

FUNDAMENTALS OF AI AND KR - Module 2

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1) The KB can be extended in this way:

- only people that respect the rules can be considered safe
- safe people can not be infected
- infected people can die of covid-19, while not infected people cannot die of covid-19
- not infected people cannot transmit the virus, while infected people can transmit it to unsafe people only

2) In order to represent this KB we can choose Predicate Calculus (First Order Logic):

- $\forall x. [\text{follows}(x, \text{rule1}) \leftrightarrow \text{stay-home}(x) \vee \text{forced-to-go-out}(x)]$
- $\forall x. [\text{follows}(x, \text{rule2}) \leftrightarrow \text{work}(x, \text{home}) \vee \neg \text{can-work}(x, \text{home})]$
- $\forall x. [\text{follows}(x, \text{rule3}) \leftrightarrow \forall y. (\neg \text{meet}(x, y) \vee \text{necessary-meeting}(x, y))]$
- $\forall x. [\text{follows}(x, \text{rule4}) \leftrightarrow \neg \text{go-out}(x) \vee \forall y. (\text{keep-distance}(x, y))]$
- $\forall x. [\text{follows}(x, \text{rule5}) \leftrightarrow \text{stay-home}(x) \vee (\neg \text{has-symptoms}(x) \wedge \neg \exists y. (\text{household}(x, y) \wedge \text{has-symptoms}(y)))]$
- $\forall x. [\text{follows}(x, \text{rule6}) \leftrightarrow \text{wash-hand}(x, \text{regularly})]$
- $\forall x. [\text{safe}(x) \leftrightarrow \forall y. (\text{follows}(x, y))]$
- $\forall x. [\text{safe}(x) \rightarrow \neg \text{infected}(x)]$
- $\forall x. [\neg \text{infected}(x) \rightarrow \neg \text{die}(x, \text{covid19})]$
- $\forall x \forall y. [\text{transmit}(x, y) \rightarrow \text{infected}(x) \wedge \neg \text{safe}(y) \wedge x \neq y]$

Finally, we need to include in the KB at least these terms:

rule 1, rule 2, rule 3, rule 4, rule 5, rule 6,
home, regularly, covid 19

③ We can now add some individuals to the KB:

- Luca, Anna, Mario
- wash-hand (Luca, regularly)
wash-hand (Mario, never)
- has-symptoms (Mario), infected (Mario)
- forced-to-go-out (Luca)
stay-home (Anna)
- necessary-meeting (Luca, Mario)
- can-work (Anna, home)
work (Anna, home)

④ We know that only infected people can transmit the virus, and that they can transmit it to unsafe people only, thus the query would be:

$$\text{infected}(x) \wedge \exists y. (\neg \text{safe}(y) \wedge x \neq y)$$

With respect to the KB we built above, this query will unify x with Mario only, indeed he is the only infected people in the KB and there is at least one unsafe person different from Mario, namely Anna that does not follow rule6 as no fact says that she washes her hands regularly.