

# 11. An Attempt at a Formalisation of “The Urban Space”

## 11.1. Main Parts

- To the left, in the framed box, we **narrate** the story.
- To the right, in the framed box, we **formalise** it.
- One way of observing *the urban space* is presented:

65 We can speak of The Urban Space,  
 TUS, in terms of its  
 66 GeoDecy (i.e., geodetic features),  
 67 GeoTechniques,  
 68 Meteorology,  
 69 Social features,  
 70 Economic features, etcetera.

**type**

65 TUS, GeoD, GeoT, Met, Soc, Eco, ...

**value**

66 obs\_GeoD: TUS  $\rightarrow$  GeoD

67 obs\_GeoT: TUS  $\rightarrow$  GeoT

68 obs\_Met: TUS  $\rightarrow$  Met

69 obs\_Soc: TUS  $\rightarrow$  Soc

70 obs\_Eco: TUS  $\rightarrow$  Eco

- The  $\text{obs}_P: M \rightarrow P$  is the **signature** of a postulated (*observer*) *function*.
- From parts of type  $M$  it **observes** [sub-]parts of type  $P$ .

## 11.2. Attributes

### 11.2.1. Urban Space Attributes – Informal

- Attributes are also called *properties*, *qualities* or *indicators*.
- We list some urban space attributes:
  - ❖ *Geodetic*:
    - ⊗ land elevation (isometric lines etc.)
    - ⊗ water: springs, creeks, rivers, lakes, oceans; dams, canals, ...
    - ⊗ road net: lanes, road, highways, freeways/toll-roads, tunnels, bridges, ...
  - ❖ *Geotechnical*:
    - ⊗ top layer soil composition
    - ⊗ lower layer soil etc. composition, by depth levels
    - ⊗ ground water occurrence, by depth levels
    - ⊗ gas, oil occurrence, by depth levels

❖ *Meteorological:*

- ⊗ **precipitation**<sup>12</sup>, for example, averaged by month (incl., perhaps, “hi/lo”), and possibly also changes by year, past and future
- ⊗ **air humidity**, by level, for example, averaged by month (incl., perhaps “hi/lo”), and possibly also changes by year, past and future
- ⊗ **evaporation**, by level, for example, averaged by month (incl., perhaps, “hi/lo”), and possibly also changes by year, past and future

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<sup>12</sup>Precipitation: the amount of rain, snow, hail, etc., that has fallen at a given place within a given period, usually expressed in inches or centimeters of water.

- *Social and Citizen Economics:*

- ❖ **income distribution**,  
currently, by year, ...  
and possibly also changes by year, past and future
- ❖ **housing situation**,  
by housing category: apt., etc.; currently, by year, ...  
and possibly also changes by year, past and future
- ❖ **migration**,  
and possibly also changes by year, past and future
- ❖ **social welfare support**,  
by citizen category  
and possibly also changes by year, past and future
- ❖ **health status**,  
by citizen category  
and possibly also changes by year, past and future
- ❖ etcetera.

- *Industry and Business Economics:*

- ◇ ... ,

- ◇ ... ,

- ◇ ... ,

etcetera.

- *Etcetera.*

## 11.2.2. General on Attributes

- Parts (like TUS, GeoD, GeoT, ...) “possess” attributes.
- Attributes are intrinsically associated with parts, that is, with a part type.
- All parts of a given type have the same attributes.
- We must distinguish between an *attribute name* and an *attribute value*.
  - ⊠ Let  $\eta A_1, \eta A_2, \dots, \eta A_n$  be all the attribute names of parts of type  $P$ .
  - ⊠ Then two different parts,  $p_i$  and  $p_j$ , of type  $P$ ,
    - ⊗ may have the same value,  $\text{attr}_{\eta A_k}(p_i)$  respectively  $\text{attr}_{\eta A_k}(p_j)$ , for attribute  $A_k$ ,
    - ⊗ or may have different values.
- If you try “remove” (whatever that would mean) an attribute
  - ⊠ from a part, of a given type, say  $P$ ,
  - ⊠ then that ‘part’ is no longer of type  $P$ .

## 11.2.3. Urban Space Attributes – Formal

### 11.2.3.1 General

- Informal attribute names were given on slides 112–115 in the  $\diamond$  itemized entries.
- We now treat attribute names and value abstractly.

71 Let  $\eta A_1, \eta A_2, \dots, \eta A_n$  be the (undoubtedly large) set of all attribute *names of interest* for some urban space.

72 And let  $A_1, A_2, \dots, A_n$  be type names for for corresponding attribute value sets.

73 The observation, from a part of type  $P$ , (which has attributes of name  $\eta A$ ) of values of type  $A$  is expressed by the attribute observer function  $\mathbf{attr}_{\eta A}$ .

#### type

71  $\eta A_1, \eta A_2, \dots, \eta A_n$

72  $A_1, A_2, \dots, A_n$

#### value

73  $\mathbf{attr}_{\eta A_i}: P \rightarrow A_i \quad [\text{for } 1 \leq i \leq n]$

## 11.2.3.2 Structured Attributes



## 11.2.3.3 An Analysis of Structured Attributes

## 11.2.3.4 Structured Attribute Names

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## 11.2.3.5 Structured Attribute Values

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