Fundamentals
of Software Architecture

Looking beyond the hype

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1

Introduction


Frustrated by
all the hype?


If so
this presentation
is for you.


Otherwise
you should leave ☺

People often talk about technologies instead of architectural concepts.

Technology-discussions create a lot of accidental complexity.


Architectural essence
is hidden behind
tech gobbledygook


Concepts change much
More slowly than the
Hype-driven techno
marketing

This presentation:

Timeless concepts

This presentation:

Relationships between them

This presentation:

Examples

- languages
- architecture
- technology

awareness

when building systems

Goals

checklists

for reviewing systems

Goals

education

of developers and architects

Goals

Concepts

Atomic Combinable
Technology Neutral
Describable Named
(Patterns, Laws, Principles)

Combinators

B ! A

B ⊗ A

B ▸ A

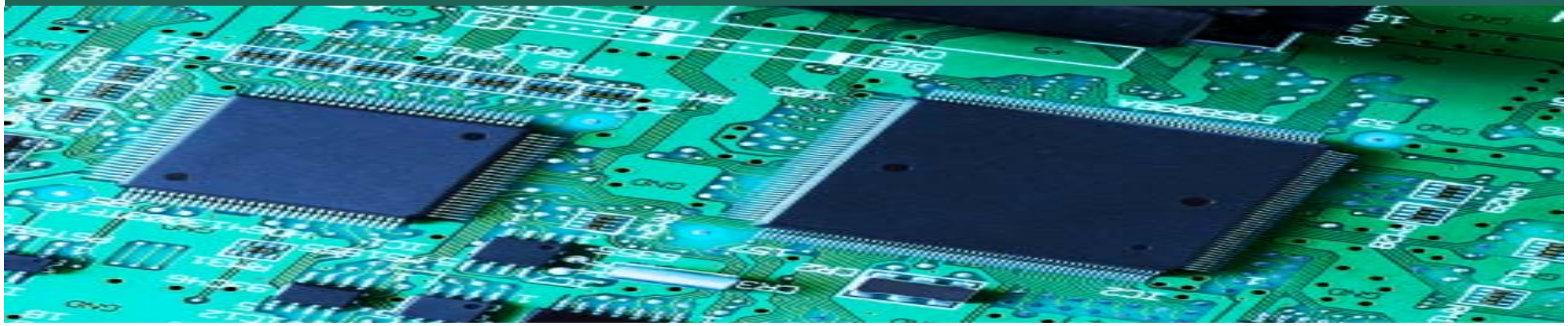
Ok, let‘s go…

2

Breaking Things Down

Modularize

Procedures, Classes, Components, Services, User Stories



! Modularize

Encapsulate

Private Members
Frameworks
Facade Pattern
Components
Layers/Rings/Levels
Packed Data Wrapper

! Modularize

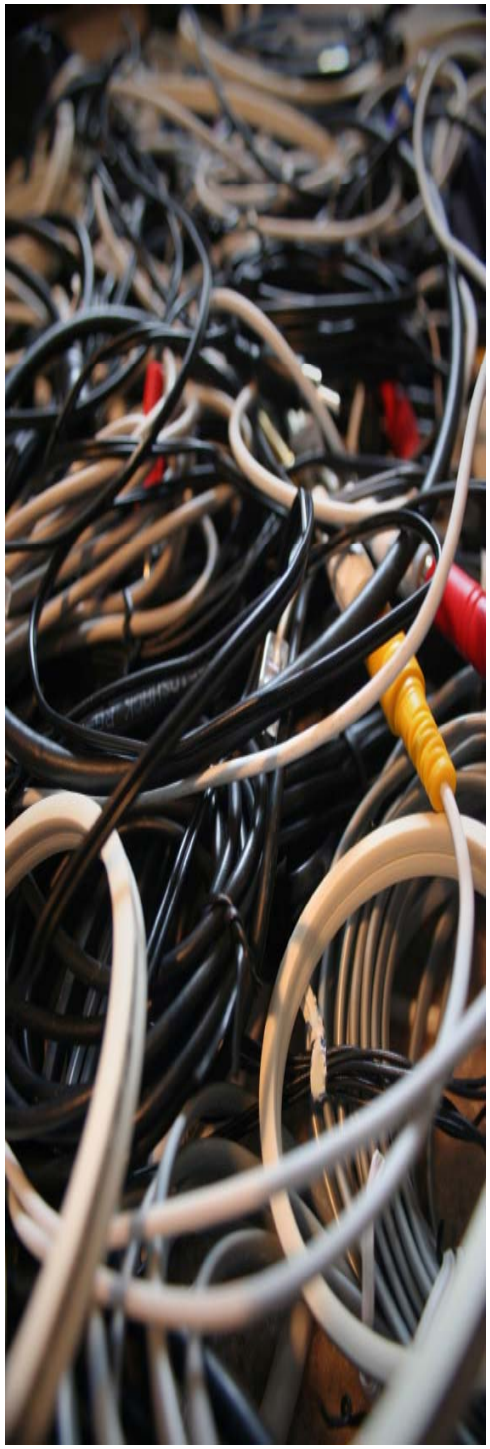
Contracts

Interfaces
Pre/Post Conditions
Protocol State Machines
Message Exchange Patterns
Published APIs

Decoupling

Compensating Tx
Message Queues

! Modularization



- Modularize

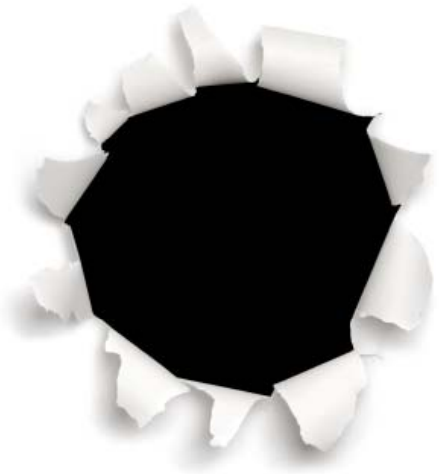
Handle Crosscuts

Aspect Orientation
Interceptors
Application Servers
Exception Handling

Go Down

⊗ **Encapsulate**

! **Modularize**



Assembler in C
C in Python/Ruby
SQL in Java

Isolate

Pure functional vs. Impure

Safety Critical Parts

Real-Time Kernel

OS Processes

! Modularize

Isolate Technology

- Modularize
- ▶ Isolate

3

Scaling things up

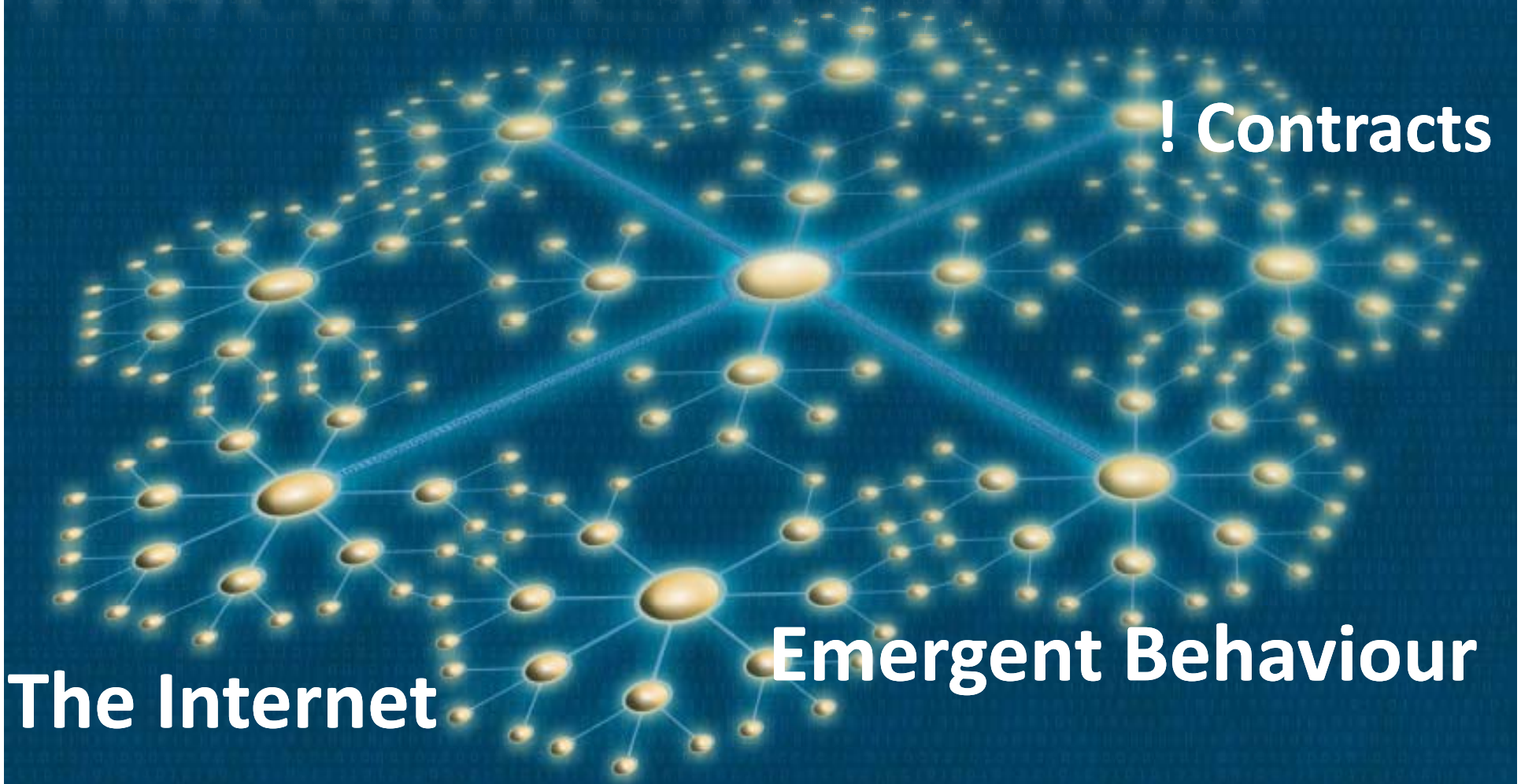
Parametrization

Function Arguments
Command-Line Args
Configuration Files

Simplicity

Web
Lisp
XML

Decentralization



! Contracts

Emergent Behaviour

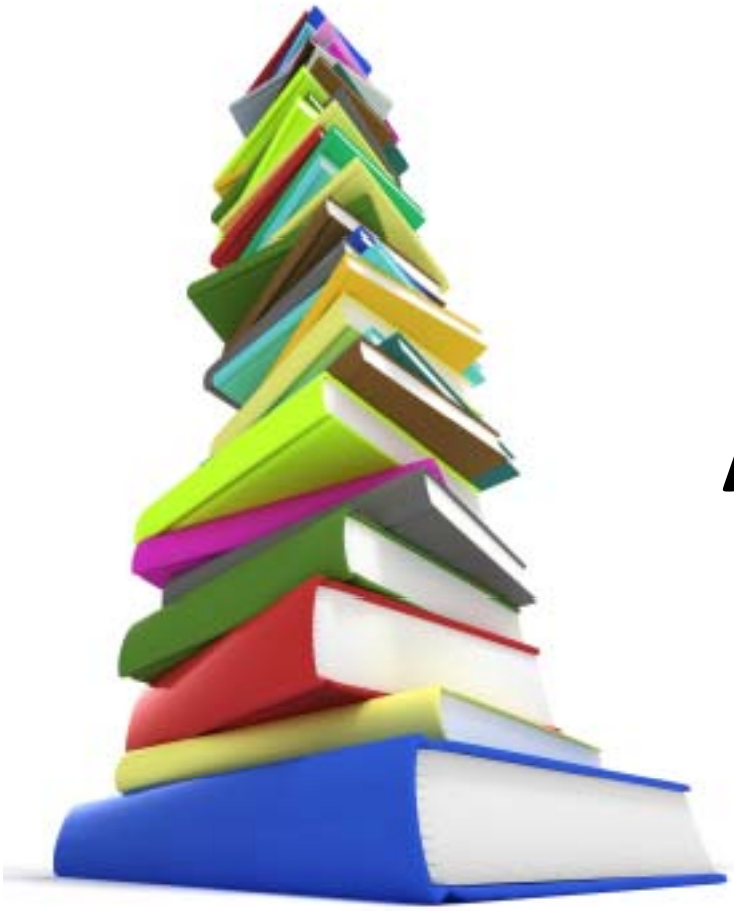
The Internet

Service-Oriented Architecture

Bootstrapping

Languages
Compilers
IDEs

Standard Library



Lisp (Grow A Language)

Autosar Sys Components

Microkernel OSs

! Modularize

! Types & Instances

Orthogonality

Closures, Program As Data, Macros, Higher-Order Functions

Identity

Pointers
GUIDs
MAC-Address
URI
Qualified Names

4

Conceptualization

Abstraction

Operating Systems
High-Level Languages
Models, DSLs

Types & Instances

Programming Languages
Components

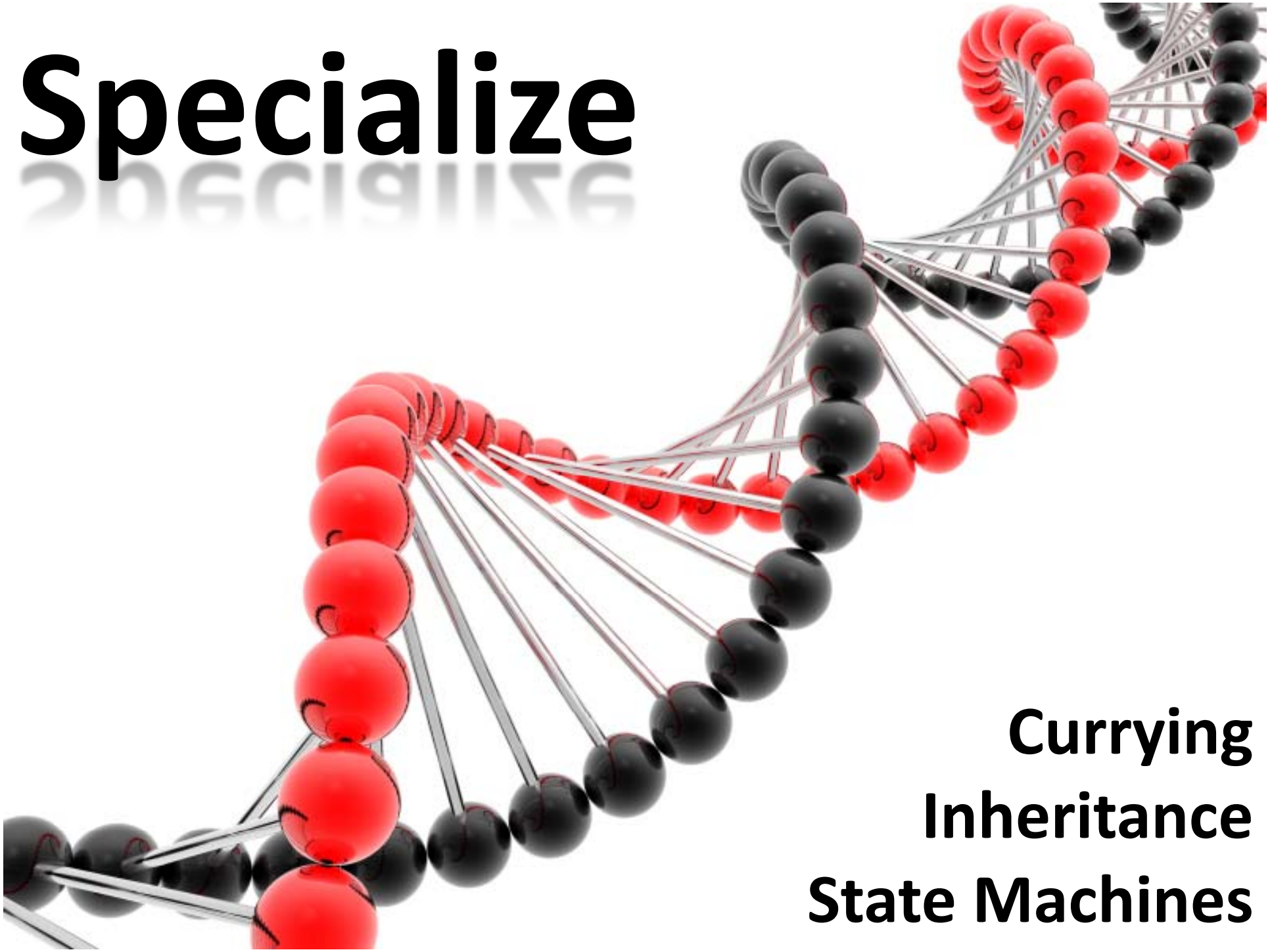
Models & Metamodels
RDBMS/XML Schemas

Hierarchical Decomposition

- Modularize

Procedures/Methods
State Machines, Components

Specialize

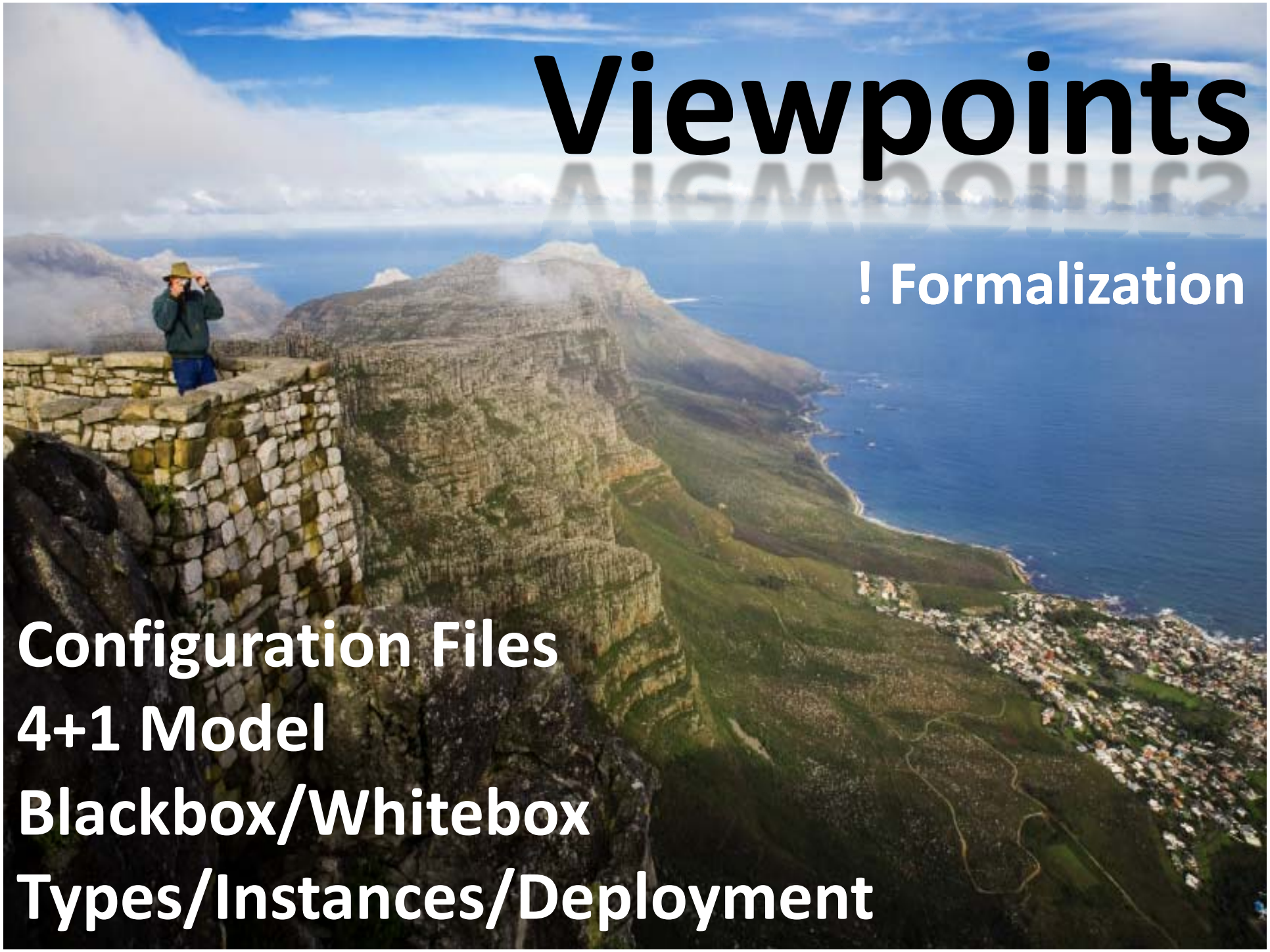


Currying
Inheritance
State Machines

! Abstraction

Formalize

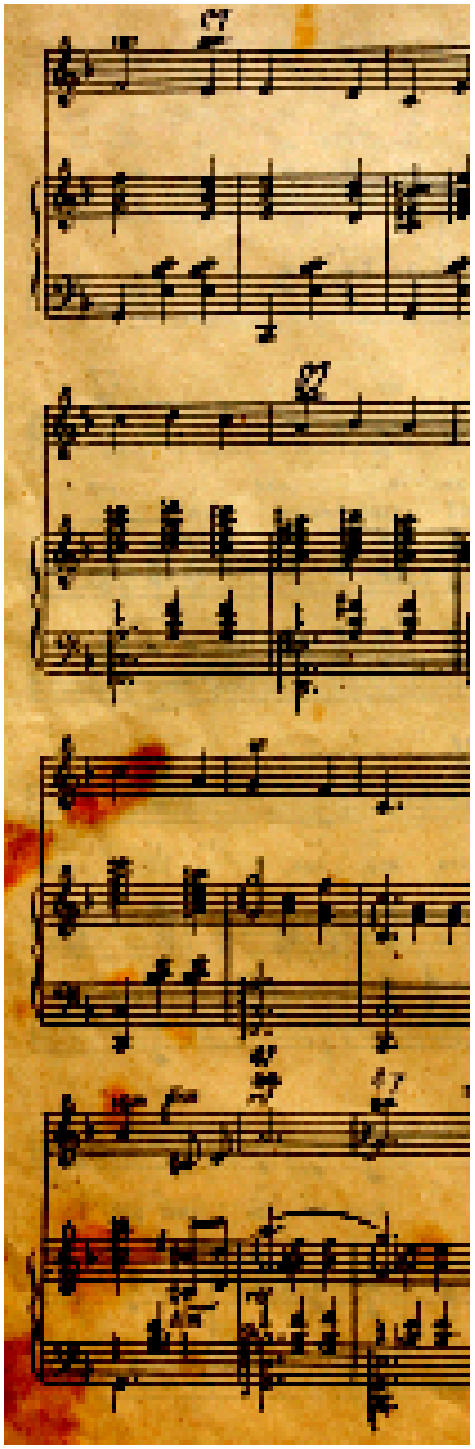
Languages
Contracts
Models
State Machines


Viewpoints
! Formalization
Configuration Files
4+1 Model
Blackbox/Whitebox
Types/Instances/Deployment

! Formalization

Notation

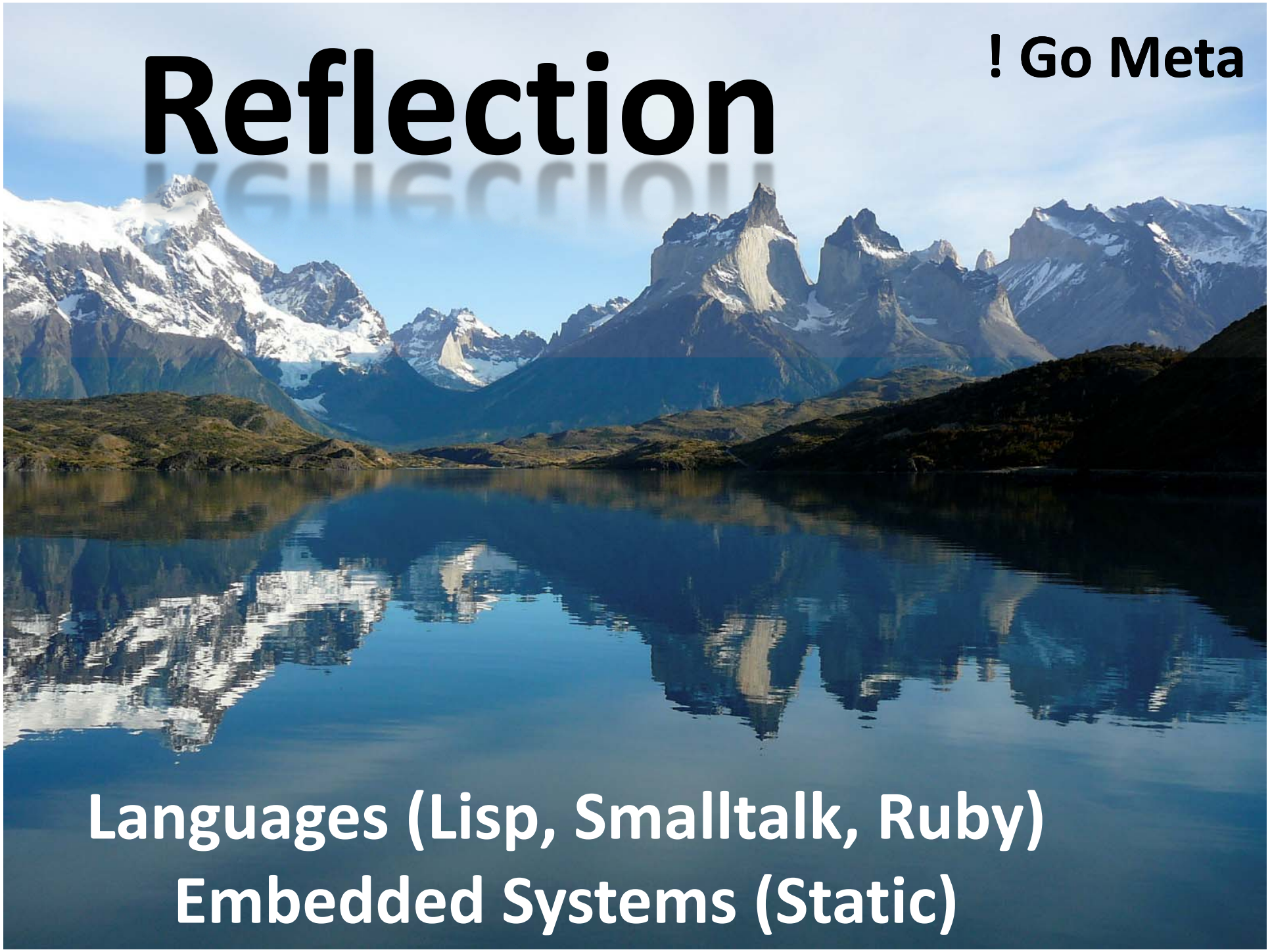
UML
Lisp
Java
Ruby



! Modularize

Go Meta

Translators, Reflection,
Meta Programming, AOP


Reflection
! Go Meta
Languages (Lisp, Smalltalk, Ruby)
Embedded Systems (Static)

! Formalization

! Go Meta

Translate

Compilers, Transformers, Generators, Macros (Lisp, Converge)

! Formalization

! Go Meta

Interpret

Business Process Engines
Data Driven Systems
(Dynamic) Languages

Tracking

Impurity in Haskell: io(…)
Tainting (Static Analysis)
Session State
ACT Pattern

Automate

Build, Test, Translate

! Formalization

5

Dos and Don‘ts

! Formalization

Protocols

Transctions
Locking/Synchronization
Resource Access


⊗ Make Explicit
DOC Middleware
Orthogonal Persistence
(OR Mappers)
Make
Transparent

⊗ **Make Transparent**

Make Explicit

Dependencies

SOA, Messaging

Functional Programming

PLE Variabilities

Persistence: Loading Data

Software Architecture
DSL: expressiveness
MDSD: skeletons
Scade/SystemC

Limit Freedom

! Formalization

! Go Meta

Declaration

Implementation

App Servers (EJB), Plugin RT (Eclipse)
Models, Transaactional Memory

Test semantics, not syntax (code gen)
Higher Order Functions (map, foreach)
Transactional Memory

Don't Overspecify

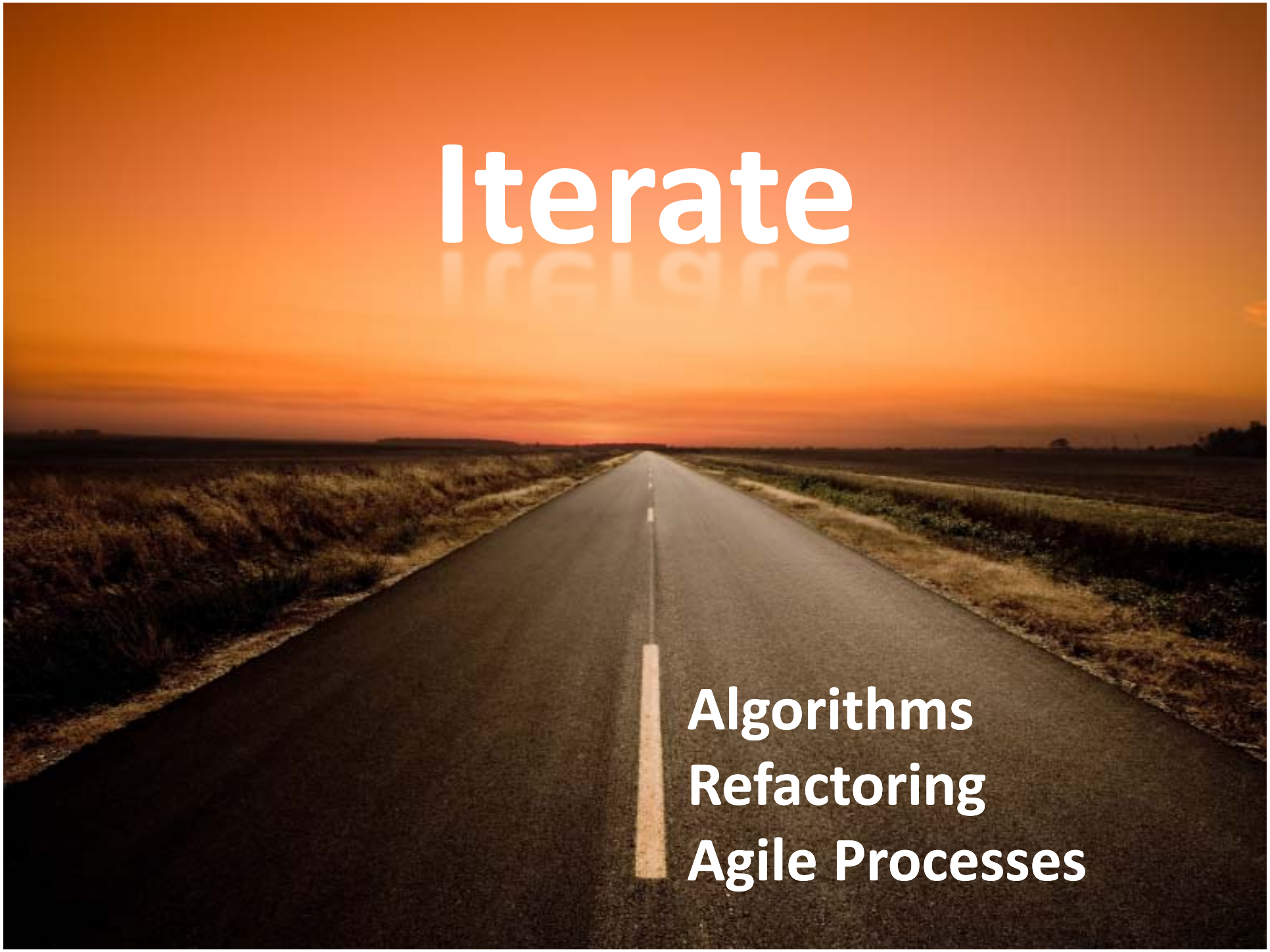
- Limit Freedom

Avoid Sideeffects

Functional Programming
Concurrency (Sharing)
Distribution

6

Process


Iterate
Algorithms
Refactoring
Agile Processes

Capture Best Practices

Patterns, DSLs, Models, Translators

More I

Ownership vs. Reference

Build Languages

Cohesion and Coupling (do one thing right, composability)

Indirection (polymorphism, mem references for compaction, naming service)

Prevention vs. Compensation

More II

Build Platforms
Versioning
Pessimistic/Optimistic/Compensating
Localize (Sync in MP, UML-M2M)
Container (AppServer)
Lazy/On-demand, Eager
Self Modification (Meta Prog, MOPs,
  Embedded Optimization
Measure: metrics, performance tuning, scalability,
  test coverage

What do you think?
More Fundamentals?
More Examples?

Please let me know!

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THE END.