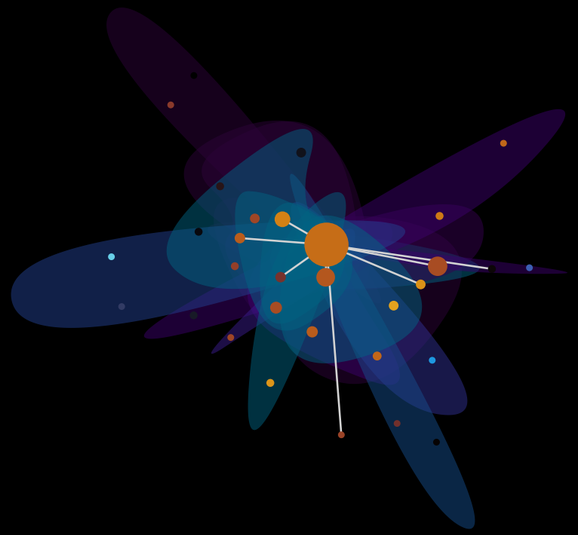

Toward a Computational Theory of Legal Complexity

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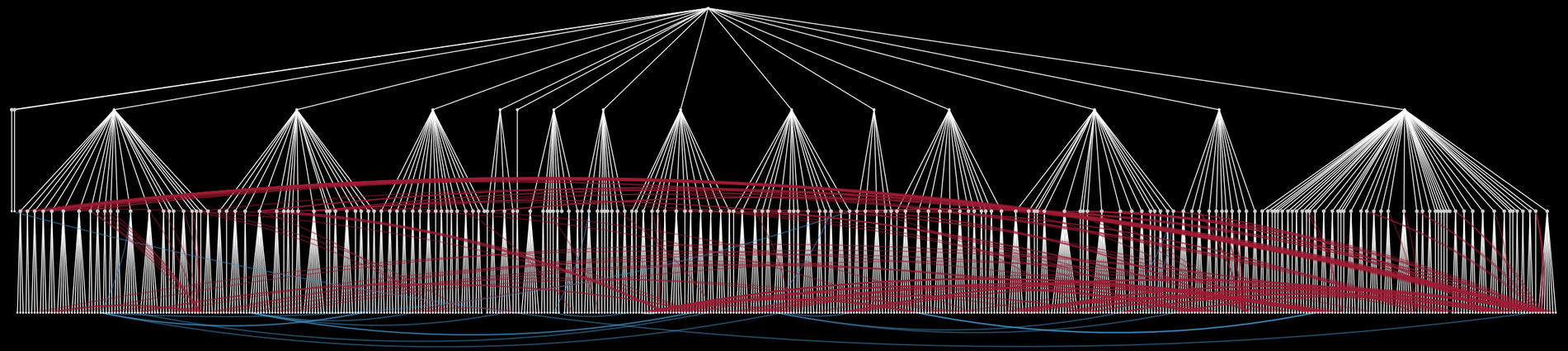

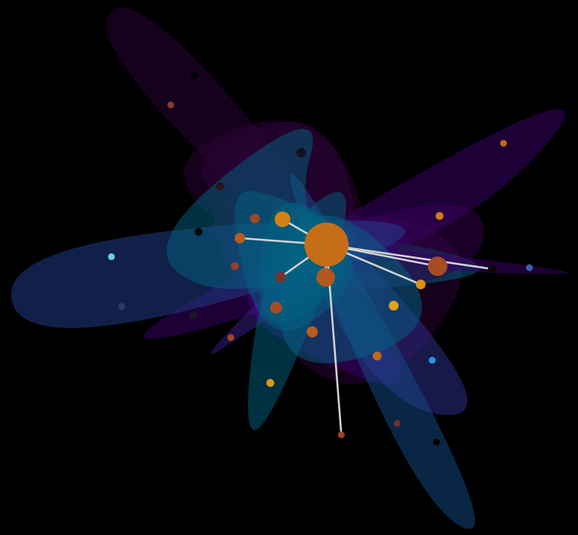

Toward a Computational Theory of Legal ~~Complexity~~

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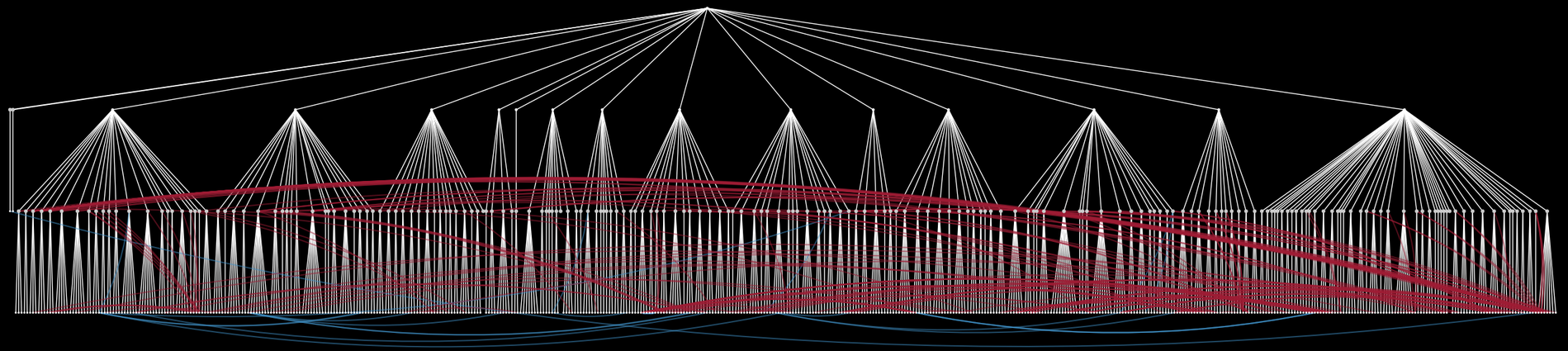
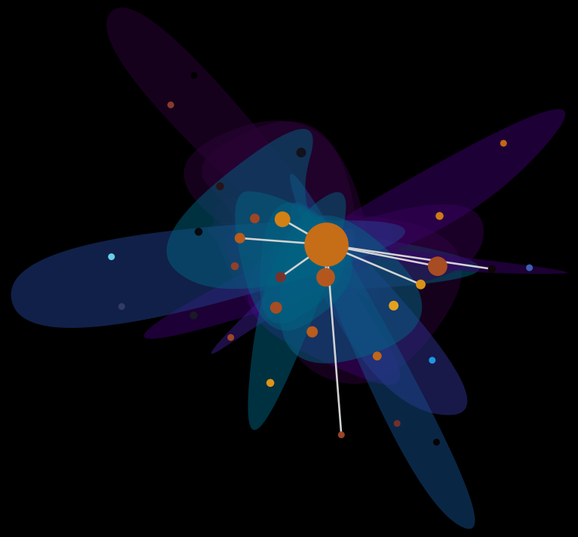
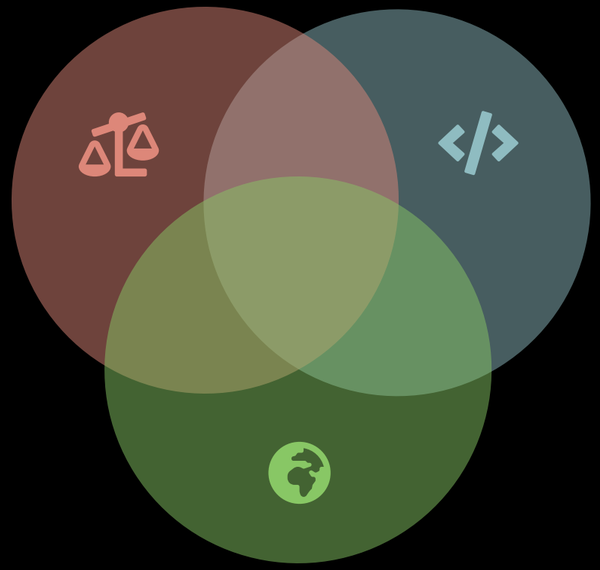
Legal Systems as Complex Systems







Toward a Computational Theory of Legal Complexity

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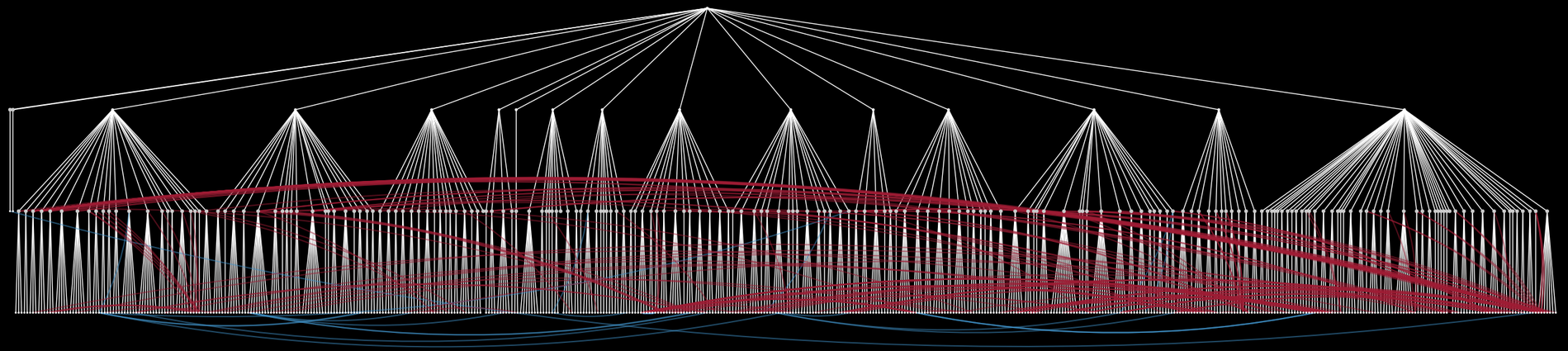
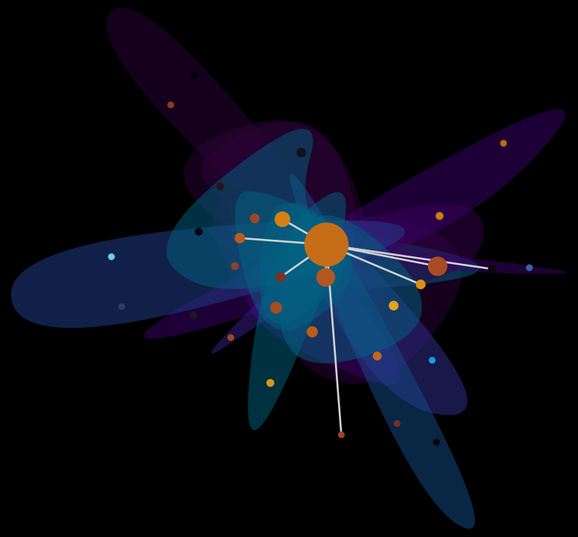
Legal Systems as Complex Systems





A!

Toward a Computational Theory of Legal Complexity

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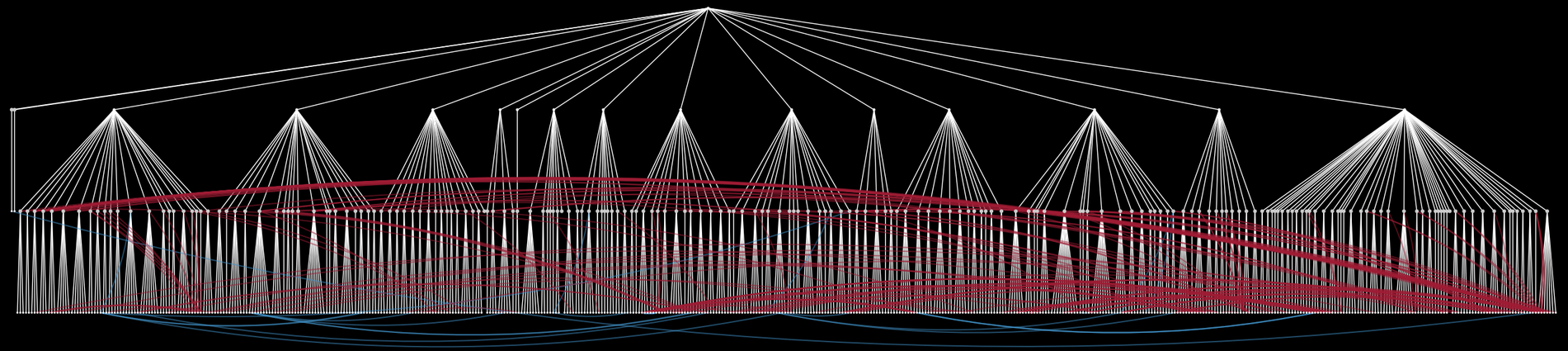
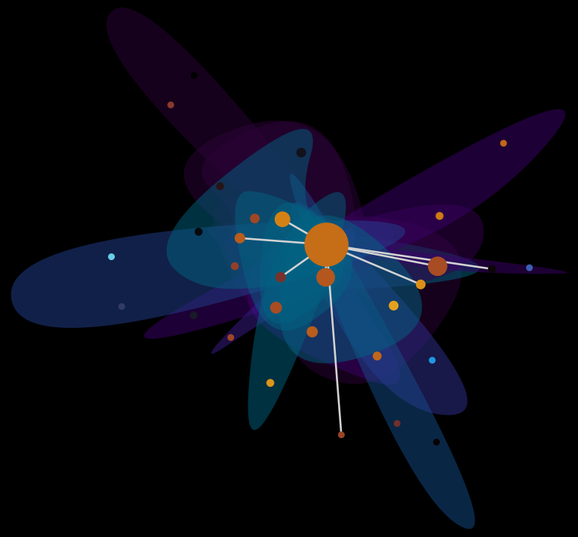
Legal Systems as Complex Systems





A!

Big Picture: Background + Vision

Toward a Computational Theory of Legal ~~Complexity~~

Legal Systems as Complex Systems

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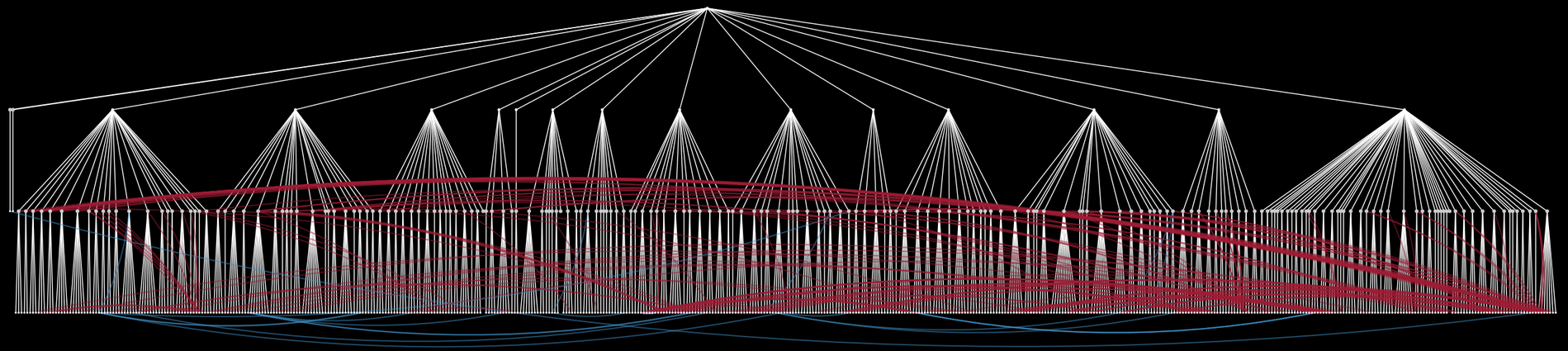

What do we mean by *Legal Systems*?

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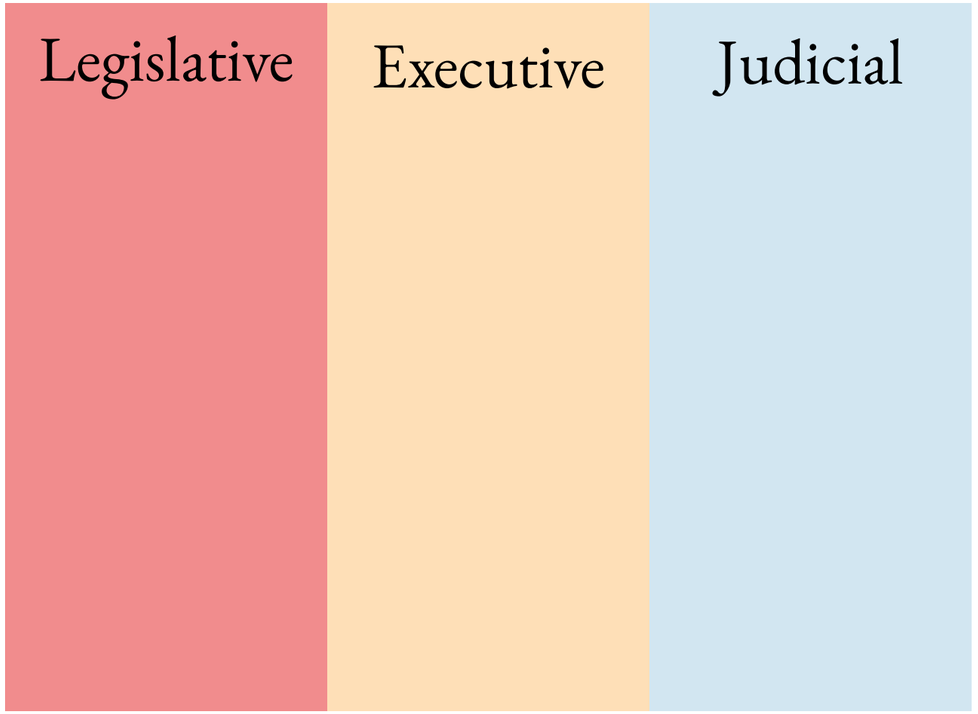

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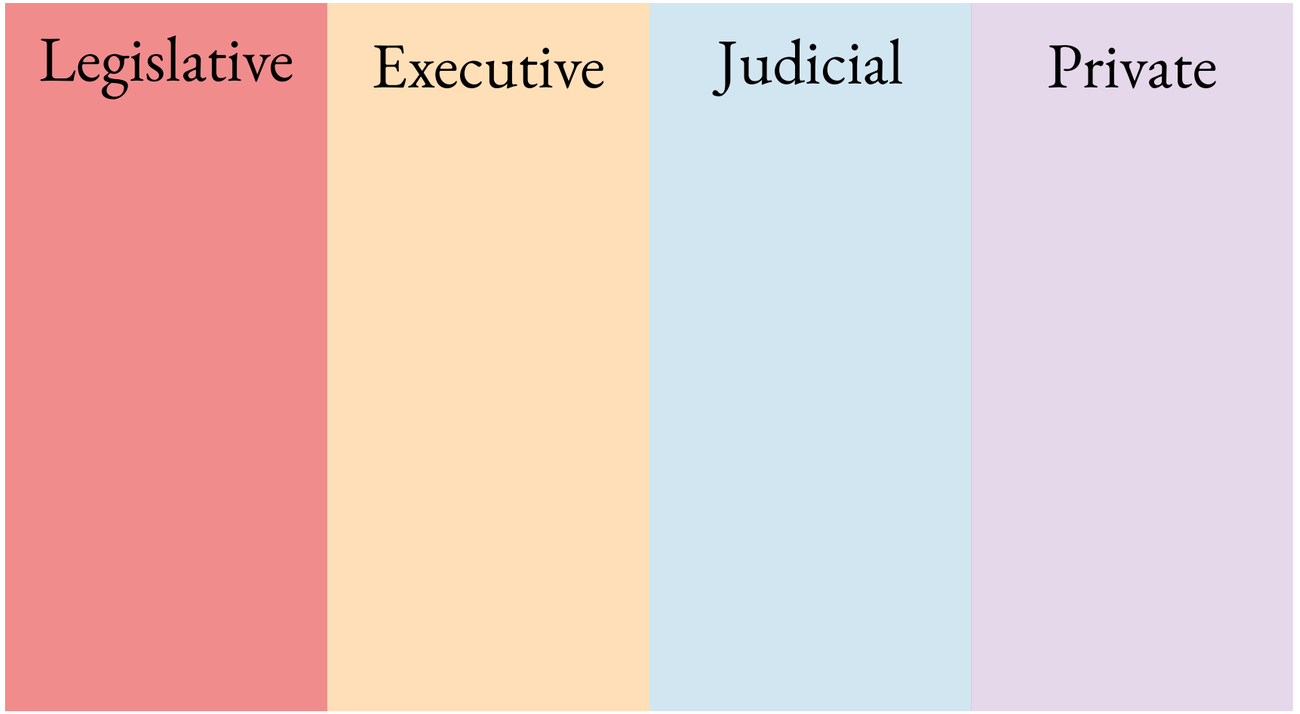

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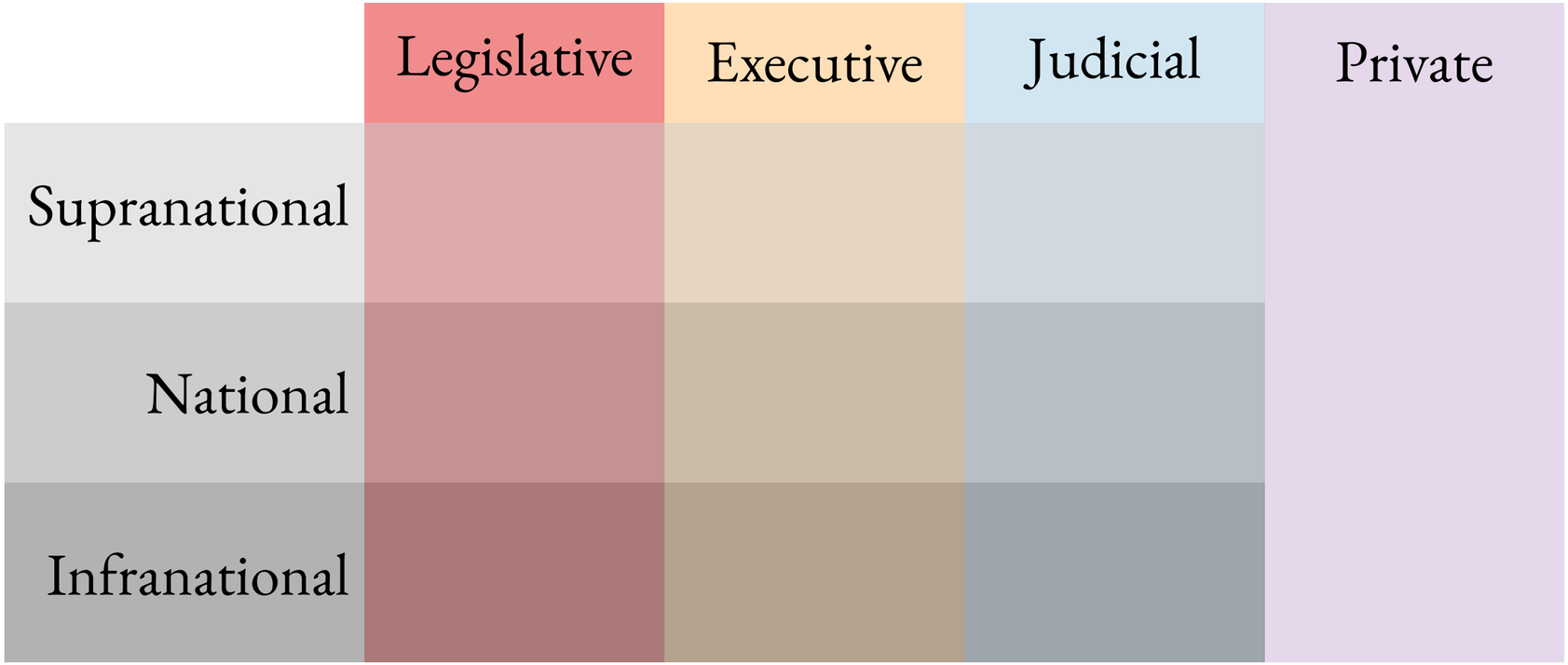

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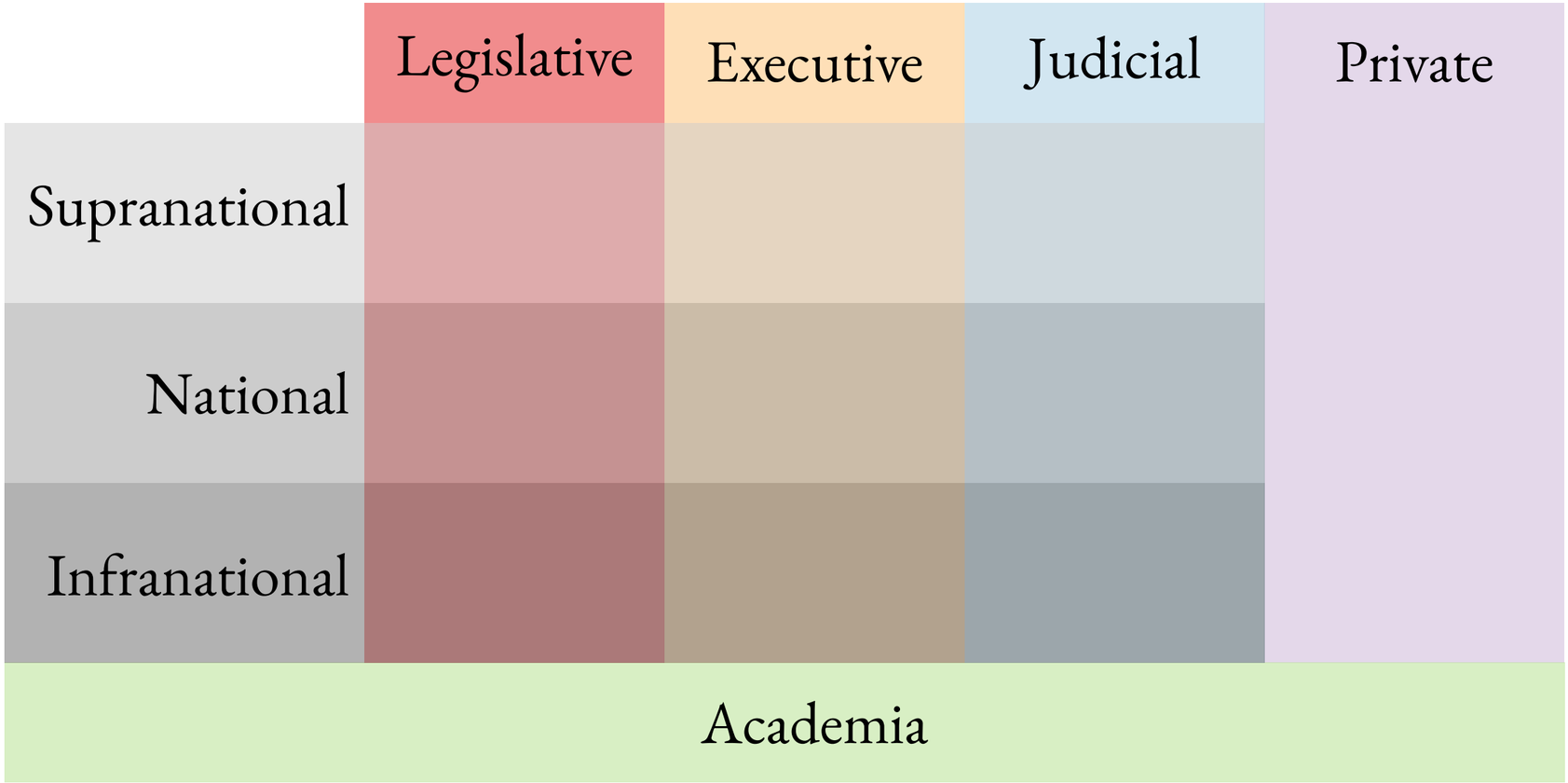

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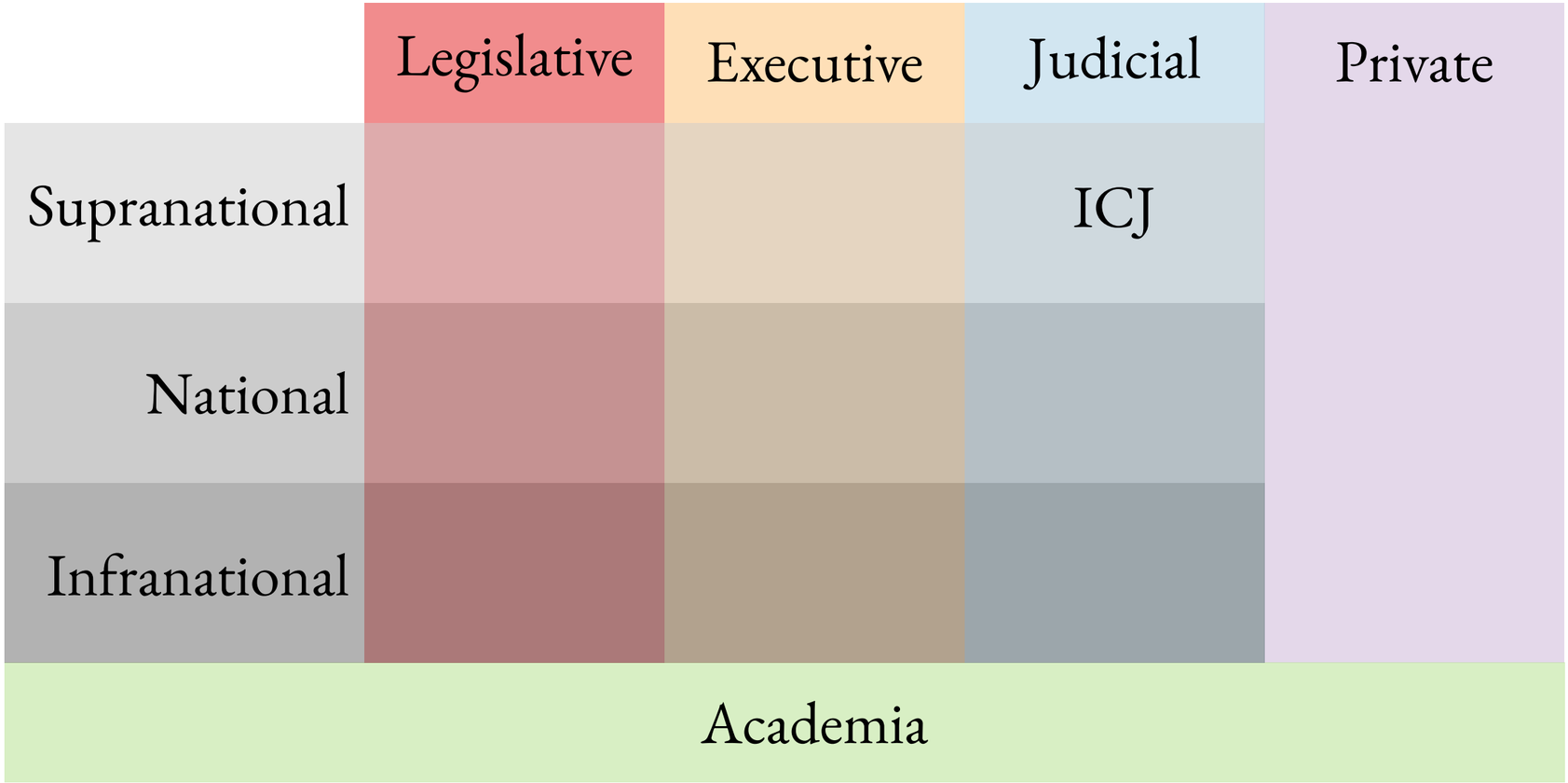

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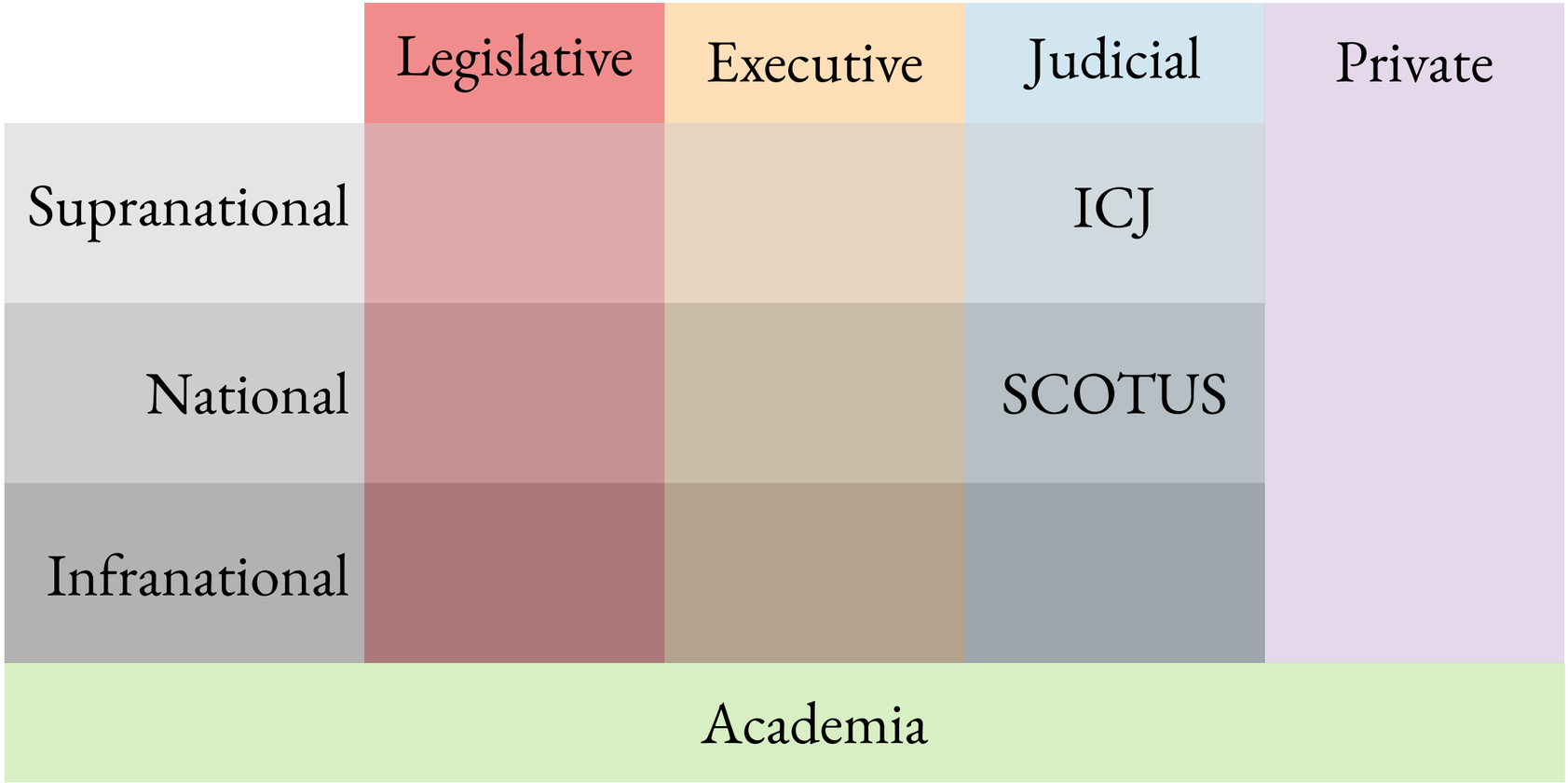

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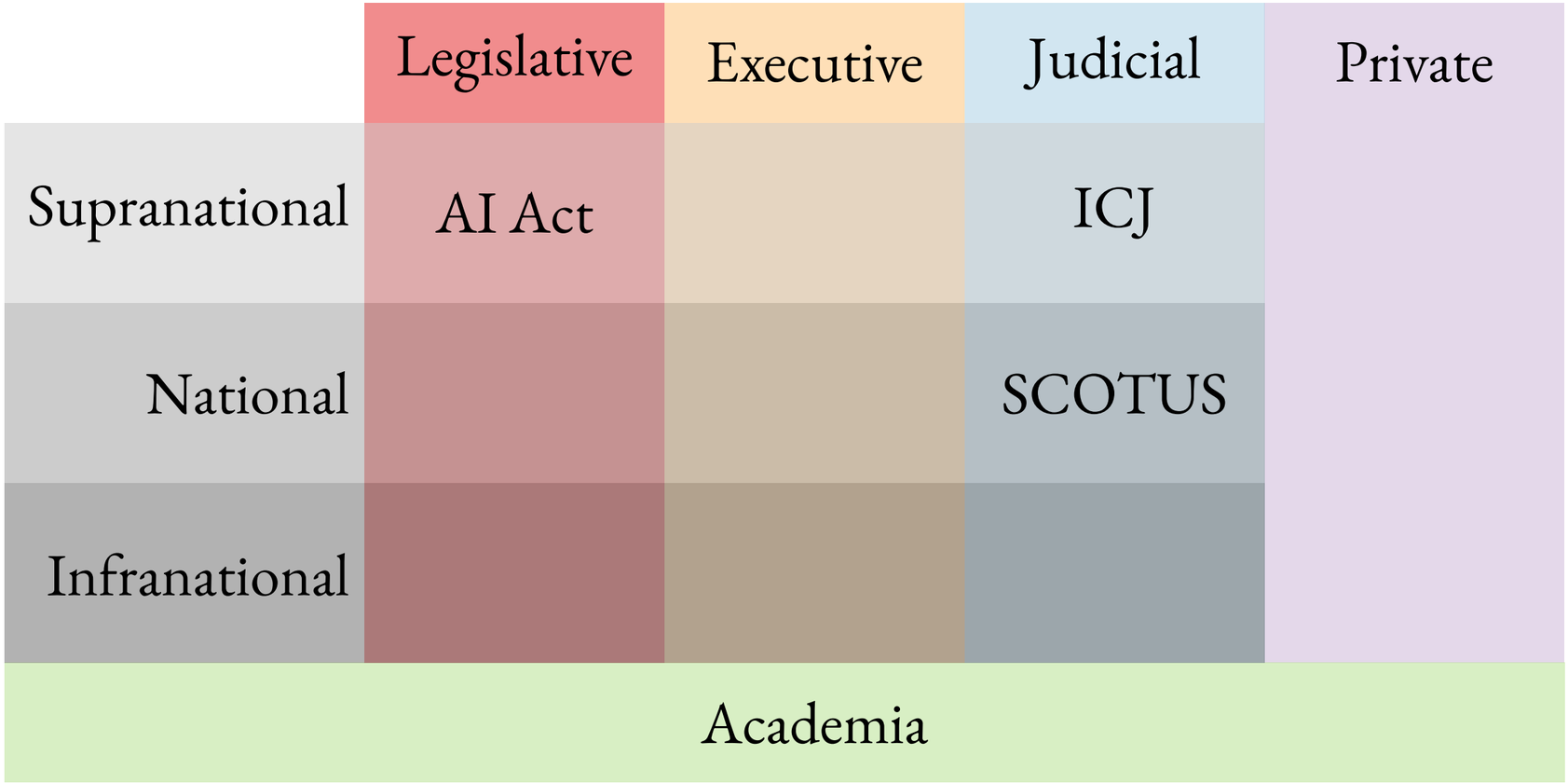

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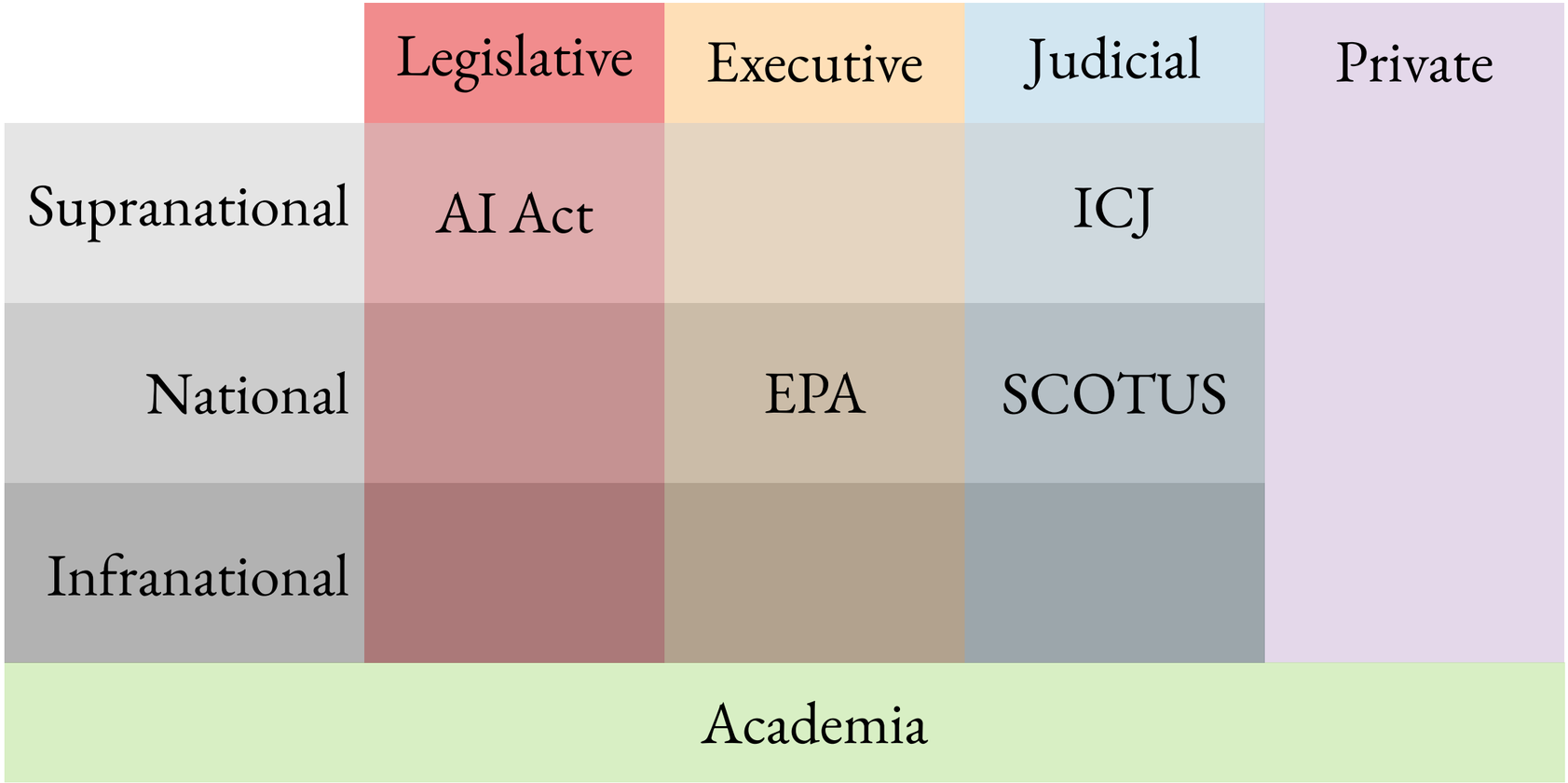

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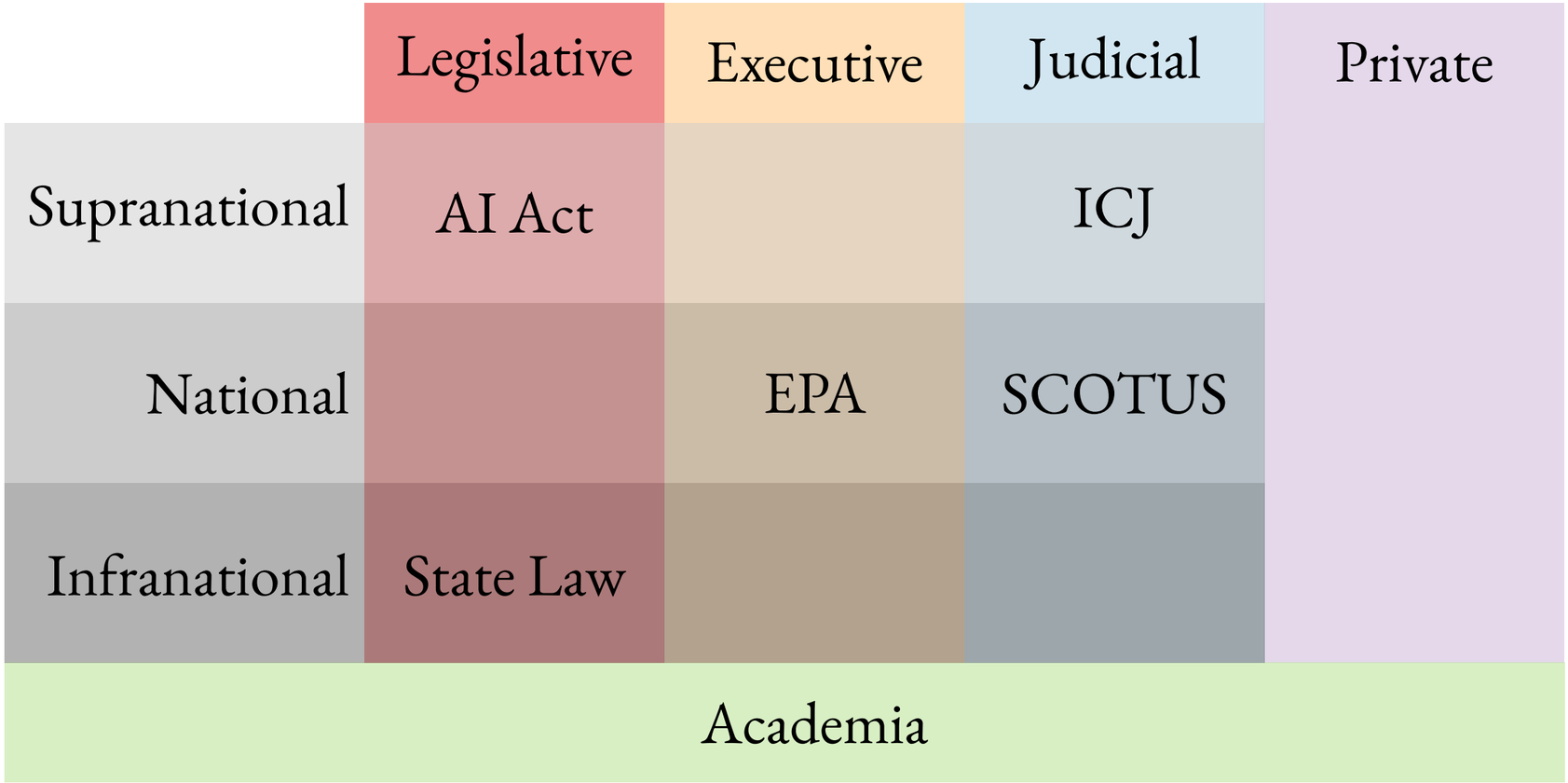

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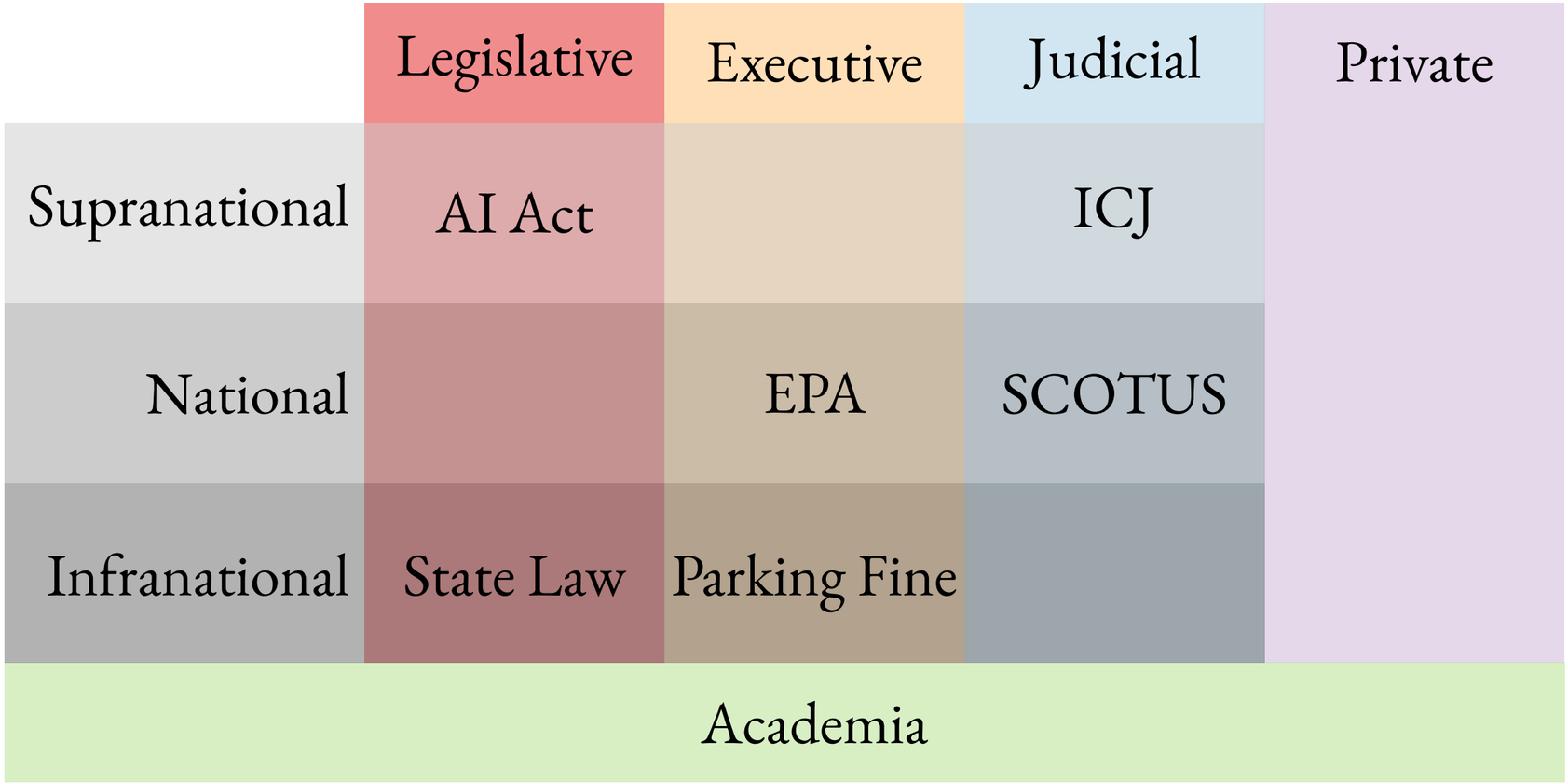

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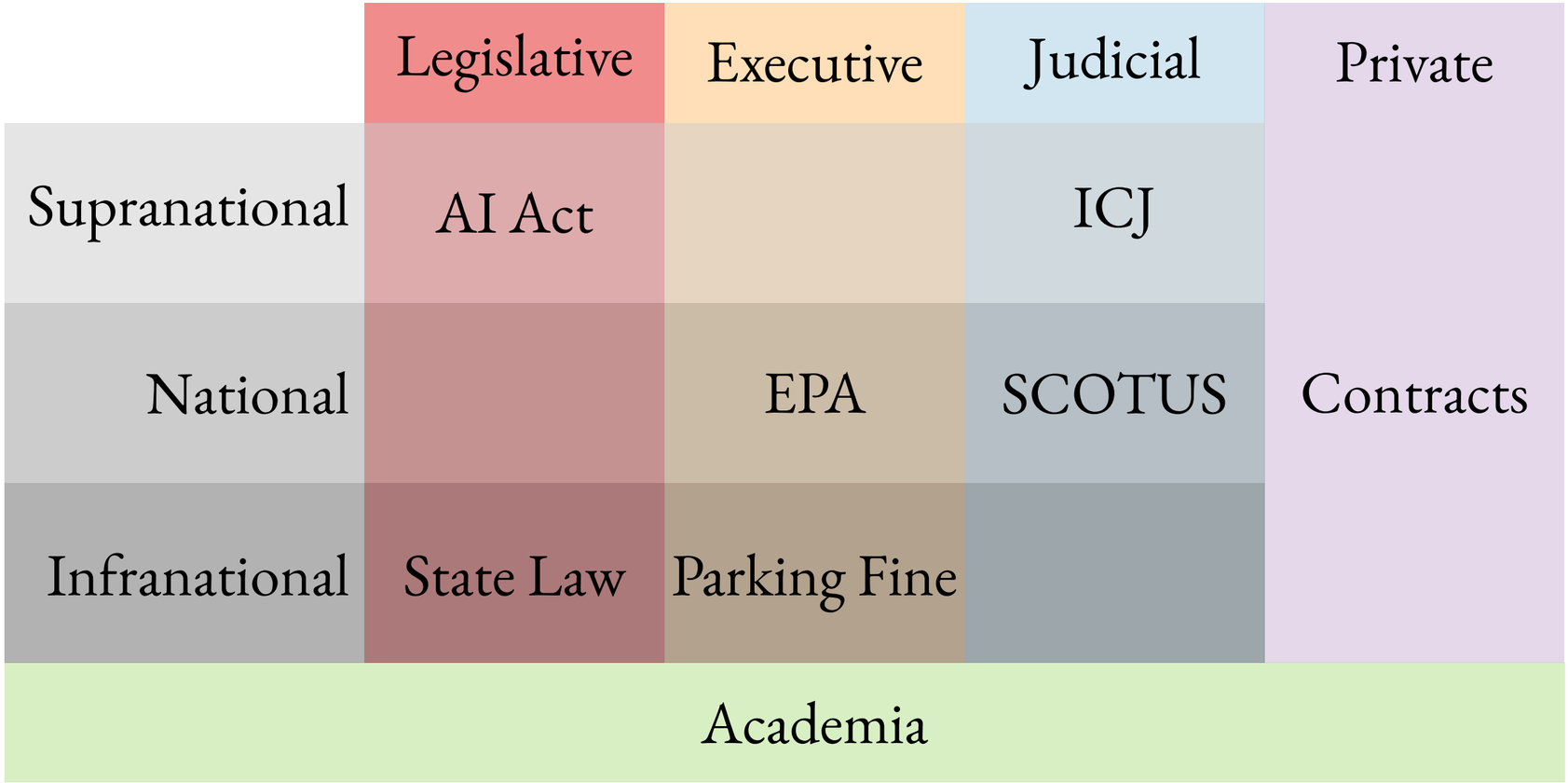

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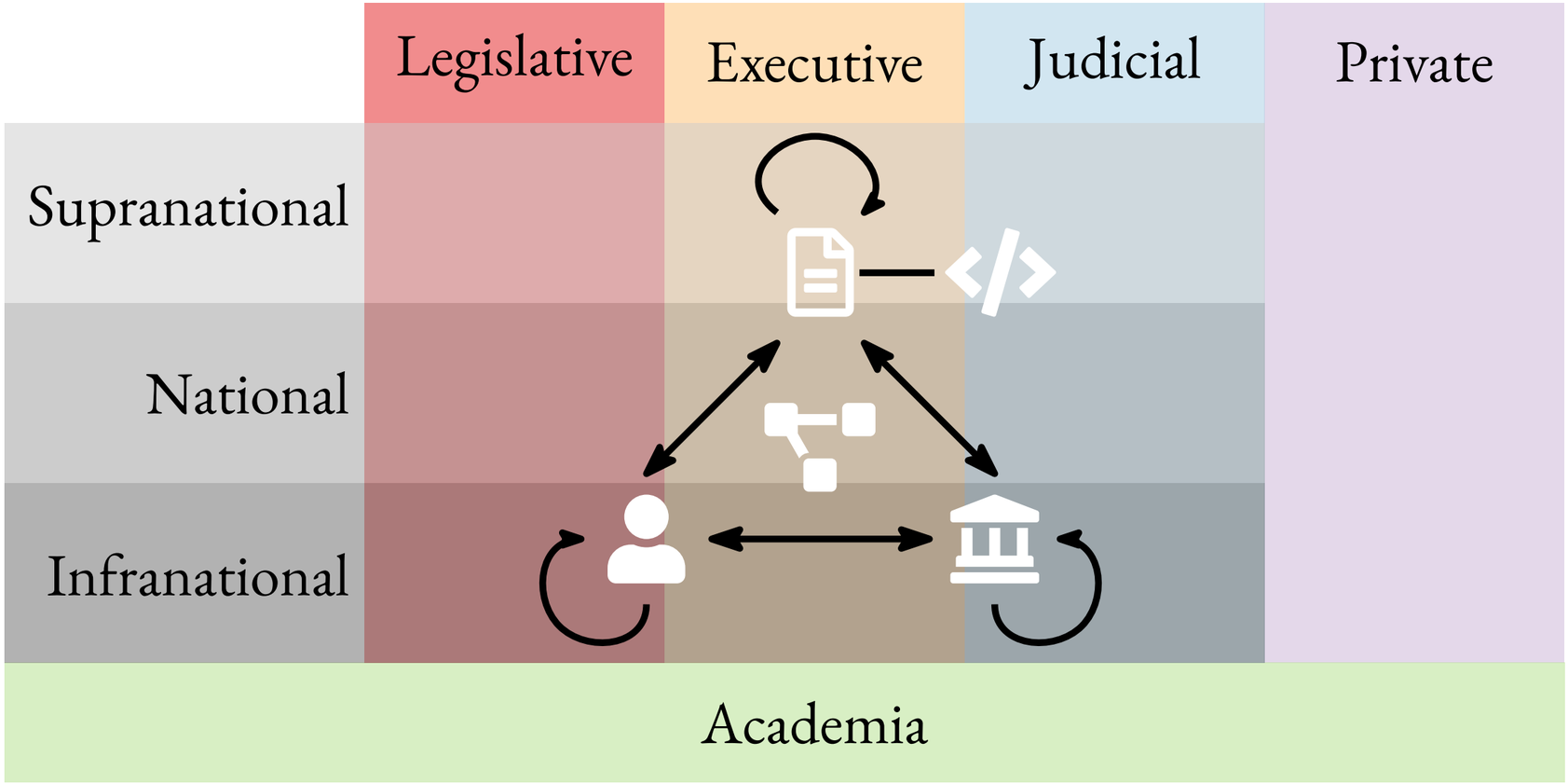

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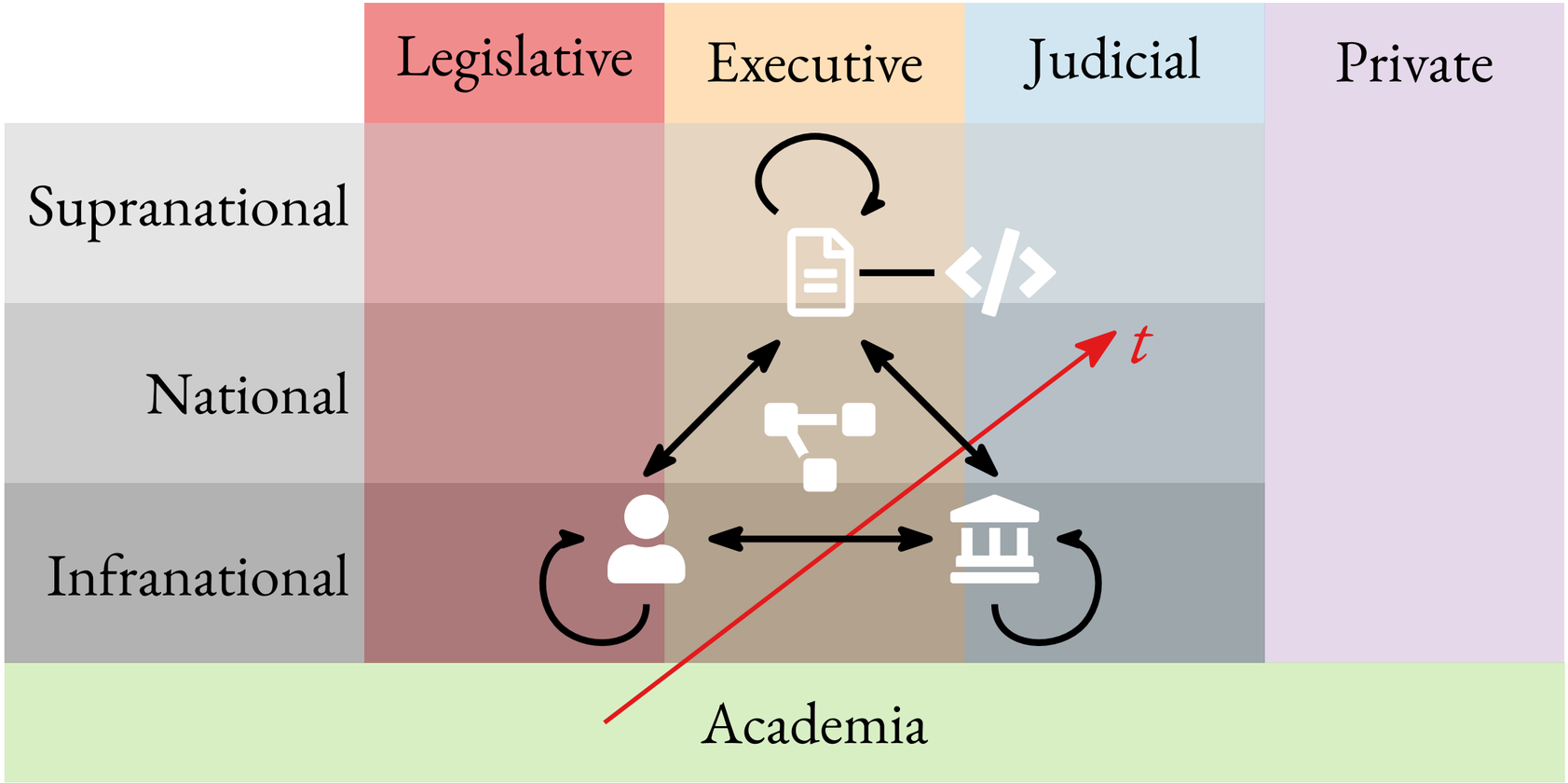

What do we mean by *Complex Systems*?

What do we mean by *Complex Systems*?

Systems that exhibit *complexity*.

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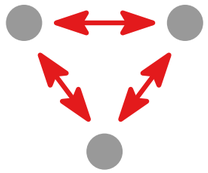
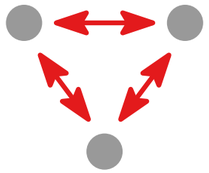


Interactions

What do we mean by *Complex Systems*?

Systems that exhibit *complexity*, i.e., that are characterized by. . .



Interactions

✓(Rules)

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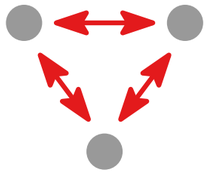
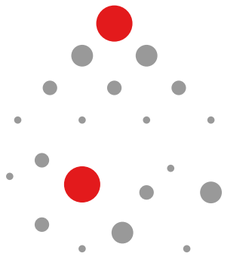


Interactions

✓(Rules)



Emergence

What do we mean by *Complex Systems*?

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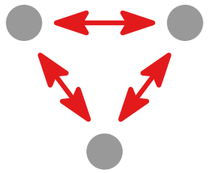
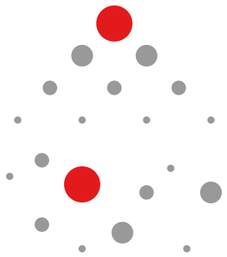


Interactions

✓(Rules)



Emergence

✓(Concepts)

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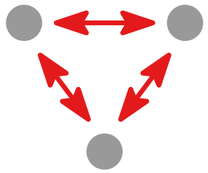
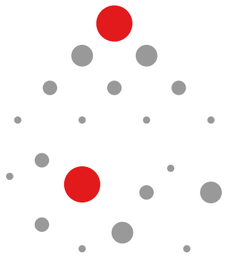


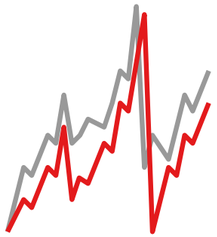
Interactions

✓(Rules)



Emergence

✓(Concepts)



Dynamics

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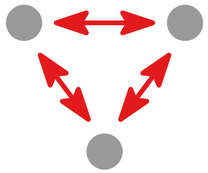
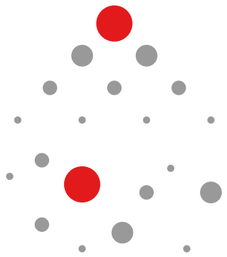


Interactions

✓(Rules)



Emergence

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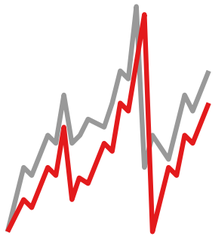

Dynamics

✓(Change)

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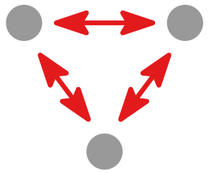
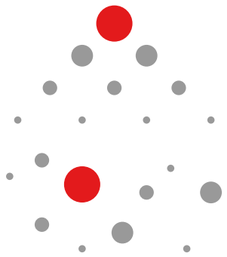


Interactions

✓(Rules)

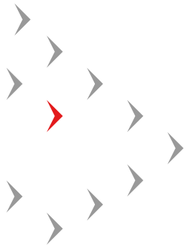


Emergence

✓(Concepts)

Dynamics

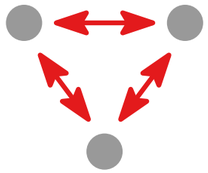
✓(Change)



Self-Organization

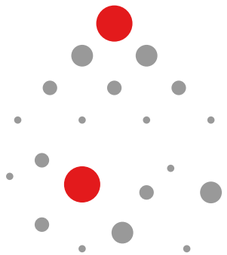
What do we mean by *Complex Systems*?

Systems that exhibit *complexity*, i.e., that are characterized by. . .



Interactions

✓(Rules)

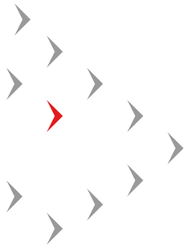


Emergence

✓(Concepts)

Dynamics

✓(Change)



Self-Organization

✓(Justice)

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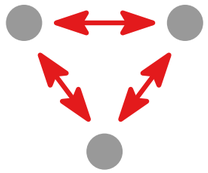
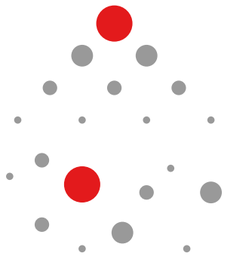


Interactions

✓(Rules)

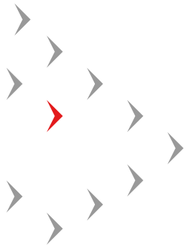


Emergence

✓(Concepts)

Dynamics

✓(Change)



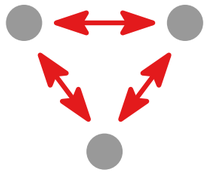
Self-Organization

✓(Justice)

Adaptation

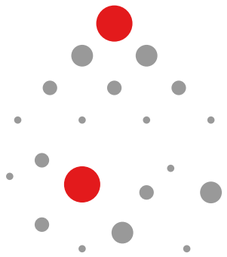
What do we mean by *Complex Systems*?

Systems that exhibit *complexity*, i.e., that are characterized by. . .



Interactions

✓(Rules)

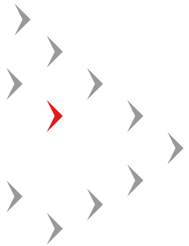


Emergence

✓(Concepts)

Dynamics

✓(Change)



Self-Organization

✓(Justice)

Adaptation

✓(Incentives)

What do we mean by *Complex Systems*?

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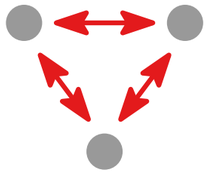

Interactions

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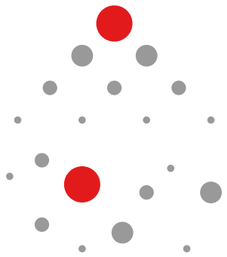

Emergence

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Dynamics

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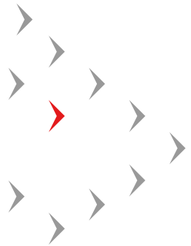

Self-Organization

✓(Justice)

Adaptation

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Legal systems not only *regulate* complex systems, they also *are* complex systems.

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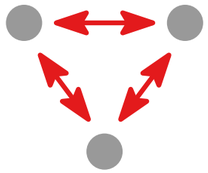
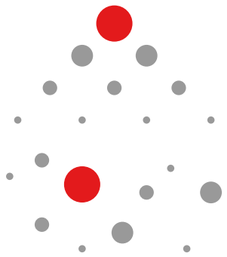


Interactions

✓(Rules)

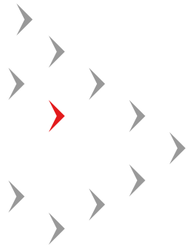


Emergence

✓(Concepts)

Dynamics

✓(Change)



Self-Organization

✓(Justice)

Adaptation

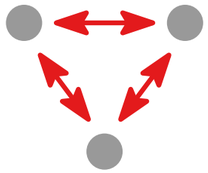
✓(Incentives)

Legal systems not only *regulate* complex systems, they also *are* complex systems.

How can we build a *computational theory* of these systems?

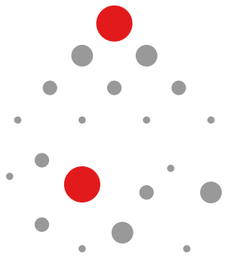
What do we mean by *Complex Systems*?

Systems that exhibit *complexity*, i.e., that are characterized by. . .



Interactions

✓(Rules)



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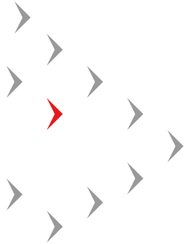

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What do we even *mean* by *computational theory*?

What do we mean by *Computational Theory*?

What do we mean by *Computational Theory*?

Types of Theory

What do we mean by *Computational Theory*?

Types of Theory

Focus	What *Is* (Reality)
Nature	Descriptive
Fields*	Qual. Social Science Humanities

What do we mean by *Computational Theory*?

Types of Theory

Focus	What *Is* (Reality)	*Why* Is It
Nature	Descriptive	Explanatory
Fields*	Qual. Social Science Humanities	Quant. Social Science Natural Sciences

What do we mean by *Computational Theory*?

Types of Theory

Focus	What *Is* (Reality)	*Why* Is It	What *Will Be*
Nature	Descriptive	Explanatory	Predictive
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What do we mean by *Computational Theory*?

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Types of *Computational* Theory

What do we mean by *Computational Theory*?

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Types of *Computational* Theory

Modeling the *object* as computational

Using computational *methods*

What do we mean by *Computational Theory*?

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Types of *Computational* Theory

Ontologically computational — Modeling the *object* as computational

Methodologically computational — Using computational *methods*

What do we mean by *Computational Theory*?

Types of Theory

Focus	What *Is* (Abstraction)	What *Is* (Reality)	*Why* Is It	What *Will Be*	What *Ought to Be*
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Types of *Computational* Theory

Our Focus

Ontologically **computational** Modeling the *object* as computational — Foundations first

Methodologically **computational** Using computational *methods* — Realize synergies

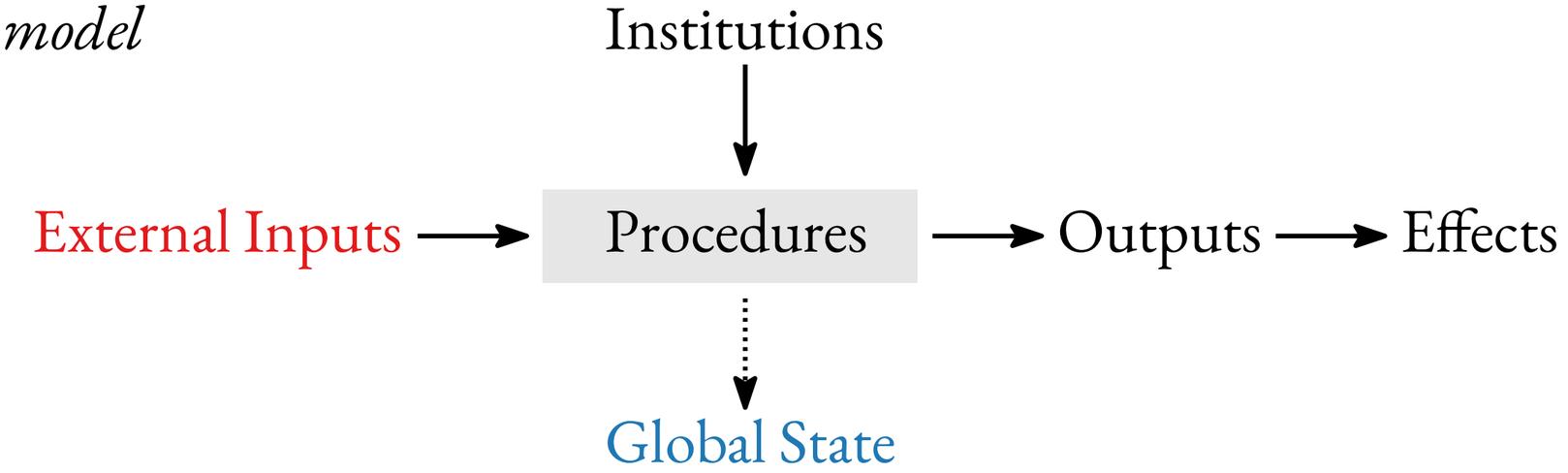
Ontologically Computational *Formal* Legal Theory

Focus: Model and analyze legal systems as *information-processing systems*

Ontologically Computational *Formal* Legal Theory

Focus: Model and analyze legal systems as *information-processing systems*

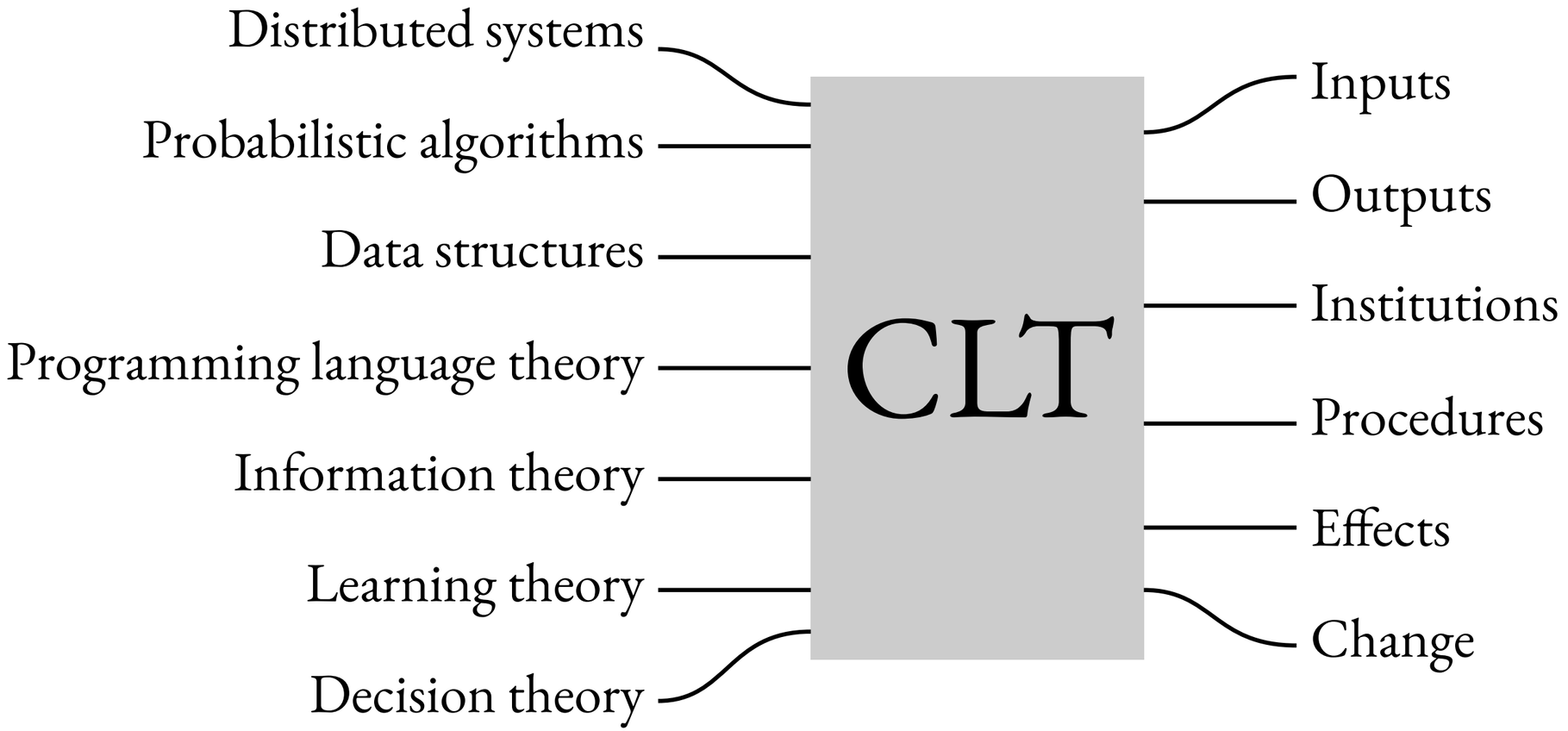
Naïve computational model



Ontologically Computational *Formal* Legal Theory

Focus: Model and analyze legal systems as *information-processing systems*

Main inspiration: Theoretical computer science



Methodologically Computational *Descriptive* Legal Theory

Focus: Model and analyze legal systems as *complex systems*

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Methodologically Computational *Descriptive* Legal Theory

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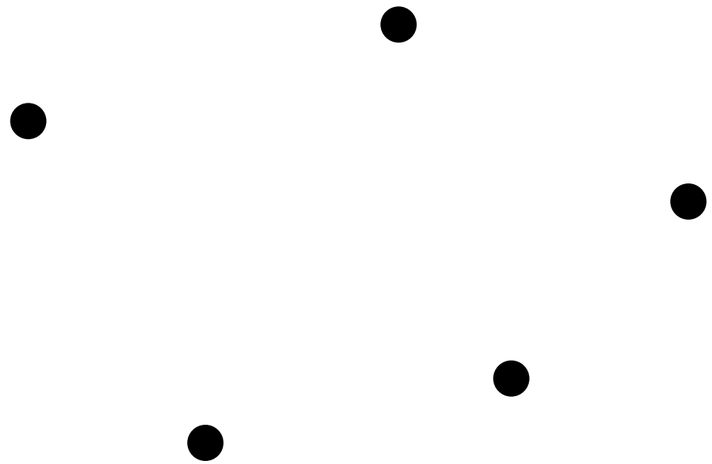
- Nodes V



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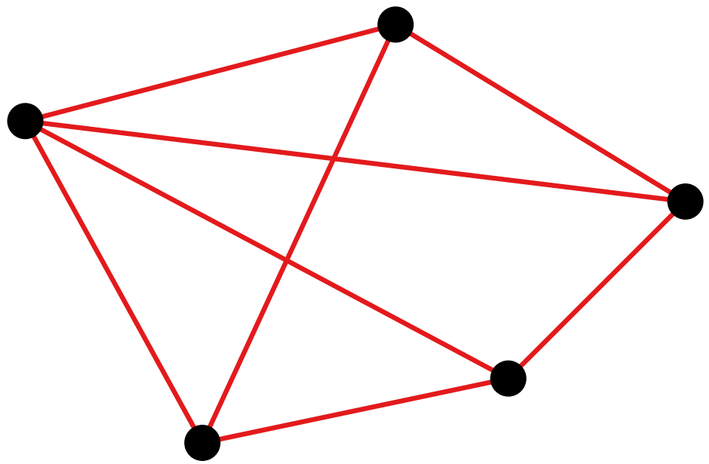

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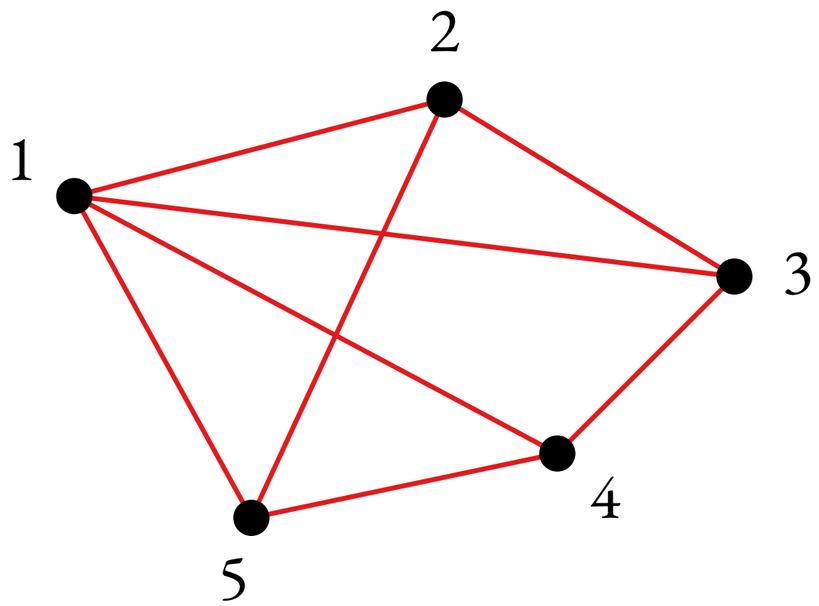

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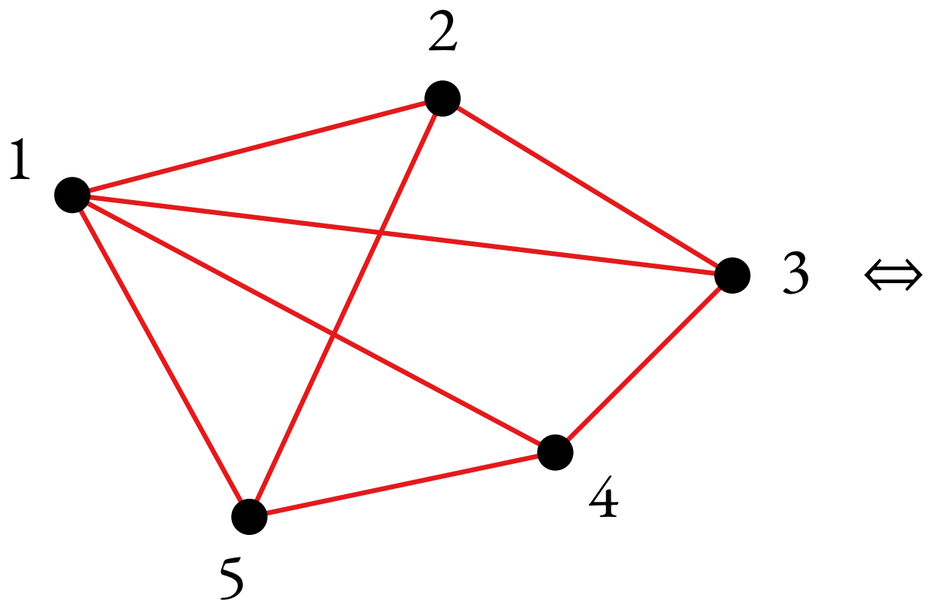
Graph G



$\Leftrightarrow$

Adjacency Matrix A

$$\begin{bmatrix} 0 & 1 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 \end{bmatrix}$$

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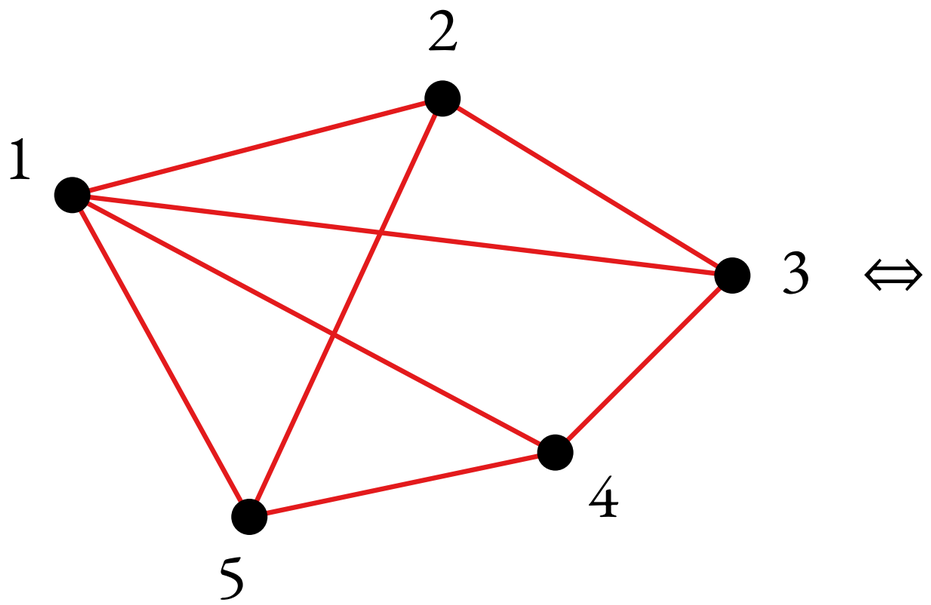

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Great for computation!

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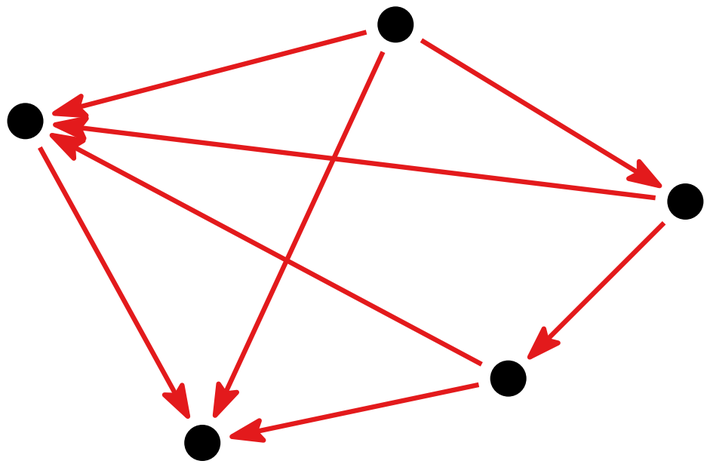
Directed Graph



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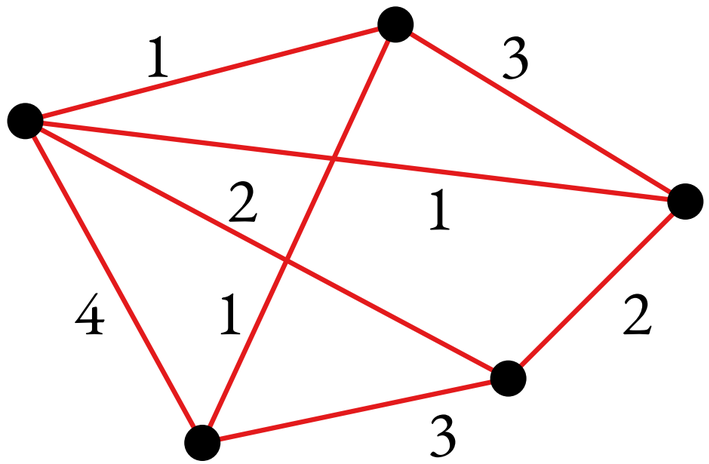
Weighted Graph



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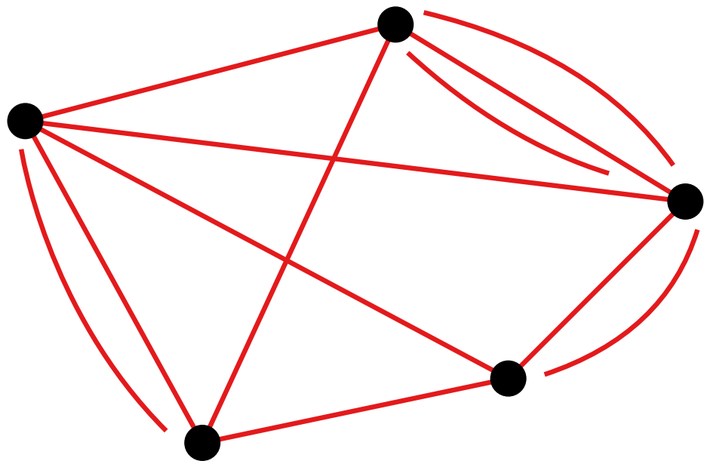
Multigraph



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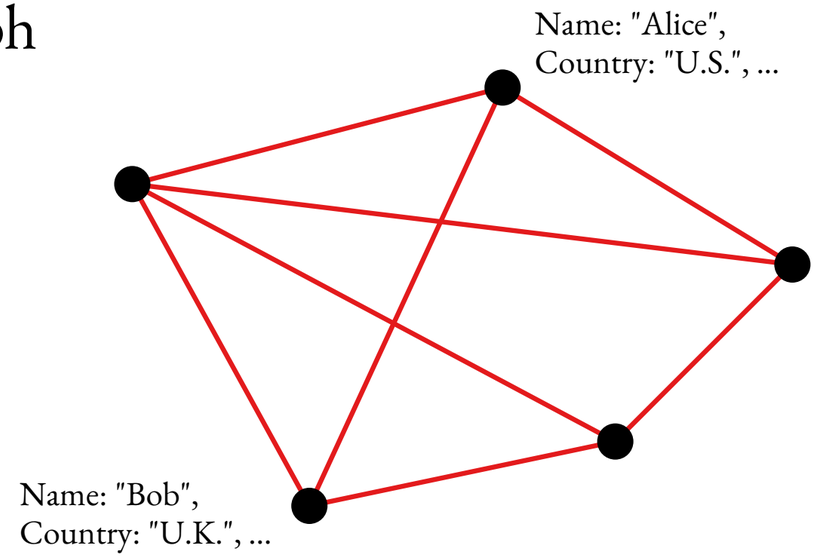
Attributed Graph



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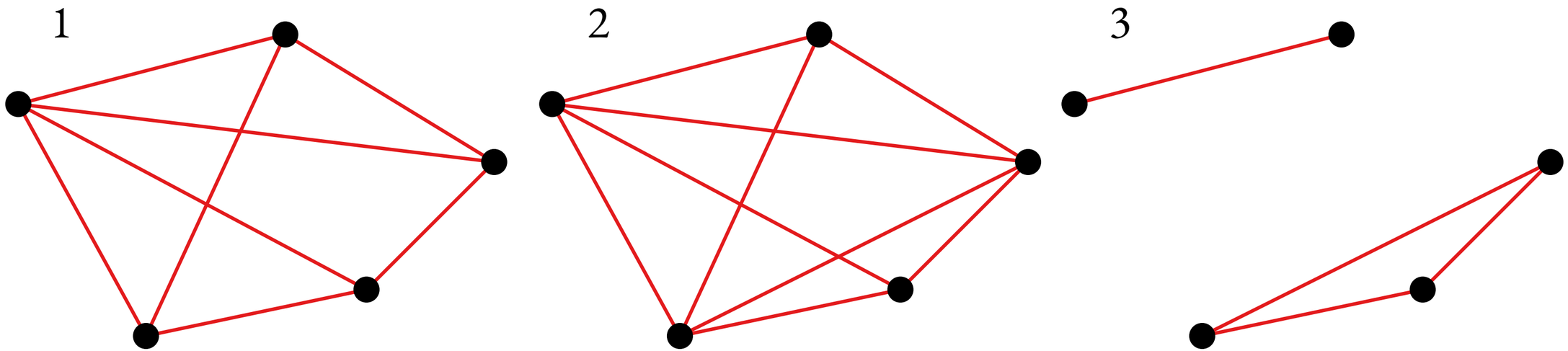
Temporal Graph



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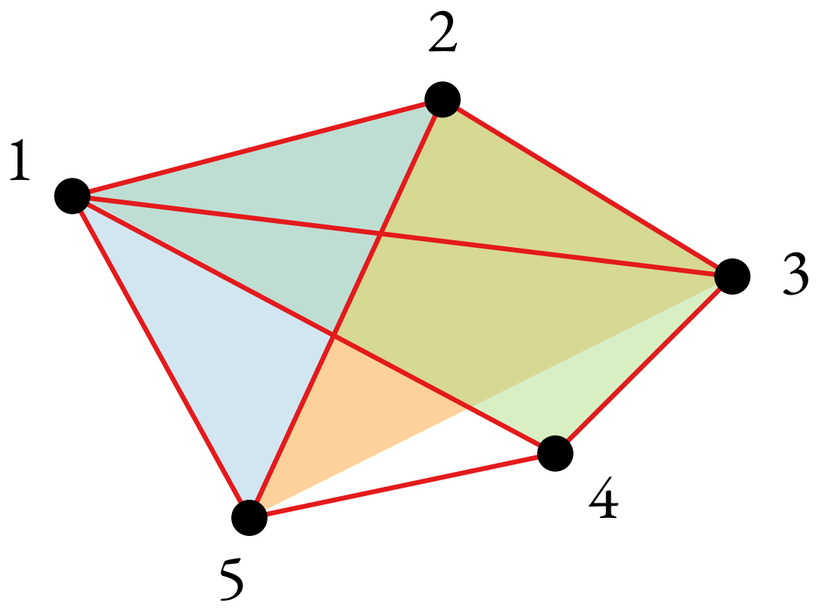
Hypergraph



$h_1 = \{1, 2, 5\}$

$h_2 = \{1, 3, 4, 5\}$

$h_3 = \{1, 3, 5\}$

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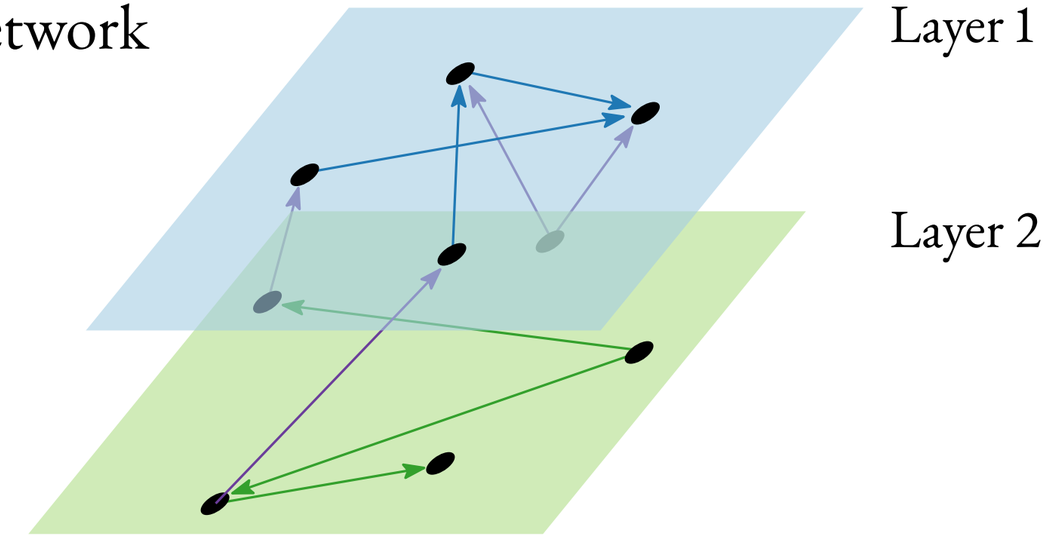
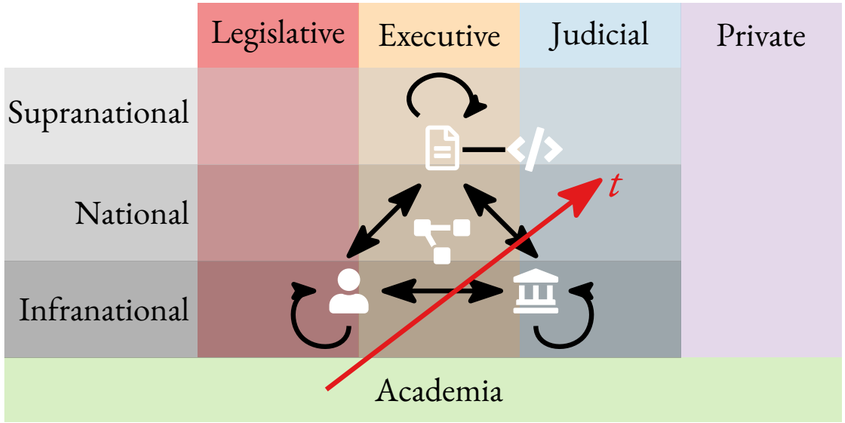
Multilayer Network



Legal Systems as Networks



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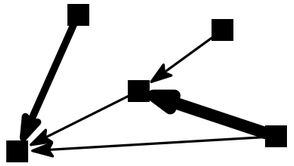
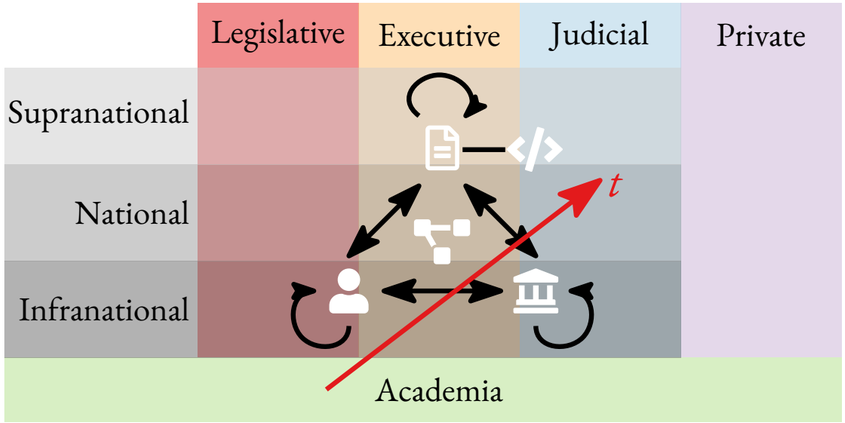


Textual Interactions

- Texts



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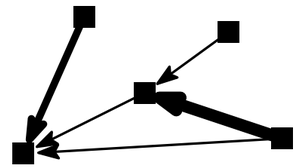

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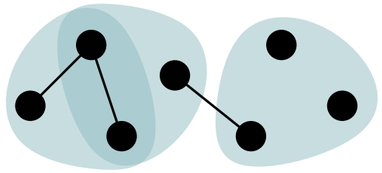
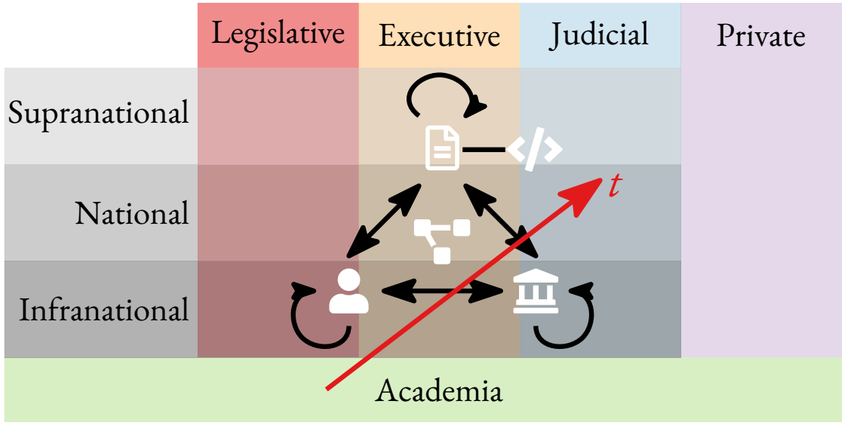


Social Interactions

- Individuals
- Texts



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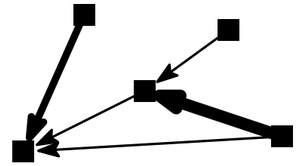
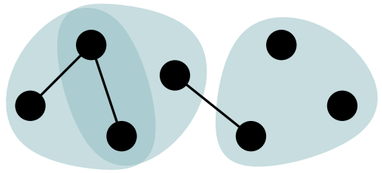
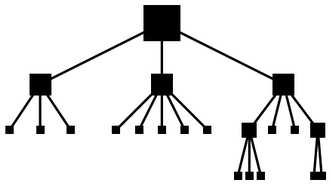


Textual Interactions

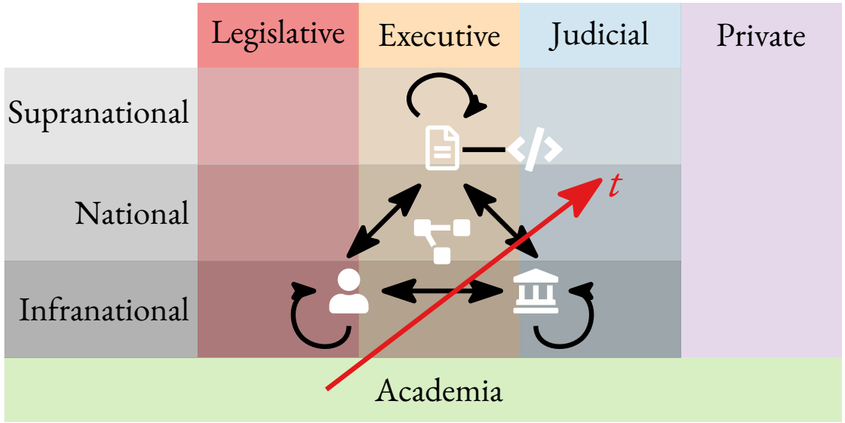


Social Interactions

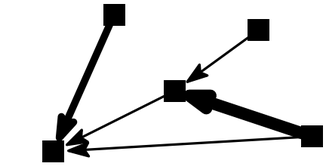


Textual Structure

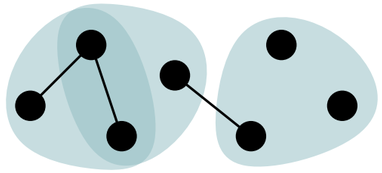
- Individuals
- Texts



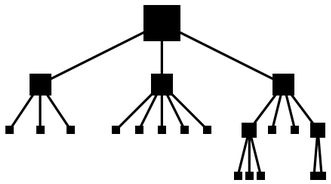
Legal Systems as Networks



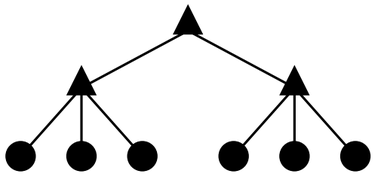
Textual Interactions



Social Interactions

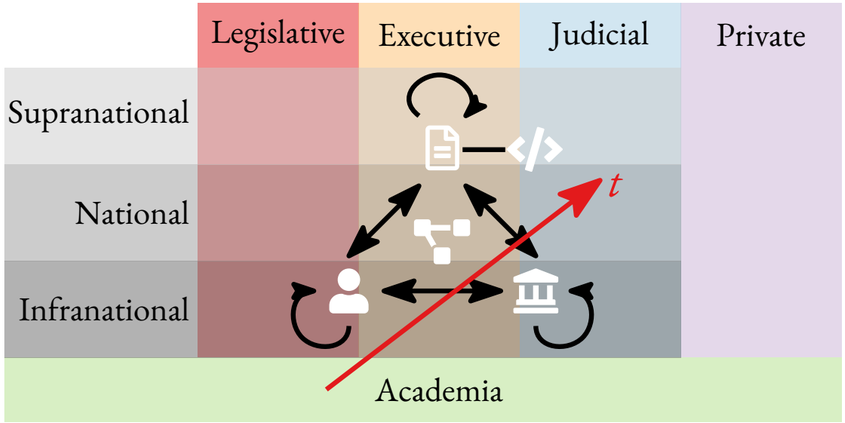


Textual Structure

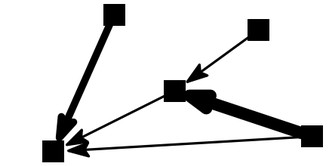


Institutional Structure

- ▲ Institutions
- ● Individuals
- ■ Texts



Legal Systems as Networks



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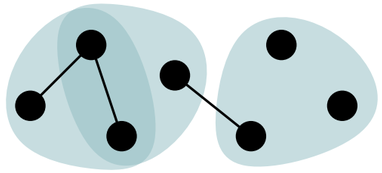
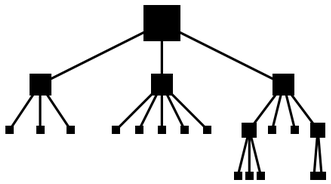
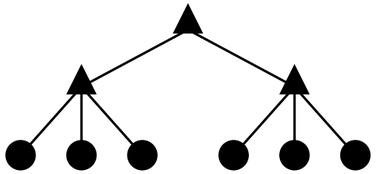


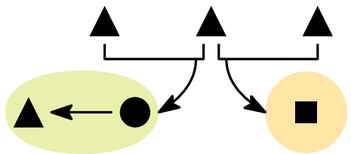
Social Interactions



Textual Structure

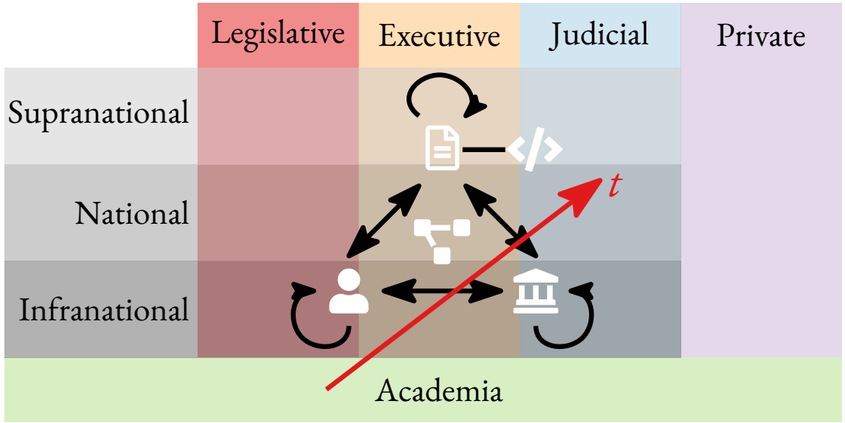


Institutional Structure

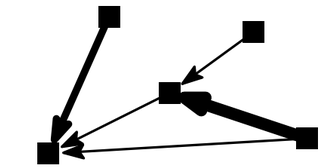


Institutional Interdependencies

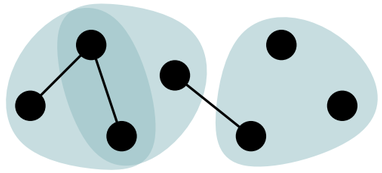
- Institutions
- Individuals
- Texts



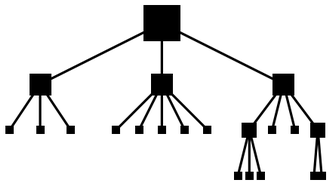
Legal Systems as Networks



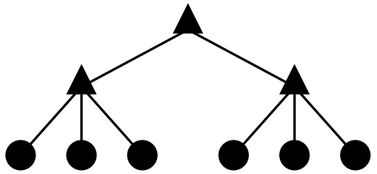
Textual Interactions



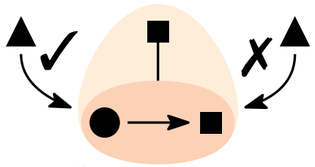
Social Interactions



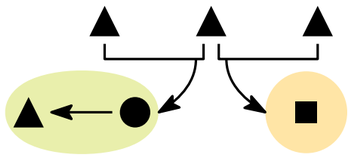
Textual Structure



Institutional Structure

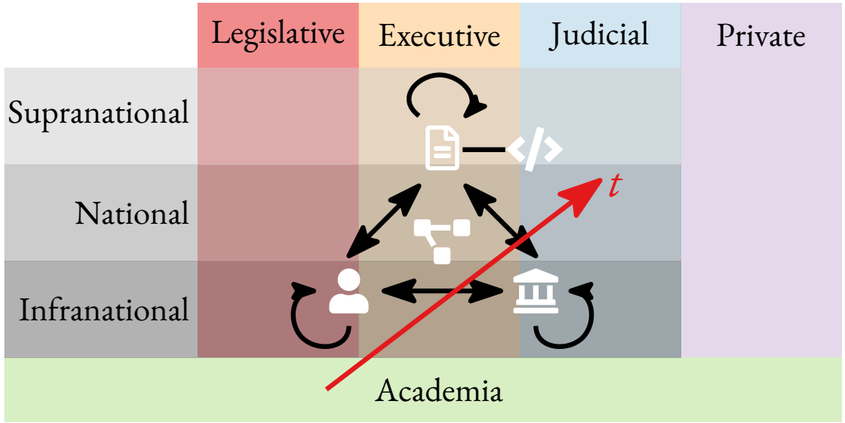


Textual Interpretations

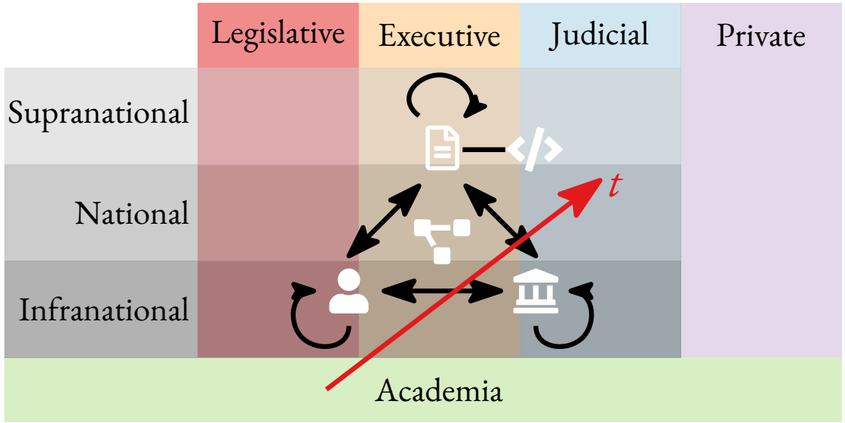


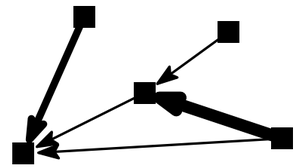
Institutional Interdependencies

- Institutions
- Individuals
- Texts

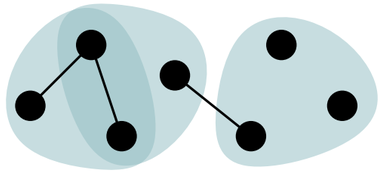


Legal Systems as Networks

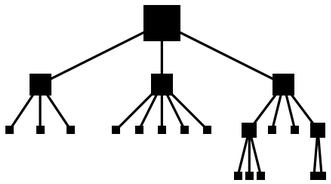




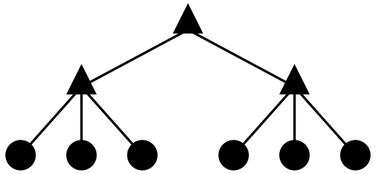
Textual Interactions



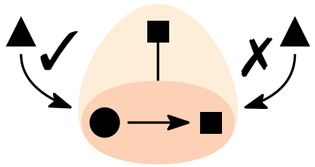
Social Interactions



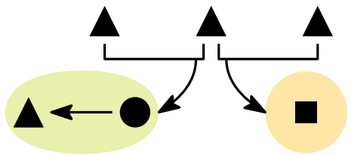
Textual Structure



Institutional Structure

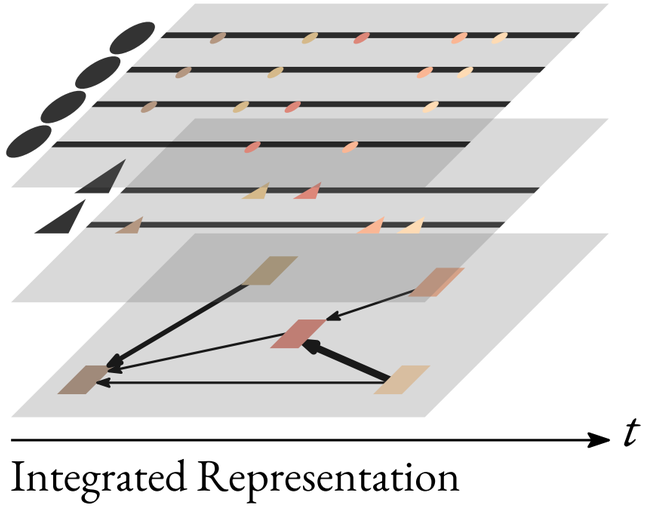


Textual Interpretations



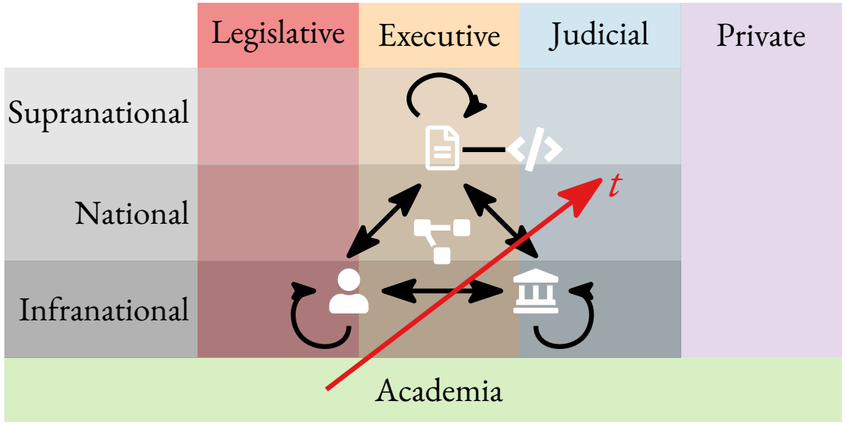
Institutional Interdependencies

- Institutions
- Individuals
- Texts

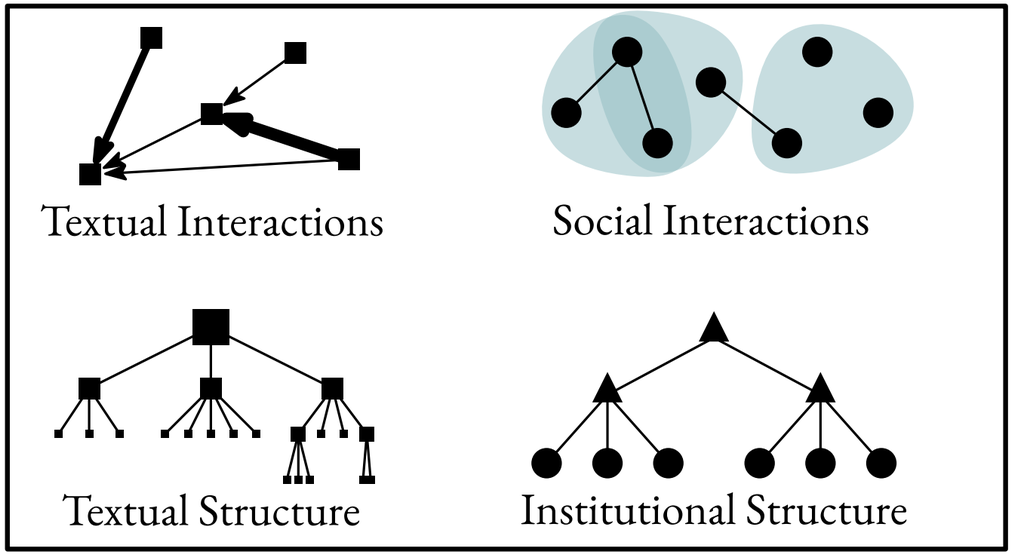


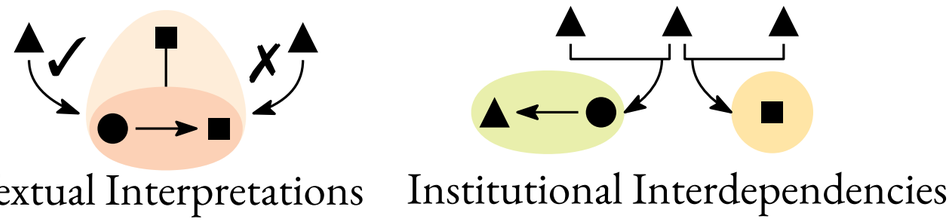
Integrated Representation

Legal Systems as Networks

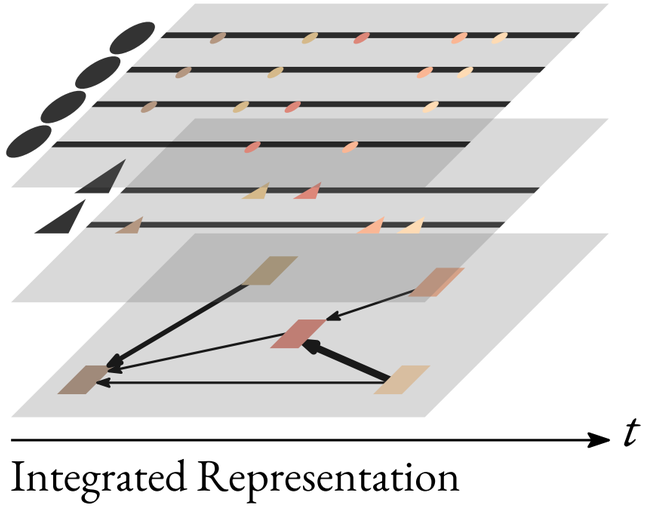


Can be handled by existing models

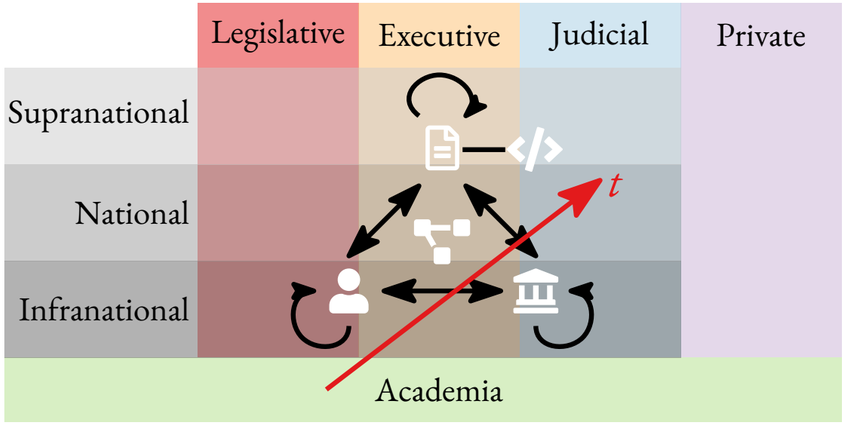




▲ Institutions
● Individuals
■ Texts



Legal Systems as Networks



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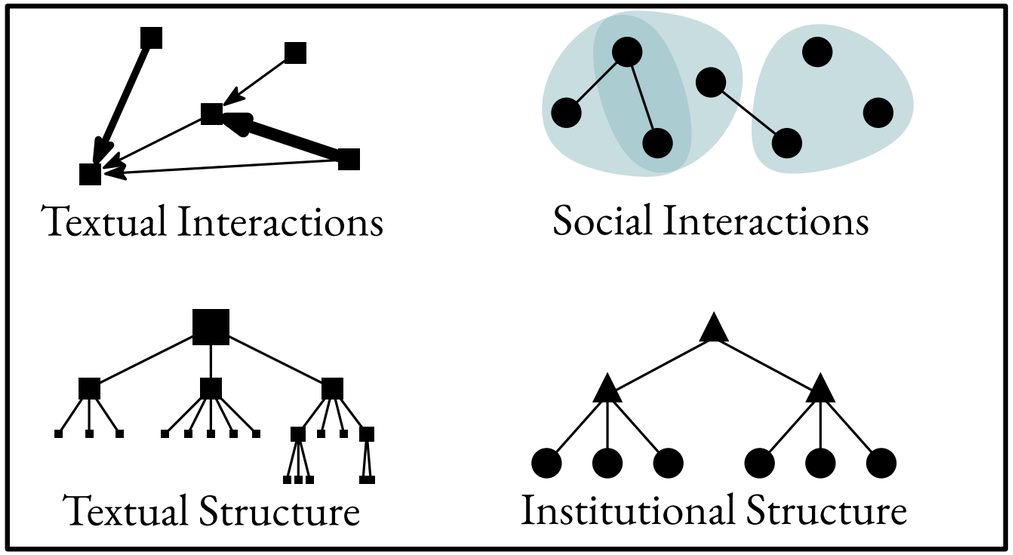

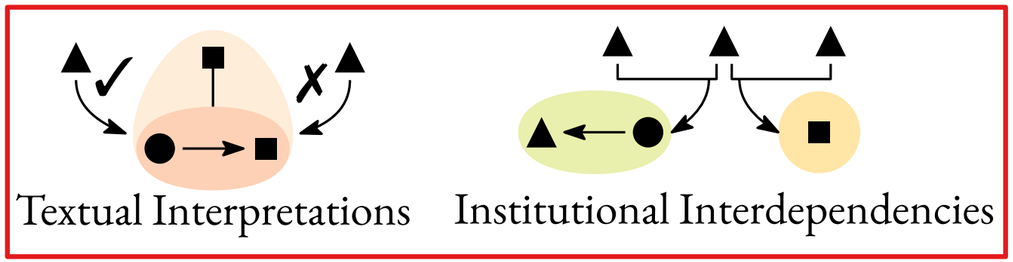

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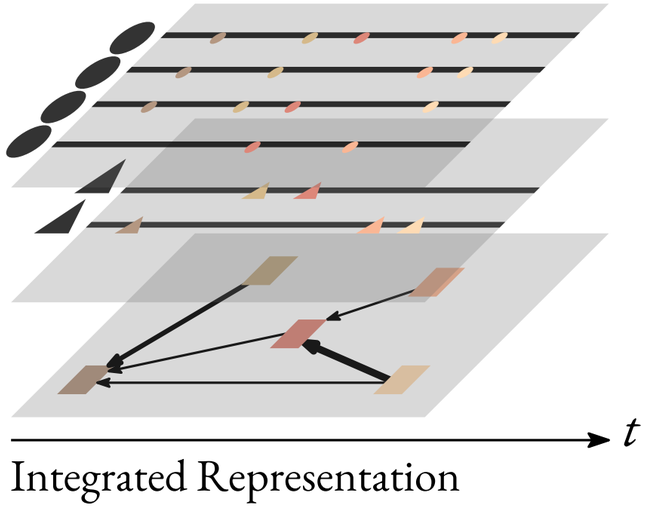


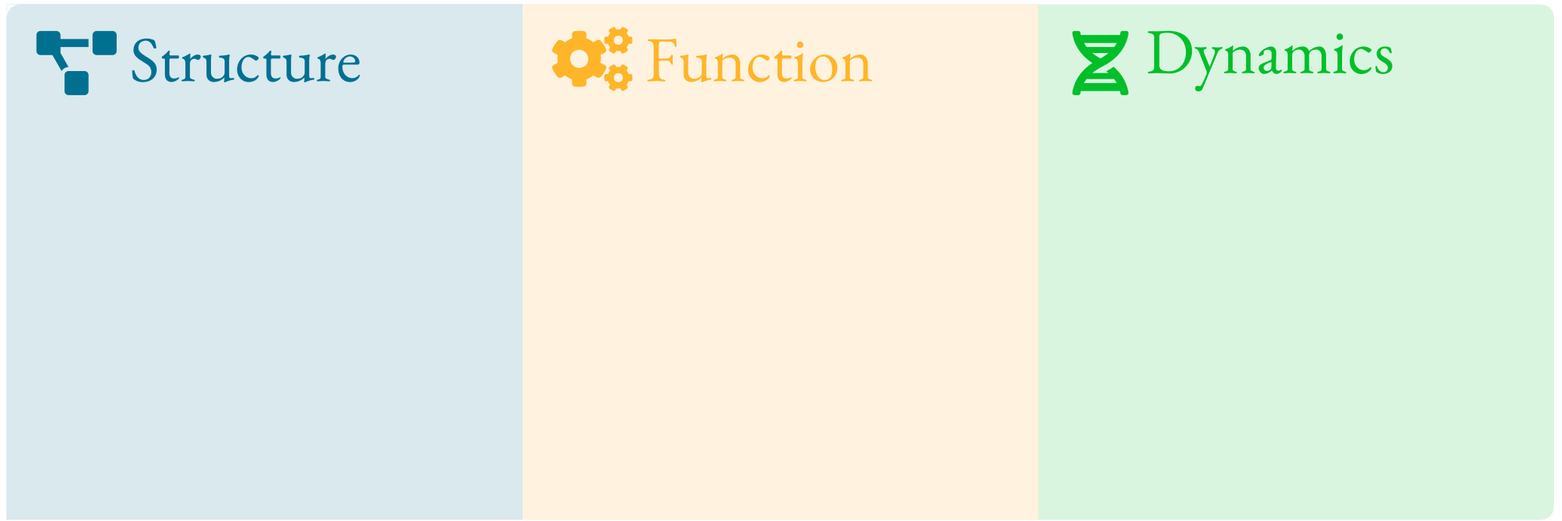
Need to go beyond existing models

Computational Theory of Legal Systems: A Research Agenda

Computational Theory of Legal Systems: A Research Agenda

Complex systems are characterized by their *structure*, *function*, and *dynamics*.

Computational Theory of Legal Systems: A Research Agenda



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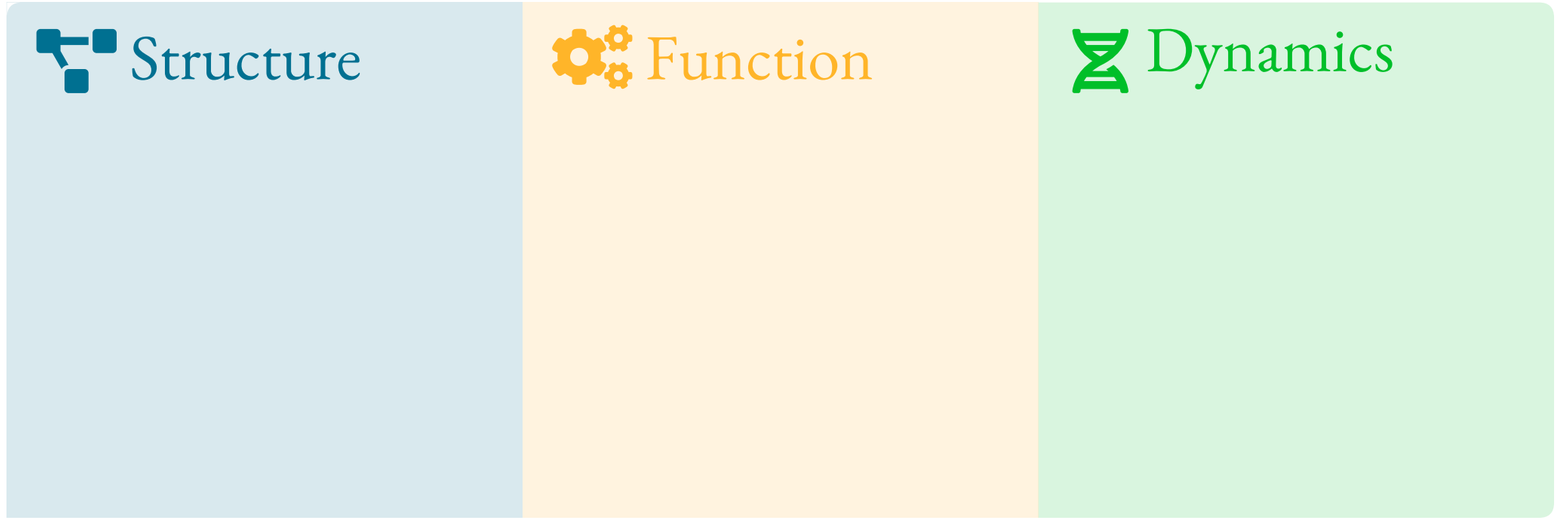
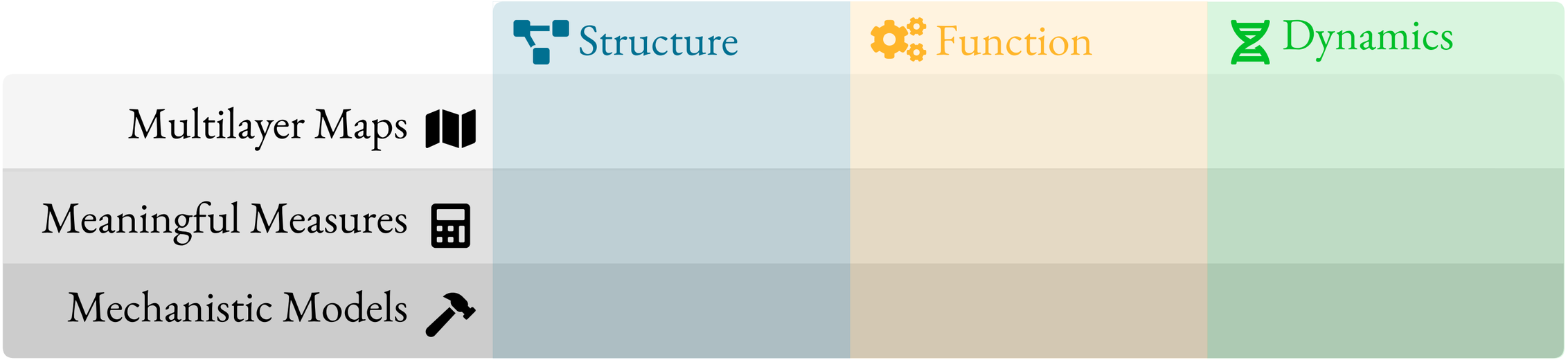
Computational Theory of Legal Systems: A Research Agenda



Complex systems are characterized by their *structure*, *function*, and *dynamics*.
In the theory of complex systems, researchers work to *capture*, *analyze*, and *explain* them.

Computational Theory of Legal Systems: A Research Agenda



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Computational Theory of Legal Systems: A Research Agenda

	Structure	Function	Dynamics
Multilayer Maps	*De iure* Interdepend.	*De facto* Interactions	*De iure*/*De facto* Conn.
Meaningful Measures			
Mechanistic Models			

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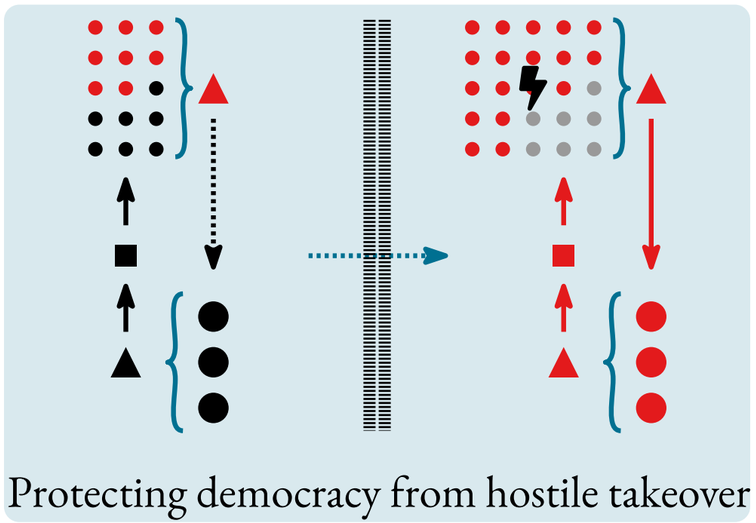
Computational Theory of Legal Systems: A Research Agenda

	Structure	Function	Dynamics
Multilayer Maps	*De iure* Interdepend.	*De facto* Interactions	*De iure*/*De facto* Conn.
Meaningful Measures	*Robustness* to Attacks		
Mechanistic Models			

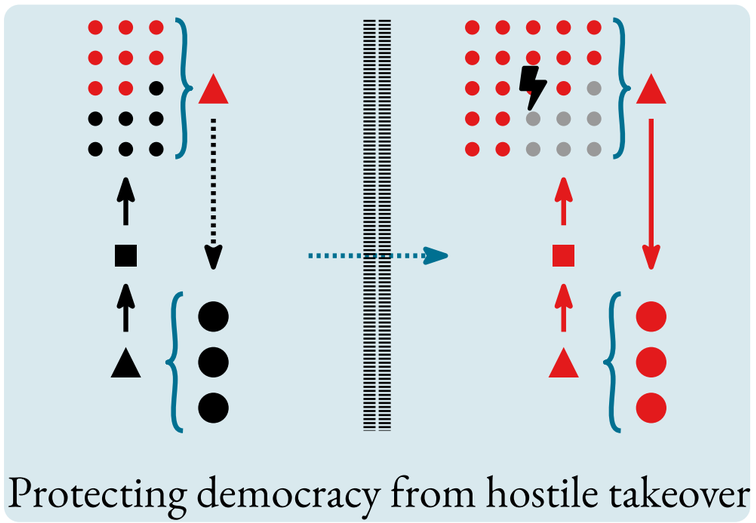


Protecting democracy from hostile takeover

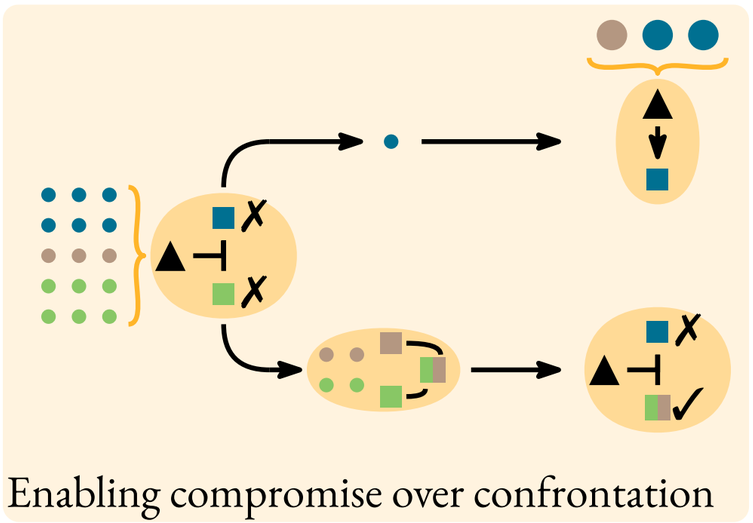
▲ Institutions
● Individuals
■ Texts

Computational Theory of Legal Systems: A Research Agenda

	Structure	Function	Dynamics
Multilayer Maps	*De iure* Interdepend.	*De facto* Interactions	*De iure*/*De facto* Conn.
Meaningful Measures	*Robustness* to Attacks	*Resilience* to Failures	
Mechanistic Models			



Protecting democracy from hostile takeover

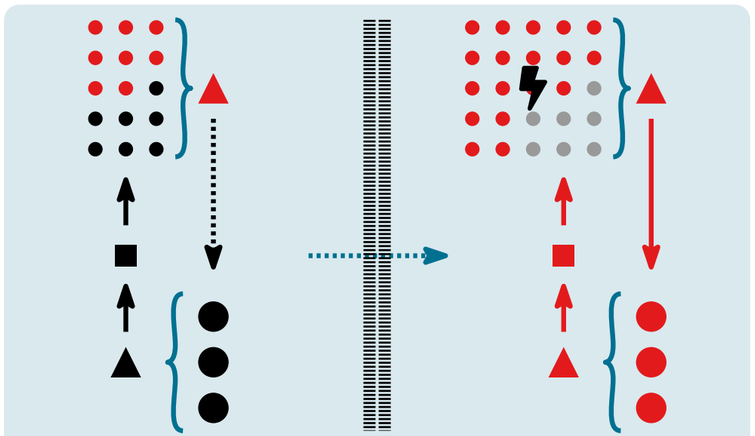


Enabling compromise over confrontation

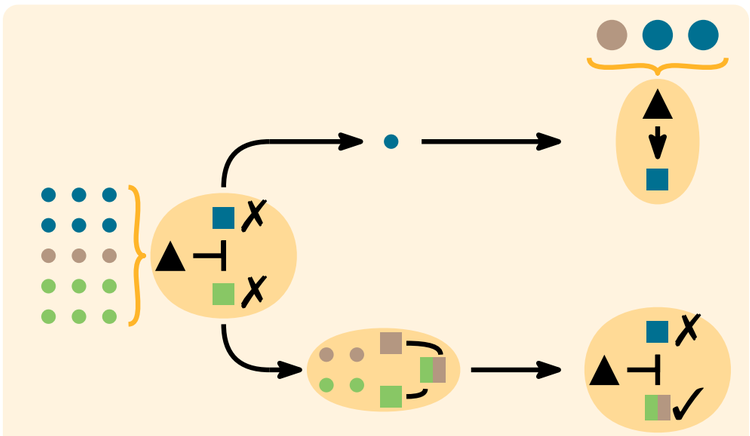
- ▲ Institutions
- ● Individuals
- ■ Texts

Computational Theory of Legal Systems: A Research Agenda

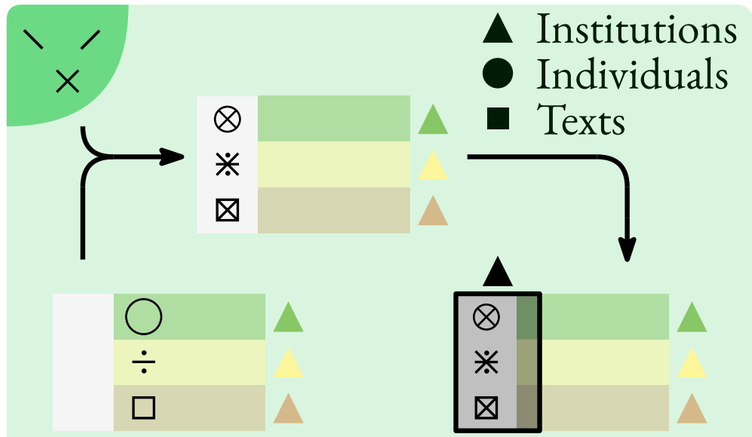
	Structure	Function	Dynamics
Multilayer Maps	*De iure* Interdepend.	*De facto* Interactions	*De iure*/*De facto* Conn.
Meaningful Measures	*Robustness* to Attacks	*Resilience* to Failures	*Adaptation* to Change
Mechanistic Models			



Protecting democracy from hostile takeover



Enabling compromise over confrontation



Responding to regulatory challenges

Computational Theory of Legal Systems: A Research Agenda

	Structure	Function	Dynamics
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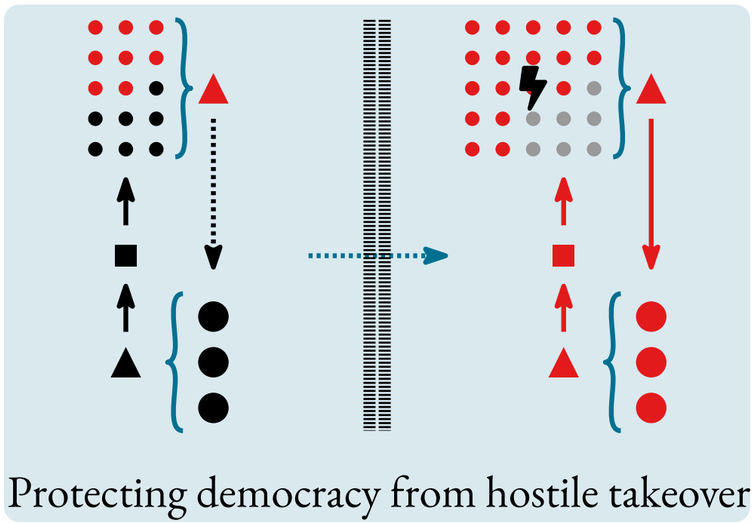
Meaningful Measures	*Robustness* to Attacks	*Resilience* to Failures	*Adaptation* to Change
Mechanistic Models	Impact of *Temporality*		



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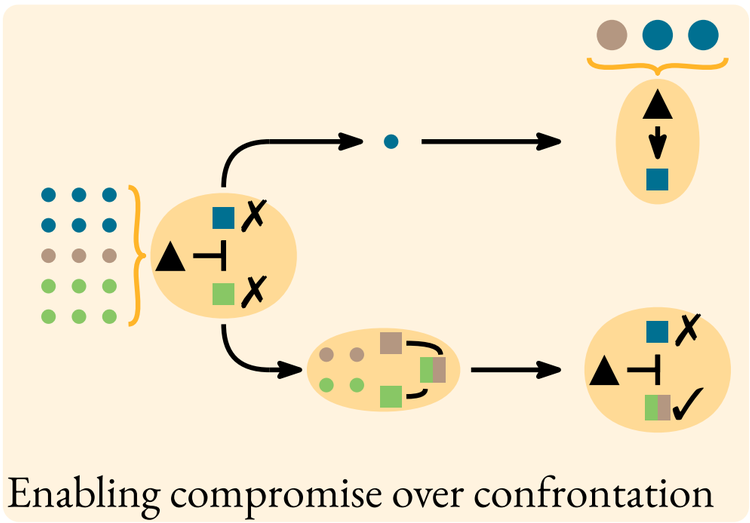
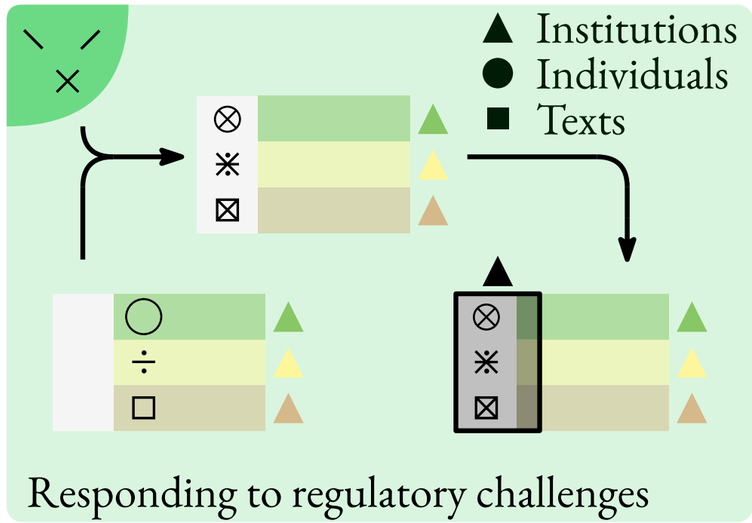


Enabling compromise over confrontation



Responding to regulatory challenges

Computational Theory of Legal Systems: A Research Agenda

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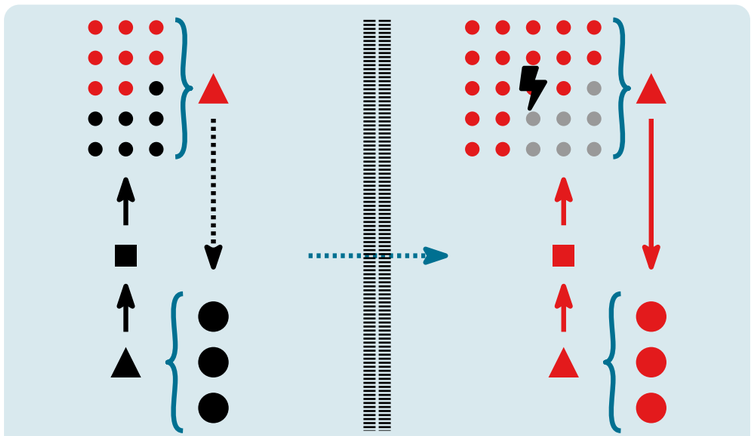
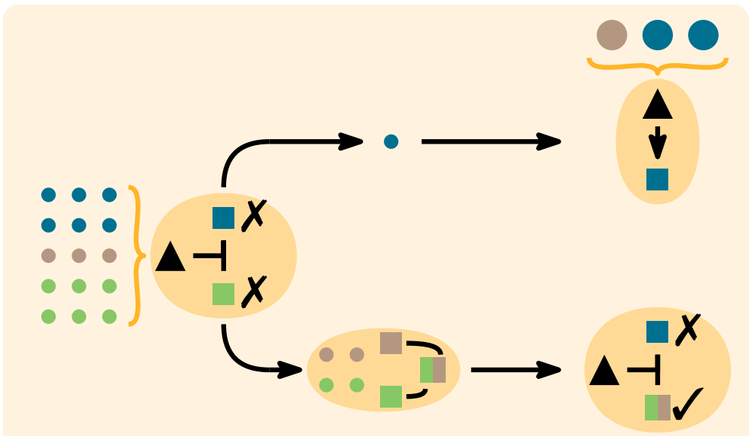
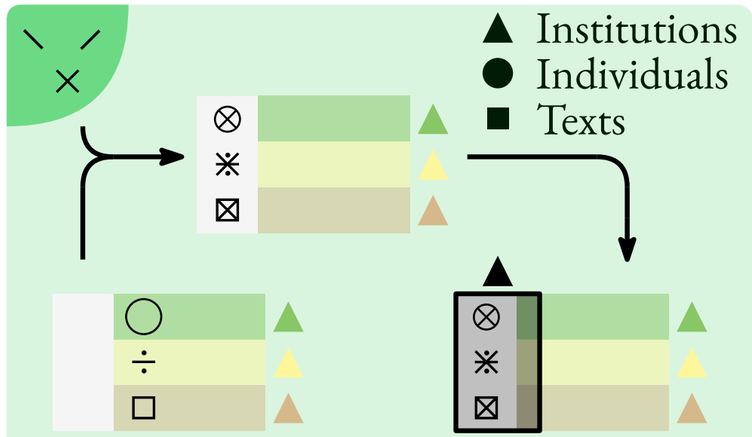
Meaningful Measures	*Robustness* to Attacks	*Resilience* to Failures	*Adaptation* to Change
Mechanistic Models	Impact of *Temporality*	Impact of *Transparency*	



Protecting democracy from hostile takeover



Enabling compromise over confrontation



Responding to regulatory challenges

Computational Theory of Legal Systems: A Research Agenda

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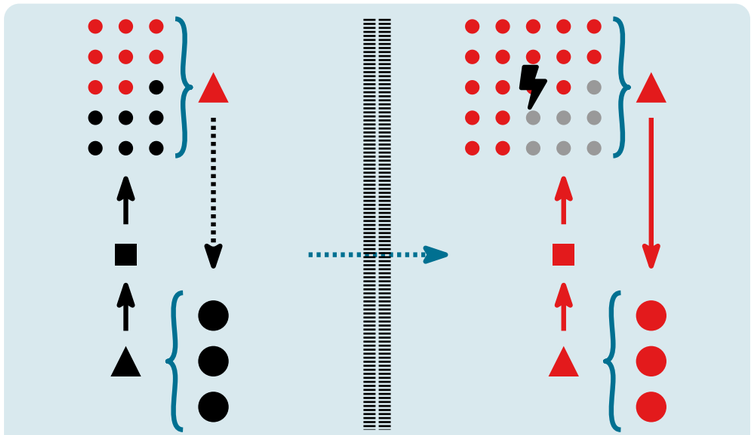
Meaningful Measures	*Robustness* to Attacks	*Resilience* to Failures	*Adaptation* to Change
Mechanistic Models	Impact of *Temporality*	Impact of *Transparency*	Impact of *AI*



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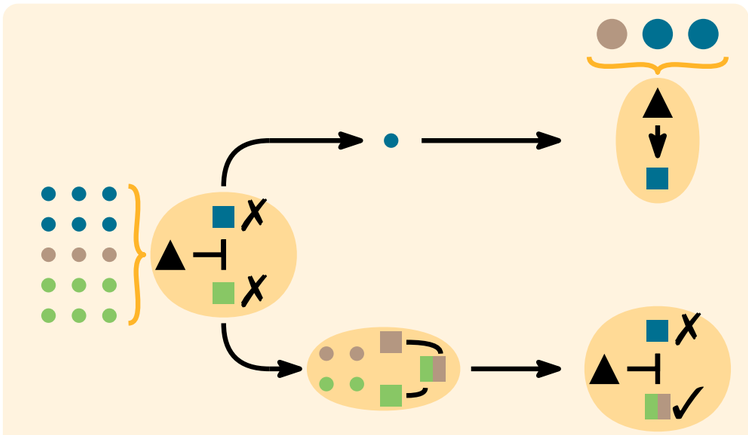
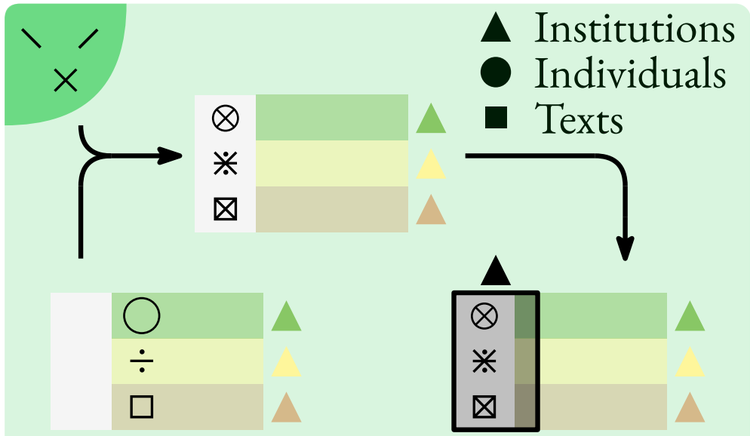
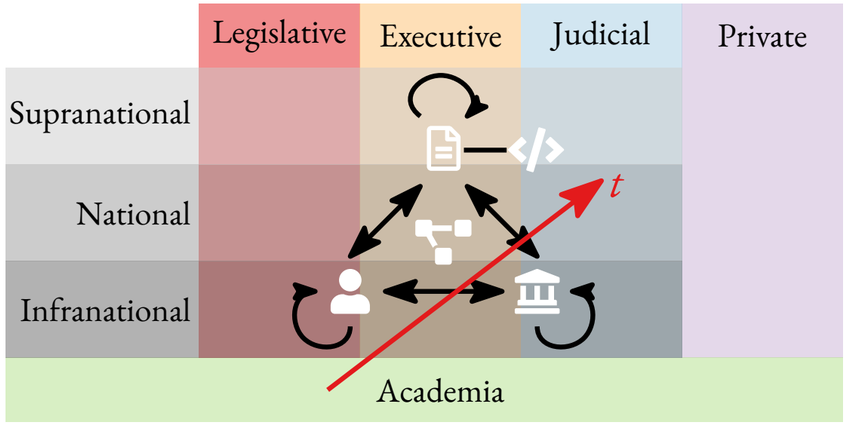


Enabling compromise over confrontation



Responding to regulatory challenges

Summary


Legislative
Executive
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Private
Supranational
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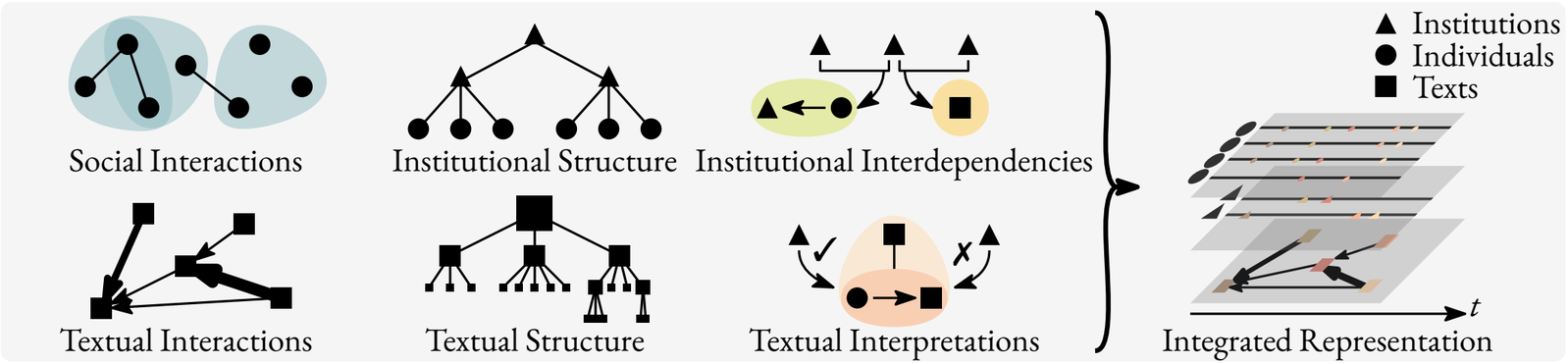
Academia


Social Interactions
Institutional Structure
Institutional Interdependencies
Textual Interactions
Textual Structure
Textual Interpretations
Institutions
Individuals
Texts
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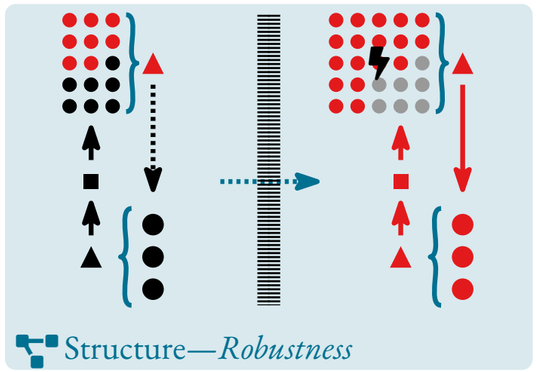
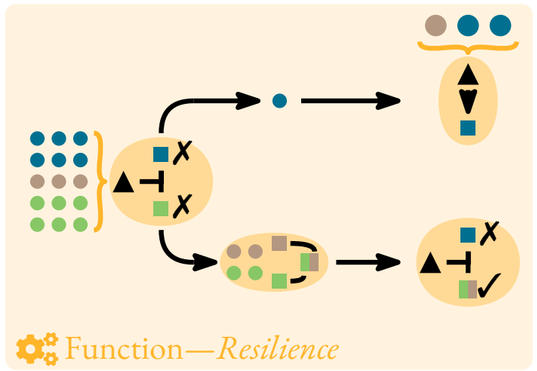
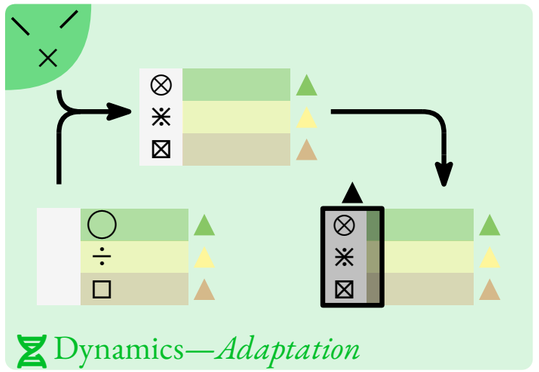
Integrated Representation

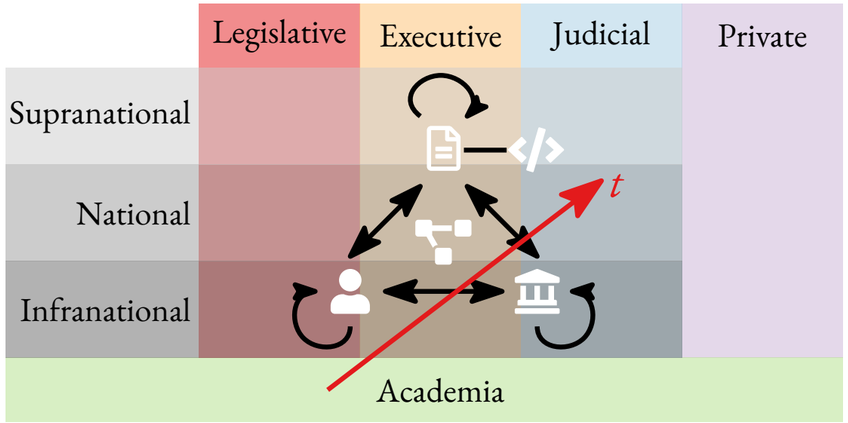

Structure—*Robustness*

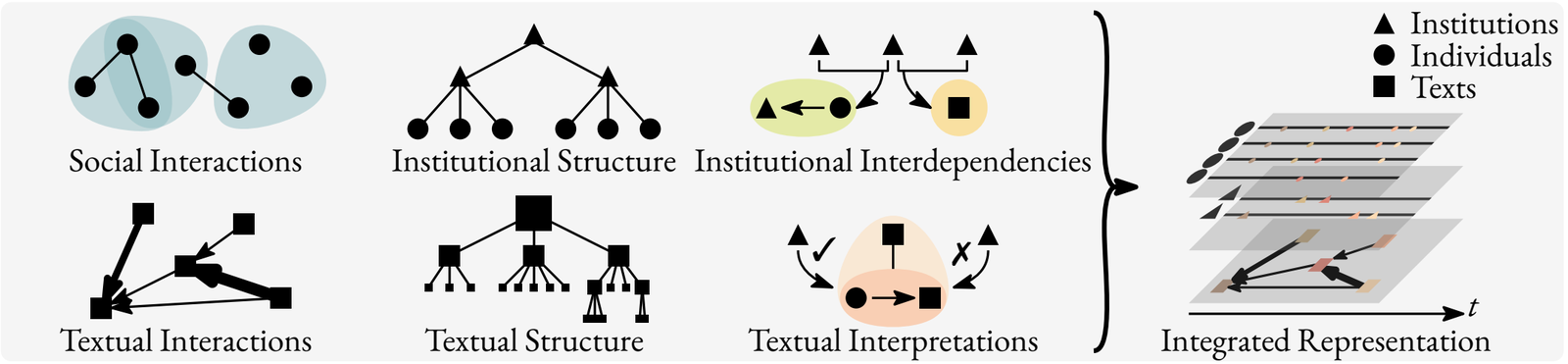

Function—*Resilience*

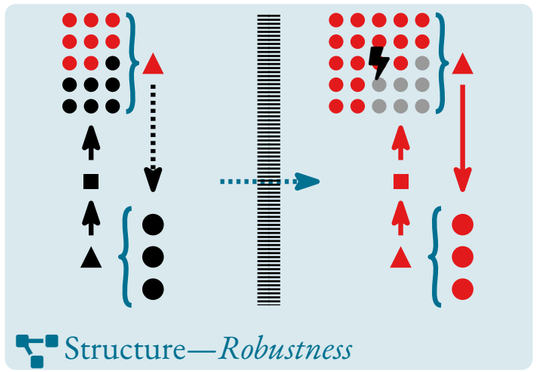

Dynamics—*Adaptation*

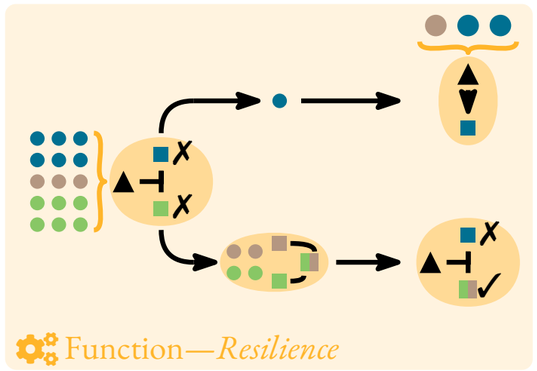
Summary

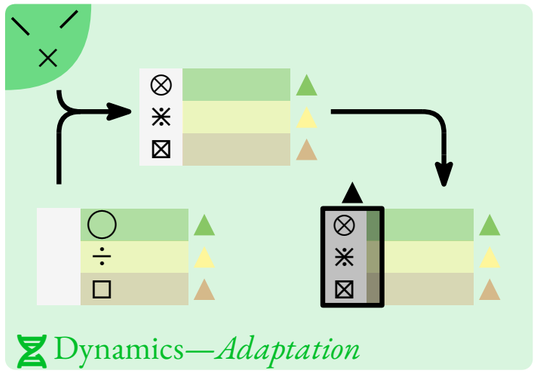
Want to learn more about the nitty-gritty of legal networks?
→ Join Titus's talk on *Network Pluralism*!











Summary

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→ Join Titus's talk on *Network Pluralism*!

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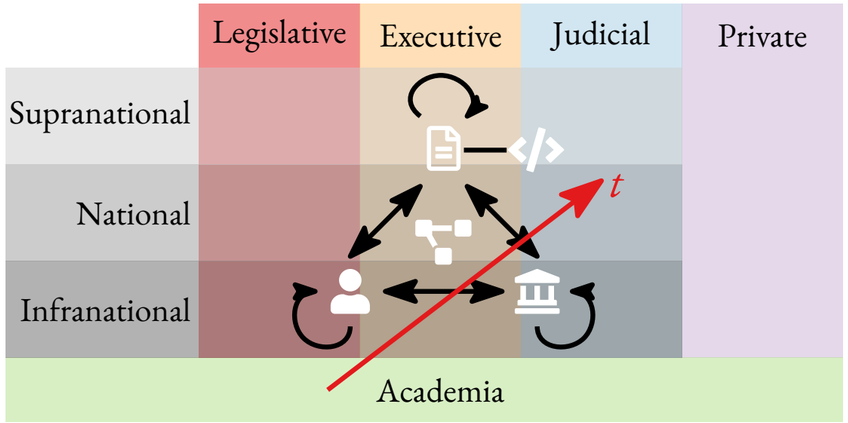
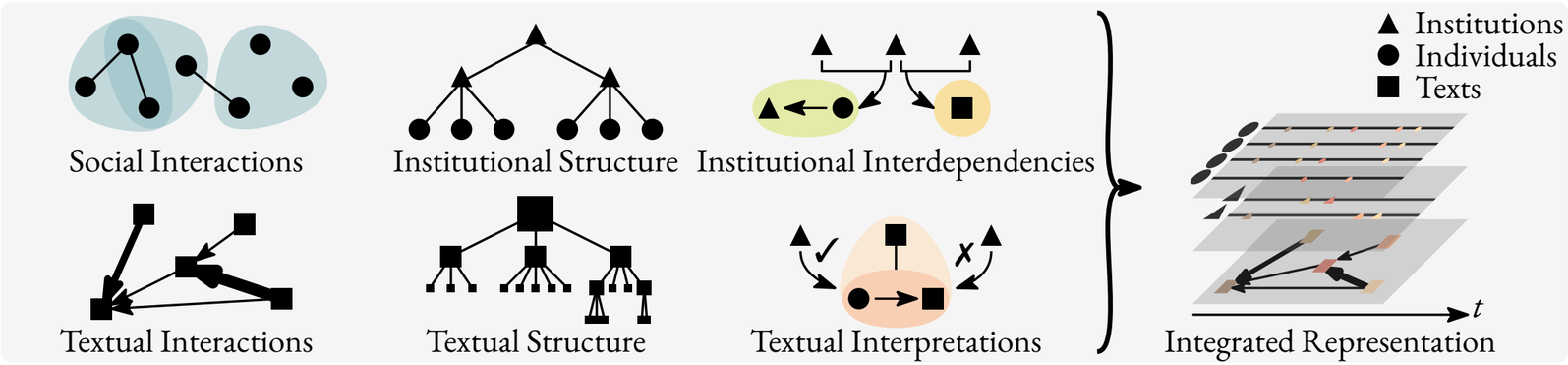
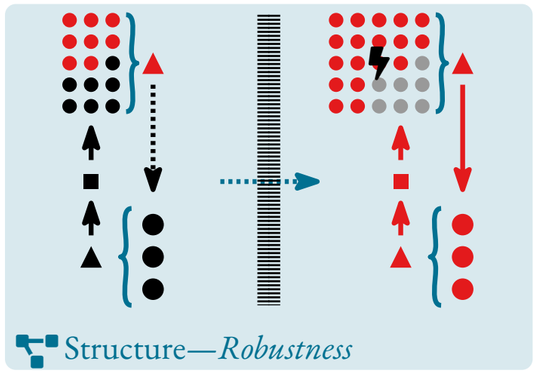
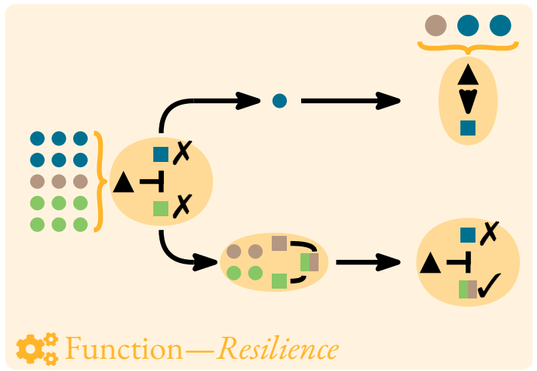
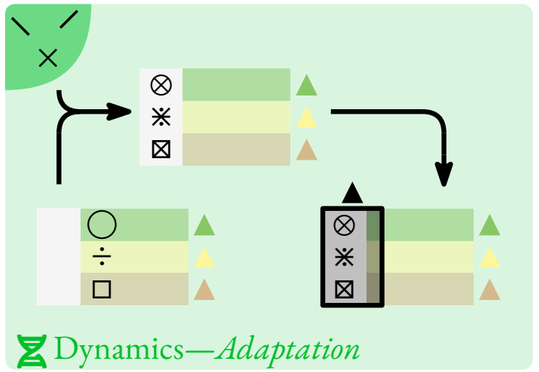
→ Happy to collaborate + always looking for good students!











Thank you! Questions? Comments?

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