ACTION TREES FOR SCALABLE GOAL RECOGNITION IN ROBOTIC APPLICATIONS

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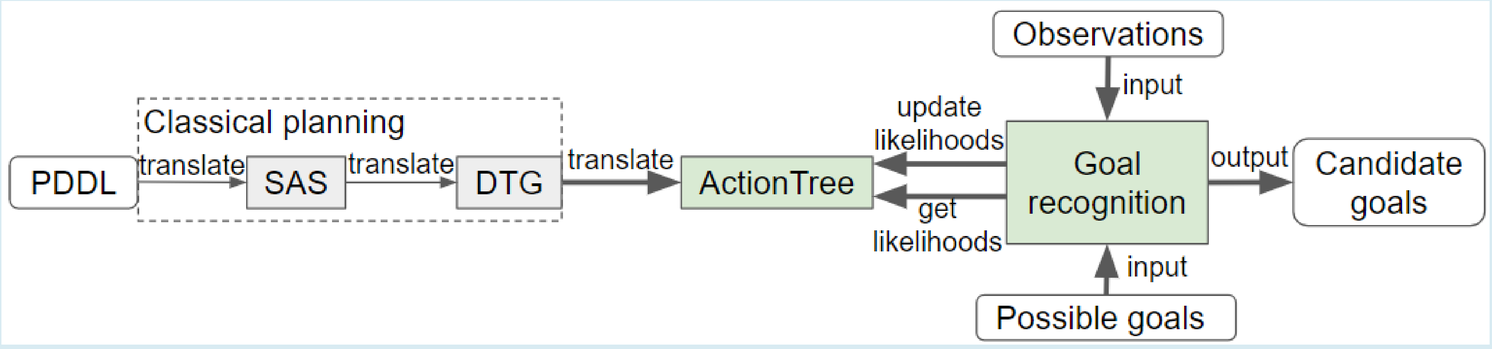
Aim: Recognise what goal a human is attempting to achieve to enable a robot to assist the human

Overview: PDDL is translated into Domain Transition Graphs (DTGs) by FD, which our system then translate into an Action Tree. The probability of an action being performed is updated based on the observations. The most probable goal(s) (i.e. candidate goals) are returned.

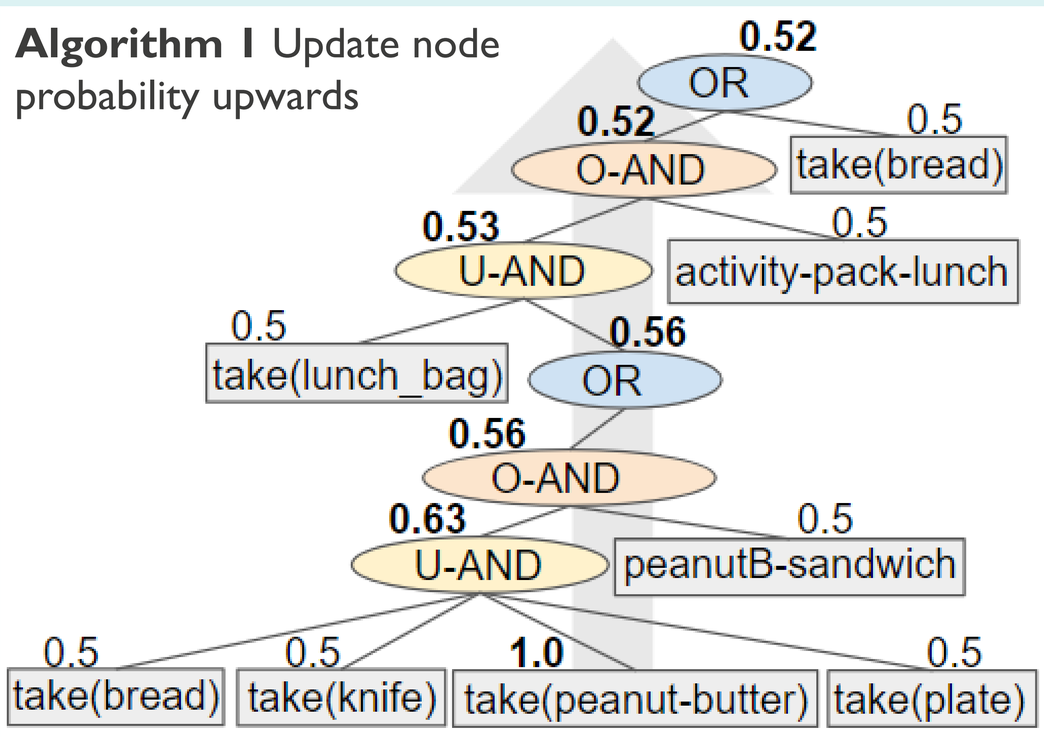


Update probability based on an observation

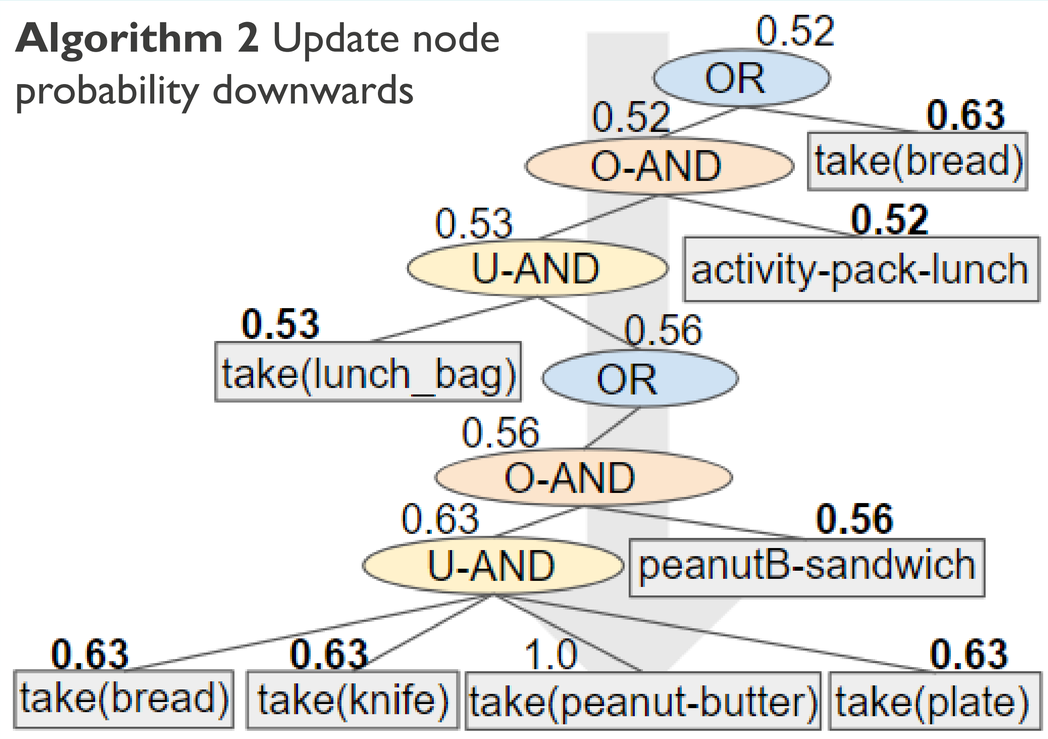
Part of the Action Tree created from the kitchen domain is shown in the figures. O-AND stands for ORDERED-AND and U-AND is UNORDERED-AND. In the figures nodes have been repeated to represent that they have multiple parent nodes.

Observation: *take(peanut-butter)*

Algorithm 1 Update node probability upwards



Algorithm 2 Update node probability downwards



Goal recognition: We find the probability of each goal by calculating the mean of the most probably action whose effects contain one of the goal statement's atoms.

$$p(G_i) = \frac{\sum_{f \in G_i} \max(p(a_{1f \in eff}), ..., p(a_{Nf \in eff}))}{|f \in G_i|}$$

If a goal's probability is equivalent to the highest goal probability it is added to the set of candidate goals.

$$p(G_i) \equiv \max(p(G_1), p(G_2), ..., p(G_N))$$

Results: The dataset consists of 15 domains and a total of 6313 goal recognition problems.

Goal recognition times:

	Ours		Pereira et al.	
$\|probs\|$	$\sum t$	$\bar{t} \pm$ std	$\sum t$	$\bar{t} \pm$ std
6313	1727.27	0.27 ± 0.20	7797.56	1.24 ± 0.84

Accuracy:

		Ours		Pereira et al.	
$\|\mathcal{G}\|$	Obs %	$\|\mathcal{C}\|$	A	$\|\mathcal{C}\|$	A
10.43	10	3.86	0.86	1.71	0.62
	30	2.16	0.87	1.36	0.79
	50	1.62	0.92	1.25	0.87
	70	1.33	0.96	1.15	0.96

References:

- Pereira,R.F.; Oren,N.; and Meneguzzi,F. 2017. Landmark based heuristics for goal recognition. (AAAI-17)
- Helmert, M. 2006. The fast downward planning system. Journal of Artificial Intelligence Research 26:191–246

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