

CS 462

Assignment 4

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Part 1. Inference

① Show what the initial KB looks like, using the abbreviations for each rule and fact.

Rules

- ① $x \wedge y \rightarrow a$
- ② $x \rightarrow w$
- ③ $x \wedge z \rightarrow b$
- ④ $y \wedge w \rightarrow c$
- ⑤ $q \wedge z \wedge a \rightarrow d$
- ⑥ $q \rightarrow y$
- ⑦ $a \wedge b \wedge c \wedge d \rightarrow e$
- ⑧ $w \rightarrow z$

Facts

- ① x
- ② q

Initial KB:

$$KB = \{ x \wedge y \rightarrow a, x \rightarrow w, x \wedge z \rightarrow b, y \wedge w \rightarrow c, q \wedge z \wedge a \rightarrow d, q \rightarrow y, a \wedge b \wedge c \wedge d \rightarrow e, w \rightarrow z, x, q \}$$

② Forward Chain

step	given Facts	Rule Matched	Resulting Fact
1	q	$q \rightarrow y$	y
2	x	$x \rightarrow w$	w
3	w	$w \rightarrow z$	z
4	x, y	$x \wedge y \rightarrow a$	a
5	x, z	$x \wedge z \rightarrow b$	b
6	y, w	$y \wedge w \rightarrow c$	c
7	q, z, a	$q \wedge z \wedge a \rightarrow d$	d
8	a, b, c, d	$a \wedge b \wedge c \wedge d \rightarrow e$	e

③

Using backward chaining
to determine if a particular fact can
be derived from our KB

Step	Stack	Goal fact we need to prove	Rule Used	Subgoals
1	e	e	$a \wedge b \wedge c \wedge d \rightarrow e$	a, b, c, d
2	a, b, c, d	a	$x \wedge y \rightarrow a$	x, y
3	x, y, b, c, d	x	Given Fact	-
4	y, b, c, d	y	$q \rightarrow y$	q
5	q, b, c, d	q	Given Fact	-
6	b, c, d	b	$x \wedge z \rightarrow b$	x, z
7	x, z, c, d	x	Proved already	-
8	z, c, d	z	$w \rightarrow z$	w
9	w, c, d	w	$x \rightarrow w$	x
10	x, c, d	x	Proved already	-
11	c, d	c	$y \wedge w \rightarrow c$	y, w
12	y, w, d	y	Proved already	-
13	w, d	w	Proved already	-
14	d	d	$q \wedge z \wedge a \rightarrow d$	q, z, a
15	q, z, a	q	Proved already	-
16	z, a	z	Proved already	-
17	a	a	Proved already	-

Q 4:

② Let's start by stating the given rules:

1. $x \wedge y \rightarrow a$
2. $x \rightarrow w$
3. $x \wedge z \rightarrow b$
4. $y \wedge w \rightarrow c$
5. $q \wedge z \wedge a \rightarrow d$
6. $q \rightarrow y$
7. $a \wedge b \wedge c \wedge d \rightarrow e$
8. $w \rightarrow z$

① Now let's eliminate the implication

1. $\neg(x \wedge y) \vee a$
2. $\neg x \vee w$
3. $\neg(x \wedge z) \vee b$
4. $\neg(y \wedge w) \vee c$
5. $\neg(q \wedge z \wedge a) \vee d$
6. $\neg q \vee y$
7. $\neg(a \wedge b \wedge c \wedge d) \vee e$
8. $\neg w \vee z$

② Move negation inward

1. $(\neg x \vee \neg y) \vee a$
2. $\neg x \vee w$
3. $(\neg x \vee \neg z) \vee b$
4. $(\neg y \vee \neg w) \vee c$
5. $(\neg q \vee \neg z \vee \neg a) \vee d$
6. $\neg q \vee y$
7. $(\neg a \vee \neg b \vee \neg c \vee \neg d) \vee e$
8. $\neg w \vee z$

So the Conjunction Normal Form of our KB is:

$$KB = \{ (\neg x \vee \neg y \vee a), (\neg x \vee w), (\neg x \vee \neg z \vee b), (\neg y \vee \neg w \vee c), (\neg q \vee \neg z \vee \neg a \vee d), (\neg q \vee y), (\neg a \vee \neg b \vee \neg c \vee \neg d \vee e), (\neg w \vee z) \}$$

⑥

Step	Terms Being Resolved	Resulting New Sentence
1	$(\neg x \vee w) \wedge (\neg w \vee z)$	$(\neg x \vee z)$
2	$(\neg x \vee z) \wedge (\neg x \vee \neg z \vee b)$	$(\neg x \vee b)$
3	$(\neg x \vee \neg y \vee a) \wedge (\neg q \vee y)$	$(\neg x \vee \neg y \vee a \vee \neg q)$
4	$(\neg x \vee \neg y \vee a \vee \neg q) \wedge (\neg q \vee y)$	$(\neg x \vee a)$
5	$(\neg x \vee a) \wedge (\neg a \vee \neg b \vee \neg c \vee \neg d \vee e)$	$(\neg x \vee \neg b \vee \neg c \vee \neg d \vee e)$
6	$(\neg x \vee \neg b \vee \neg c \vee \neg d \vee e) \wedge e$	$(\neg x \vee \neg b \vee \neg c \vee \neg d)$
7	$(\neg x \vee \neg b \vee \neg c \vee \neg d) \wedge (\neg q \vee \neg z \vee \neg a \vee d)$	$(\neg x \vee \neg b \vee \neg c \vee \neg q \vee \neg z)$
8	$(\neg x \vee \neg b \vee \neg c \vee \neg q \vee \neg z) \wedge (\neg x \vee z)$	$(\neg x \vee \neg b \vee \neg c \vee \neg q)$
9	$(\neg x \vee \neg b \vee \neg c \vee \neg q) \wedge (\neg q \vee y)$	$(\neg x \vee \neg b \vee \neg c \vee y)$
10	$(\neg x \vee \neg b \vee \neg c \vee y) \wedge (\neg y \vee \neg w \vee c)$	$(\neg x \vee \neg b \vee \neg w)$
11	$(\neg x \vee w) \wedge (\neg x \vee \neg b \vee \neg w)$	$\neg x$
12	$\neg x \wedge x$	empty clause

Part 3

a) How many results come up? What are they?

10 results come up and they are as follow:

item	itemLabel
wd:Q176276	Spirit
wd:Q223652	Astrobiology Field Laboratory
wd:Q193538	Opportunity
wd:Q1770537	Sojourner
wd:Q3445540	Rosalind Franklin
wd:Q3216558	LAMA robot - CnAM 44681
wd:Q48485	Curiosity
wd:Q87749354	Perseverance
wd:Q25415685	Hyperion Rover
wd:Q106614244	Zhurong

I got one result for “part of” “mars 2020”

item	itemLabel
wd:Q87749354	Perseverance

b) Visualize

. 1. The space launch vehicle that carried Perseverance to Mars is "Atlas V 541" and the country that built it is the United States of America.

2. The launch contractor for Mars 2020 mission was the “United Launch Alliance” I was unable to find any information on which companies that owns them in the perseverance however based on a google search I found out that ULA is a joint venture between Martin And Boeing.

3. Perseverance followed the “Curiosity” mission and it landed in the “Jezero” crater on Mars.

4. Perseverance is powered by a “ multi-mission radioisotope thermoelectric generator” and the two organizations associated with Perseverance are NSA “National Aeronautics and Space Administration” and “Jet Propulsion Laboratory.”

