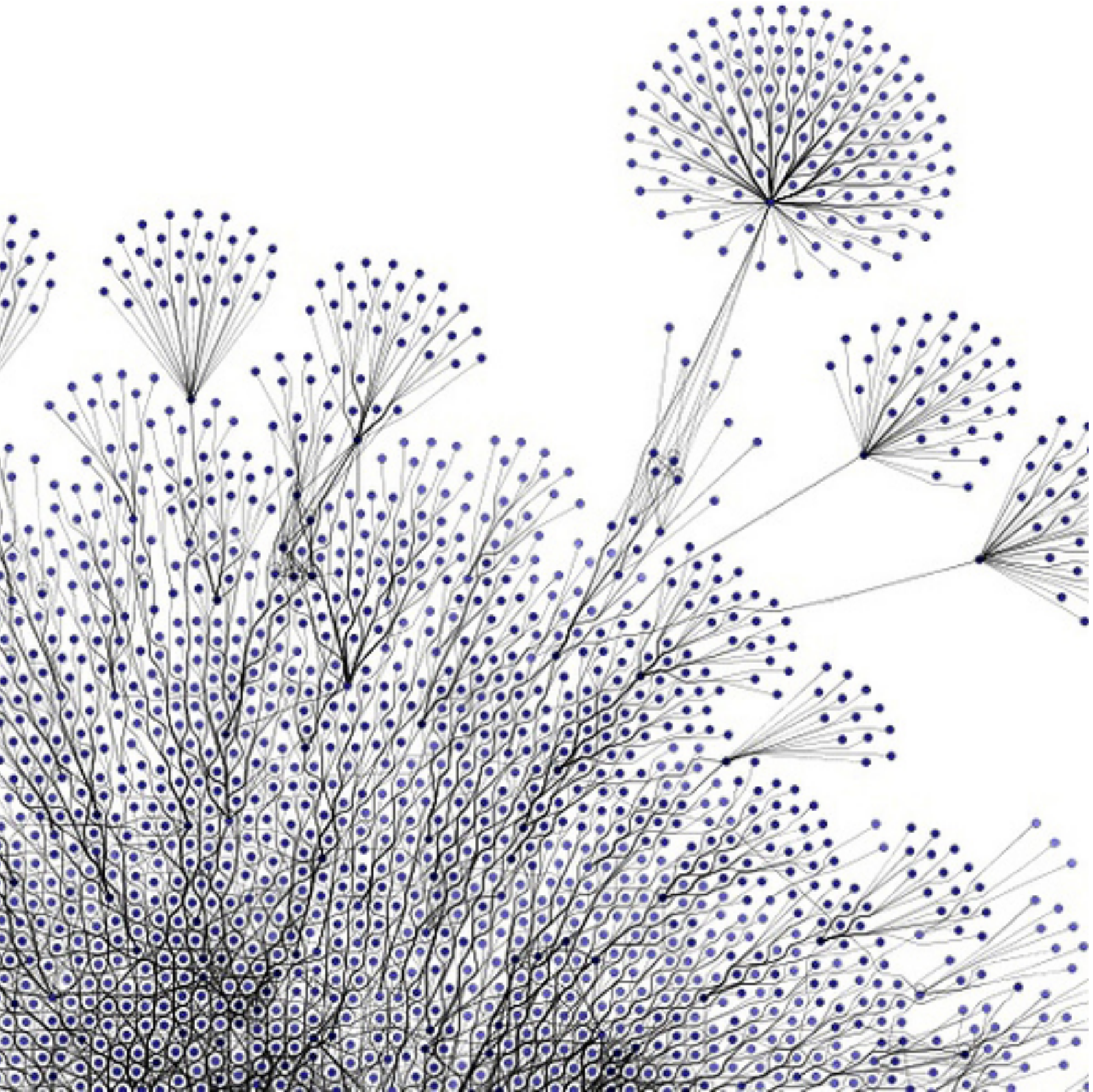

SYSTEMS THINKING

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Outline

What is a system?
Understanding systems - fundamentals of systems thinking
Systems change and design

What is a system?

"A system is an interconnected set of elements that is coherently organised in a way that achieves something."

(Meadows, 2008)

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Components of a System

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elements

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relationships between elements

elements

Components of a System

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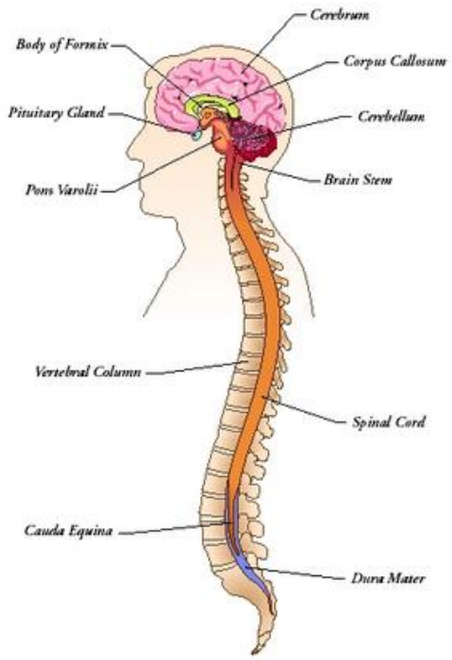
purpose

relationships between elements

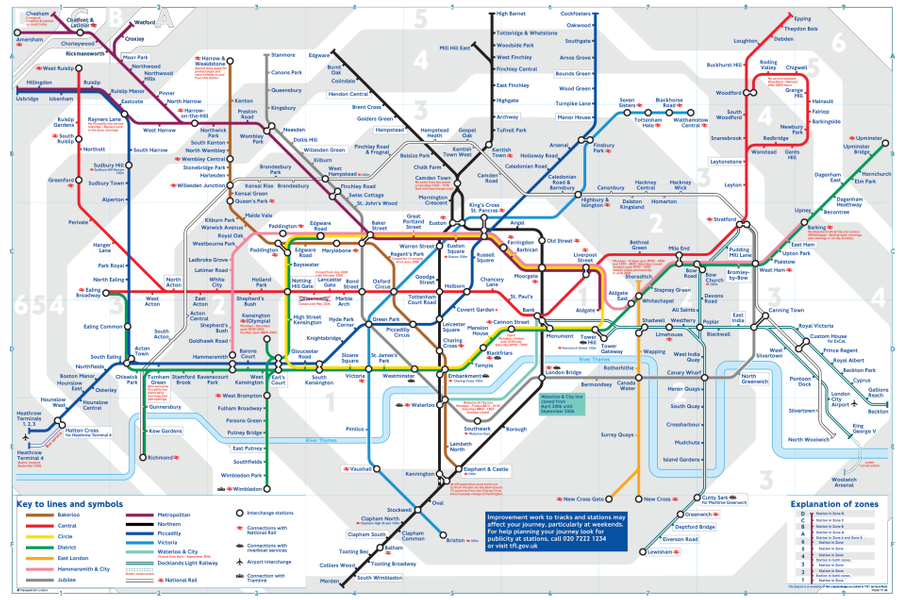
elements

Components of a System

Examples of Systems



Nervous system

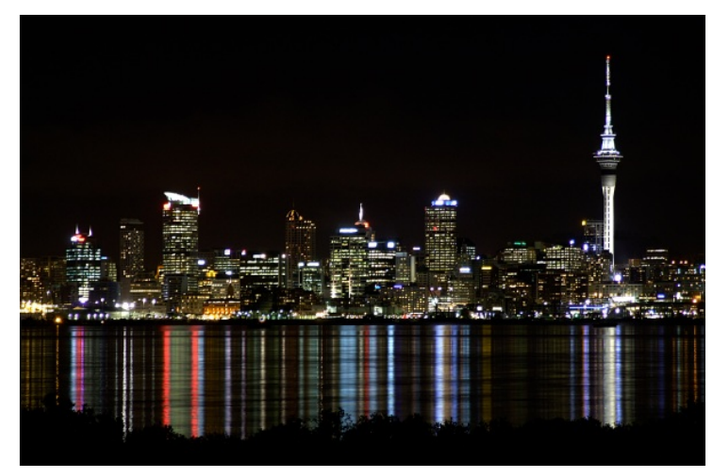


London metro

Andromeda galaxy

A Frog

A Bicycle



A City

What is a system?

"A system is an interconnected set of elements that is coherently organised in a way that achieves something."

(Meadows, 2008)

purpose

relationships between elements

elements - human and non-human

Components of a System

What is a system?

"A system is an interconnected set of elements that is coherently organised in a way that achieves something."

(Meadows, 2008)

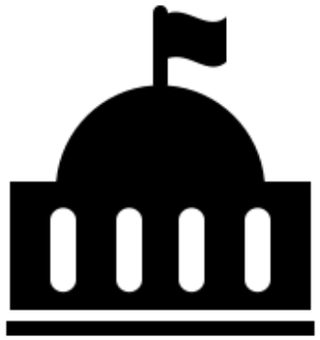
purpose - differs based on perspective

relationships between elements

elements - human and non-human

Components of a System

Municipal Waste Collection



City Council

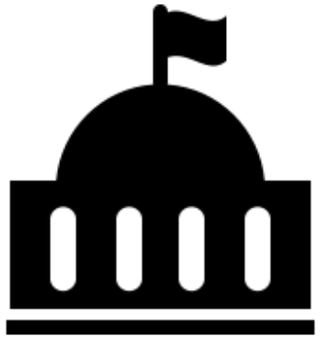
Households

Waste treatment facility

Waste bins

Waste collectors

Municipal Waste Collection



City Council

A system that sorts, collects and treats municipal waste

Households

A system that takes away household waste

Waste treatment facility

A system that treats municipal waste

Waste bins

A system that helps households sort their waste

A system that helps waste collectors to collect waste

Waste collectors

A system that carries household waste to waste treatment plant

A system that creates jobs

Types of Systems

Types of Systems

A complex system

A simple system

Types of Systems

A complex system

A simple system

In design we deal with both and mostly at the same time as components of larger (highly-complex) systems.

Types of Systems

A complex system

A simple system

So, what are some of the differences between these two?

Types of Systems

A complex system

unpredictable behaviour

large number of components

many interactions

decentralised decision making

limited or no reducibility

A simple system

predictable behaviour

small number of components

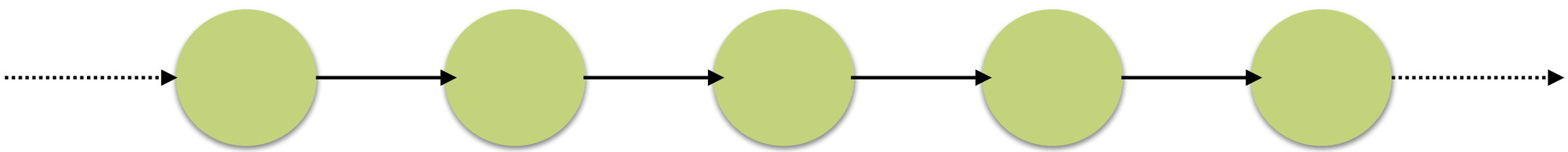
few interactions

centralised decision making

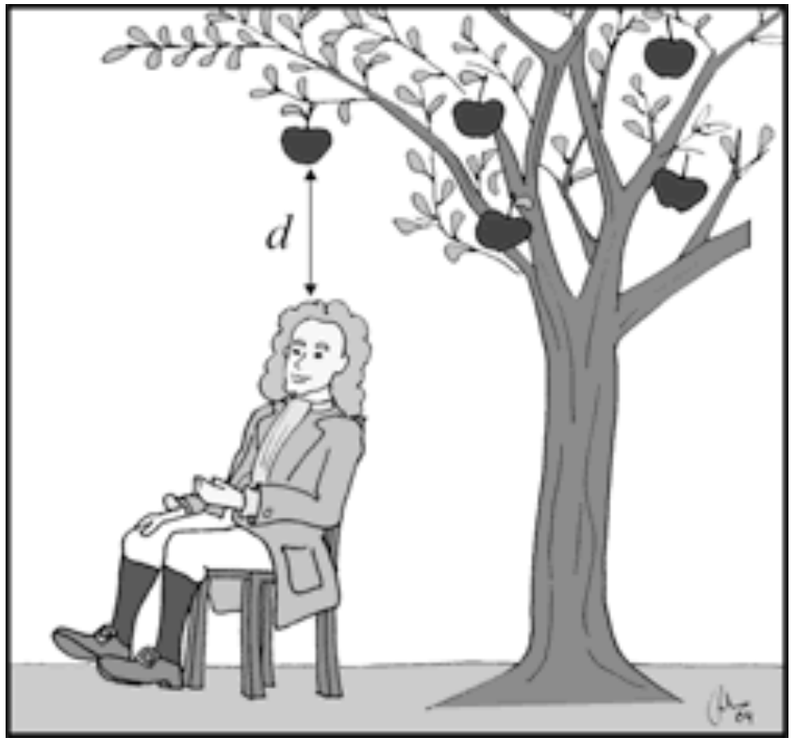
reducibility

(Casti, 1996)

Understanding Systems - Causality



Mechanistic (linear) thinking of cause and effect chains

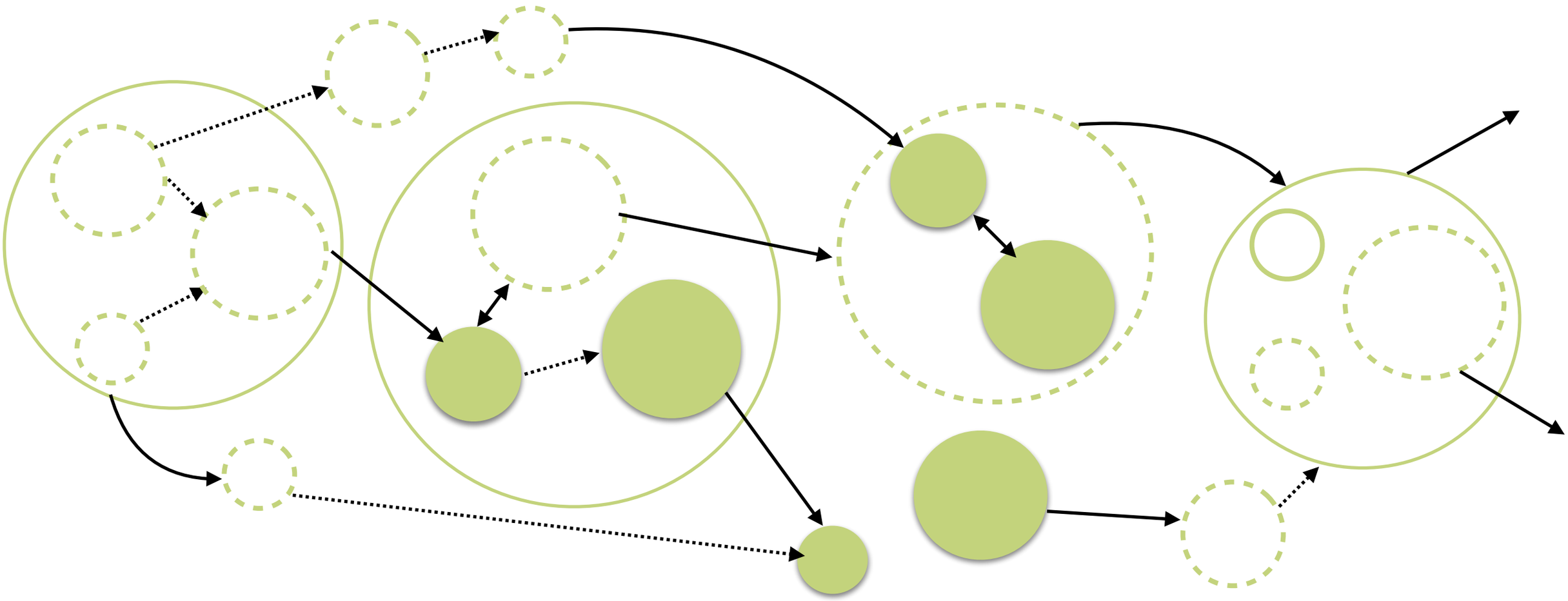


What did cause the apple to fall?

A causes B

“Gravitational force caused the apple to fall.”

Only partially true.



Systemic thinking of cause and effect chains

Multiple Causes (or more precisely, Multiple Influences)

The apple is denser than air - The material cause
The apple broke apart from the branch - The formal cause
The gravitational force pulled the apple towards the centre of the earth - The efficient cause
The apple was ripe - The final cause

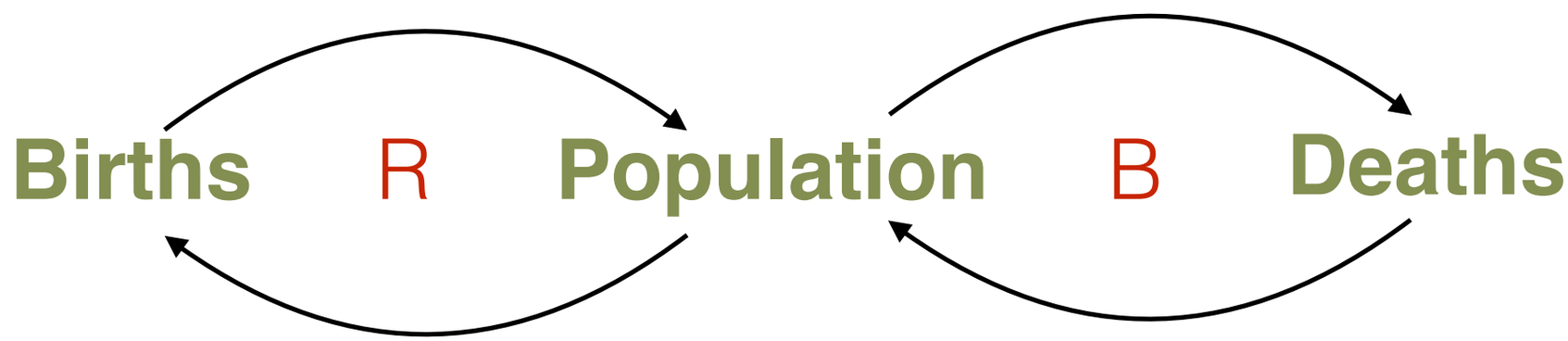
Understanding Systems - Feedback Loops

If A causes B, is it also possible that B causes A?

Feedback is the situation when output from an event in the past will influence an occurrence or occurrences of the same event in the present or future.

Reinforcing feedback loops – amplifies, increases, moves in the same direction

Balancing feedback loops – decreases, moves in the opposite direction



Depending on which loop dominates the population will either decline or increase. If neither of the loops dominate than the population will not change.

Understanding Systems - Shifting the Burden

Shifting the burden arise when a solution to a systemic problem reduces (or disguises) the symptoms, but does nothing to solve the problem

Exporting waste
Drug abuse for psychological relief
Symptomatic relief medicines
More roads to combat congestion
ETC.

Shifting the burden is a result of either reductionism or short-termism or both

Understanding Systems - Causal Layers

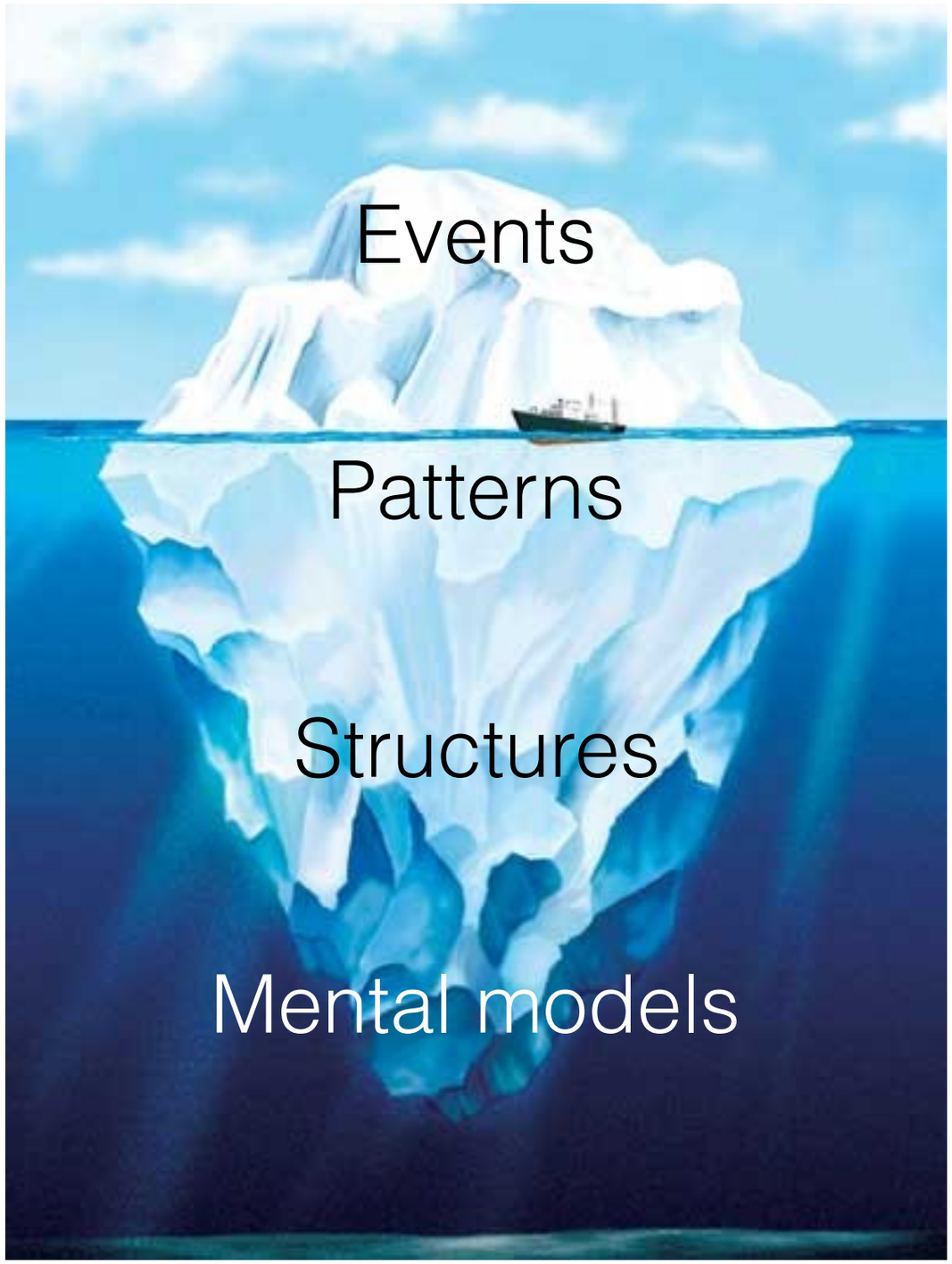
Events
(who does what to whom?)
Reactive
What happened?

Patterns
(reoccurring patterns over time)
Adaptive
What is happening over time?

Structures
(how the parts of the system organised)
Creative
Why is this happening?

Mental models
(mental models and assumptions)
Generative
In what ways our mental models created and sustained the structures in place?

Understanding Systems - Causal Layers



increasing poverty

rich gets richer, poor gets poorer

current economic paradigm results in assets to be accumulated in nodes

wealth=financial wealth; it's ok to have a lot of disposable income; inequality is ok; my wellbeing is independent from the wellbeing of others

Exercise 1: Map Your System

How would you set the boundaries of “a system” to work on given the problem at hand?

What’s the purpose of the system? What does the system achieve?

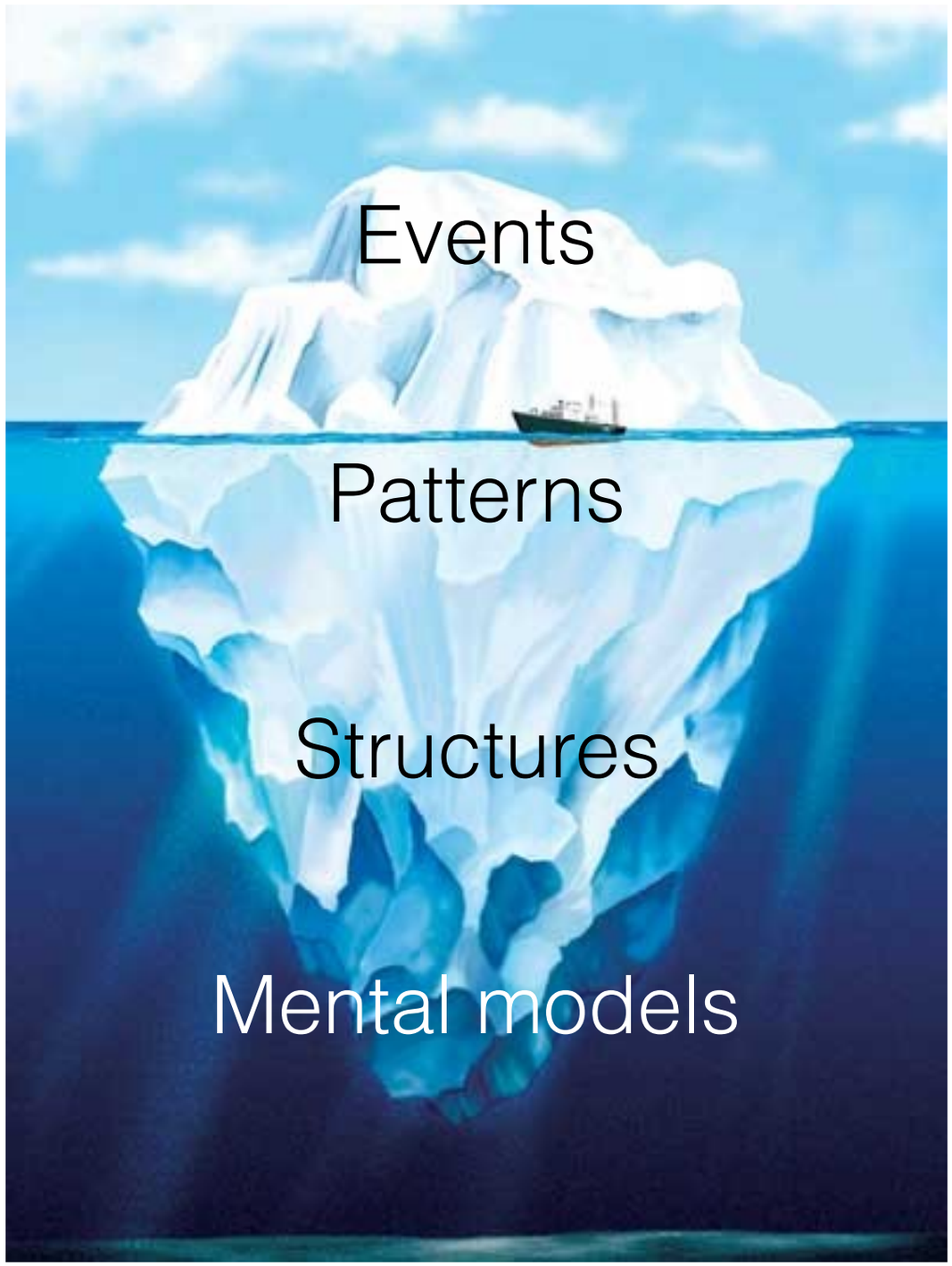
What are the elements of the system?

How are these elements related to one another?

Make a map of your system showing elements and relationships.

Think before you start!
How would you approach this task? What is a good way to show elements? What is a good way to show relationships?

Exercise 2: ‘Unpack’ Your System



(who does what to whom?)
Reactive
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(mental models and assumptions)
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In what ways our mental models
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Links:

Here you can try out using feedback loops and build your own simple simulation: https://ncase.me/loopy/

Thank You!