GST 17 — Summary and Transition to Systems

Formal Description

The ontology developed in the previous modules establishes that all empirically observable existence is realised within space-time and consists of physically instantiated entities distinguished by boundaries.

Entities may be considered individually or as collections and sets, exhibiting set duality. Abstract entities are understood as distributed physical patterns across space-time.

Structure is defined as the spatio-temporal configuration of entities, and information as non-random, recurring structure. Relationships connect entities either configurationally (through structure) or causally (through transfer). Events are time-bounded causal relationships, and networks are configurations of interconnected events.

Causality in systems may be represented both as transfers between systems (PTP) and as transformations within systems (TPT). Entities are described by characteristics, whose values define states, and changes in these characteristics constitute changes of state.

Together, these concepts provide the ontological foundation for systems theory.

Plain English Explanation

In this course, we have developed a way of understanding reality step by step. We began with the idea that everything we can observe exists within space and time, providing a common foundation for describing all phenomena. Within this space-time framework, we identified entities as distinguishable parts of reality, each defined by a boundary that separates it from its environment.

We then explored how entities can be grouped. Individual entities may form collections, and these collections can be treated as sets, allowing the same grouping to be understood either as many separate elements or as a single entity. This dual perspective provides a way of moving between different levels of analysis.

We also examined abstract entities, showing that they are not non-physical but are instead distributed configurations across space-time. Such entities can be understood either as collections of instances or as characteristics that define those instances, often taking the form of fields distributed across space and time.

Building on this, we considered how entities are configured and structured. Configuration describes the spatial and temporal positioning of entities, while structure reflects how entities and their relationships are organised. From this perspective, information can be understood as non-random, recurring structure in space-time, meaning that wherever stable patterns exist, information is present.

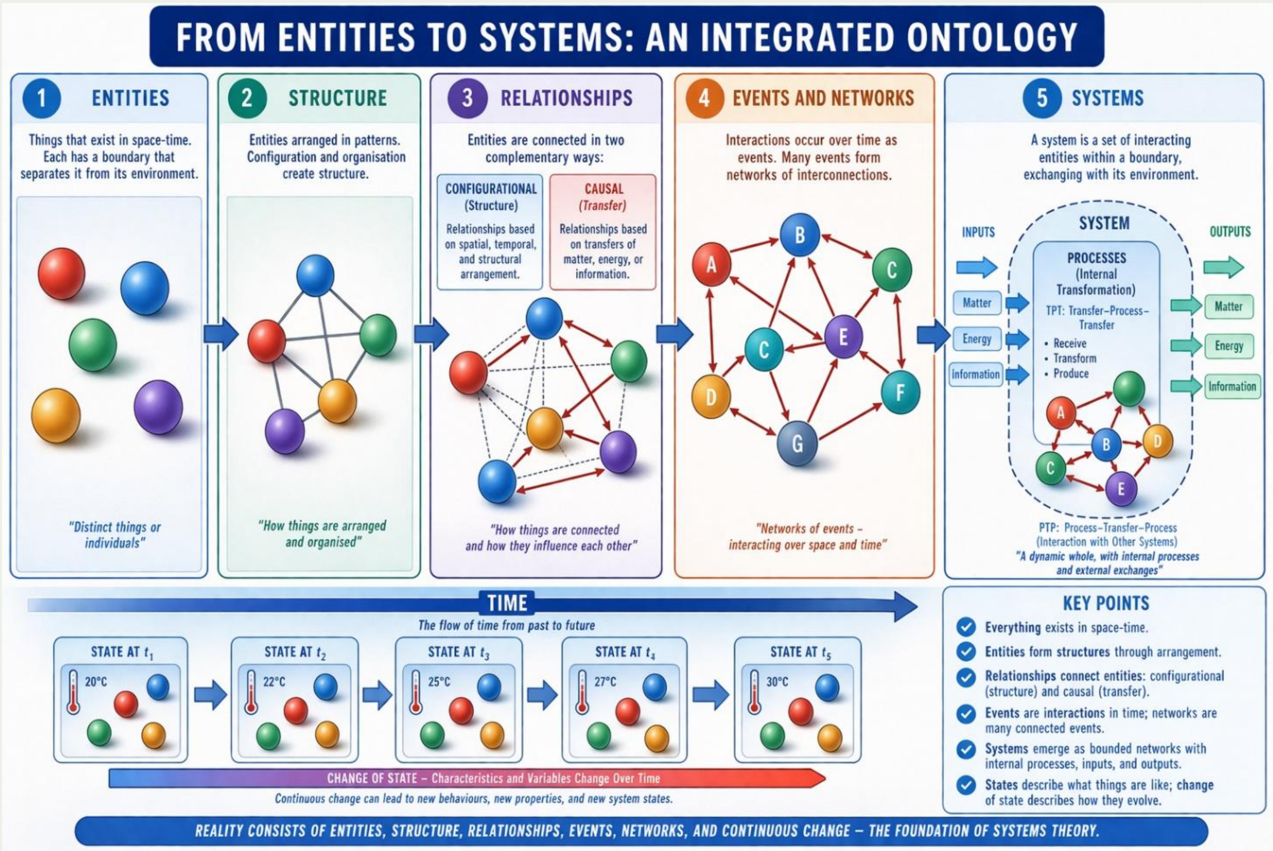
We then examined how entities are connected through relationships. Configurational relationships arise from the way entities are arranged, while causal relationships involve transfers of matter, energy, or information that produce change. These two forms are complementary: configuration determines what interactions are possible, while transfer brings about actual change.

From these relationships, we moved to events and networks. Events are time-bound instances of causal interaction, and networks are formed when many such interactions are linked together. Systems can therefore be understood as networks of interconnected events unfolding over time.

We then explored causality in more detail, showing that it can be represented in two complementary ways. The process–transfer–process (PTP) perspective describes causality in terms of interactions between systems, while the transfer–process–transfer (TPT) perspective describes what happens within systems. These are not different kinds of causality, but two ways of describing the same underlying processes.

Finally, we considered how entities are described and how they change. Characteristics define what an entity is like, variables are characteristics that can change, and the state of an entity is the set of its characteristics at a given moment. When these characteristics change, the state changes, and it is through such changes of state that systems evolve over time.

Taken together, these ideas provide a coherent picture of reality. Reality consists of entities configured in space-time, organised into structures, connected through relationships, interacting through events, forming networks, and undergoing continuous change. This integrated view forms the foundation of systems theory.



Example 1 – Human Body

- entities → cells
- structure → organs
- relationships → biological processes
- events → chemical reactions
- network → bodily systems
- change → growth, metabolism

👉 A complex system built from all the concepts.

Example 2 – A City

- entities → people, buildings
- structure → layout and infrastructure
- relationships → social and economic interactions
- events → transactions, movement
- network → transport and communication systems
- change → development over time

👉 A social system based on the same principles.

Example 3 – Ecosystem

- entities → organisms
- structure → habitats
- relationships → food chains
- events → energy transfer
- network → ecological interactions
- change → evolution and adaptation

👉 A natural system.

Provenance and Links

This module integrates concepts from systems theory, physics, cybernetics, and philosophy to present a unified ontological framework for understanding reality in systems terms.

The foundational idea that reality can be understood as a set of interconnected entities within space-time reflects developments in modern physics, where all observable phenomena are treated as occurring within a unified space-time framework. The description of systems in terms of components, relationships, and organisation builds on general systems theory, particularly the work of Ludwig von Bertalanffy, who emphasised that systems are organised wholes composed of interacting parts.

The treatment of relationships, interaction, and feedback draws on cybernetics, including the work of Norbert Wiener and W. Ross Ashby, where systems are understood in terms of communication, control, and transformation processes. These approaches highlight the interplay between structure and dynamic processes in producing system behaviour.

The representation of systems as networks of interacting elements aligns with developments in complexity and network science, including the work of Albert-László Barabási, where large-scale behaviour emerges from patterns of interconnected interactions.

The description of systems in terms of states, variables, and change over time reflects foundational ideas in physics and dynamical systems theory, including the work of Henri Poincaré, where system behaviour is understood as trajectories through a space of possible states.

The integration of these perspectives into a single framework reflects the central aim of General Systems Theory: to provide a coherent way of understanding how entities, structure, relationships, events, and change combine to produce systems and their behaviour. The explicit unification of these elements into a single ontological progression is developed here as part of this framework.

This integrated view provides the conceptual foundation for subsequent work on structure, information, thermodynamics, and the analysis of complex social and natural systems.

Practical Exercise

Choose one real-world system (e.g. a household, a business, a natural system).

Describe it using the concepts from this course:

1. Identify the **entities**
2. Describe the **structure**
3. Identify **relationships** (configurational and causal)
4. Identify **events** and **networks**
5. Describe how the system **changes over time**

👉 Write a short structured description using these headings.