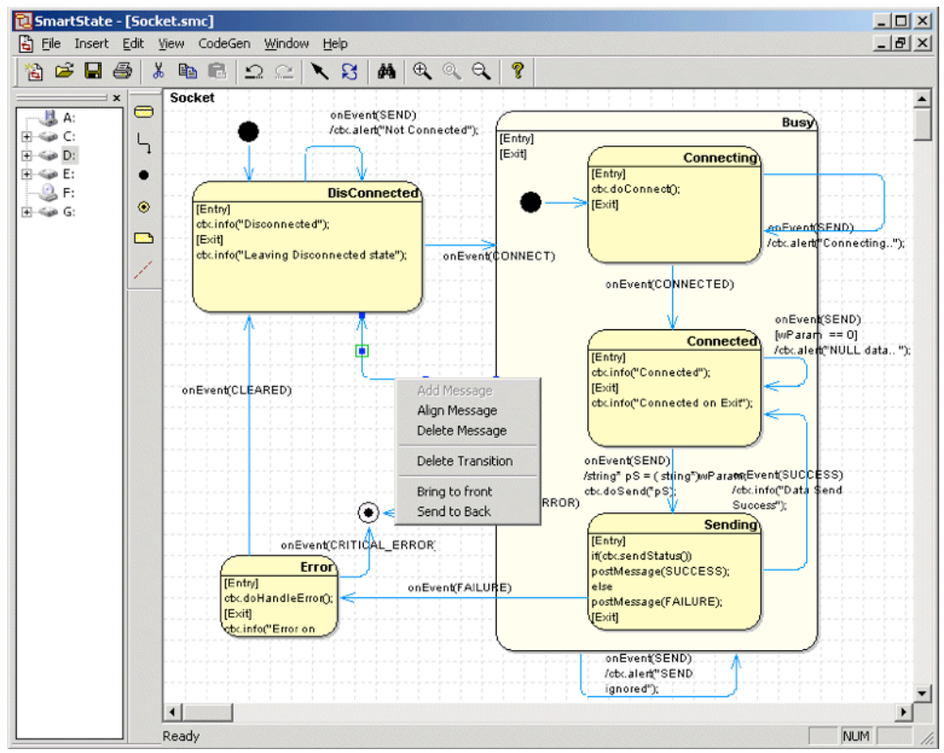
- One way is to make it so simple that there are obviously no deficiencies.
- And the other way is to make it so complicated that there are no obvious deficiencies.

C.A.R. Hoare
Turing Award
Speech, 1980

Design Disciplines

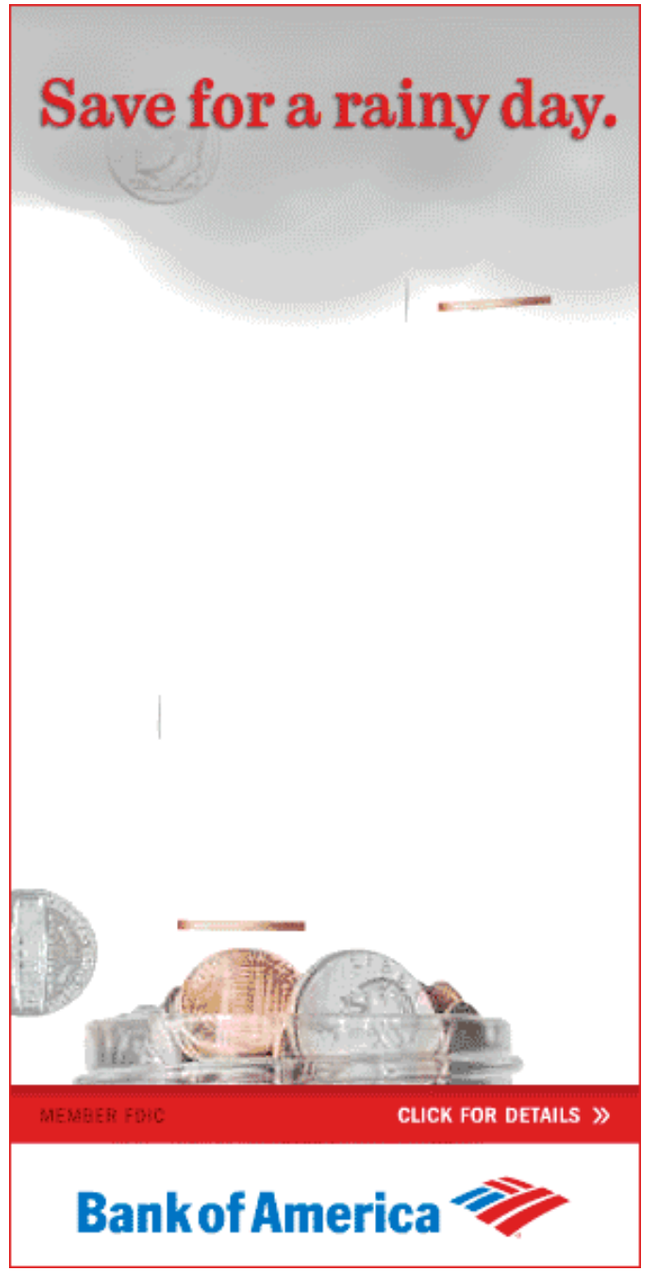
Part II

Is there something common amongst the design disciplines?




intercell
SMART VACCINES

IDEO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Ergo.

Process E.

Physics

Human

Technical

Web

H.C.I.

Hardware E.

CS

Interaction

Software E.

Conceptual

Definitions

- The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.
- A plan for arranging elements in such a way as to best accomplish a particular purpose.

Design Process

Part III

The Design Process

1. Ideation →

← 2. Analysis

3. Selection →

4. Elaboration

Iterate

How to get new ideas?

- try a different architectural style
- relax a constraint
- change the technology
- re-imagine the problem
- draw inspiration from another problem/soln
- try a different point on the Pareto-front

Criteria for Analysis

- Fitness for Purpose
- Fitness for Future
- Production Cost
- Operating Cost

Characterizing Fitness for Purpose

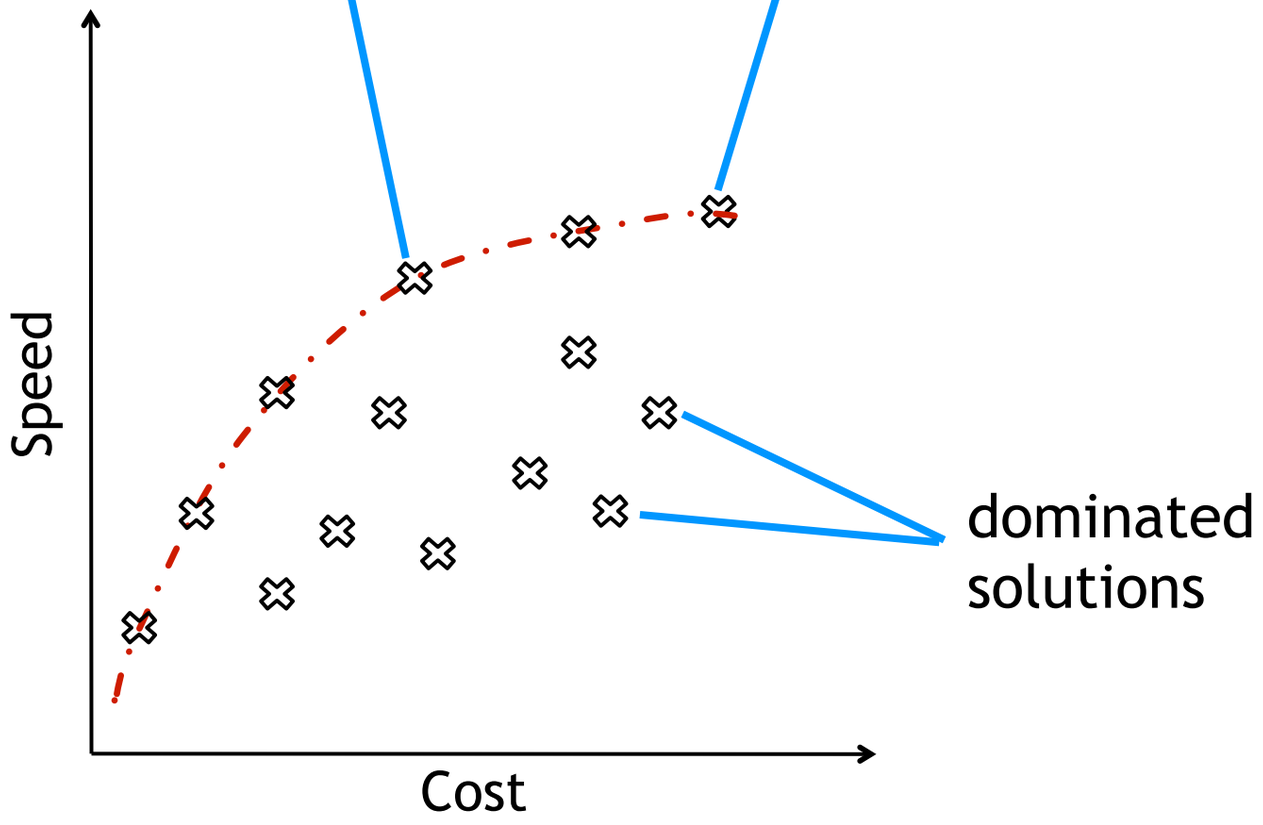
- Absence of deadlocks
- ACID
- Book checked out by at most one patron
- Linked-list is acyclic
- *etc.*

Analyzing Fitness for Purpose

- Other engineering disciplines use math.
- We can use it too!
- Model-checking
- Queuing theory
- *etc.*

Comparative Analysis

Comparative Analysis



The Pareto Front

- The set of non-dominated solutions/designs.
- aka Pareto-Optimal, Pareto-Efficient designs
- N.B.:
  - the design space is partially ordered
  - not totally ordered!

Summary

- Normal vs Radical Design
- Commonalities amongst Design Disciplines
- *The* Design Process
  - Ideation
  - Single Design Analysis: Fitness for Purpose
  - Comparative Design Analysis: Pareto Front

creativity

math!

math!