

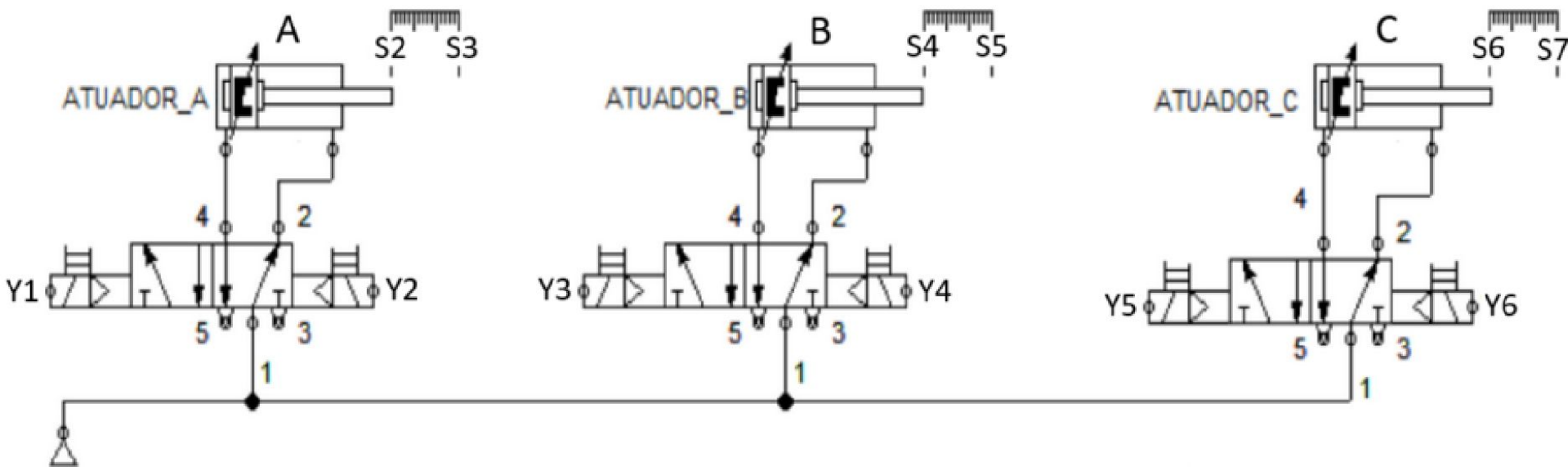
# Controladores Lógicos Programáveis

Técnico em Automação Industrial

# Método de Programação por Minimização de contatos

Cascata ou Sequência Mínima

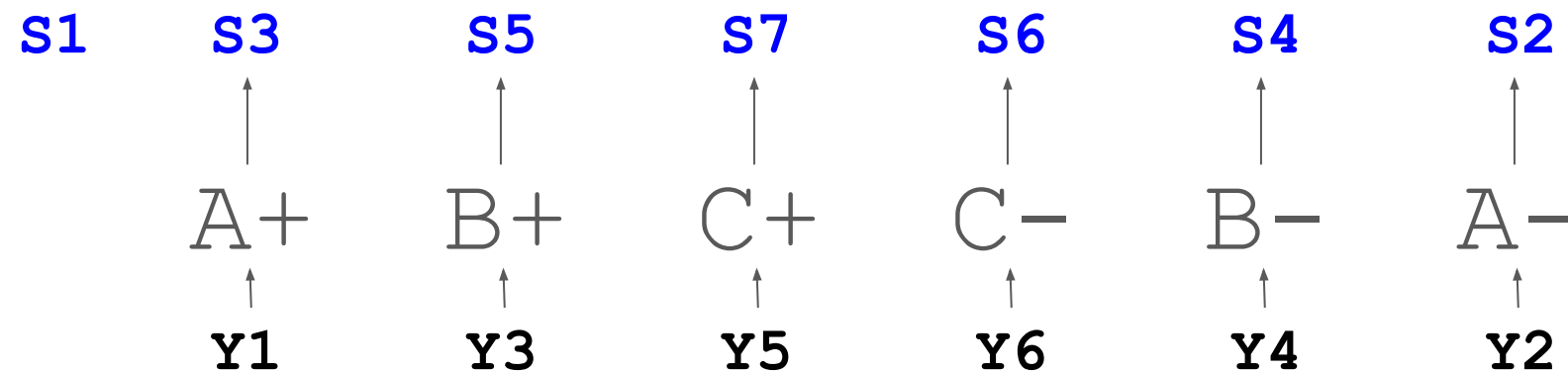
# Circuito



## Passo 0: Sequência de acionamento

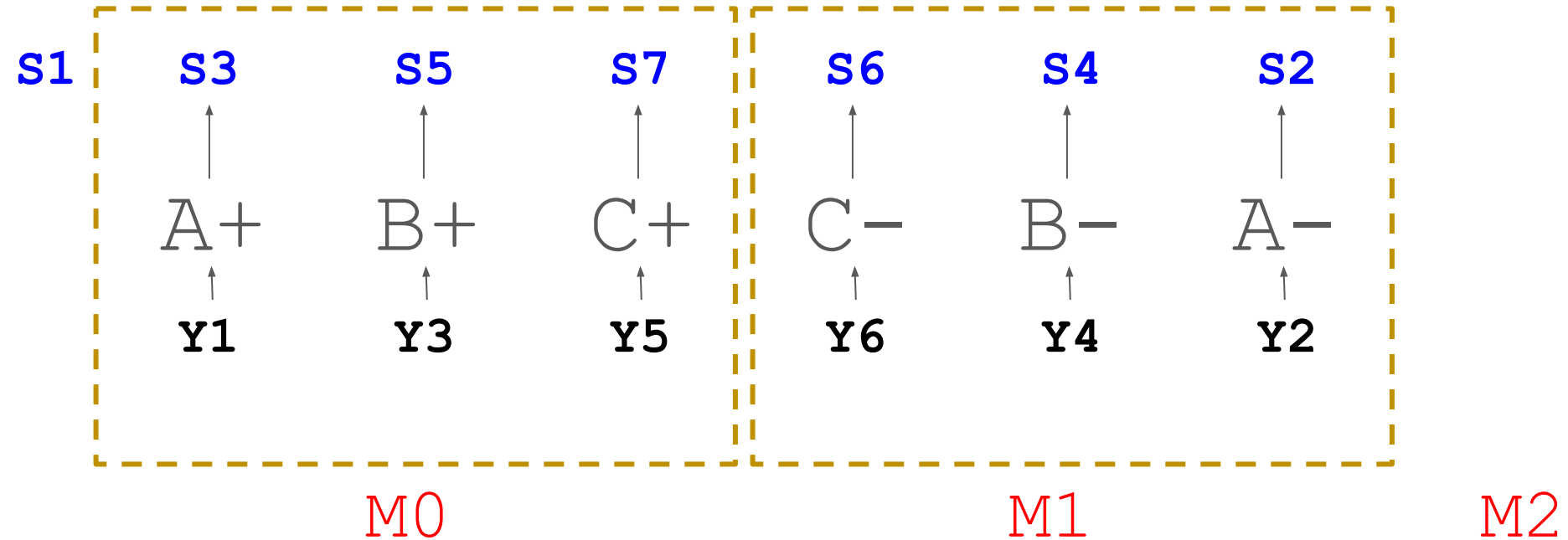
A+    B+    C+    C-    B-    A-

## Passo 1: Atuadores e Fins de Curso



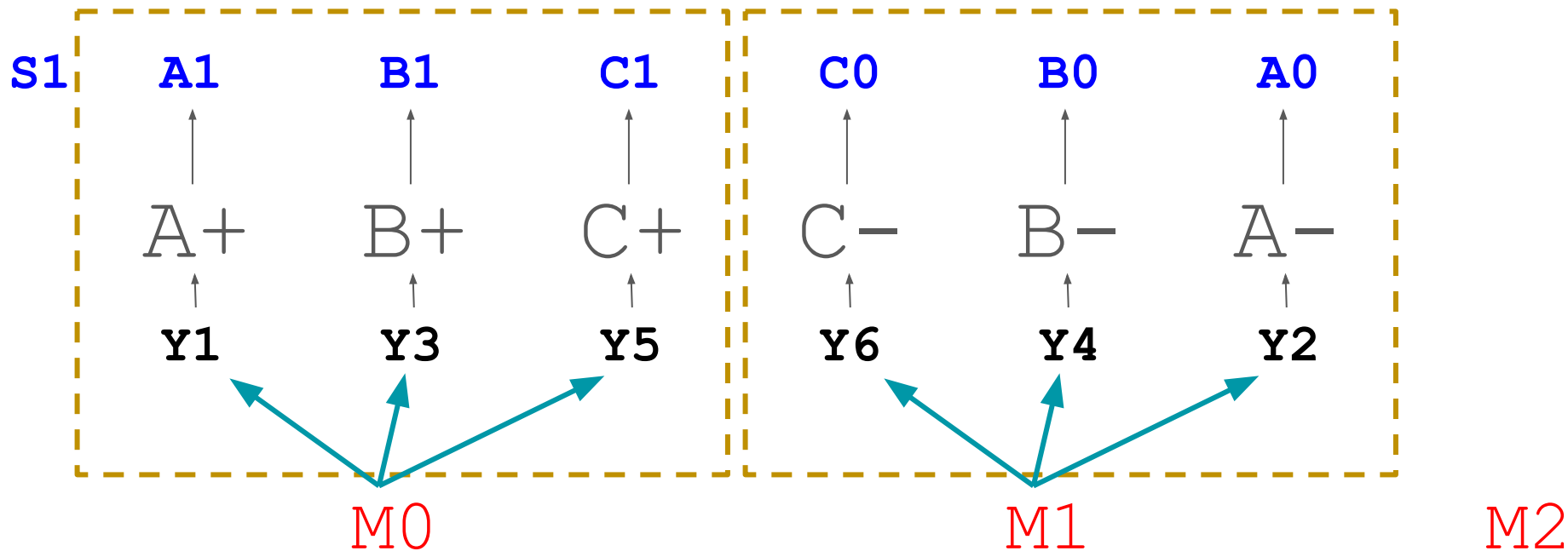
## Passo 2: Agrupamentos e memórias

Maior grupo possível, sem repetir qualquer **atuador**.

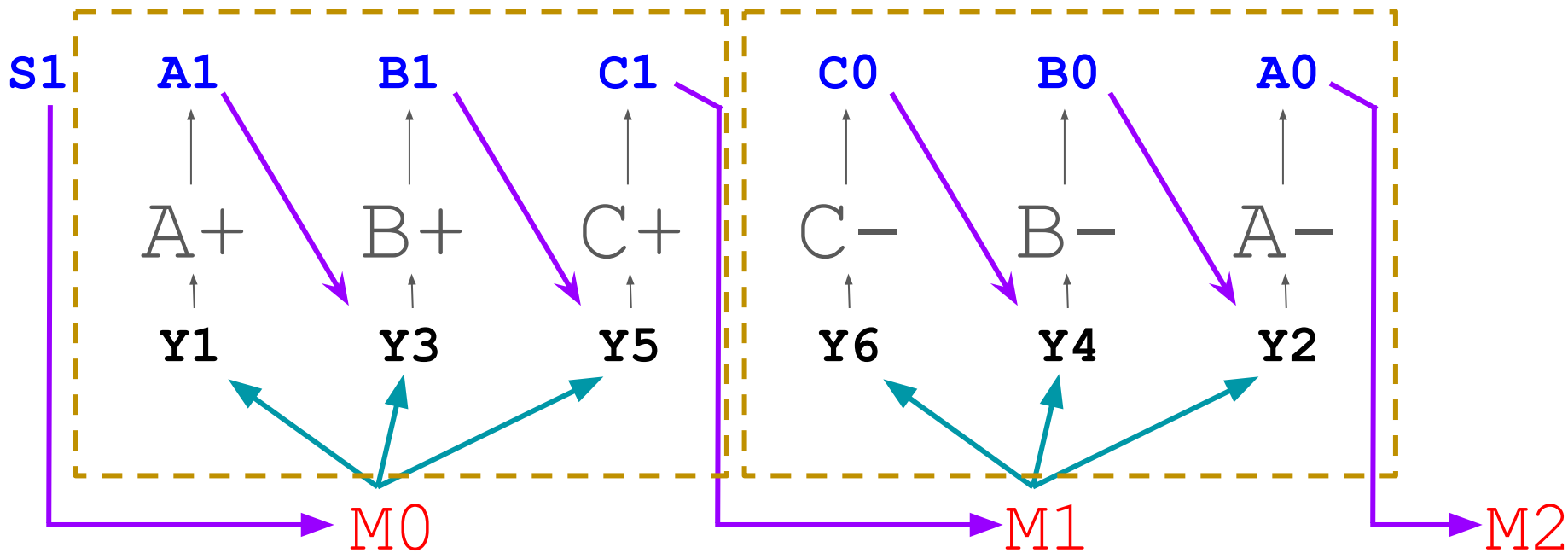


$$\text{Memórias} = \text{Grupos} + 1$$

### Passo 3: **Memórias** habilitando atuadores

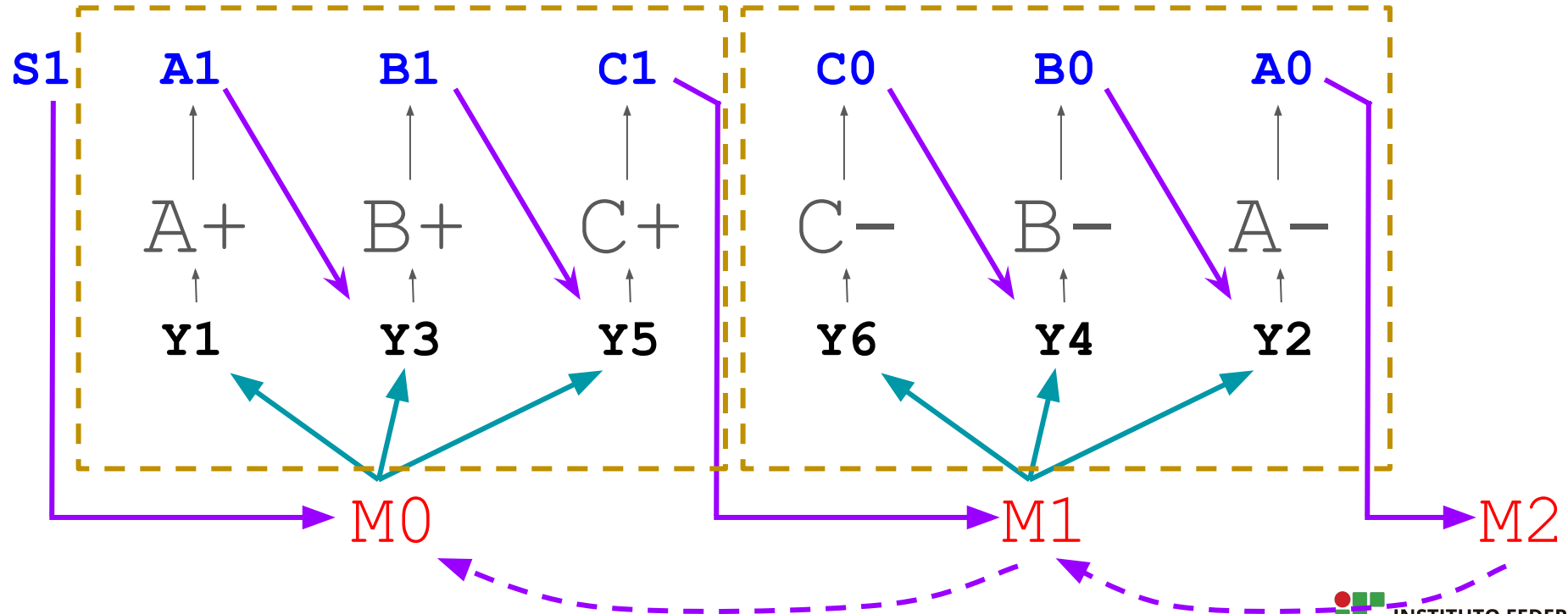


## Passo 4: **Acionamento** de **Memórias** e **Atuadores**





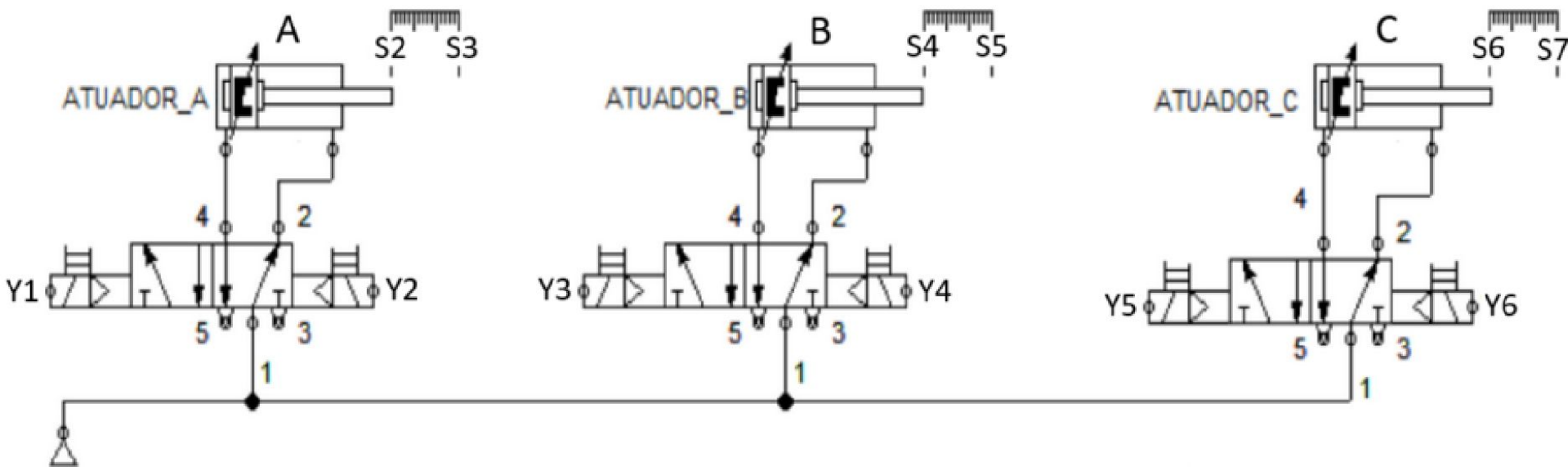
## Passo 5: Desacionamento de Memória Anterior



# Programação no PLC

Linguagem Ladder

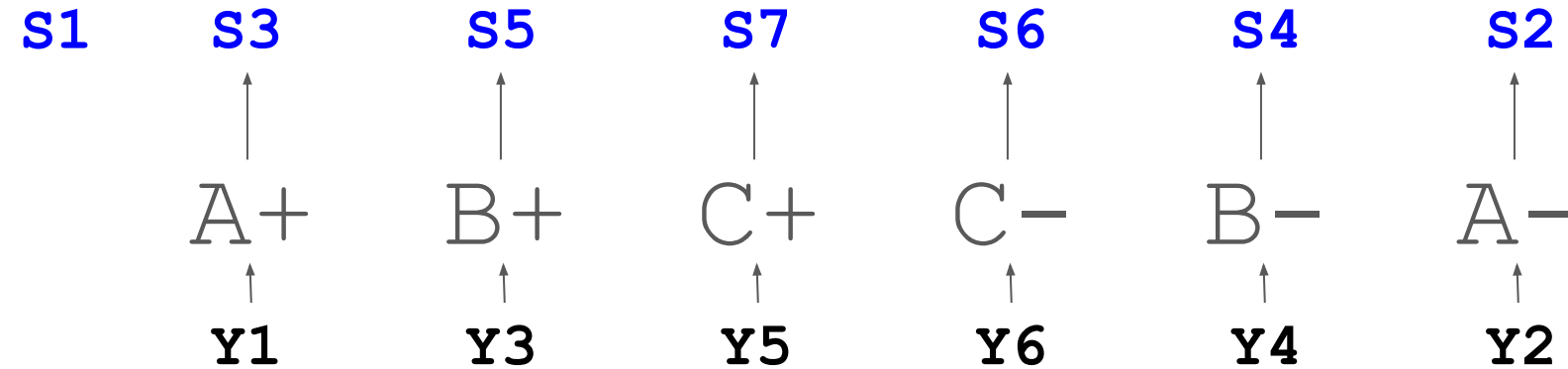
# Circuito



## Passo 0: Sequência de acionamento

A+    B+    C+    C-    B-    A-

## Passo 1: Atuadores e Fins de Curso



# Declaração de Entradas (Fins de curso) e Saídas (Atuadores) de acordo com o diagrama

POUs

- NAVEGA (PRG)
- PLC\_PRG (PRG)
- seq\_ABCcba (FB)

PLC\_PRG (PRG-LD)

```
0001 PROGRAM PLC_PRG
0002 VAR
0003     Exemplo: seq_ABCcba;
0004     (* Entradas *)
0005     S1 AT %IX0.1: BOOL;
0006     S2 AT %IX0.2: BOOL;
0007     S3 AT %IX0.3: BOOL;
0008     S4 AT %IX0.4: BOOL;
0009     S5 AT %IX0.5: BOOL;
0010     S6 AT %IX0.6: BOOL;
0011     S7 AT %IX0.7: BOOL;
0012     (* Saídas *)
0013     Y1 AT %QX1.2: BOOL;
0014     Y2 AT %QX1.3: BOOL;
0015     Y3 AT %QX1.4: BOOL;
0016     Y4 AT %QX1.5: BOOL;
0017     Y5 AT %QX1.6: BOOL;
0018     Y6 AT %QX1.7: BOOL;
0019 END VAR
```

seq\_ABCcba (FB-LD)

```
0001 FUNCTION_BLOCK seq_ABCcba
0002 VAR_INPUT
0003     LIGAR: BOOL;
0004     XA0: BOOL;
0005     XA1: BOOL;
0006     XB0: BOOL;
0007     XB1: BOOL;
0008     XC0: BOOL;
0009     XC1: BOOL;
0010 END_VAR
0011 VAR_OUTPUT
0012     Em_execucao: BOOL;
0013     YA1: BOOL;
0014     YA0: BOOL;
0015     YB1: BOOL;
0016     YB0: BOOL;
0017     YC1: BOOL;
0018     YC0: BOOL;
0019 END_VAR
0020 VAR
0021     M0: BOOL;
0022     M1: BOOL;
0023     M2: BOOL;
0024 END_VAR
```

0001

Exemplo

seq\_ABCcba

LIGAR

Em\_execucao

S2-XA0

S3-XA1

S4-XB0

S5-XB1

S6-XC0

S7-XC1

YA1-Y1

YA0-Y2

YB1-Y3

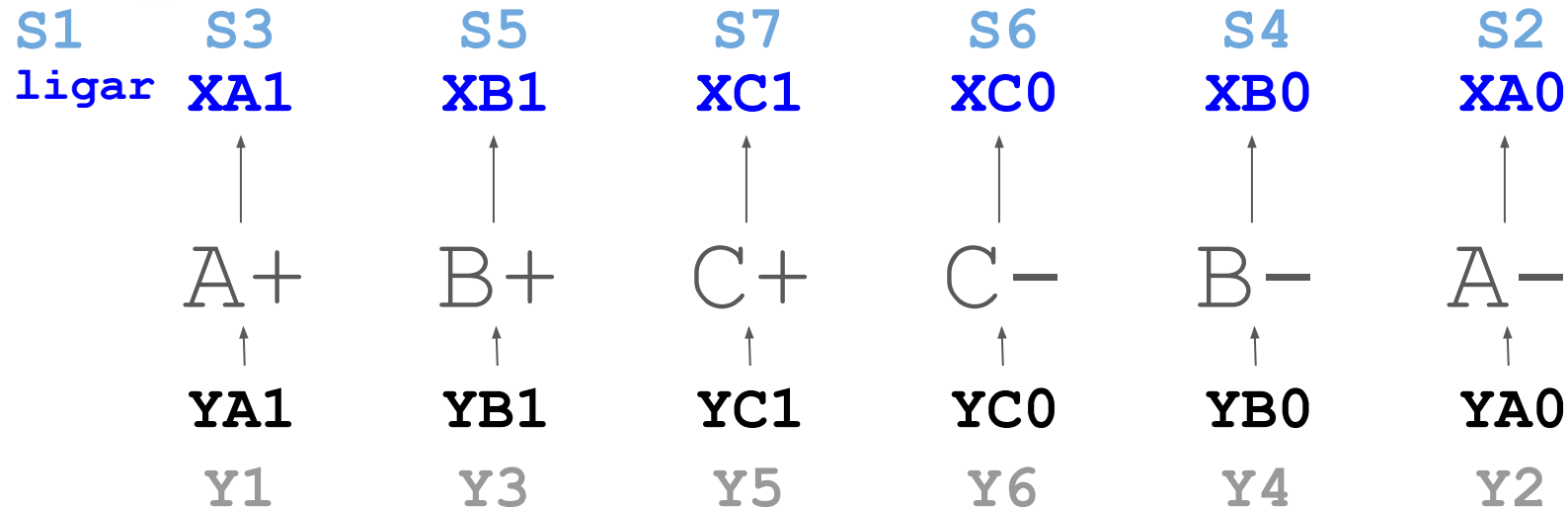
YB0-Y4

YC1-Y5

YC0-Y6

Carregar biblioteca 'C:\Program Files (x86)\Altus\MasterTool IEC\Library\Iecsfclib'

## Passo 2: Atuadores e Fins de Curso no Bloco Funcional



# Declaração de interface do Bloco Funcional da Sequência

POUs

- NAVEGA (PRG)
- PLC\_PRG (PRG)
- seq\_ABCcba (FB)

PLC\_PRG (PRG-LD)

```
0001 PROGRAM PLC_PRG
0002 VAR
0003     Exemplo: seq_ABCcba;
0004
0005     S1 AT %IX0.1: BOOL;
0006     S2 AT %IX0.2: BOOL;
0007     S3 AT %IX0.3: BOOL;
0008     S4 AT %IX0.4: BOOL;
0009     S5 AT %IX0.5: BOOL;
0010     S6 AT %IX0.6: BOOL;
0011     S7 AT %IX0.7: BOOL;
0012     (* Sidas *)
0013     Y1 AT %QX1.2: BOOL;
0014     Y2 AT %QX1.3: BOOL;
0015     Y3 AT %QX1.4: BOOL;
0016     Y4 AT %QX1.5: BOOL;
0017     Y5 AT %QX1.6: BOOL;
0018     Y6 AT %QX1.7: BOOL;
0019 END VAR
```

seq\_ABCcba (FB-LD)

```
0001 FUNCTION_BLOCK seq_ABCcba
0002 VAR_INPUT
0003     LIGAR: BOOL;
0004     XA0: BOOL;
0005     XA1: BOOL;
0006     XB0: BOOL;
0007     XB1: BOOL;
0008     XC0: BOOL;
0009     XC1: BOOL;
0010 END_VAR
0011 VAR_OUTPUT
0012     Em_execucao: BOOL;
0013     YA1: BOOL;
0014     YA0: BOOL;
0015     YB1: BOOL;
0016     YB0: BOOL;
0017     YC1: BOOL;
0018     YC0: BOOL;
0019 END_VAR
0020 VAR
0021     M0: BOOL;
0022     M1: BOOL;
0023     M2: BOOL;
0024 END_VAR
```

Exemplo

seq\_ABCcba

Em\_execucao

S1

LIGAR

S2-XA0

S3-XA1

S4-XB0

S5-XB1

S6-XC0

S7-XC1

YA1-Y1

YA0-Y2

YB1-Y3

YB0-Y4

YC1-Y5

YC0-Y6

Carregar biblioteca 'C:\Program Files (x86)\Altus\MasterTool IEC\Library\Iecsfclib'



# Inserir → Bloco Funcional... → FB def. pelo usuário

POUs

- NAVEGA (PRG)
- PLC\_PRG (PRG)
- seq\_ABCcba (FB)

PLC\_PRG (PRG-LD)

```
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0009     S5 AT %IX0.5: BOOL;
0010     S6 AT %IX0.6: BOOL;
0011     S7 AT %IX0.7: BOOL;
0012     (* Saídas *)
0013     Y1 AT %QX1.2: BOOL;
0014     Y2 AT %QX1.3: BOOL;
0015     Y3 AT %QX1.4: BOOL;
0016     Y4 AT %QX1.5: BOOL;
0017     Y5 AT %QX1.6: BOOL;
0018     Y6 AT %QX1.7: BOOL;
0019 END VAR
```

seq\_ABCcba (FB-LD)

```
0001 FUNCTION_BLOCK seq_ABCcba
0002 VAR_INPUT
0003     LIGAR: BOOL;
0004     XA0: BOOL;
0005     XA1: BOOL;
0006     XB0: BOOL;
0007     XB1: BOOL;
0008     XC0: BOOL;
0009     XC1: BOOL;
0010 END_VAR
0011 VAR_OUTPUT
0012     Em_execucao: BOOL;
0013     YA1: BOOL;
0014     YA0: BOOL;
0015     YB1: BOOL;
0016     YB0: BOOL;
0017     YC1: BOOL;
0018     YC0: BOOL;
0019 END_VAR
0020 VAR
0021     M0: BOOL;
0022     M1: BOOL;
0023     M2: BOOL;
0024 END_VAR
0025
0026
0027
0028
0029
0030
0031
0032
0033
```

0001

Exemplo

seq\_ABCcba

LIGAR

Em\_execucao

S1

S2-XA0

S3-XA1

S4-XB0

S5-XB1

S6-XC0

S7-XC1

YA1-Y1

YA0-Y2

YB1-Y3

YB0-Y4

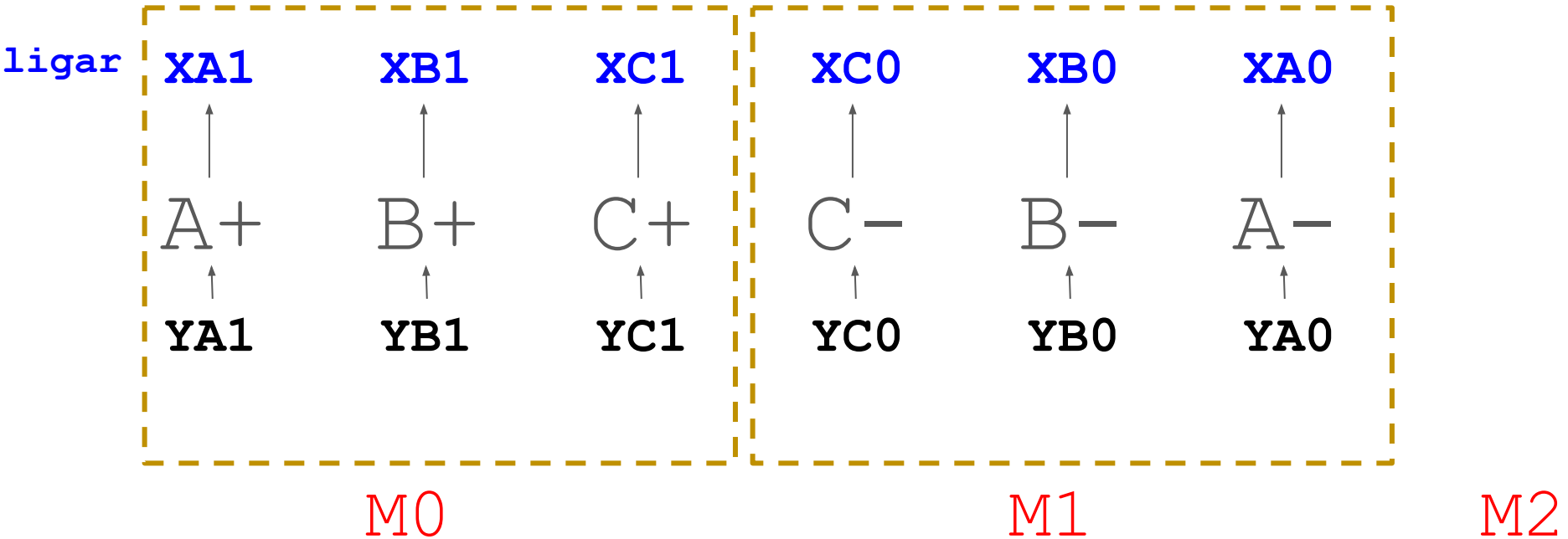
YC1-Y5

YC0-Y6

Carregar Biblioteca "C:\Program Files (x86)\Altus\Masterloop IEC\Library\Iecsfclib"

### Passo 3: Agrupamentos e memórias

Maior grupo possível, sem repetir qualquer **atuador**.



$$\text{Memórias} = \text{Grupos} + 1$$

## Passo 3: Agrupamentos e memórias

POUs

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- seq\_ABCcba (FB)

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0008     S4 AT %IX0.4: BOOL;
0009     S5 AT %IX0.5: BOOL;
0010     S6 AT %IX0.6: BOOL;
0011     S7 AT %IX0.7: BOOL;
0012     (* Saídas *)
0013     Y1 AT %QX1.2: BOOL;
0014     Y2 AT %QX1.3: BOOL;
0015     Y3 AT %QX1.4: BOOL;
0016     Y4 AT %QX1.5: BOOL;
0017     Y5 AT %QX1.6: BOOL;
0018     Y6 AT %QX1.7: BOOL;
0019 END VAR
```

seq\_ABCcba (FB-LD)

```
0001 FUNCTION_BLOCK seq_ABCcba
0002 VAR_INPUT
0003     LIGAR: BOOL;
0004     XA0: BOOL;
0005     XA1: BOOL;
0006     XB0: BOOL;
0007     XB1: BOOL;
0008     XC0: BOOL;
0009     XC1: BOOL;
0010 END_VAR
0011 VAR_OUTPUT
0012     Em_execucao: BOOL;
0013     YA1: BOOL;
0014     YA0: BOOL;
0015     YB1: BOOL;
0016     YB0: BOOL;
0017     YC1: BOOL;
0018     YC0: BOOL;
0019 END_VAR
0020 VAR
0021     M0: BOOL;
0022     M1: BOOL;
0023     M2: BOOL;
0024 END_VAR
```

Exemplo

seq\_ABCcba

Em\_execucao

S1

LIGAR

XA0

XA1

XB0

XB1

XC0

XC1

YA1

YA0

YB1

YB0

YC1

YC0

Y1

Y2

Y3

Y4

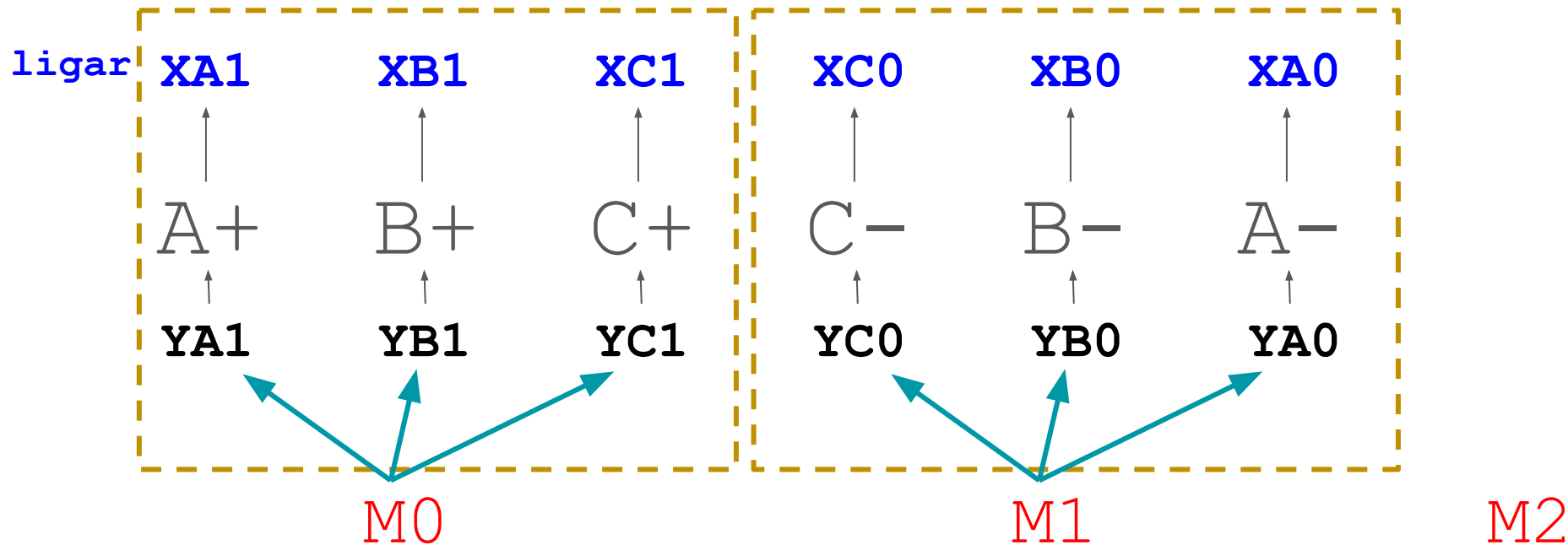
Y5

Y6

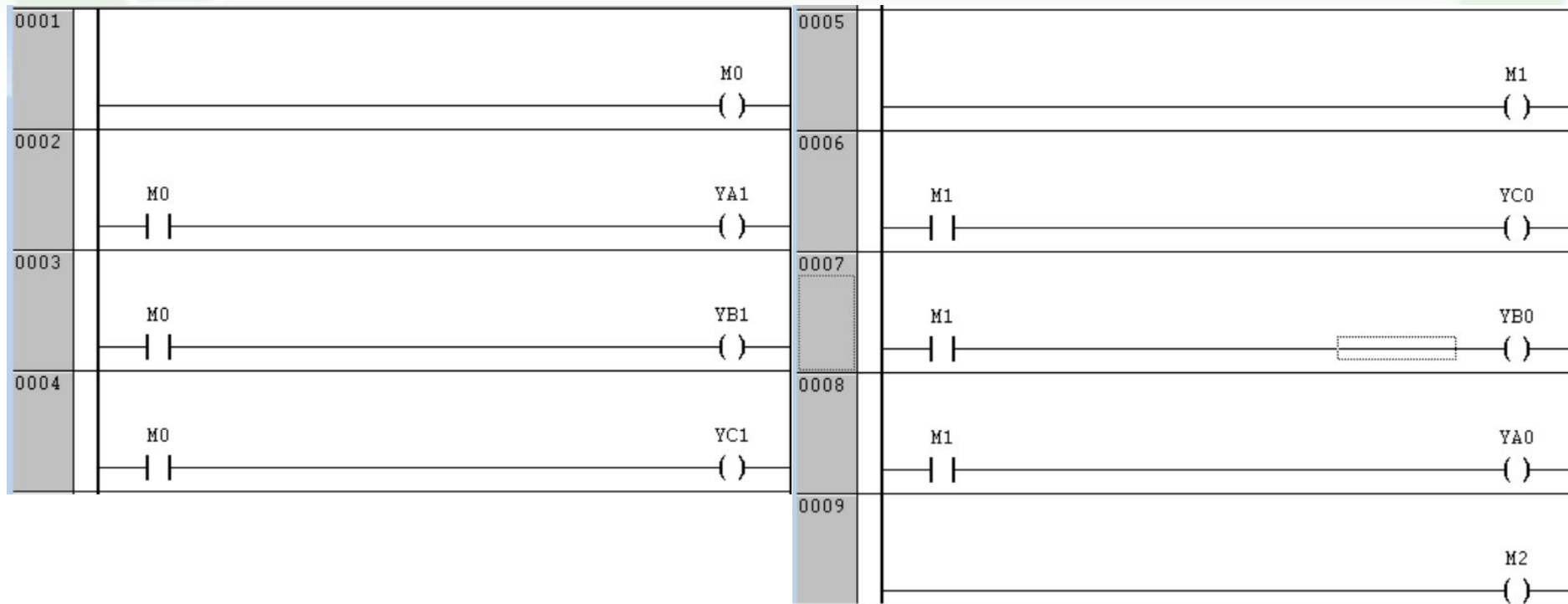
Número grupos + 1

Carregar biblioteca 'C:\Program Files (x86)\Altus\MasterTool IEC\Library\Iecsfclib'

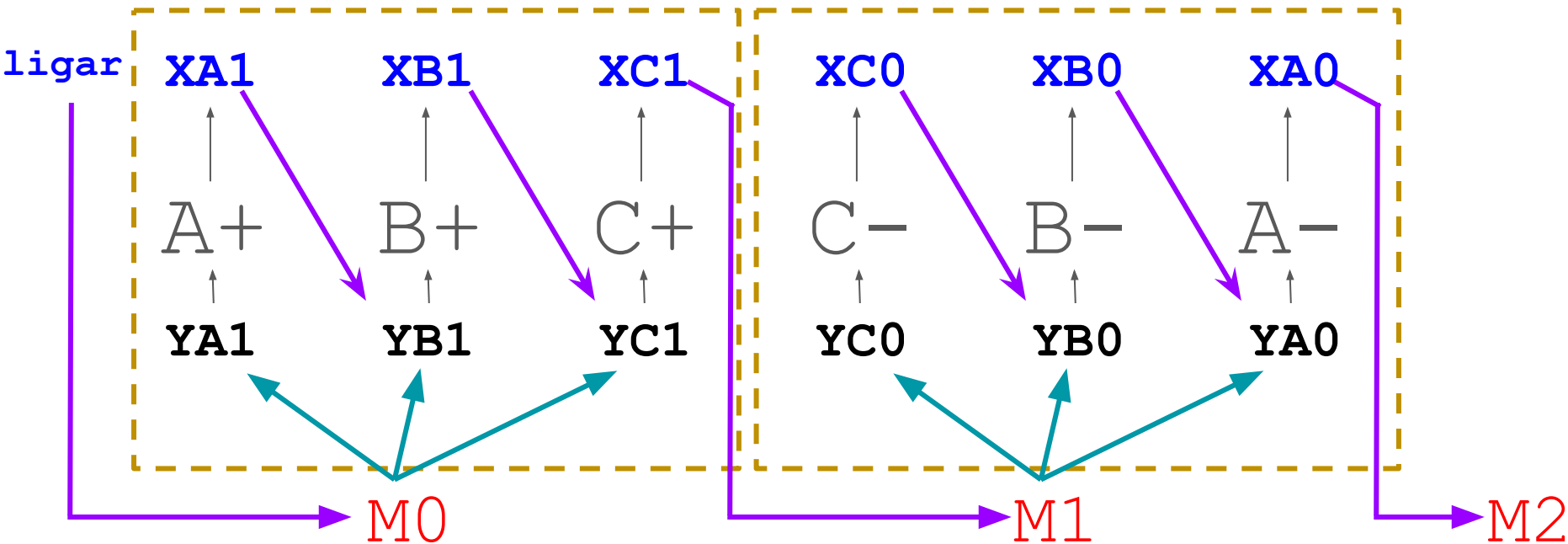
## Passo 4: **Memórias** habilitando atuadores



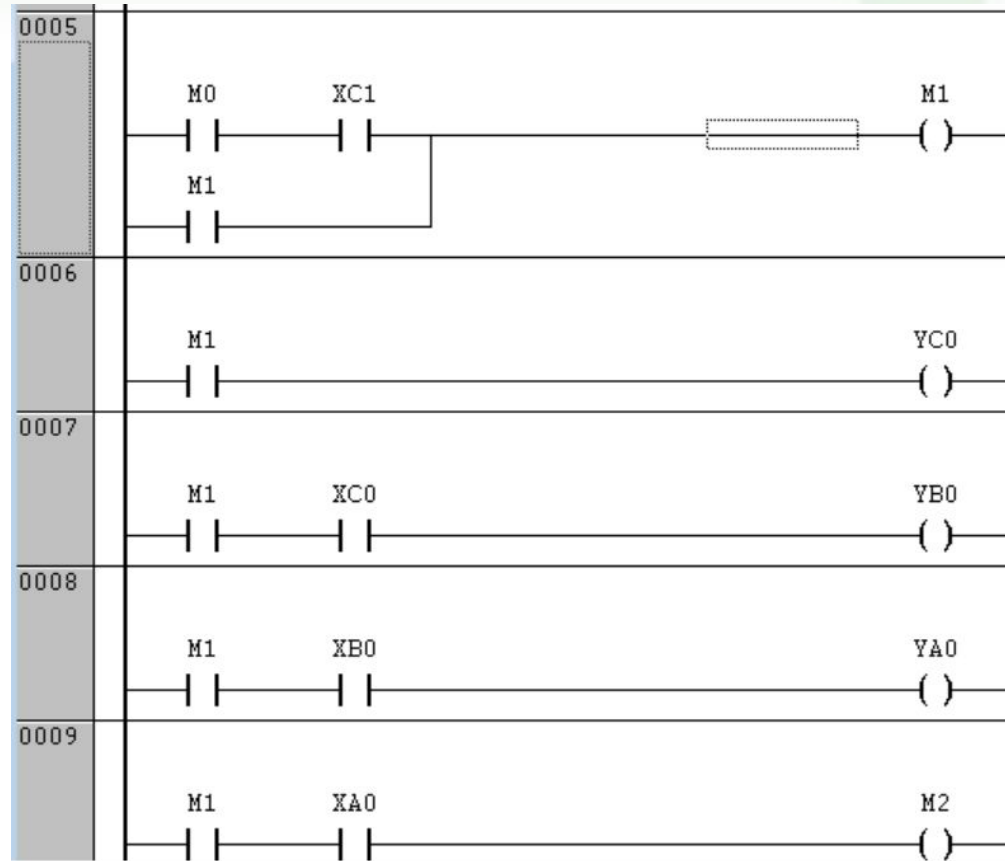
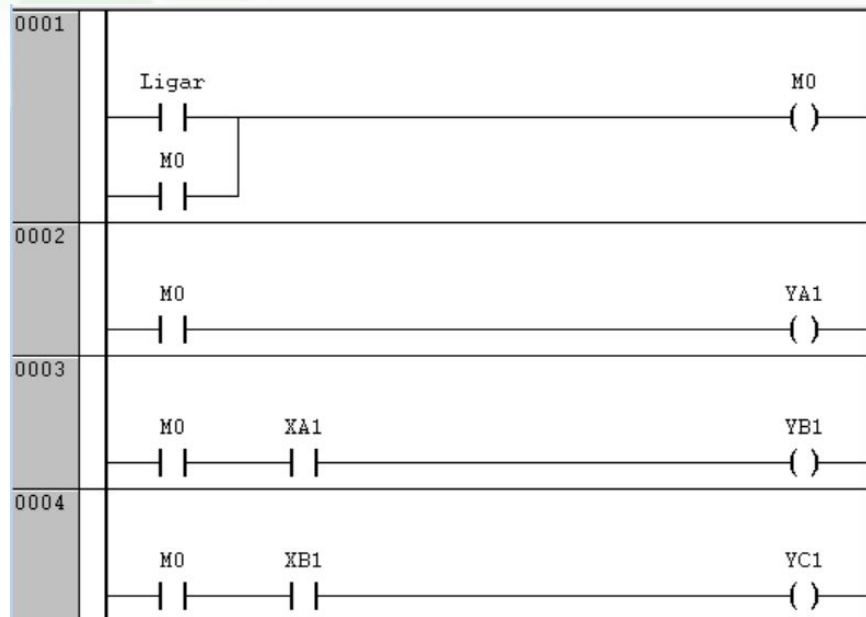
## Passo 4: **Memórias** habilitando atuadores



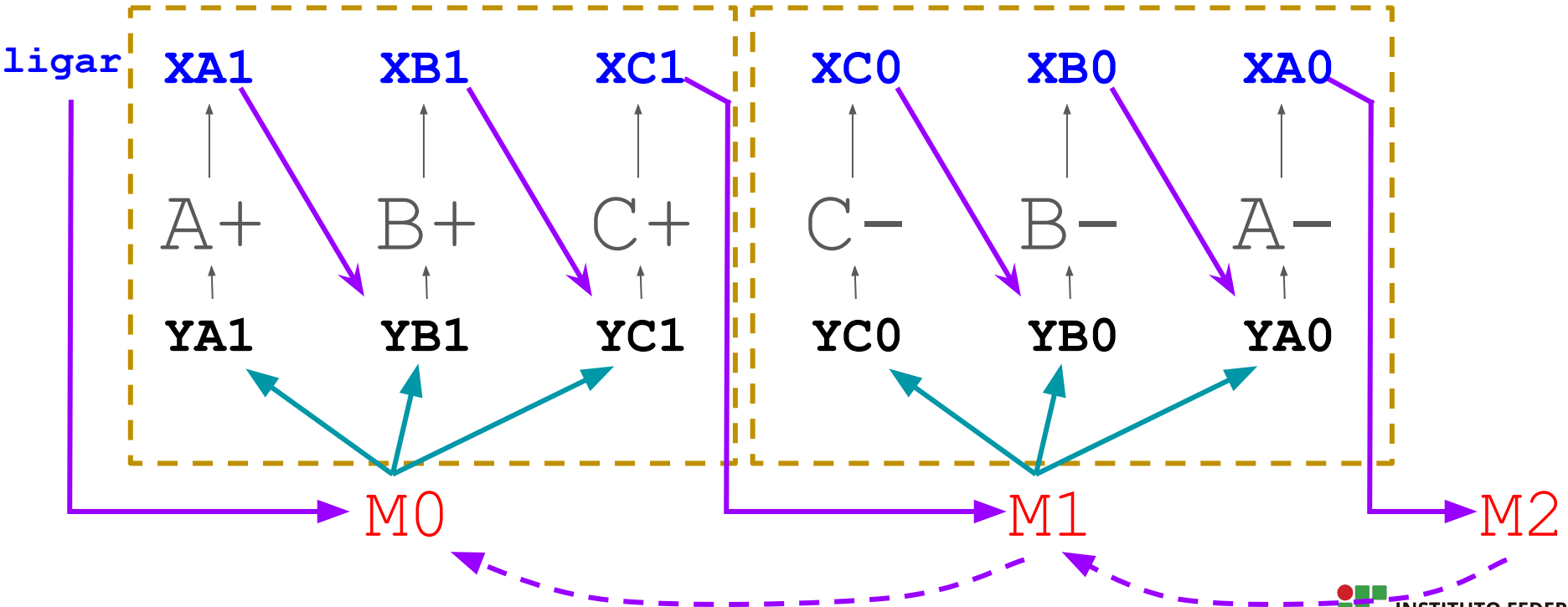
## Passo 5: **Acionamento** de **Memórias** e **Atuadores**



## Passo 5: **Acionamento** de **Memórias** e **Atuadores**

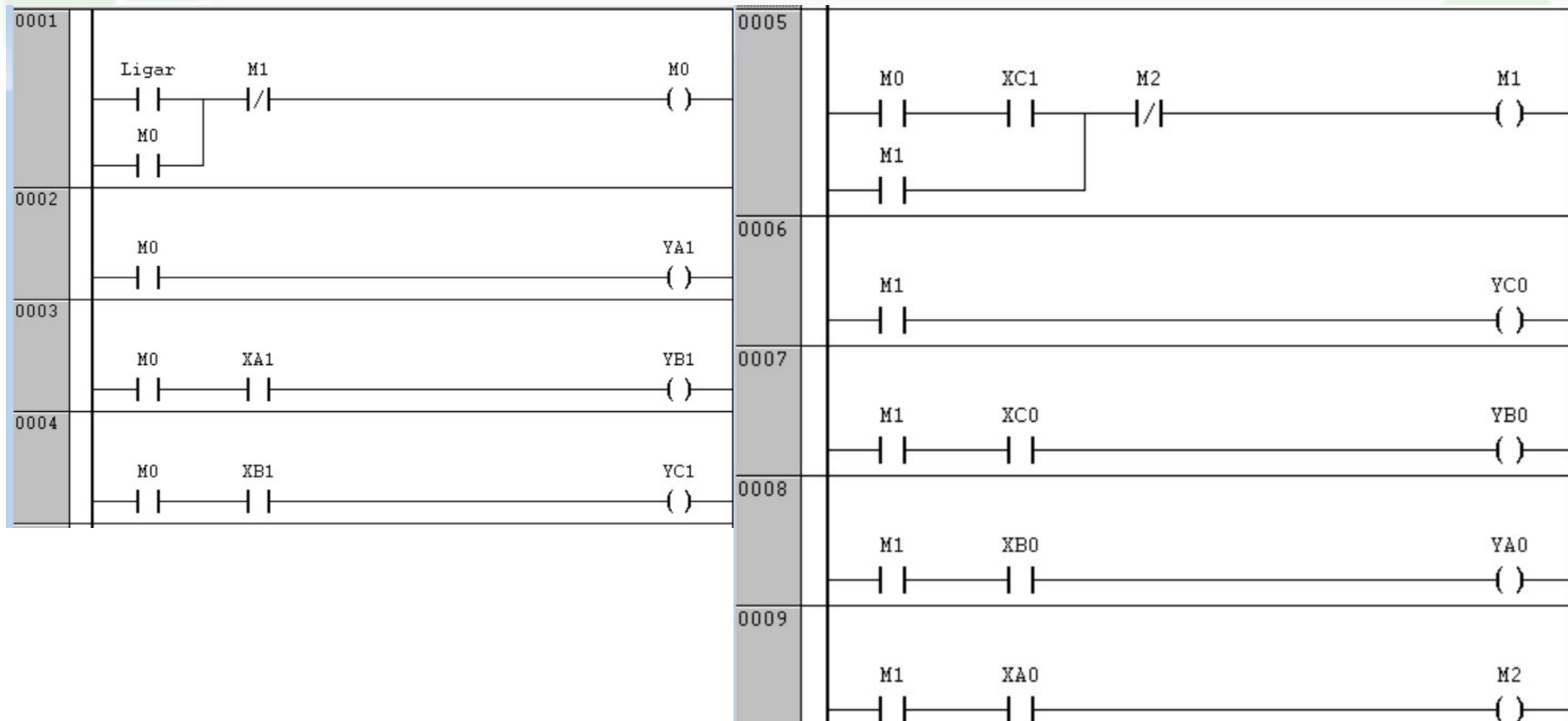


## Passo 6: Desacionamento de Memória Anterior





## Passo 6: Desacionamento de Memória Anterior



# Exercícios

Aplicar o método de Minimização de contatos, para produzir as seguintes sequências de acionamento:

1) A+ C+ C- B+ A- B-

2) A+ A- B+ B- C+ C-

3) A+ C+ [A- B+] B- C-

4) C+ B+ B- A+ C- B+ B- A-

Obs.: [A- B+]: Movimentos simultâneos