

# Airspace Management Decision Tool

*Behavioral and Structural Analysis  
In Software Design*

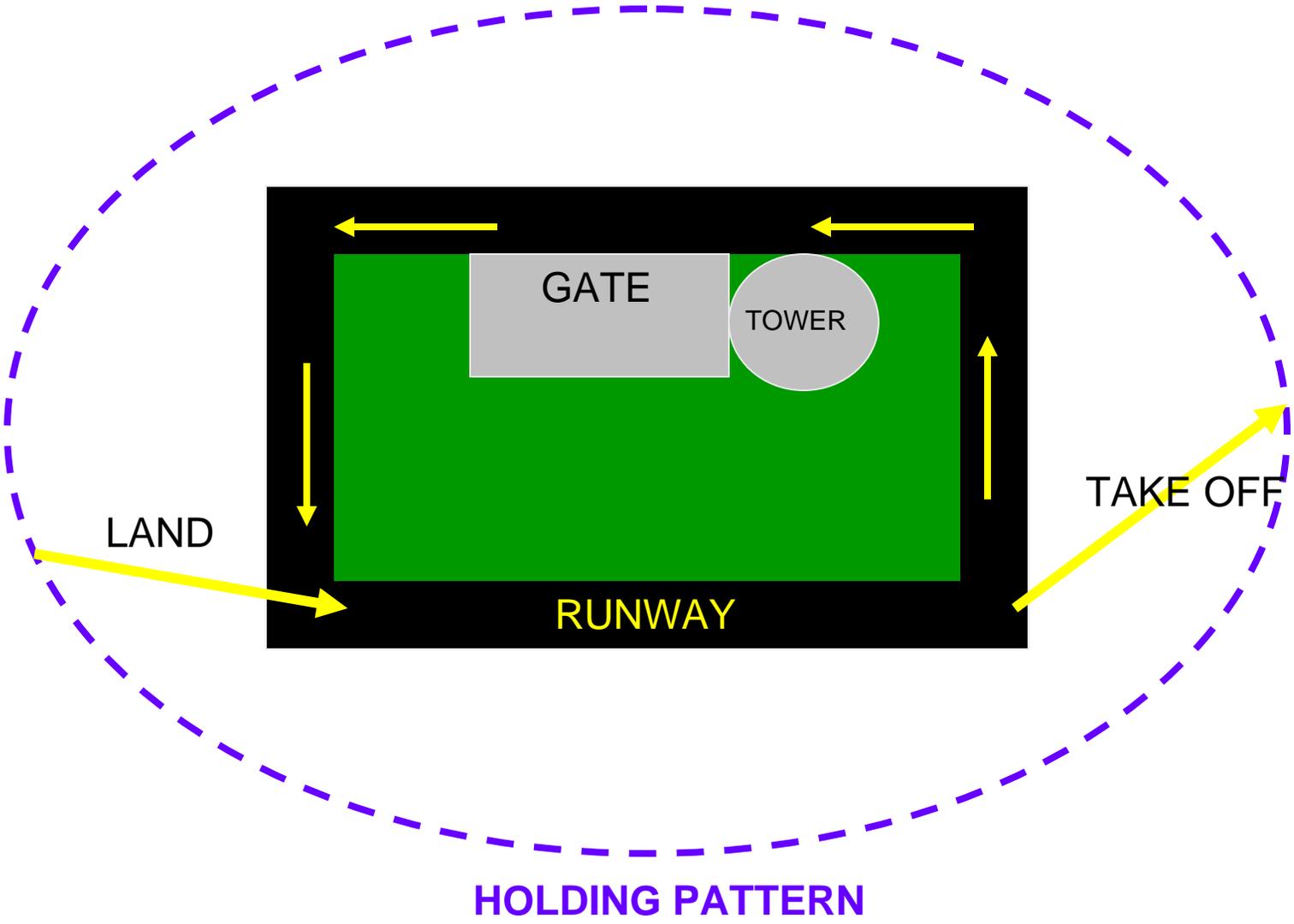
Kerin Thornton  
ENPM642  
May 9, 2005

# Introduction

- ◆ World of Air Traffic Control (ATC) is a constantly changing environment
- ◆ NO COMPROMISES!!  
SAFETY CRITICAL!!
- ◆ What happens during a shift change? How do controllers “inherit” situation awareness?

# Solution

- ◆ Create a tool that models airport situations
  - Enable outgoing controller to enter current state
  - Enable incoming controller to enter pilot requests
  - Program outputs controller action and updates the current state



LAND

GATE

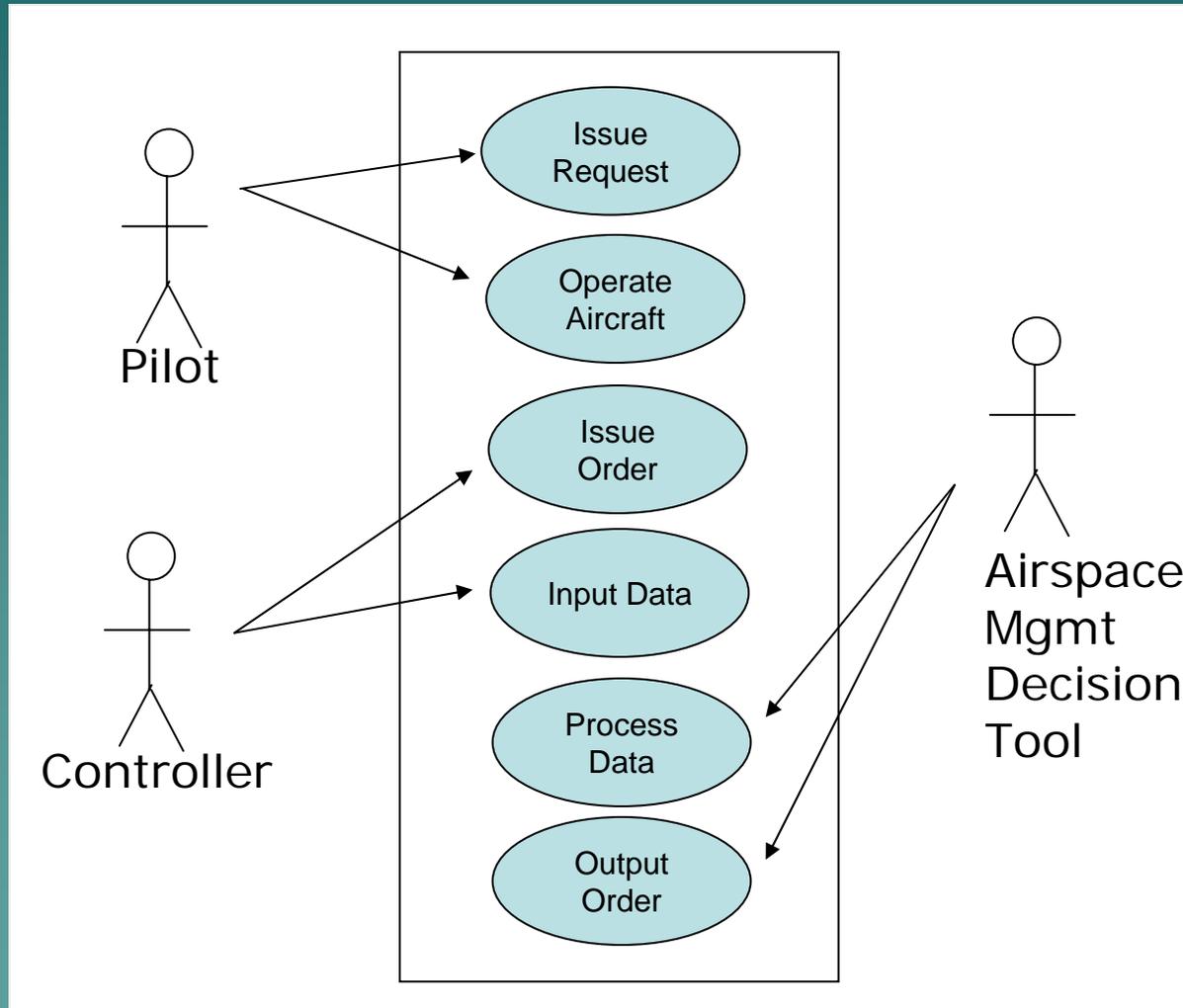
TOWER

RUNWAY

TAKE OFF

HOLDING PATTERN

# Use Case Diagram



# Finite State Machine

- ◆ States: 4 combinations of aircraft in holding pattern & at terminal gate
- ◆ Inputs: 3; Request to enter holding pattern, request to land and taxi to gate, request to taxi to runway and take off
- ◆ Output:  $4 \times 3 = 12$ ; Depends on initial state and input
- ◆ New State

# Validation Tables

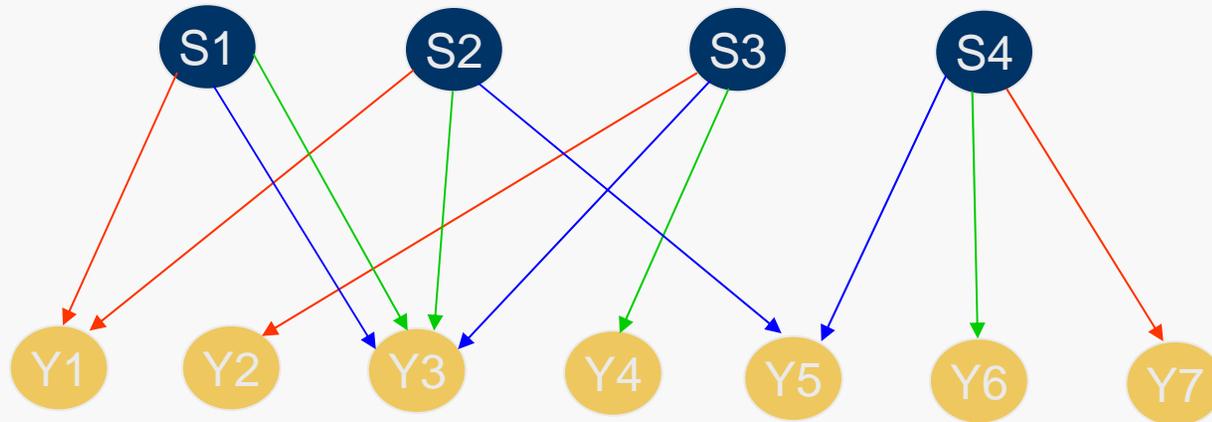
States (location of aircraft)	Input (Request from pilot)
S1	[0,0]
S2	[0,1]
S3	[1,0]
S4	[1,1]

Output (Action for Controller)
Y1
Y2
Y3
Y4
Y5
Y6
Y7

Output/Controller Action		Initial State			
		S1	S2	S3	S4
Input	X1	Y1	Y1	Y2	Y7
	X2	Y3	Y3	Y4	Y6
	X3	Y3	Y5	Y3	Y5

New State		Initial State			
		S1	S2	S3	S4
Input	X1	S3	S4	S4	S4
	X2	#	#	S2	S2
	X3	#	S1	#	S3

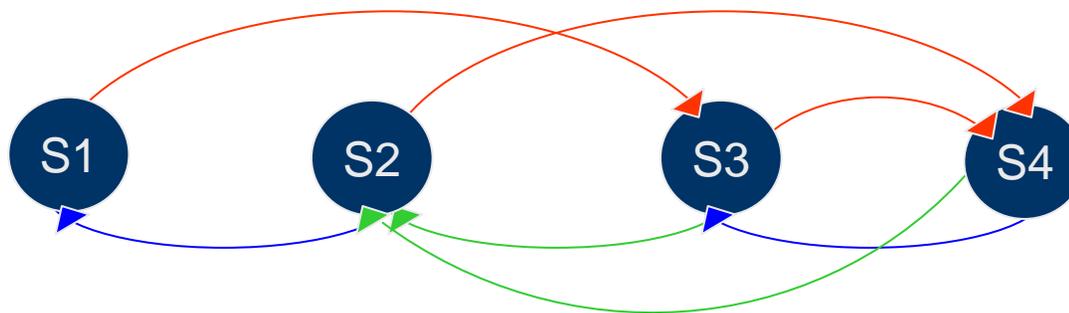
# Finite State Machine (cont)



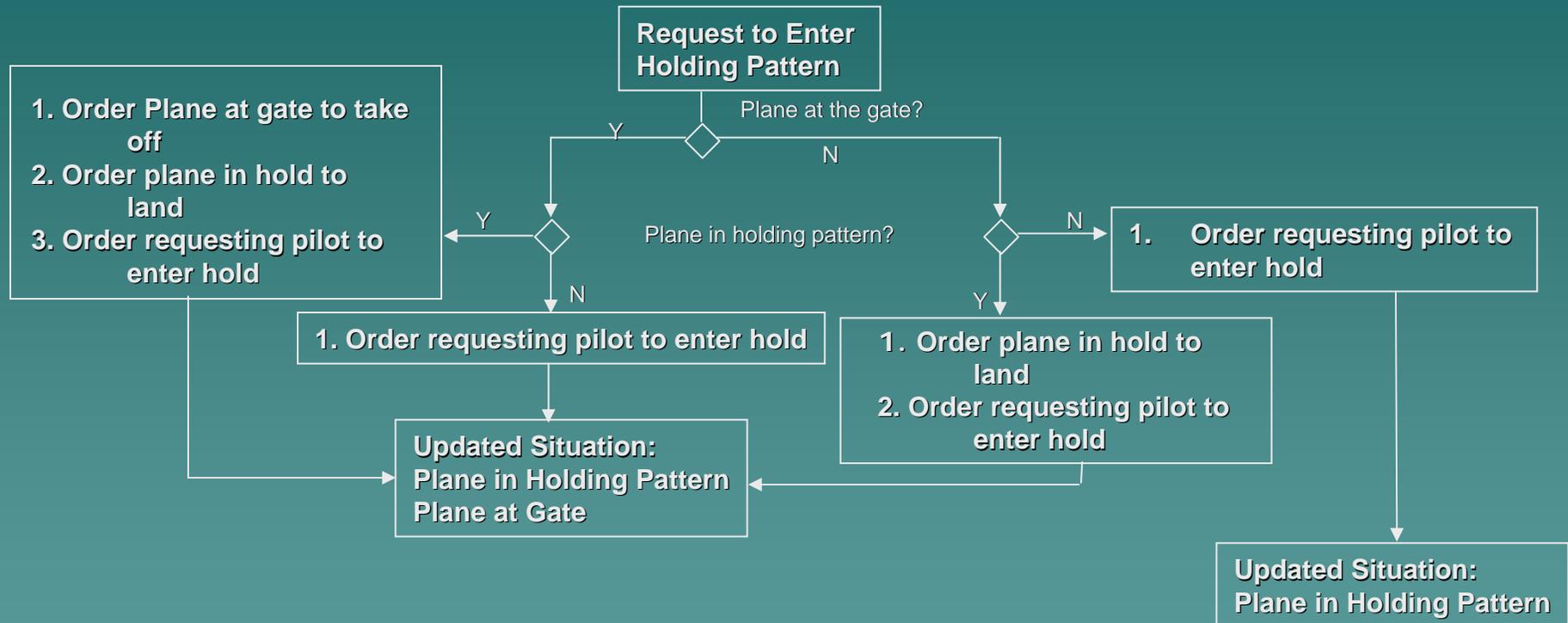
X1

X2

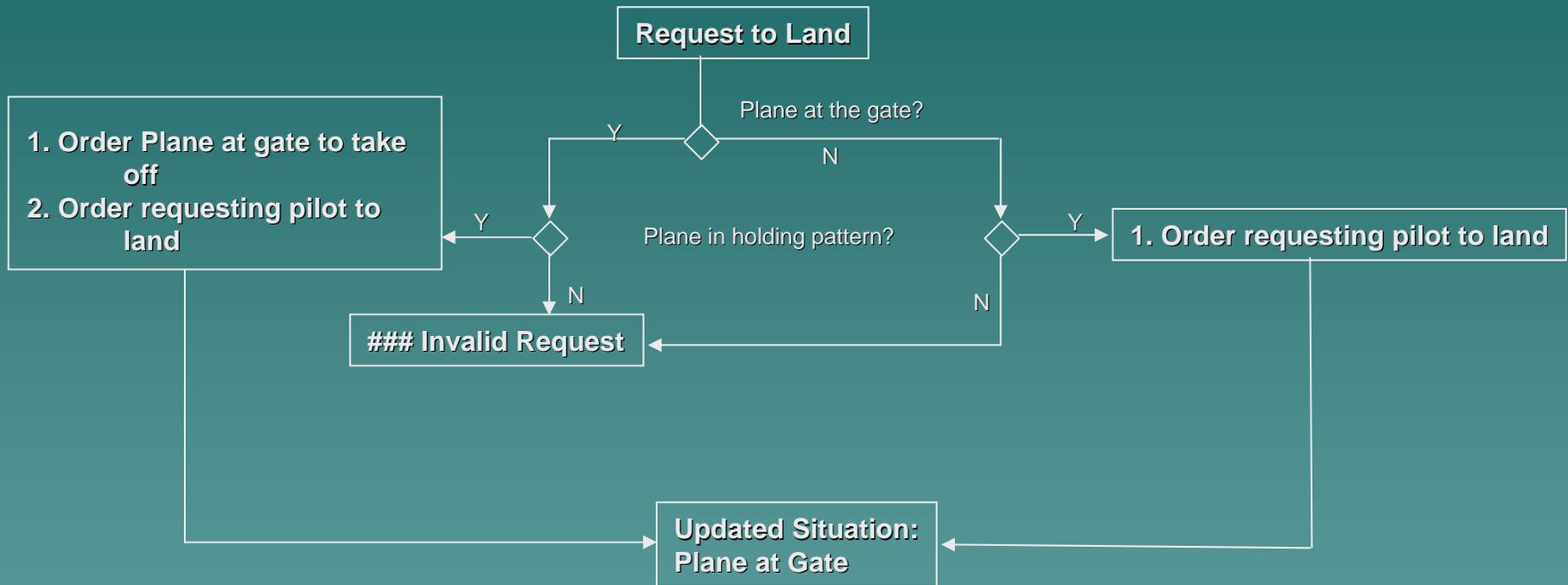
X3



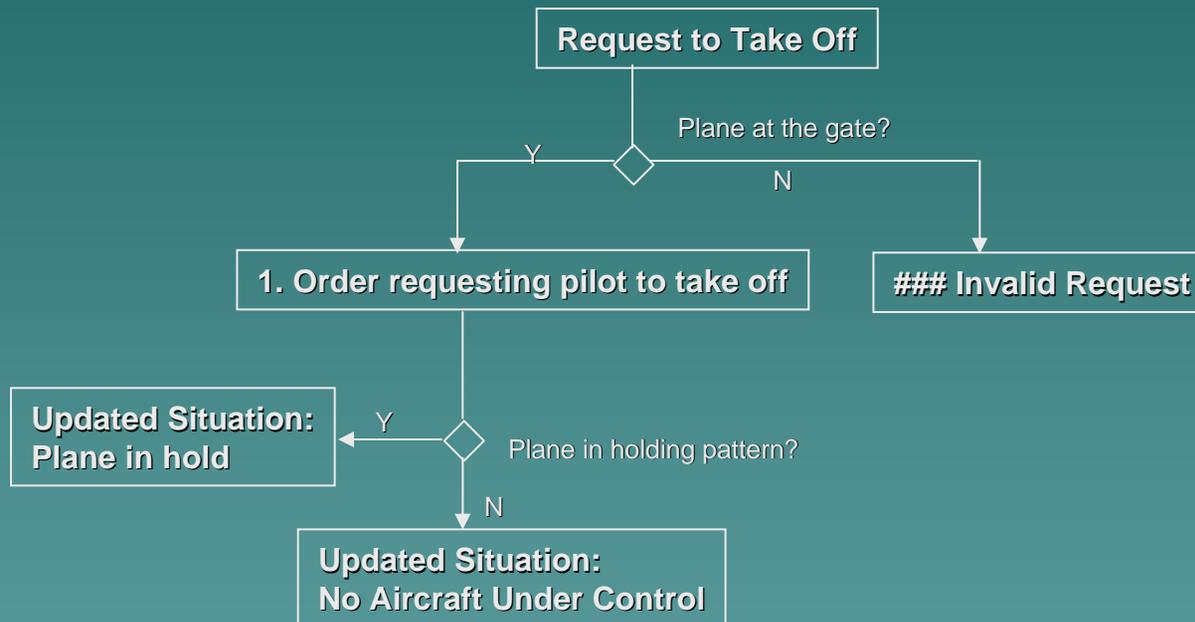
# State Diagrams



# State Diagrams (cont)



# State Diagrams (cont)



# MATLAB

```
Request=input('Enter Pilot Request','s')

if Request=='E'
    if hold==1
        if gate==1
            disp('Order aircraft at gate to taxi to
runway and takeoff')
            disp('Order aircraft in hold to land and
taxi to gate')
            disp('Approve request to enter holding
pattern')
            hold=1;
            gate=1;
            current_state=[hold, gate]
        else disp('Order aircraft in hold to land
and taxi to gate')
            disp('Approve request to enter holding
pattern')
            hold=1;
            gate=1;
            current_state=[hold, gate]
        end
    else disp('Approve request to enter holding
pattern')
        hold=1;
        current_state=[hold, gate]
    end
    k=k+1;
end
```

```
if Request=='L'
    if hold==0
        disp('Invalid Request')
    else
        if gate==1
            disp('Order aircraft at gate to taxi and
takeoff')
            disp('Approve request to land')
            hold=0;
            gate=1;
            current_state=[hold, gate]
        end
        if gate==0
            disp('Approve request to land')
            hold=0;
            gate=1;
            current_state=[hold, gate]
        end
    end
    k=k+1;
end
```

# Next Steps

- ◆ System simulation and thorough verification through LTSA/UPPAAL modeling
  - Animation
  - Multiple Input, Dynamic Behavior validation