Lab 3 : Requirement Description

- **連結**
  - 投影片
  - 影片

- **基礎題（70%）**
  - **題目敘述**

    請利用 bitwise 指令(NOT、AND、OR、XOR、ROTATE)實作算術移位和邏輯移位，對 TRISA 先進行一次算術右移後再進行一次邏輯右移

  - **範例與測資**

$$11010111 \xrightarrow{\text{算數右移}} 11101011 \xrightarrow{\text{邏輯右移}} 01110101$$

0xD7　　0xEB　　0x75

  - **評分標準**
    1. 請使用上述測資
    2. 會檢查是否使用至少一個 bitwise 指令
    3. 請勿使用 branch 相關指令
    4. 違反評分標準將斟酌扣分

- **進階題（30%）**
  - **題目敘述**

    請實作 16-bit 的加法器

  - **範例與測資**

7408 + 4046 = B44E (hex)

address	00	01
000	74	08
010	40	46
020	B4	4E

  - **評分標準**
    1. 第一個數放在 0x000 - 0x001，第二個數放在 0x010 - 0x011，結果存放在 0x020 - 0x021
    2. 請使用表格中的測資

3. 請勿使用 ADDWFC
4. 違反評分標準將斟酌扣分

- **加分題（20%）**
  - **題目敘述**

    給定輸入(範圍從 0x01 到 0x0F)分別存放在 TRISA 和 TRISB，請實作一個 4-bit x 4-bit unsigned multiplier，結果存在 TRISC。

  - **範例與測資**

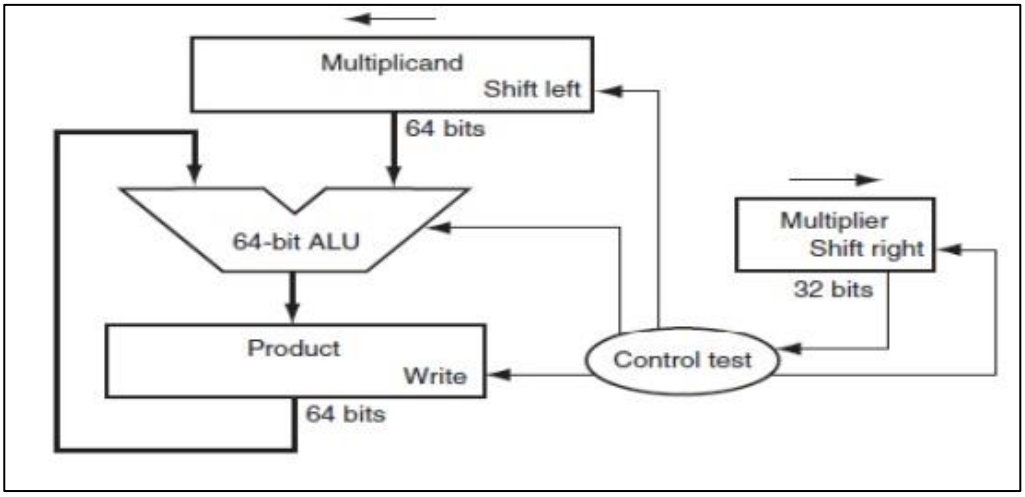
    0x08 x 0x0B = 0x58

  - **評分標準**
    1. 請使用上述測資
    2. 請使用乘法器結構(simple multiplier 或 optimized multiplier)，請勿直接使用展開加法如下，若使用展開加法本題將拿不到分

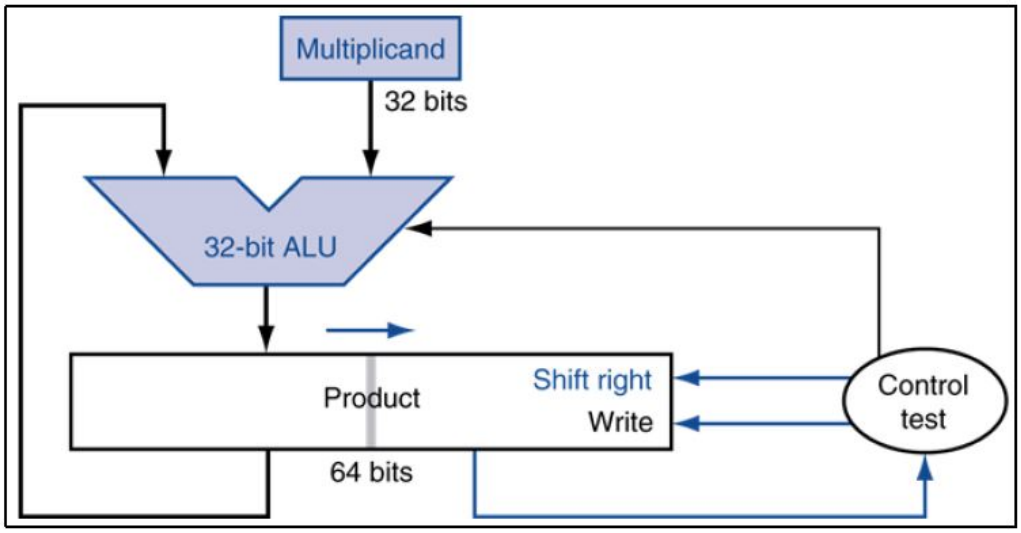
       00001000 + 00010000 + 00000000 + 01000000

    3. 請不要使用 MUL 相關的指令
    4. 請不要使用 goto 指令
    5. 違反評分標準將斟酌扣分

  - **提示：**乘法器架構請參考下圖
    - simple multiplier



- optimized multiplier



Lab 3 : Requirement Description

- **Link**
  - Slide
  - Video

- **Basic (70%)**
  - **Description**

    Use bitwise instructions bitwise instructions (NOT, AND, OR, XOR, and ROTATE) to implement both arithmetic and logical shifts. First, perform an arithmetic right shift, followed by a logical right shift, on the TRISA.

  - **Example and test data**

$$\underset{\text{0xD7}}{11010111} \xrightarrow{\text{arithmetic right shift}} \underset{\text{0xEB}}{11101011} \xrightarrow{\text{logical right shift}} \underset{\text{0x75}}{01110101}$$

  - **Standard of grading**
    1. Please use the test data mentioned above**.**
    2. Use at least one bitwise instruction to implement it.
    3. Do not use the branch instruction.
    4. Points will be deducted for any violation.

- **Advance (30%)**
  - **Description**

    Implement a 16-bit adder.

  - **Example and test data**

7408 + 4046 = B44E (hex)

address	00	01
000	74	08
010	40	46
020	B4	4E

  - **Standard of grading**
    1. Store the first number in the memory addresses 0x000 to 0x001, store

the second number in the memory addresses 0x010 to 0x011, and store the result in the memory addresses 0x020 to 0x021.

2. Please use the test data provided in the table above.
3. Avoid using the ADDWFC instruction.
4. Points will be deducted for any violation.

- **Bonus (20%)**
  - **Description**

    Given inputs ranging from 0x01 to 0x0F, which are stored at TRISA and TRISB respectively, please implement a 4-bit by 4-bit unsigned multiplier and store the result at TRISC.

  - **Example and test data**

    0x08 x 0x0B = 0x58

  - **Standard of grading**

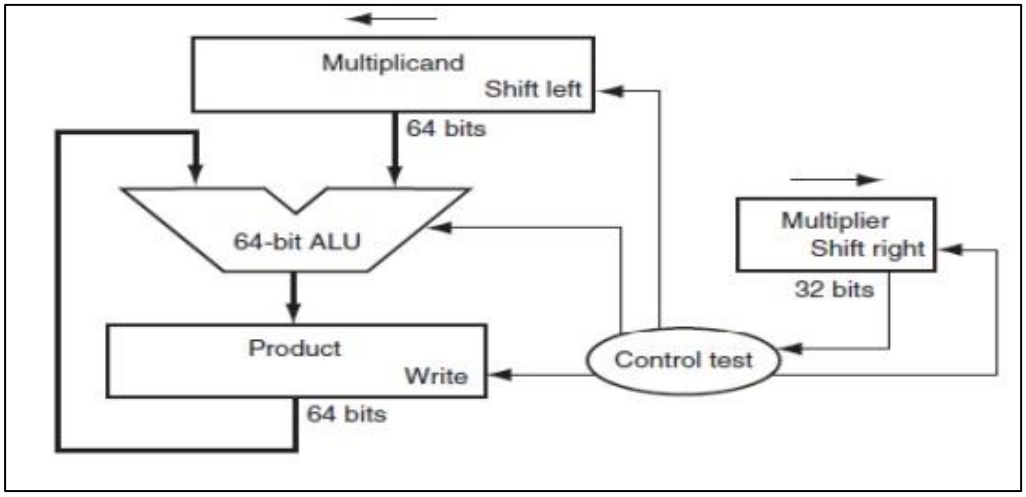
    1. Please use the test data mentioned above.
    2. Please use the multiplier architecture, whether it is a simple or optimized multiplier. Do not expand and add the directly, as shown in the following example. Violation of this rule will result in zero point for this question.

       Wrong example (do not expand and add directly):

       00001000 + 00010000 + 00000000 + 01000000

    3. Do not use MUL-related instructions.
    4. Do not use the GOTO instruction.
    5. Points will be deducted for any violation.

- **Hint:** you can refer to the multiplier architecture diagram below.
  - simple multiplier



  - optimized multiplier