GST 47 – Continua and Dimensions

Formal Description

Many properties vary over a range of possible values rather than existing in only one condition. Such ranges are referred to as continua, while the aspects of reality along which properties vary are referred to as dimensions. A dimension provides a framework for describing variation in a particular property, enabling entities to be compared according to their positions within that range. Continua and dimensions provide the foundation for describing variables, values and system states.

Plain English Explanation

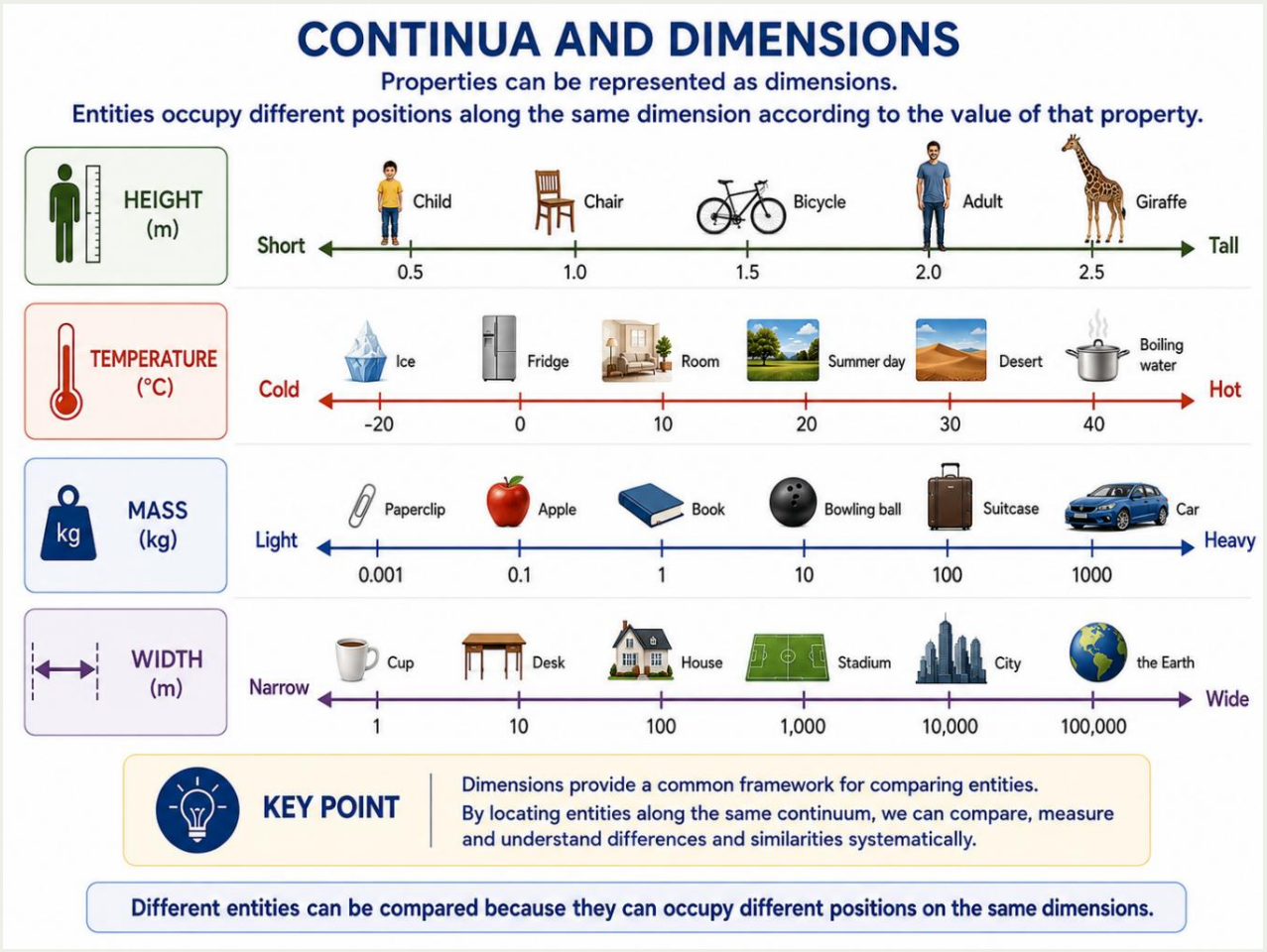
Many of the properties we use to describe entities can vary. A person may be tall or short, a river may be wide or narrow, and a vehicle may travel quickly or slowly. These descriptions are useful, but they simplify what is often a continuous range of possibilities.

Consider the height of a tree. There is no single height that separates a "short" tree from a "tall" tree. Instead, height varies continuously from very small values to very large ones. We describe this continuous range as a continuum. The underlying aspect of reality along which height varies is called a dimension.

The same idea applies to many other properties. Temperature varies from colder to hotter values. Mass varies from lighter to heavier values. Distance varies from nearer to farther locations. In each case, the property changes along a dimension that allows different entities to be compared.

Not every property forms a smooth continuum. Some properties have distinct categories, such as biological species or blood groups. Many such properties can be represented as discrete dimensions with a limited set of possible values. Nevertheless, a very large proportion of the properties used in science, engineering and everyday life can be represented as dimensions with values that vary over a continuum.

Understanding dimensions is important because it allows us to describe entities more precisely. Instead of simply saying that two objects are heavy or light, we can compare their positions along the same dimension. This prepares us for the next module, where these positions become the values of variables used to describe the state of a system.



Examples

The height of three trees can be compared because they all possess the property of height. Although each tree has a different value, all three values lie along the same height dimension.

Similarly, the temperatures recorded in different cities can be compared because temperature is measured along a common dimension. One city may be warmer than another, but both occupy positions within the same temperature continuum.

Provenance and Links

The idea of representing properties as dimensions has developed through mathematics, physics and engineering, where quantities are commonly represented as continuous variables. René Descartes' development of coordinate geometry demonstrated how positions could be represented along dimensions, while later developments in mathematics and measurement theory extended dimensional thinking to many other properties. State-space methods, widely used in engineering and dynamical systems theory, depend upon representing system properties as dimensions whose values change through time.

Practical Exercise

Choose five properties that can be observed in your everyday surroundings. For each property, identify the dimension along which it varies and describe the range of possible values.

Now select two entities that possess each property and compare their positions along the relevant dimension. Finally, consider whether any of the properties would be better described using categories rather than a continuum, and explain your reasoning.