Lessons Learned from Engineering Emergence Research

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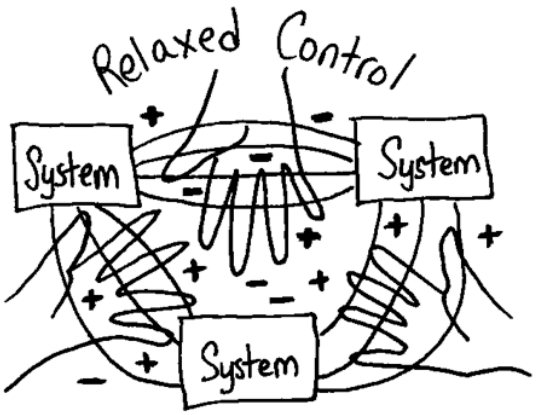
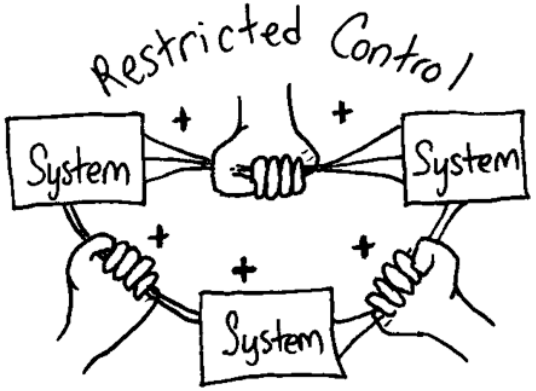
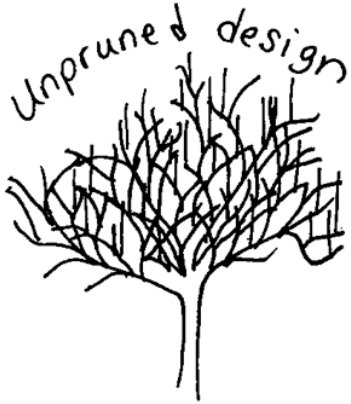
INCOSE SoS Research Roundtable

January 21, 2018

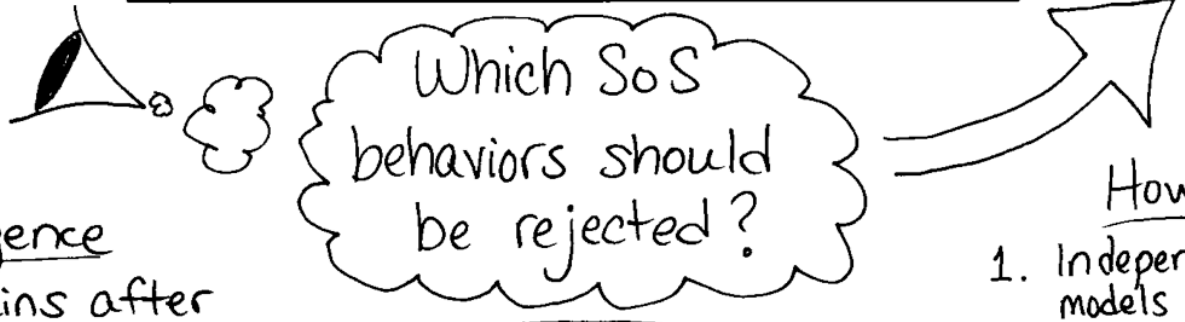


...before...





Lesson 1:
Relax control over system interactions *before* restricting control.



Positive emergence is what remains after thoroughly exposing and removing negative emergence.

Next:
How to integrate this approach into requirements analysis process?

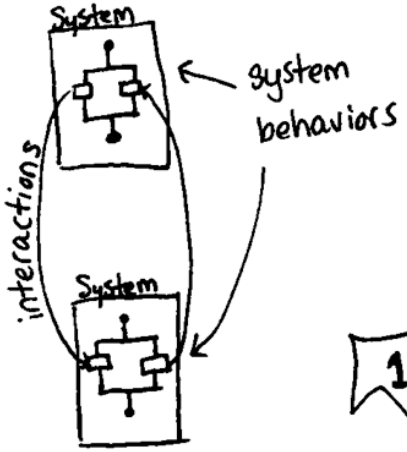
How?

1. Independent system models with alternative behaviors
2. Fewer initial constraints
3. Scope-complete scenario generation (MP)

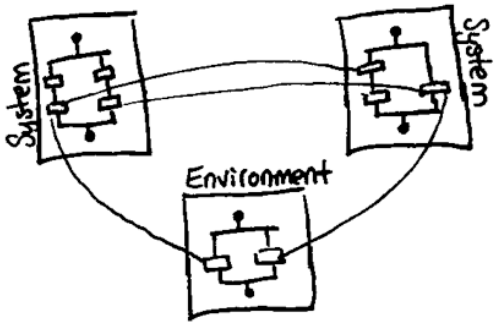
Lesson 2: Employ these modeling concepts.

1

Separate system behaviors and interactions



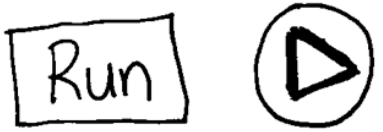
2



Model system behaviors and environment behaviors

3

Formalize models for automatic execution



MBSE

4

Properly allocate tasks to a

Human

error prone

lived experience
imagination
creativity

(brain)

- inspection
- evaluation
- pattern detection

or Machine

can't do what it's not programmed to do

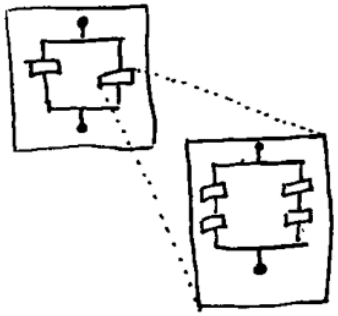
- computation
- automation
- generation
- view projection

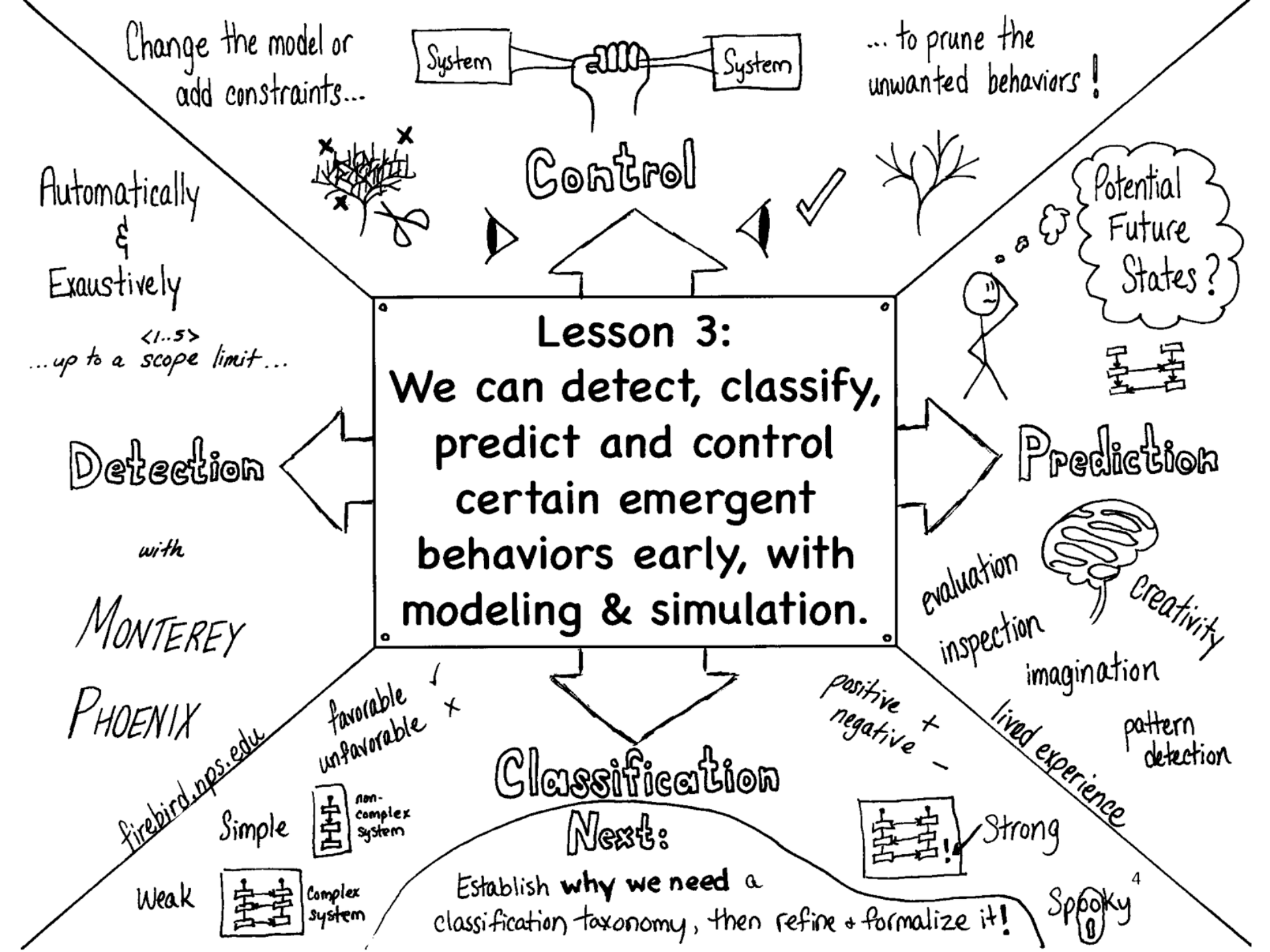
Searches on large data sets

Next:
Automate more of these functions

5

Use abstraction and refinement to manage large models.




Change the model or add constraints...
System
System
... to prune the unwanted behaviors!
Control
Automatically & Exaustively
<1..5>
...up to a scope limit...
Potential Future States?
Lesson 3:
We can detect, classify, predict and control certain emergent behaviors early, with modeling & simulation.
Detection
with
MONTEREY
PHOENIX
firebird.nps.edu
Prediction
evaluation
inspection
creativity
imagination
pattern detection
lived experience
favorable
unfavorable
+
positive
negative
+
−
Classification
Next:
Establish why we need a classification taxonomy, then refine & formalize it!
Simple
non-complex system
Weak
complex system
Strong
Spooky

Questions and Discussion

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