

Industrial Automation

(Automação de Processos Industriais)

GRAFCET

(Sequential Function Chart) 2/2

<http://users.isr.ist.utl.pt/~jag/courses/api1415/api1415.html>

2011-2015 Prof. José Gaspar

Syllabus:

Chap. 3 – PLC Programming languages [2 weeks]

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

The GRAFCET norm.

Elements of the language.

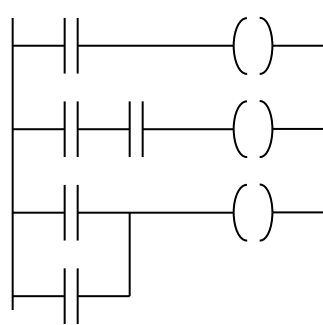
Modelling techniques using GRAFCET.

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

PLC Programming languages (IEC 1131-3)

Ladder Diagram



Structured Text

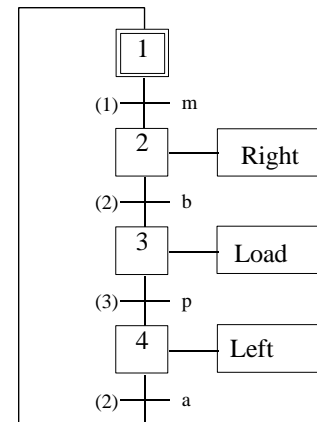
```

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)



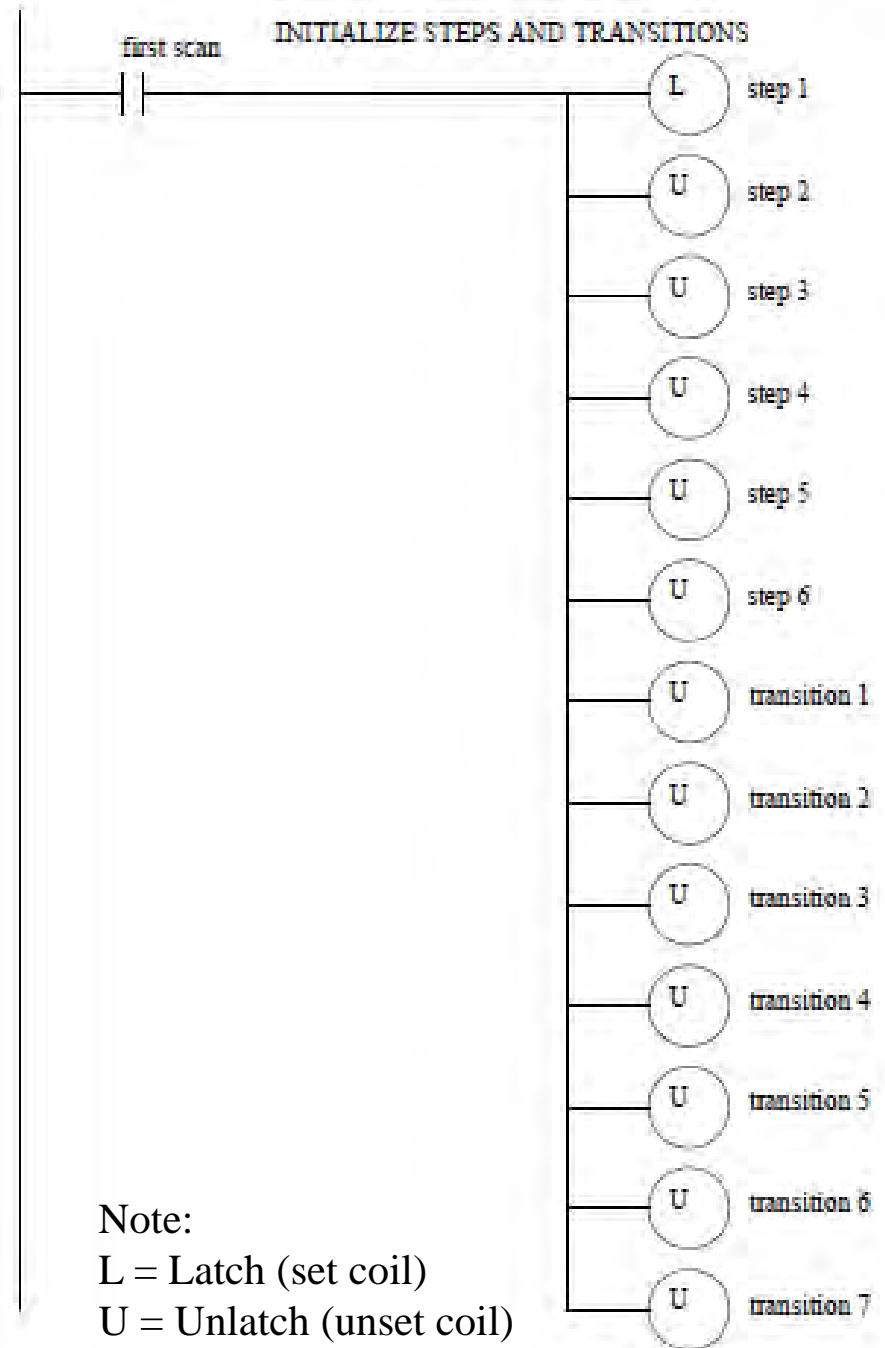
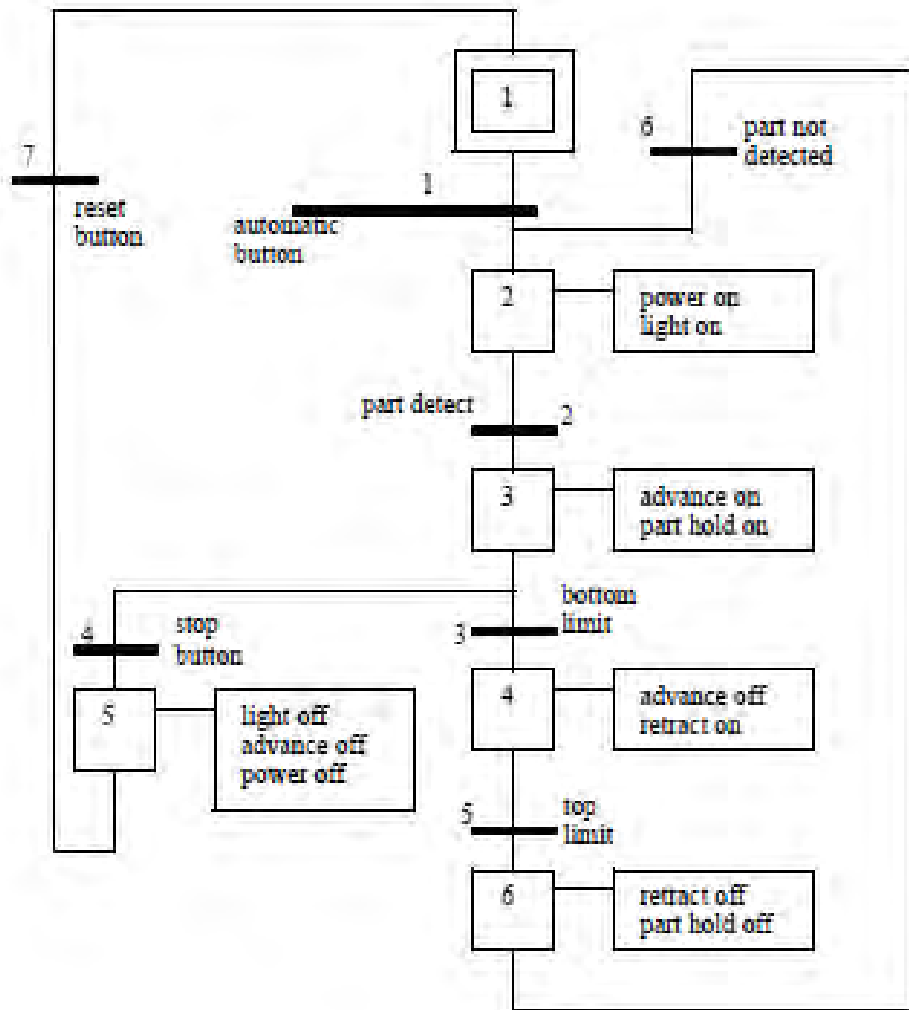
GRAFCET vs Ladder

Grafcet/SFC can be converted directly to ladder logic:

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

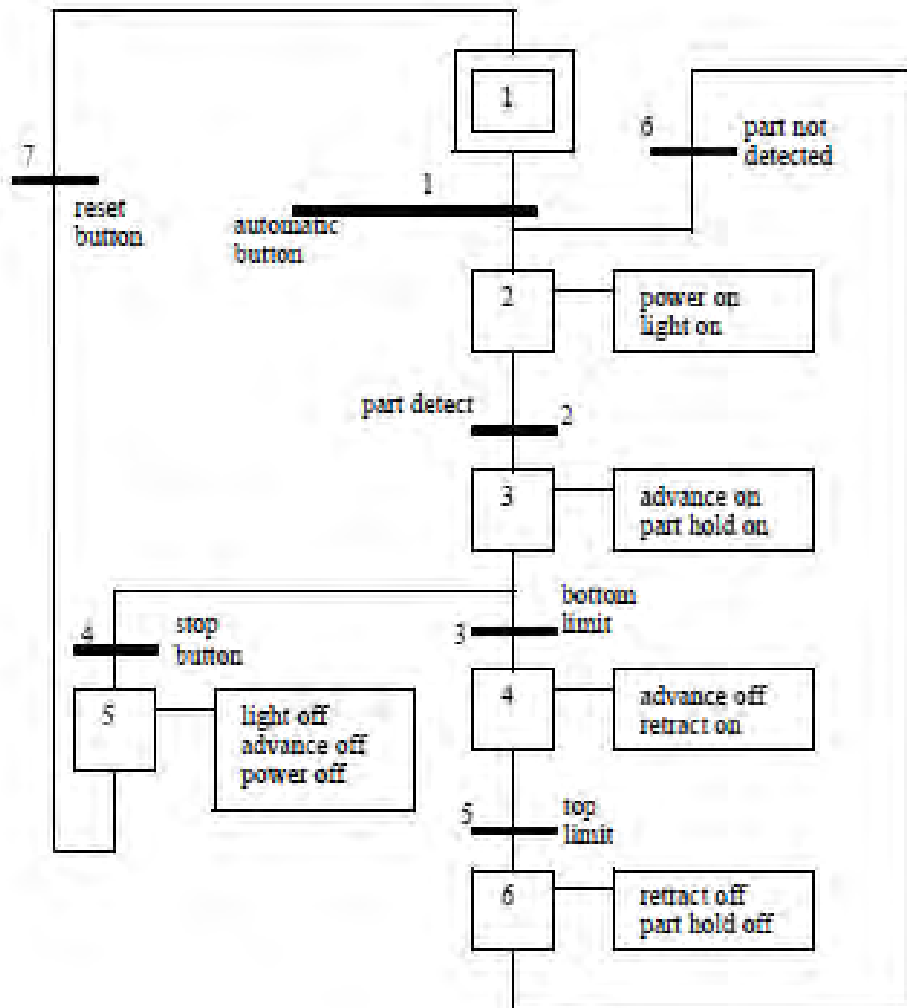
Ref: [Hugh Jack 2008]

1. Initialize steps and transitions

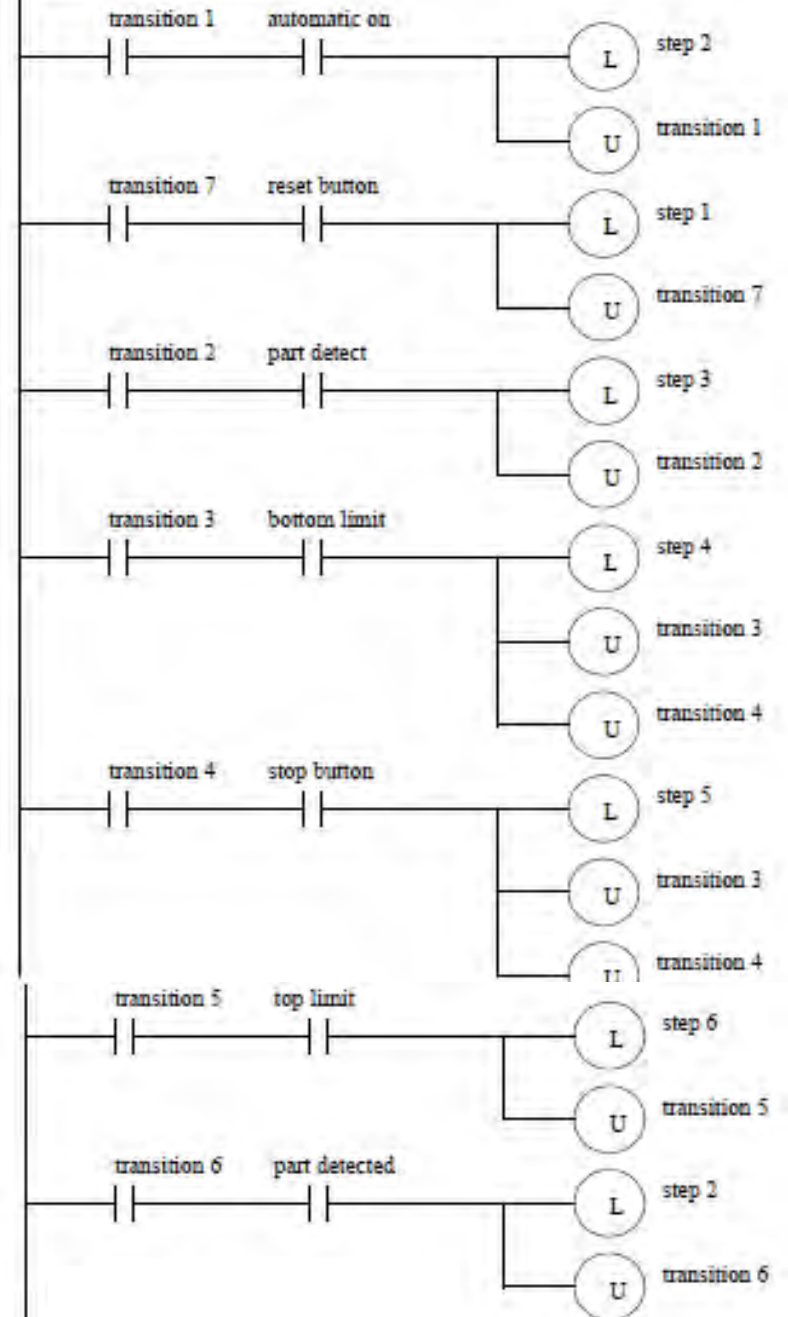


Note:
 L = Latch (set coil)
 U = Unlatch (unset coil)

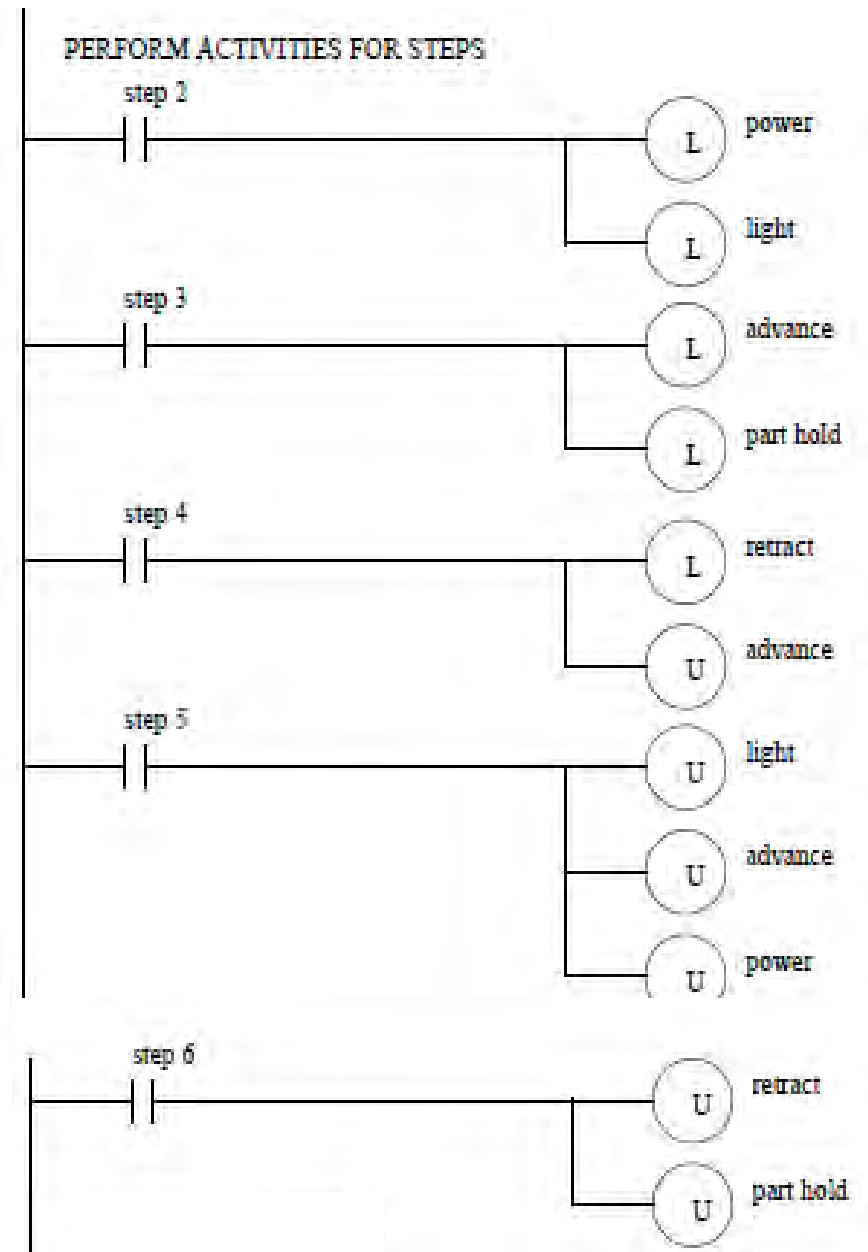
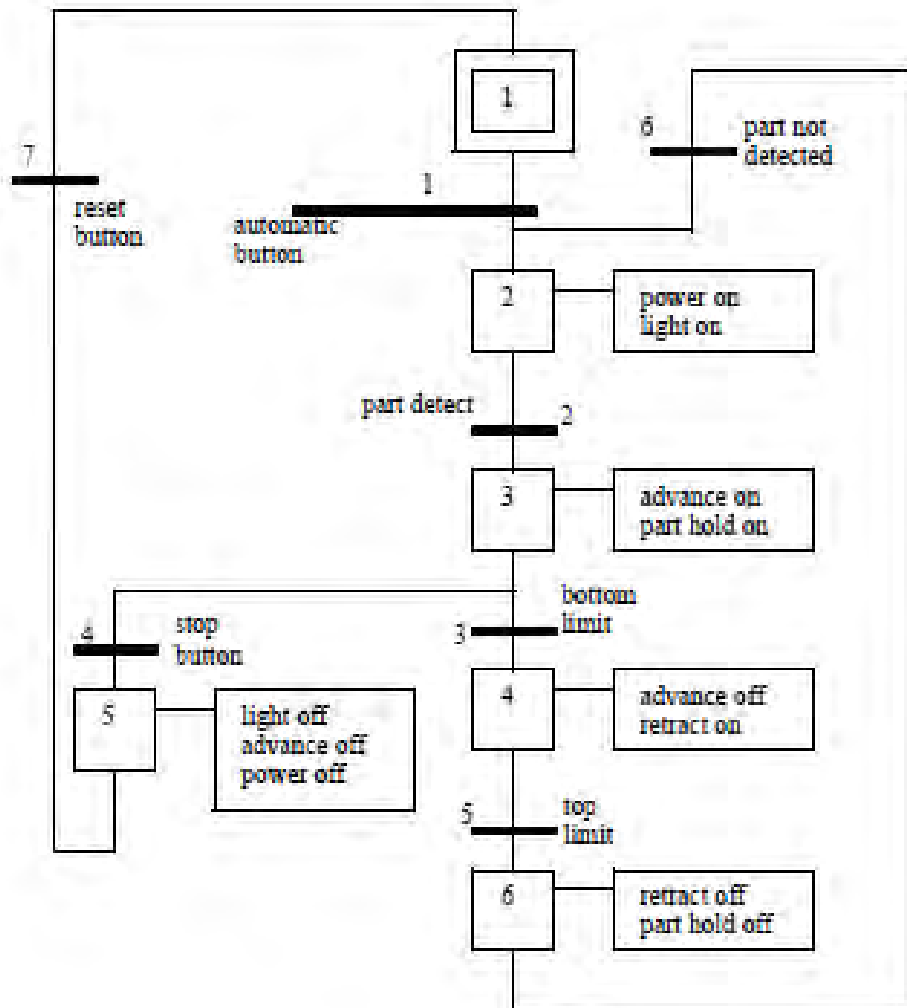
2. Check transitions



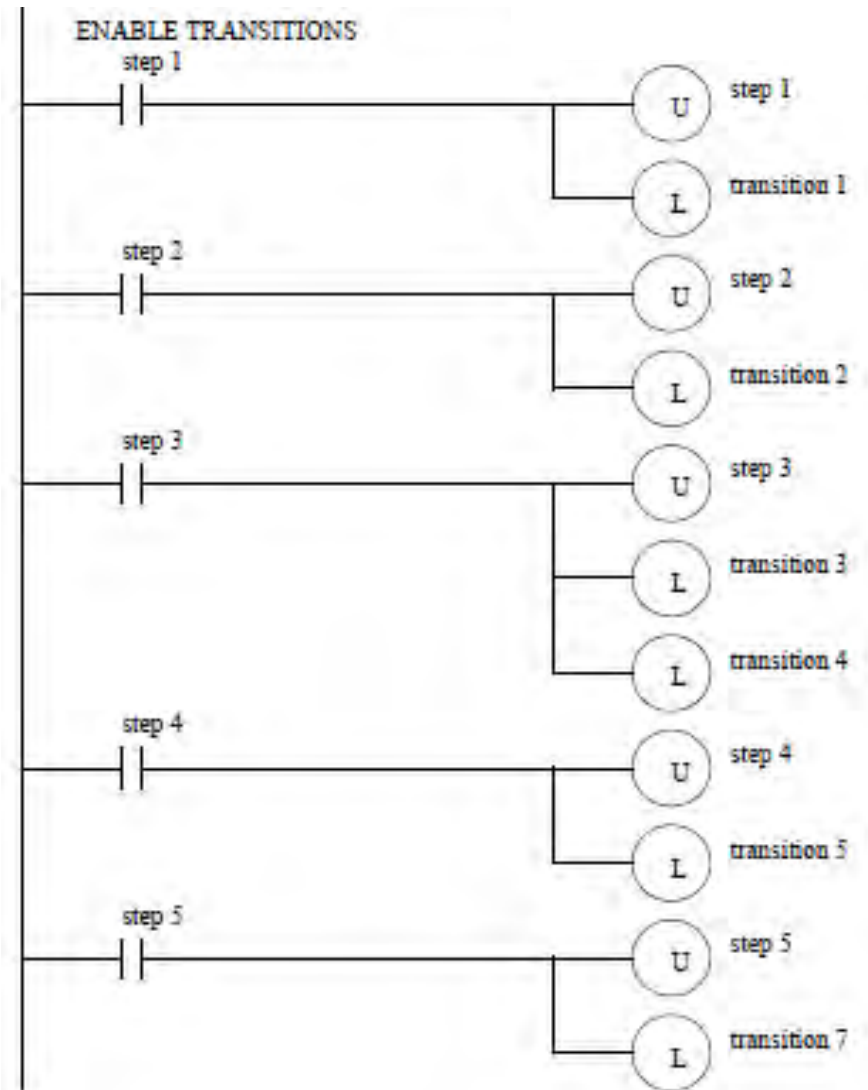
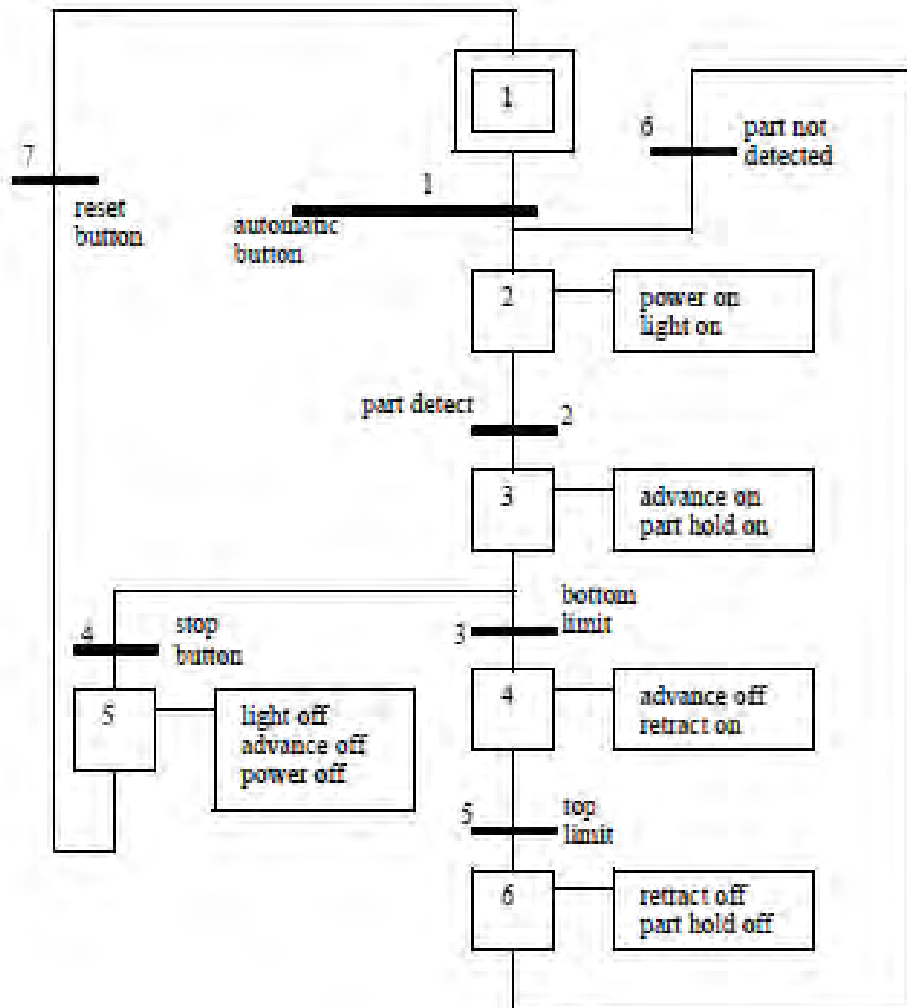
CHECK TRANSITIONS



3. Perform activities for steps



4. Enable transitions

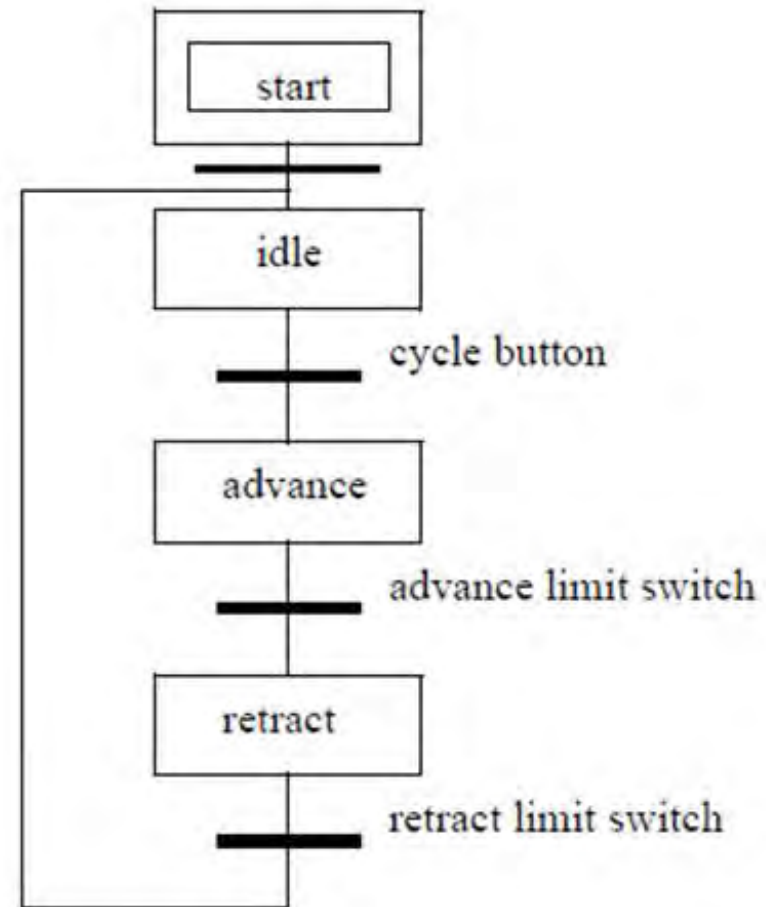


GRAFCET Practice Problem 1

Draw **one SFC** for one stamping press that can **advance and retract** when a **cycle button** is pushed, and then stop until the button is pushed again. The press has **limit switches** indicating stop advancing and stop retracting.

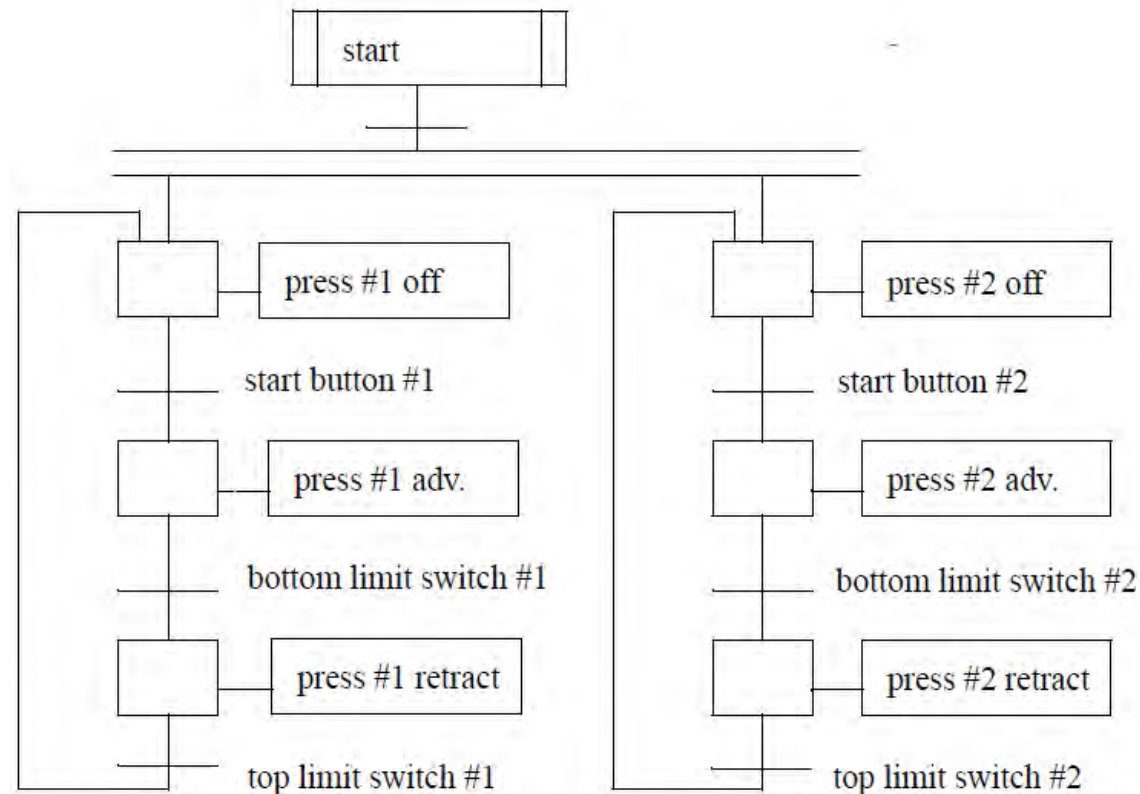
Further study: discuss the advantages of using SFC as compared with using Ladder in this problem.

From [Hugh Jack 2008]



GRAFCET Practice Problem 2

Develop **one SFC** for a two person assembly station. The station has **two presses** that may be used at the same time, **independently**. 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. The two presses are enabled only after a common starting procedure.



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.
- There are **top/bottom limit switches to stop** the motion of the door.
- If the button is pushed once while moving, the door will **stop**. A second push will start motion again in the **opposite direction**.
- 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.

