EECE 276
Embedded Systems

Techniques:

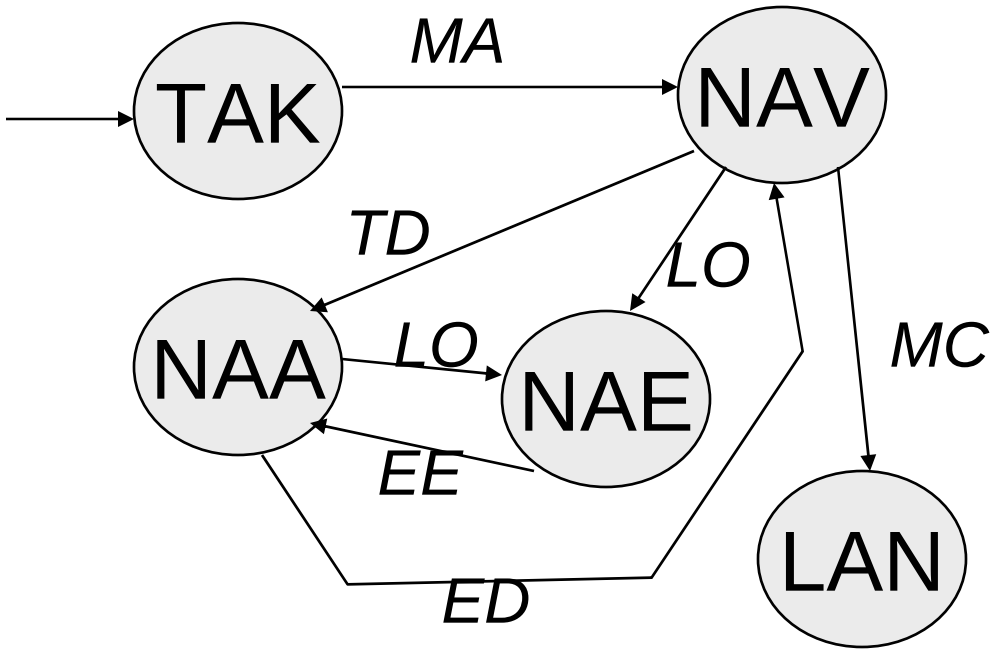
FSMs and StateCharts

Finite State Machines

- Finite state model
  - » States: States of the system (finite set)
  - » Initial State: a single element of States
  - » Terminal States: a subset of States for “stopping”
  - » Events: cause state transitions
  - » State transition function:

    F: States X Events -> States
- Variants:
  - » Self-loops
  - » Deterministic/non-deterministic transitions

FSM Example: Fighter aircraft



Self-loops are not shown!

States:
TAK: takeoff
NAV: navigate
NAE: navigate/evade
NAA: navigate/attach
LAN: land
Events:
MA: mission assignment
LO: enemy lock-on
TD: target detected
EE: enemy evaded
ED: enemy destroyed
MC: mission completed

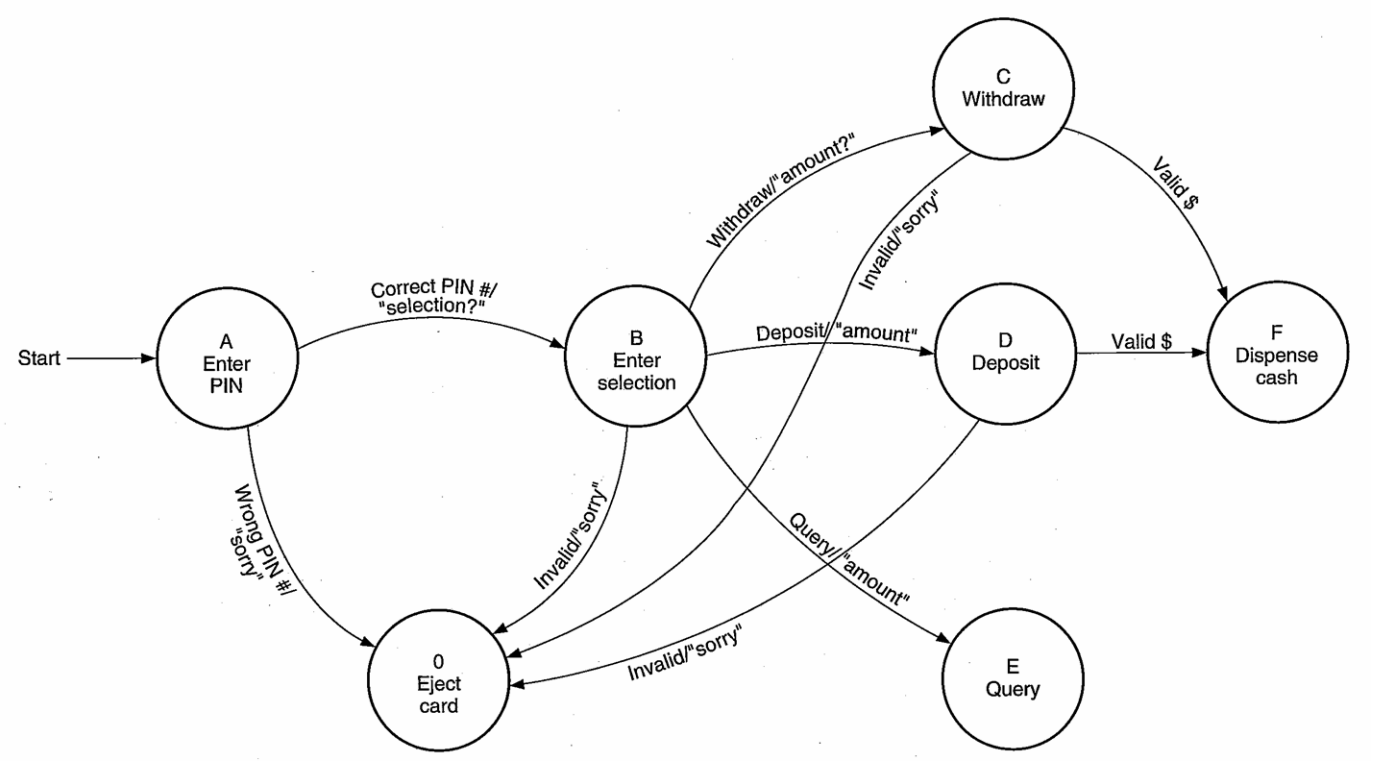
FSM Example: Table

- Tabular form

	MA	*LO*	*TD*	*MC*	*EE*	*ED*
TAK	NAV	TAK	TAK	TAK	TAK	TAK
NAV	NAV	NAE	NAA	LAN	NAV	NAV
NAE	NAE	NAE	NAE	NAE	NAA	NAE
NAA	NAA	NAE	NAA	NAA	NAA	NAV
LAN	LAN	LAN	LAN	LAN	LAN	LAN

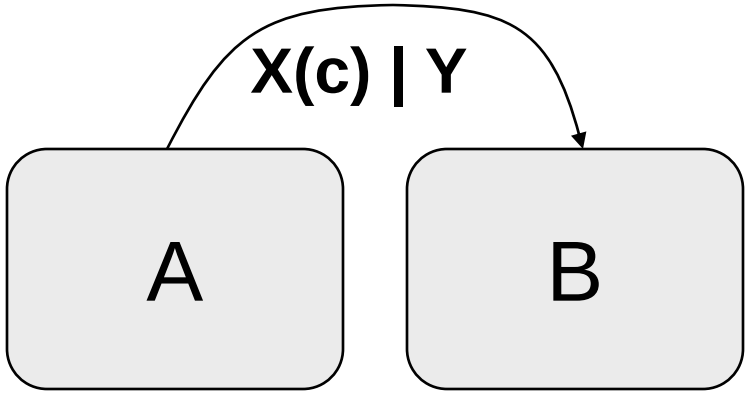
- Extensions:
  - Time triggers, variables.

FSM Example


Start
A
Enter
PIN
Correct PIN #/
"selection?"
B
Enter
selection
Withdraw/"amount?"
C
Withdraw
Invalid/"sorry"
Valid $
Deposit/"amount"
D
Deposit
Valid $
F
Dispense
cash
Wrong PIN #/
"sorry"
Invalid/"sorry"
Query/"amount"
0
Eject
card
Invalid/"sorry"
E
Query

Statecharts

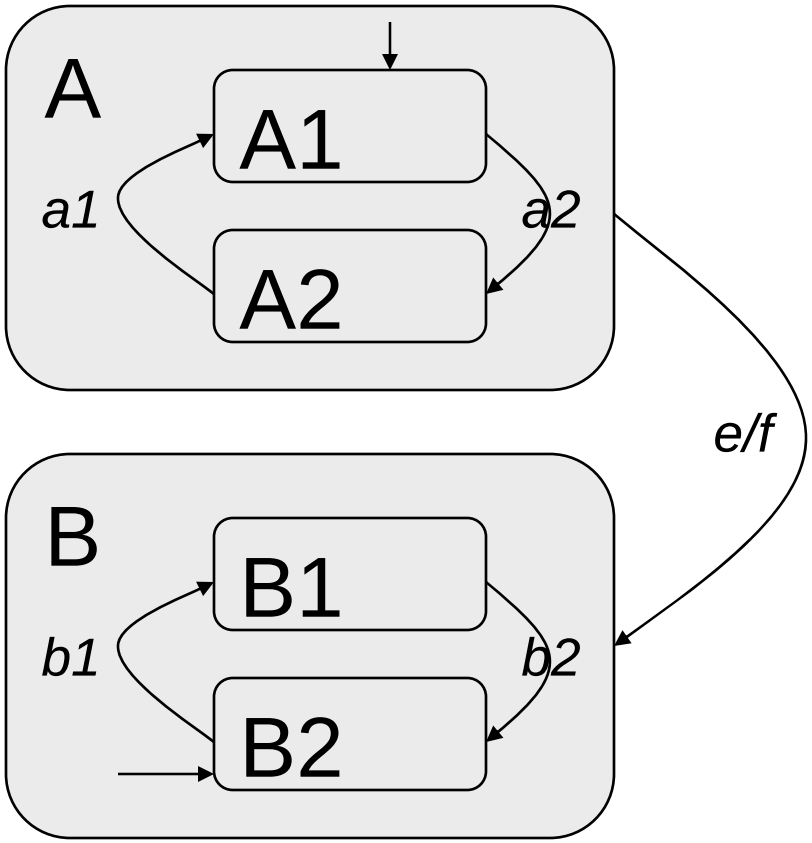
- Statecharts extend FSMs with
  - » Hierarchy: containment of states
  - » Orthogonality: concurrent states
  - » Broadcast communication: events triggering events



Event X triggers a transition if condition C is true. When the transition is taken, event Y is broadcast.

Statecharts

- Hierarchy

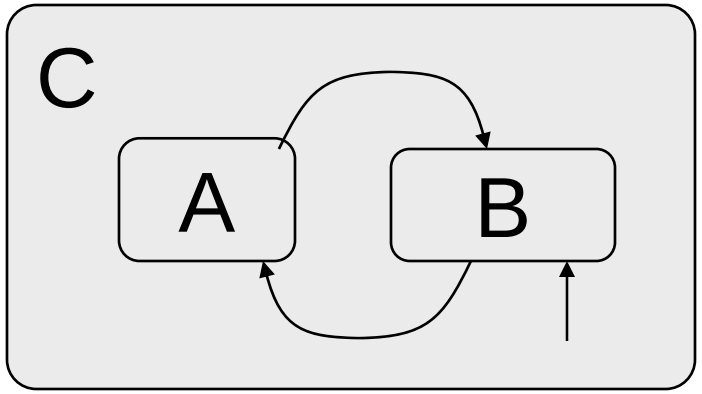


A has two sub-states: A1(initial),A2

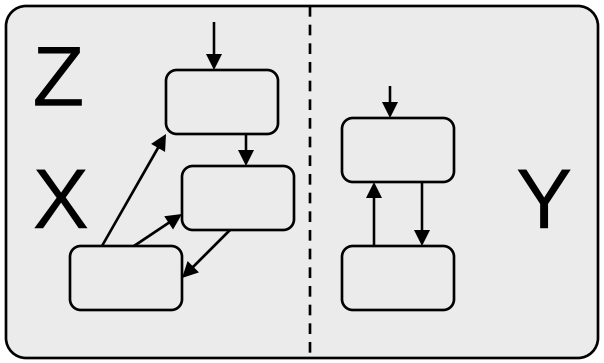
B has two sub-states: B1,B2(initial)

Statecharts

- Orthogonality

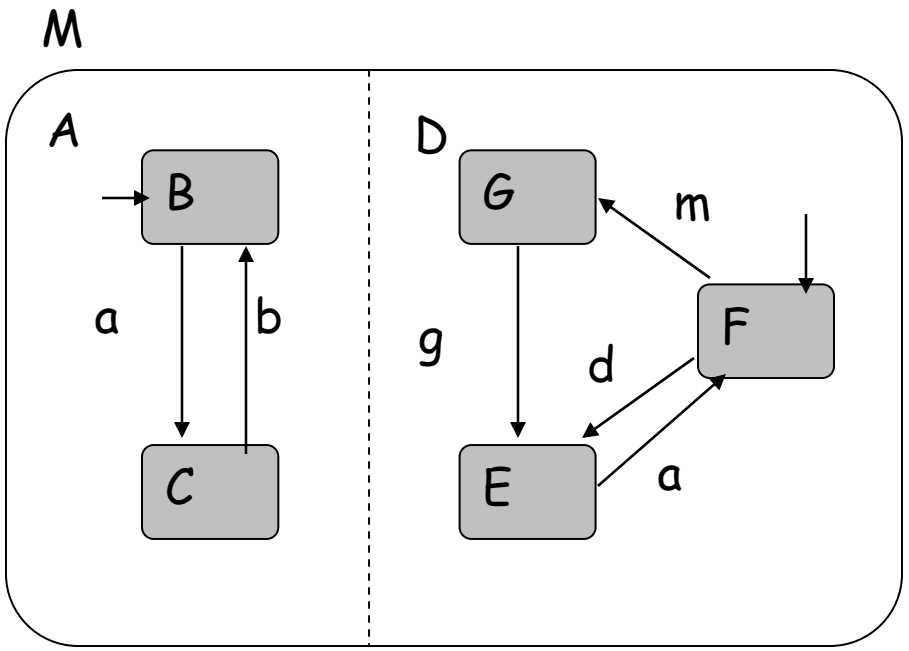


OR-state "C": The system is either in A or B, but never in both.



AND-state Z: The system is in ***both*** *X* ***and*** *Y*

Statechart Summary



Summary:

- *Concise notation to describe complex reactive systems*
- *Easy to generate code from*
- *Standardized (UML)*

Statechart Example