Design Patterns

Commonly occurring structures in software

Embedded systems used in

- Reactive systems
- Data processing applications
- Repeatedly used applications

Design Patterns in embedded systems

- State Machines
- Circular Buffers

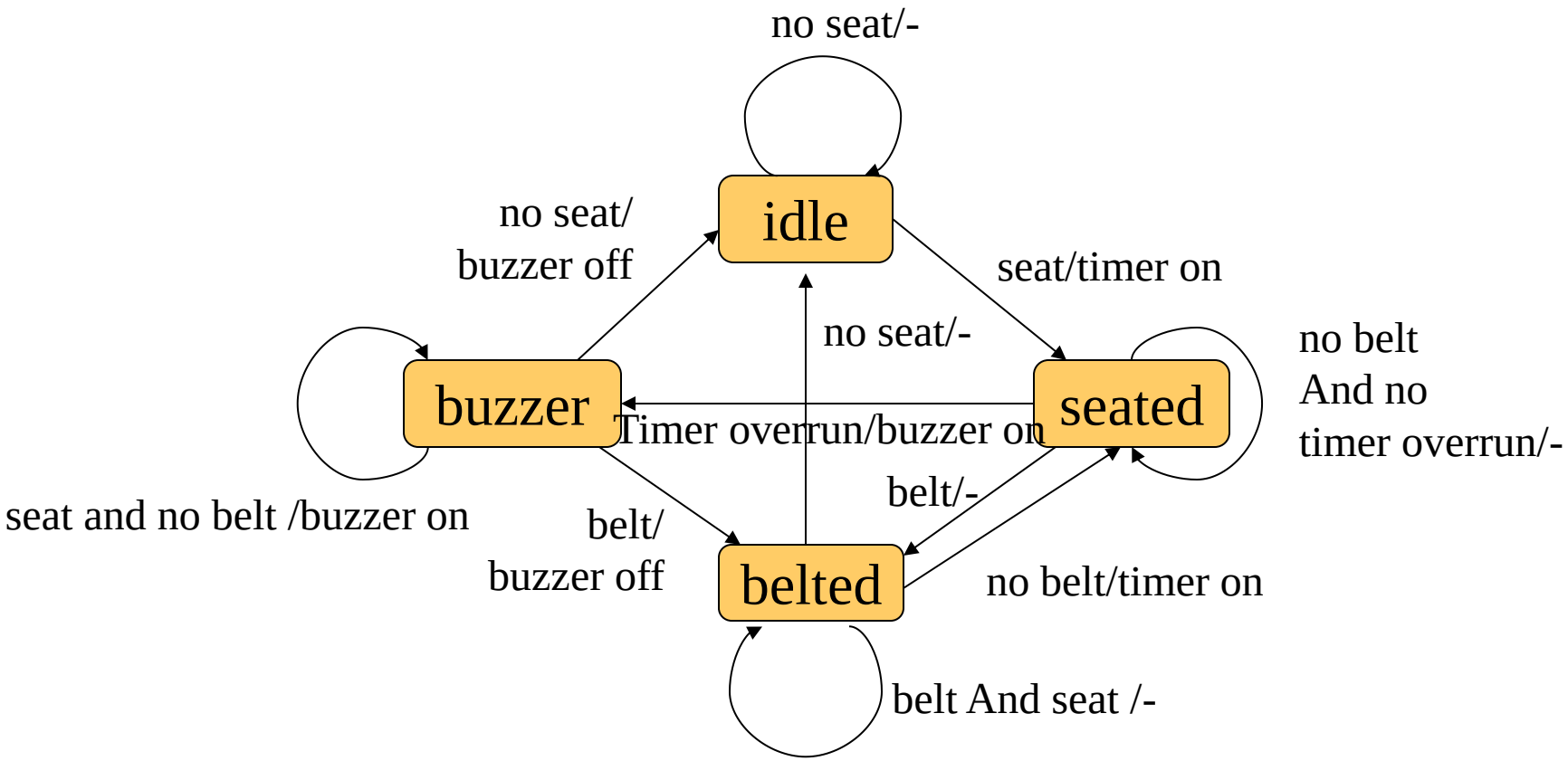
Software State Machine

State machine keeps internal state as a variable, changes state based on inputs.

Uses:

- control-dominated code;
- reactive systems.

Example – Car Seat Belt Alarm System



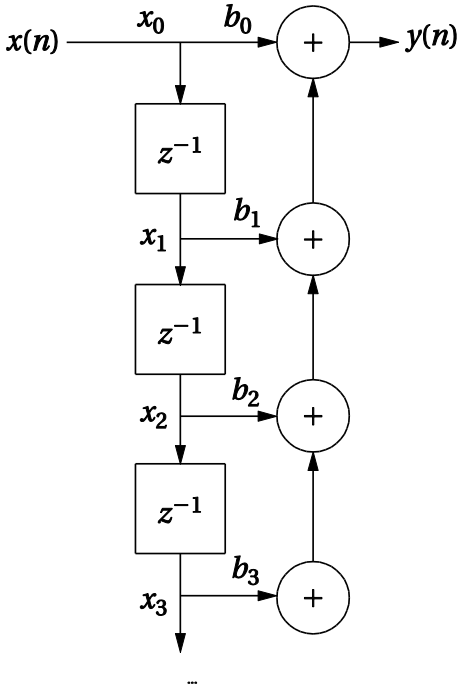
C Implementation

```
#define IDLE 0
#define SEATED 1
#define BELTED 2
#define BUZZER 3
switch (state) {
    case IDLE: if (seat) { state = SEATED; timer_on = TRUE; }
                    break;
    case SEATED: if (belt) state = BELTED;
                                    else if (timer) {state = BUZZER; buzzer_on=TRUE;}

                    break;
    …
}
```

Example – FIR Filter

Finite impulse response Filter

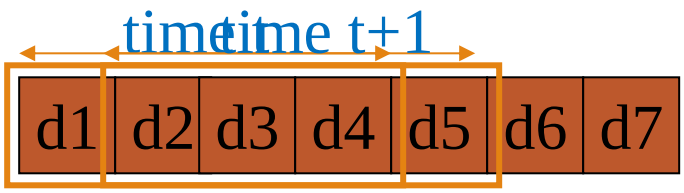


Signal processing and circular buffer

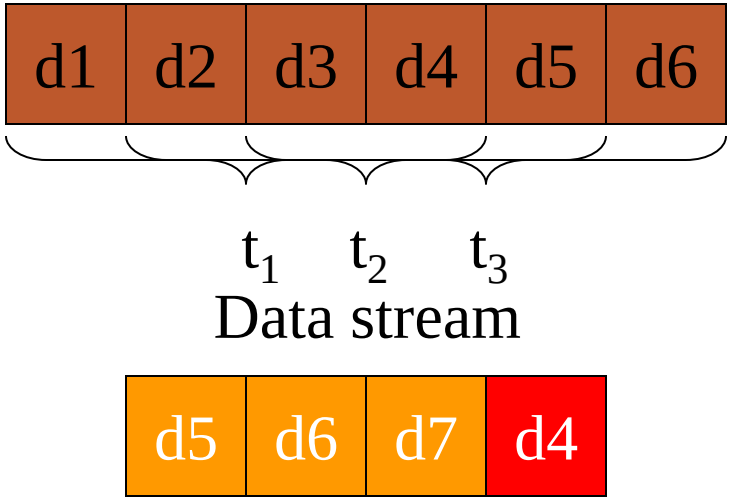
Commonly used in signal processing:

- new data constantly arrives;
- each datum has a limited lifetime.

Use a circular buffer to hold the data stream.



Circular buffer



Pseudo code

i=0;

x[0]=x[1]=x[2]=x[3]=0

While

- If i=4 then i=0;
  - x[i]=in;
  - out=c1*x[i]+c4*x[(i+1)%4]+ c3*x[(i+2)%4]+ c2*x[(i+3)%4];
  - i=i+1;

end