Industrial Automation
(Automação de Processos Industriais)

GRAFCET
(Sequential Function Chart) 3/3

http://users.isr.ist.utl.pt/~jag/courses/api1718/api1718.html

Prof. José Gaspar, rev. 2017/2018

GRAFCET   **vs Ladder**

GRAFCET/SFC can be converted directly to ladder logic

Memory variables:

Assign one Boolean variable to each step (si) and transition (tj)

Code to run once:

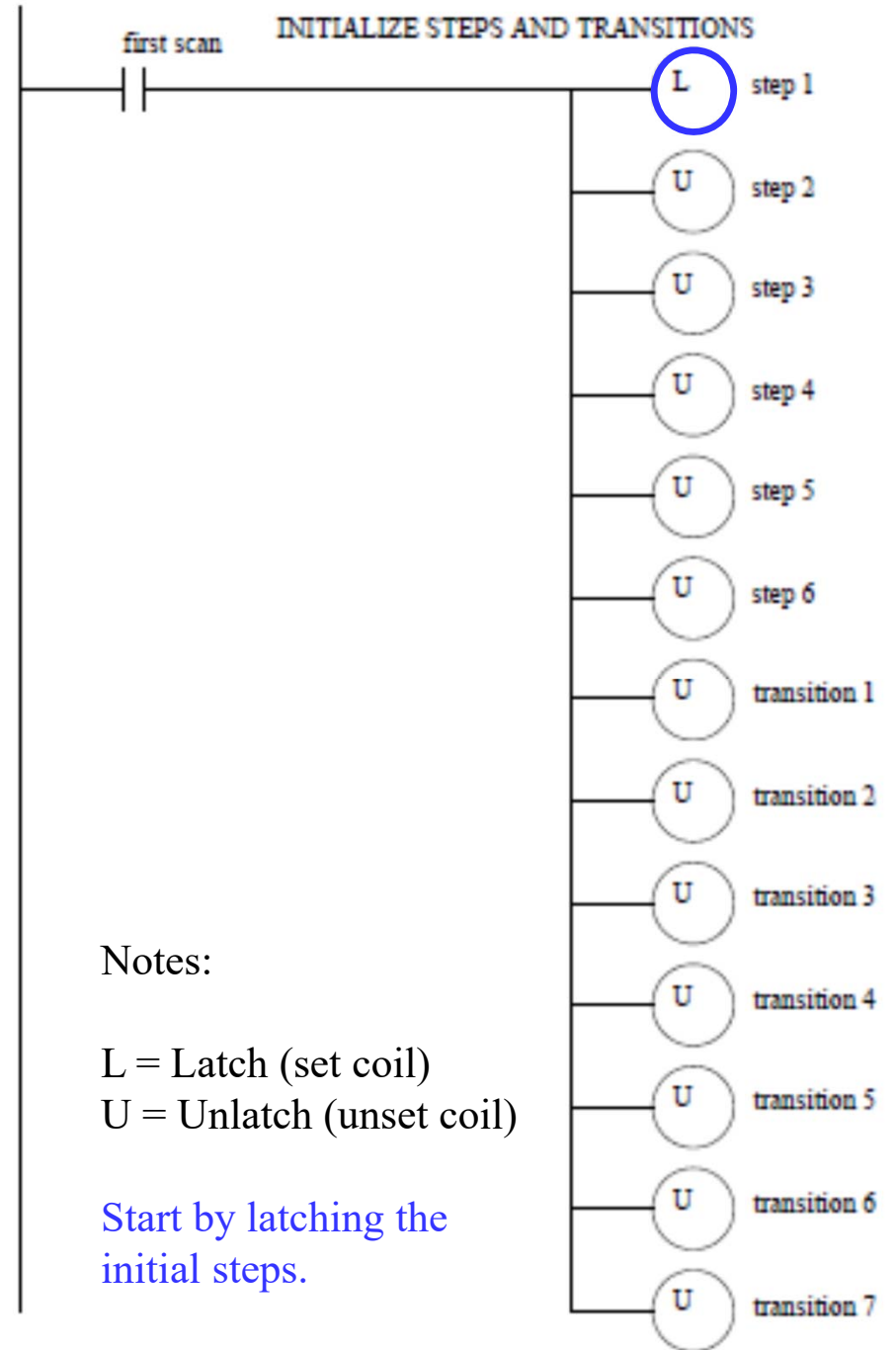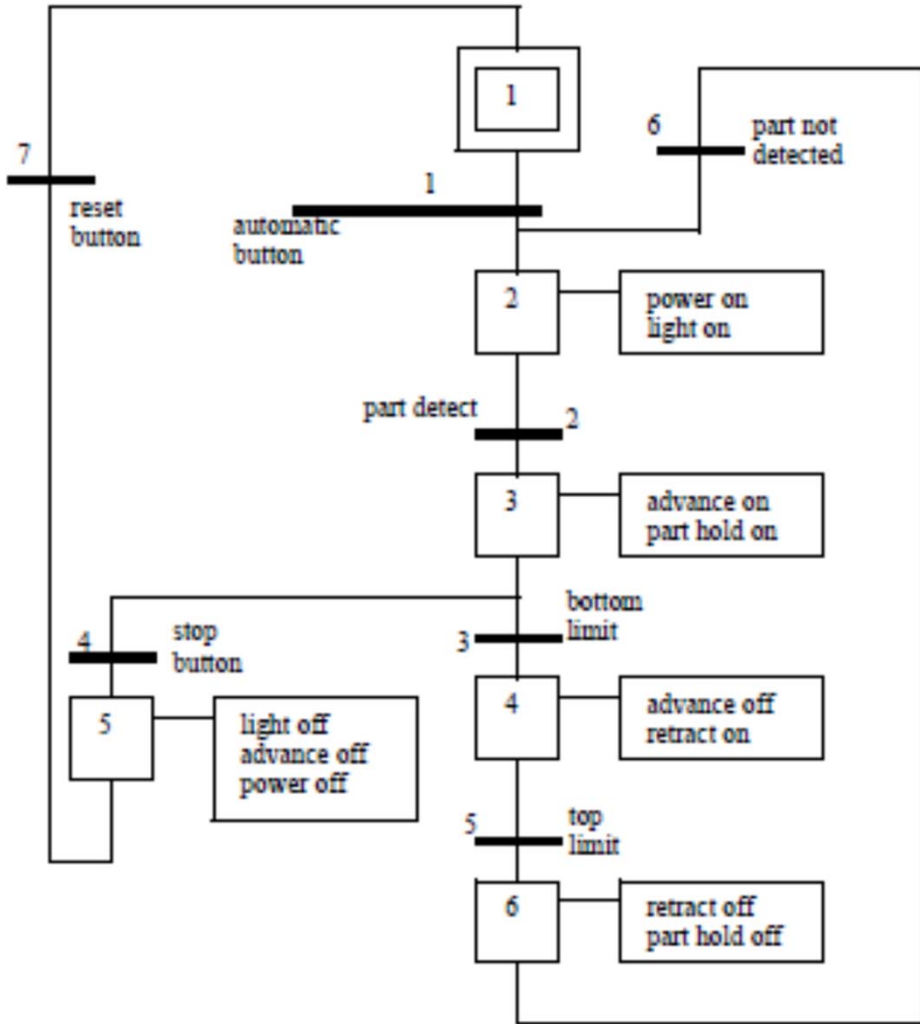1.   Initialize steps and transitions

Code to run at every scan cycle:

2. Check transitions and activate steps

3. Perform activities for steps

4. Enable transitions (jump to 2.)

Ref: [Hugh Jack 2008]

IST / DEEC / API

1. Initialize steps and transitions

INITIALIZE STEPS AND TRANSITIONS

first scan

L — step 1
U — step 2
U — step 3
U — step 4
U — step 5
U — step 6
U — transition 1
U — transition 2
U — transition 3
U — transition 4
U — transition 5
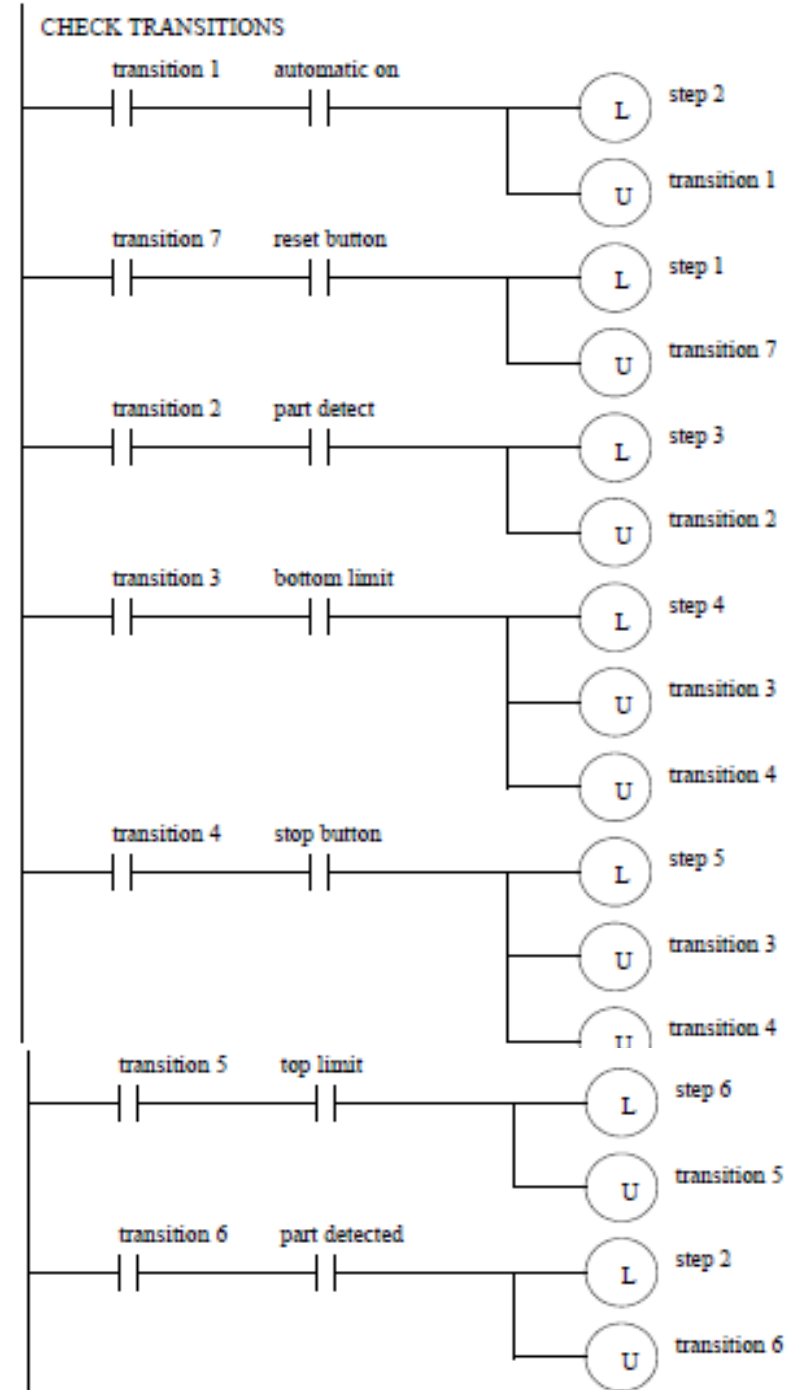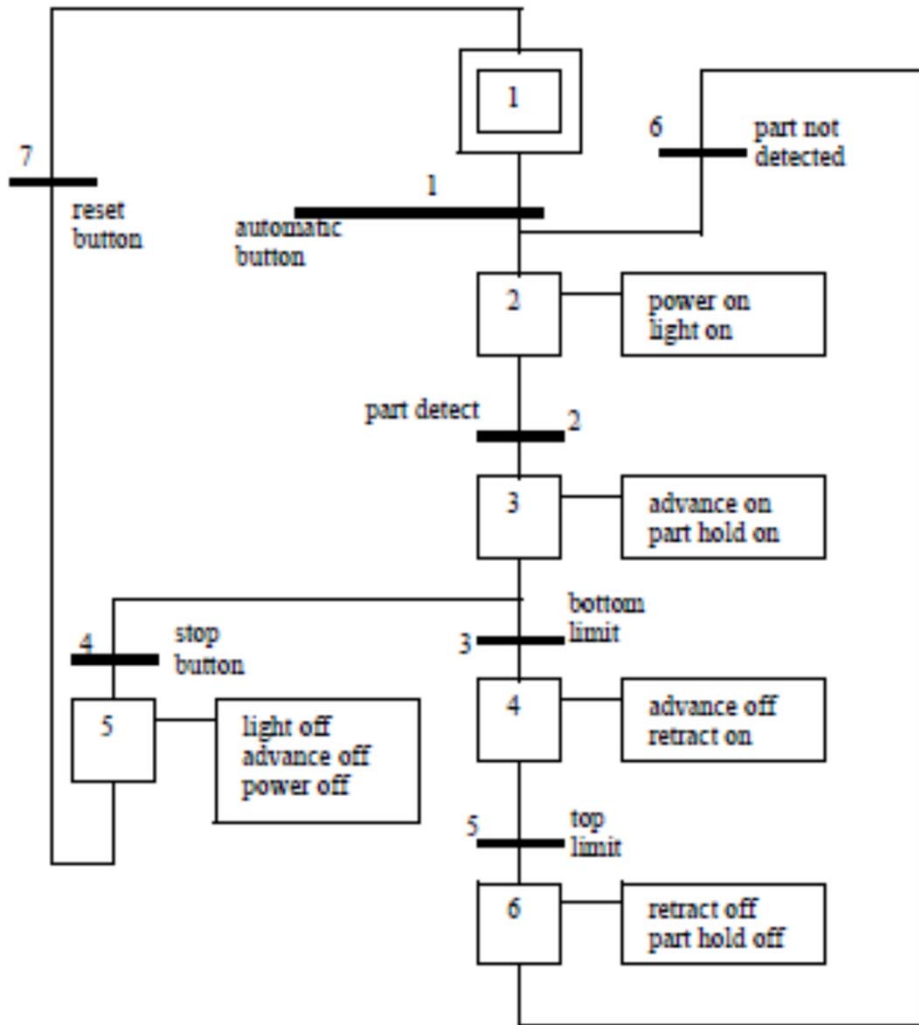U — transition 6
U — transition 7

Notes:

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

Start by latching the initial steps.

SFC diagram labels

- 1
- 6 — part not detected
- 7 reset button
- 1 automatic button
- 2 — power on / light on
- part detect — 2
- 3 — advance on / part hold on
- 3 — bottom limit
- 4 stop button
- 5 — light off / advance off / power off
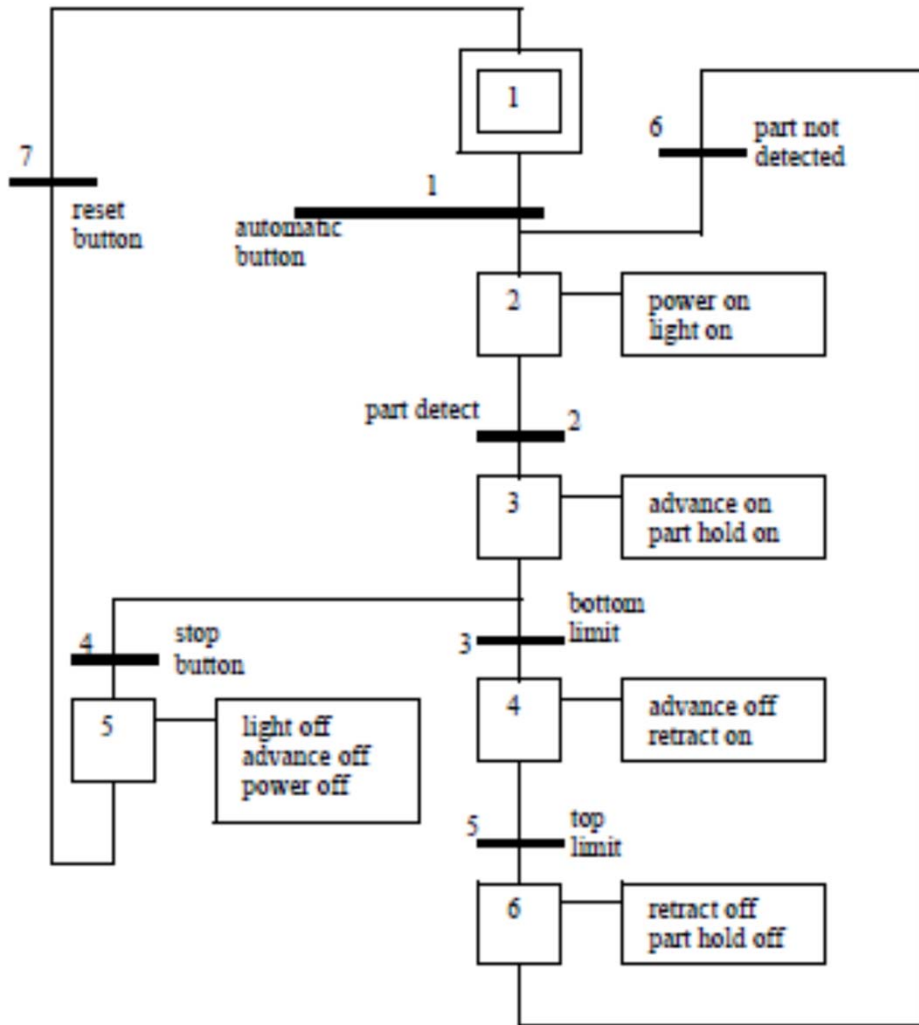- 4 — advance off / retract on
- 5 — top limit
- 6 — retract off / part hold off

2. Check transitions & activate steps

7 reset button

1 automatic button

1

6 part not detected

2 power on light on

part detect 2

3 advance on part hold on

bottom limit 3

4 stop button

5 light off advance off power off

4 advance off retract on

5 top limit

6 retract off part hold off

CHECK TRANSITIONS

| transition 1 | automatic on | | L | step 2 |
transition 1			U	transition 1
transition 7	reset button		L	step 1
			U	transition 7
transition 2	part detect		L	step 3
			U	transition 2
transition 3	bottom limit		L	step 4
			U	transition 3
			U	transition 4
transition 4	stop button		L	step 5
			U	transition 3
			U	transition 4
transition 5	top limit		L	step 6
			U	transition 5
transition 6	part detected		L	step 2
			U	transition 6

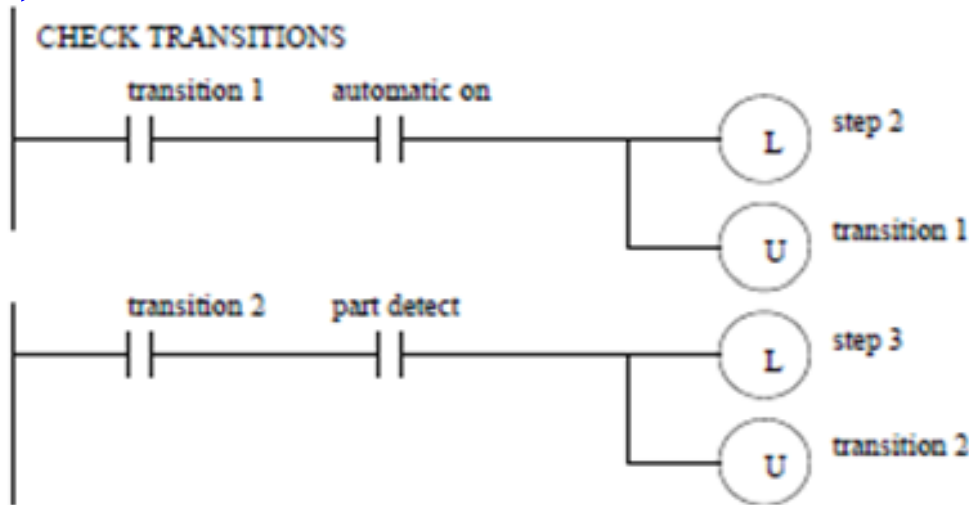# 3. Perform activities for steps

PERFORM ACTIVITIES FOR STEPS

4. Enable transitions

Discussion: not-keeping vs keeping steps active

1)

CHECK TRANSITIONS

2)

PERFORM ACTIVITIES FOR STEPS

3)

ENABLE TRANSITIONS
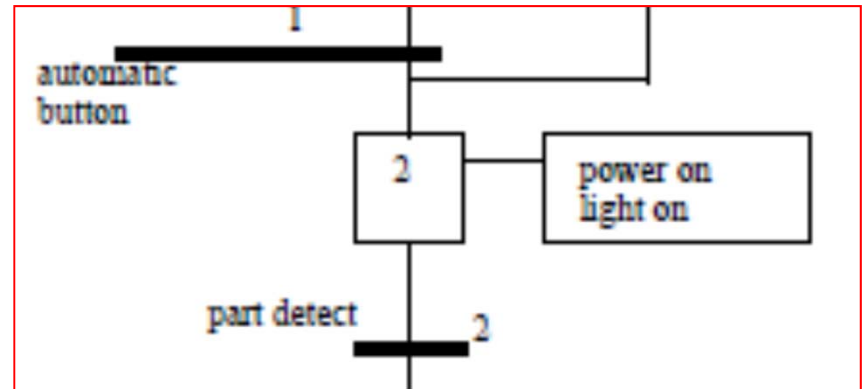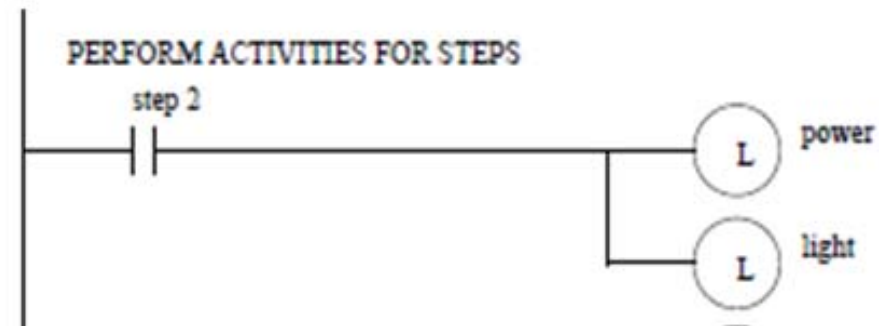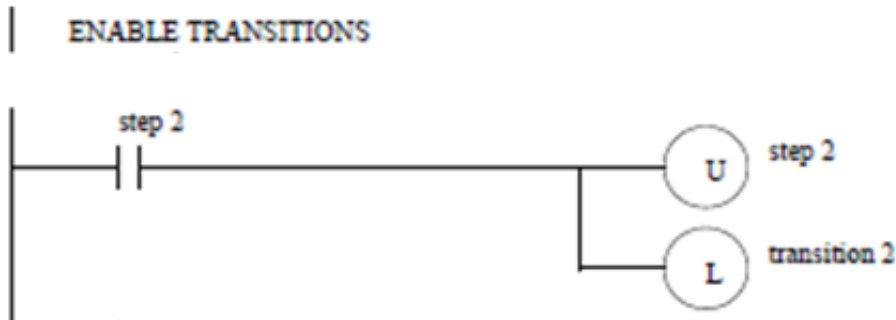

If step2 is active then it is going to be made inactive (unlatched). Note however that the code parts 1,2 and 3 run in a single scan cycle.

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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.

start

idle

cycle button

advance

advance limit switch

retract

retract limit switch

From [Hugh Jack 2008]
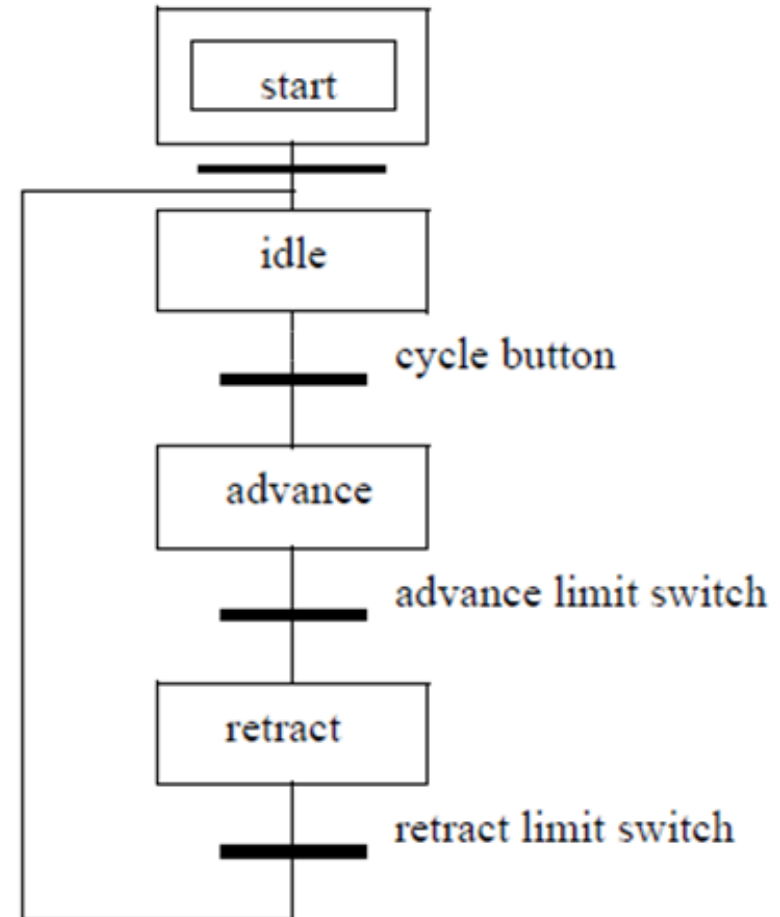
GRAFCET   Practice Problem 2

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.
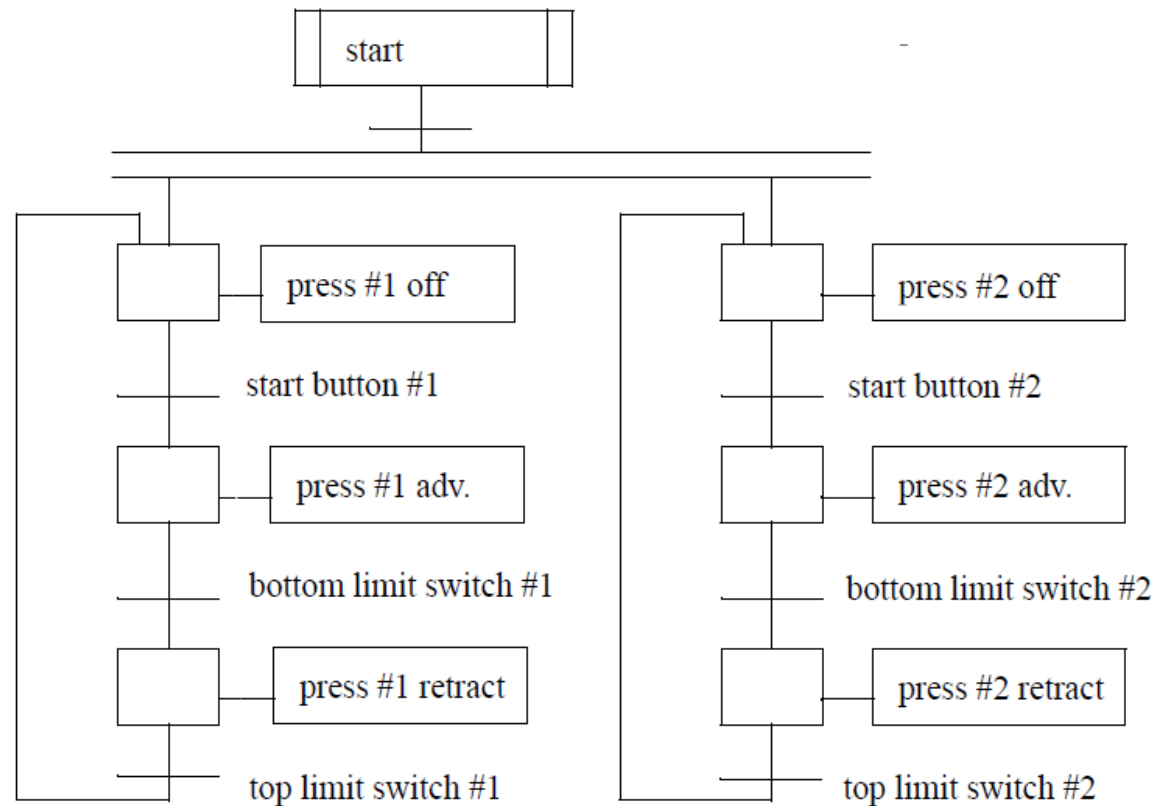
From [Hugh Jack 2008]

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.

step 1		
step 2		
T1	button + remote	
step 3	close door	
T3	T2	button + remote + bottom limit
light beam		
step 4		
T4	button + remote	
step 5	open door	
T5	button + remote + top limit	

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