

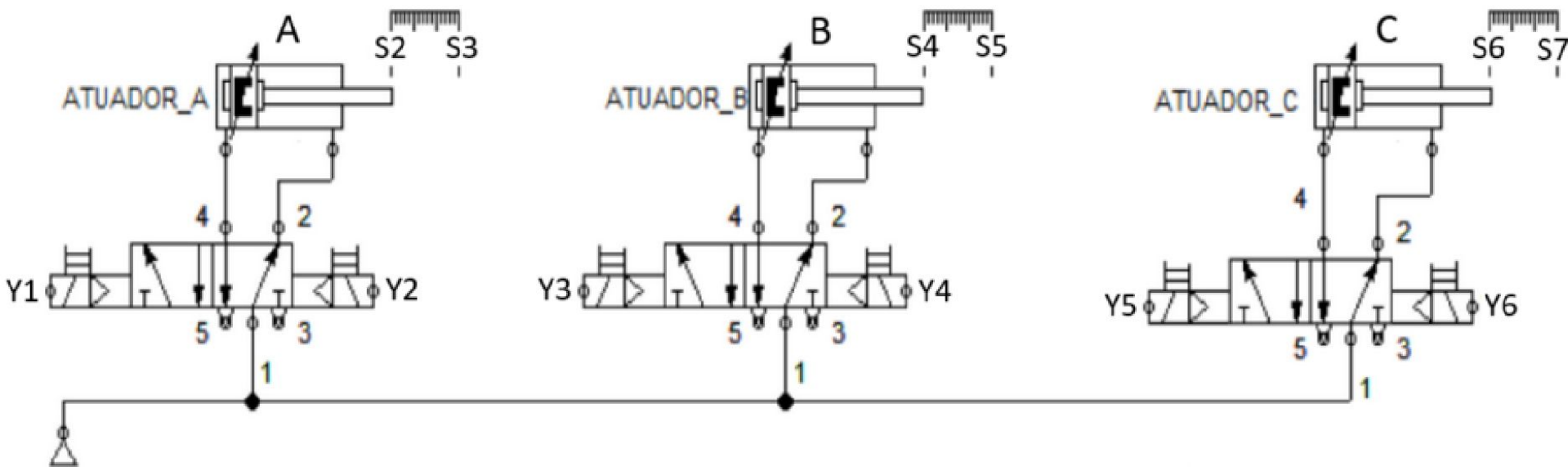
Controladores Lógicos Programáveis

Técnico em Automação Industrial

Método de Programação por Minimização de contatos

Cascata ou Sequência Mínima

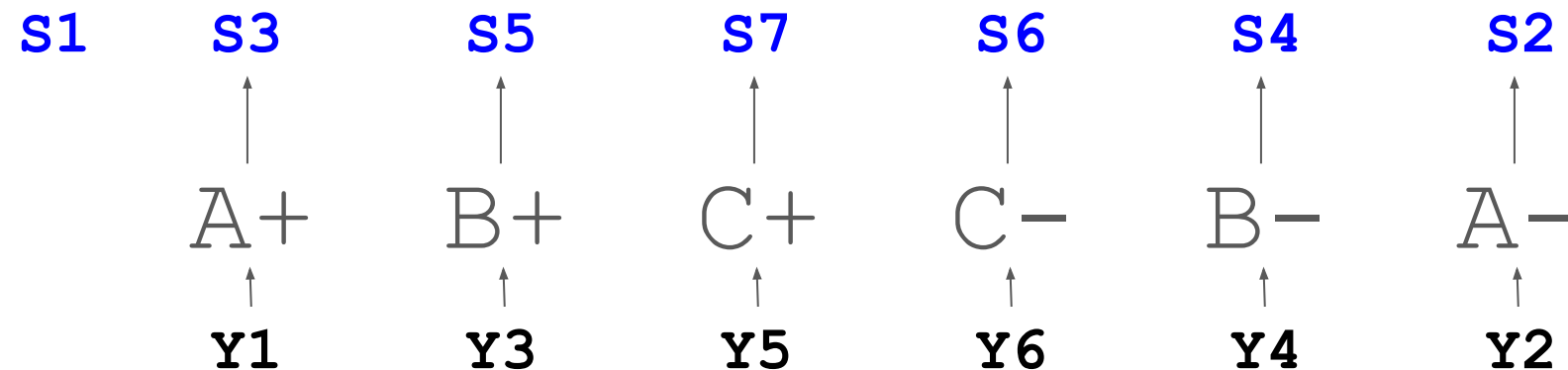
Circuito



Passo 0: Sequência de acionamento

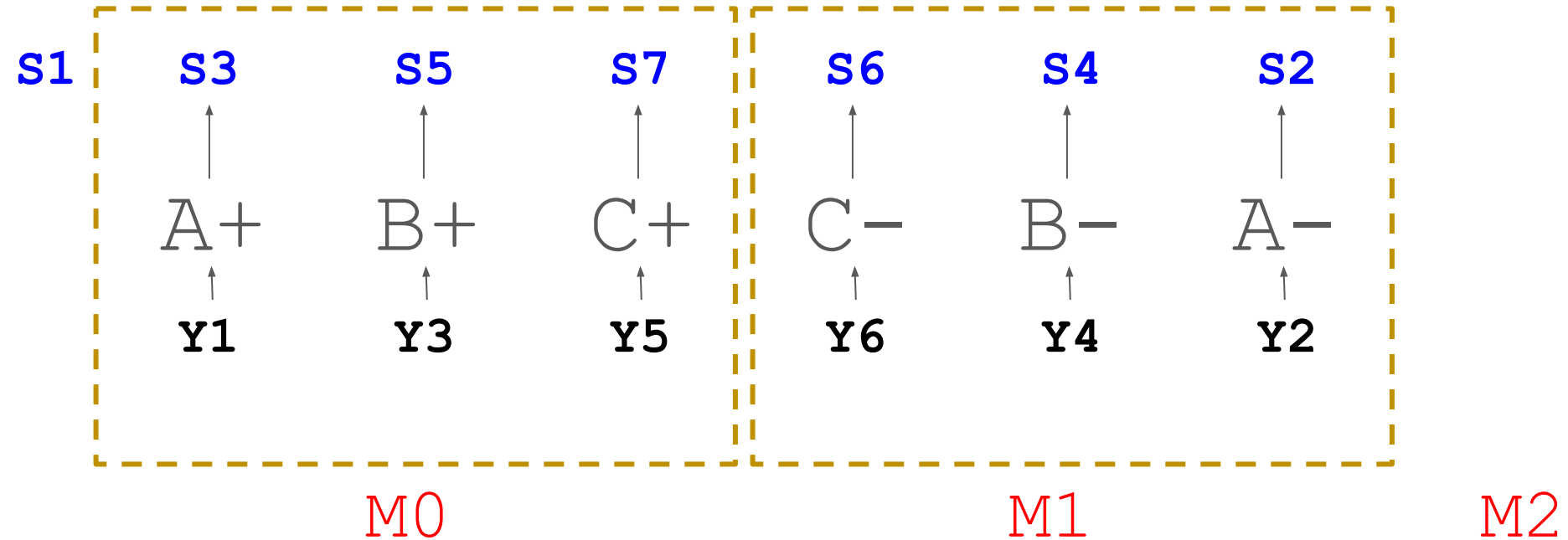
A+ B+ C+ C- B- A-

Passo 1: Atuadores e Fins de Curso



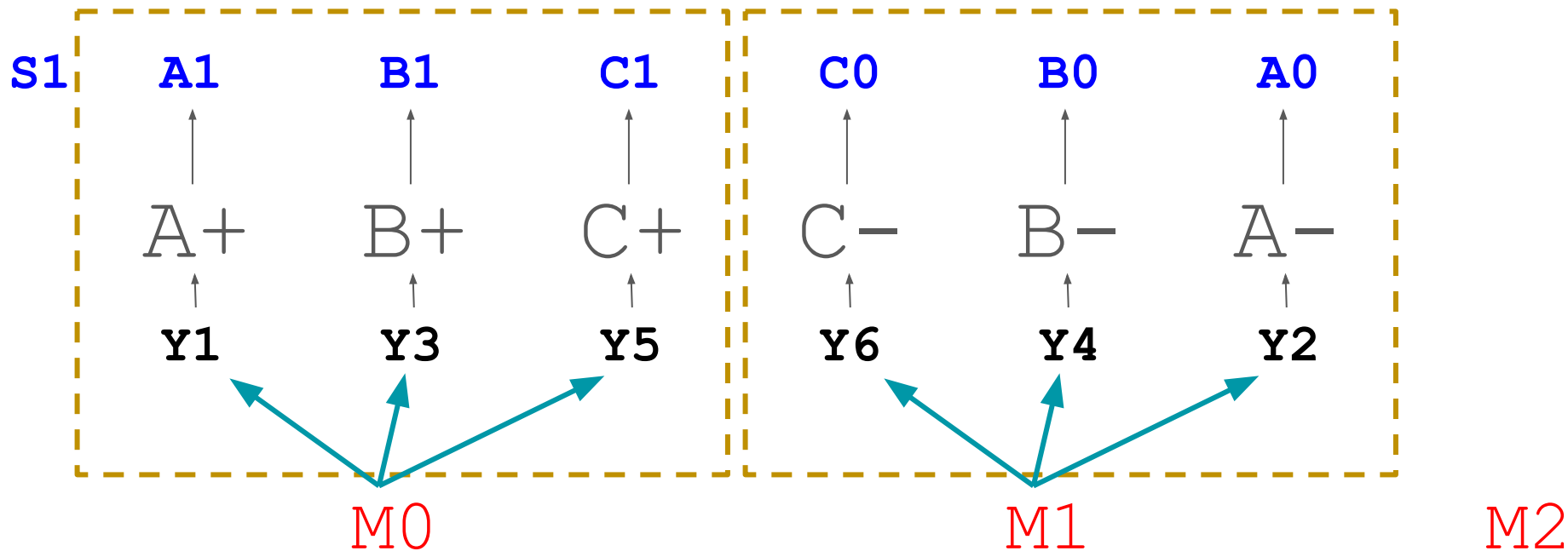
Passo 2: Agrupamentos e memórias

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

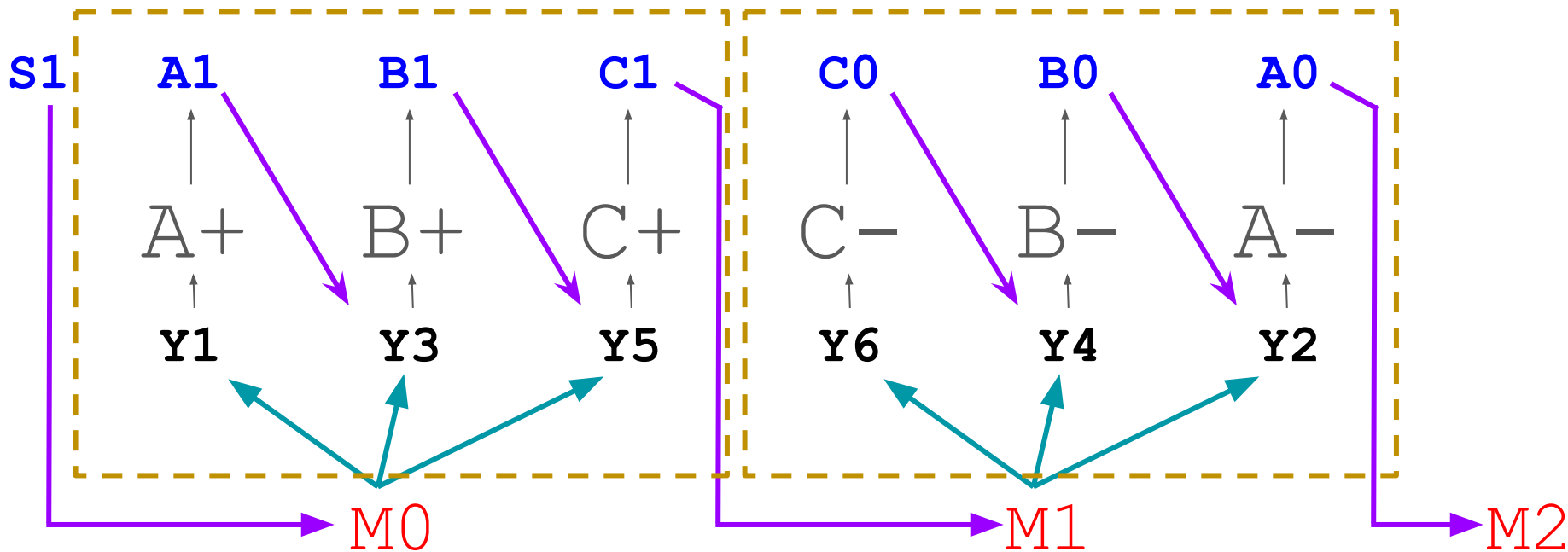


$$\text{Memórias} = \text{Grupos} + 1$$

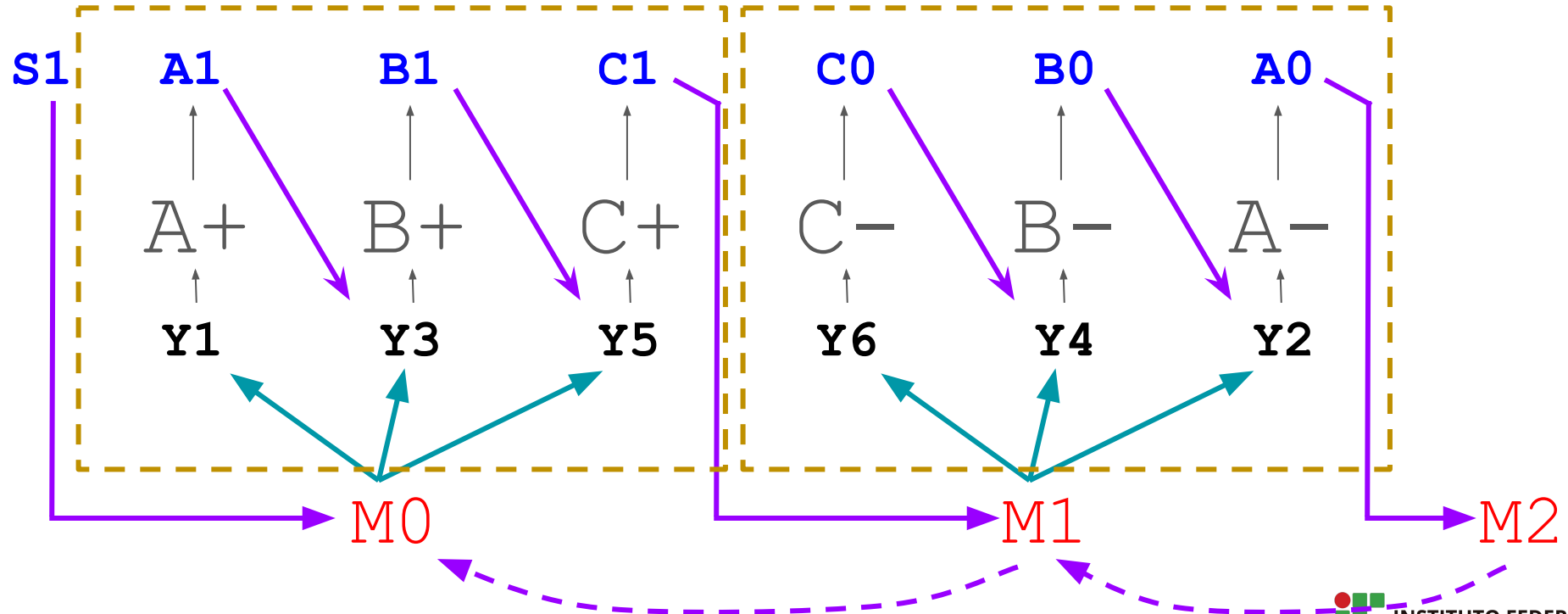
Passo 3: **Memórias** habilitando atuadores



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



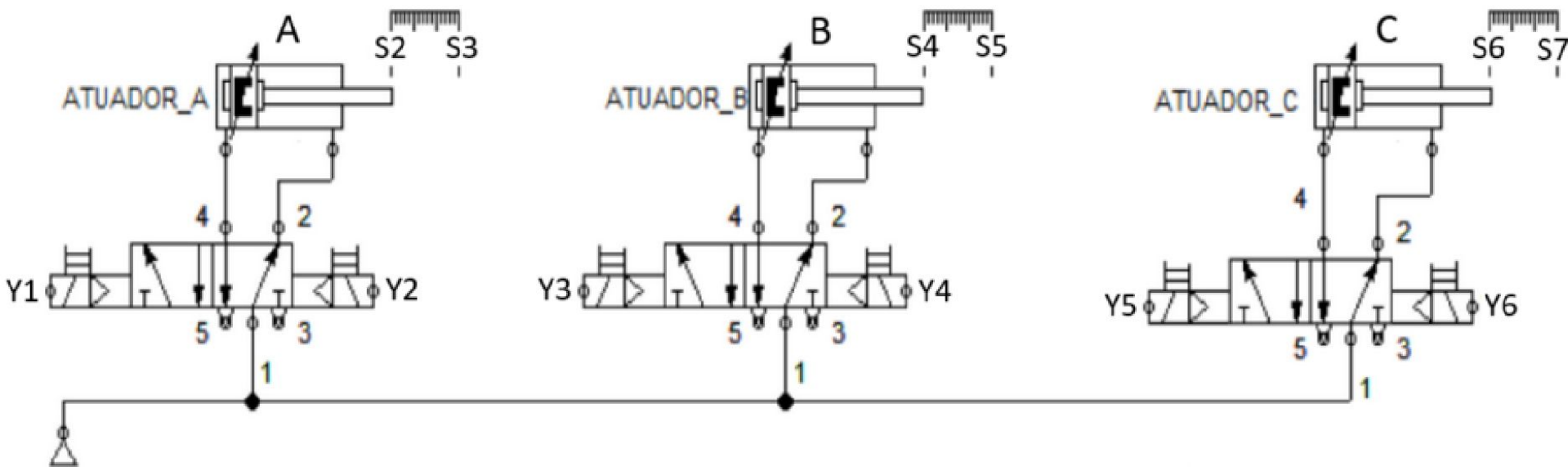
Passo 5: Desacionamento de Memória Anterior



Programação no PLC

Linguagem Ladder

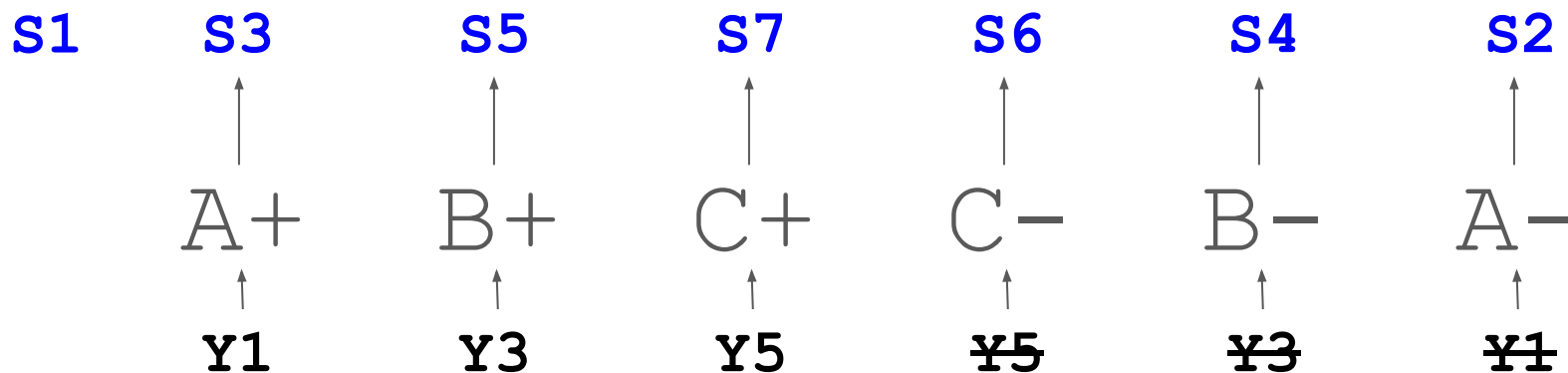
Circuito



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

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\MasterTool IEC\Library\Iecsfclib'

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 (* 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

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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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

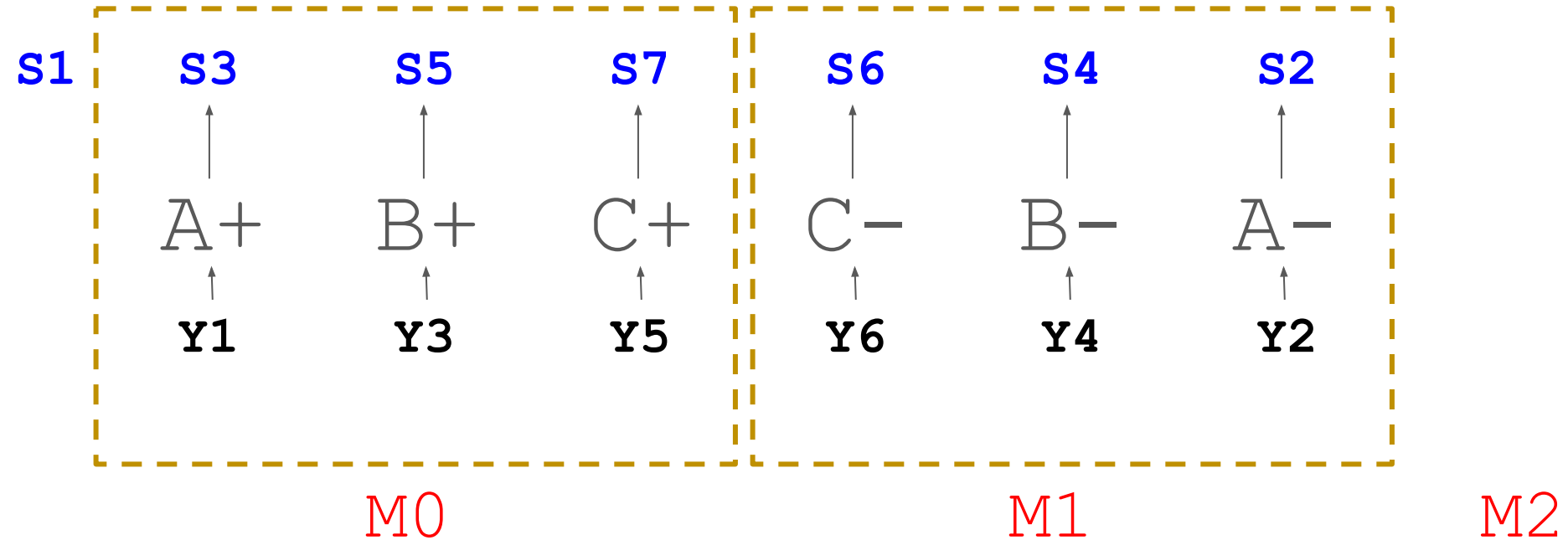
YC1-Y5

YC0-Y6

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

Passo 2: Agrupamentos e memórias

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



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

Passo 2: Agrupamentos e memórias

POUs

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- PLC_PRG (PRG)
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0013     Y1 AT %QX1.2: BOOL;
0014     Y2 AT %QX1.3: BOOL;
0015     Y3 AT %QX1.4: BOOL;
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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;
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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

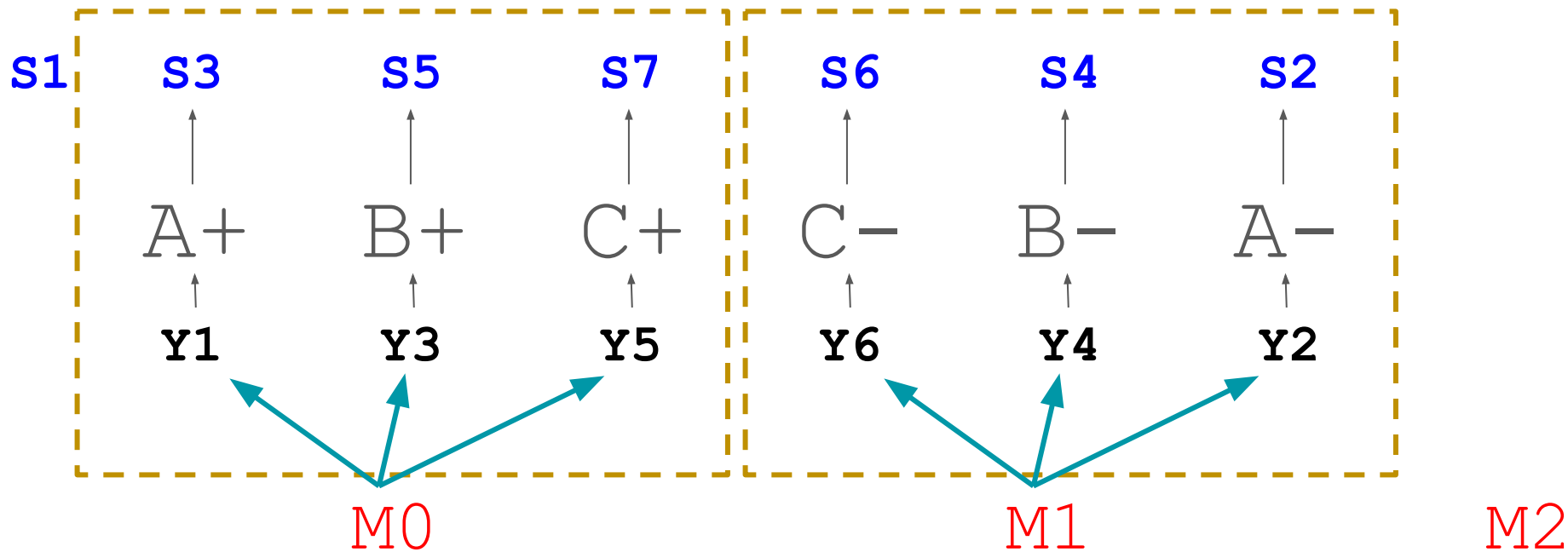
YC1-Y5

YC0-Y6

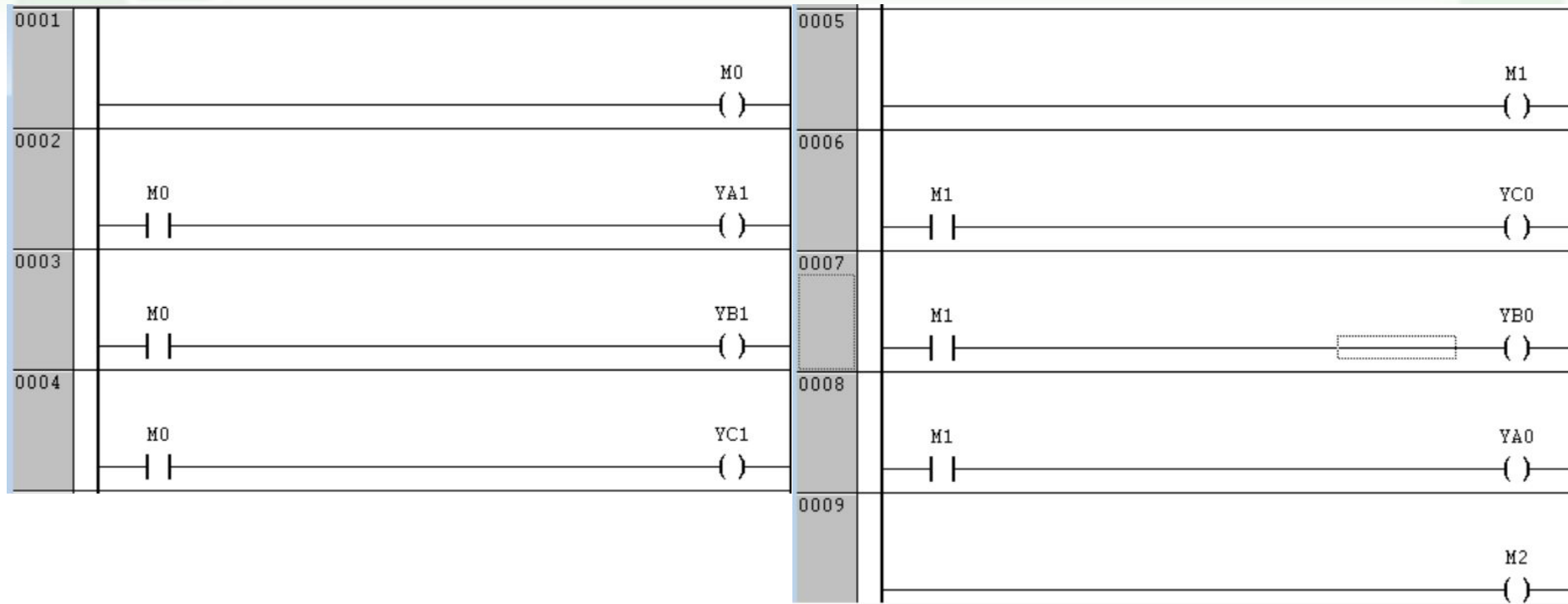
Número grupos + 1

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

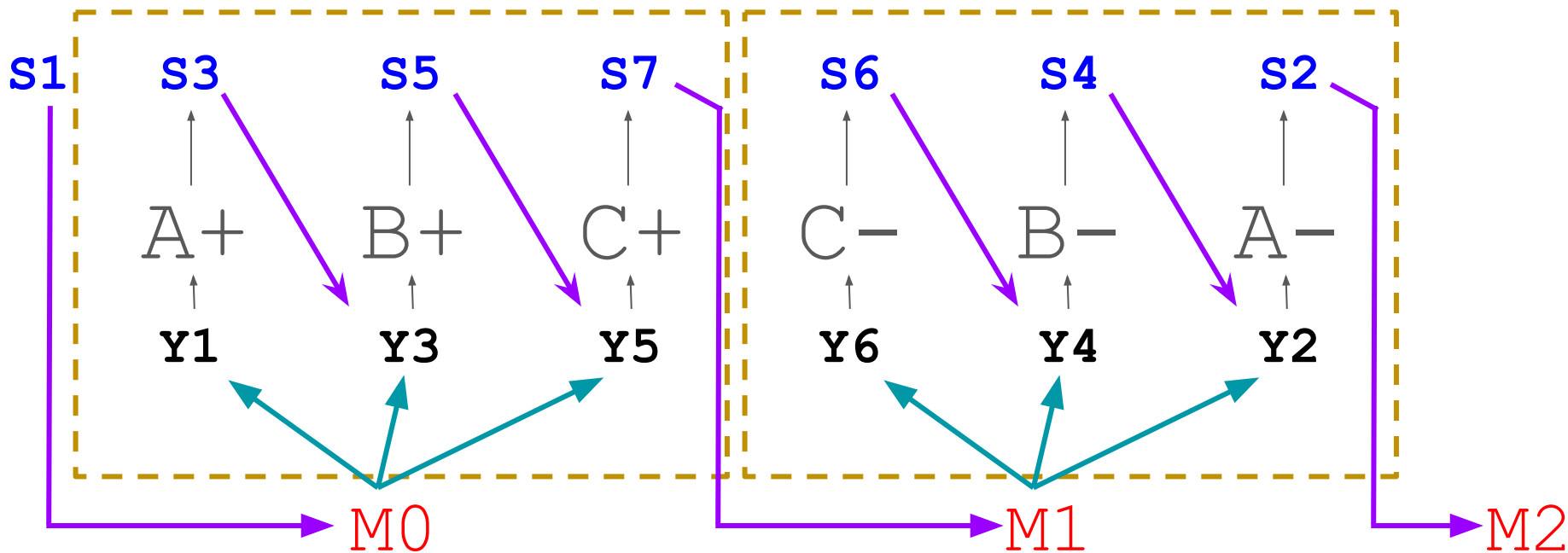
Passo 3: **Memórias** habilitando atuadores



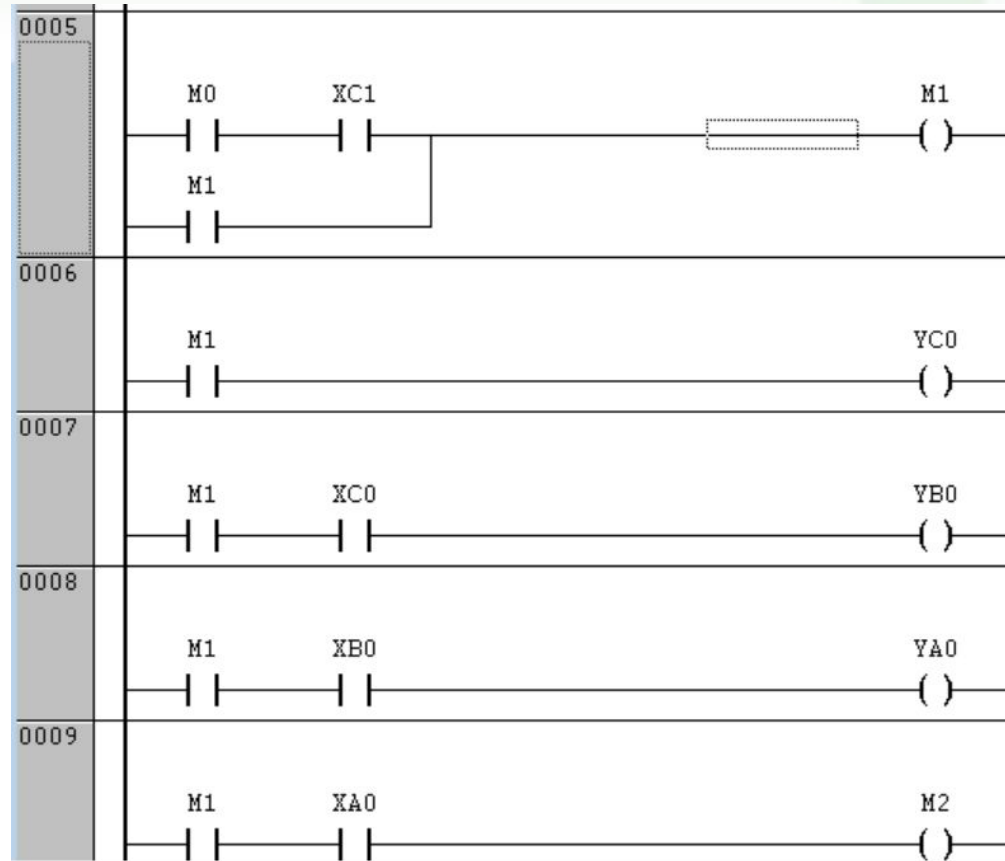
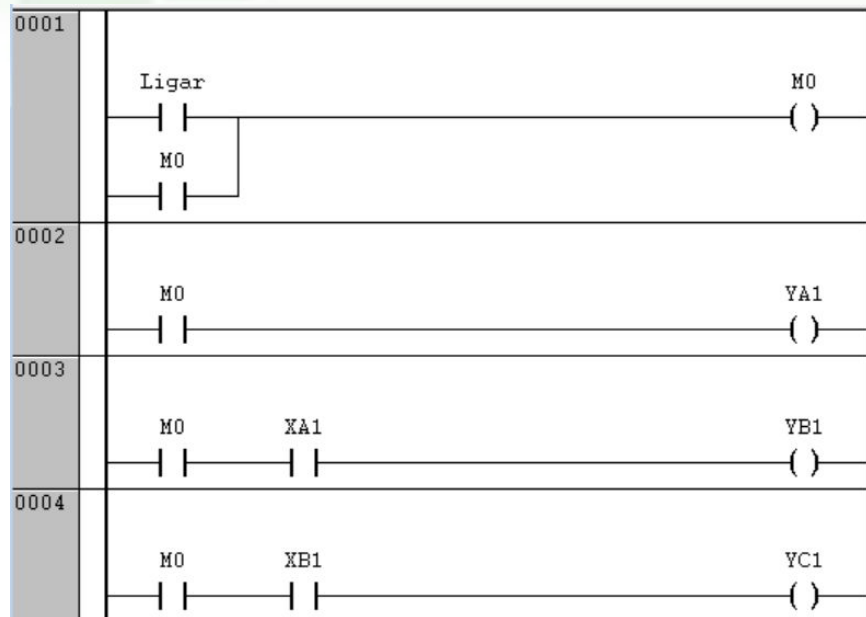
Passo 3: Memórias habilitando atuadores



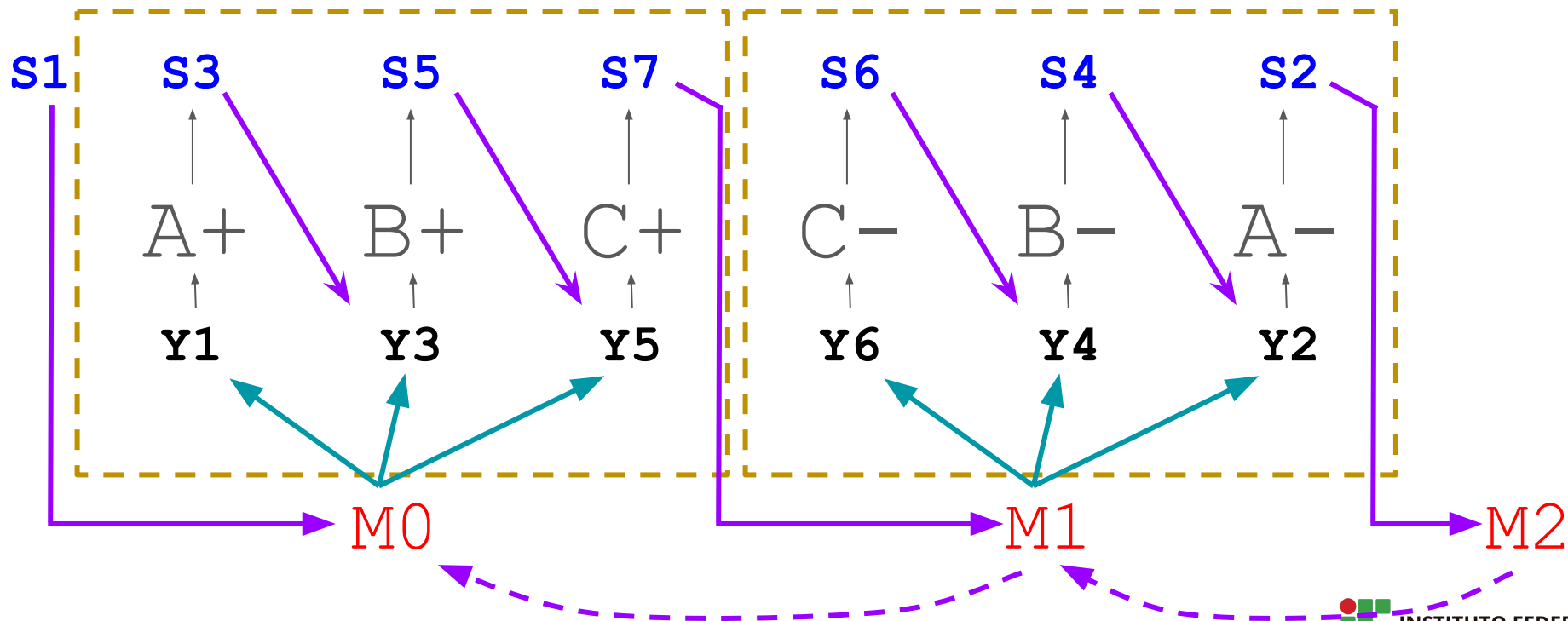
Passo 4: Acionamento de Memórias e Atuadores



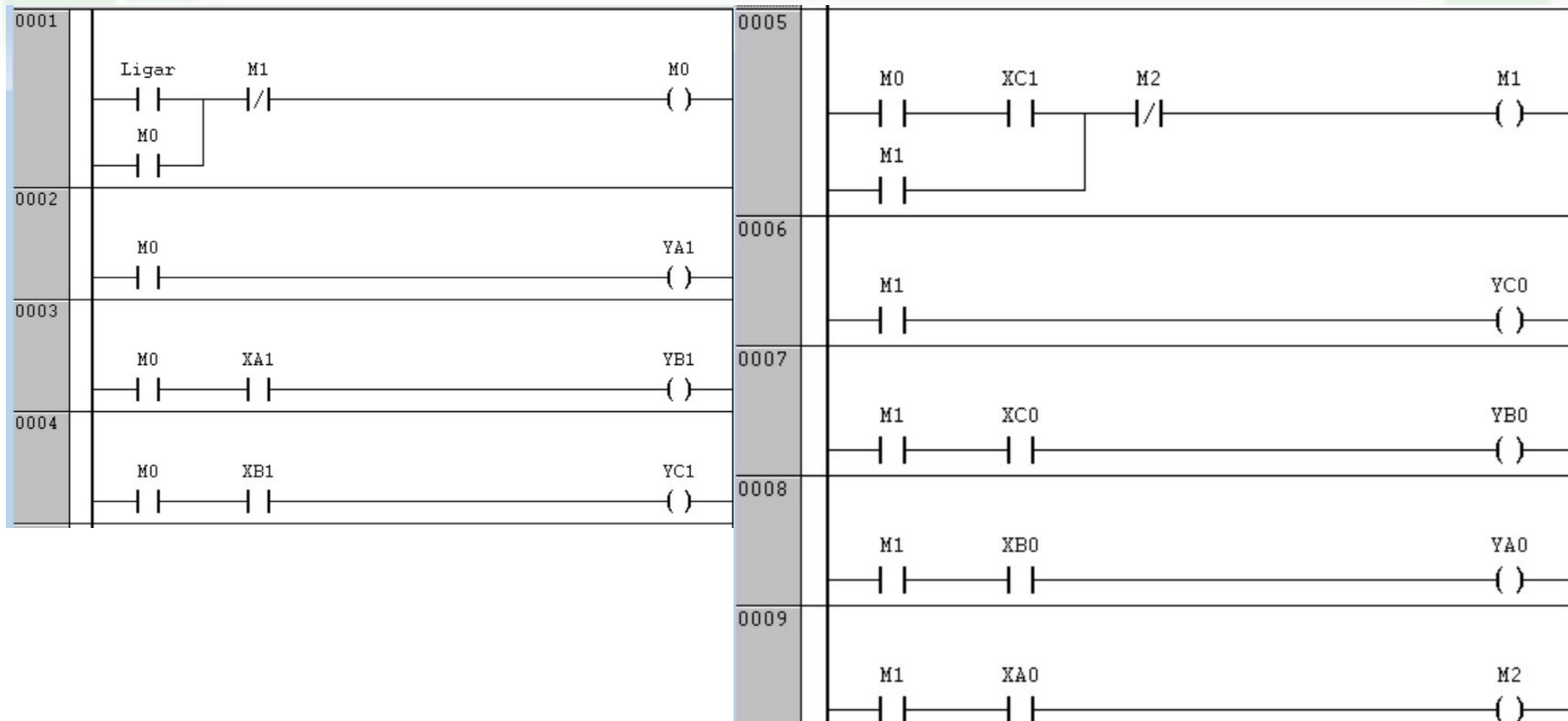
Passo 4: **Acionamento** de **Memórias** e **Atuadores**



Passo 5: Desacionamento de Memória Anterior



Passo 5: 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