# Industrial Automation

## (Automação de Processos Industriais)

## GRAFCET

## *(Sequential Function Chart) 2/2*

http://users.isr.ist.utl.pt/~jag/courses/api1112/api1112.html

2011/2012 Prof. José Gaspar

# Syllabus:

**Chap. 3 – PLCs Programming Languages [2 weeks]**

**...**

**Chap. 4 - GRAFCET *(Sequential Function Chart)* [1 week]**

The GRAFCET norm.

Elements of the language.

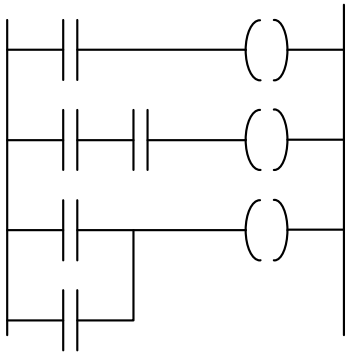
Modelling techniques using GRAFCET.

...

**Chap. 5 – CAD/CAM and CNC Machines [1 week]**

# PLCs Programming Languages (IEC 1131-3)

## *Ladder Diagram*



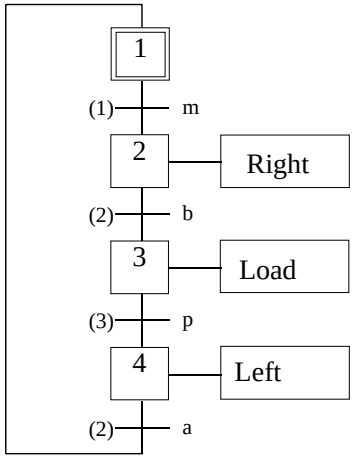
## *Structured Text*

```
If  %I1.0  THEN
  %Q2.1 := TRUE
ELSE
  %Q2.2 := FALSE
END_IF
```

## *Instruction List*

```
LD      %M12
AND     %I1.0
ANDN    %I1.1
OR      %M10
ST      %Q2.0
```

## *Sequential Function Chart (GRAFCET)*



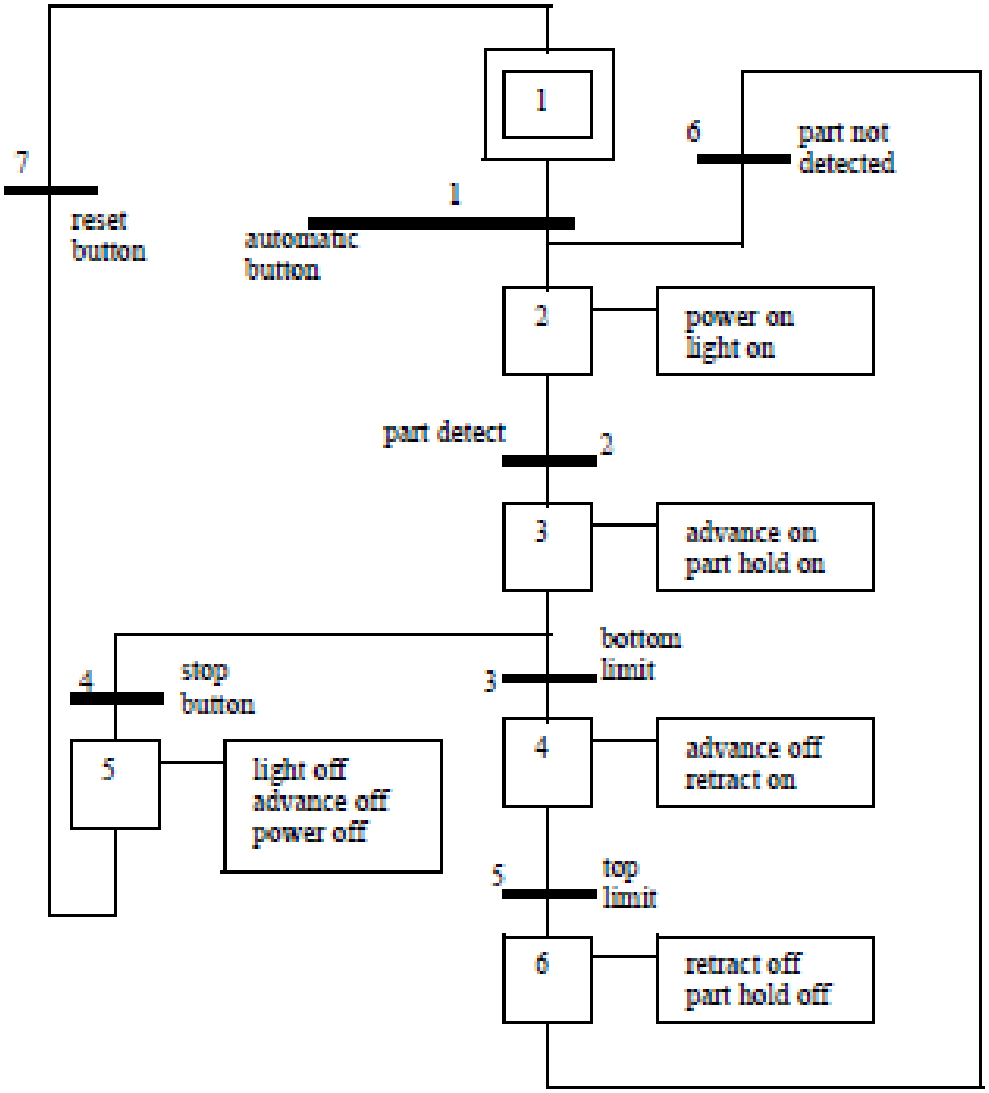
# GRAFCET vs Ladder

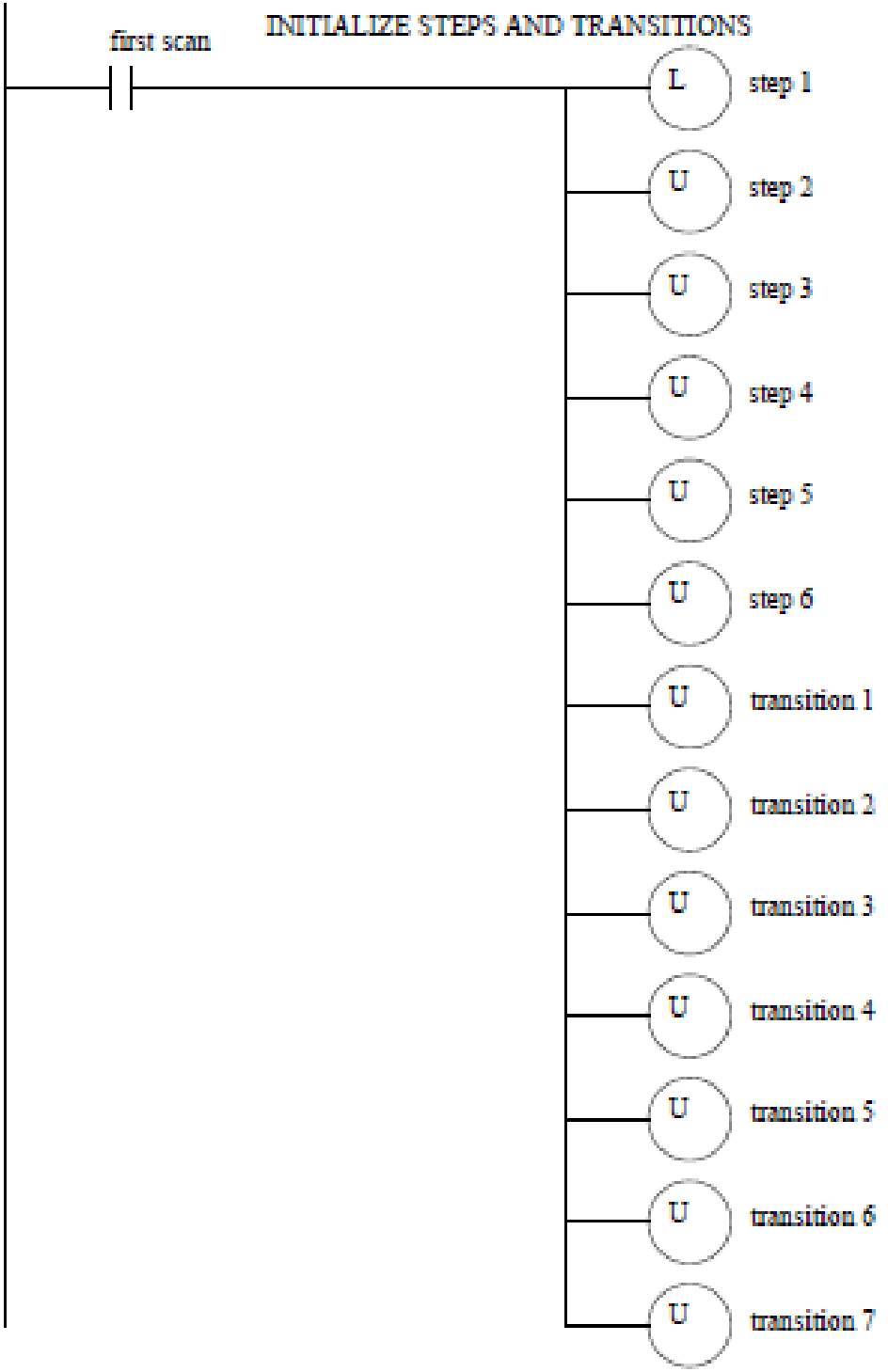
**Grafcet/SFC can be converted directly to ladder logic:**

0. Assign one Boolean variable to each step (si) and transition (tj)
1. Initialize steps and transitions
2. Check transitions
3. Perform activities for steps
4. Enable transitions

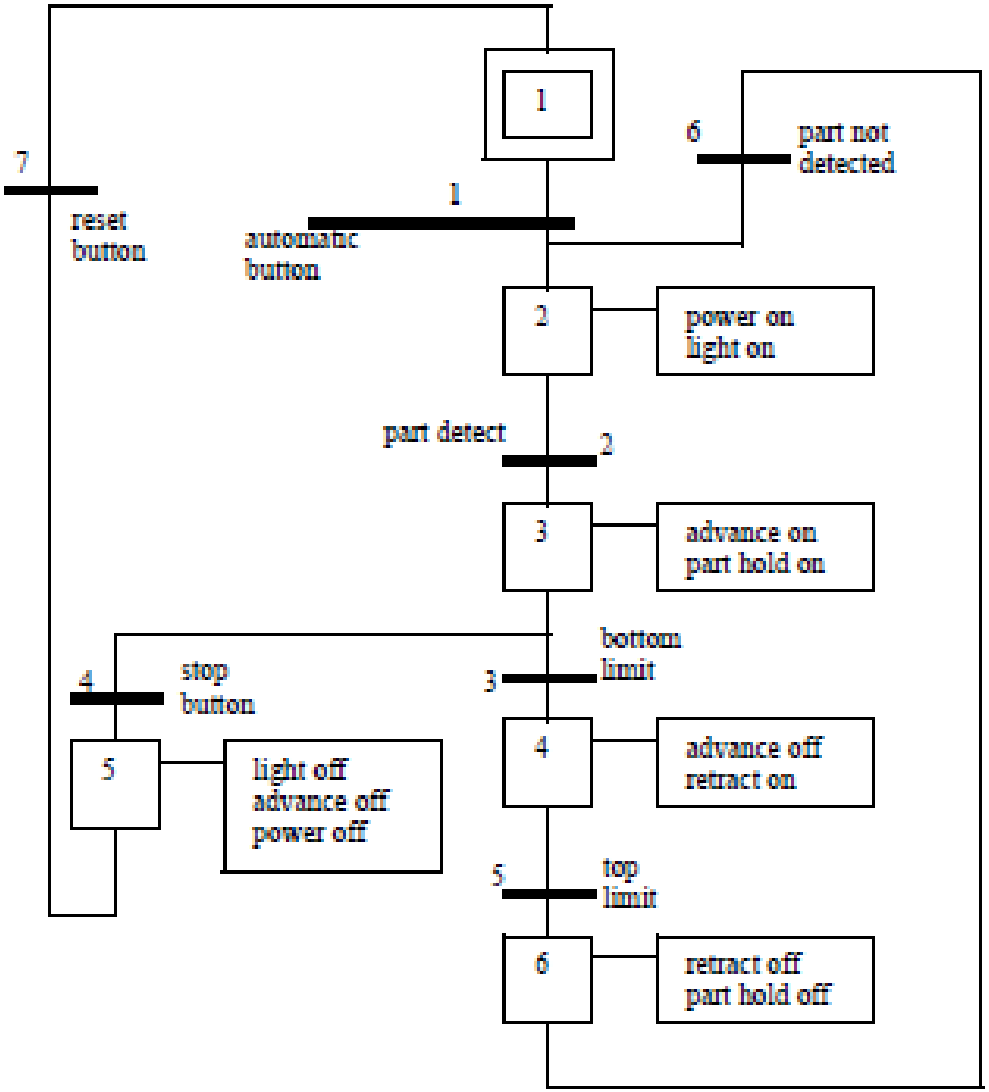
Ref: [Hugh Jack 2008]

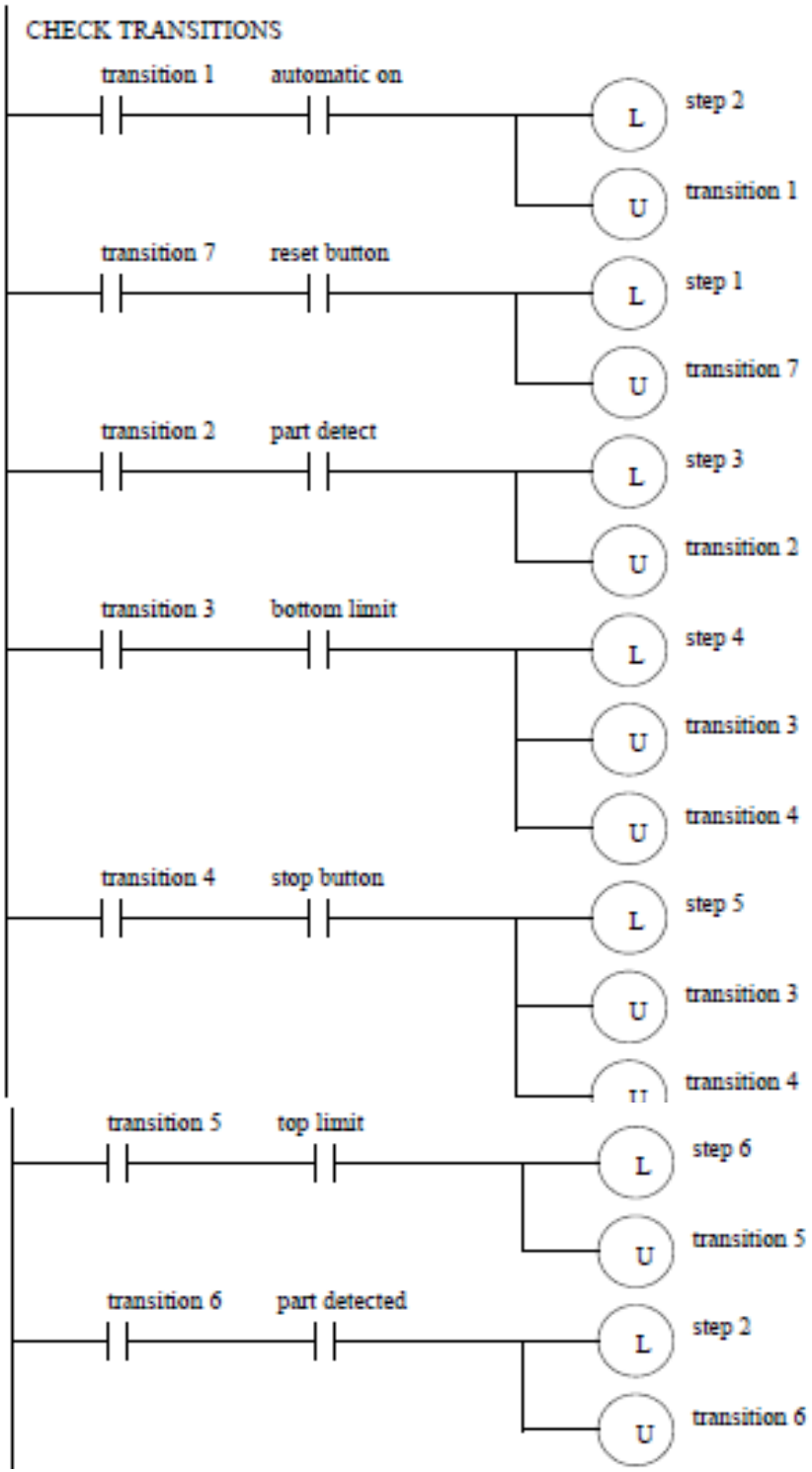
# 1. Initialize steps and transitions



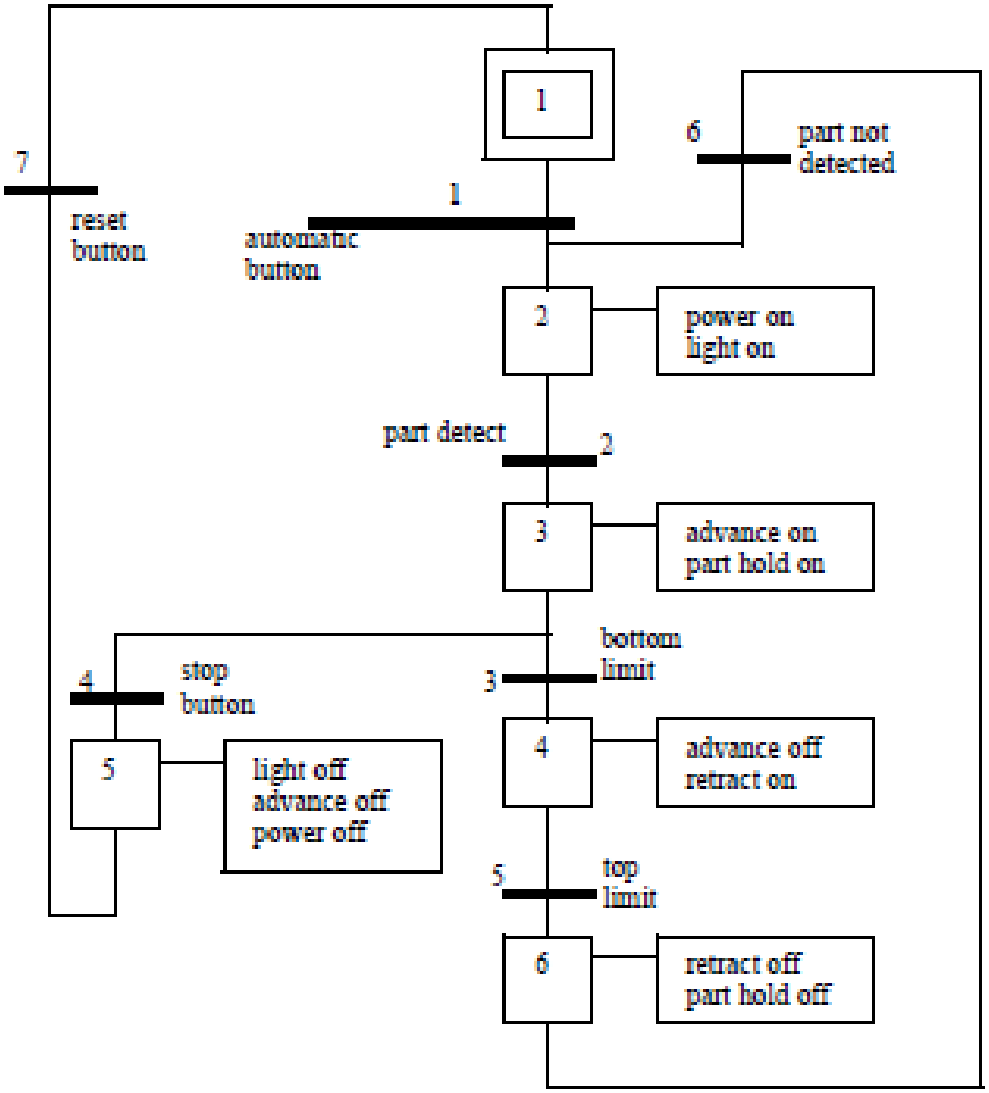



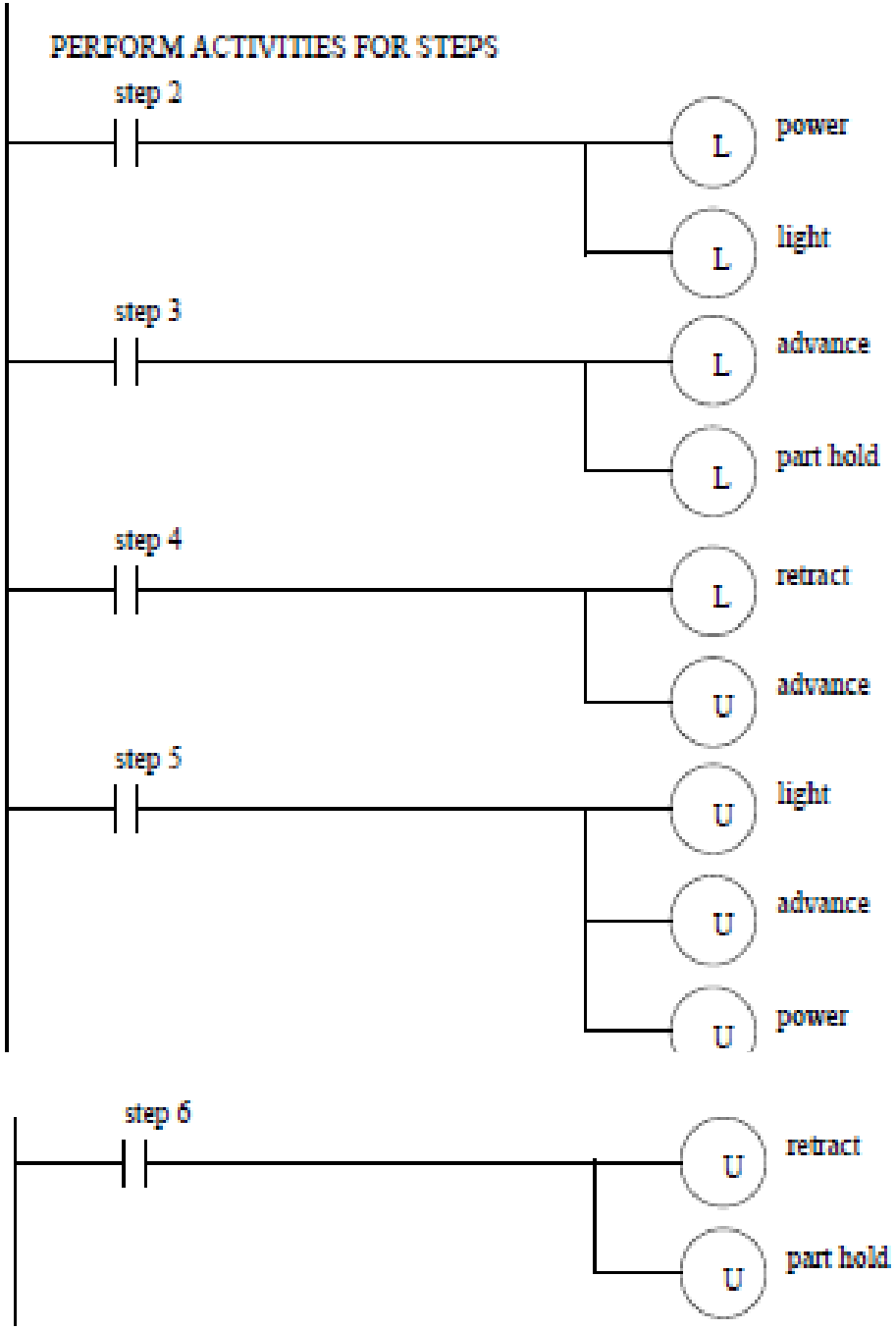
# 2. Check transitions



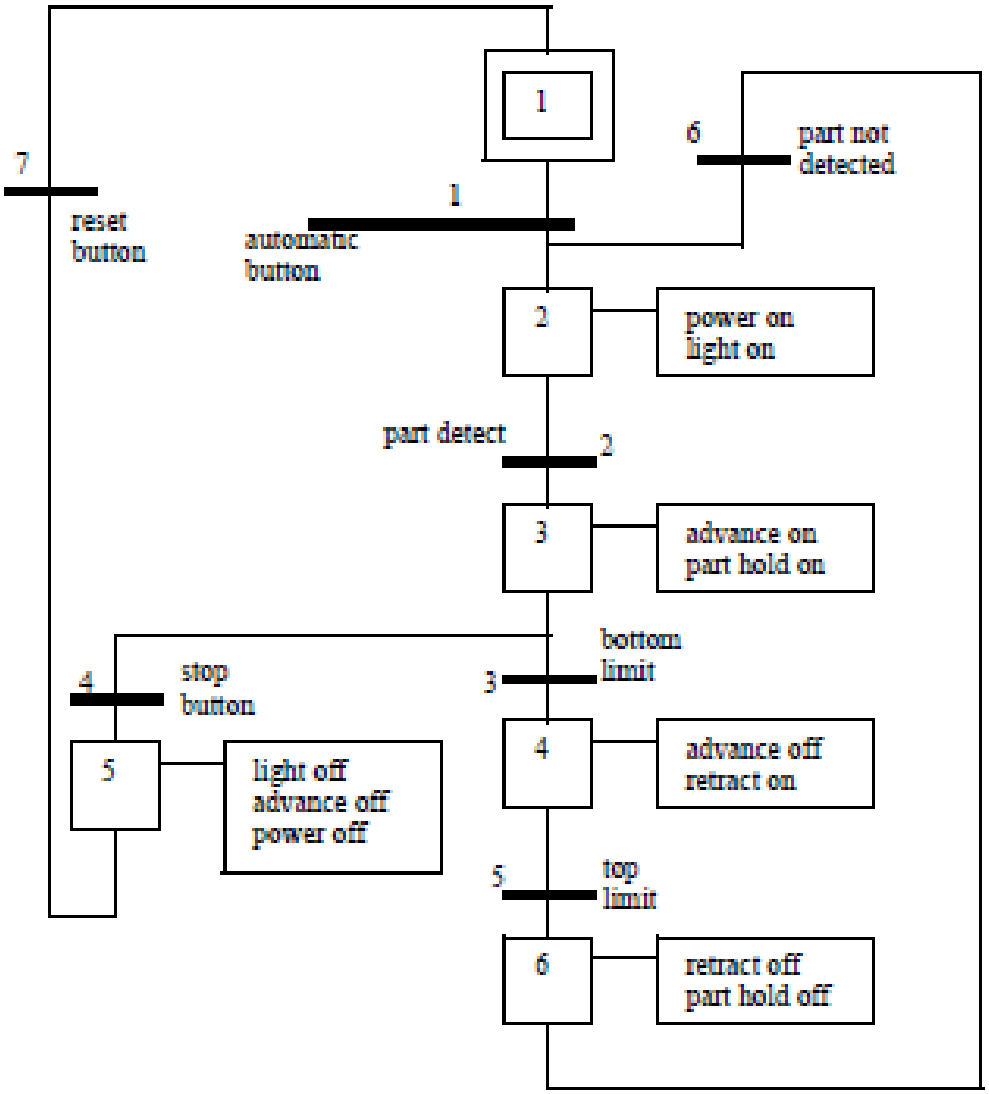



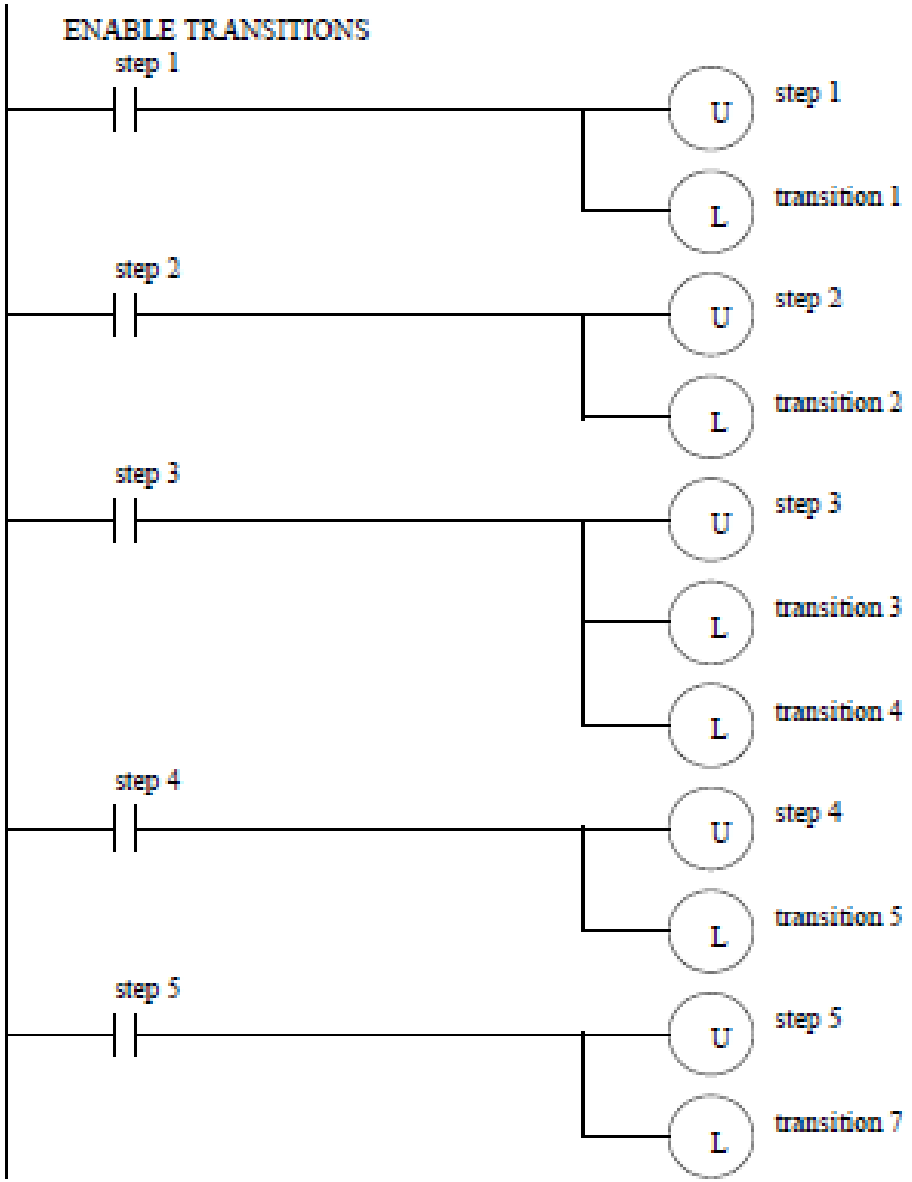
# 3. Perform activities for steps



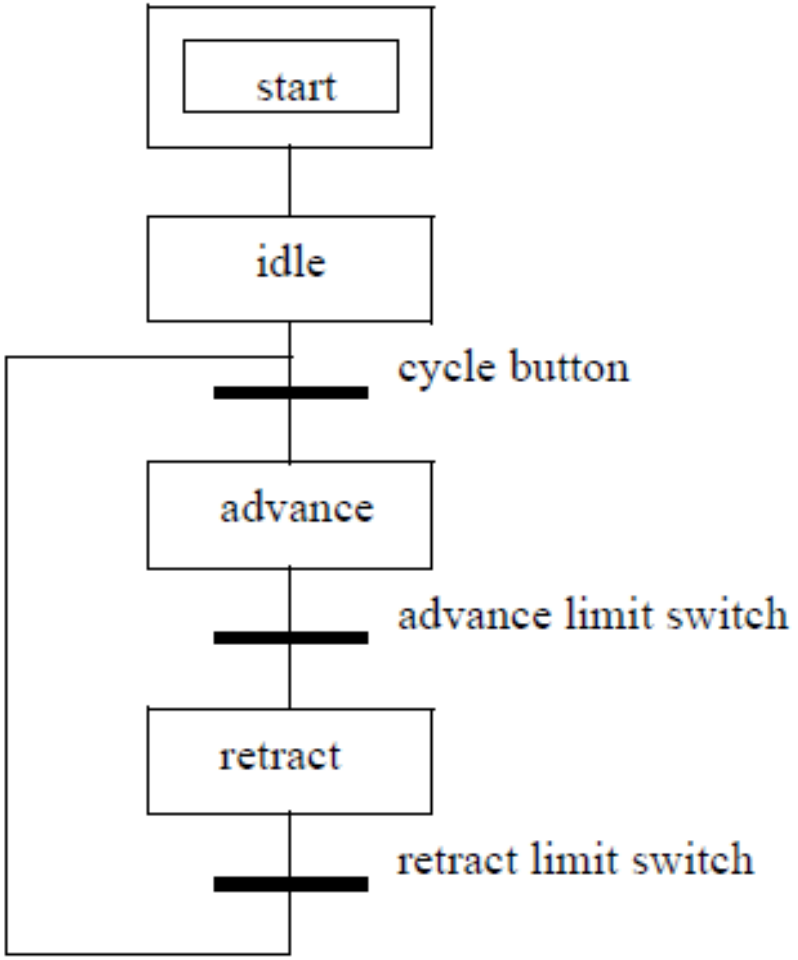
# 4. Enable transitions



# GRAFCET **Practice Problem 1**

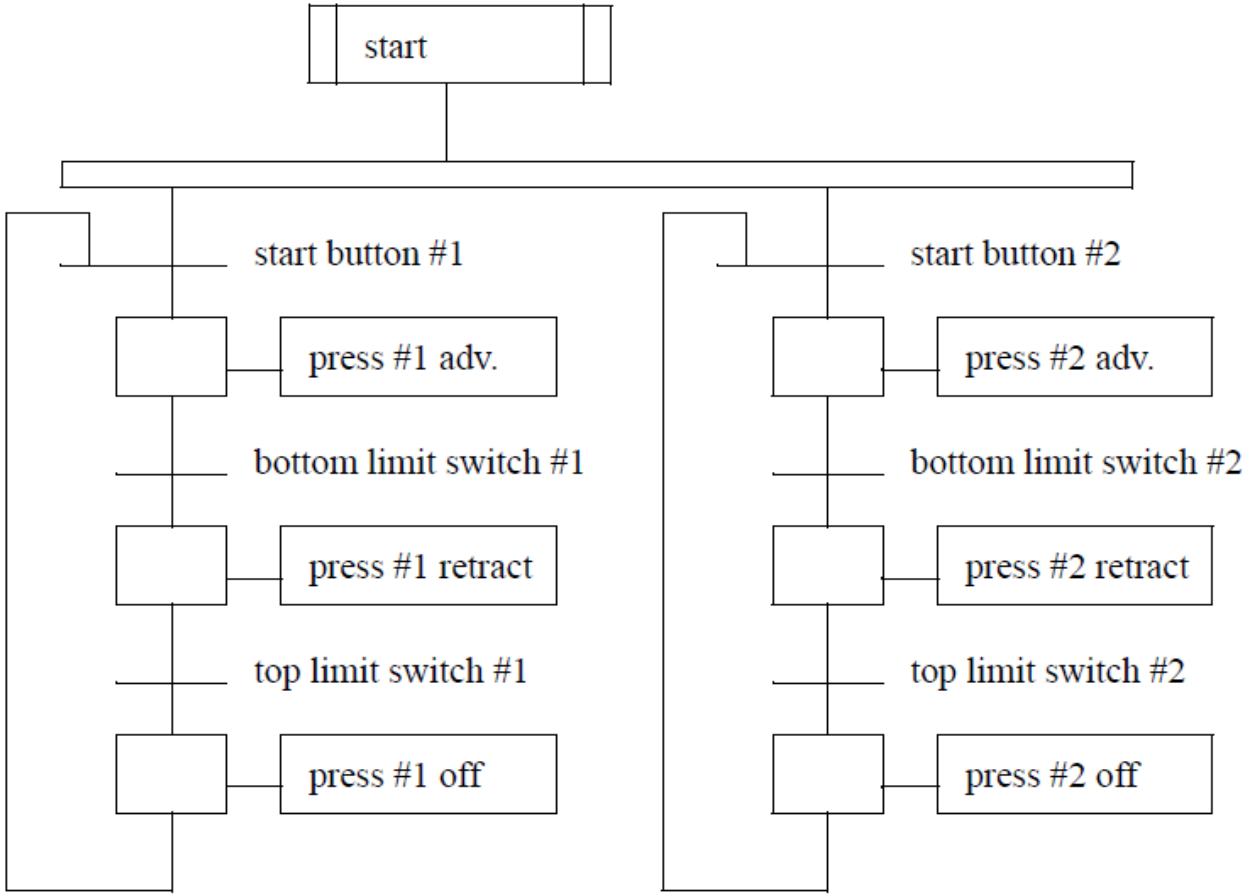
Draw an SFC for a stamping press that can advance and retract when a cycle button is pushed, and then stop until the button is pushed again.




*From [Hugh Jack 2008]*

# GRAFCET **Practice Problem 2**

Develop an SFC for a two person assembly station. The station has two presses that may be used at the same time. Each press has a cycle button that will start the advance of the press. A bottom limit switch will stop the advance, and the cylinder must then be retracted until a top limit switch is hit.

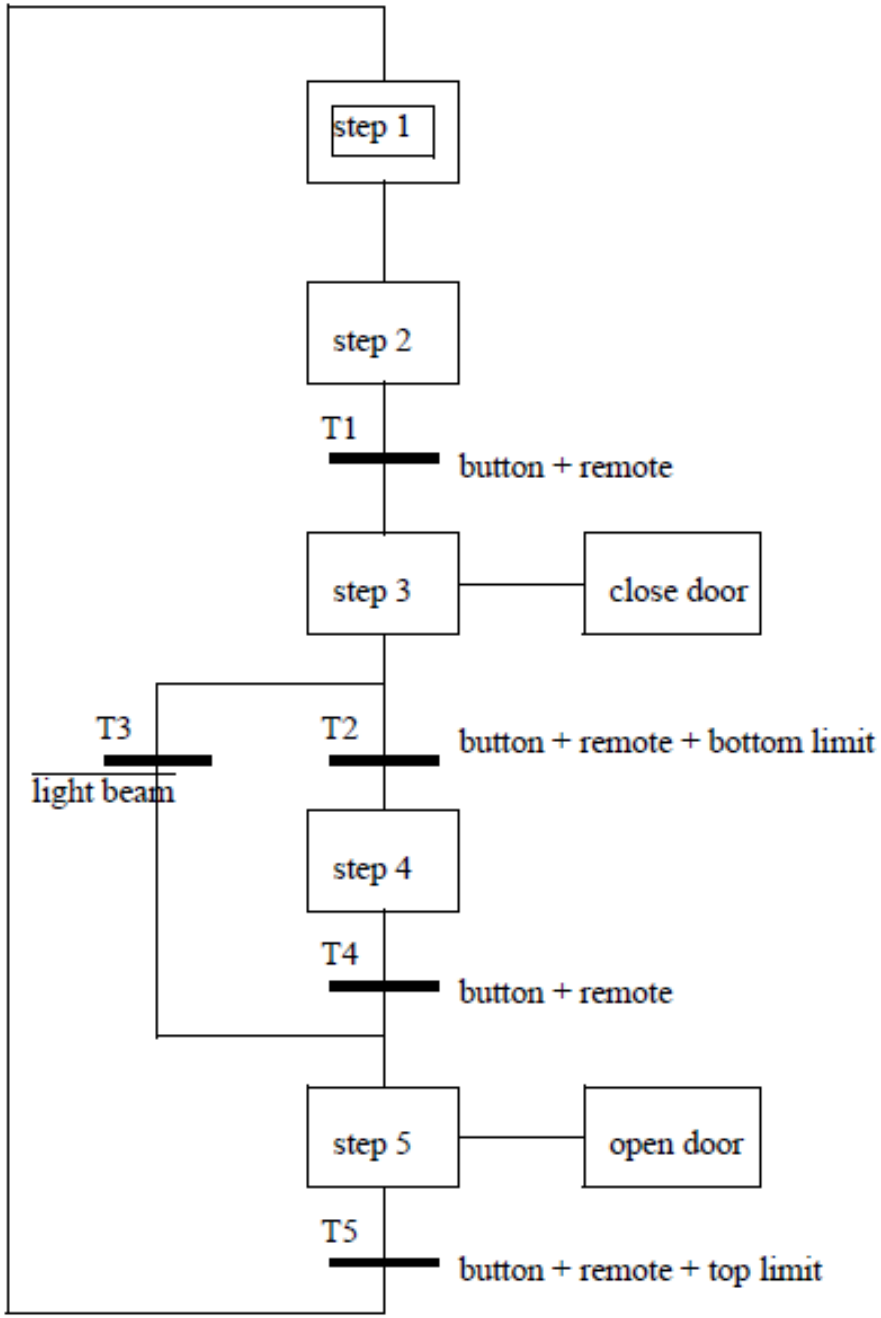



*From [Hugh Jack 2008]*

# GRAFCET **Practice Problem 3**

Design a garage door controller using an SFC. The behavior of the garage door controller is as follows:

- there is a single button in the garage, and a single button remote control.
- when the button is pushed the door will move up or down.
- if the button is pushed once while moving, the door will stop, a second push will start motion again in the opposite direction.
- there are top/bottom limit switches to stop the motion of the door.
- there is a light beam across the bottom of the door. If the beam is cut while the door is closing the door will stop and reverse.
- there is a garage light that will be on for 5 minutes after the door opens or closes.




*From [Hugh Jack 2008]*