1   Generalised Modus Ponens
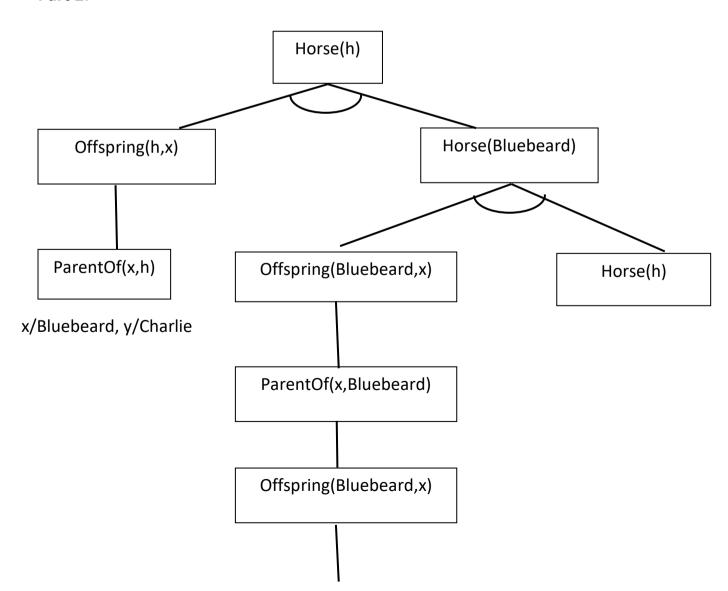
Part 1:

1) $Horse(x) => Mammal(x)$

   $Cow(x) => Mammal(x)$

   $Pig(x) => Mammal(x)$

2) $Offspring(y, x) \land Horse(x) => Horse(y)$ (y is offspring of x).

3) $Horse(Bluebeard)$.

4) $ParentOf(Bluebeard, Charlie)$ (a is ParentOf b).

5) $Offspring(x, y) <=> ParentOf(y, x)$.

Part 2:

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                          ┌─────────────┐
                          │  Horse(h)   │
                          └─────────────┘
                         ╱       ⌣       ╲
          ┌─────────────┐               ┌──────────────────┐
          │Offspring(h,x)│               │ Horse(Bluebeard) │
          └─────────────┘               └──────────────────┘
                 │                       ╱       ⌣        ╲
        ┌──────────────┐   ┌────────────────────────┐   ┌──────────┐
        │ ParentOf(x,h)│   │ Offspring(Bluebeard,x) │   │ Horse(h) │
        └──────────────┘   └────────────────────────┘   └──────────┘
    x/Bluebeard, y/Charlie            │
                          ┌────────────────────────┐
                          │  ParentOf(x,Bluebeard) │
                          └────────────────────────┘
                                      │
                          ┌────────────────────────┐
                          │ Offspring(Bluebeard,x) │
                          └────────────────────────┘
                                      │
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2   Resolution

1) $\forall x.\, \text{Horse}(x) \Rightarrow \text{Animal}(x).$

$\forall x, h.\, \text{Horse}(x) \wedge \text{HeadOf}(h, x) \Rightarrow \text{Animal}(x).$

2)

3)

3   Situation Calculus

a) If the agent is heading in direction dir1 and the result of turning x is dir2 then the agent is heading in direction dir2 in the situation after turning x.

Precondition: $Heading(dir1, s) \land Newdir(dir1, x, dir2) =>$
$Heading(dir2, Result(Turn(x), s))$.

Effect: $Poss(Turn(x), s)) => Heading(dir2, Result(Turn(x), s))$.

b) If the agent is at square sq1 and heading in direction dir and the next square in the direction dir is sq2 then the result of shooting is that the wumpus is not in square sq2 (as if it were there then it would be dead).

Precondition: $At(sq), s) \land Heading(dir, s) \land Next(sq1, dir, sq2)) =>$
$\neg Wumpus(sq2, Result(Shoot, s))$.

Effect: $Poss(Shoot, s)) => \neg Wumpus(sq2, Result(Shoot, s))$.

c) If the agent is at square sq1 and heading in direction dir and the next square in direction dir is sq2 and the wumpus is in square sq3 and square sq2 is not equal to sq3 then the Wumpus is still at square sq3 after shooting.

$At(sq1, s) \land Heading(dir, s) \land Next(sq1, dir, sq2) \land Wumpus(sq3, s) \land sq2 \neq sq3 => Wumpus(sq3, result(Shoot, s))$.