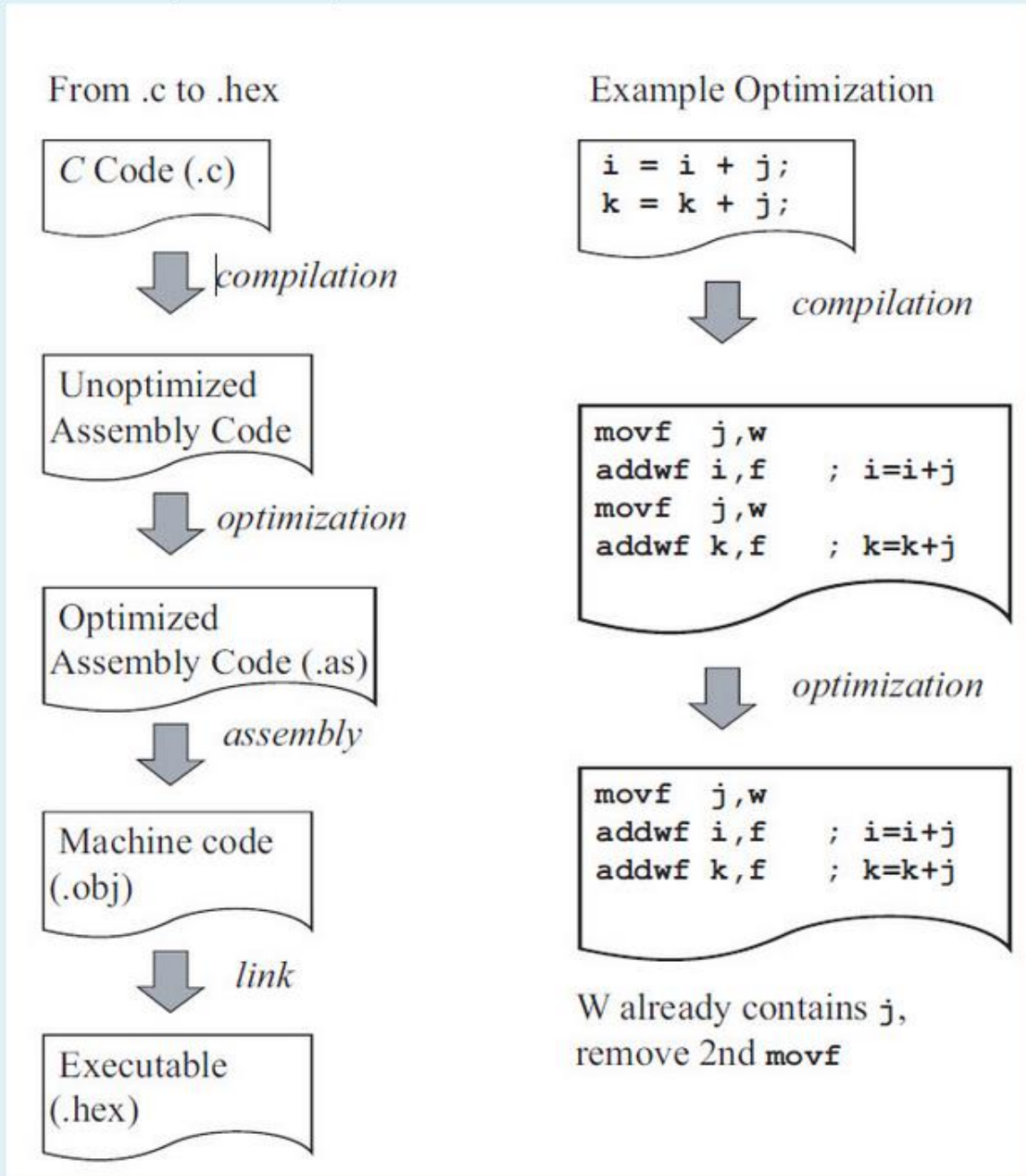


Questionnaire Q9_12: Example questions referring to projects P9-P10-P11-P12

C compilers allows us programming microcontroller applications skipping the inner details and complications of assembly language. However, the optimisation process as represented for example in the picture below is not for free, excepting some demonstrative versions of the compilers, because optimising is not a simple process. Typically, code size is reduced and performance improved after optimisation.



Select one:

Answers

- True
 False

These are common logic bitwise operations coded in both, C and assembly languages. Name them.

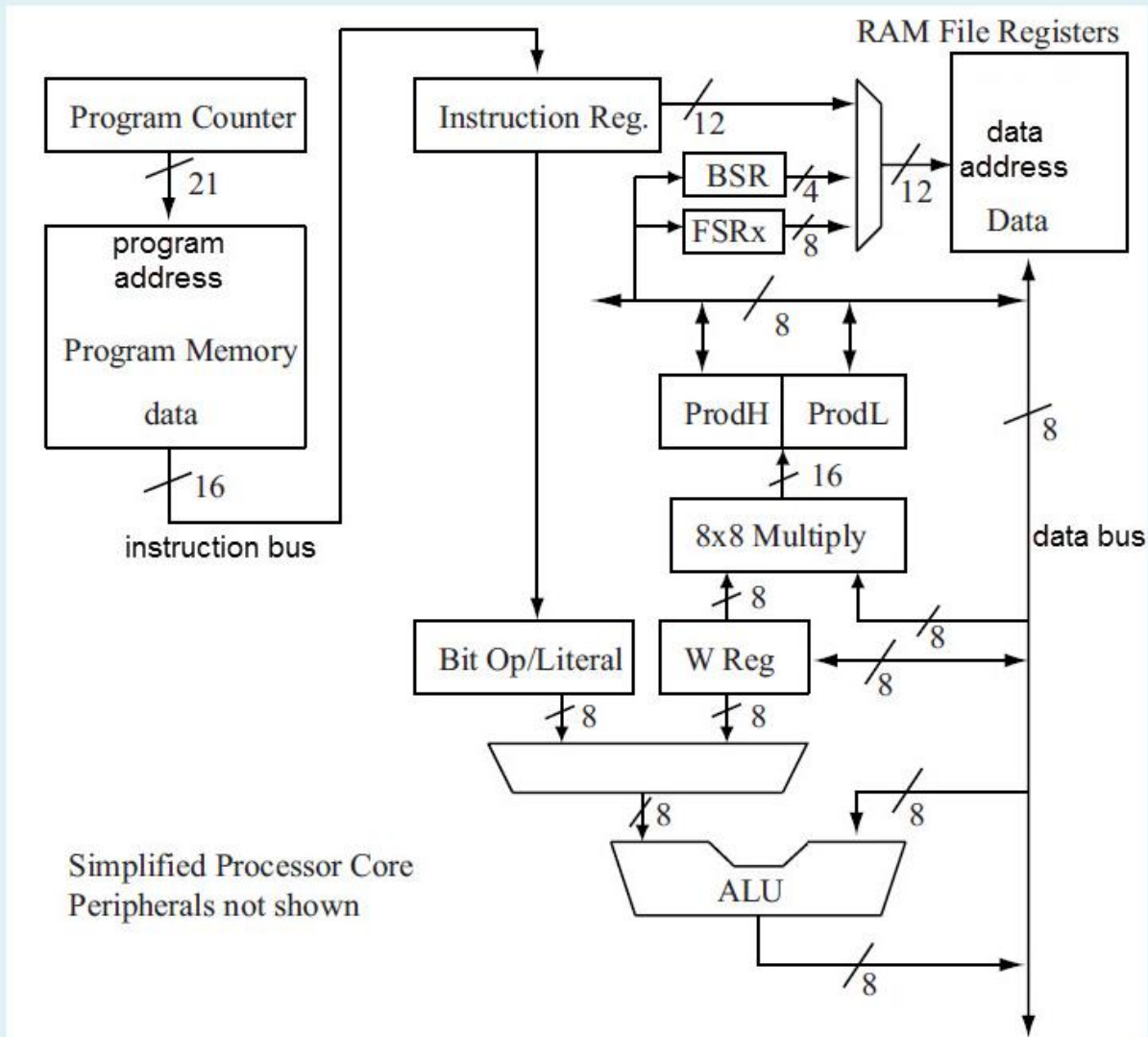
In C	In Assembly	Execution
A) <code>i = i & 0x0F;</code>	<code>movf 0x020,w</code> <code>andlw 0x0F</code> <code>movwf 0x20</code>	<code>i = 0x2C = 0010 1100</code> <code> &&&& &&&&</code> <code>mask = 0x0F = 0000 1111</code> <code> -----</code> <code>result = 0000 1100 = 0x0C</code>
B) <code>i = i 0x0F;</code>	<code>movf 0x020,w</code> <code>iorlw 0x0F</code> <code>movwf 0x20</code>	<code>i = 0x2C = 0010 1100</code> <code> </code> <code>mask = 0x0F = 0000 1111</code> <code> -----</code> <code>result = 0010 1111 = 0x2F</code>
C) <code>i = i ^ 0x0F;</code>	<code>movf 0x020,w</code> <code>xorlw 0x0F</code> <code>movwf 0x20</code>	<code>i = 0x2C = 0010 1100</code> <code> ^ ^ ^ ^ ^ ^ ^ ^</code> <code>mask = 0x0F = 0000 1111</code> <code> -----</code> <code>result = 0010 0011 = 0x23</code>
D) <code>i = ~i;</code>	<code>comf 0x020,f</code>	<code>i = 0x2C = 0010 1100</code> <code> ~ ~ ~ ~ ~ ~ ~ ~</code> <code>result = 1101 0011 = 0xD3</code>

Select one:

- 1. A) AND; B) NOR; C) NXOR; D) NOT
- 2. A) AND; B) OR; C) XOR; D) NOT
- 3. A) OR; B) AND; C) NOT; D) XOR
- 4. A) AND; B) OR; C) NOT; D) XOR

Microcontrollers are characterized by having small amounts of program (flash memory) and data (RAM) memory, and take advantage of the Harvard architecture to speed processing by concurrent instruction and data access. The separate storage means the program and data memories may feature different bit widths, for example using 16-bit wide instructions and 8-bit wide data.

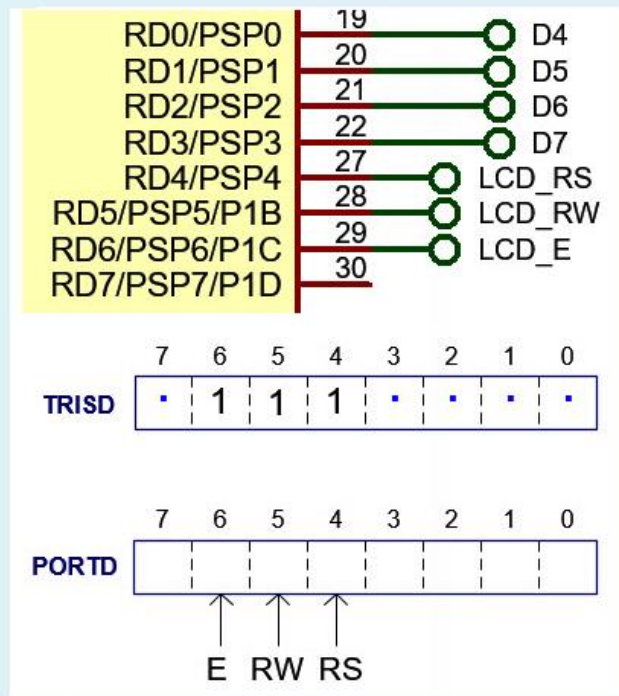
This is a simplified RTL schematic of a PIC CPU from Microchip. Which are the RAM and program memory addressing capacities?



Select one:

- a. RAM memory = 4 kB (kbytes); Program memory = 2 M positions (16-bit words)
- b. RAM memory = 512 B (bytes); Program memory = 512 k positions (16-bit words)
- c. RAM memory = 1 kB (kbytes); Program memory = 1 M positions (16-bit words)
- d. RAM memory = 4 kB (kbytes); Program memory = 64 k positions (16-bit words)

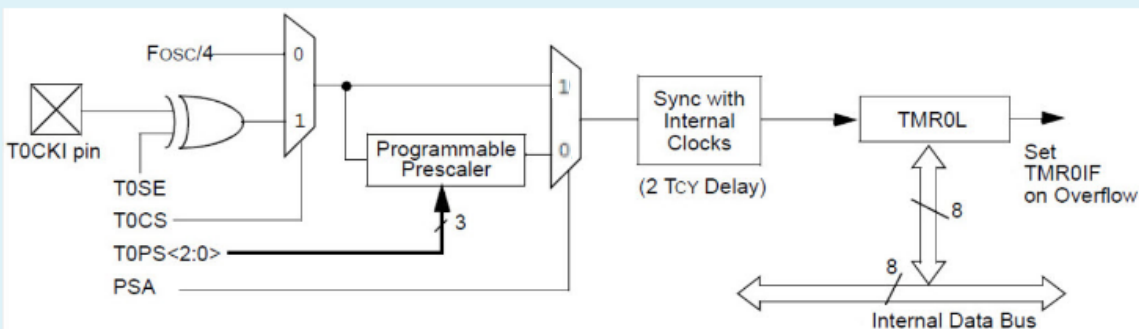
- d. In order to configure the LCD hardware, the control lines RS, E, RW must be set as inputs:



This is the PIC18F4520 Timer0 (**TMR0L**) block diagram for 8-bit mode of operation. We program the configuration bits as follows in order to use the Timer0 to measure the frequency of an external signal connected to the **TOCKI** pin:

TOSE = 0; TOCS = 1; PSA = 0; TMR0L = 0x00; TOPS(2..0) = "011"; and the $F_{osc} = 4 \text{ MHz}$.

If we enable by software the Timer0 for **100 ms**, which is the maximum frequency that can be measured before there is an overflow error that invalidates the measurement?



TOPS<2:0>: Timer0 Prescaler Select bits

- 111 = 1:256 Prescale value
- 110 = 1:128 Prescale value
- 101 = 1:64 Prescale value
- 100 = 1:32 Prescale value
- 011 = 1:16 Prescale value
- 010 = 1:8 Prescale value
- 001 = 1:4 Prescale value
- 000 = 1:2 Prescale value

Select one:

- a. $F_{max} = 250 \text{ Hz}$
- b. $F_{max} = 4.096 \text{ Hz}$
- c. $F_{max} = 250 \text{ kHz}$
- d. $F_{max} = 40.96 \text{ kHz}$