The Second International Symposium on
Computer Science, Digital Economy and Intelligent Systems
(CSDEIS2020)

18-20 December 2020
Moscow, Russia

Intelligent Information Systems based on Notional Models without Relationships

Valery S. Vykhovanets

Institute of Control Sciences of the Russian Academy of Sciences,
Bauman Moscow State Technical University

Knowledge representations

Logical model

Production rule model

Frame model

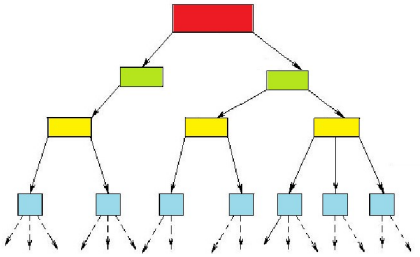
Semantic network

Entity-Relationship model

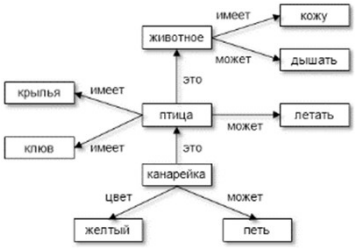
Object model

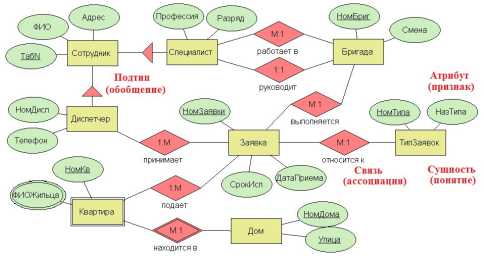
Notional model

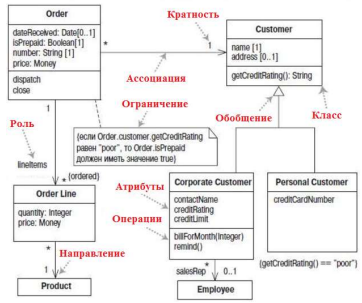
$$\exists x S(x) \,\&\, \exists x P(x) \,\&\, \exists x M(x)$$
$$\exists x \neg S(x) \,\&\, \exists x \neg P(x) \,\&\, \exists x \neg M(x)$$
$$\forall x (M(x) \supset \neg P(x))$$
$$\forall x (S(x) \supset \neg\neg M(x))$$
$$\exists x S(x)$$
$$S(x) \supset \neg\neg M(x)$$
$$\neg\neg M(x)$$
$$M(x) \supset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



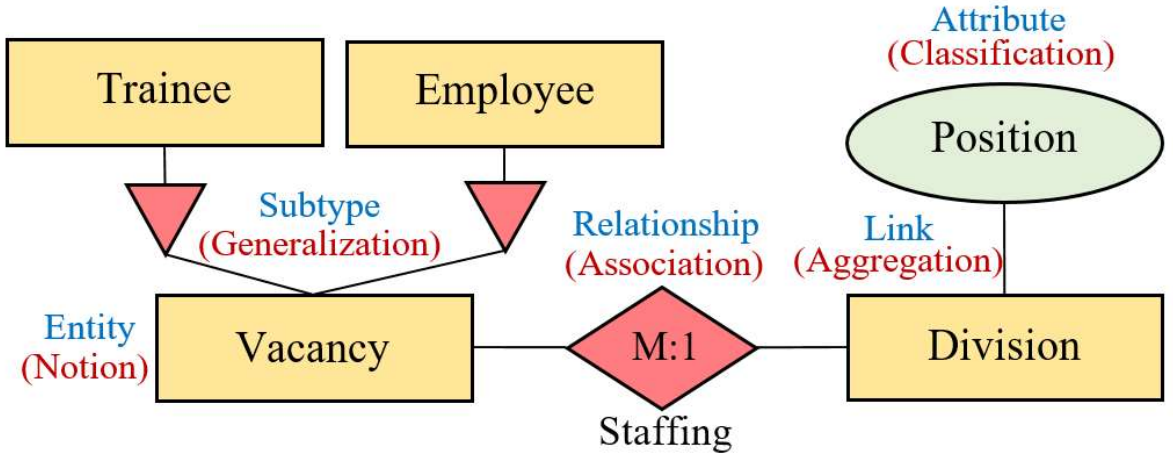
РУКОВОДИТЕЛЬ		
Имя слота	**Значение слота**	**Тип значения слота**
Имя	Иванов И. И.	Строка символов
Рожден	01.01.1965	Дата
Возраст	age(Рожден)	Процедура
Специальность	Юрист	Строка символов
Отдел	Отдел кадров	Строка символов
Зарплата	80000	Число
Адрес	ДОМ_АДРЕС	Фрейм







Entity-Relationship models



Notions

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 (**subject domain**).

Notions are formed (defined) during the mental **abstraction** by performing mental operations on entities.

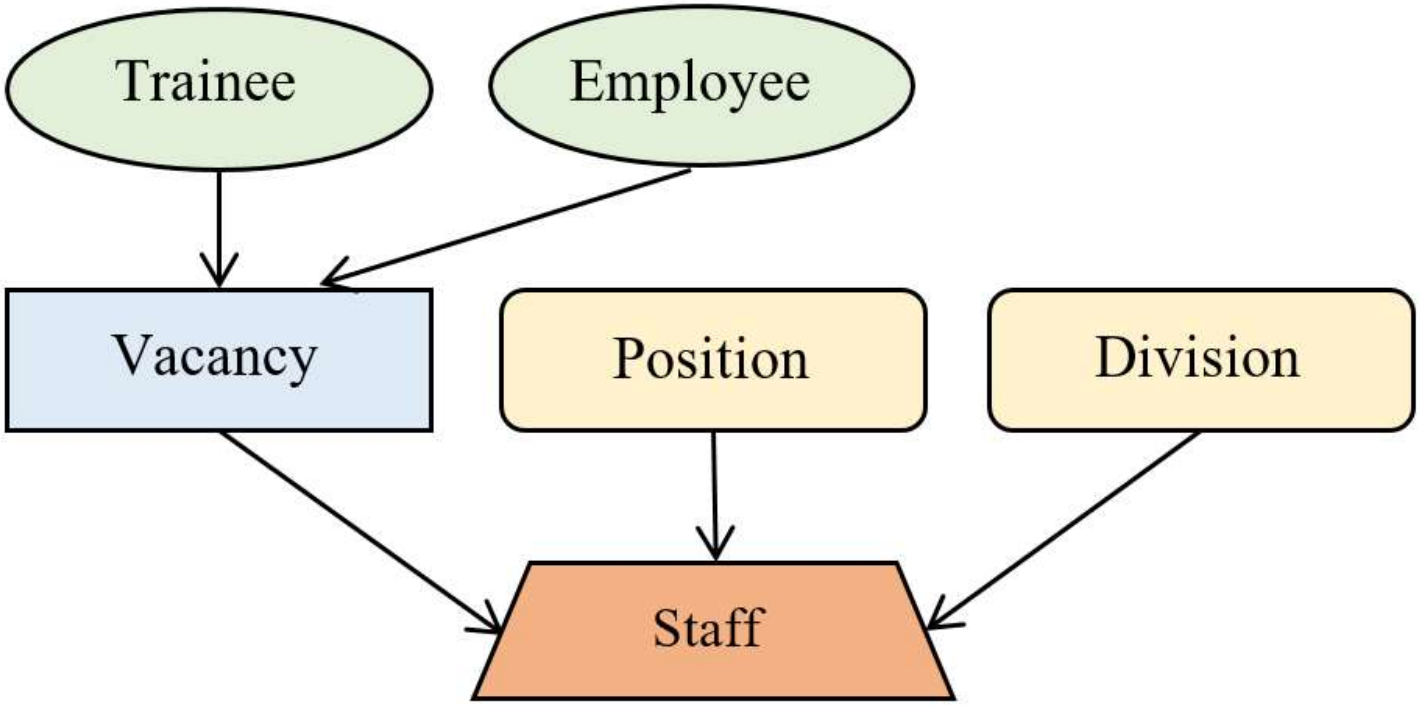
Abstractions

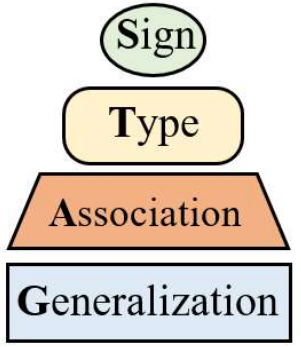
Identification is the replacement of the entity with a notion-sign.

Generalization is the union of notions so that the entities the notion-generalization are the all entities of the generalized notions.

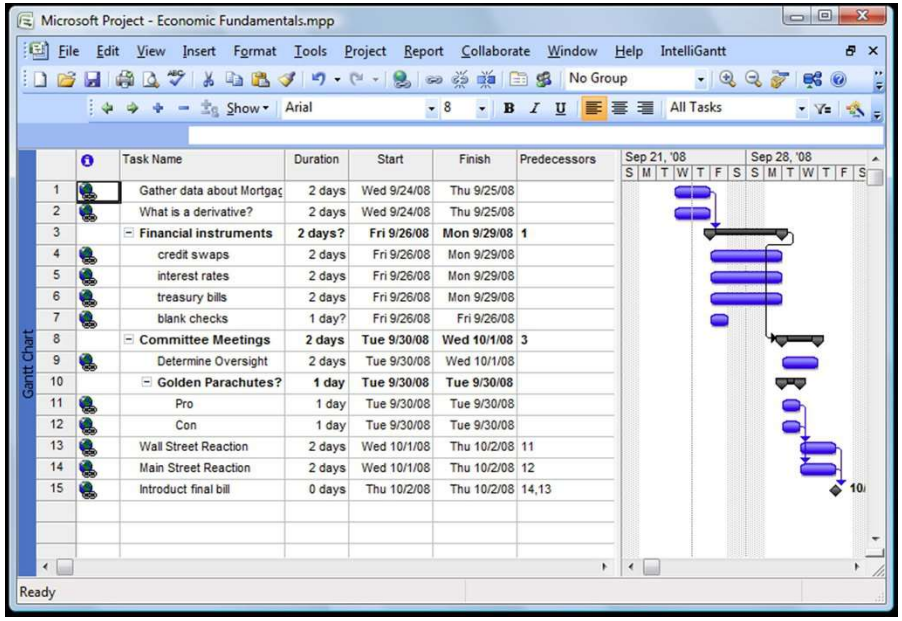
Association is the joining of notions so that the entity of the notion-association includes one of the entities of the associated notions.

Notional analysis

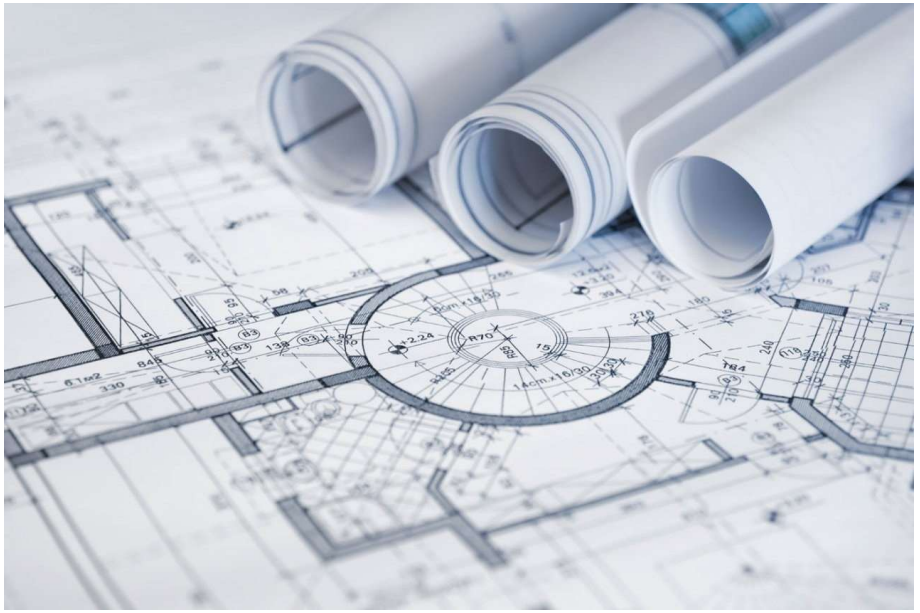




Problem areas



Project @ Plan

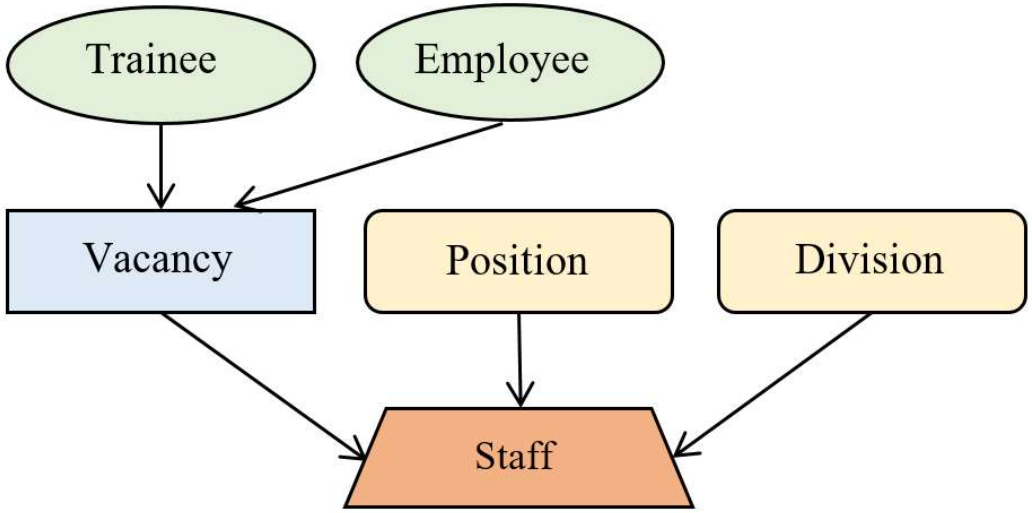


Project @ Design

Notional structures

A schema of a notion (Title @ Aspect, Abstract, Notion, …)

Common attributes — Private attributes



(Trainee, **S**)

(Employee, **S**)

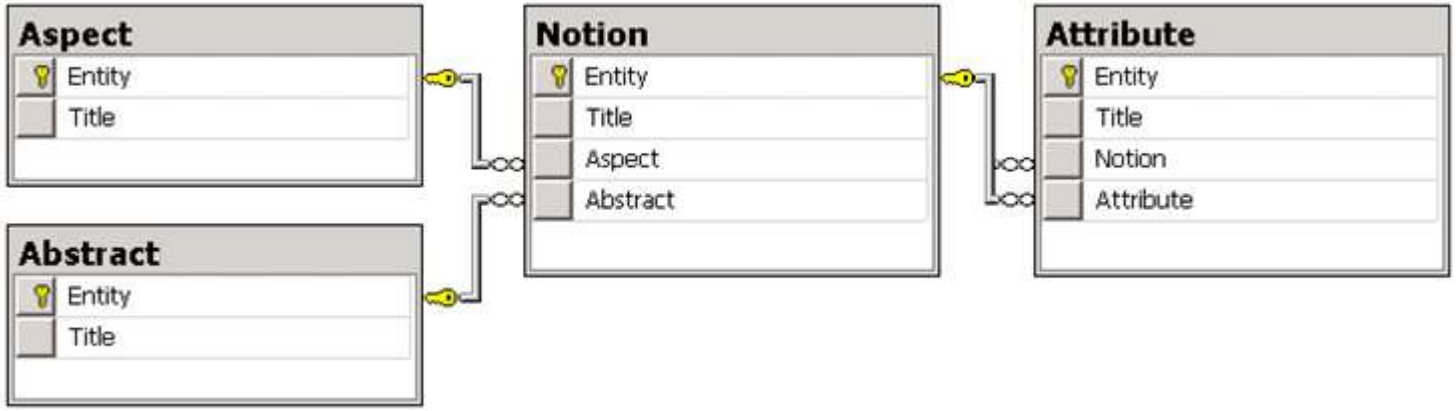
(Vacancy, **G**, Trainee, Employee)

(Position, **T**, *Number*)

(Division, **T**, *String*)

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

Databases



Notion

	Entity	Title	Abstract	Aspect
	61000000061	Понятия	64000000002	65000000000
	61000000062	Цвета	64000000002	65000000000
	61000000063	Пиктограммы	64000000002	65000000000
	61000000064	Абстракции	64000000001	65000000000
	61000000065	Аспекты	64000000001	65000000000
	61000000066	Атрибуты	64000000002	65000000000
	61000000067	Пользователи	64000000002	65000000000

Attribute

Entity	Title	Notion	Attribute
66000000001	Понятие	61000000060	61000000061
66000000002	Атрибут	61000000060	61000000061
66000000003	Абстракция	61000000061	61000000064
66000000004	Аспект	61000000061	61000000065
66000000005	Имя	61000000061	61000000035
66000000007	Пиктограмма	61000000063	61000000035
66000000008	Картинка	61000000063	61000000050

Facts

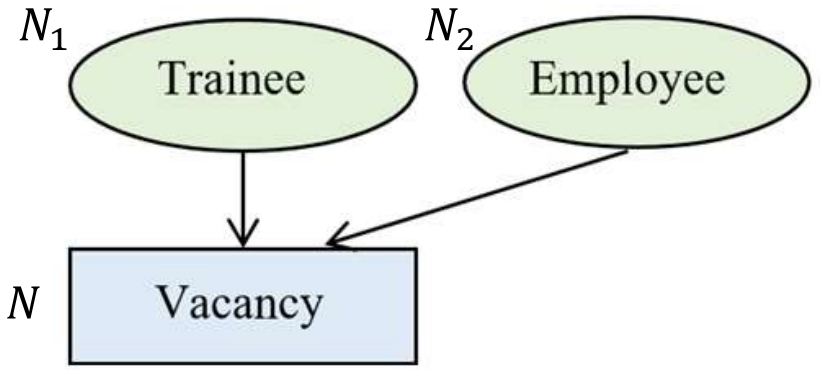
Facts are true propositions with logical connectives AND ($\wedge$), OR ($\vee$), NOT ($\neg$), parentheses, and two types of atomic propositions:

- a predicate $N(E)$ of belonging of the entity E to the notion N;

- $N[E]\circ V$, 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.

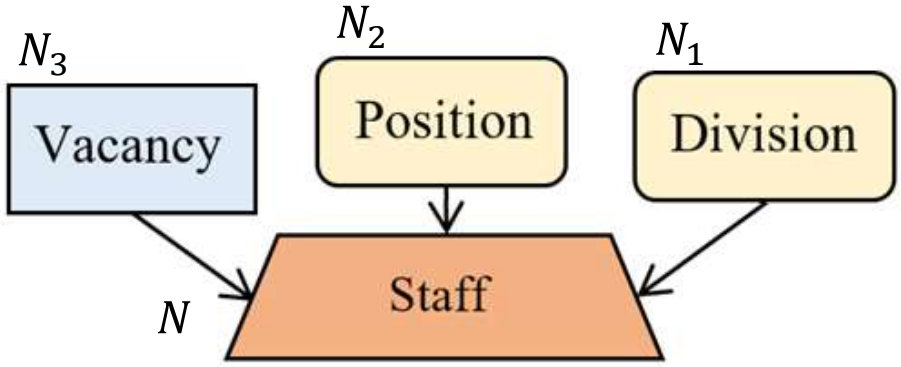
Inference rules

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



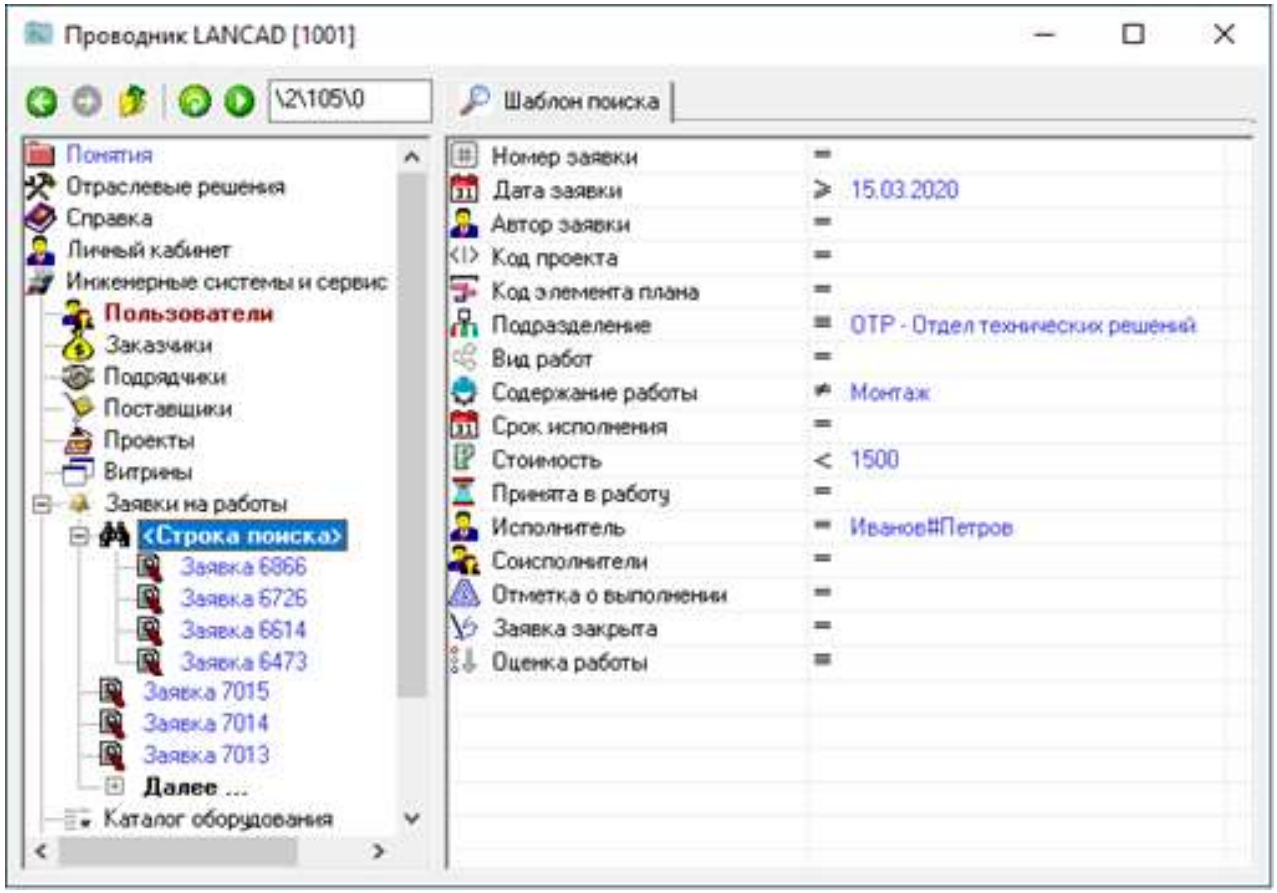
Vacancy(E) ↔ Trainee(E) ∨ Employee(E)

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



Staff(E) → Division[E] ∧ Position[E] ∧ Vacancy[E]

Queries


Проводник LANCAD [1001]
\2\105\0
Шаблон поиска
Понятия
Отраслевые решения
Справка
Личный кабинет
Инженерные системы и сервис
Пользователи
Заказчики
Подрядчики
Поставщики
Проекты
Витрины
Заявки на работы
<Строка поиска>
Заявка 6866
Заявка 6726
Заявка 6614
Заявка 6473
Заявка 7015
Заявка 7014
Заявка 7013
Далее ...
Каталог оборудования
Номер заявки =
Дата заявки ≥ 15.03.2020
Автор заявки =
Код проекта =
Код элемента плана =
Подразделение = ОТР - Отдел технических решений
Вид работ =
Содержание работы = Монтаж
Срок исполнения =
Стоимость < 1500
Принята в работу =
Исполнитель = Иванов#Петров
Соисполнители =
Отметка о выполнении =
Заявка закрыта =
Оценка работы =

Conclusion

1) It is used an another semantic invariant in addition to formal logic – the formal theory of notions.
2) A concept can be presented as a set of eponymous notions in various aspects.
3) A query to the knowledge base requires linear execution time and consists only of the unary predicates.

Thanks!