Notional models based on primary mental abstractions

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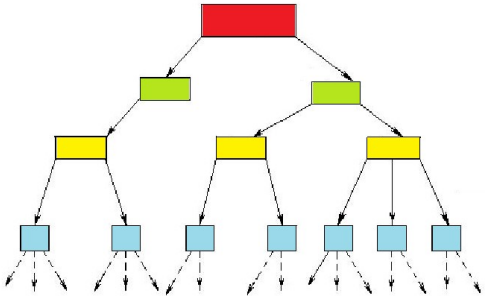
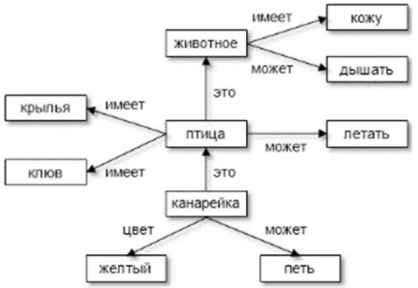
Conceptual approach

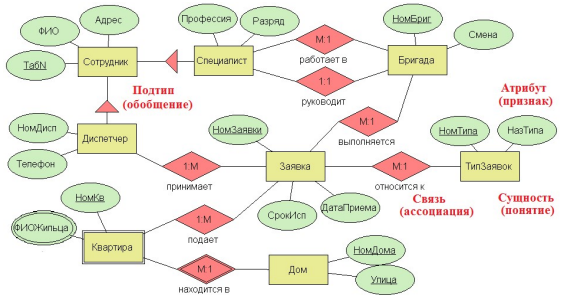
- Logical models
- Production rule models
- Frame models
- Semantic networks
- Entity-Relationship models
- Object models

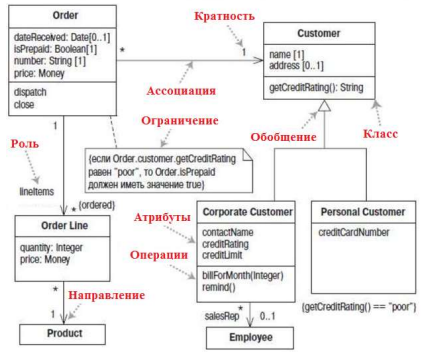
$$\exists x S(x) \;\&\; \exists x P(x) \;\&\; \exists x M(x)$$
$$\exists x \neg S(x) \;\&\; \exists x \neg P(x) \;\&\; \exists x \neg M(x)$$
$$\forall x (M(x) \supset \neg P(x))$$
$$\forall x (S(x) \supset \neg\neg M(x))$$
$$\exists x S(x)$$
$$S(x) \supset \neg\neg M(x)$$
$$\neg\neg M(x)$$
$$M(x) \supset \neg P(x)$$
$$\neg P(x)$$
$$S(x) \;\&\; \neg P(x)$$
$$\exists x (S(x) \supset \neg P(x))$$



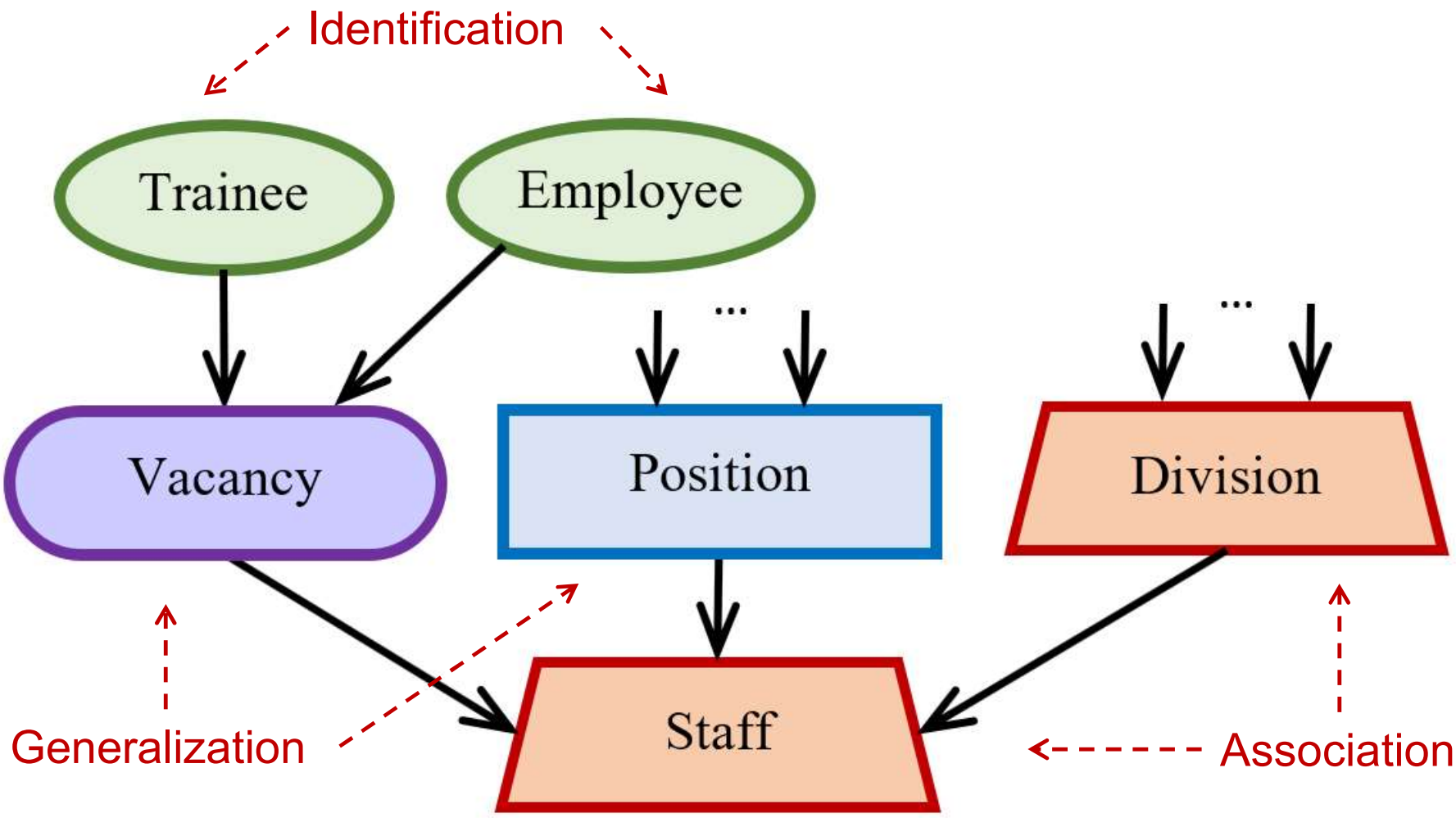
РУКОВОДИТЕЛЬ		
Имя слота	**Значение слота**	**Тип значения слота**
Имя	Иванов И. И.	Строка символов
Рожден	01.01.1965	Дата
Возраст	age(Рожден)	Процедура
Специальность	Юрист	Строка символов
Отдел	Отдел кадров	Строка символов
Зарплата	80000	Число
Адрес	ДОМ_АДРЕС	Фрейм







Notional approach

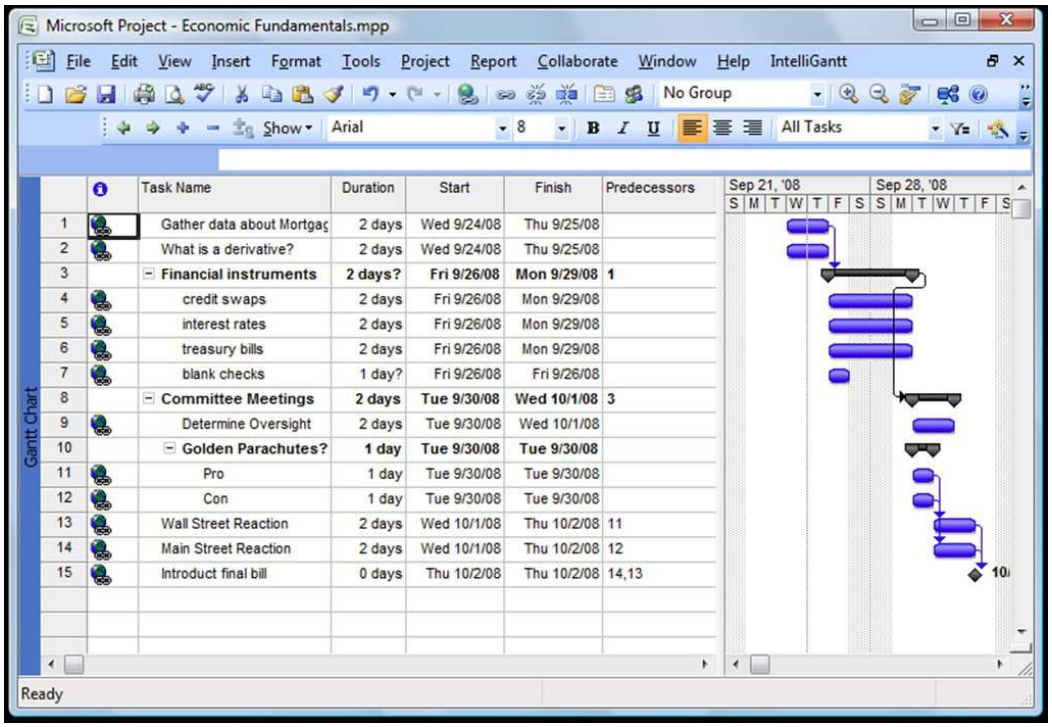


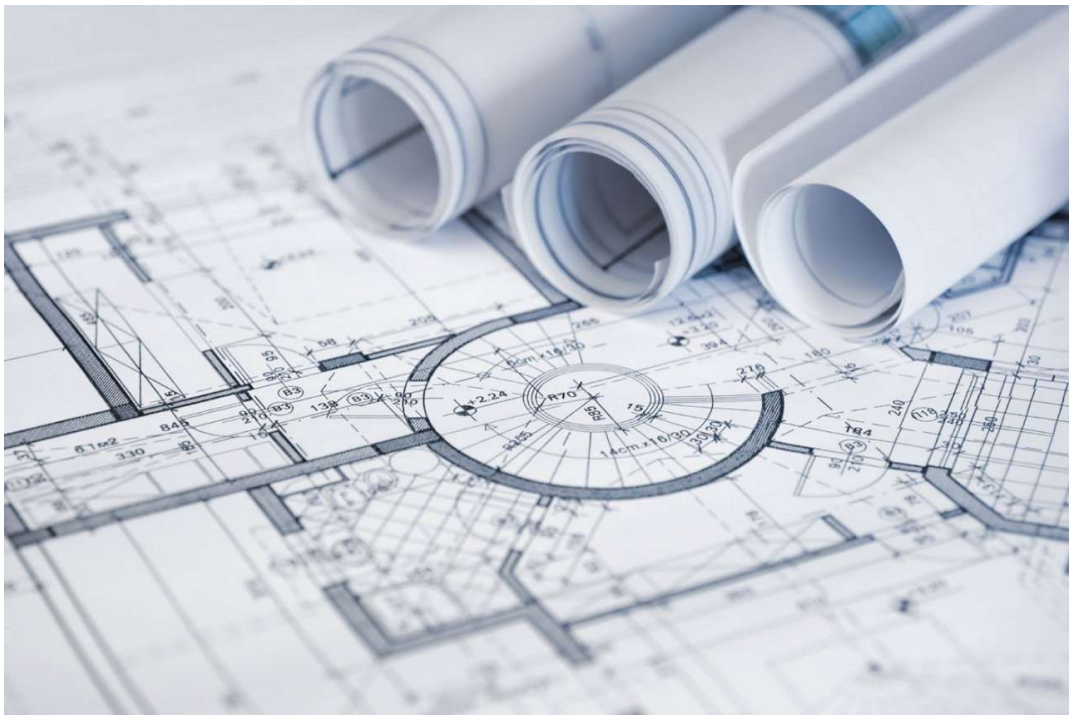
Notions and Concepts

A **notion** is a kind of thought that relates to a certain set of unique representations (**entities**) of the inner or outer world of a person (**a subject domain**).

A **concept** is a general notion, an abstract idea, consists of **instances**; each instance is characterized by a set of **properties**.

Aspects





Notion of Project@Plan

Notion of Project@Design

Concept of Project

Mental abstractions

Identification is *the replacement* of the entity with a notion-sign.

Generalization (**Typification**) is *the union* of notions (notion-signs) so that the entities the notion-generalization (notion-type) are the all entities of the generalized (typed) notions.

Association is *the joining* of notions so that the entity of the notion-association includes one of the entities of the associated notions.

Example of notions

Notion-signs are Red, Long, One, First, Many, Often, Love, Other, etc.

Notion-type is Color, which union the notions-signs of Red, Green, Blue, etc.

Notion-generalization is Tree, which is the union of the notion-entities of such notions as Birch, Beech, Fir, Pine, Poplar, etc.

Notion-association is Weather, which joins such notions as Place, Date, Temperature, Humidity, Wind, Cloudiness, etc.

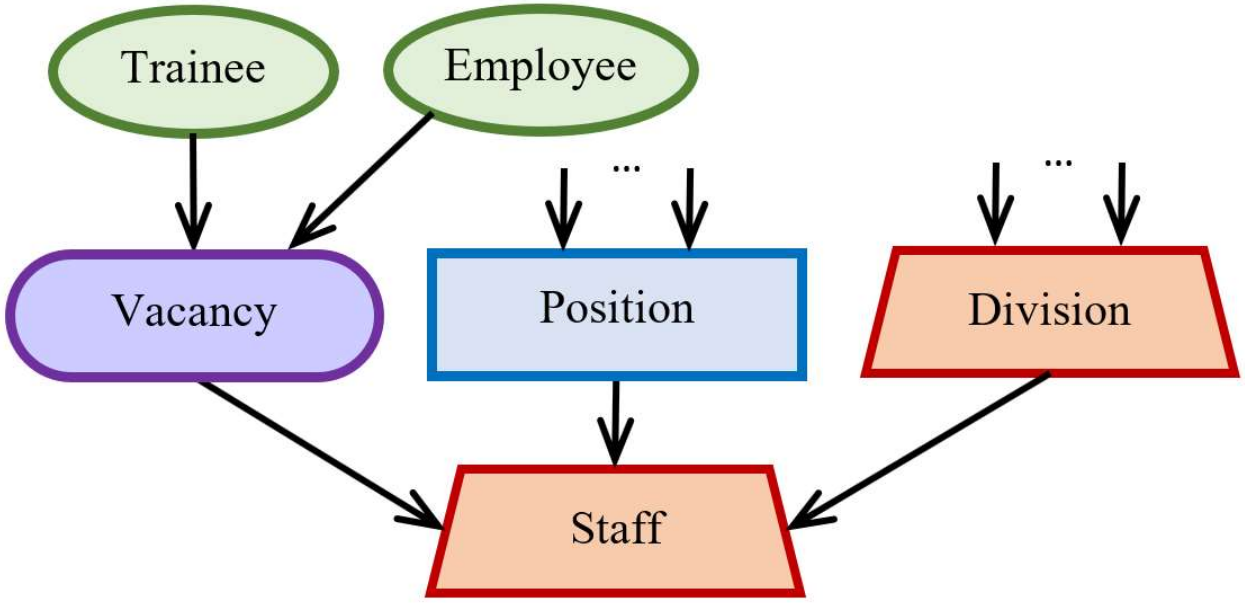
Notional structures

Abstractions are **C**, **T**, **G**, **A**. Notion is Concept@Aspect.

A schema of a notion is (Concept@Aspect, Abstraction, Notion, …).

Common attributes

Private attributes



(Trainee@, **C**)

(Employee@, **C**)

(Vacancy@, **T**, Trainee@, Employee@)

(Position@, **G**, …)

(Division@, **A**, …)

(Staff@, **A**, Vacancy@, Position@, Division@)

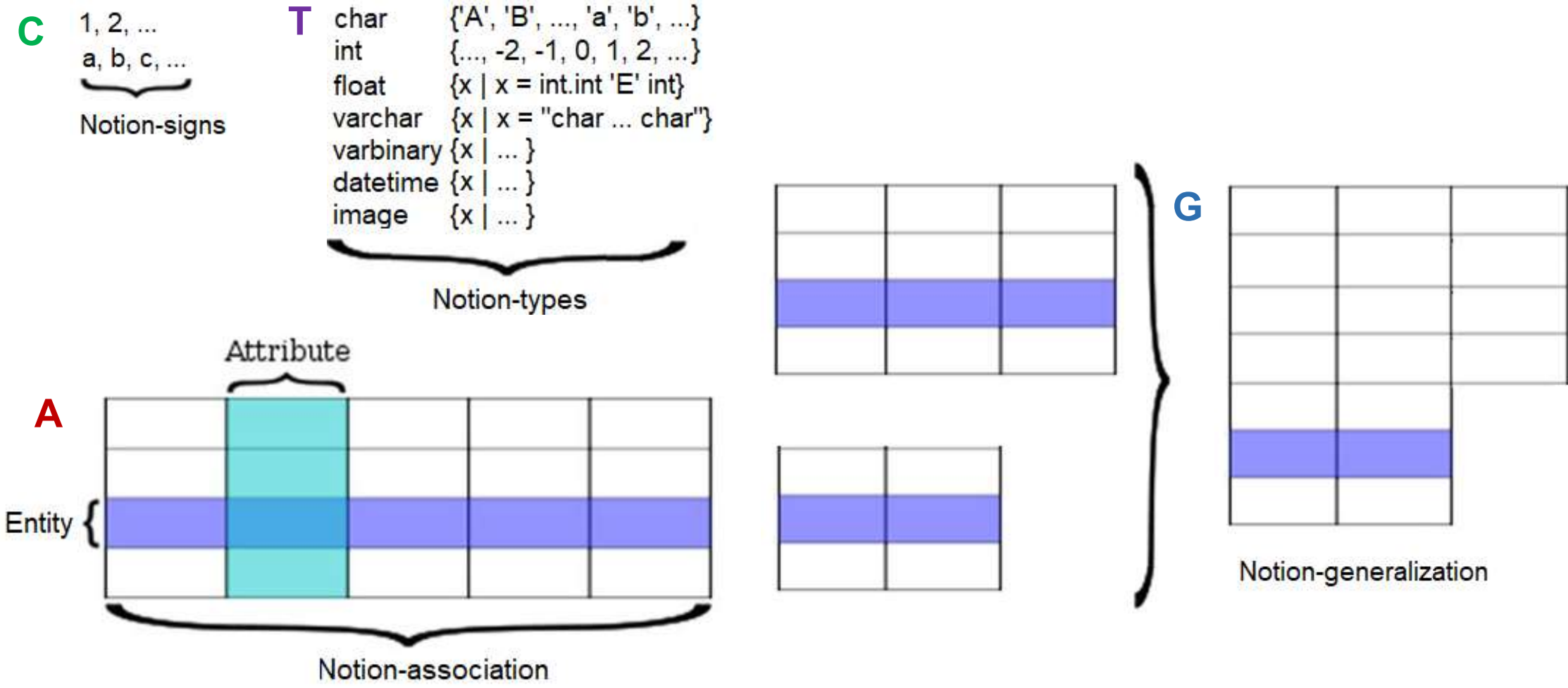
Notional models

A notional model M of some subject domain is its notional structure S that is supplemented by a description of contents D of all notions in it,

$$M = \{S, D\},$$

where the contents D is the set of the enumerable or solvable sets of the notion-entities belonging to each notion in S.

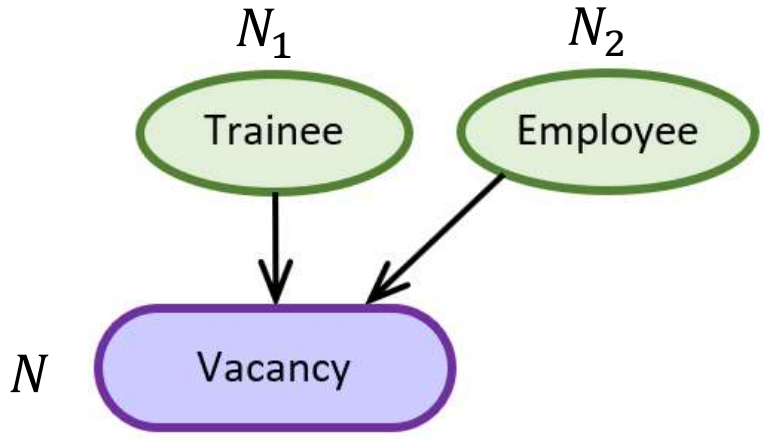
Content of notions



Inference rules

$$N(E) \leftrightarrow \bigvee_{\forall N_i \in N} N_i(E)$$

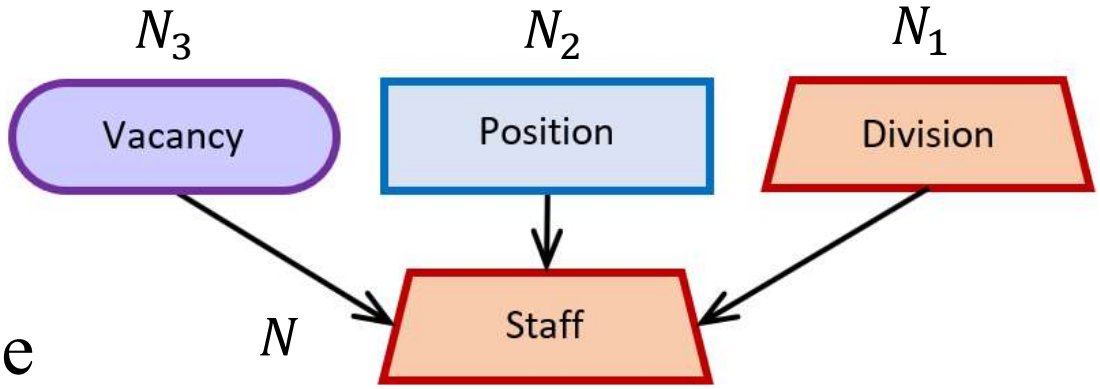
$N(E)$ – the predicate of belonging of the entity E to the notion N.



$\text{Vacancy}(E) \leftrightarrow \text{Trainee}(E) \vee \text{Employee}(E)$

$$N(E) \rightarrow \bigwedge_{\forall N_i \in N} N_i\{E\}$$

$N\{E\}$ – the predicate of the existence the attribute N in the entity E.



$\text{Staff}(E) \rightarrow \text{Division}\{E\} \wedge \text{Position}\{E\} \wedge \text{Vacancy}\{E\}$

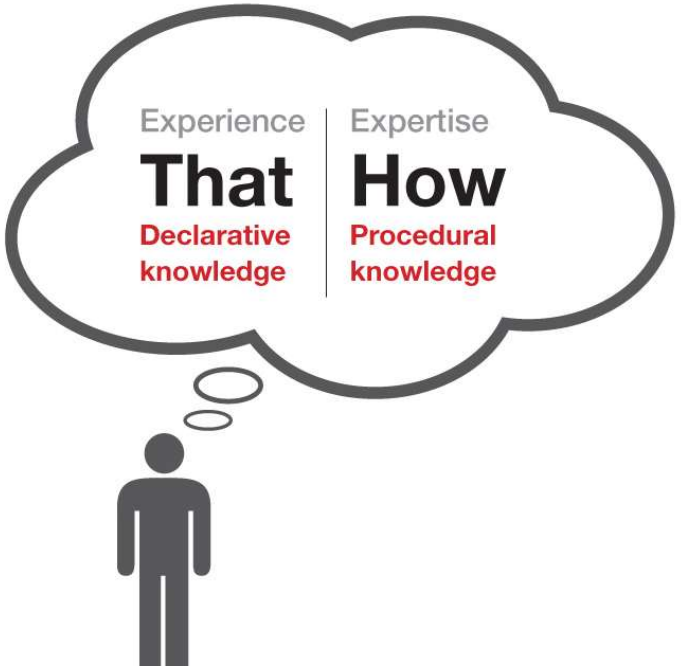
Declarative knowledge

Facts are true propositions with logical connectives AND ($\wedge$), OR ($\vee$), NOT ($\neg$), parentheses **(** and **)**, and two types of atomic propositions:

- a predicate $\boldsymbol{N(E)}$ of belonging of the entity E to the notion N;

- $\boldsymbol{N[E]\circ V}$, where $N[E]$ is a functor that returns the entity of the attribute N of the entity E, $\circ$ is a relation that allowed between entities $N[E]$ and V.

Procedural knowledge



Abstraction operations:
[N1 : X1, …, ND : XD] – new association,
{N1 : X1, …, ND : XD} – new generalization.
Intensional operations:
X[] – number of attributes the notion X,
X[Y] – access to attribute Y of the entity X,
[X]Y – access to attribute X of the notion Y,
[]X – the notion of the entity X.
Extensional operations:
X{} – number of entities of the notion X,
X{Y} – access to the entity Y the notion X,
{X}Y – creation a entity X of the notion Y,
{}X – deletion the entity X.

Conclusions

1) It is used an another semantic invariant in addition to formal logic – the notional language.

2) A concept can be presented as a set of eponymous notions in various aspects.

3) The notional language is better then the description logic.

Thank you for your attention!