به نام خدا

فرزان رحمانی – ۹۹۵۲۱۲۷۱
تمرین ششم هوش مصنوعی و سیستم های خبره
بخش تئوری

۱. دو روش چک کردن مدل ها و اثبات قضیه برای استنتاج منطقی قابل استفاده هستند.
به بیان بهتر:

- Method 1: ***model-checking***

  - For every possible world, if α is true make sure that is β true too. i.e., the α-worlds are a subset of the β-worlds [***models***(α) $\subseteq$ ***models***(β)]. ($\alpha \models \beta$)

  - OK for propositional logic (finitely many worlds).

  Also In model checking, programs are usually verified by means of test scenarios. A model checker takes the program and test scenarios as input and exhaustively searches for possible violations. The difference of test scenarios compared to test cases is that they can include arbitrary values (e.g., a boolean value or a positive integer), which are all considered during model checking.

- Method 2: ***theorem-proving***

  - Search for a sequence of proof steps (applications of ***inference rules***) leading from α to β .

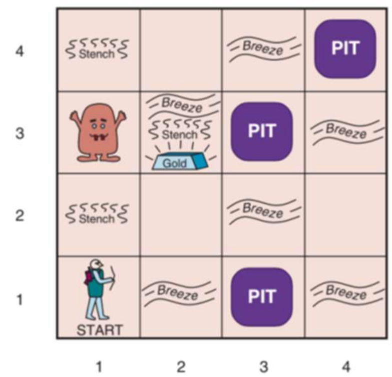
  - E.g., from P $\wedge$ (P $\Rightarrow$ Q), infer Q by ***Modus Ponens.***

  Also In theorem proving, programs are typically verified method-by-method. Given a method and its contract, a theorem prover transforms the precondition while symbolically executing the method. Then, it checks whether the transformed precondition is a model of the postcondition (i.e., it implies the postcondition).

برای مثال هم از اسلاید های درس کمک میگیریم:
پایگاه دانش در هر دو مثال مشترک است و با یک مسئله روبه رو هستیم.

A Simple Knowledge Base

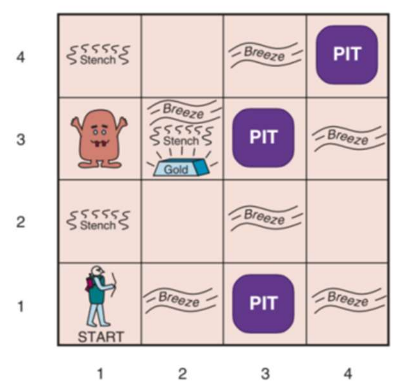
- We focus first on the immutable aspects of the wumpus world
  - $P_{x,y}$ is true if there is a pit in $[x, y]$
  - $W_{x,y}$ is true if there is a wumpus in $[x, y]$, dead or alive
  - $B_{x,y}$ is true if there is a breeze in $[x, y]$
  - $S_{x,y}$ is true if there is a stench in $[x, y]$
  - $L_{x,y}$ is true if the agent is in location $[x, y]$
- We label each sentence R_i so that we can refer to them



A Simple Knowledge Base

- R_1: $\neg P_{1,1}$
- R_2: $B_{1,1} \Leftrightarrow (P_{1,2} \vee P_{2,1})$
- R_3: $B_{2,1} \Leftrightarrow (P_{1,1} \vee P_{2,2} \vee P_{3,1})$

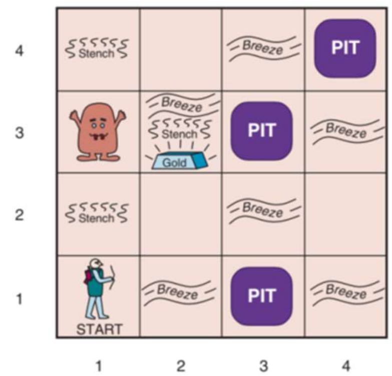
- Consider the breeze percepts for the first two squares:
  - R_4: $\neg B_{1,1}$
  - R_5: $B_{2,1}$



حال این مثال را با model checking و تست کردن همه حالات حل میکنیم.

A Simple Inference Procedure

- Our goal now is to decide whether KB |= α for some sentence α
  - For example, is $\neg P_{1,2}$ entailed by our KB?
- Our first algorithm for inference is a model-checking approach that is a direct implementation of the definition of entailment:
  - Enumerate the models, and check that α is true in every model in which KB is true



A Simple Inference Procedure

- The relevant proposition symbols are $B_{1,1}, B_{2,1}, P_{1,1}, P_{1,2}, P_{2,1}, P_{2,2}, P_{3,1}$
- Only in 3 of 128, KB is true
- $\neg P_{1,2}$ is true in all of them, hence there is no pit in [1,2]
- We cannot yet tell whether there is a pit in [2,2]

$B_{1,1}$	$B_{2,1}$	$P_{1,1}$	$P_{1,2}$	$P_{2,1}$	$P_{2,2}$	$P_{3,1}$	R_1	R_2	R_3	R_4	R_5	KB
false	*false*	*false*	*false*	*false*	*false*	*false*	*true*	*true*	*true*	*true*	*false*	*false*
false	*false*	*false*	*false*	*false*	*false*	*true*	*true*	*true*	*false*	*true*	*false*	*false*
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
false	*true*	*false*	*false*	*false*	*false*	*false*	*true*	*true*	*false*	*true*	*true*	*false*
false	*true*	*false*	*false*	*false*	*false*	*true*	*true*	*true*	*true*	*true*	*true*	<u>*true*</u>
false	*true*	*false*	*false*	*false*	*true*	*false*	*true*	*true*	*true*	*true*	*true*	<u>*true*</u>
false	*true*	*false*	*false*	*false*	*true*	*true*	*true*	*true*	*true*	*true*	*true*	<u>*true*</u>
false	*true*	*false*	*false*	*true*	*false*	*false*	*true*	*false*	*false*	*true*	*true*	*false*
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
true	*true*	*true*	*true*	*true*	*true*	*true*	*false*	*true*	*true*	*false*	*true*	*false*

حال این مثال را با استفاده از روش theorem proving و کمک گیری از قواعد استنتاج و اثبات، validity، satisfiability و همچین Resolution Rule حل می کنیم.