GST 12 – Structure, Configuration, and Information

Formal Description

Configuration is the spatial and temporal arrangement of entities with respect to one another, without implying interaction.

Structure is the organisation of entities and their relationships within a configuration. Structure may be **static**, persisting over time, or **dynamic**, changing in a non-random manner.

Randomness refers to a condition in which interactions are unconstrained or insufficiently recurrent to give rise to non-random, recurring structure.

Information is defined as non-random, recurring structure in space-time, independent of interpretation.

Plain English Explanation

Now that we understand entities and how they can be distributed across space-time, the next question is how those entities are arranged and why that arrangement matters. The most basic way to describe entities is in terms of their configuration — that is, where they are in relation to one another. For example, two objects may be next to each other, one object may be above another, or events may occur in sequence. This describes their spatial and temporal arrangement, but does not in itself imply any interaction.

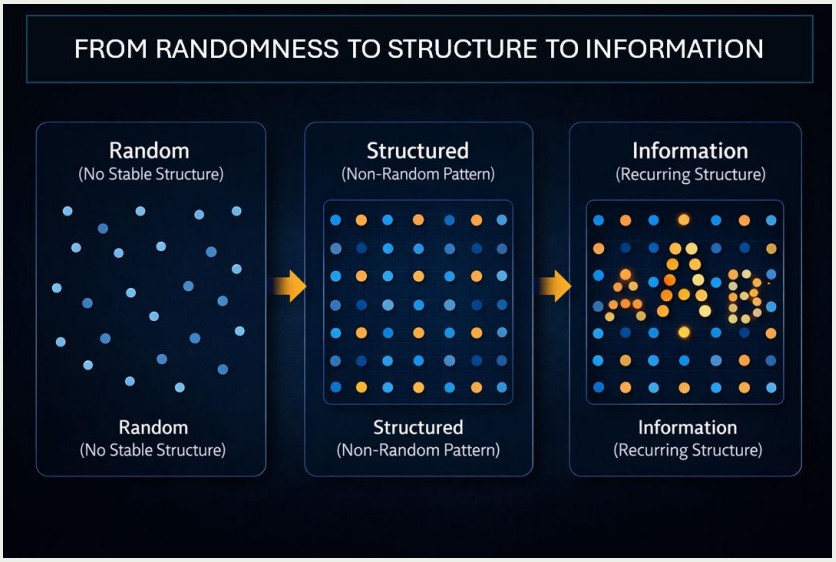
When we consider many entities together, their arrangement forms a structure. Structure goes beyond simple positioning and includes how entities are organised and related within a configuration. This may involve spatial arrangement, connections between components, and ordering over time. For example, atoms arranged in a crystal, words arranged in a sentence, or buildings arranged in a city all exhibit structure. What distinguishes structure is that the arrangement is not arbitrary, but organised in a meaningful way.

Structures may be either static or dynamic. Some structures remain relatively stable over time, such as a building or a crystal. These are static structures. Others change over time, such as traffic flow, weather systems, or biological processes. These are dynamic structures. In both cases, however, the key point is that the organisation is not random, but follows identifiable patterns.

Where no such organised or recurring pattern exists, we describe the condition as random. For example, gas molecules moving freely or noise without any discernible pattern may be treated as random. In this sense, randomness refers to the absence of stable, recurring structure.

Within this framework, information is defined as non-random, recurring structure in space-time. Wherever there is consistent pattern — wherever structure persists or repeats — there is information. This includes, for example, a written sentence, a DNA sequence, or the arrangement of components in a machine. Importantly, this information exists whether or not it is observed or interpreted.

This is fundamental to systems theory because structure makes systems possible, enables them to function, and carries the information that defines their behaviour. Without structure, there would be no systems, no function, and no information.



Example 1 – Written Text
A page of random letters has no meaning or structure.
A sentence has:

- ordered letters
- consistent structure

👉 This structure is information.

Example 2 – Crystal vs Gas
In a crystal:

- atoms are arranged in a regular pattern
- structure is stable

In a gas:

- particles move randomly

👉 The crystal contains structured information; the gas does not.

Example 3 – DNA
DNA consists of a sequence of molecules arranged in a specific order.
👉 The order of these molecules is **information** that guides biological processes.

Example 4 – Traffic Flow
Cars moving randomly would be chaotic.
In reality:

- lanes
- signals
- patterns of flow

👉 These create structured movement — information in action.

Provenance and Links

This module draws on foundational concepts from systems theory, information theory, and physics concerning structure, order, and the nature of information.

The distinction between the spatial and temporal positioning of entities and the relationships that connect them reflects core ideas in general systems theory, particularly in the work of Ludwig von Bertalanffy, where systems are understood as organised wholes composed of interrelated components. In this context, structure is not merely the positioning of entities, but includes the relationships that give rise to system-level properties.

The concept of information as non-random, recurring structure aligns with the development of information theory by Claude Shannon, who formalised the relationship between information, uncertainty, and signal structure. While Shannon's work is primarily concerned with communication, it provides a foundation for understanding information in terms of constraint and pattern.

The distinction between structure and randomness also connects to thermodynamics and statistical mechanics, where the behaviour of physical systems is described in terms of the distribution of states. In this context, randomness corresponds to a lack of stable, constrained structure, while structured systems exhibit patterns of configuration and relationship that can be persistent over time and recurrent.

The interpretation of information as existing independently of observation reflects an ontological perspective consistent with contemporary physics and philosophy of science, in which structure and pattern are treated as real features of physical systems rather than purely interpretive constructs.

Within General Systems Theory, these ideas support the analysis of how entities are configured in space-time, how relationships give rise to structure, and how persistent, non-random structure constitutes information. They provide a foundation for further work on system behaviour, information dynamics, and thermodynamic processes.

Practical Exercise

Choose one real-world example (e.g. text, a physical object, a system, or a natural pattern).

1. Describe the **arrangement of its components**
2. Explain whether this arrangement is:
    - random
    - structured
3. Identify what **information** is present in that structure
4. Reflect:
    - What would happen if the structure were lost?

👉 Write a short paragraph explaining your example.