Out of the Tar Pit

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Overview: Complexity is the problem!

- Complexity is cause of the vast majority of problems with software.
- The unfortunate truth: Simplicity is *Hard*
- Complexity makes informal reasoning about system behavior difficult (i.e., a “white box” inspection of code and using that to inform a mental model of its behavior.)
- “Testing is hopelessly inadequate” – Dijkstra – Why?
- Simplicity > Testing

Overview: Causes of Complexity

- "State"
  - What is "State?"
  - Impact on testing
  - Impact on informal reasoning
- "Control"
  - Sequence of events/concurrency
  - Implicit sequence of program execution

Overview: More causes of complexity

- Complexity caused by code base size
- “Complexity breeds complexity”
- ”Power corrupts”

Approaches to manage complexity

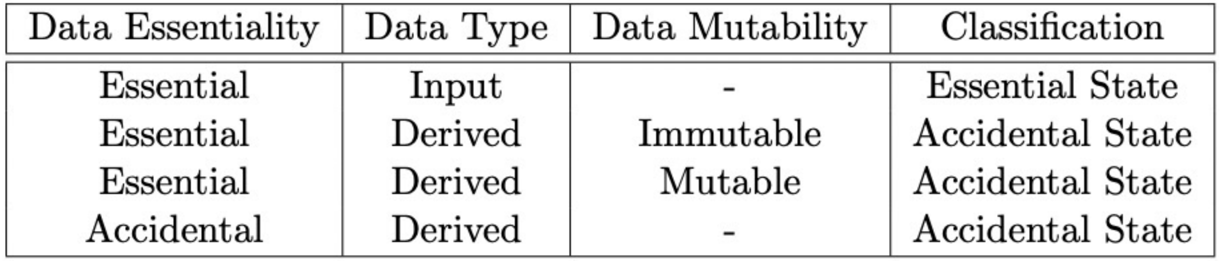
- Object orientation
  - ”suffer[s] greatly from state-derived and control-derived complexity”
- Functional programming
  - “goes a long way towards avoiding the problems of state-derived complexity”
- Logic programming
  - “offers the tantalizing promise… to escape from complexity problems”

Essential and accidental complexity

- **Essential complexity** is inherent in and the essence of “the problem” as perceived by users.
  - Important implication: complexity the user doesn’t know about/care about are not ***essential!*** (It may be *necessary* for the sake of efficiency, but for the purposes of this paper, it’s not *essential*.)
- **Accidental complexity** is “all the rest” of complexity.
  - ”Complexity with which developers would not have to deal in the ideal world.”

Recommended General Approach

- A thought experiment in "the ideal world"
  - Informal specification → formal specification
  - "no relevant ambiguity"
- State management
  - State (data) directly input by users
  - Derived from input



Data Essentiality	Data Type	Data Mutability	Classification
Essential	Input	-	Essential State
Essential	Derived	Immutable	Accidental State
Essential	Derived	Mutable	Accidental State
Accidental	Derived	-	Accidental State

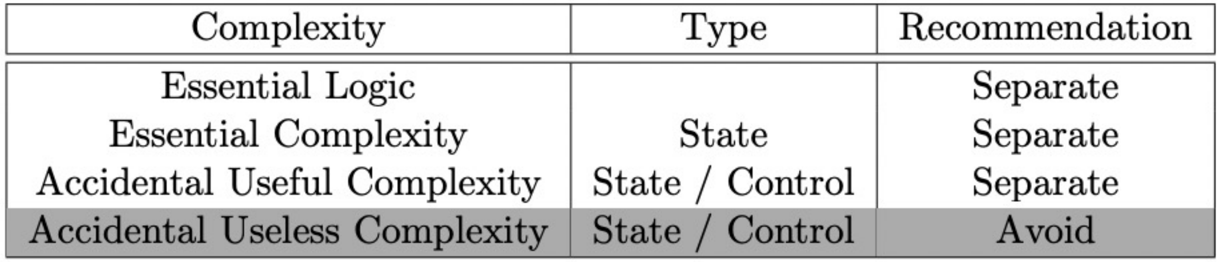
Table 1: Data and State

Required Accidental Complexity

- Performance
- Ease of expression (of logic/business rules)

How to deal with complexity

- Avoid it
- Separate it



Complexity	Type	Recommendation
Essential Logic		Separate
Essential Complexity	State	Separate
Accidental Useful Complexity	State / Control	Separate
Accidental Useless Complexity	State / Control	Avoid

Table 2: Types of complexity within a system

Functional Relational Programming

- Draws on the work of E.F. Codd
- Relational algebra has 8 operators:
  - Restrict
  - Project
  - Product
  - Union
  - Intersection
  - Difference
  - Join
  - Divide

Constructing a model in FRP

- (Essential) state expressed as relations between entities
- (Essential) logic (business rules) expressed as relational algebraic operations.
- Concepts:
  - Feeders: turn input into entities with associated relationships
  - Observers: generate output in response to changes of relational values.

Conclusion

- Complexity causes more problems than anything else.
- Only by means of a concerted effort to avoid or separate complexity can it be tamed.
- In cases where separation cannot be achieved, strive at all costs to *get rid of code*.
- “So, what is the way out of the tar pit? What is the silver bullet?”

Simplicity!

Your experiences

- Let’s talk about our experiences as developers?
- Do you agree or disagree with the premise of this paper?
  - Why or why not?
- Have you worked in a language/framework which you felt encouraged “simplicity” as a top-level language feature? Tell us about it.
- Have you worked in a language/framework where you felt “complexity” was inherent to the language design? Did your system design suffer from complexity? How?