

CISC 481 Homework 2

April 12, 2022

1. (25 pts total) Consider the following collection of statements:

All dogs have a breed
A dog is a mutt only if it is not purebred
A dog is purebred if both of its parents are purebred and are the same breed
A Yellow Labrador is a purebred

Brandi was a dog
Brandi's mother was Tabatha, and her father was Moondog Moses
Moondog Moses was a Yellow Labrador
Tabatha was a Yellow Labrador

Here is a first-order logic representation of the above:

$\forall x(Dog(x) \implies \exists y Breed(x, y))$
 $\forall x((Dog(x) \wedge Mutt(x)) \implies \neg Purebred(x))$
 $\forall x, y, z((Dog(x) \wedge Mother(x, y) \wedge Father(x, z) \wedge Purebred(y) \wedge Purebred(z) \wedge \exists u(Breed(y, u) \wedge Breed(z, u))) \implies Purebred(x))$
 $\forall x(Breed(x, Lab) \implies Purebred(x))$

$Dog(Brandi)$
 $Mother(Brandi, Tabatha)$
 $Father(Brandi, MoonDogMoses)$
 $Breed(Tabatha, Labrador)$
 $Breed(MoonDogMoses, Labrador)$

- (10 pts) Convert the above FO logic statements into conjunctive normal form.
- (15 pts) Using the above as your knowledge base, start the proof that Brandi was not a mutt by resolution, using the *set of support* strategy (that is, initialize the set to be the negated goal, and then on each resolution step resolve one clause from the set of support with every applicable clause in the knowledge base) and a breadth-first search. **You only need to do this for the first two levels of the tree** - that is, explore the negated goal and then explore each of its children. Be sure to number your resolvents in the order they're generated, and for each one list the numbers of both parents, and the full set of bindings used in unifying those parents.

2. (25 pts total) Imagine we have a lawn care agent tasked with MOWing the grass and EDGEing around the sidewalk and driveway. The robot has at its disposal a mower, a string trimmer, and one battery to share between the two of them¹ The robot would also like to leave the sidewalk and driveway clear of clippings. Before one of the tools can be used, it must have the battery CONNECTED to it and the battery must be CHARGED. Of course, the battery can only be in one tool at a time, so it must be REMOVED from one before being connected to

¹Luckily, our robot is both strong enough and deft enough to handle the trimmer when it's got a battery big enough to power the mower connected to it!

the other. Using the mower to mow all the grass will cause the battery to discharge entirely. It will also cause mulched up grass to be blown onto the sidewalk and the driveway. Using the trimmer to do the edging will leave the battery discharged enough that it needs to be charged again before the grass can be fully mowed, as well as leaving bits of grass clippings on the sidewalk and driveway. The robot can SWEEP the driveway and sidewalk to clear away the bits of grass.

- (10 pts) Write down the initial state description, as well as a description of the goal.
- (15 pts) Write out the six action schemas.