This lecture has two levels:

"Semantic Web"

- RDF data model
  SPARQL queries
  DB-style: algebraic

- RDFS metadata
  Simple forward (rule) reasoning

- OWL knowledge bases
  & metadata
  DL reasoning
  Background: FOL,
  lecture "Formal Systems"

Applications/Technologies
LOD

Application of "classical" Artificial Intelligence

"Symbolic Reasoning"
Deduction, Logics

Sl 43

$$\varphi = (I, \vartheta) \quad \text{as on slide 43}$$

$\varphi \models wf(Alice, Sales) \Longleftrightarrow (I(Alice), I(Sales)) \in I(wf)$
$\qquad\qquad\qquad\qquad\qquad \Longleftrightarrow (alice, sales) \in I(wf)$
$\varphi \models manages(Alice, Sales) \qquad\qquad \Longleftrightarrow \checkmark$

$\varphi \models_? \neg manages(Alice, Production)$
$\quad \hookrightarrow$ no. $\varphi \not\models \ldots$

more general:

consider $\varphi' :=$ Axioms$_{company}$ $\wedge$ ...all facts in _our_ company as ground atoms ....

(see Sl. 44)

full form Sl. 42

$\Rightarrow$ there are _many_ models of φ'

$\varphi \models \varphi'$, but also many φ_1, φ_2 that have more persons etc...

? $\quad \varphi' \models$ manages(Alice, Sales)   yes. holds in all models of φ

$\varphi' \models$ worksfor(Larry, Sales)   yes (Larry is Mary's "slave")

$\varphi' \not\models$ worksfor(Larry, Production)

maybe. in _our_ φ, not.
but in φ_2 where Larry has two part-time contracts, this can be the case.

$\varphi' \not\models \neg$ manages(Alice, Production)

consider an SQL DB with our DB:
Select ... (from yesterday)
$\rightsquigarrow$ considers only a _single_ DB/model

$\models$ asks for all models ?

(Reasoner)

Can we conclude that Alice does not manage the Prod. dept.?

Yes. every mngr manages exactly one dept. Since Alice manages the Sales dept, she cannot also manage the Prod. dept.

$\rightarrow$ Tableau Reasoner

Tableau   Axioms$_{company}$
                ... grnd facts as known ...
                $\hookrightarrow$ manages(Alice, Sales)
negated "Query":   manages(Alice, Production)

$\left. \right\} \varphi'$

Sl.40:   manages(Alice, Sales)

$\forall m, d_1 \text{ and } d_2 : mg(m, d_1) \wedge mg(m, d_2) \rightarrow d_1 = d_2$

$\neg(mg(M, D_1) \wedge mg(m, P_2))$

$\neg mg(M, D_1)$ $\neg mg(M, D_2)$

$\square\{M/\text{Alice, Production}\}$ $\square\{D_2/\text{Production}\}$

$A \rightarrow B$
$\neg A \vee B$

$D_1 = P_2$

Sales = Production

$\boxtimes \square$

S&50 : "2-variable subset"

?— $p(x,y) \wedge \exists x : p(y,x)$

"x is a grandparent"

?— $p(x,y) \wedge (\exists x : p(x)) \wedge (\exists x : q(y,x))$ ✓

local scope, allowed