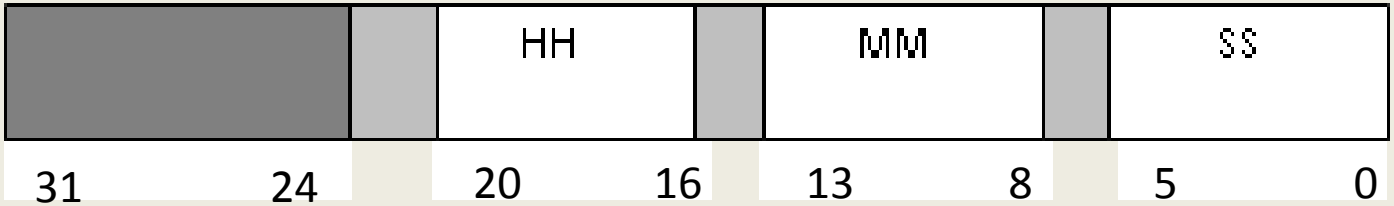
Lab Session 6

INTEGER ARITHMETIC

ADDITION, SUBTRACTIONS AND SHIFT

Multiplication using shifts, addition and subtraction instructions



Method to convert time in format HH:MM:SS into the equivalent seconds

seconds = HH * 3600 + MM*60 + SS

$3600 = 2^{11} + 2^{10} + 2^9 + 2^4$

$60 = 2^5 + 2^4 + 2^3 + 2^2$

In both cases 4 shifts and

3 additions are needed

DESPLAZAMIENTO

sll rd, rt, shamt *Desplamiento logico a la izquierda* **R**

Desplaza el registro rt a la izquierda tantos bits como indica shamt

sll $t0, $t1, 16 # $t0 ← $t1 << 16

srl rd, rt, shamt *Desplazamiento logico a la derecha* **R**

Desplaza el registro rt a la derecha tantos bits como indica shamt.

srl $s0,$t1, 4 # $s0 ← $t1 >> 4

Multiplication using shifts, addition and subtraction instructions

- Second option: Booth algorithm
- Using shift, addition and subtraction instructions
- 3600 and 60 can be recoded as:

$$3600 = 2^{12} - 2^{9} + 2^{5} - 2^{4}$$

$$60 = 2^{6} - 2^{2}$$

Exercise 1: Routine that receives as input parameter the variable *reloj* (HH:MM:SS) and returns its value in seconds

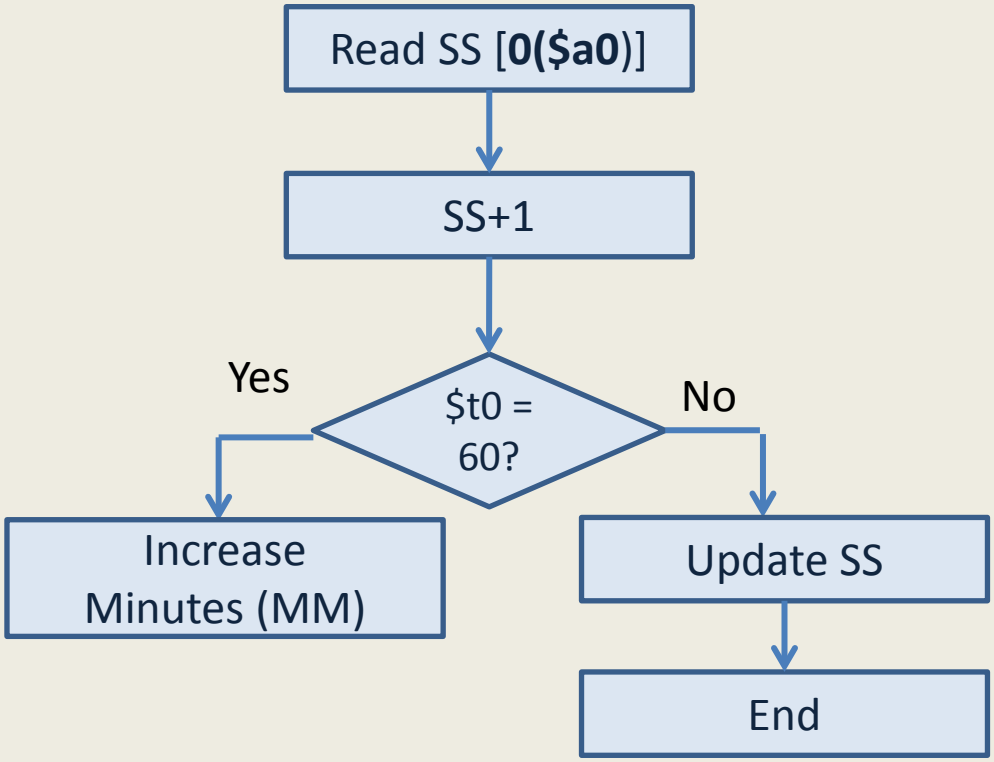
Redesign Session 5 routine using Booth algorithm for multiplication:

1. Select an accumulator register. Initialize it to 0
2. Get HH (byte access) and multiply by 3600
   - Use shift/addition/subtraction instructions
   - $3600 = 2^{12} - 2^9 + 2^5 - 2^4$
3. Accumulate into the selected register
4. Get MM (byte access) and multiply by 60
   - Use shift/addition/subtraction instructions
   - $60 = 2^6 - 2^2$
5. Accumulate into the selected register
6. Get SS (byte access) and accumulate
7. Return result in $v0

Exercise 2: Stepping up the time

$a0 = memory address of reloj

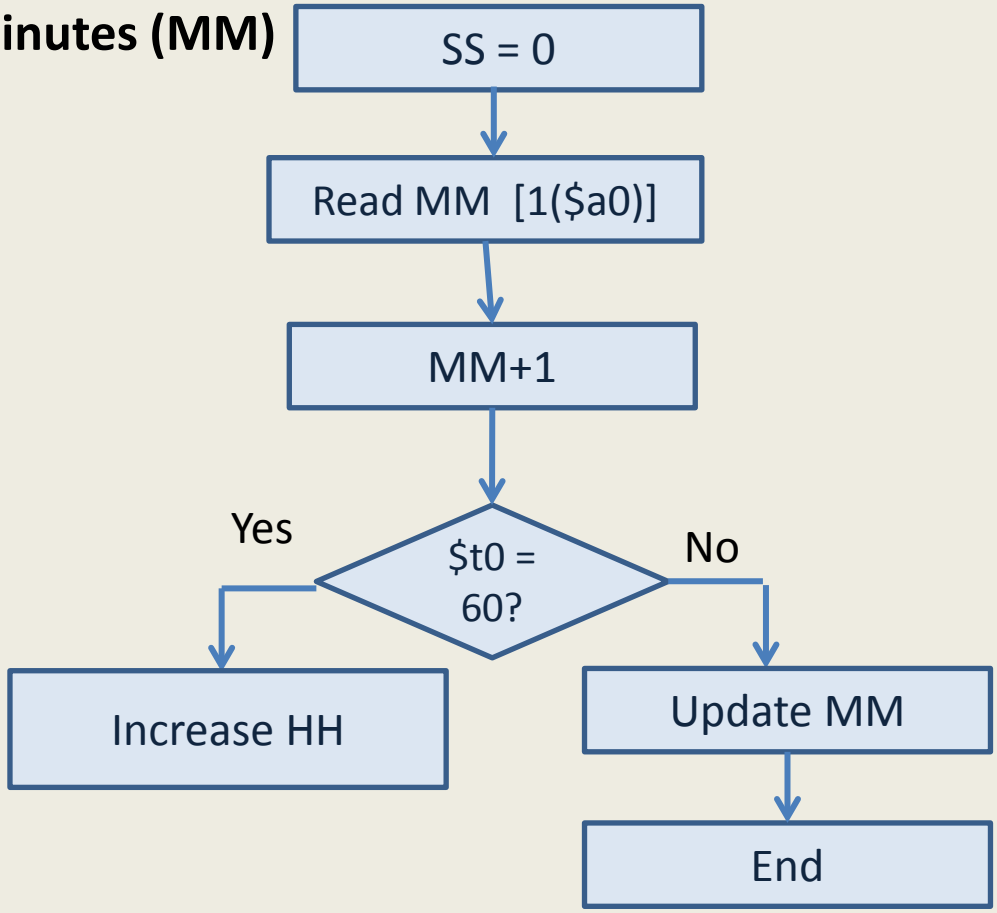
Increase Seconds (SS)



Exercise 2: Stepping up the time

$a0 = memory address of reloj

Increase Minutes (MM)



Exercise 2: Stepping up the time

$a0 = memory address of reloj

Increase Hours (HH)