

Tableau calculus:

- 5 rules, one for each logical operator, $\{ \exists, \forall, \wedge, \vee, \neg, \rightarrow, \leftrightarrow \}$
 - pull FOL directly
 - + advantage: input formula can be taken unchanged
 - apply rules
 - intuitive
 - however multiple possibilities:
 - which branch
 - which formula
- ⇒ choices?
⇒ strategy!

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Resolution calculus

- (-) works only on ^{sets of} DISJUNCTIONS
 - ⇒ logical rules = Horn-Clauses
 - ⇒ Prolog
 - (+) only one rule, but multiple situations where it is applied
 - ⇒ strategy (simplest) for Horn Clauses
- is that a restriction?
No!

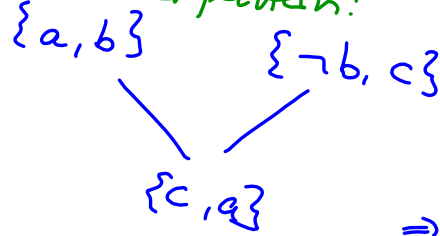
arbitrary FOL formula → pull quantifiers in front (Prenex Normal form)
 $\forall x \exists z \forall y \dots$ matrix($\neg, \wedge, \vee, \dots$)
 → matrix in CNF conjunctive Normal form:
 $\forall x \exists y ((x \vee y) \wedge (x \vee \neg y) \wedge (\neg x \vee y))$
 etc.
 ⇒ Resolution calculus applicable

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A problem that naturally occurs in KNF:

- Sudoku
- Fish puzzle

Basic structure/pattern:



⇒ conclusion is a disjunction

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Sudoku (from wikipedia)

3		1	9	5				
	8				6			
6		8		6				1
4			8					
			2					
	6					2	8	
?	?	2	4	1	9	?	?	5
							7	

H2: $\{a, b, c, d, e, f, g, h, i\}$
 $\Rightarrow \{h, 2, 3\}$
 empty cells only once in empty row
 $\forall x_1, x_2, y, n: \neg f(x_1, y, n) \vee \neg f(x_2, y, n) \vee x_1 = x_2$
 same for columns, same for squares...

A2: 2,7,7,7
 B2: 2,7,8,7
 C2: 2,7,7,7

$\{f(h, 2, 3)\}$
 $\{f(a, 2, 2), f(a, 2, 3), f(a, 2, 7)\}$
 $\{f(b, 2, 2), f(b, 2, 7), f(b, 2, 8)\}$
 $\{f(c, 2, 2), f(c, 2, 3), f(c, 2, 7)\}$
 $\{f(a, 2, 2), f(a, 2, 7)\}$
 $\{f(b, 2, 2)\}$
 $\{f(c, 2, 3)\}$
 $\{f(a, 2, 2), f(a, 2, 7)\}$
 a disjunctive conclusion (can't be true)

$\{ \neg f(a, 2, 2), \neg f(a, 2, 7), \neg f(b, 2, 2) \}$
 $\{ \neg f(a, 2, 7), \neg f(c, 2, 3) \}$
 $\{ \neg f(a, 2, 2), \neg f(c, 2, 3) \}$
 $\{ \neg f(a, 2, 7), \neg f(c, 2, 3) \}$
 $\{ \neg f(a, 2, 2), \neg f(c, 2, 7) \}$
 $\{ \neg f(a, 2, 7), \neg f(b, 2, 2) \}$
 $\{ \neg f(a, 2, 7), \neg f(c, 2, 3) \}$
 $\{ \neg f(a, 2, 7), \neg f(b, 2, 2) \}$
 $\{ \neg f(a, 2, 7), \neg f(c, 2, 3) \}$
 $\{ \neg f(a, 2, 7), \neg f(b, 2, 2) \}$
 $\{ \neg f(a, 2, 7), \neg f(c, 2, 3) \}$
 since $f(b, 2, 2)$ and $f(b, 2, 7)$ can be excluded

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Fish puzzle :

item 9: livesIn (1, north)

item 14: nonpolar lives next to the blue house

$\{ \rightarrow \text{livesIn}(X, \text{north}), \text{blue}(\text{left}(X)), \text{blue}(\text{right}(X)) \}$

\downarrow
 $\text{b: } X \rightarrow 1$
 \downarrow

$\{ \rightarrow \text{livesIn}(1, \text{north}), \text{false}, \text{blue}(2) \}$

$\{ \text{blue}(2) \}$

\uparrow plus symbol

$\text{left}(2) = 1$

$\text{right}(2) = 3$

$\text{left}(1) = 1$

$\text{right}(1) = 2$

undefined