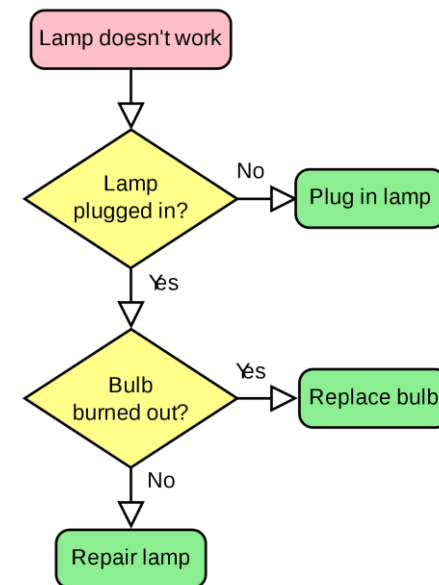
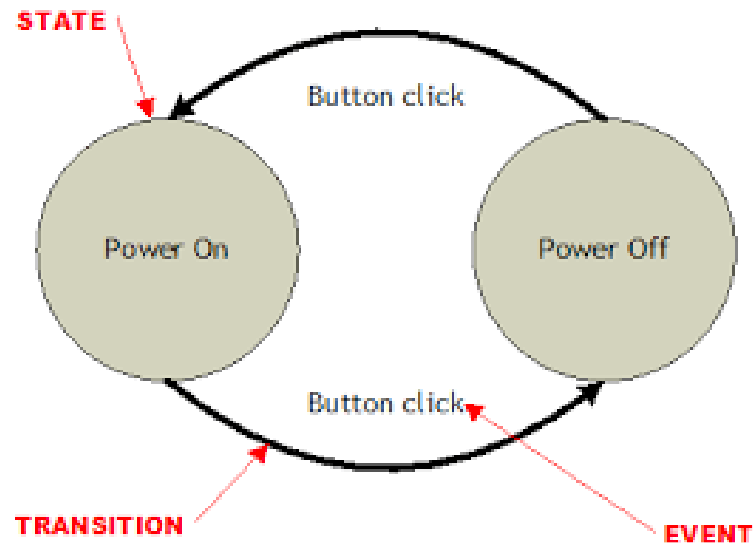


CO3053 – Embedded Systems

4. State Machine & Flow-Chart

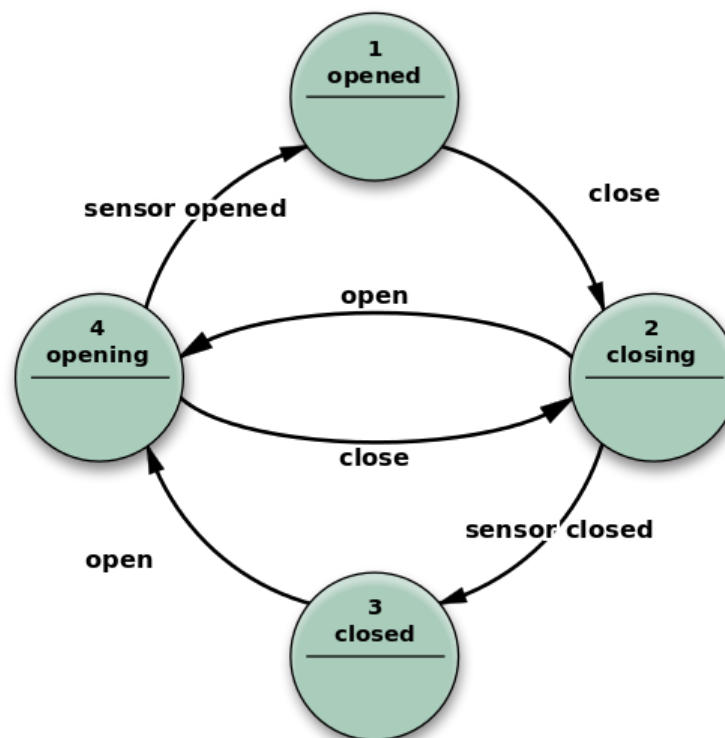


Contents

- State machine/chart/diagram to describe an embedded system
- Present algorithms by flow-chart

State Machine Diagram

- A state machine is any device that stores **the status** of something at a given time and can operate on **input** to change the status and/or cause an action or **output** to take place for any given change.



System Description by State Machine

■ State

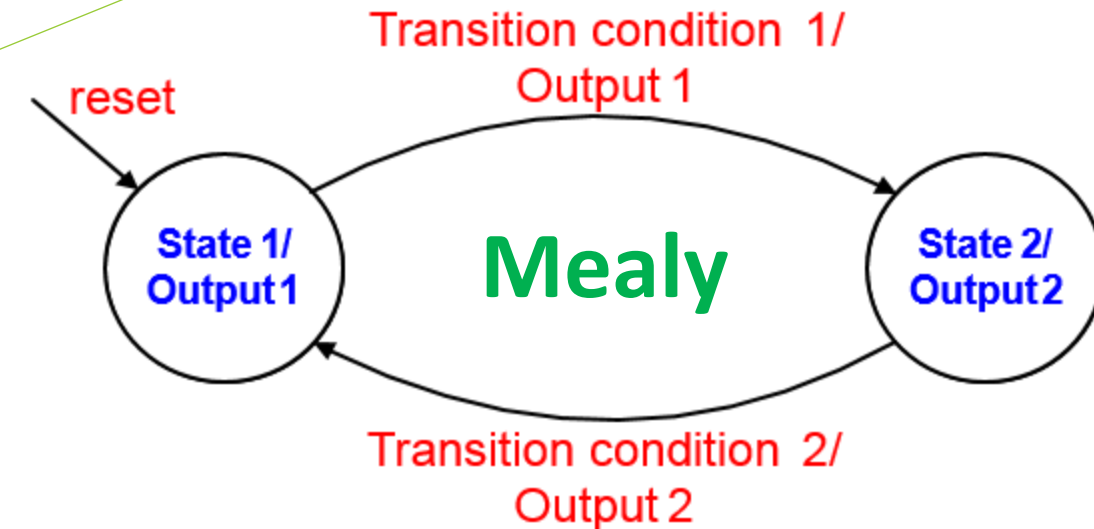
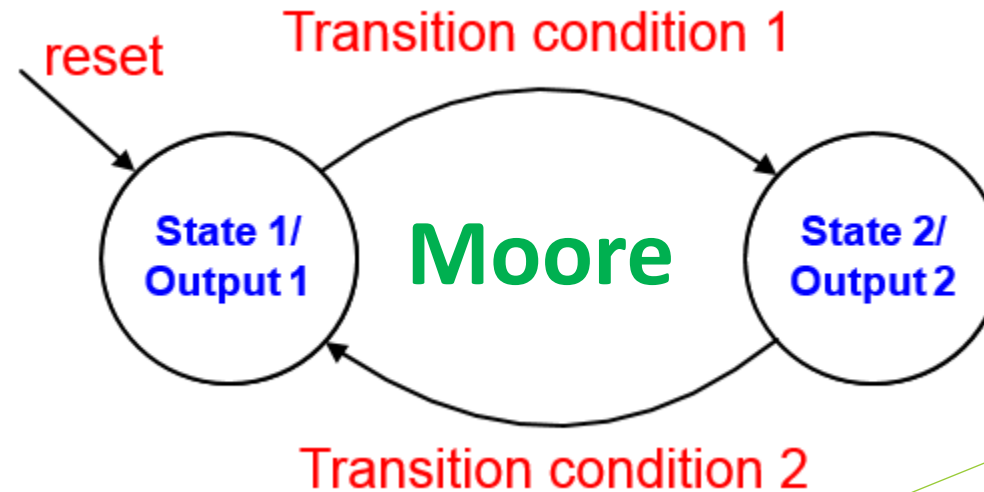
- Present state
- Next state

■ Input

- Transition condition
- Event

■ Output

- Functions of the present states (inputs)



System Description by State Machine

■ State

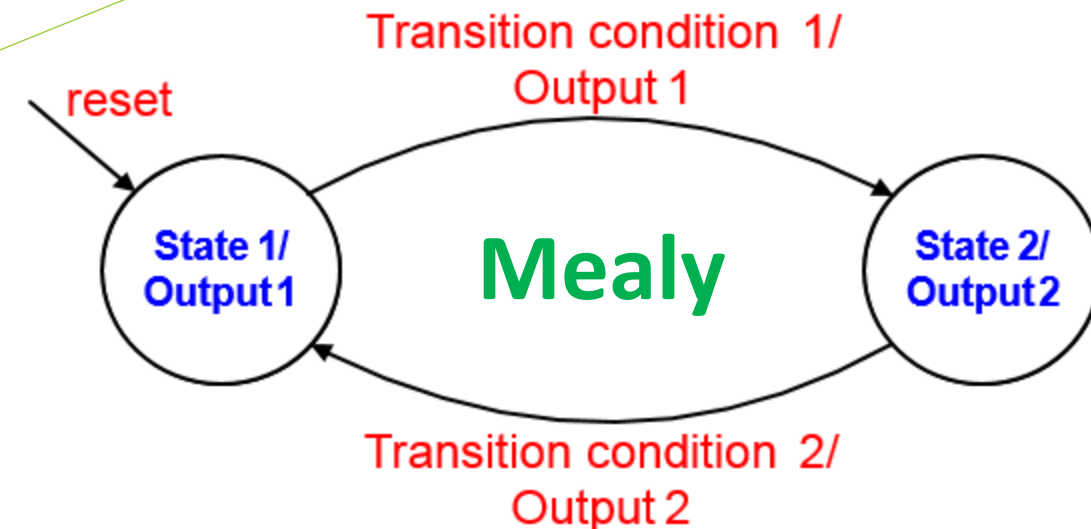
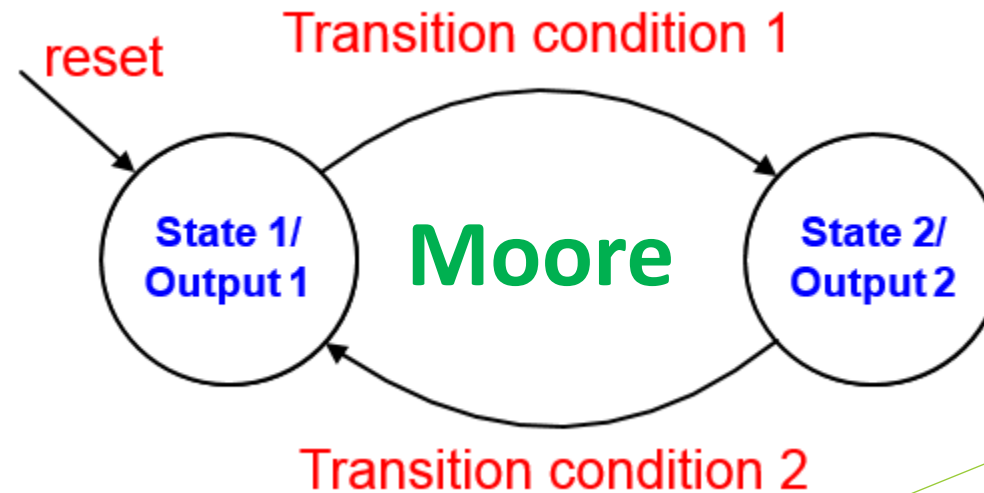
- Present state
- Next state

■ Input

- Transition condition
- Event

■ Output

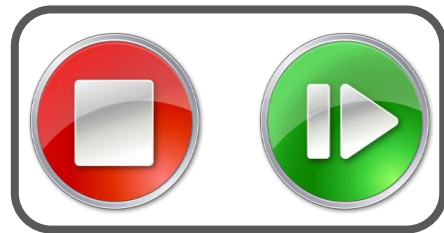
- Functions of the present states (inputs)



State Machine – Example

■ Music Player

- stop button
- start/pause

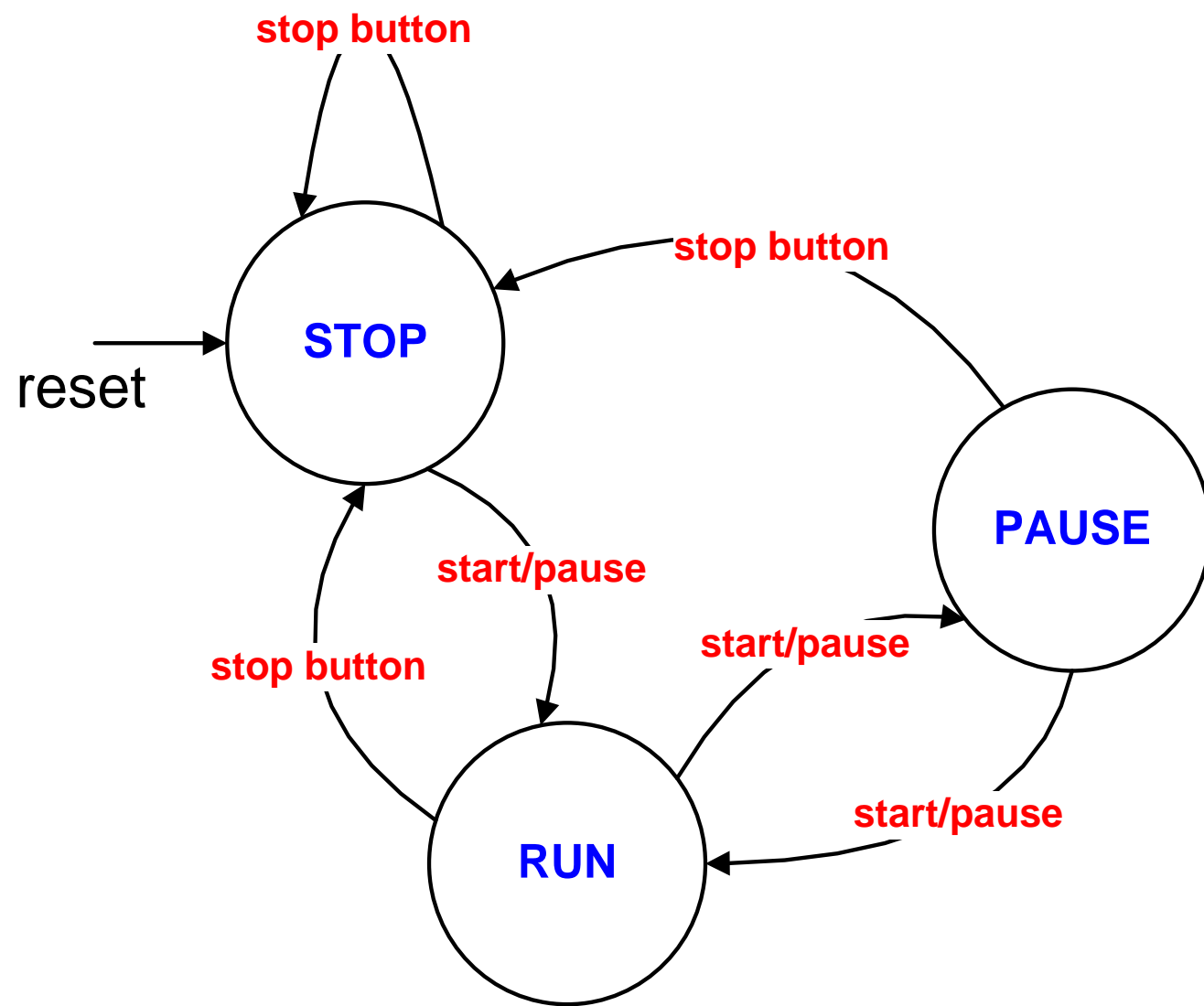


■ State determination

- STOP
- RUN
- PAUSE

■ Transition condition

- Button click



State Machine – Example

■ Garage Door Control

- Remote control
- Door Actuators

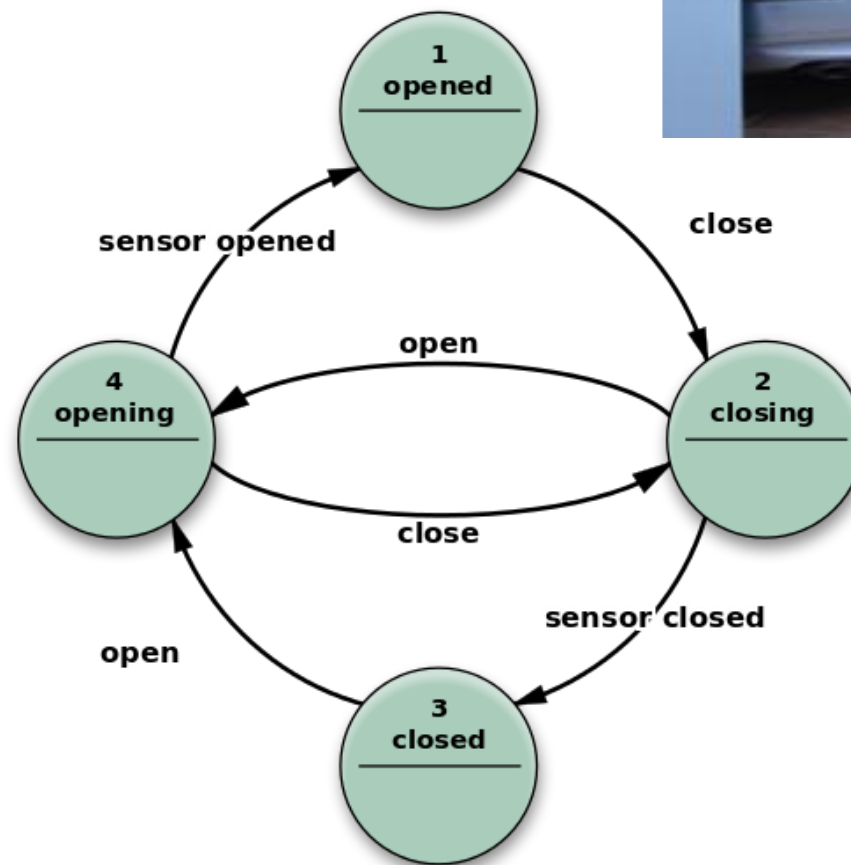


■ State determination

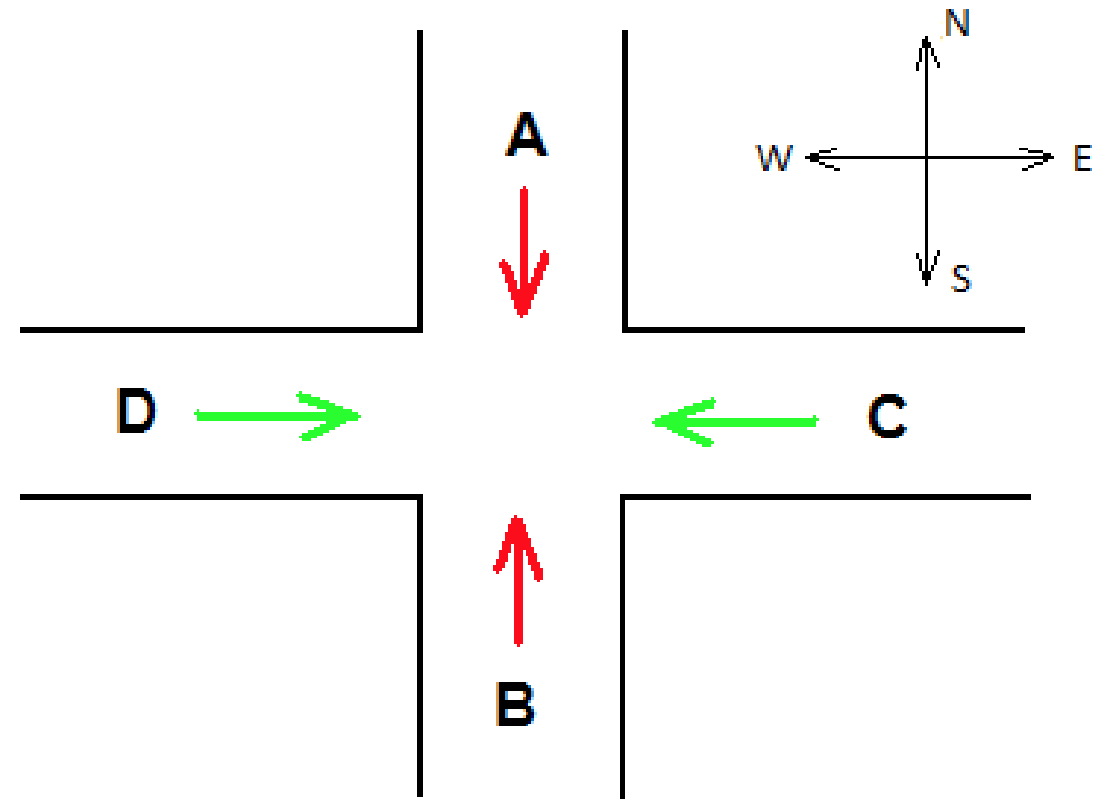
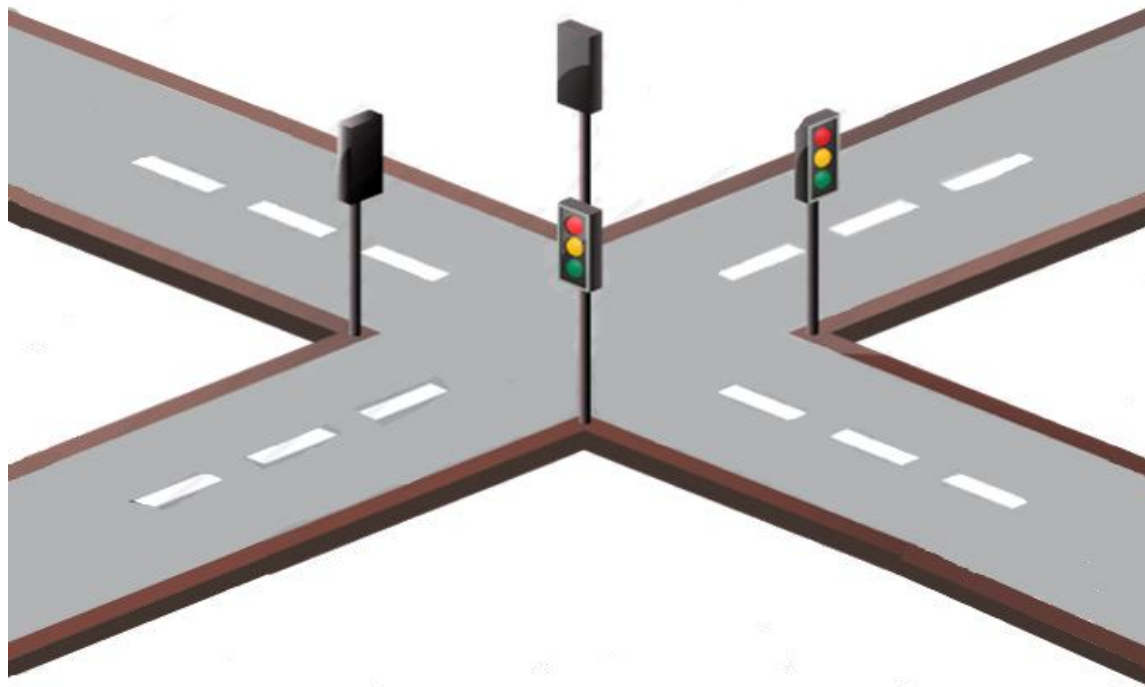
- Opened
- Opening
- Closed
- Closing

■ Transition condition

- Button click
- Sensor event



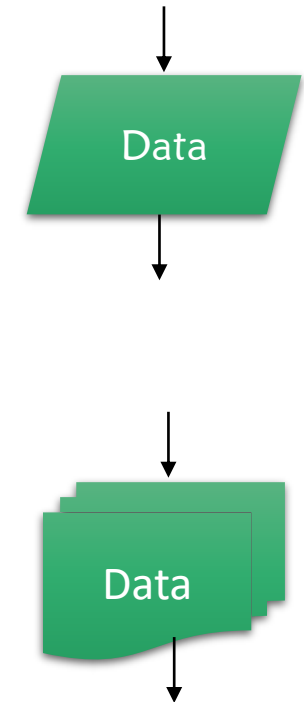
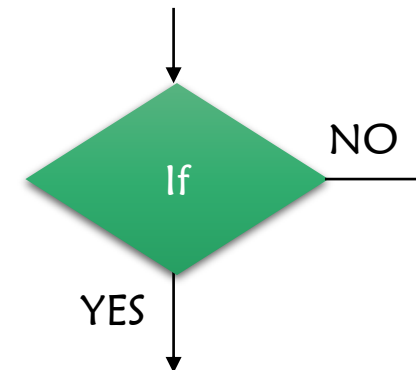
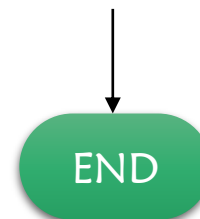
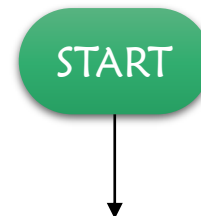
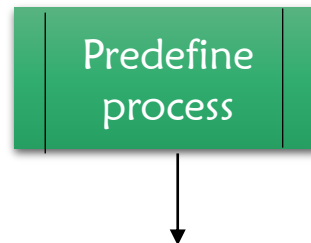
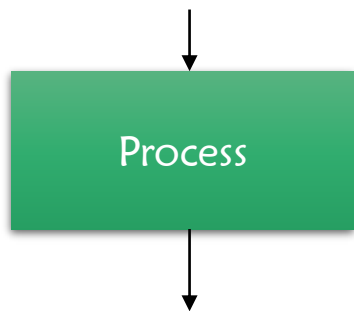
State Machine – Exercise (Traffic Light 1)



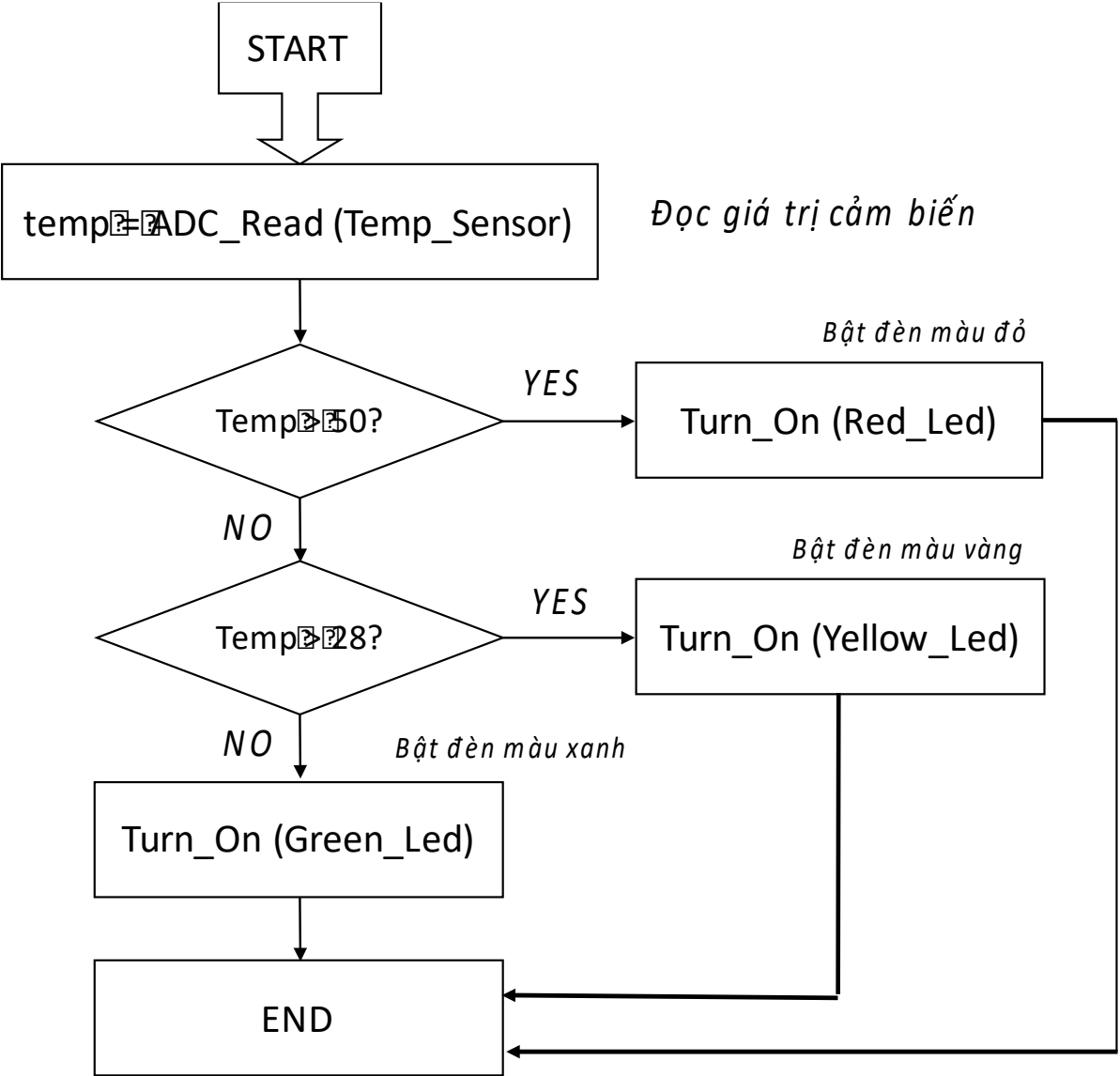
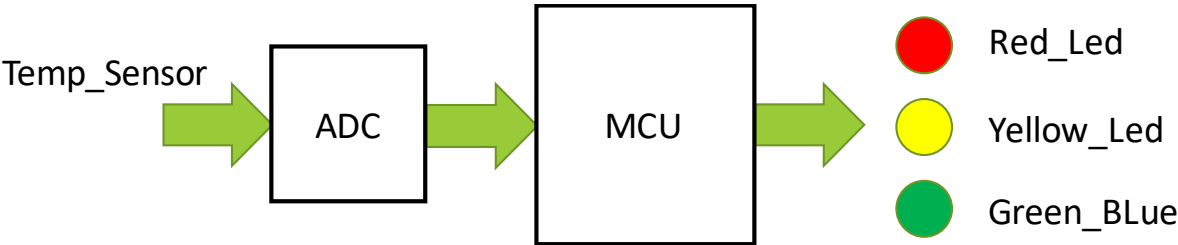
Flow-chart

- **To represent an algorithm for a specific function.**

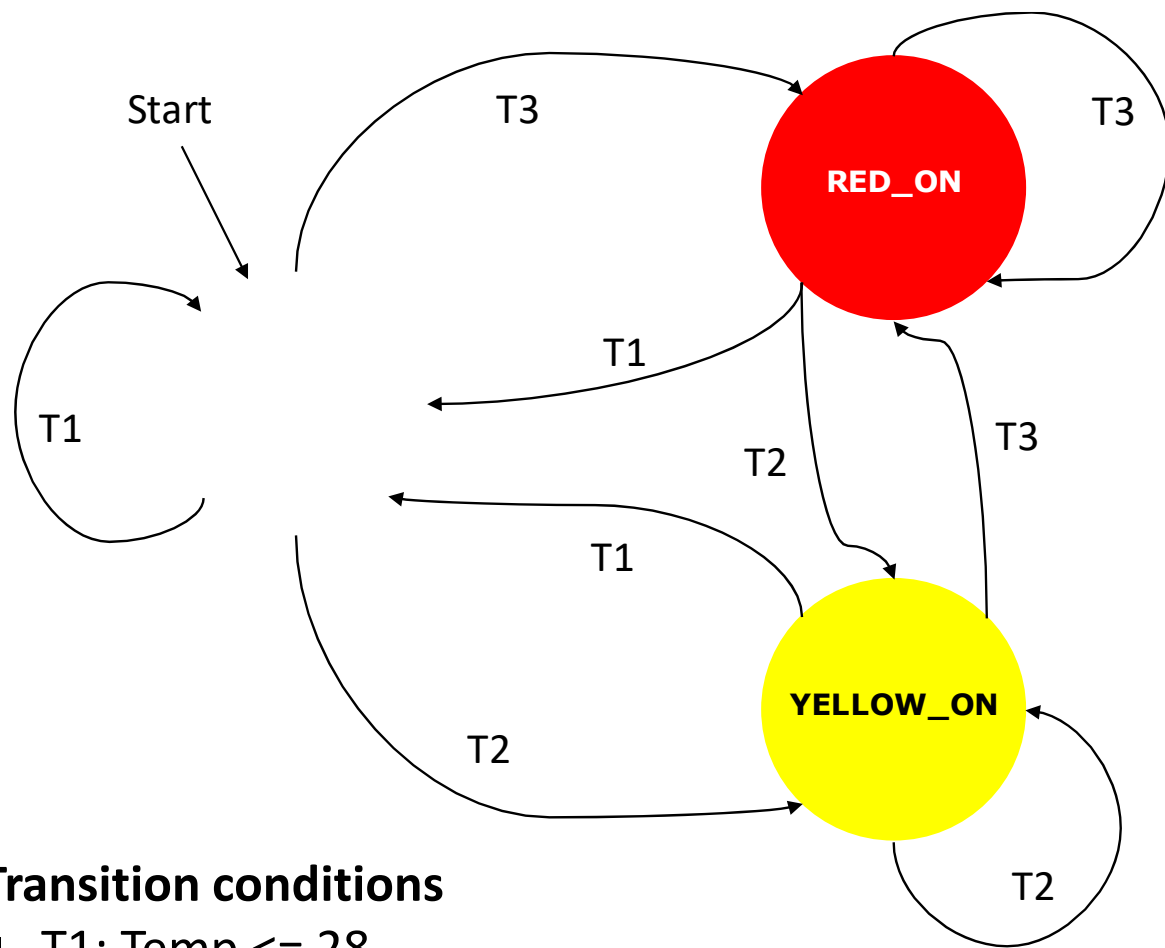
- Use a rectangle for a **process**
- Use a rounded rectangle for a **terminator** (START, END)
- Use a diamond shape for a **decision**
- Use a parallelogram for **data**
- Use a rectangle with two vertical lines for **predefine process**



Flow-chart - Example

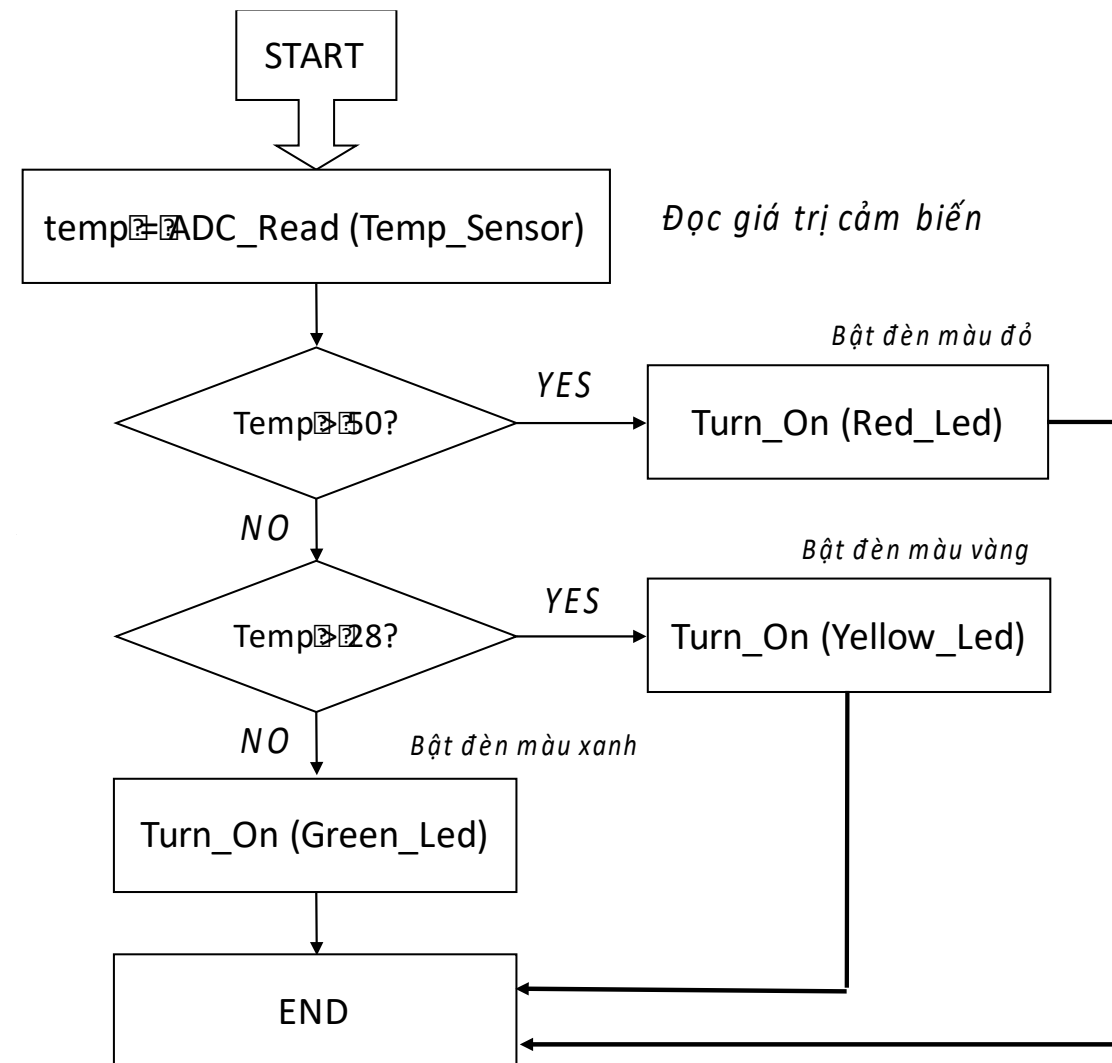


State Machine and Flow-Chart



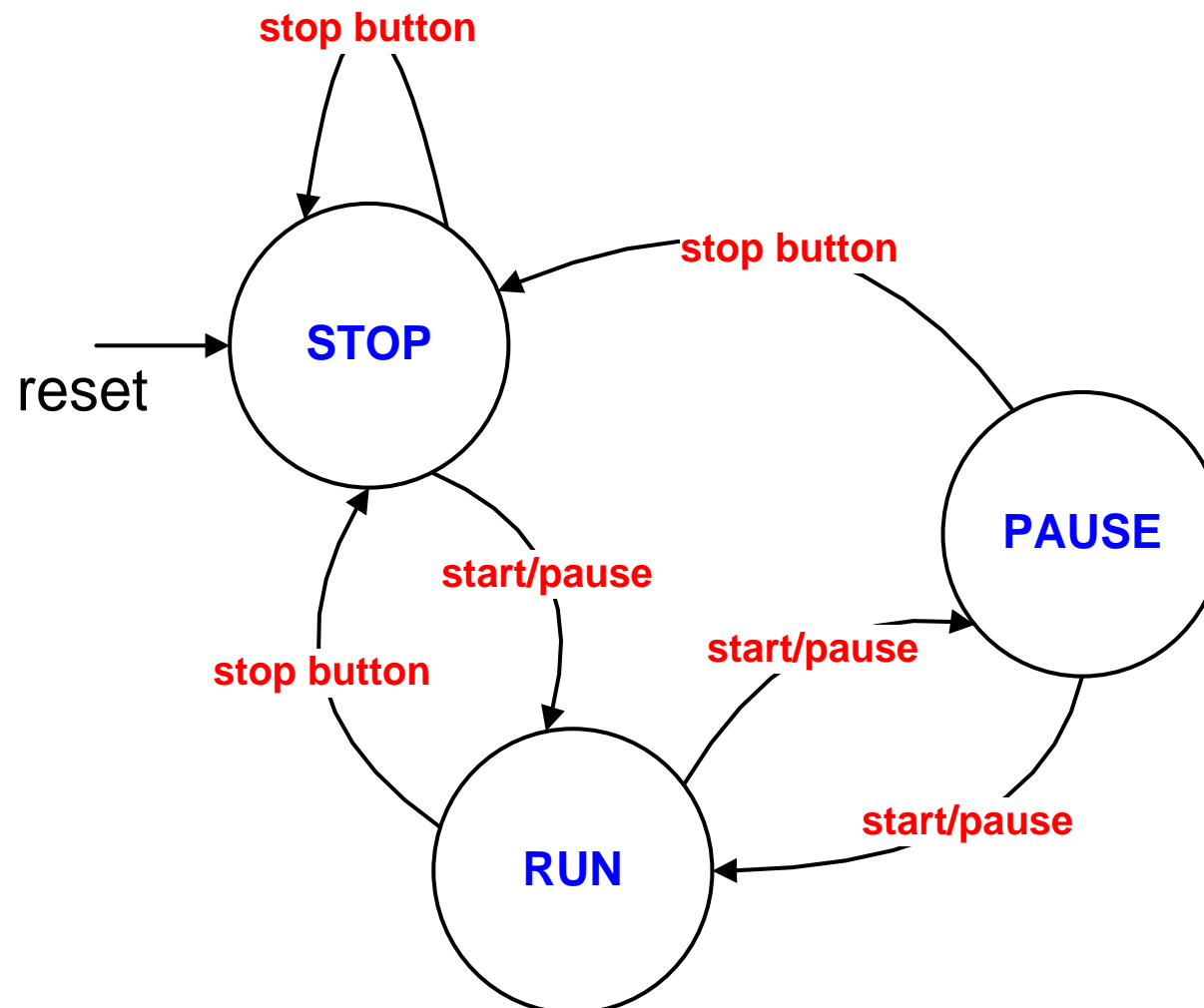
Transition conditions

- T1: Temp ≤ 28
- T2: 28 < Temp ≤ 50
- T3: Temp > 50



Flow-chart - Exercise

- Represent the system described by the state machine in forms of flow-chart



Exercise

- Let's design and implement the control unit of a washing machine that is described as follows:
 - The machine can be controlled by three buttons (STOP, RUN, PAUSE).
 - The washing machine is only able to execute after at least 50-cents is added.
 - The machine only accepts 10-cent, 20-cent, 50-cent coins.
 - When there is enough money, the machine will execute if the RUN button is pressed. Then, the money will be clear without returning the redundancies (if any).
 - When the machine is running, it will be paused as the PAUSE button is pressed. The machine will re-execute when the RUN button is pressed again.
 - The executing machine will be automatically terminated after 30 minutes or when the STOP button is pressed.