GST 11 – Abstract Entities as Distributed Physical Configurations

Formal Description

An **abstract entity** is a physically instantiated pattern distributed across space-time that cannot be apprehended in its entirety at a single moment.

Abstract entities may be understood in two complementary ways:

- **Extensional**: as a collection of concrete entities or events distributed across space-time.
- **Intensional**: as a characteristic or property defining a class of entities, which may be expressed logically or symbolically.

In the latter sense, characteristics may be understood as **fields of patterned occurrence across space-time**, where the presence or absence of the characteristic defines the structure of the field.

These two perspectives are equivalent: the extensional description identifies instances, while the intensional description defines the rule by which those instances are included.

Plain English Explanation

Some things are easy to point to, such as a chair, a tree, or a car. These are concrete entities that occupy a clearly defined region of space-time. However, concepts such as justice, temperature, or an ecosystem do not exist in one specific location in the same way. Because of this, they are often described as abstract, and sometimes it is assumed that they are not "real" in the same sense as physical objects. In systems theory, we take a different view.

An abstract entity is still physically real, but it is distributed across space and time. This is why it cannot be observed in its entirety at a single moment. Rather than being located in one place, it is spread across many locations and instances.

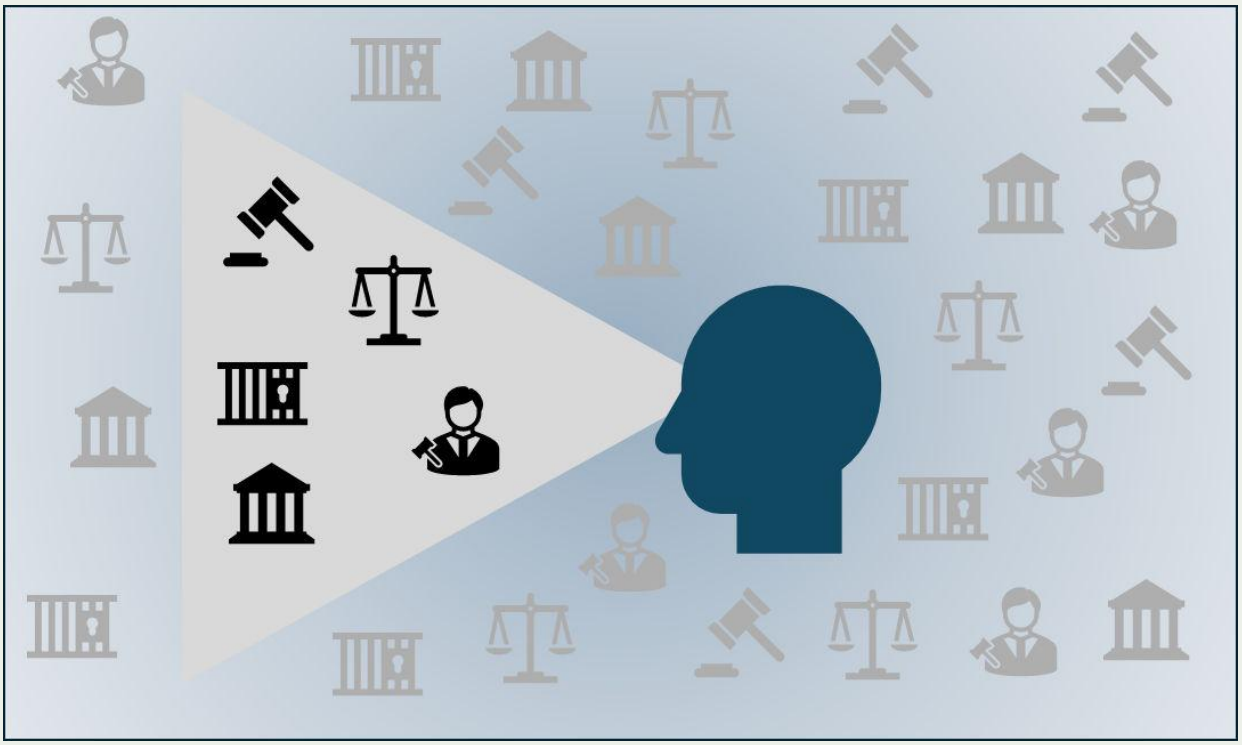
There are two complementary ways to understand such entities. The first is as a collection of instances, sometimes called the extensional view. From this perspective, an abstract entity consists of many concrete occurrences. Justice, for example, can be understood as the collection of individual actions that are considered just. An ecosystem consists of many organisms interacting across a region, and a traffic system consists of many vehicles and movements. Each instance is physically real, but the entity as a whole is distributed.

The second is as a characteristic or rule, sometimes called the intensional view. In this case, the abstract entity is understood as a property that applies to certain things. Justice becomes the property of being just, temperature becomes the degree of heat at different locations, and membership becomes the condition of belonging to a group. This can be expressed as a rule: all things that possess a given characteristic are included.

These characteristics can also be understood as fields distributed across space-time. Temperature, for example, exists at every point in a room, varying from place to place. Justice appears wherever just actions occur, and vegetation density varies across a landscape. In each case, the distribution of where something is present, and how strongly it is present, forms a field.

These two ways of thinking are equivalent. The collection view tells us where the entity occurs, while the characteristic view tells us what defines it. Together, they describe the same distributed physical configuration.

This perspective is important because it allows us to treat phenomena such as social systems, ecosystems, economic activity, and cultural norms as real, physically instantiated configurations rather than vague abstractions. This is essential for the development of a coherent systems theory.



Example 1 – Temperature in a Room
Temperature is not located in one place. It varies across the room.

- As a collection → many measurements at different points
- As a field → a continuous temperature distribution

👉 This is a physical field.

Example 2 – Justice in Society
Justice is not a single object.

- As a collection → many individual actions, laws, and decisions
- As a property → the condition of being just

👉 It exists as a distributed social pattern.

Example 3 – An Ecosystem
An ecosystem consists of many organisms interacting across a region.

- As a collection → individual species and interactions
- As a pattern → a structured system across space

👉 It cannot be fully observed at once.

Example 4 – Traffic Flow
Traffic in a city is:

- many individual vehicles (instances)
- forming patterns of movement (flows and densities)

👉 This can be represented as a field of activity.

Provenance and Links

This module draws on foundational ideas from philosophy, formal logic, and physics concerning the nature of properties, classes, and distributed phenomena.

The distinction between understanding entities as collections of instances and as properties or defining rules reflects a long-standing distinction in logic and philosophy between extensional and intensional definitions. This distinction has been developed in formal logic and analytic philosophy, including the work of Gottlob Frege, where the meaning of a concept can be understood either by the set of things it applies to or by the rule that defines it.

The treatment of abstract entities as physically instantiated configurations distributed across space-time aligns with contemporary physicalist approaches to ontology, in which apparently abstract phenomena are understood as arising from real physical states and processes rather than existing outside them. This perspective is reflected in modern philosophy of science and physics (e.g. Sean Carroll).

The interpretation of characteristics as fields connects directly to physical field theory, in which properties such as temperature, electromagnetic intensity, or pressure are understood as quantities defined at every point in space-time. Field-based descriptions are central to modern physics and provide a natural way of understanding distributed phenomena.

Within systems theory, these ideas support the treatment of social, ecological, and economic phenomena as real, distributed configurations that can be analysed in terms of both their instances and their defining characteristics. This provides a foundation for later work on structure, information, and complex systems.

Practical Exercise

Choose one abstract concept (for example: temperature, traffic, fairness, or population density).

1. Describe it as a **collection of instances**
2. Describe it as a **property or field**
3. Explain how these two descriptions refer to the same underlying reality

👉 Write a short paragraph explaining both views.