Visualization

This example shows a setting of a world with two inspection locations. The drone initially takes off at Home. It succeeds in inspecting the first location, but on its way to the second location, the policy decides upon returning Home (due to low battery). In this scenario, the overall goal was not reached (as not all inspection locations are inspected), but the drone did reach Home again safely.
First we show the output model (i.e. an instantiation of the structure), followed by the visualization itself.

Output Model

```
structure  : V {
  Distance = { 0..3 }
  FlyHeight = { 3..4 }
  GroundHeight = { 0..0 }
  Height = { 0..5 }
  Inspection = { Insp1; Insp2 }
  InspectionHeight = { 1..2 }
  Power = { 0..100 }
  PowerUsage = { 0..5 }
  RestrictedHeight = { 5..5 }
  Time = { 0..40 }
  AllPicturesTaken = {  }
  AtCriticalPower = { 34; 35; 36; 37; 38; 39; 40 }
  AtFlyHeight = { 5; 6; 7; 8; 9; 10; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23 }
  AtGroundHeight = { 0; 1; 26; 27; 28; 29; 30; 31; 32; 33; 34; 35; 36; 37; 38; 39; 40 }
  AtHome = { 0; 1; 2; 3; 4; 5; 23; 24; 25; 26; 27; 28; 29; 30; 31; 32; 33; 34; 35; 36;
             37; 38; 39; 40 }
  AtInspection = { 10; 11; 12; 13; 14; 15; 16; 17 }
  AtInspectionHeight = { 2; 3; 4; 11; 12; 13; 24; 25 }
  AtInspectionToDo = { 10; 11 }
  AtLowPower = { 18; 19; 20; 21; 22; 23; 24; 25; 26; 27; 28; 29; 30; 31; 32; 33; 34;
                 35; 36; 37; 38; 39; 40 }
  AtNormalPower = { 0; 1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16; 17 }
  AtRestrictedHeight = {  }
  AtTravelSpace = { 6; 7; 8; 9; 18; 19; 20; 21; 22 }
  CN_DistanceToHome = { 5,0; 5,2; 5,3; 17,0; 17,1; 17,2; 18,0; 18,1; 18,3; 20,0;
                        20,2; 20,3 }
  CN_DistanceToRA = { 5,0; 5,2; 5,3; 7,0; 7,1; 7,3; 9,0; 9,2; 9,3; 15,0; 15,1;
                      15,3; 18,0; 18,2; 18,3; 19,0; 19,1; 19,3 }
  CN_DistanceToTarget = { 5,0; 5,2; 5,3; 17,0; 17,1; 17,2; 18,0; 18,1; 18,3;
                          20,0; 20,2; 20,3 }
  CN_Height = { 1,0; 1,2; 1,3; 1,4; 1,5; 3,0; 3,1; 3,3; 3,4; 3,5; 4,0; 4,1; 4,2;
                4,4; 4,5; 10,0; 10,1; 10,3; 10,4; 10,5; 13,0; 13,1; 13,2; 13,4;
                13,5; 23,0; 23,1; 23,3; 23,4; 23,5; 24,0; 24,2; 24,3; 24,4; 24,5;
                25,1; 25,2; 25,3; 25,4; 25,5 }
```

```
CN_Location = { 5,Home; 5,Insp1; 5,Insp2; 5,Insp3; 5,Insp4; 9,Home; 9,Insp2;
                9,Insp3; 9,Insp4; 9,TravelSpace; 17,Home; 17,Insp1; 17,Insp2;
                17,Insp3; 17,Insp4; 22,Insp1; 22,Insp2; 22,Insp3; 22,Insp4;
                22,TravelSpace }
C_DistanceToHome = { 5,1; 17,3; 18,2; 20,1 }
C_DistanceToRA = { 5,1; 7,2; 9,1; 15,2; 18,1; 19,2 }
C_DistanceToTarget = { 5,1; 17,3; 18,2; 20,1 }
C_Height = { 1,1; 3,2; 4,3; 10,2; 13,3; 23,2; 24,1; 25,0 }
C_Location = { 5,TravelSpace; 9,Insp1; 17,TravelSpace; 22,Home }
C_Picture_Taken = { 11,Insp1 }
CloseToRA = { 6; 7; 10; 11; 12; 13; 14; 15; 19 }
NonDetDecreaseDistRA = { 5; 9; 18 }
NonDetIncreaseDistRA = {  }
NonDetMove = { 1; 3; 4; 5; 7; 9; 10; 11; 13; 15; 17; 18; 19; 20; 22; 23; 24; 25;
               26; 27; 28; 29; 30; 31; 32; 33; 34; 35; 36; 37; 38; 39; 40 }
Picture_Taken = { 12,Insp1; 13,Insp1; 14,Insp1; 15,Insp1; 16,Insp1; 17,Insp1;
                  18,Insp1; 19,Insp1; 20,Insp1; 21,Insp1; 22,Insp1; 23,Insp1;
                  24,Insp1; 25,Insp1; 26,Insp1; 27,Insp1; 28,Insp1; 29,Insp1;
                  30,Insp1; 31,Insp1; 32,Insp1; 33,Insp1; 34,Insp1; 35,Insp1;
                  36,Insp1; 37,Insp1; 38,Insp1; 39,Insp1; 40,Insp1 }
BackLoopTime = 0
Battery = { 0->100; 1->95; 2->90; 3->85; 4->80; 5->75; 6->72; 7->69; 8->66;
            9->63; 10->60; 11->58; 12->56; 13->51; 14->46; 15->43; 16->40;
            17->37; 18->34; 19->31; 20->28; 21->25; 22->22; 23->19; 24->17;
            25->15; 26->13; 27->12; 28->11; 29->10; 30->9; 31->8; 32->7; 33->6;
            34->5; 35->4; 36->3; 37->2; 38->1; 39->0; 40->0 }
Battery_Init = 100
ClosestInspectionLocationToDo =
  { 0->Insp1; 1->Insp1; 2->Insp1; 3->Insp1; 4->Insp1; 5->Insp1; 6->Insp1;
  7->Insp1; 8->Insp1; 9->Insp1; 10->Insp1; 11->Insp1; 12->Insp2; 13->Insp2;
  14->Insp2; 15->Insp2; 16->Insp2; 17->Insp2; 18->Insp2; 19->Insp2; 20->Insp2;
  21->Insp2; 22->Insp2; 23->Insp2; 24->Insp2; 25->Insp2; 26->Insp2; 27->Insp2;
  28->Insp2; 29->Insp2; 30->Insp2; 31->Insp2; 32->Insp2; 33->Insp2; 34->Insp2;
  35->Insp2; 36->Insp2; 37->Insp2; 38->Insp2; 39->Insp2; 40->Insp2 }
CriticalPower = 5
Curr_DistanceToHome = { 0->0; 1->0; 2->0; 3->0; 4->0; 5->0; 6->1; 7->1; 8->1;
                        9->1; 10->2; 11->2; 12->2; 13->2; 14->2; 15->2; 16->2;
                        17->2; 18->3; 19->2; 20->2; 21->1; 22->1; 23->0; 24->0;
                        25->0; 26->0; 27->0; 28->0; 29->0; 30->0; 31->0; 32->0;
                        33->0; 34->0; 35->0; 36->0; 37->0; 38->0; 39->0; 40->0 }
Curr_DistanceToRA = { 0->2; 1->2; 2->2; 3->2; 4->2; 5->2; 6->1; 7->1; 8->2;
                      9->2; 10->1; 11->1; 12->1; 13->1; 14->1; 15->1; 16->2;
                      17->2; 18->2; 19->1; 20->2; 21->2; 22->2; 23->2; 24->2;
                      25->2; 26->2; 27->2; 28->2; 29->2; 30->2; 31->2; 32->2;
                      33->2; 34->2; 35->2; 36->2; 37->2; 38->2; 39->2; 40->2 }
Curr_DistanceToTarget = { 0->2; 1->2; 2->2; 3->2; 4->2; 5->2; 6->1; 7->1; 8->1;
                          9->1; 10->0; 11->0; 12->2; 13->2; 14->2; 15->2; 16->2;
                          17->2; 18->3; 19->2; 20->2; 21->1; 22->1; 23->0; 24->0;
                          25->0; 26->0; 27->0; 28->0; 29->0; 30->0; 31->0; 32->0;
                          33->0; 34->0; 35->0; 36->0; 37->0; 38->0; 39->0; 40->0 }
Curr_Height = { 0->0; 1->0; 2->1; 3->1; 4->2; 5->3; 6->3; 7->3; 8->3; 9->3;
                10->3; 11->2; 12->2; 13->2; 14->3; 15->3; 16->3; 17->3; 18->3;
                19->3; 20->3; 21->3; 22->3; 23->3; 24->2; 25->1; 26->0; 27->0;
                28->0; 29->0; 30->0; 31->0; 32->0; 33->0; 34->0; 35->0; 36->0;
                37->0; 38->0; 39->0; 40->0 }
Curr_Location = { 0->Home; 1->Home; 2->Home; 3->Home; 4->Home; 5->Home;
                  6->TravelSpace; 7->TravelSpace; 8->TravelSpace; 9->TravelSpace;
                  10->Insp1; 11->Insp1; 12->Insp1; 13->Insp1; 14->Insp1;
                  15->Insp1; 16->Insp1; 17->Insp1; 18->TravelSpace;
                  19->TravelSpace; 20->TravelSpace; 21->TravelSpace;
                  22->TravelSpace; 23->Home; 24->Home; 25->Home; 26->Home;
                  27->Home; 28->Home; 29->Home; 30->Home; 31->Home; 32->Home;
                  33->Home; 34->Home; 35->Home; 36->Home; 37->Home; 38->Home;
                  39->Home; 40->Home }
DistanceBetween = { Home,Home->0; Home,Insp1->2; Home,Insp2->3; Insp1 ,Home->2;
                    Insp1 ,Insp1->0; Insp1 ,Insp2->2; Insp2 ,Home->3;
                    Insp2 ,Insp1->2; Insp2 ,Insp2->0 }
InitialRestrictedDistance = 2
LiftPower = 5
LowPower = { 0->19; 1->19; 2->19; 3->19; 4->19; 5->19; 6->25; 7->25; 8->25;
             9->25; 10->31; 11->31; 12->31; 13->31; 14->31; 15->31; 16->31;
             17->31; 18->37; 19->31; 20->31; 21->25; 22->25; 23->19; 24->19;
             25->19; 26->19; 27->19; 28->19; 29->19; 30->19; 31->19; 32->19;
             33->19; 34->19; 35->19; 36->19; 37->19; 38->19; 39->19; 40->19 }
LowerPower = 2
MoveToPower = 3
```

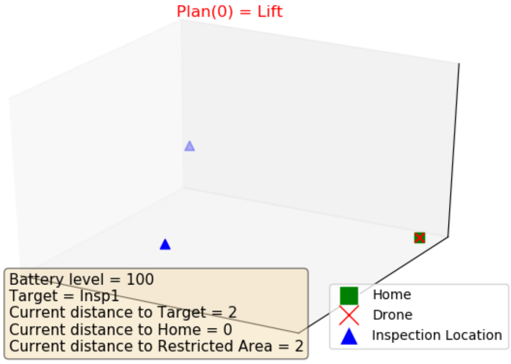
```
  Next = { 0->1; 1->2; 2->3; 3->4; 4->5; 5->6; 6->7; 7->8; 8->9; 9->10; 10->11;
           11->12; 12->13; 13->14; 14->15; 15->16; 16->17; 17->18; 18->19; 19->20;
           20->21; 21->22; 22->23; 23->24; 24->25; 25->26; 26->27; 27->28; 28->29;
           29->30; 30->31; 31->32; 32->33; 33->34; 34->35; 35->36; 36->37; 37->38;
           38->39; 39->40 }
  NoOpPower = 1
  Plan = { 0->Lift; 1->Lift; 2->Lift; 3->Lift; 4->Lift; 5->MoveTowardsTarget;
           6->MoveAwayFromRA; 7->MoveAwayFromRA; 8->MoveTowardsTarget;
           9->MoveTowardsTarget; 10->Lower; 11->TakePicture; 12->Lift; 13->Lift;
           14->MoveAwayFromRA; 15->MoveAwayFromRA; 16->MoveTowardsTarget;
           17->MoveTowardsTarget; 18->MoveTowardsTarget; 19->MoveAwayFromRA;
           20->MoveTowardsTarget; 21->MoveTowardsTarget; 22->MoveTowardsTarget;
           23->Lower; 24->Lower; 25->Lower; 26->NoOp; 27->NoOp; 28->NoOp; 29->NoOp;
           30->NoOp; 31->NoOp; 32->NoOp; 33->NoOp; 34->NoOp; 35->NoOp; 36->NoOp;
           37->NoOp; 38->NoOp; 39->NoOp; 40->NoOp }
  PowerUsageAt = { 0->5; 1->5; 2->5; 3->5; 4->5; 5->3; 6->3; 7->3; 8->3; 9->3;
                   10->2; 11->2; 12->5; 13->5; 14->3; 15->3; 16->3; 17->3; 18->3;
                   19->3; 20->3; 21->3; 22->3; 23->2; 24->2; 25->2; 26->1; 27->1;
                   28->1; 29->1; 30->1; 31->1; 32->1; 33->1; 34->1; 35->1; 36->1;
                   37->1; 38->1; 39->0; 40->0 }
  Start = 0
  StaticLowPower = 5
  TakePicturePower = 2
  Target = { 0->Insp1; 1->Insp1; 2->Insp1; 3->Insp1; 4->Insp1; 5->Insp1; 6->Insp1;
             7->Insp1; 8->Insp1; 9->Insp1; 10->Insp1; 11->Insp1; 12->Insp2;
             13->Insp2; 14->Insp2; 15->Insp2; 16->Insp2; 17->Insp2; 18->Home;
             19->Home; 20->Home; 21->Home; 22->Home; 23->Home; 24->Home;
             25->Home; 26->Home; 27->Home; 28->Home; 29->Home; 30->Home;
             31->Home; 32->Home; 33->Home; 34->Home; 35->Home; 36->Home;
             37->Home; 38->Home; 39->Home; 40->Home }
  Weight = 1
}
```

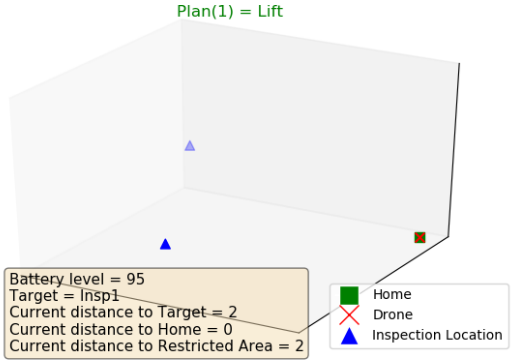
Visualization

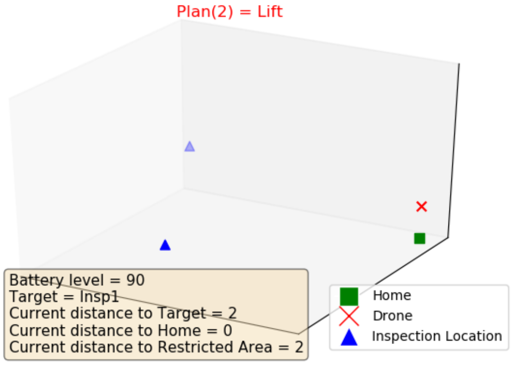
The visualization can be ran by executing the command

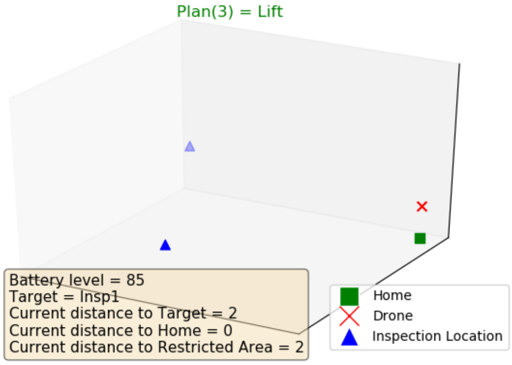
$$\textit{Vis}\backslash \textit{main.py normal\_flight}.$$

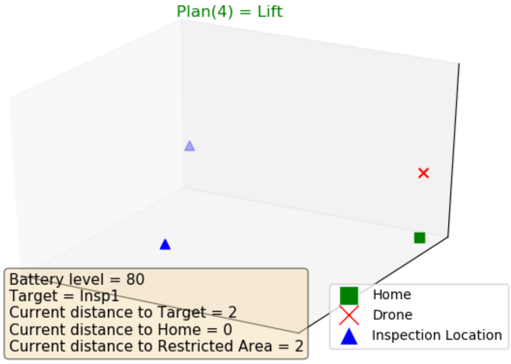
The individual titles of the following plots (starting at the next page) indicate the planned action at the corresponding time step. This action is supposedly executed during the succession of the current time step to the next one. The color of the title denotes whether or not the action was successful. A green title indicates a successful action, a red title indicates a failed attempt. The symbols on the plots represent the Locations, as indicated in the legend. The first 30 time steps are shown. After time step 26, the drone remains landed at home, draining the battery under normal operation (of communication etc.).

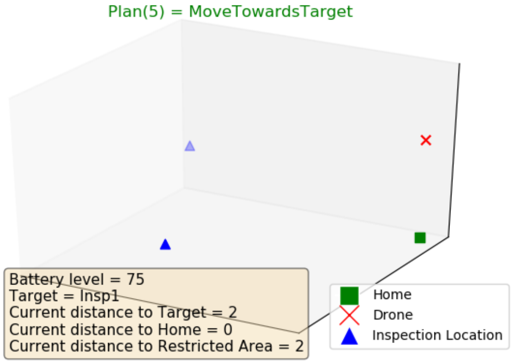

Plan(0) = Lift
Battery level = 100
Target = Insp1
Current distance to Target = 2
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location

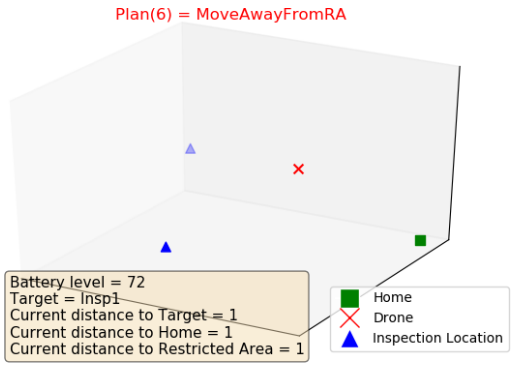

Plan(1) = Lift
Battery level = 95
Target = Insp1
Current distance to Target = 2
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location

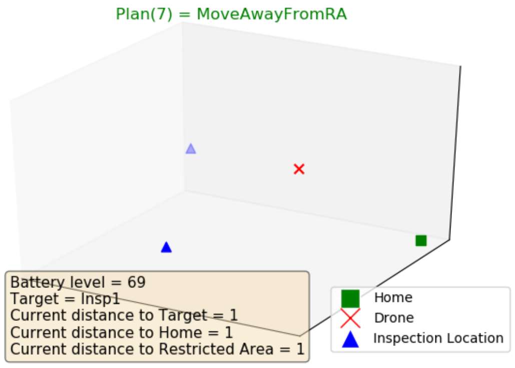

Plan(2) = Lift
Battery level = 90
Target = Insp1
Current distance to Target = 2
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location

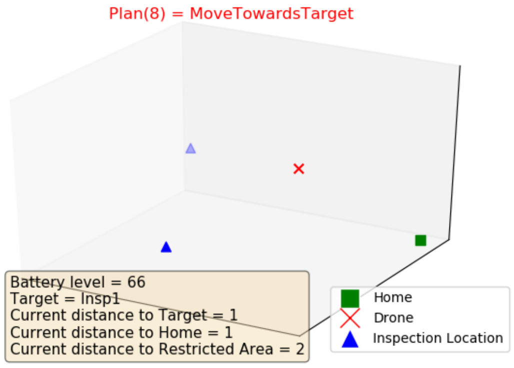

Plan(3) = Lift
Battery level = 85
Target = Insp1
Current distance to Target = 2
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location

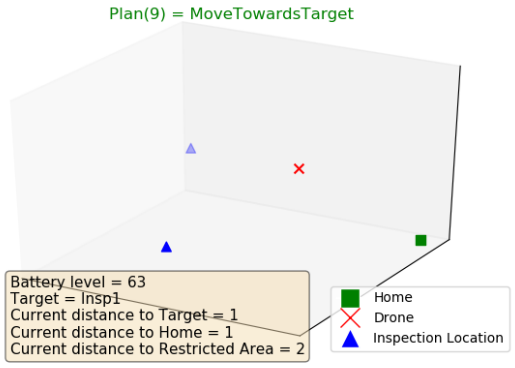

Plan(4) = Lift
Battery level = 80
Target = Insp1
Current distance to Target = 2
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location

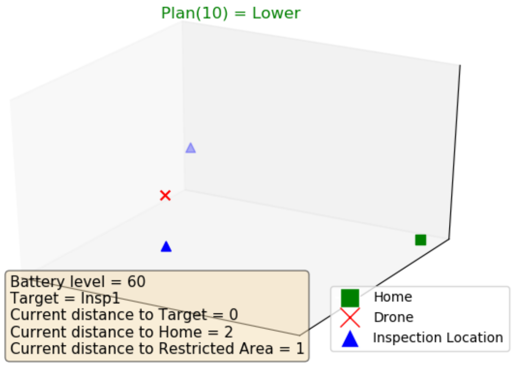

Plan(5) = MoveTowardsTarget
Battery level = 75
Target = Insp1
Current distance to Target = 2
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location

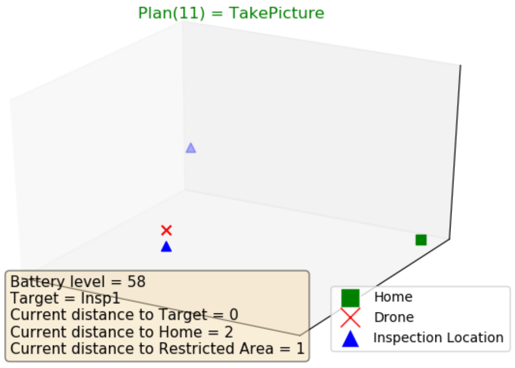

Plan(6) = MoveAwayFromRA
Battery level = 72
Target = Insp1
Current distance to Target = 1
Current distance to Home = 1
Current distance to Restricted Area = 1
Home
Drone
Inspection Location

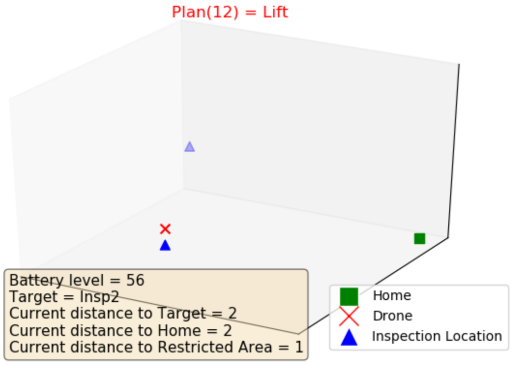

Plan(7) = MoveAwayFromRA
Battery level = 69
Target = Insp1
Current distance to Target = 1
Current distance to Home = 1
Current distance to Restricted Area = 1
Home
Drone
Inspection Location


Plan(8) = MoveTowardsTarget
Battery level = 66
Target = Insp1
Current distance to Target = 1
Current distance to Home = 1
Current distance to Restricted Area = 2
Home
Drone
Inspection Location

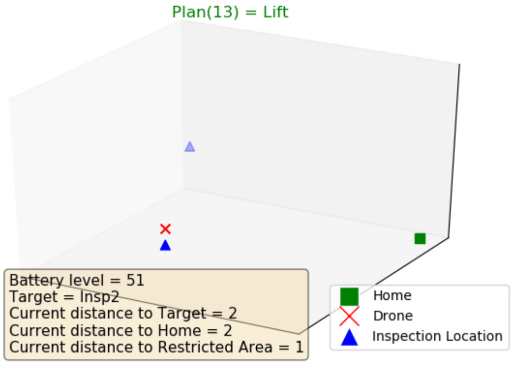

Plan(9) = MoveTowardsTarget
Battery level = 63
Target = Insp1
Current distance to Target = 1
Current distance to Home = 1
Current distance to Restricted Area = 2
Home
Drone
Inspection Location


Plan(10) = Lower
Battery level = 60
Target = Insp1
Current distance to Target = 0
Current distance to Home = 2
Current distance to Restricted Area = 1
Home
Drone
Inspection Location

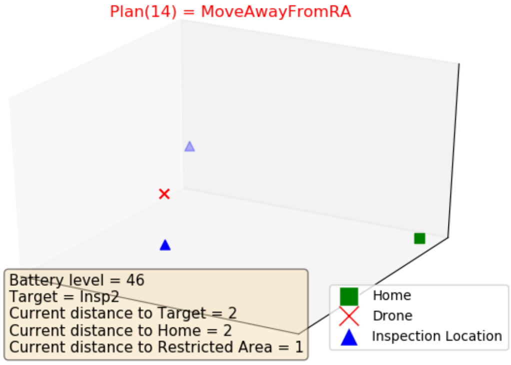

Plan(11) = TakePicture
Battery level = 58
Target = Insp1
Current distance to Target = 0
Current distance to Home = 2
Current distance to Restricted Area = 1
Home
Drone
Inspection Location


Plan(12) = Lift

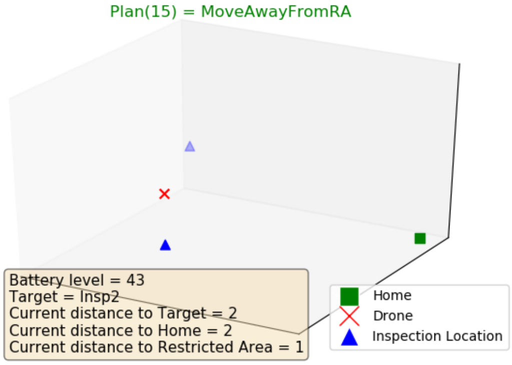
Battery level = 56
Target = Insp2
Current distance to Target = 2
Current distance to Home = 2
Current distance to Restricted Area = 1


Plan(13) = Lift

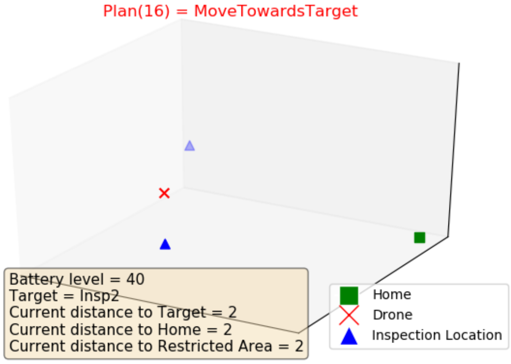
Battery level = 51
Target = Insp2
Current distance to Target = 2
Current distance to Home = 2
Current distance to Restricted Area = 1


Plan(14) = MoveAwayFromRA

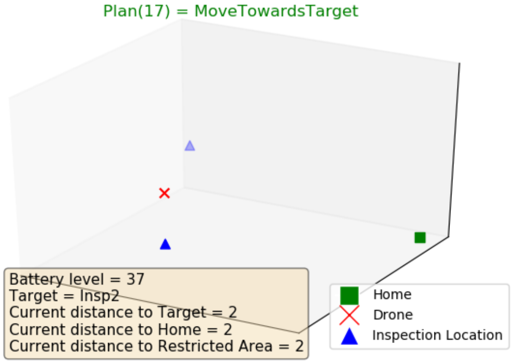
Battery level = 46
Target = Insp2
Current distance to Target = 2
Current distance to Home = 2
Current distance to Restricted Area = 1


Plan(15) = MoveAwayFromRA

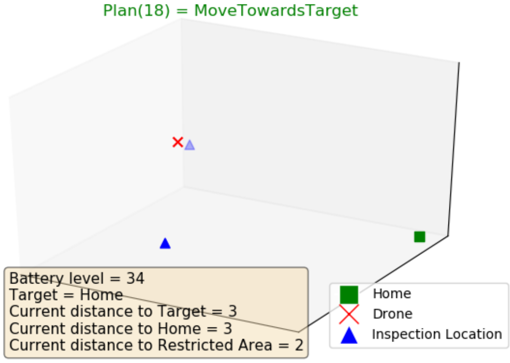
Battery level = 43
Target = Insp2
Current distance to Target = 2
Current distance to Home = 2
Current distance to Restricted Area = 1


Plan(16) = MoveTowardsTarget

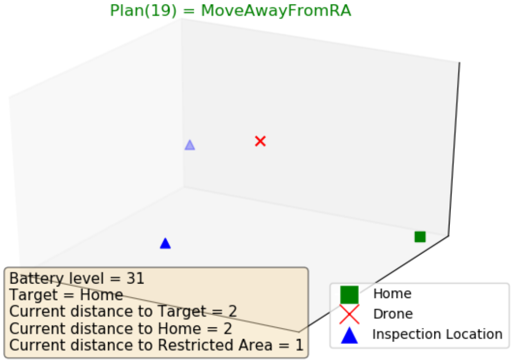
Battery level = 40
Target = Insp2
Current distance to Target = 2
Current distance to Home = 2
Current distance to Restricted Area = 2


Plan(17) = MoveTowardsTarget

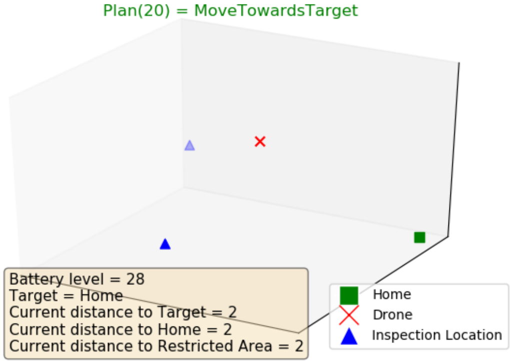
Battery level = 37
Target = Insp2
Current distance to Target = 2
Current distance to Home = 2
Current distance to Restricted Area = 2


Plan(18) = MoveTowardsTarget

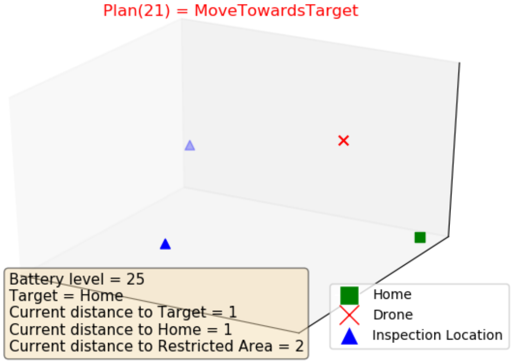
Battery level = 34
Target = Home
Current distance to Target = 3
Current distance to Home = 3
Current distance to Restricted Area = 2


Plan(19) = MoveAwayFromRA

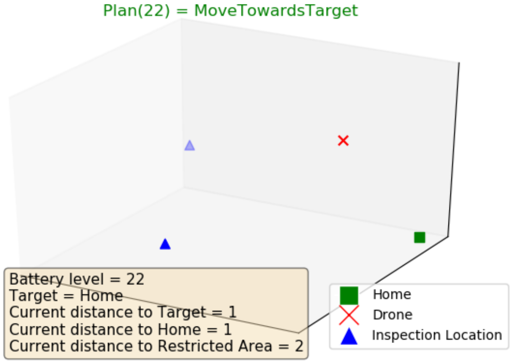
Battery level = 31
Target = Home
Current distance to Target = 2
Current distance to Home = 2
Current distance to Restricted Area = 1


Plan(20) = MoveTowardsTarget

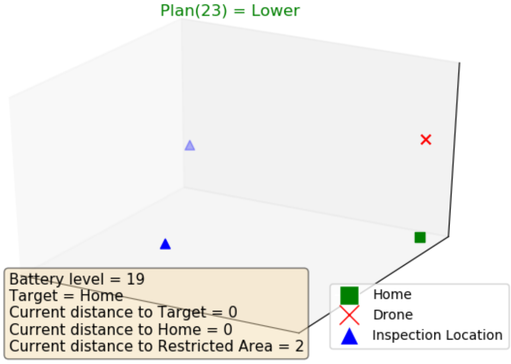
Battery level = 28
Target = Home
Current distance to Target = 2
Current distance to Home = 2
Current distance to Restricted Area = 2


Plan(21) = MoveTowardsTarget

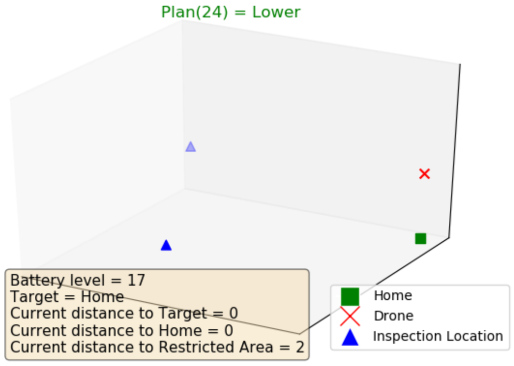
Battery level = 25
Target = Home
Current distance to Target = 1
Current distance to Home = 1
Current distance to Restricted Area = 2

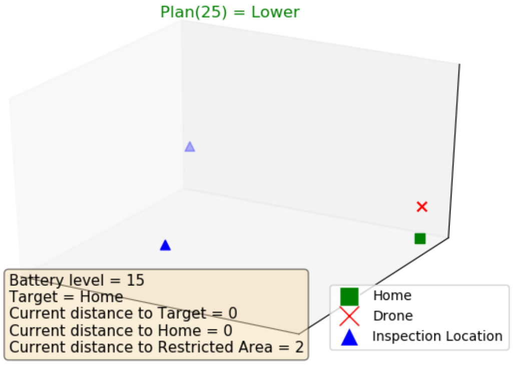

Plan(22) = MoveTowardsTarget

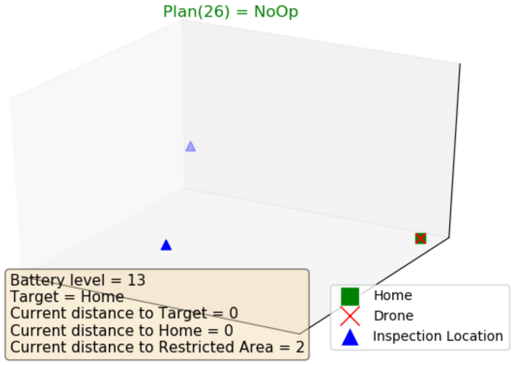
Battery level = 22
Target = Home
Current distance to Target = 1
Current distance to Home = 1
Current distance to Restricted Area = 2

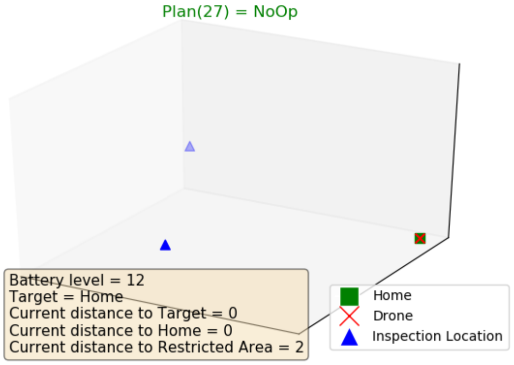

Plan(23) = Lower

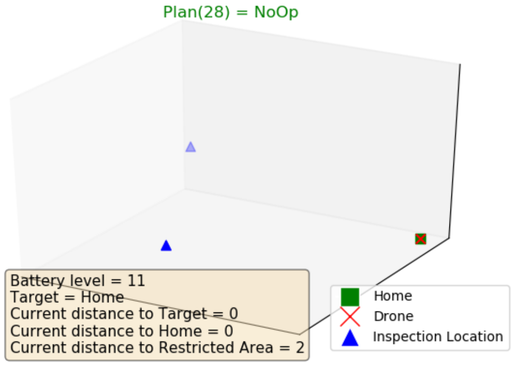
Battery level = 19
Target = Home
Current distance to Target = 0
Current distance to Home = 0
Current distance to Restricted Area = 2

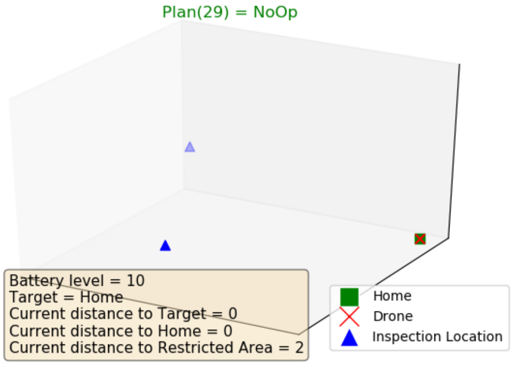

Plan(24) = Lower
Battery level = 17
Target = Home
Current distance to Target = 0
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location


Plan(25) = Lower
Battery level = 15
Target = Home
Current distance to Target = 0
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location


Plan(26) = NoOp
Battery level = 13
Target = Home
Current distance to Target = 0
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location


Plan(27) = NoOp
Battery level = 12
Target = Home
Current distance to Target = 0
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location


Plan(28) = NoOp
Battery level = 11
Target = Home
Current distance to Target = 0
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location


Plan(29) = NoOp
Battery level = 10
Target = Home
Current distance to Target = 0
Current distance to Home = 0
Current distance to Restricted Area = 2
Home
Drone
Inspection Location