Practica 1 - Subrutinas

1 de octubre de 2024

Ejercicio 7 - Multiplicación de números sin signo

- El programa utiliza una subrutina para multiplicar dos números sin signo mayores que cero.
- Se pasan los números a multiplicar por valor.
- Se para por referencia la dirección donde se debe guardar el resultado.
- Todos los parámetros se pasan a través de la pila

Ejercicio 7 - Pasaje de parámetros por pila

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MUL:  PUSH   BX
      PUSH   CX
      PUSH   AX
      PUSH   DX
      MOV    BX, SP
      ADD    BX, 12
      MOV    CX, [BX]
      ADD    BX, 2
      MOV    AX, [BX]
      SUB    BX, 4
      MOV    BX, [BX]
      MOV    DX, 0
SUMA: ADD    DX, AX
      DEC    CX
      JNZ    SUMA
      MOV    [BX], DX
      POP    DX
      POP    AX
      POP    CX
      POP    BX
      RET
```

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ORG   2000H ; Programa Principal
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MOV   AX, NUM2
PUSH  AX
MOV   AX, OFFSET RES
PUSH  AX
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CALL  MUL
POP   AX
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POP   AX
HLT
END
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ORG   1000h ; Variables

NUM1 DW 5H
NUM2 DW 3H
RES  DW ?
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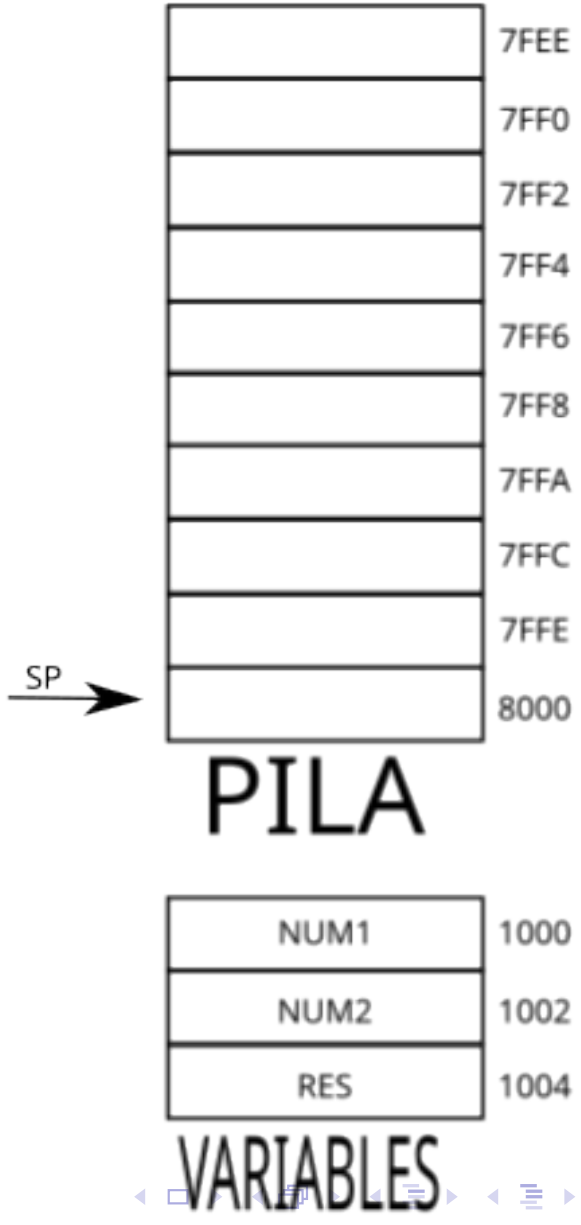

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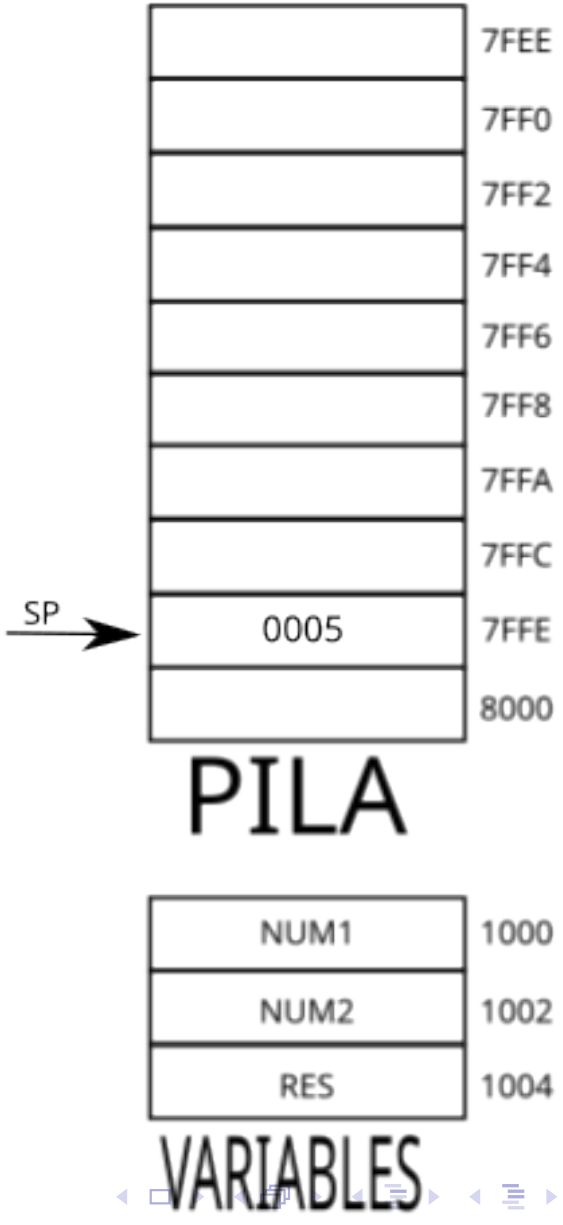

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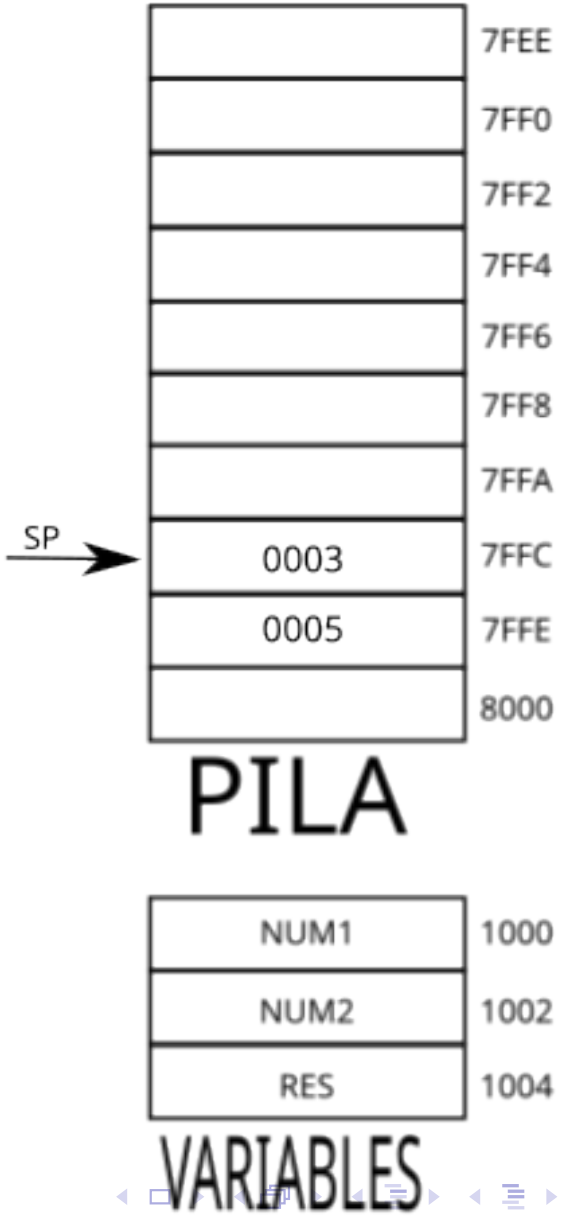

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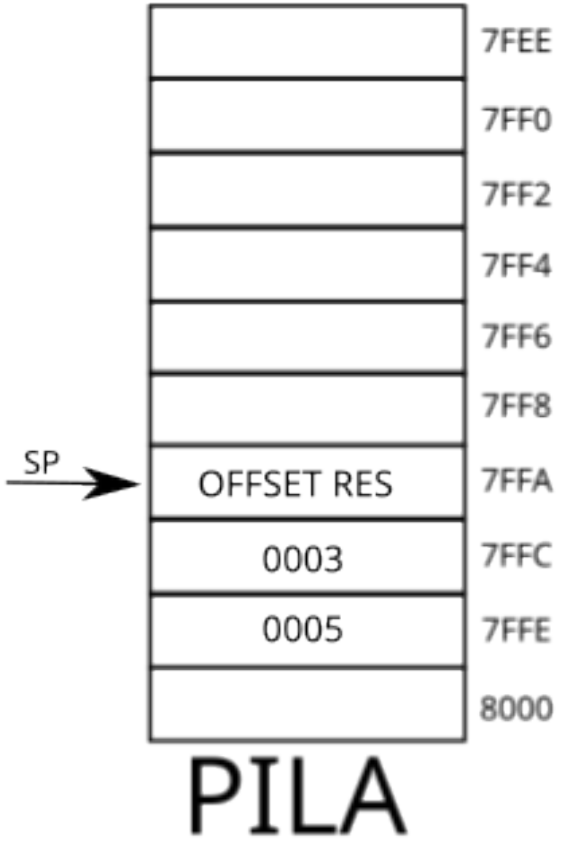

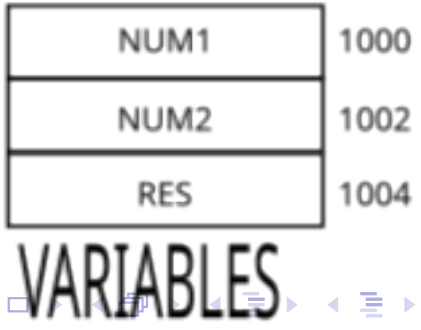

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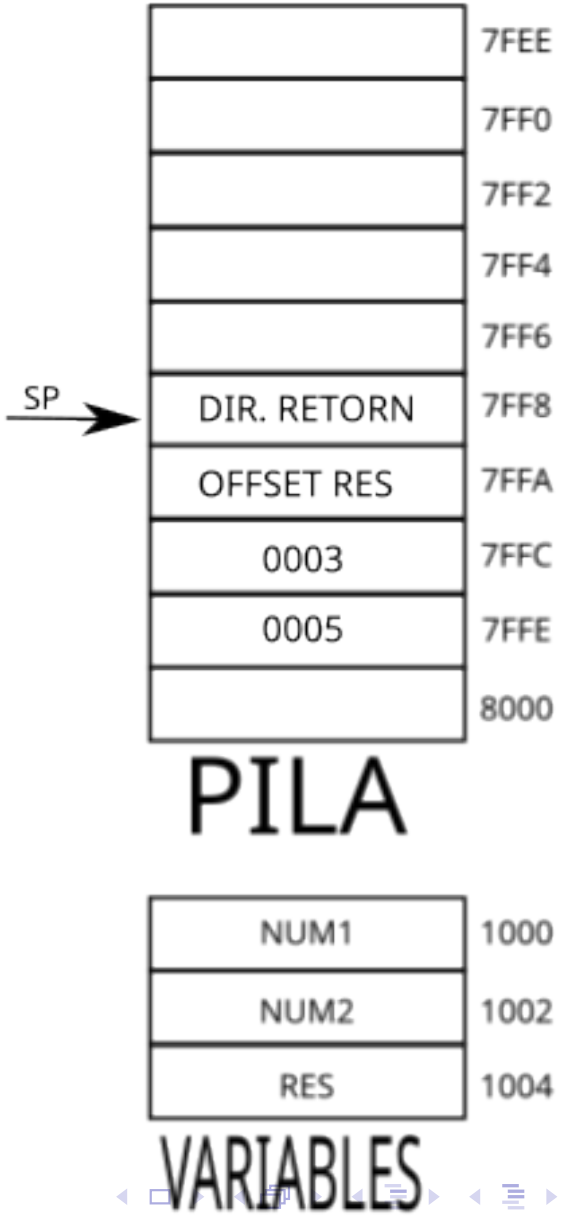

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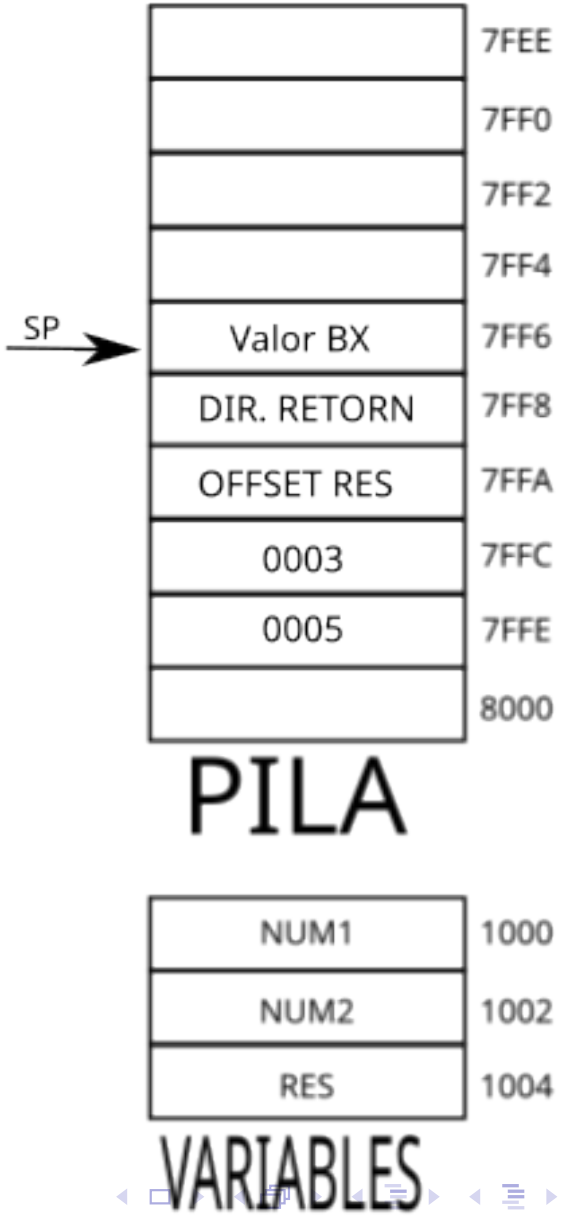

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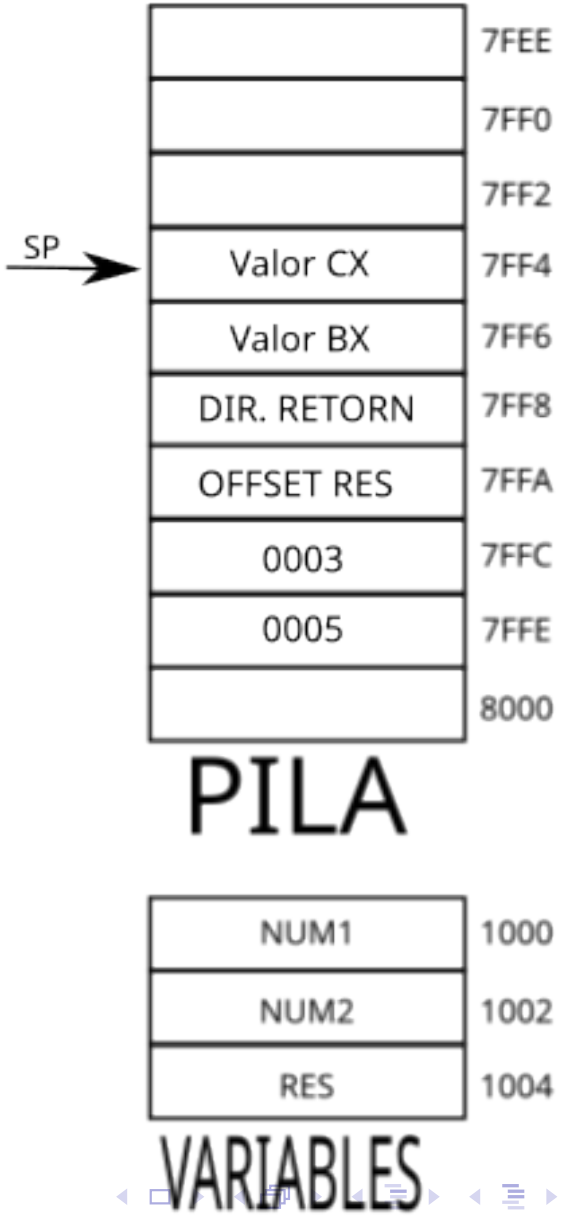

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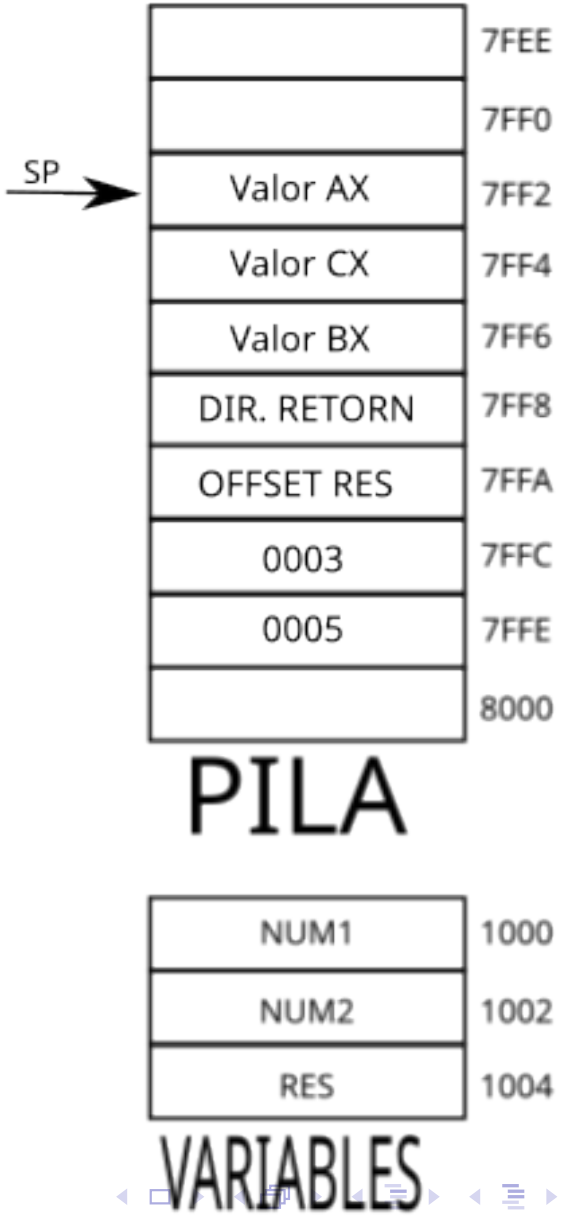

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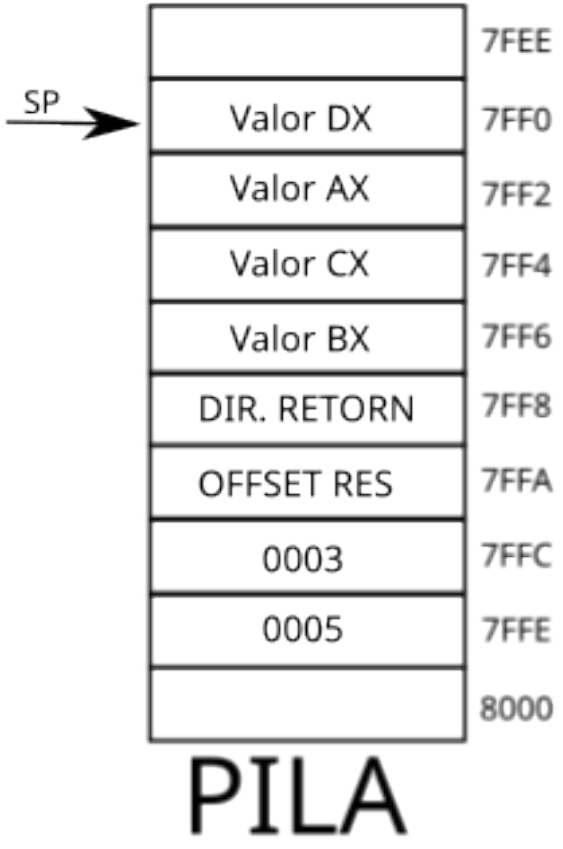

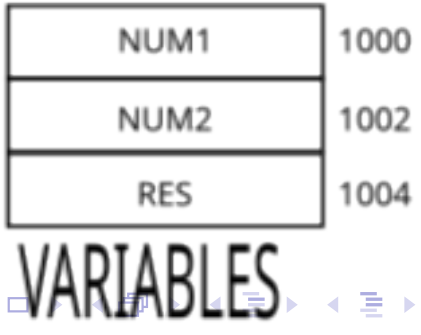

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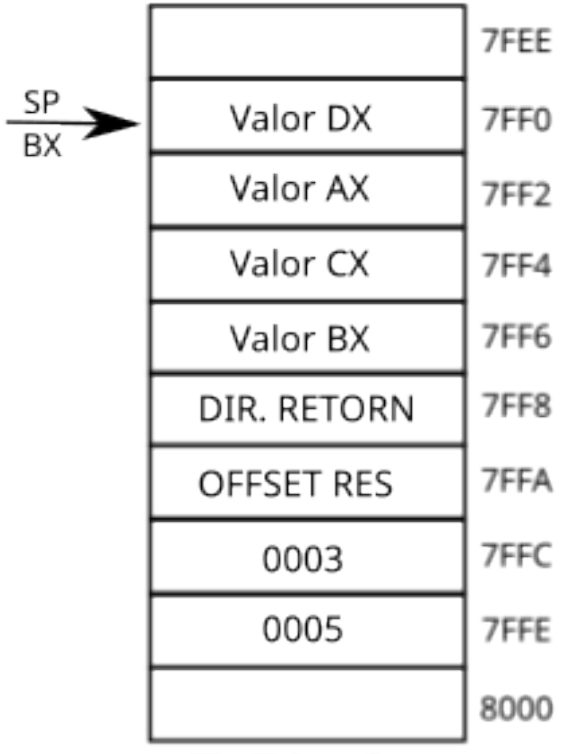

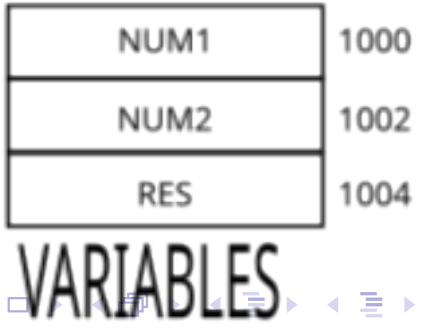

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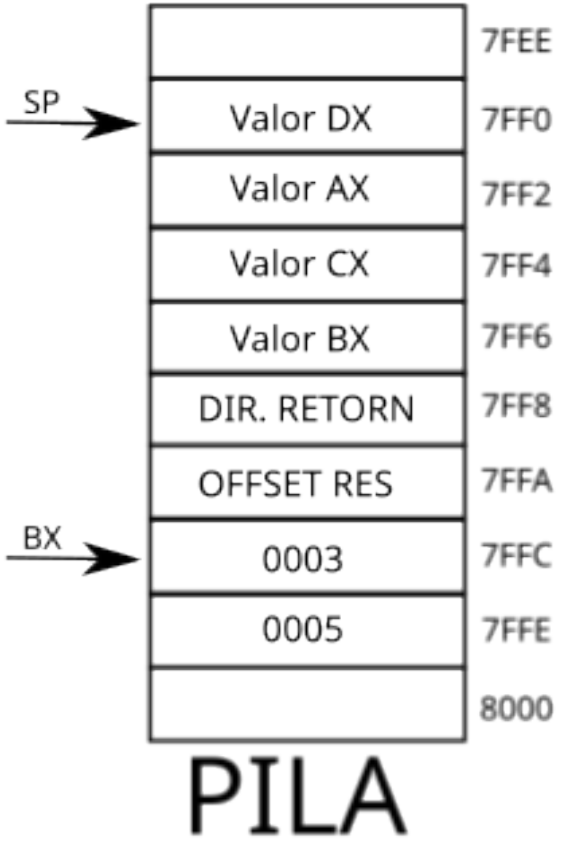

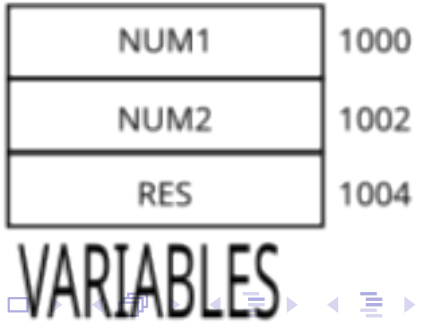

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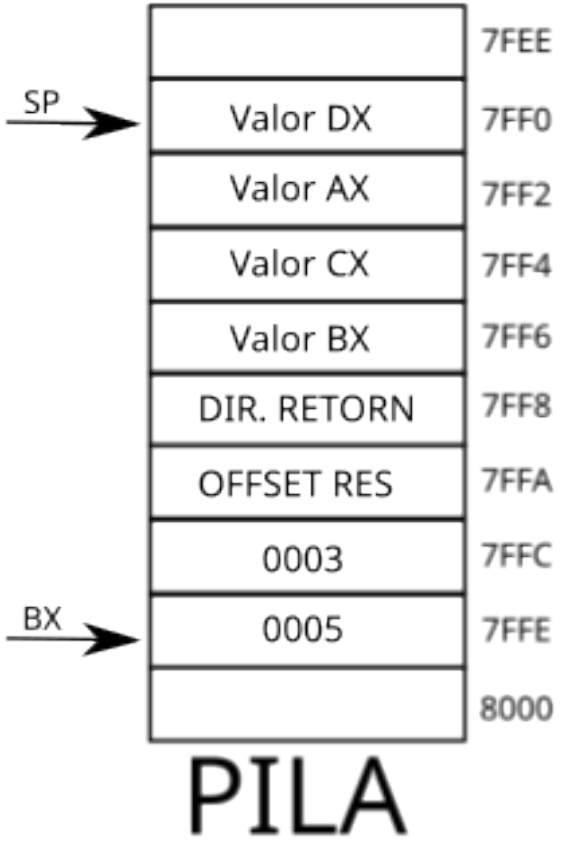

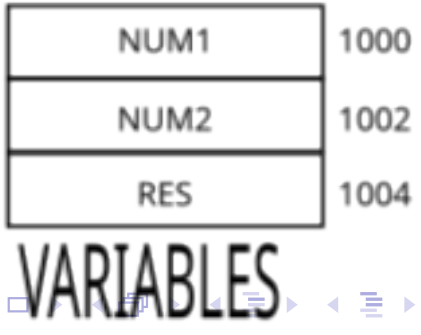

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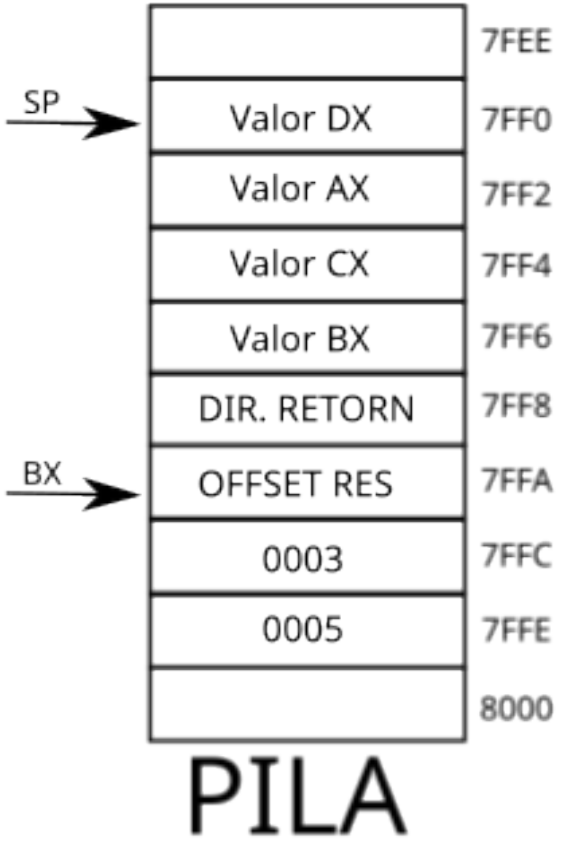

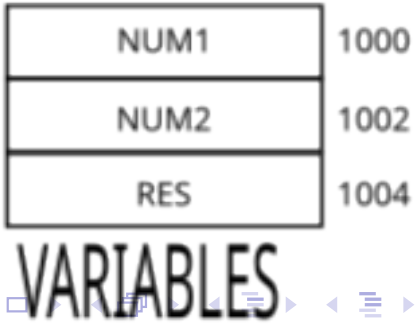

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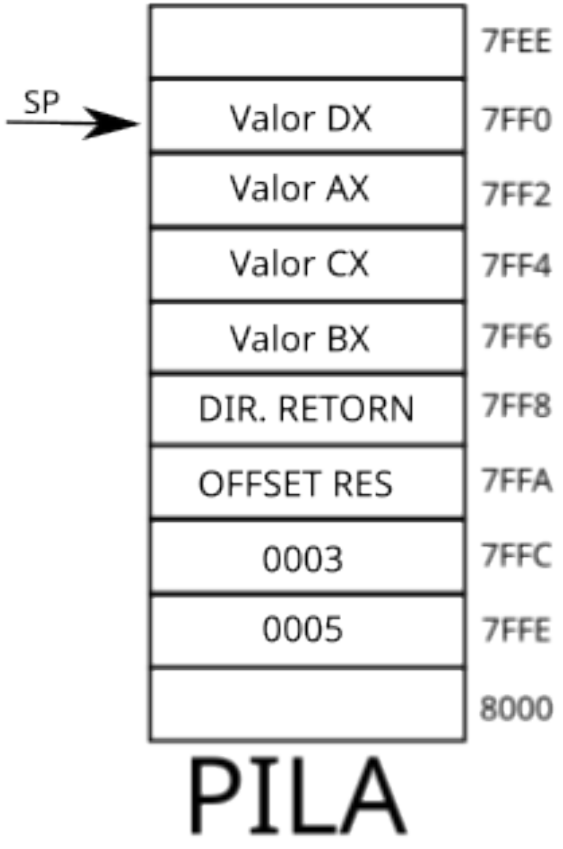

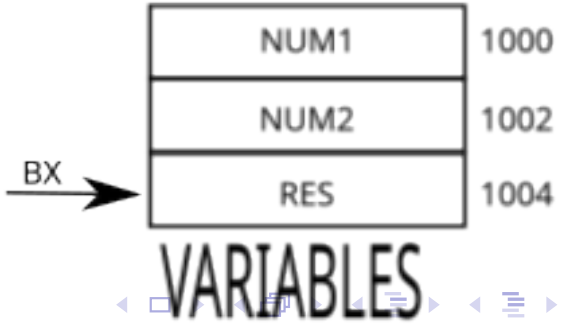

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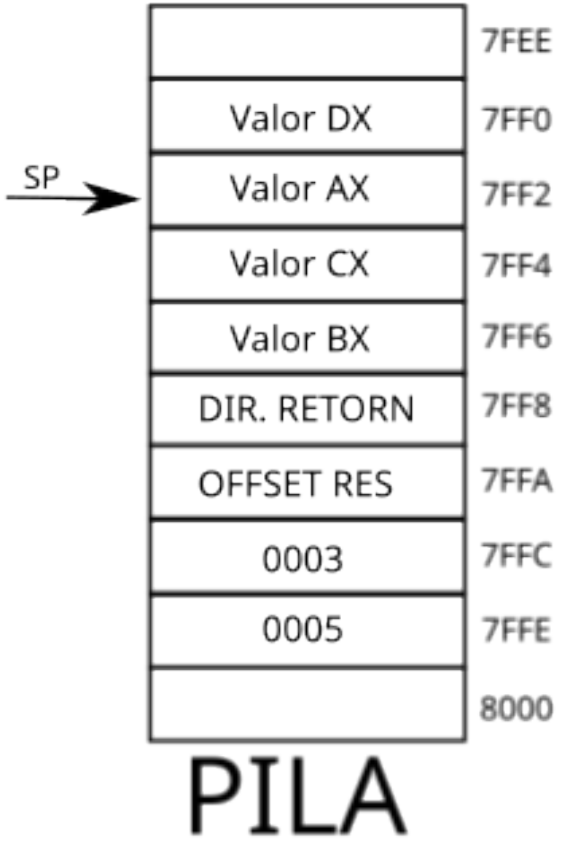
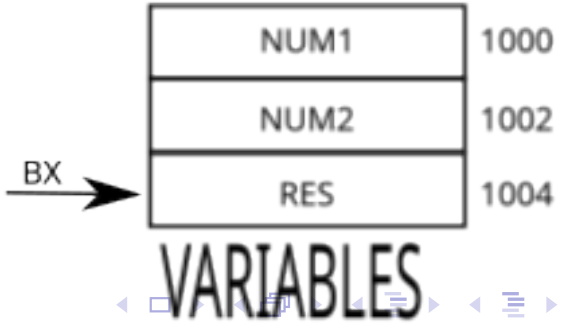




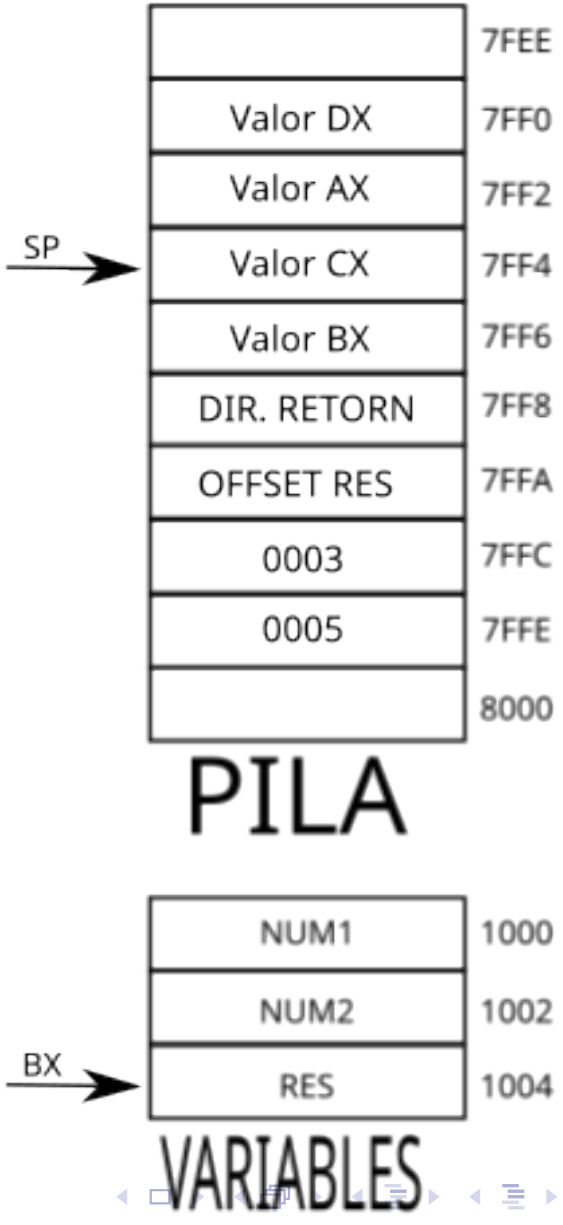
Ejercicio 7 - Pasaje de parámetros por pila

```
ORG   3000H  ; Subrutina MUL
MUL:  PUSH   BX
      PUSH   CX
      PUSH   AX
      PUSH   DX
      MOV    BX, SP
      ADD    BX, 12
      MOV    CX, [BX]
      ADD    BX, 2
      MOV    AX, [BX]
      SUB    BX, 4
      MOV    BX, [BX]
      MOV    DX, 0
SUMA: ADD    DX, AX
      DEC    CX
      JNZ    SUMA
      MOV    [BX], DX
      POP    DX
      POP    AX
      POP    CX
      POP    BX
      RET
```

```
ORG   2000H ; Programa Principal
MOV   AX, NUM1
PUSH  AX
MOV   AX, NUM2
PUSH  AX
MOV   AX, OFFSET RES
PUSH  AX
MOV   DX, 0
CALL  MUL
POP   AX
POP   AX
POP   AX
HLT
END


ORG   1000h ; Variables

NUM1 DW 5H
NUM2 DW 3H
RES  DW ?
```



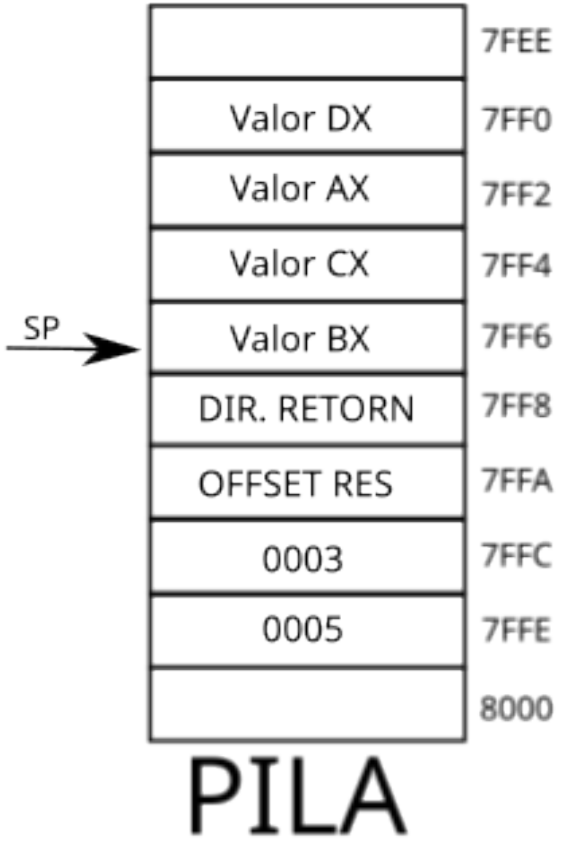
Ejercicio 7 - Pasaje de parámetros por pila

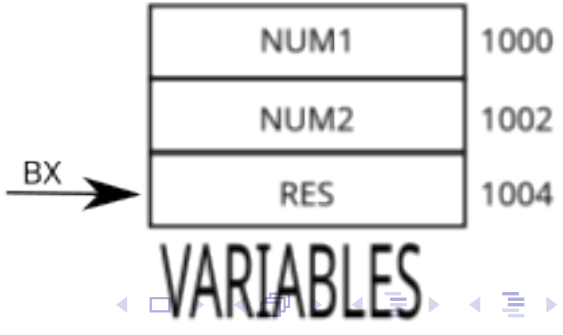
```
ORG   3000H  ; Subrutina MUL
MUL:  PUSH   BX
      PUSH   CX
      PUSH   AX
      PUSH   DX
      MOV    BX, SP
      ADD    BX, 12
      MOV    CX, [BX]
      ADD    BX, 2
      MOV    AX, [BX]
      SUB    BX, 4
      MOV    BX, [BX]
      MOV    DX, 0
SUMA: ADD    DX, AX
      DEC    CX
      JNZ    SUMA
      MOV    [BX], DX
      POP    DX
      POP    AX
      POP    CX
      POP    BX
      RET
```

```
ORG   2000H ; Programa Principal
MOV   AX, NUM1
PUSH  AX
MOV   AX, NUM2
PUSH  AX
MOV   AX, OFFSET RES
PUSH  AX
MOV   DX, 0
CALL  MUL
POP   AX
POP   AX
POP   AX
HLT
END


ORG   1000h ; Variables

NUM1 DW 5H
NUM2 DW 3H
RES  DW ?
```





Ejercicio 7 - Pasaje de parámetros por pila

```
ORG   3000H  ; Subrutina MUL
MUL:  PUSH   BX
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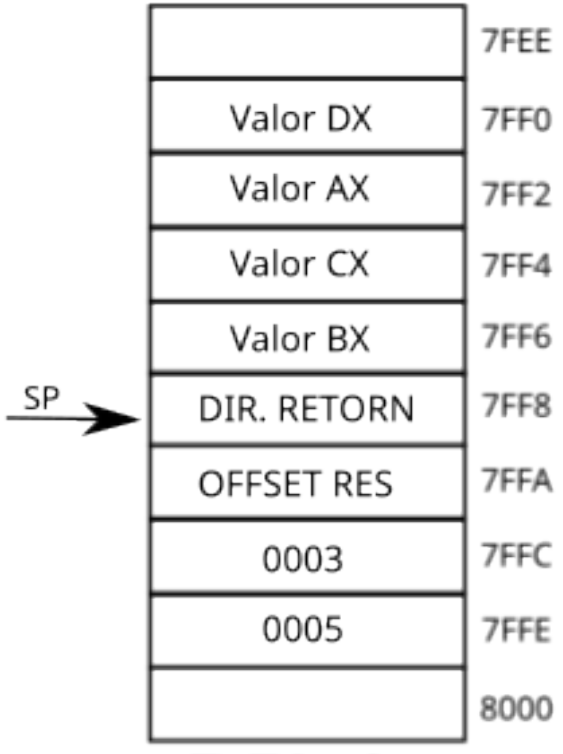
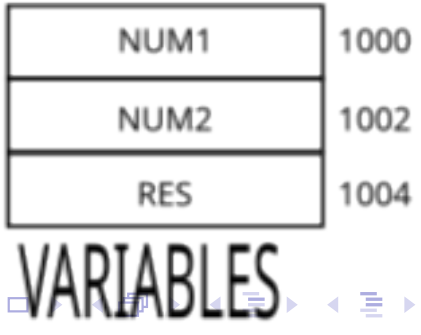
      PUSH   AX
      PUSH   DX
      MOV    BX, SP
      ADD    BX, 12
      MOV    CX, [BX]
      ADD    BX, 2
      MOV    AX, [BX]
      SUB    BX, 4
      MOV    BX, [BX]
      MOV    DX, 0
SUMA: ADD    DX, AX
      DEC    CX
      JNZ    SUMA
      MOV    [BX], DX
      POP    DX
      POP    AX
      POP    CX
      POP    BX
      RET
```

```
ORG   2000H ; Programa Principal
MOV   AX, NUM1
PUSH  AX
MOV   AX, NUM2
PUSH  AX
MOV   AX, OFFSET RES
PUSH  AX
MOV   DX, 0
CALL  MUL
POP   AX
POP   AX
POP   AX
HLT
END


ORG   1000h ; Variables

NUM1 DW 5H
NUM2 DW 3H
RES  DW ?
```





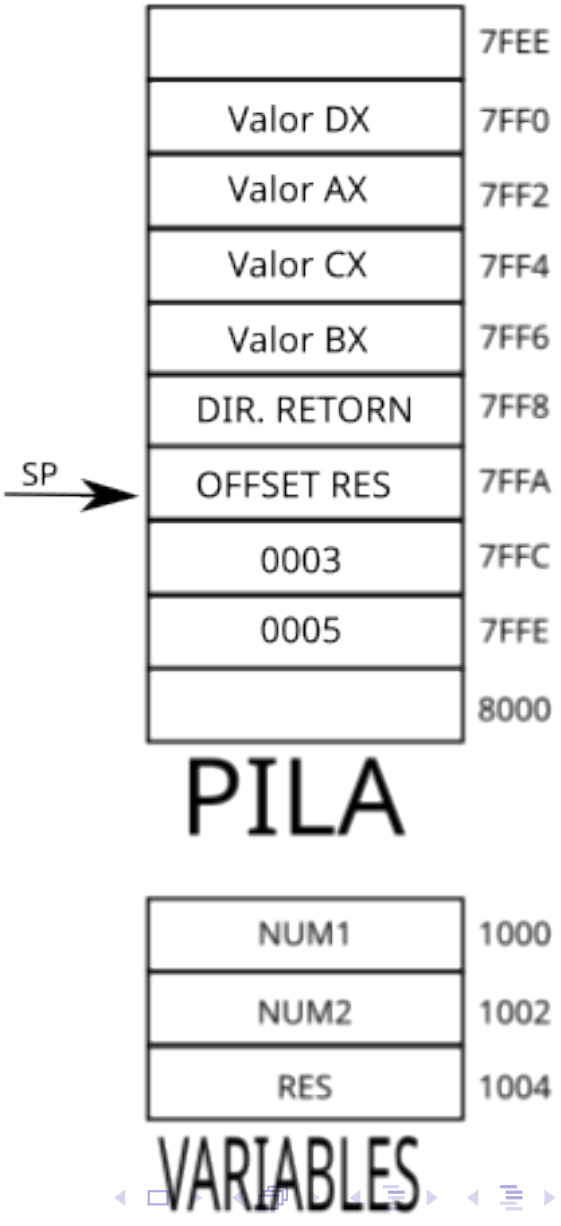
Ejercicio 7 - Pasaje de parámetros por pila

```
ORG   3000H  ; Subrutina MUL
MUL:  PUSH   BX
      PUSH   CX
      PUSH   AX
      PUSH   DX
      MOV    BX, SP
      ADD    BX, 12
      MOV    CX, [BX]
      ADD    BX, 2
      MOV    AX, [BX]
      SUB    BX, 4
      MOV    BX, [BX]
      MOV    DX, 0
SUMA: ADD    DX, AX
      DEC    CX
      JNZ    SUMA
      MOV    [BX], DX
      POP    DX
      POP    AX
      POP    CX
      POP    BX
      RET
```

```
ORG   2000H ; Programa Principal
MOV   AX, NUM1
PUSH  AX
MOV   AX, NUM2
PUSH  AX
MOV   AX, OFFSET RES
PUSH  AX
MOV   DX, 0
CALL  MUL
POP   AX
POP   AX
POP   AX
HLT
END
```

```
ORG   1000h ; Variables

NUM1 DW 5H
NUM2 DW 3H
RES  DW ?
```



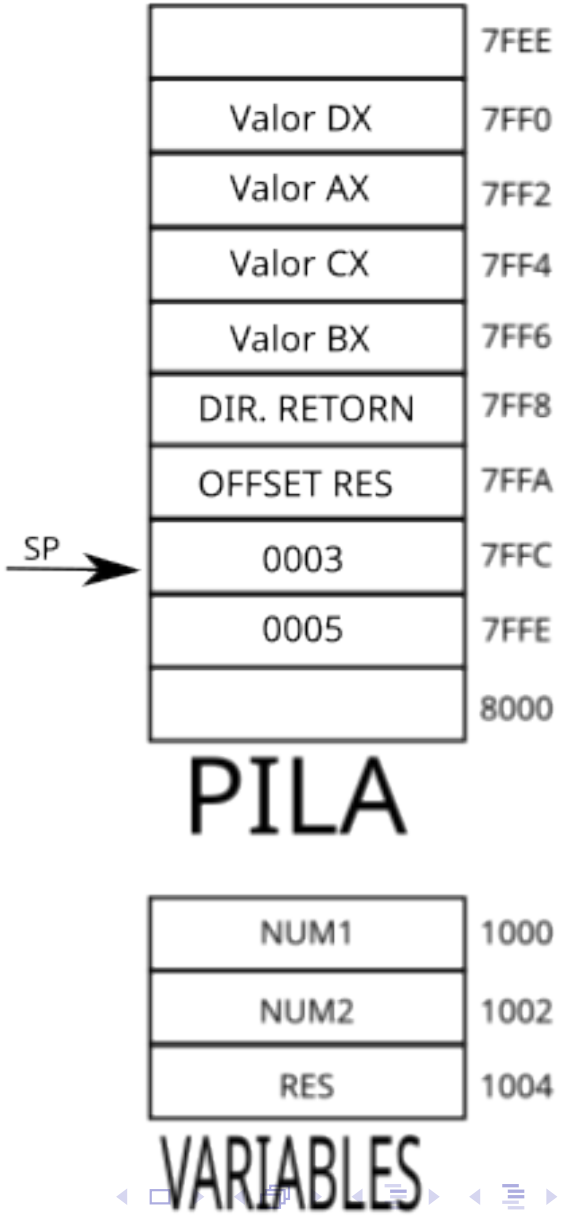
Ejercicio 7 - Pasaje de parámetros por pila

```
ORG   3000H  ; Subrutina MUL
MUL:  PUSH   BX
      PUSH   CX
      PUSH   AX
      PUSH   DX
      MOV    BX, SP
      ADD    BX, 12
      MOV    CX, [BX]
      ADD    BX, 2
      MOV    AX, [BX]
      SUB    BX, 4
      MOV    BX, [BX]
      MOV    DX, 0
SUMA: ADD    DX, AX
      DEC    CX
      JNZ    SUMA
      MOV    [BX], DX
      POP    DX
      POP    AX
      POP    CX
      POP    BX
      RET
```

```
ORG   2000H ; Programa Principal
MOV   AX, NUM1
PUSH  AX
MOV   AX, NUM2
PUSH  AX
MOV   AX, OFFSET RES
PUSH  AX
MOV   DX, 0
CALL  MUL
POP   AX
POP   AX
POP   AX
HLT
END


ORG   1000h ; Variables

NUM1 DW 5H
NUM2 DW 3H
RES  DW ?
```



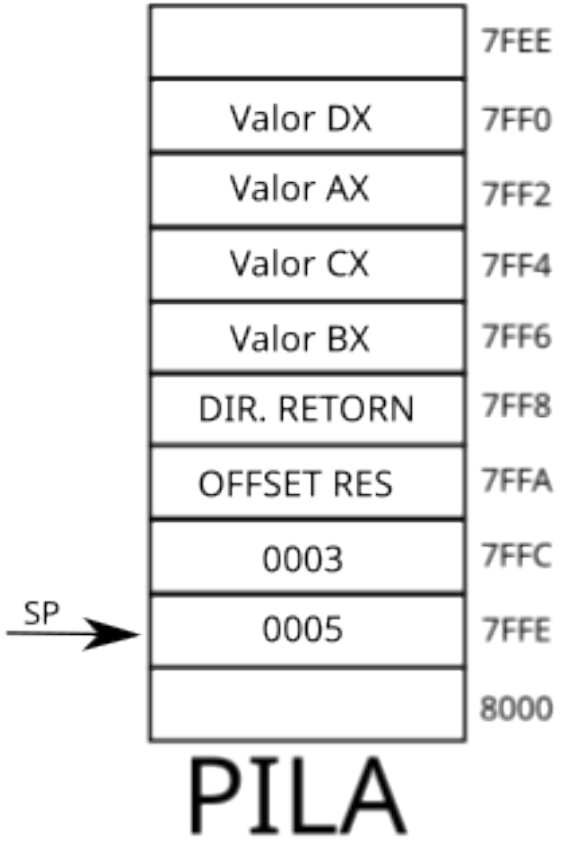
Ejercicio 7 - Pasaje de parámetros por pila

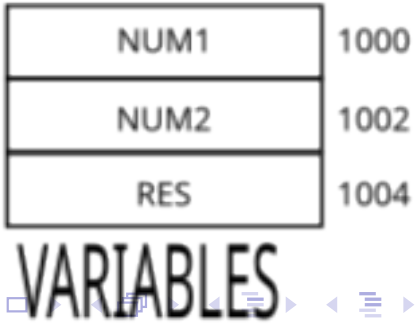
```
ORG   3000H  ; Subrutina MUL
MUL:  PUSH   BX
      PUSH   CX
      PUSH   AX
      PUSH   DX
      MOV    BX, SP
      ADD    BX, 12
      MOV    CX, [BX]
      ADD    BX, 2
      MOV    AX, [BX]
      SUB    BX, 4
      MOV    BX, [BX]
      MOV    DX, 0
SUMA: ADD    DX, AX
      DEC    CX
      JNZ    SUMA
      MOV    [BX], DX
      POP    DX
      POP    AX
      POP    CX
      POP    BX
      RET
```

```
ORG   2000H ; Programa Principal
MOV   AX, NUM1
PUSH  AX
MOV   AX, NUM2
PUSH  AX
MOV   AX, OFFSET RES
PUSH  AX
MOV   DX, 0
CALL  MUL
POP   AX
POP   AX
POP   AX
HLT
END


ORG   1000h ; Variables

NUM1 DW 5H
NUM2 DW 3H
RES  DW ?
```





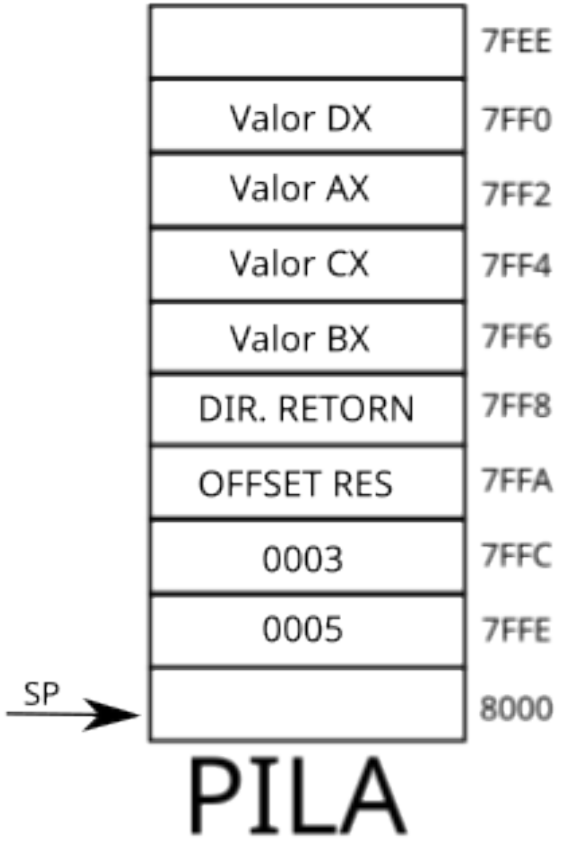
Ejercicio 7 - Pasaje de parámetros por pila

```
ORG   3000H  ; Subrutina MUL
MUL:  PUSH   BX
      PUSH   CX
      PUSH   AX
      PUSH   DX
      MOV    BX, SP
      ADD    BX, 12
      MOV    CX, [BX]
      ADD    BX, 2
      MOV    AX, [BX]
      SUB    BX, 4
      MOV    BX, [BX]
      MOV    DX, 0
SUMA: ADD    DX, AX
      DEC    CX
      JNZ    SUMA
      MOV    [BX], DX
      POP    DX
      POP    AX
      POP    CX
      POP    BX
      RET
```

```
ORG   2000H ; Programa Principal
MOV   AX, NUM1
PUSH  AX
MOV   AX, NUM2
PUSH  AX
MOV   AX, OFFSET RES
PUSH  AX
MOV   DX, 0
CALL  MUL
POP   AX
POP   AX
POP   AX
HLT
END


ORG   1000h ; Variables

NUM1 DW 5H
NUM2 DW 3H
RES  DW ?
```



Ejercicio 10 - SWAP (intercambio)

- Escribir una subrutina SWAP que intercambie dos datos de 16 bits almacenados en memoria.
- Los parámetros deben ser pasados por referencia desde el programa principal a través de la pila.

Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

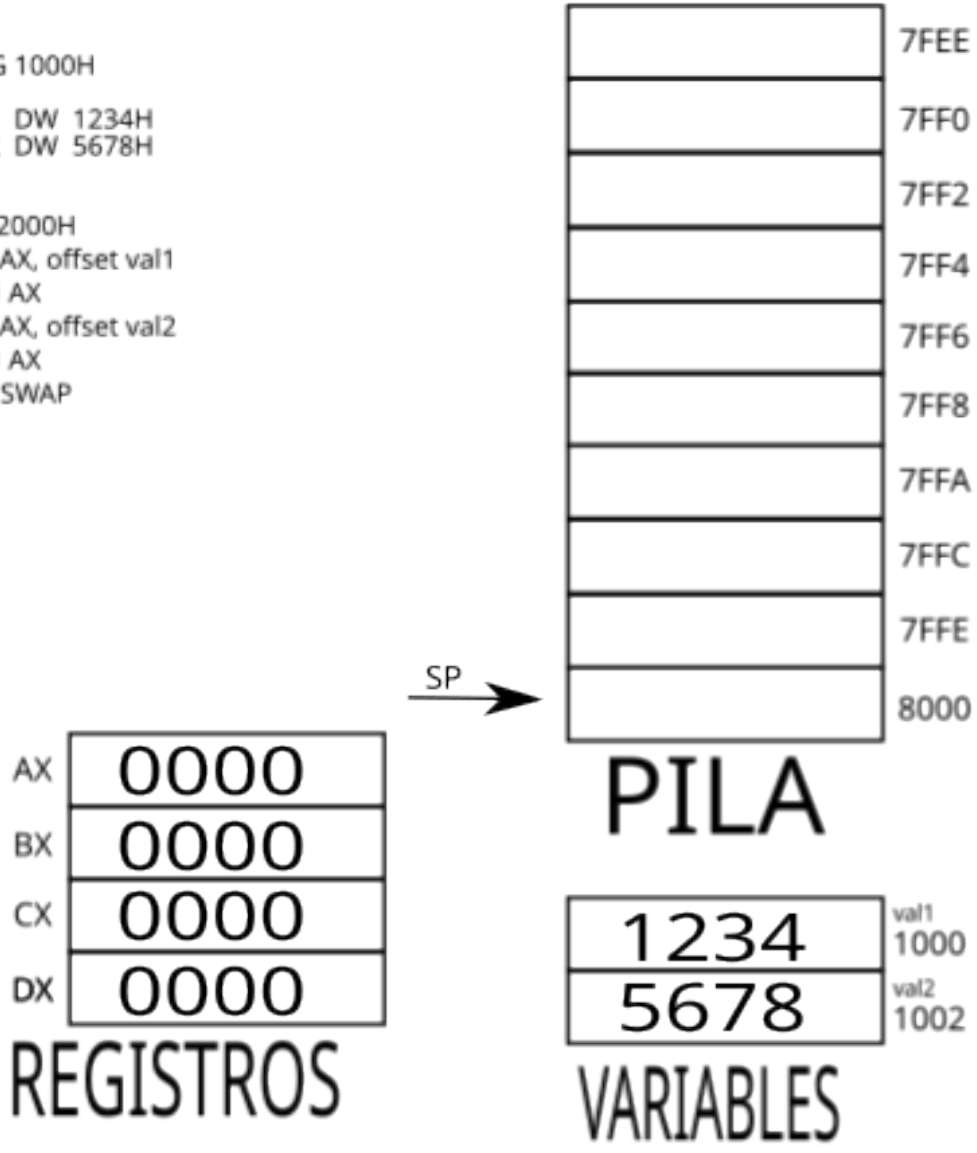
      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```



Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

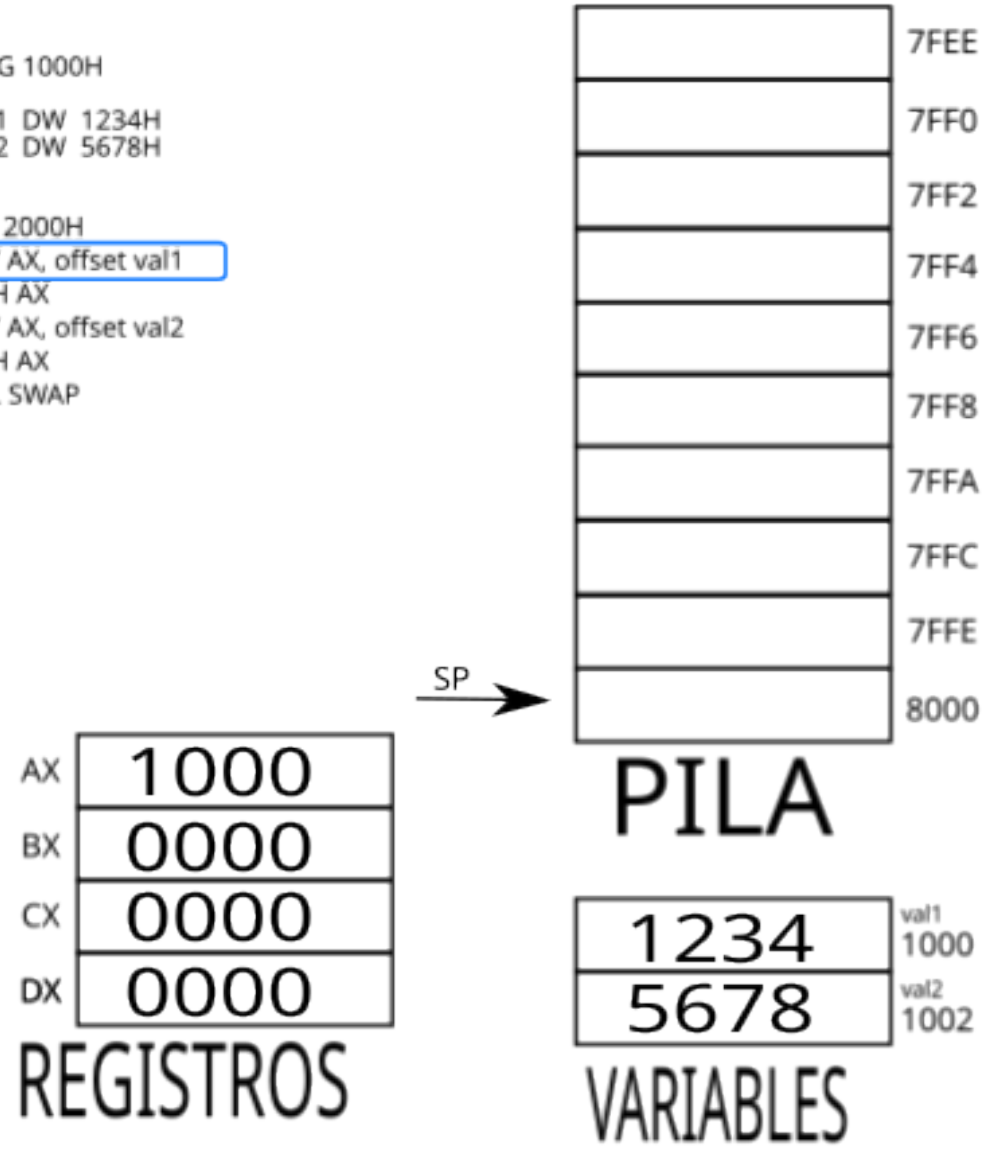
      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```



Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

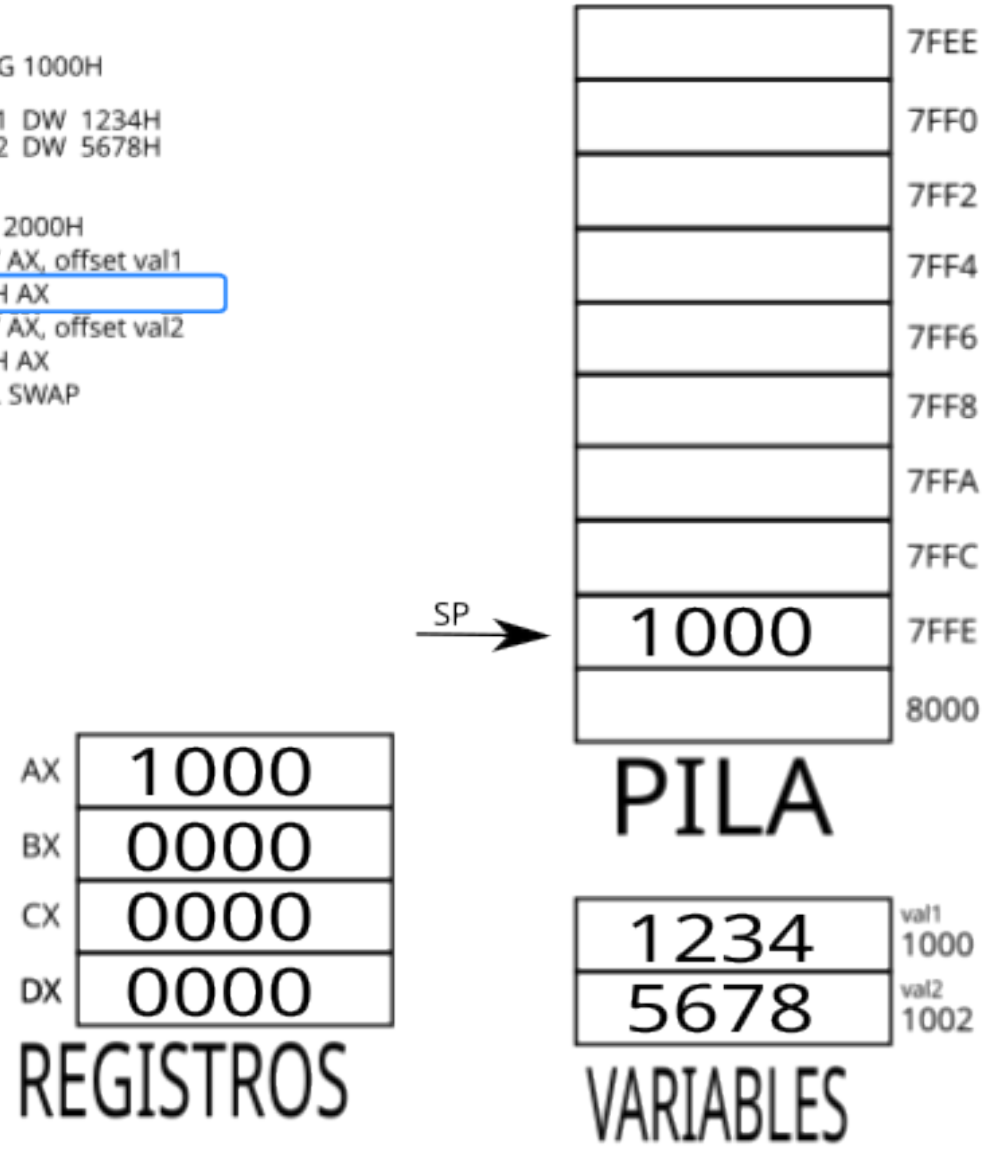
      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```



Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

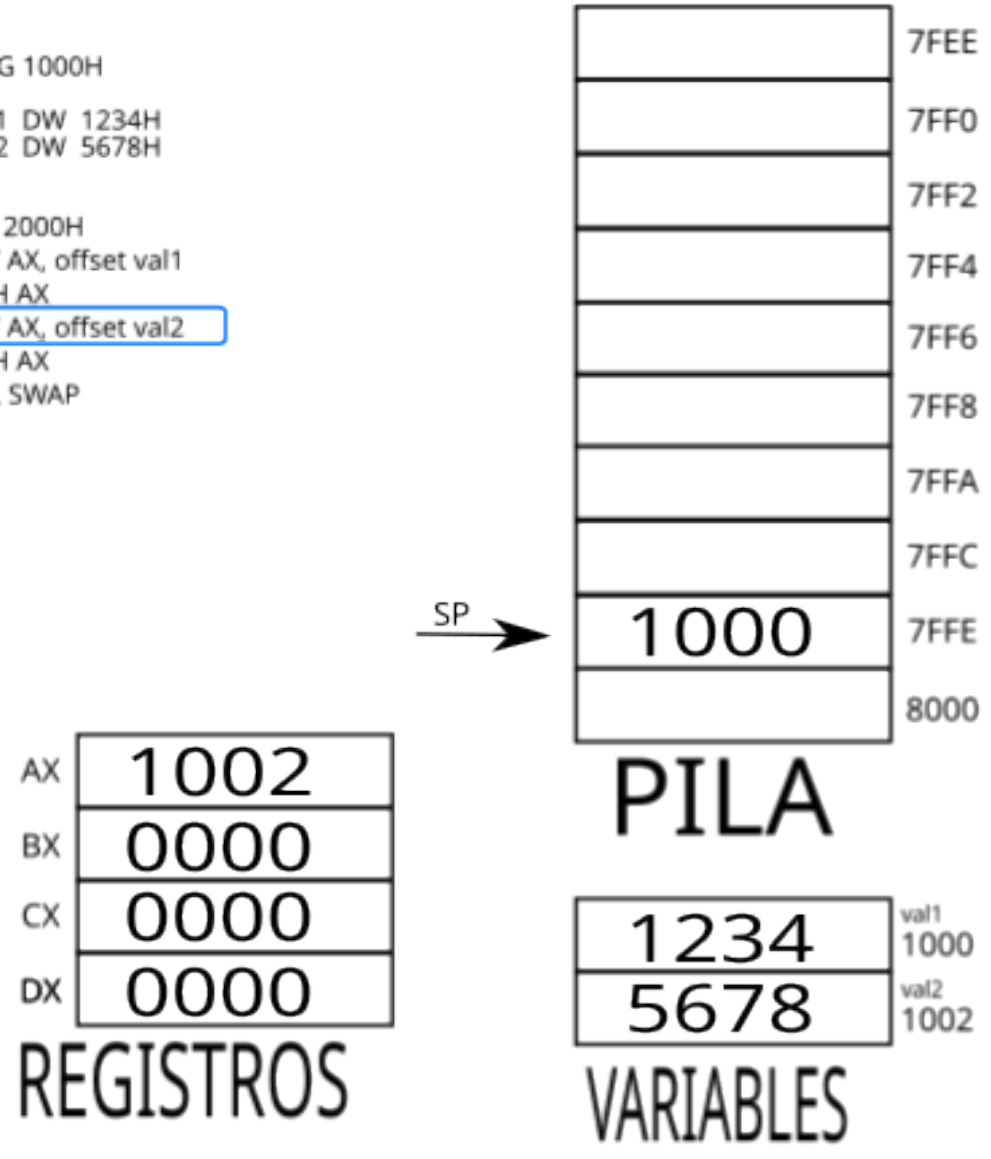
      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```



Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

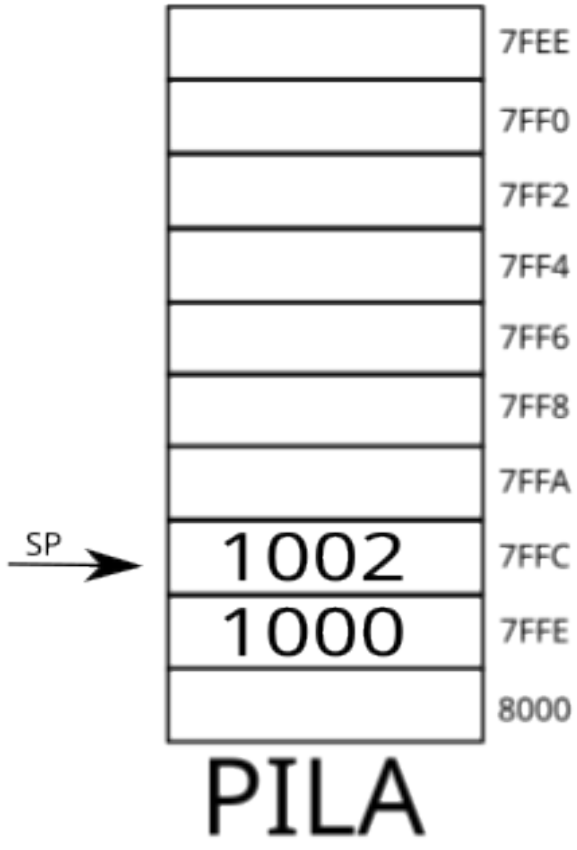
      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

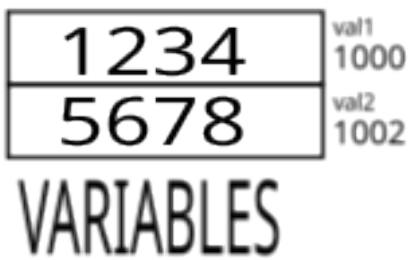
      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```





Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
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      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```

AX	1002
BX	0000
CX	0000
DX	0000

REGISTROS

	7FEE
	7FF0
	7FF2
	7FF4
	7FF6
	7FF8
SP → DIR. RETORNO	7FFA
1002	7FFC
1000	7FFE
	8000

PILA

1234	val1 1000
5678	val2 1002

VARIABLES

Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1 DW 1234H
val2 DW 5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```

AX	1002
BX	0000
CX	0000
DX	0000

REGISTROS

SP →

	7FEE
	7FF0
	7FF2
	7FF4
	7FF6
0000	7FF8
DIR. RETORNO	7FFA
1002	7FFC
1000	7FFE
	8000

PILA

1234	val1 1000
5678	val2 1002

VARIABLES

Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

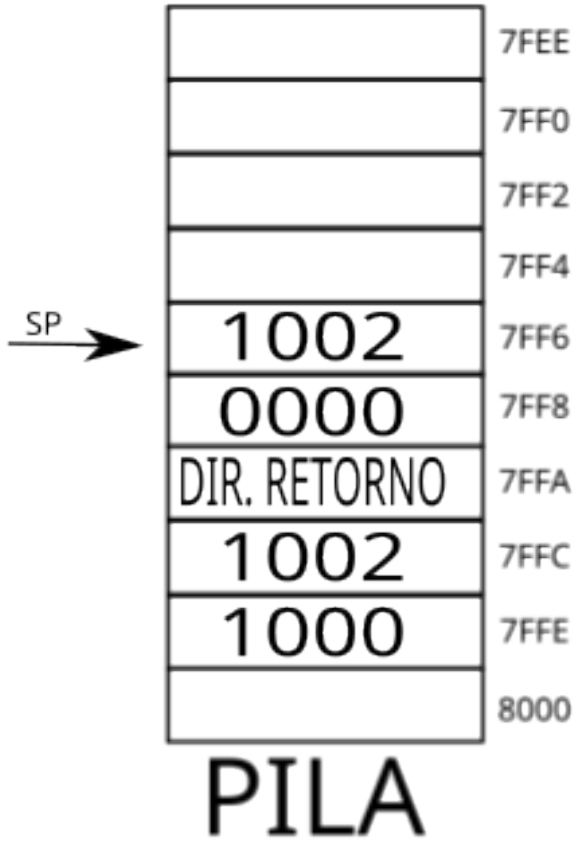
      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

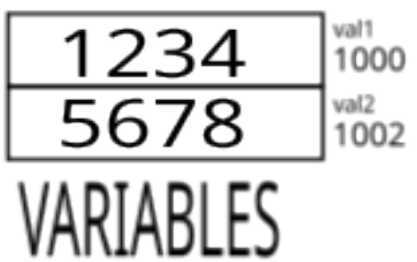
      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```





Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
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      ADD BX, 8
      MOV BX, [BX]
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      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

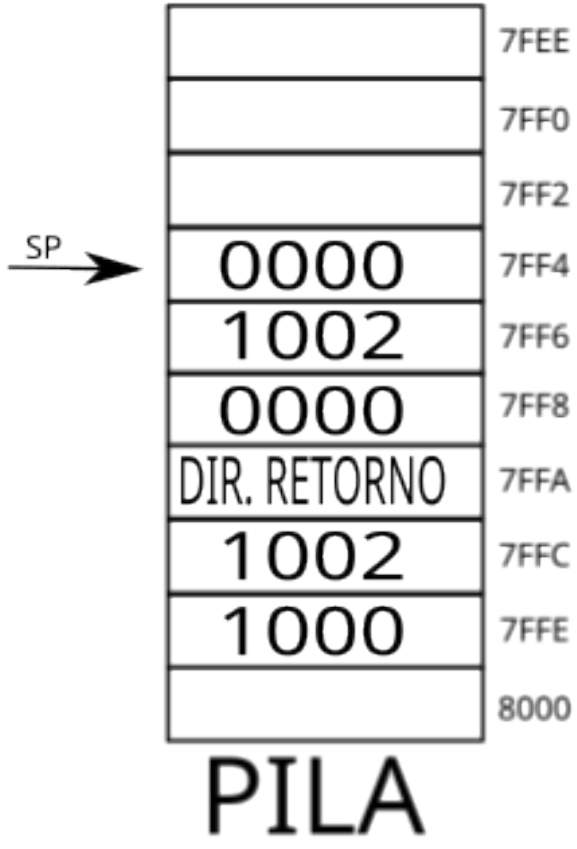
      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```



AX	1002
BX	0000
CX	0000
DX	0000

REGISTROS

1234	val1 1000
5678	val2 1002

VARIABLES

Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
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      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

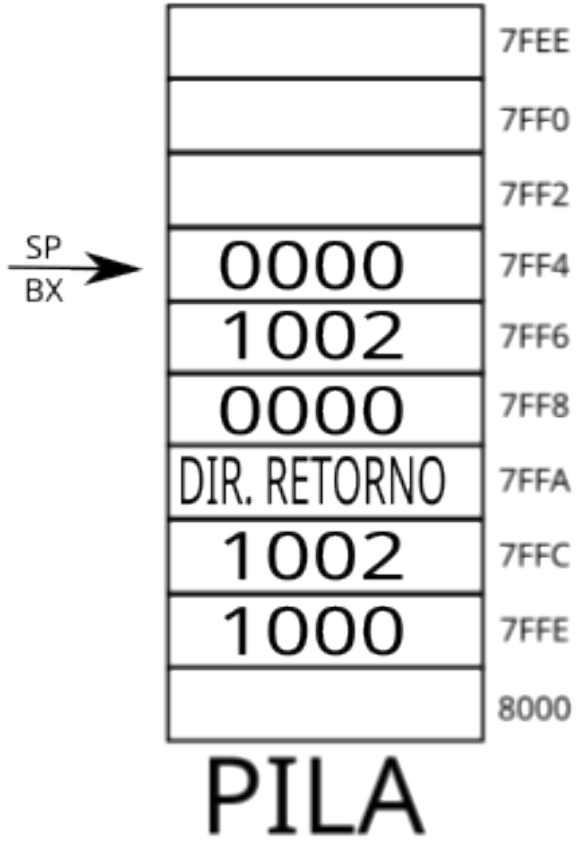
      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

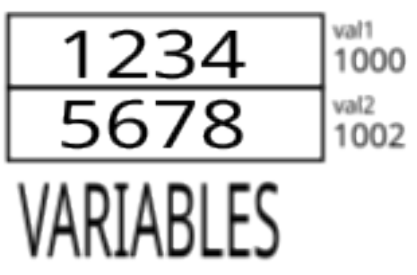
      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```





Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
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ORG 1000H

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ORG 2000H
MOV AX, offset val1
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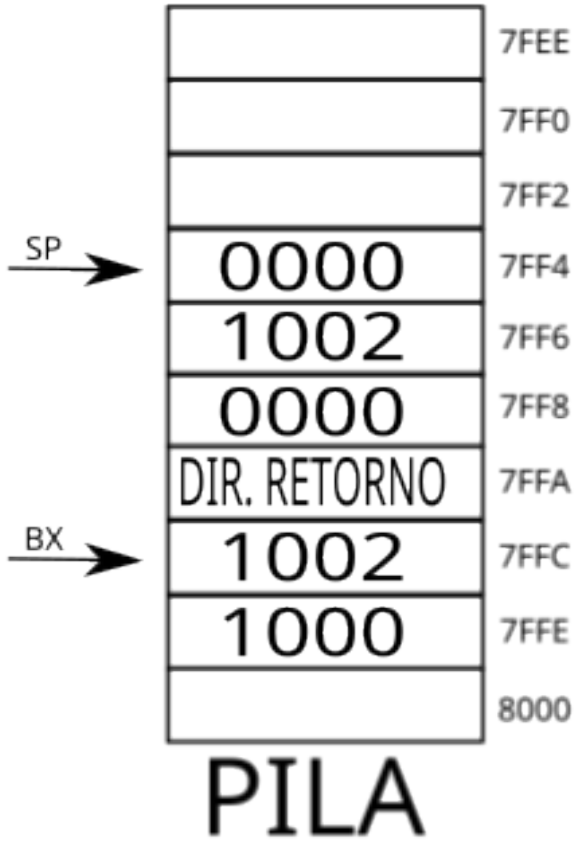
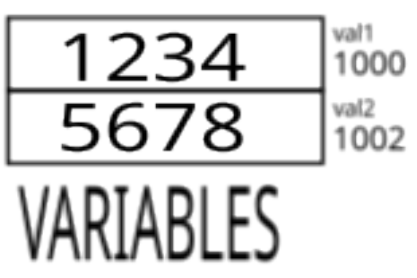
HLT
```





Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
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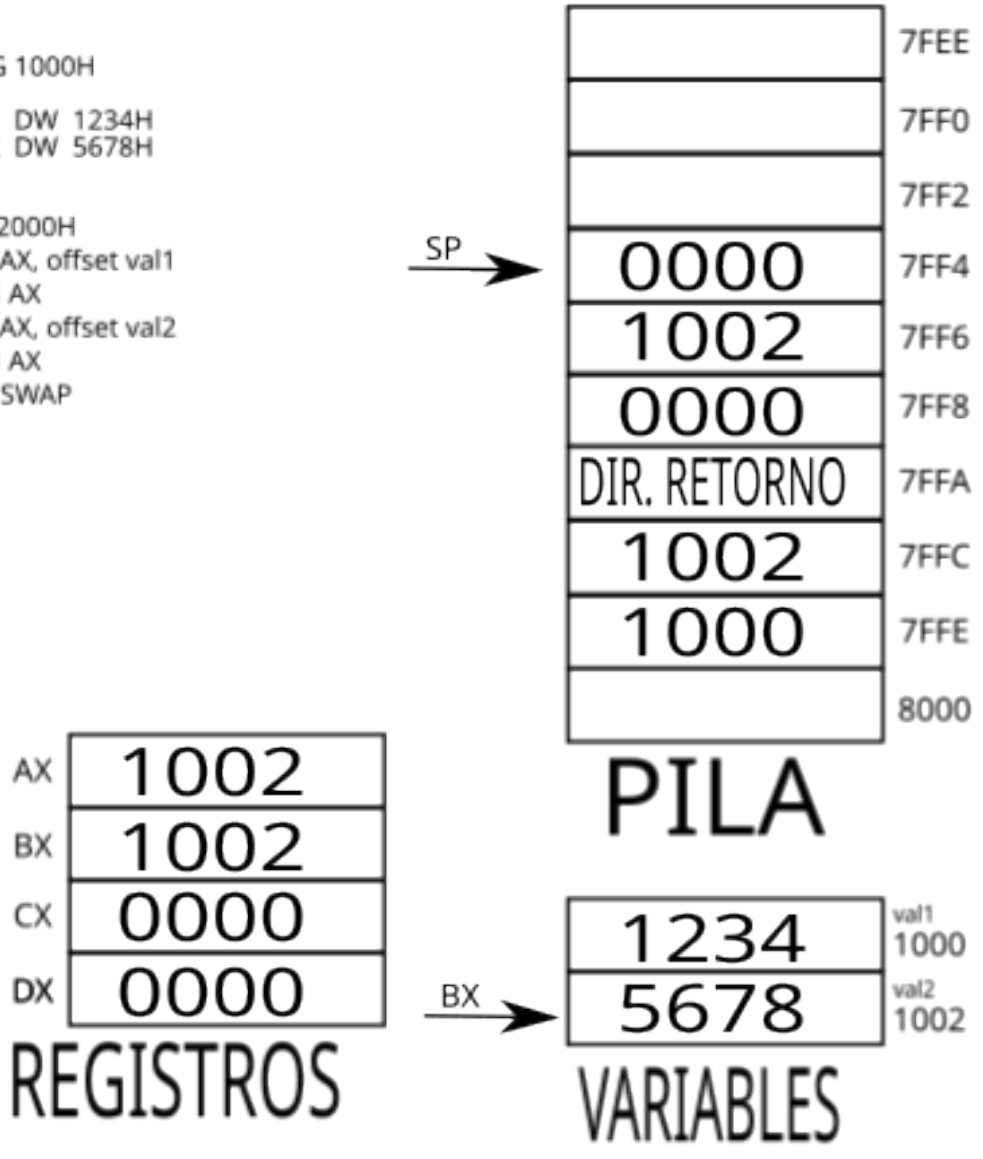

Ejercicio 10 - SWAP

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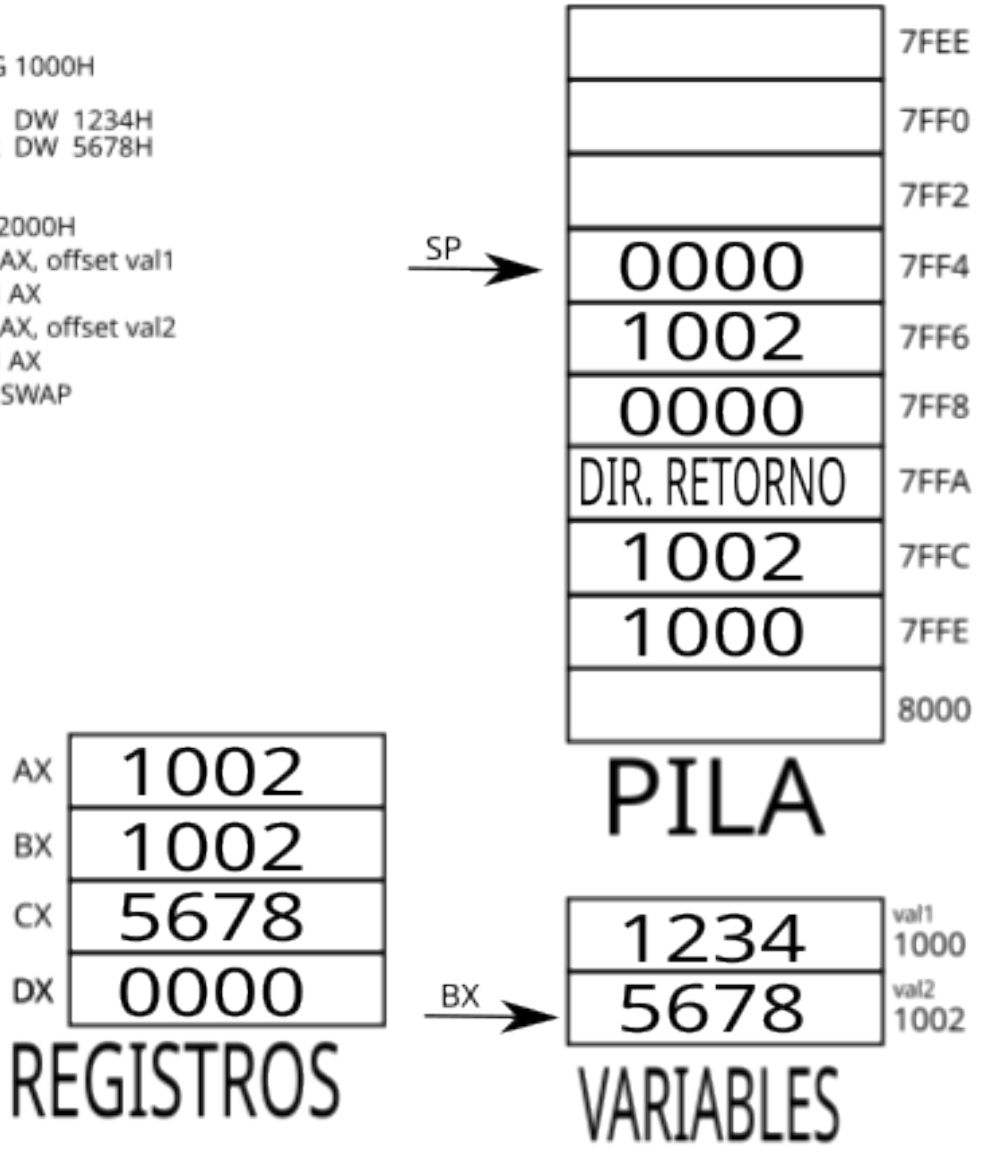

Ejercicio 10 - SWAP

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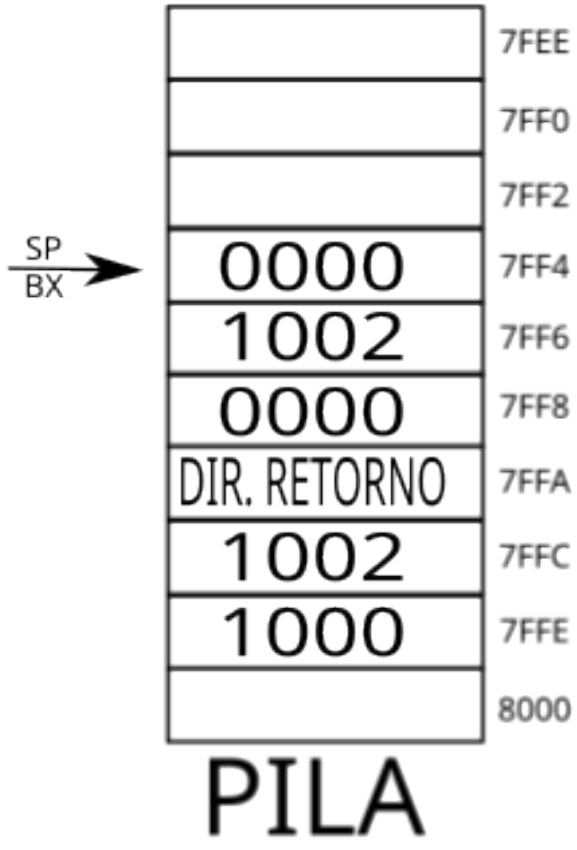

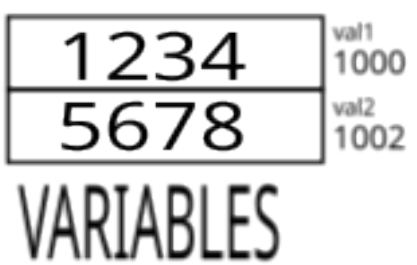

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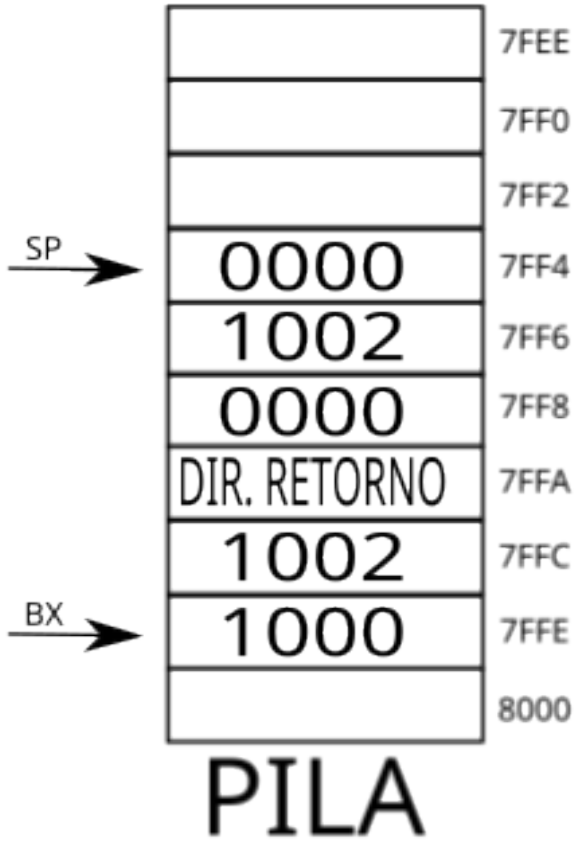

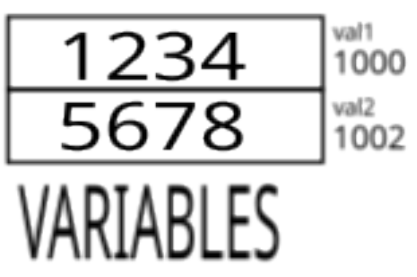

Ejercicio 10 - SWAP

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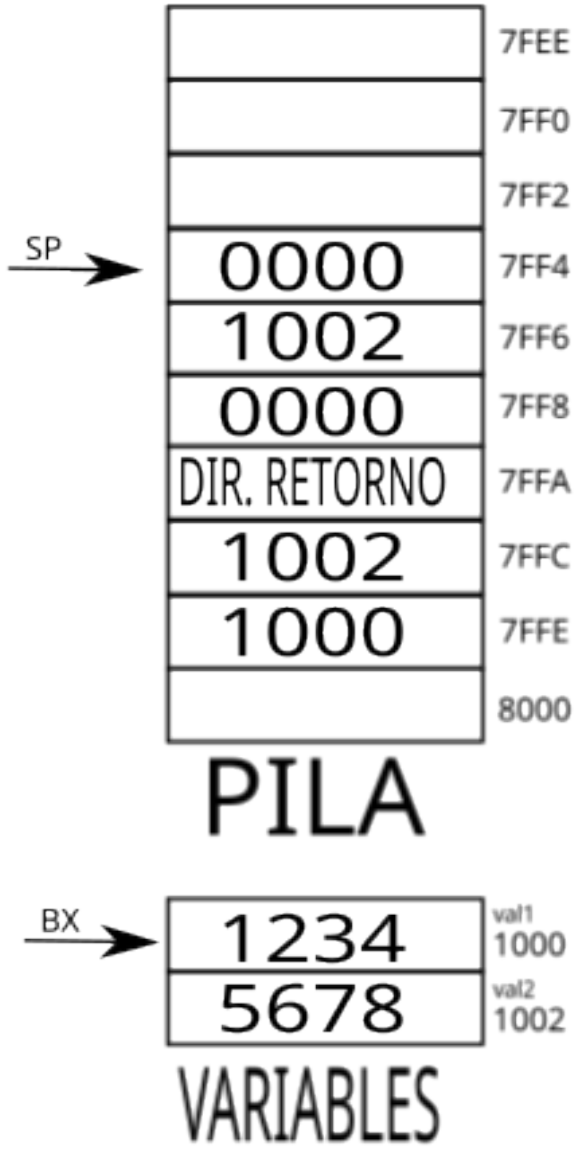

Ejercicio 10 - SWAP

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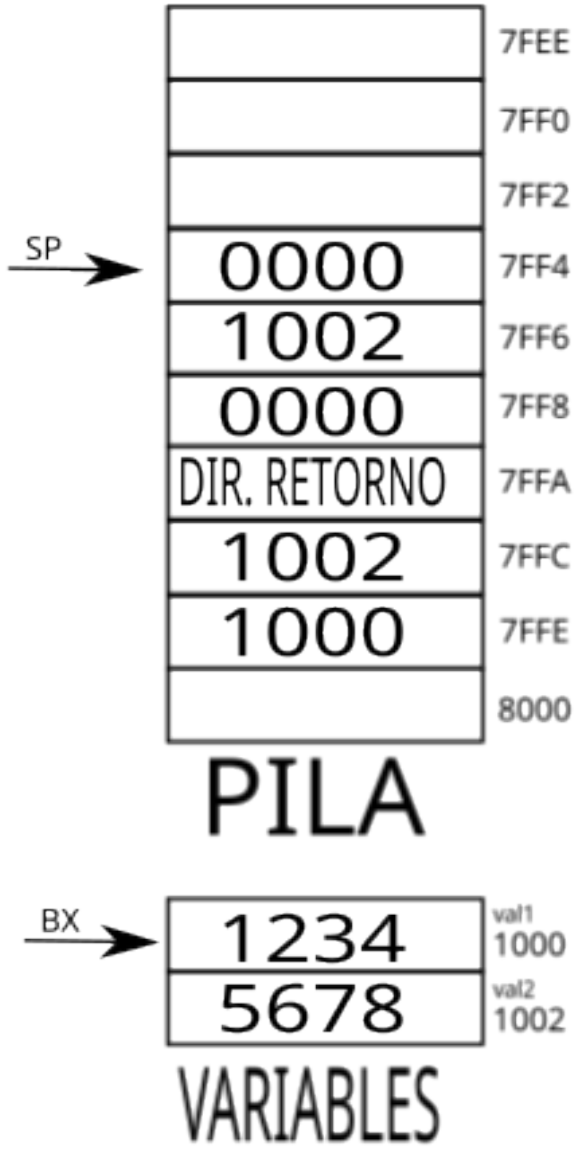

Ejercicio 10 - SWAP

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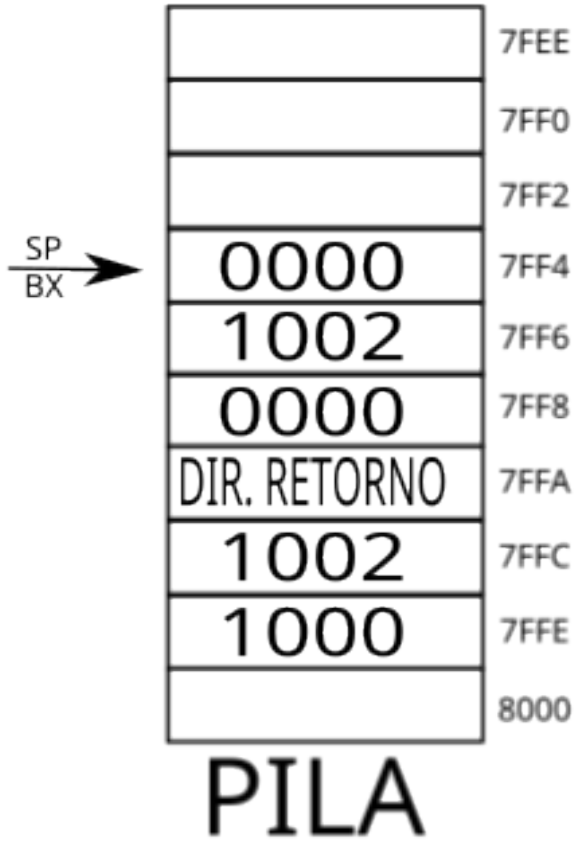

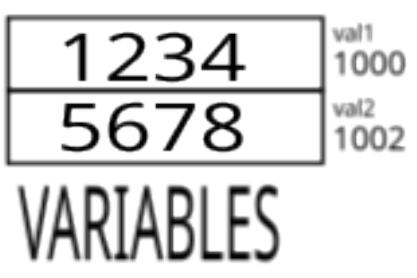

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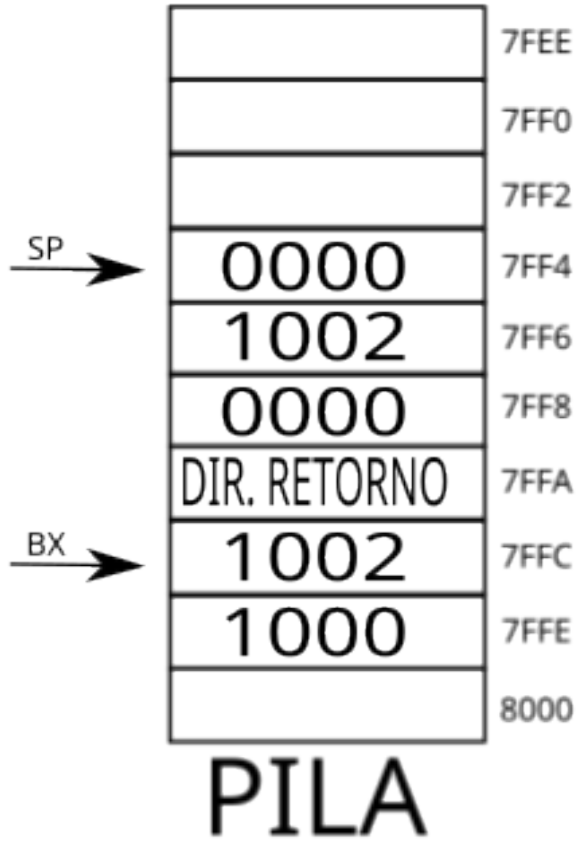

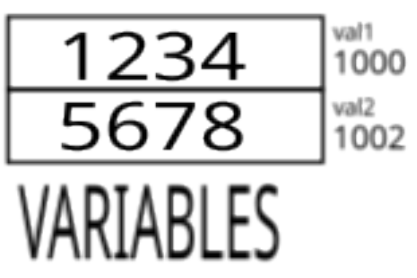

Ejercicio 10 - SWAP

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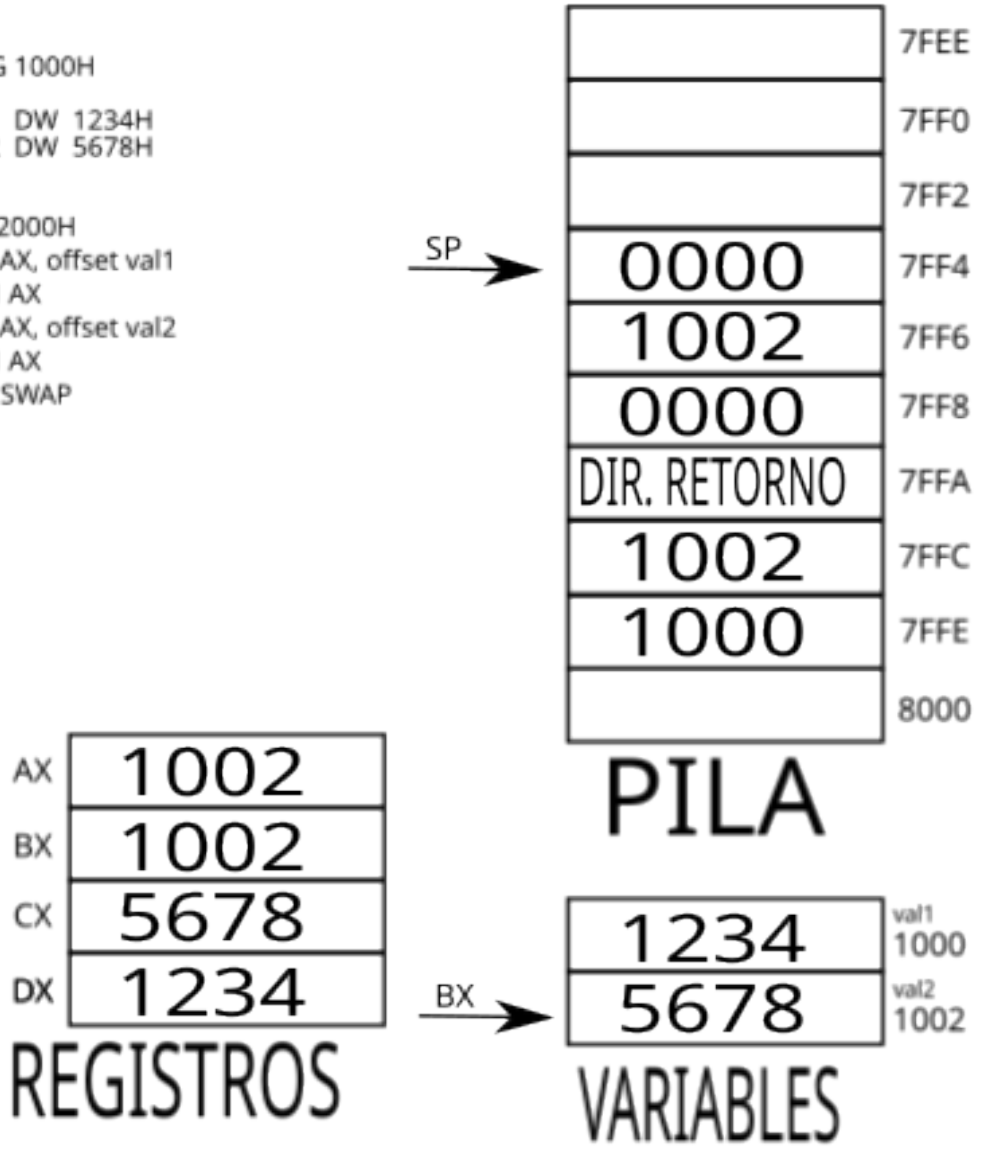

Ejercicio 10 - SWAP

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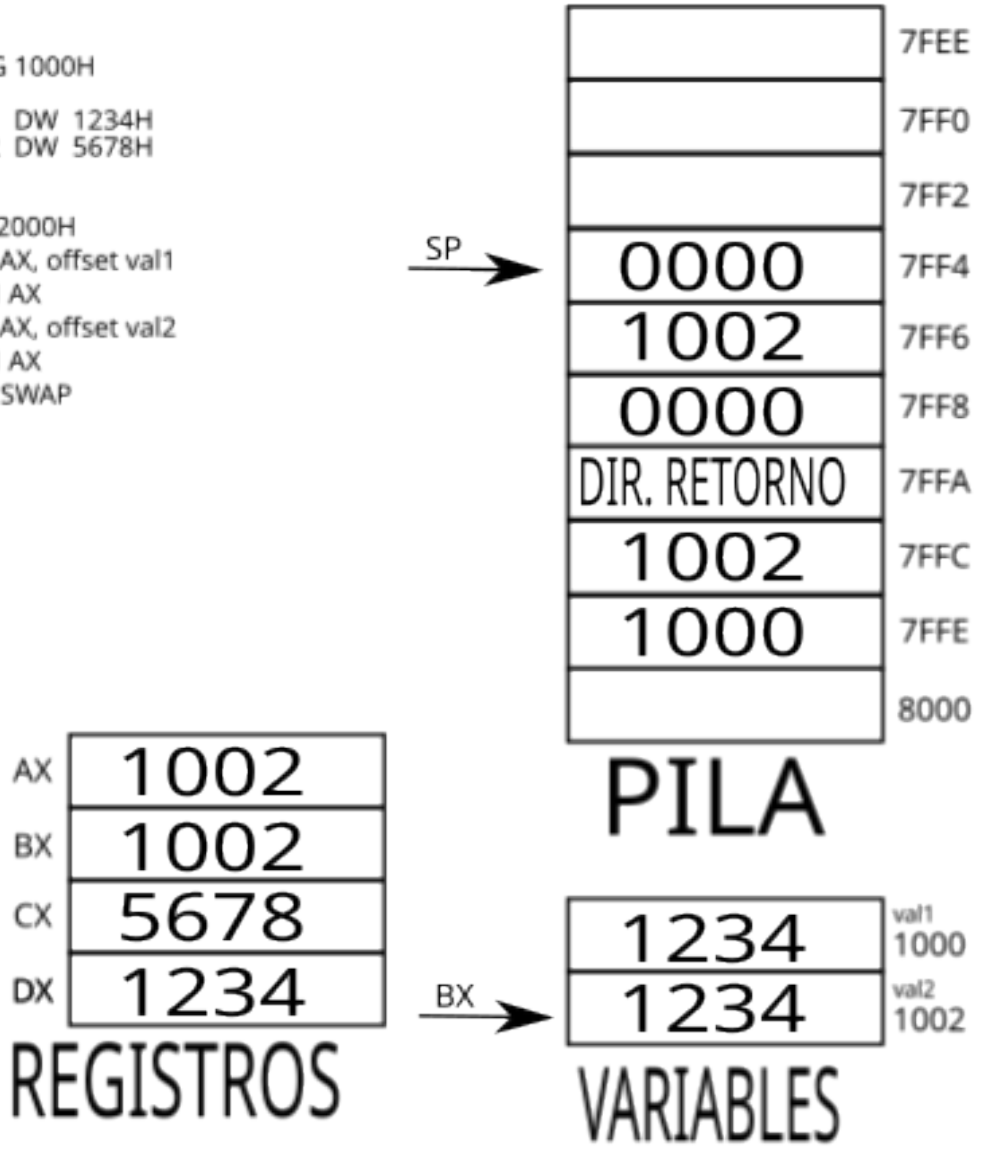

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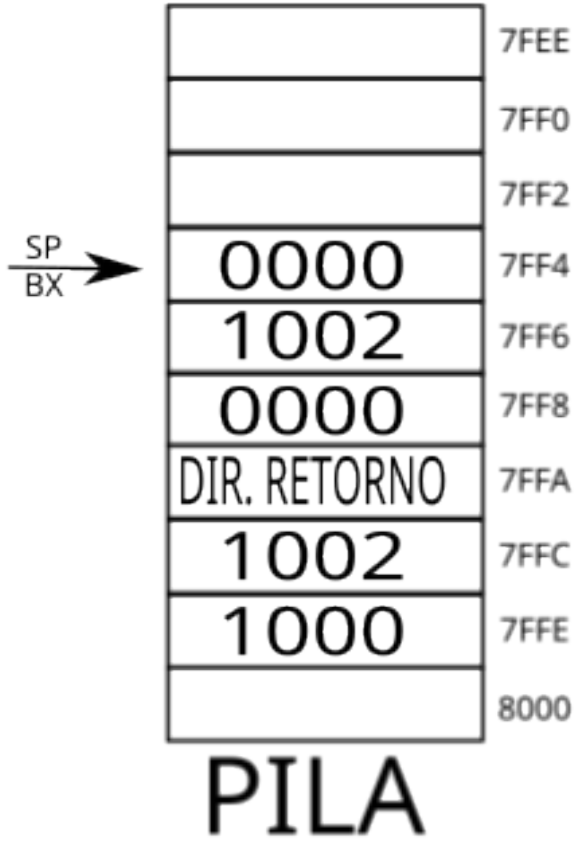

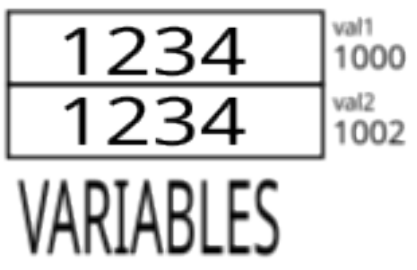

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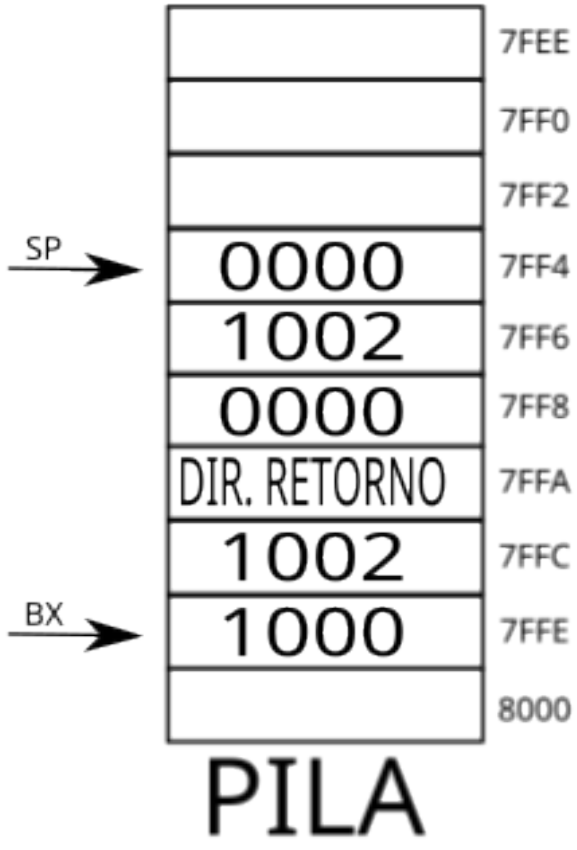

AX	1002
BX	7FFE
CX	5678
DX	1234

REGISTROS

1234	val1 1000
1234	val2 1002

VARIABLES

Ejercicio 10 - SWAP

```
ORG 3000H
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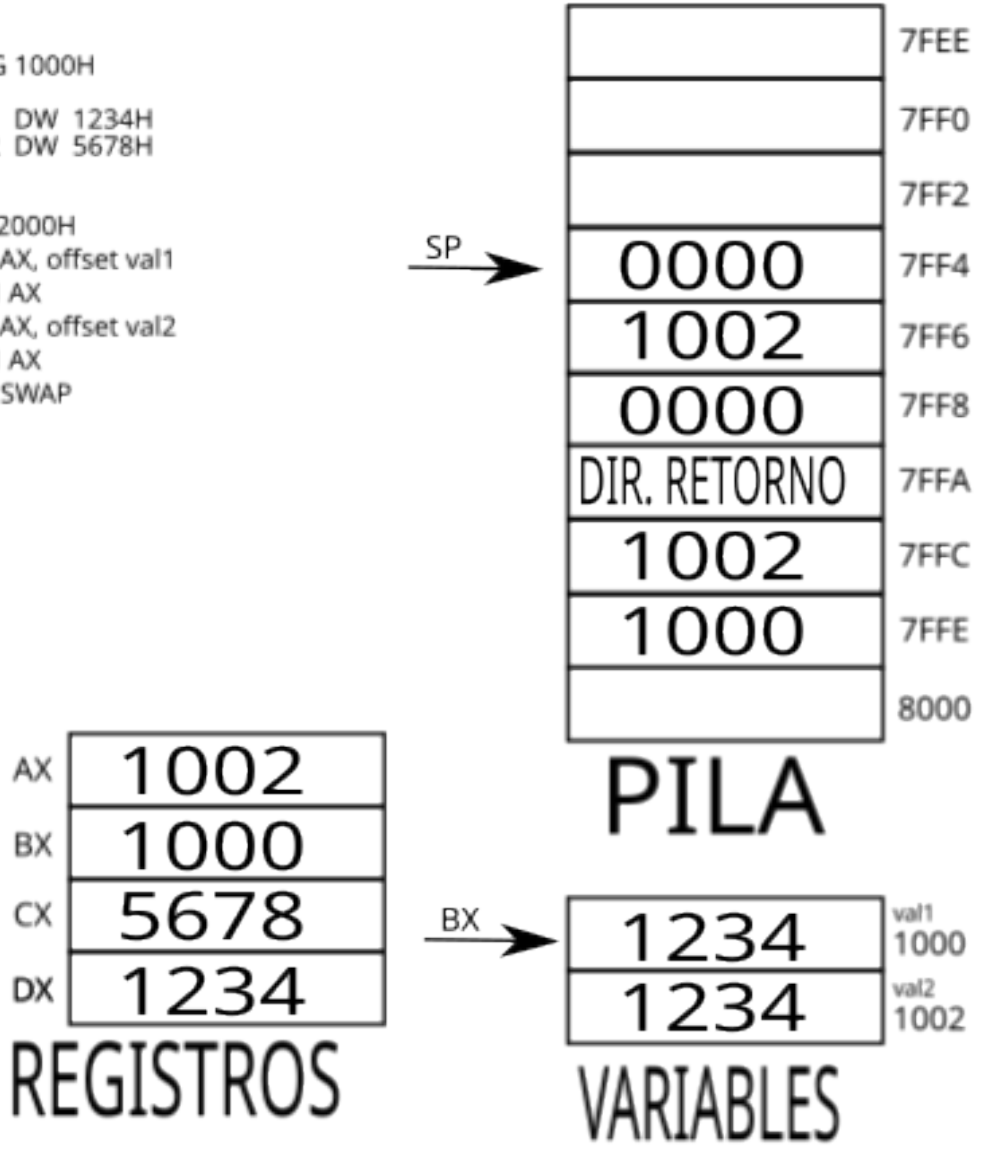

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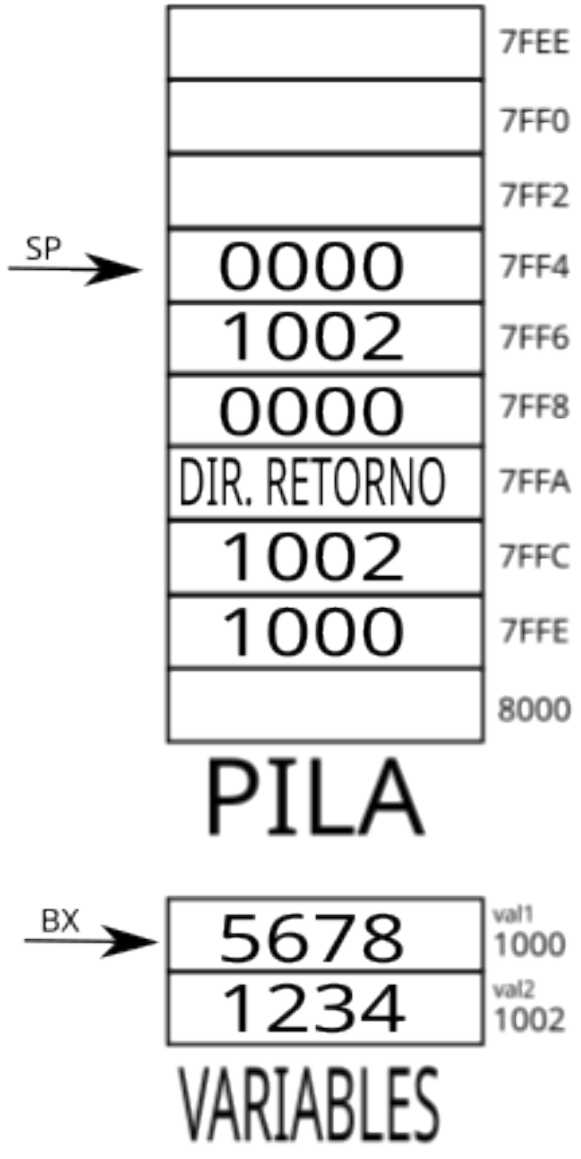

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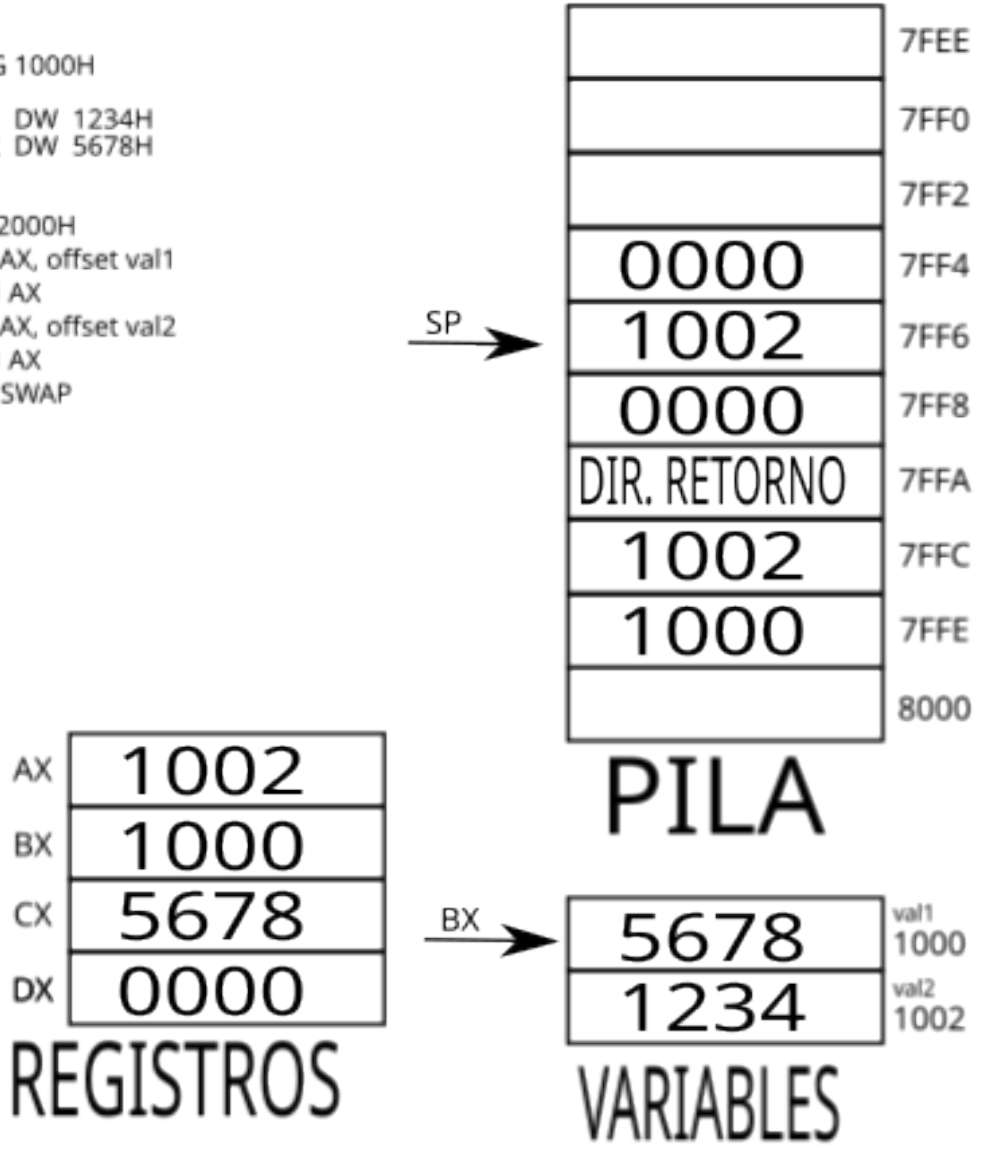

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HLT
```
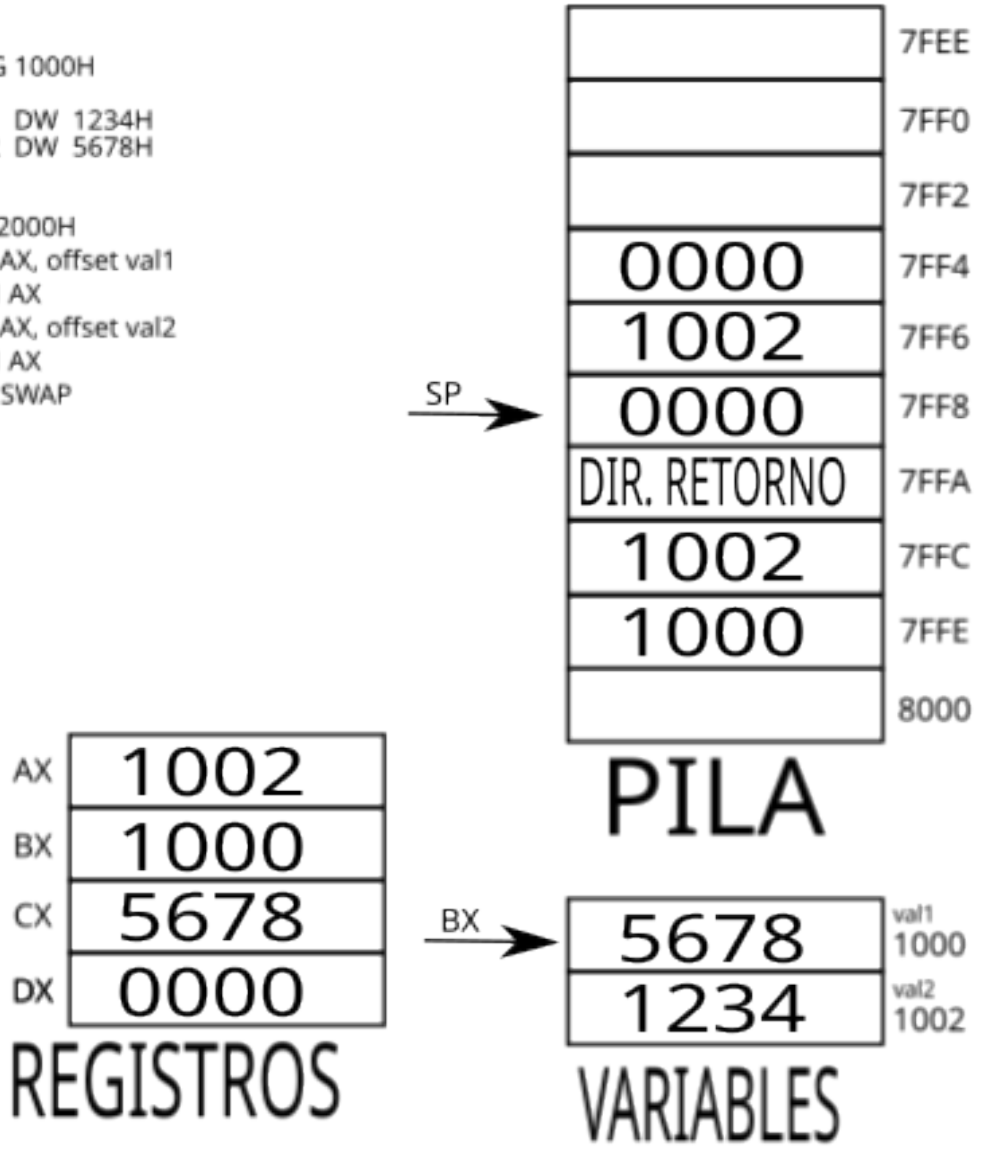
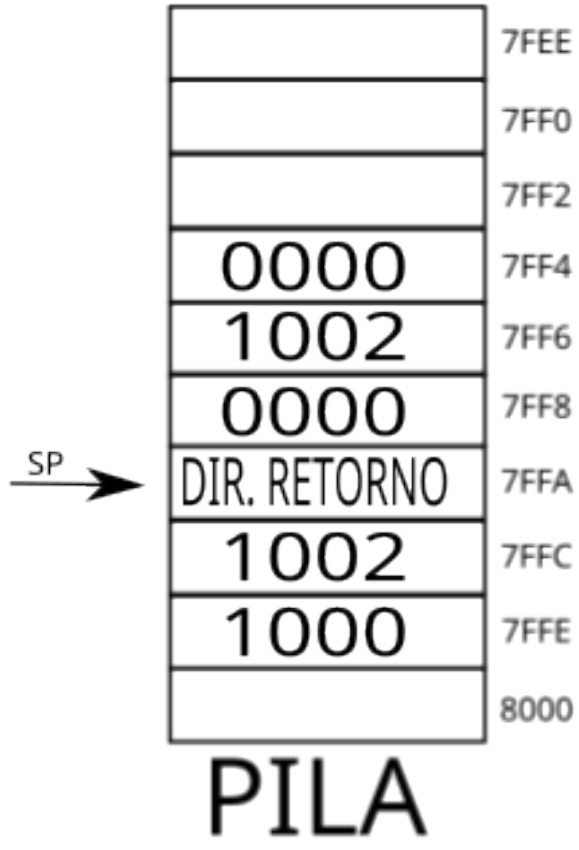



Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```



AX	1002
BX	0000
CX	5678
DX	0000

REGISTROS

5678	val1 1000
1234	val2 1002

VARIABLES

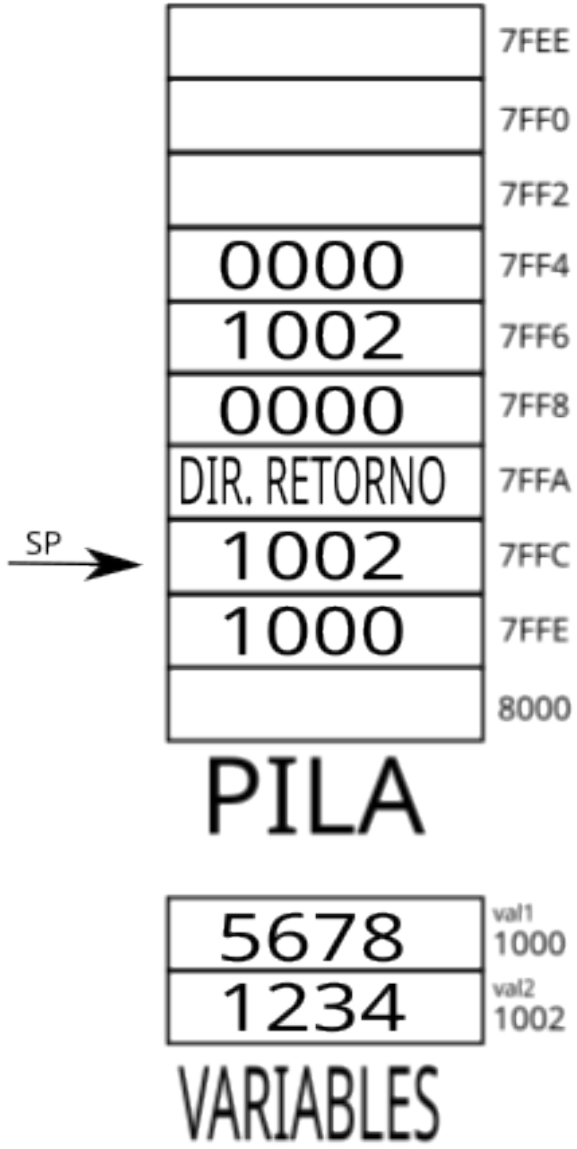
Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```

AX	1002
BX	0000
CX	5678
DX	0000

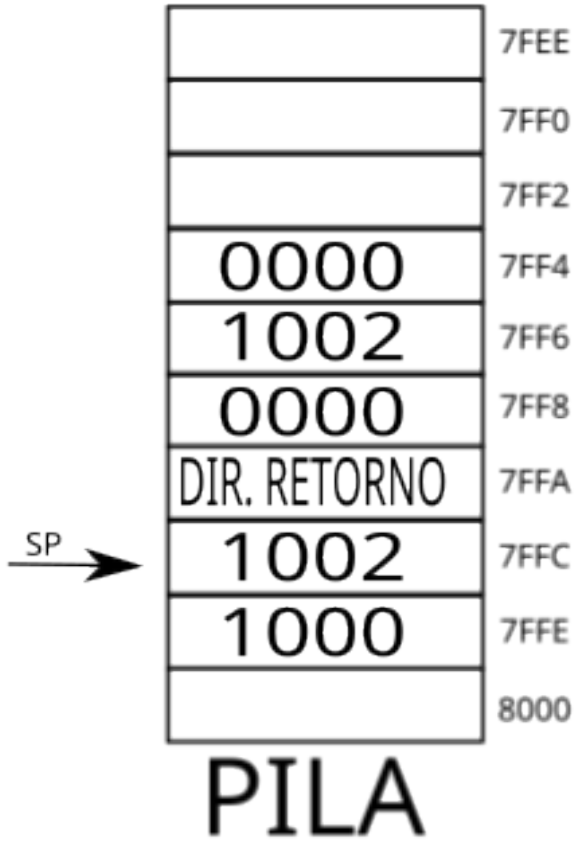
REGISTROS

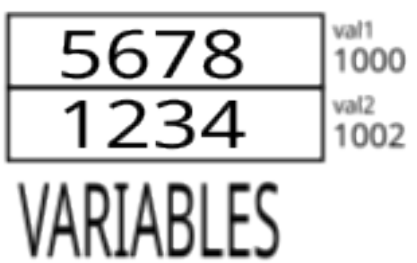


Ejercicio 10 - SWAP

```
ORG 3000H
SWAP: PUSH BX
      PUSH AX
      PUSH DX

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV CX, [BX]

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV DX, [BX]

      MOV BX, SP
      ADD BX, 8
      MOV BX, [BX]
      MOV [BX], DX

      MOV BX, SP
      ADD BX, 10
      MOV BX, [BX]
      MOV [BX], CX

      POP DX
      POP AX
      POP BX
      RET
```

```
ORG 1000H

val1  DW  1234H
val2  DW  5678H

ORG 2000H
MOV AX, offset val1
PUSH AX
MOV AX, offset val2
PUSH AX
CALL SWAP
HLT
```





Ejercicio 10 - SWAP (intercambio)

El programa cumple con el enunciado, pero...

- No desapila los dos parámetros de la pila
- La subrutina preserva los registros AX, BX y DX. Pero modifica los registro BX, CX y DX. No es necesario preservar AX, CX si.