Signals and Systems

The Big Ideas:	- The first step in using the signals and systems representation is abstraction. - Signals can be produced through linear combinations of other signals. - Block Diagrams and other representations enable modularity of the signals and systems abstraction - We can represent systems using state machines, and will be able to make long-term generalizations about those systems as well.

Introduction

Last week, we focused on important programming paradigms and concepts, and introduced state machines. This week, we continue our focus on state machines and introduce a new module, signals and systems.

The basic concepts from this module are applicable in a wide range of fields; whatever technical disciplines you differentiate into from 6.01, you'll likely be using the information you learn in this module in some form or another.

Any model of the world we want to study, that we address as a system, we also probably want to observe in some way (this is probably the reason we made the model in the first place). The information we choose to observe is the signal. Based on what we know about different kinds of signals and systems, we can choose what information to collect as a signal, and make long-term predictions about our system based on that signal, effectively.

Vocabulary

In order to engage the material, be able to communicate about the topic with others, and in particular ask questions, we encourage familiarity with the following terms:
(at this point, you've probably noticed that terms get re-listed over multiple weeks. Think about how those terms relate to this week's material).

Theory

- Signal
- System
- Sampling
- Linear
- Time-Invariant
- Modular
- Hierarchical
- Discrete time
- Difference Equation
- Step-by-step Analysis
- Block Diagram

- Sample to Signal
- Operator Equation
- Persistent Response to a Transient input

Practice

- Unit Sample Response
- Step Response
- `class Signal`
    - The basics (what are they?)
- `StepSignal`
- `SummedSignal`
- `ScaledSignal`
- `PolyR`
- `util`
- module `sm`
    - `Cascade`
    - `Parallel`
    - `Constant`
    - `Wire`

Check Yourself

After this week in 6.01, you should be familiar with the following:

Theory: you should understand:

- Motivation for studying signals and systems
- Motivation for different representations

Practice: you should be able to:

- Understand and create block diagrams, difference equations, and operator equations
- Create and manipulate signals using the 6.01 software
- Create and manipulate more complex state machines using the block diagram methods available from Module `SM`.

Resources

Chapter 4.2 of the 6.01 Course Notes is the official assigned reading for this week. It has many examples of more State Machine problems.

The first part of Chapter 5 of the 6.01 Course Notes is relevant to this week. All of Chapter 5 is relevant to this unit.

Practice: The 6.01 Software Documentation will come in handy, in particular modules `sig` and `util`.

The Lab Infrastructure Guide is a good place to learn about robots in the lab, if you need a refresher from Week 2.

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