

MAE143A Signals & Systems

This course is about

SIGNALS

*what they are and
how they get transformed by*

SYSTEMS

Our book is:

Fundamentals of Signals and Systems (First Edition) 2008
by M.J. Roberts

What do I expect you to know?

Prerequisites and assumed knowledge:

Math 20E Vector Calculus

Calculus, limits, continuity, differentiation, integration

Math 20F Linear Algebra

Vectors, matrices, eigenvalues, null spaces

Math 21D Differential Equations

Ordinary differential equations, Laplace transforms

Complex analysis, Mae 105

Basics on Fourier transform

Introduction



Block diagram representation of a system

SIGNAL - carry information

human voice, Morse code, electricity consumed, gas prices

SYSTEM – transforms signals

human ear, telegraph, electric grid, economic system

SIGNALS evolve over **TIME**:

Continuous-time or discrete-time

Introduction

SYSTEMS

amplify, delay, distort, add noise to, etc

SIGNALS

Can you fill up this table?

SYSTEM	INPUT	OUTPUT
Car		
Ear		
Camera		
Phone		
Electric Circuit from MAE 140		

Synonymia

INPUT SIGNAL: input, excitation

OUTPUT SIGNAL: output, response

SYSTEM: filter, process, computer

Recurrent question:

Given the *inputs*,
can you determine
the *outputs* of a *system*?

How to determine a system response to signals?

REALITY

MODEL

"Signal"

Information in the
form of

- audio
- video
- text

Abstract

Mathematical
functions

"System"

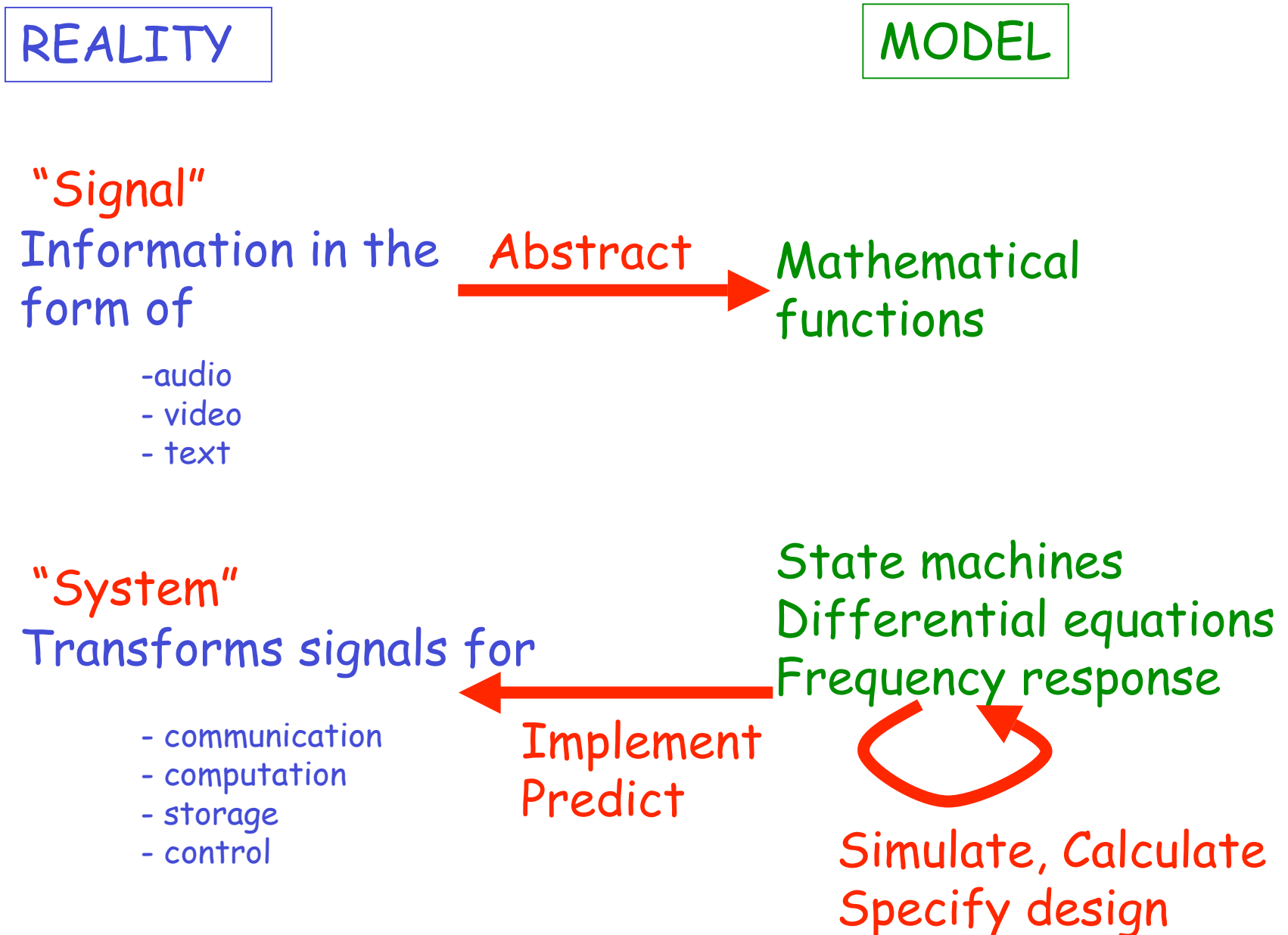
Transforms signals for

- communication
- computation
- storage
- control

State machines
Differential equations
Frequency response

Implement
Predict

Simulate, Calculate
Specify design



Why should you be excited about MAE143a&b?

The technology we will learn in MAE143a is everywhere today

The *front and back ends* of your digital cell phone are comprised of analog circuits - This is pretty much true of all *digital* technology

Why does the stagecoach wheel appear to rotate backwards?

Aliasing

A high frequency masquerading as a low frequency

Anti-aliasing filters MUST be used in all
sampled data systems

After MAE143a you will be able to start designing
such anti-aliasing filters



Why should you be excited about MAE143a?

Anti-aliasing is just one of the things systems can do to signals

Also, amplify them, delay them, distort them, introduce noise...



Introduction

Main Course Objective:

Fundamentals of systems/signals interaction

(we'd like to understand how systems transform or affect signals)

Specific Course Topics:

- Basic test signals and their properties
- Systems and their properties
- Signals and systems interaction
 - Time Domain: convolution
 - Frequency Domain: frequency response
- Signals & systems applications:
 - audio effects, filtering, AM/FM radio
- Signal sampling and signal reconstruction