Last Lecture

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5. A Triptych of Urban Planning ?

5.1. The Triptych of Software Engineering

- A major principle of ours for developing software is embodied in the **Triptych** method:
  - Before **software** can be developed we must understand its **requirements**.
  - Before requirements can be expressed we must understand the **domain**.

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- So we proceed in three, more-or-less consecutive phases:
  - **domain engineering**,
  - **requirements engineering** and
  - **software design**.
- verifying (validating, proving, testing) properties of
  - the **domain**,
  - the **requirements**,
  - the **domain-to-requirements** "translation",
  - the **software** and the
  - the **requirements-to-software** "translation".

5.2. The Triptych of Urban Planning !

- Before **urban plans** can be developed
  we must understand their **requirements**.
- Before requirements can be expressed
  we must understand the **domain**.

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- We have outlined the **Triptych of Software Development.**
- What is the parallel **Triptych for Urban Planning ?**
  I think it is this:
  - The **domain engineering of urban planning**
    is to get to understand and thus describe The Urban Space
    — before it is plannned.
    This means the development of all *The Urban Space Information:*
    - proper geodetic information,
    - proper geotechnic information,
    - proper meteorological information,
    - proper socio-economic information,
    - proper ecological information,
    - proper urban space laws,
    - etcetera.

- The **requirements engineering of urban planning** is to get to understand the customers expectations. This means the development of *The Urban Plan Requirements:*
  - proper requirements for master plan,
  - proper requirements for zoning,
  - proper requirements for residential, office, shopping and recreational areas, ...
  - proper requirements for electric power, gas, ...
  - proper requirements for wasfer management, ...
  - etcetera
- The **"software design" of urban planning** is to actually develop *The Urban Plan.*

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6. Urban Planning Management

- The description we have given of urban planning emphasizes an iterative nature of urban planning.
- Individual urban planning behaviours, such as we describe it, alternate between many, more-or-less consecutive actions:
  - gathering ("reading") information for urban planning functions;
  - actually applying urban planning functions;
  - possibly starting new, derived urban planning behaviours while
  - collecting ("writing") function results.
- The base and derived urban plannings may thus involve hundreds of urban planning actions
  - their timely interaction (via oracles and repositories)
  - and consistent "production" and "use" of information.

- The urban planning description makes precise these interactions, "productions" and "usages".
  - Thus the described urban planning development process model can serve as a basis for a computerised project management support system.
- Thus, from the description we can
  - "refine" the requirements for such software,
  - and we can then code the software design.

This is a major project.

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7. Data Management

- The description we have given of urban planning emphasizes also, one can say, separately,
  outlines major classes of information, i.e., data:
  - their iterated "production" and "use";
  - their "oracled" origin or
  - their "reposited" storage.
- These classes of information, and there are many,
  - need be formalised
  - and related.

- Thus the description may also serve as a basis for the
  - the development of requirements
  - and subsequent development of software

  for an *Urban Planning Database System*.

This is [also] a major project.

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8. Validation & Verification

8.1. Validation of a Specification of a Product

- Validation of a specification of a product is a process and a document which
  - ensures that the document specifies the right product,
  - that is, that the customer gets what is expected,
  - and that the process leads to such a document.

8.2. Verification of a Specification of a Product

- Verification of a specification of a product is a process and a document which
  - ensures that the document specifies the product right,
  - that is, that the product is correct, ie., does not fail,
  - and that the process leads to such a specification (for us: software).

8.3. V&V of the Domain Description

- So we need to formalise first our understanding of what we mean by:
  - geodetic,
  - geotechnic,
  - meteorology,
  - social,
  - economic,
  - auxiliary,
  - plan, and
  - ancillary

  information.
- Only then does it make sense to express what we mean by
  - validating and
  - verifying

  the model.

8.4. V&V of an Urban Planning Project

- Similarly !

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9. Discussion

9.1. What Have We Done ?

- Identification of Urban Planning Information Categories
- A Process Model for Urban Planning and its Formalisation
- Identification of Base- and Derived Urban Plannings
- Focus of an Iterative Nature of Urban Planning
- The Process Model as
  A Basis for Urban Planning Management
- The Information Categories as
  A Basis for Urban Planning Data Management

9.2. What Have We Not Done !

- We have not Formalised the Urban Planning Information Categories.
  - ⟐ In Sect. **??** we make a first attempt !
- We have not described the Urban Planning Functions, at all !

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9.3. What Can I Do in September 2017 ?

- Make more precise the Categories of Urban Planning Information[11]
- Sketch initial Formalisations of some of these.
- An attempt is made as from Slides 113 on ...
- Validate or refute Aspects of the Urban Planning Process Model
- Make more precise some of the Urban Planning Functions
- Sketch initial Formalisations of some of these

. . . . . .

[11] *Please: I wish to examine available example of all the eight kinds of urban planning information listed in the first • on Slide 105.*

9.4. Further to Be Done

- Requirements for Urban Planning Project Management Software
- Requirements for Urban Planning Data Management Software

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10. Closing Words

Thanks for inviting me to TongJi !

11. References

Springer Publishers:

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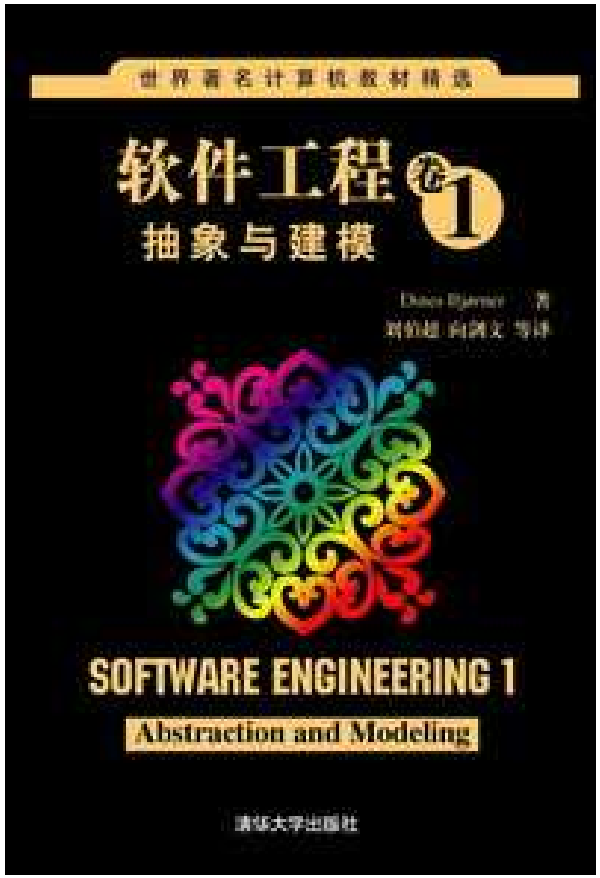
QinHua University Press:



12. An Attempt at a Formalisation of "The Urban Space"

12.1. 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 → GeoD
67 obs_GeoT: TUS → GeoT
68 obs_Met: TUS → Met
69 obs_Soc: TUS → Soc
70 obs_Eco: TUS → Eco

- The obs_P: M → P is the **signature** of a postulated *(observer) function.*
- From parts of type M it **observes** [sub-]parts of type P.

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12.2. Attributes

12.2.1. 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**[12], 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

[12] 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.

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- *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.*

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12.2.2. General on Attributes

- Parts (like TUS, GeoD, GeoT, ...) "possess" attributes.
- Attributes are intrisically 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 $\eta\mathsf{A}_1$, $\eta\mathsf{A}_2$, ..., $\eta\mathsf{A}_n$ 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, $\mathsf{attr\_}\eta\mathsf{A}_k(\mathsf{p}_i)$ respectively $\mathsf{attr\_}\eta\mathsf{A}_k(\mathsf{p}_j)$, 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.

12.2.3. Urban Space Attributes – Formal

12.2.3.1 General

- Informal attribute names were given on slides 114–117 in the ⟐ itemized entries.
- We now treat attribute names and value abstractly.

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

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

73 The observation, from a part of type P, (which has attributes of name ηA) of values of type A is expressed by the attribute observer function attr_ηA.

type
71 $\eta A_1, \eta A_2, ..., \eta A_n$
72 $A_1, A_2, ..., A_n$
value
73 attr_ηA_i: P → A_i [for 1≤i≤n]

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12.2.3.2 Structured Attributes

12.2.3.3 An Analysis of Structured Attributes

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12.2.3.4 Structured Attribute Names

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12.2.3.5 Structured Attribute Values

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