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Assignment 3

1. Key: Predicate Constant Variable

   dog(Shadow), there is a dog named shadow

   owner(Shadow, John) => owner(Shadow, Mary), John gave Shadow to Mary

   male(Shadow) => [owner(smartphone, Mary) => owner(smartphone, John)], If Shadow is male, Mary gave a smartphone to John

   female(Shadow) => [owner(laptop, Mary) => owner(laptop, John)]

   male(x) => [owner(x, John) => owner(x, y)], John gives dog(x) to people(y) if the dog is male

   owner(laptop, Mary) => owner(laptop, John)

2. {x/John, y/Son(John)}
   {x/Barry, y/Barry}
   {x/Bob}
   No unifications possible
   {x/Barry, y/John}

3. Faster(Sam, John)
   for-all x,y: Taller(x,y) ⇔ Faster(y,x)
   Faster(Sam, John) => Taller(John, Sam)
   Taller(John, Sam) => Faster(Sam, John)
   Taller(John, Sam)

4. Program problem

5. Constants: Adult 1, Adult 2, Adult 3, Child 1, Child 2, Child 3, Boat, Left, Right
   Predicates: Adult_Boat(x) is true if one adult is occupying the boat
   Child_Boat(x) is true if one child is occupying the boat
   Children_Boat(x, y) is true if two children are occupying the boat
   Empty() is true if
   Adult_right(x) is true if adult is on right side of river
   Adult_left(x) is true if adult is on left side of river
   Child_right(x) is true if child is on right side of river
   Child_left(x) is true if child is on left side of river

   Action(Children_Cross(Boat, Left, Right), PRECOND: Children_Boat(child x, child y), EFFECT: (Child_right(child x), Child_right(child y))

   Action(Drop_Off_Child(child x), PRECOND: Children_Boat(child x, child y) OR Child_Boat(x), EFFECT: Child_Boat(child x) OR Empty())

   Action(Child_Cross(Boat, Right, Left), PRECOND: Child_Boat(child x), EFFECT: Child_left(child x))

   Action(Adult_Cross(Boat, Left, Right), PRECOND: Adult_Boat(adult x), EFFECT: Adult_right(adult x))

   Action(Drop_Off_Adult(adult x), PRECOND: Adult_Boat(adult x), EFFECT: Empty())

   Action(Drop_Off_Children(child x, child y) PRECOND: Children_Boat(child x, child y), EFFECT: Empty())

   Initial state: Adult_left(Adult 1, Adult 2, Adult 3) Child_left(Child 1, Child 2, Child 3)

   Goal state: Adult_right(Adult 1, Adult 2, Adult 3) Child_right(Child 1, Child 2, Child 3)

   Plan:
   Children_Boat(Child 1, Child 2)
   Children_Cross(Boat, Left, Right)
   Drop_Off_Child(Child 1)
   Child_Cross(Boat, Right, Left)
   Drop_Off_Child(Child 2)
   Adult_Boat(Adult 1)
   Adult_Cross(Boat, Left, Right)
   Drop_Off_Adult(Adult 1)
   Child_Boat(Child 1)
   Child_Cross(Boat, Right, Left)

Children_Boat(Child 1, Child 2)
Children_Cross(Boat, Left, Right)
Drop_Off_Child(Child 1)
Child_Cross(Boat, Right, Left)
Drop_Off_Child(Child 2)
Adult_Boat(Adult 2)
Adult_Cross(Boat, Left, Right)
Drop_Off_Adult(Adult 2)
Child_Boat(Child 1)
Child_Cross(Boat, Right, Left)
Children_Boat(Child 1, Child 2)
Children_Cross(Boat, Left, Right)
Drop_Off_Child(Child 1)
Child_Cross(Boat, Right, Left)
Drop_Off_Child(Child 2)
Adult_Boat(Adult 3)
Adult_Cross(Boat, Left, Right)
Drop_Off_Adult(Adult 3)
Child_Boat(Child 1)
Child_Cross(Boat, Right, Left)
Children_Boat(Child 1, Child 2)
Children_Cross(Boat, Left, Right)
Drop_Off_Child(Child 1)
Child_Cross(Boat, Right, Left)
Children_Boat(Child 2, Child 3)
Children_Cross(Boat, Left, Right)
Drop_Off_Children(Child 2, Child 3)

6. Constants: A, B, C, D

   Possible predicate combinations:
   P(A,B,C), P(A,C,B), P(B,A,C), P(B,C,A), P(C,A,B), P(C,B,A), P(D,B,C), P(D,C,B), P(A,D,C), P(C,D,A) P(A,B,D), P(B,A,D), P(D,A,B), P(D,B,A), P(B,D,C), P(C,D,B), P(A,C,D), P(C,A,D), P(A,D,B), P(B,C,D), P(B,D,A), P(C,B,D), P(D,A,C), P(D,C,A)

   Possible predicate combinations(24) x Number of predicates(5) = 140 unique states