2021/ICTS/33

TICT3113(P) – Computer Architecture & Organization

Lab sheet 06

Title: Character Handling in ARM Assembly

Aims:

1. To understand how characters are represented in ARM Assembly using ASCII values and how they are loaded into registers.
2. To learn how to perform character classification, such as checking whether a character is uppercase, lowercase, or neither.
3. To observe how comparison instructions (CMP) update condition flags and how conditional branching is used to make decisions.

Tasks:

1. Identify the ASCII ranges for uppercase letters, lowercase letters, digits, and other characters.
2. Write an ARM Assembly program to:
    - Load a character into a register
    - Compare it against ASCII ranges
    - Set an indicator register to represent uppercase, lowercase, or other
3. Assemble and build the program using Keil µVision IDE.
4. Run the program in Debug Mode and observe how register values change during each loop iteration.
5. Analyze how the use of ASCII boundaries and branching allows ARM Assembly programs to handle different character types.

Activities - Theory:

1. What is a Character in ARM?

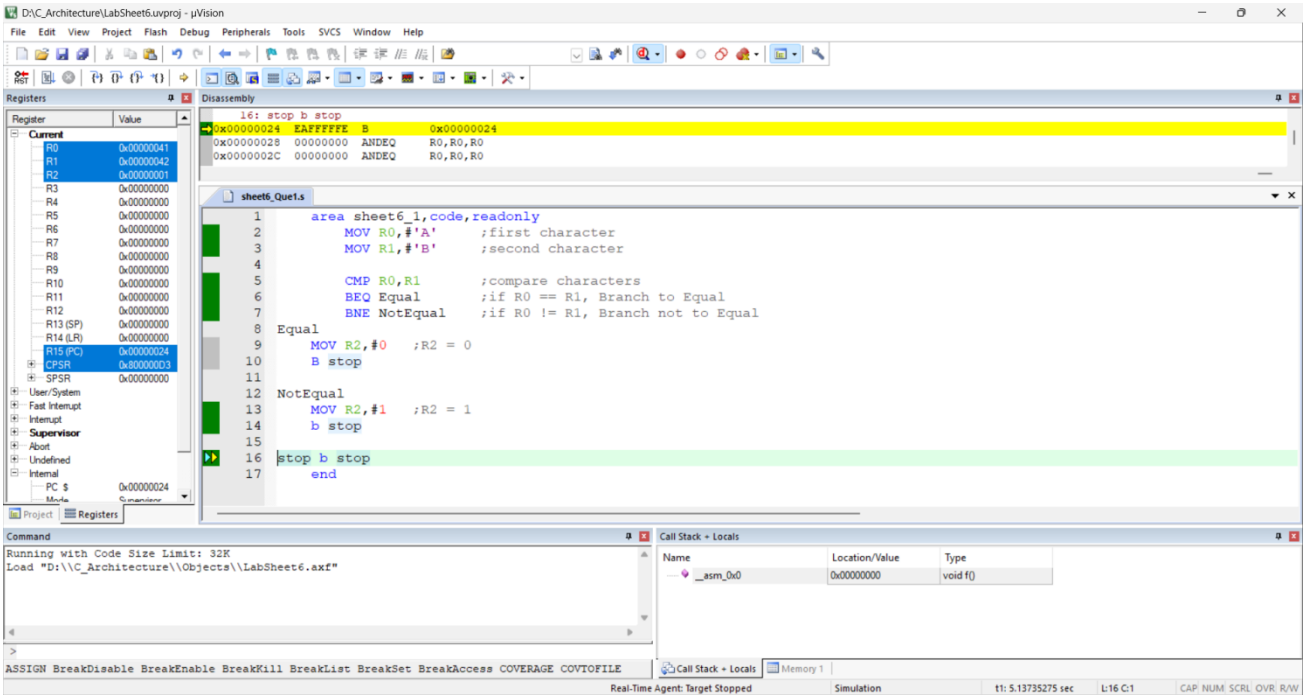
- Characters are stored as ASCII values (0–127).
  Example: 'A' = 65, 'a' = 97, '0' = 48
- In ARM Assembly, characters are loaded using:
  MOV R0, #'A' or MOV R0,'A'

2. ASCII Value Ranges
    - Uppercase letters (A–Z): 65–90
    - Lowercase letters (a–z): 97–122
    - Digits ('0'–'9'): 48–57

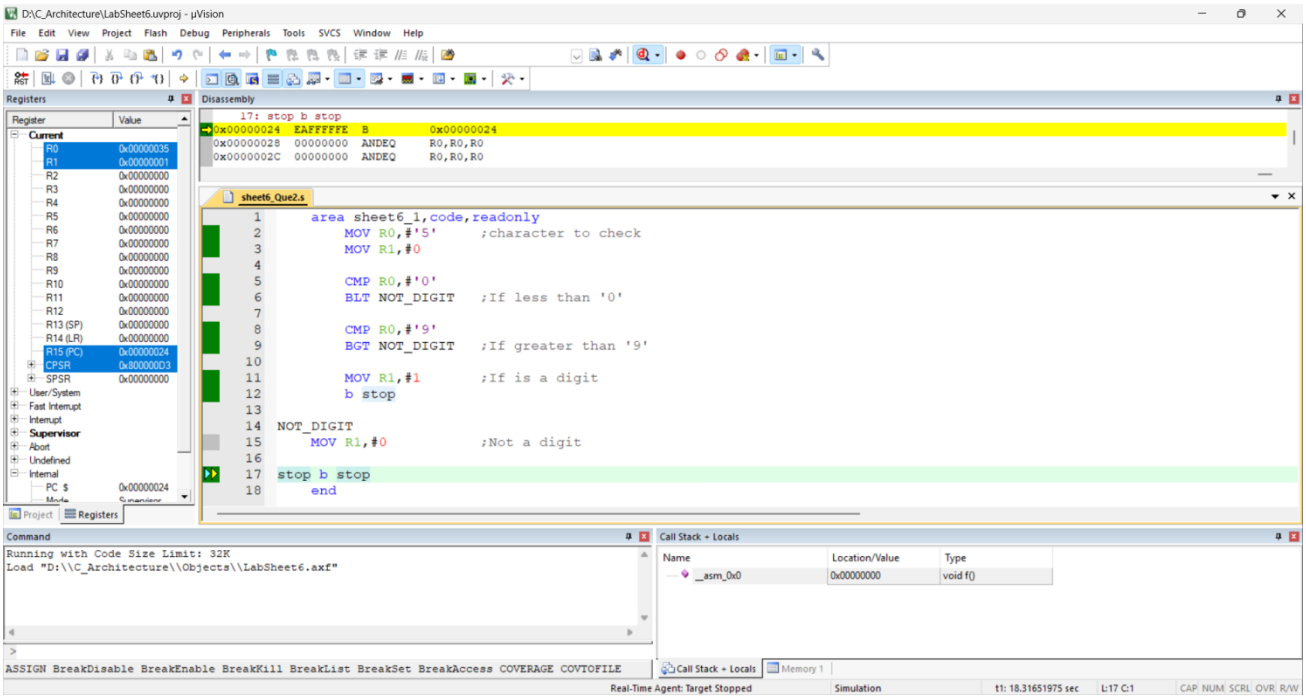
3. Loading Characters into Registers
    - Characters stored as immediate ASCII values: MOV R1, #'A'
    - Also possible using hex values: MOV R1, #0x41

Exercises:

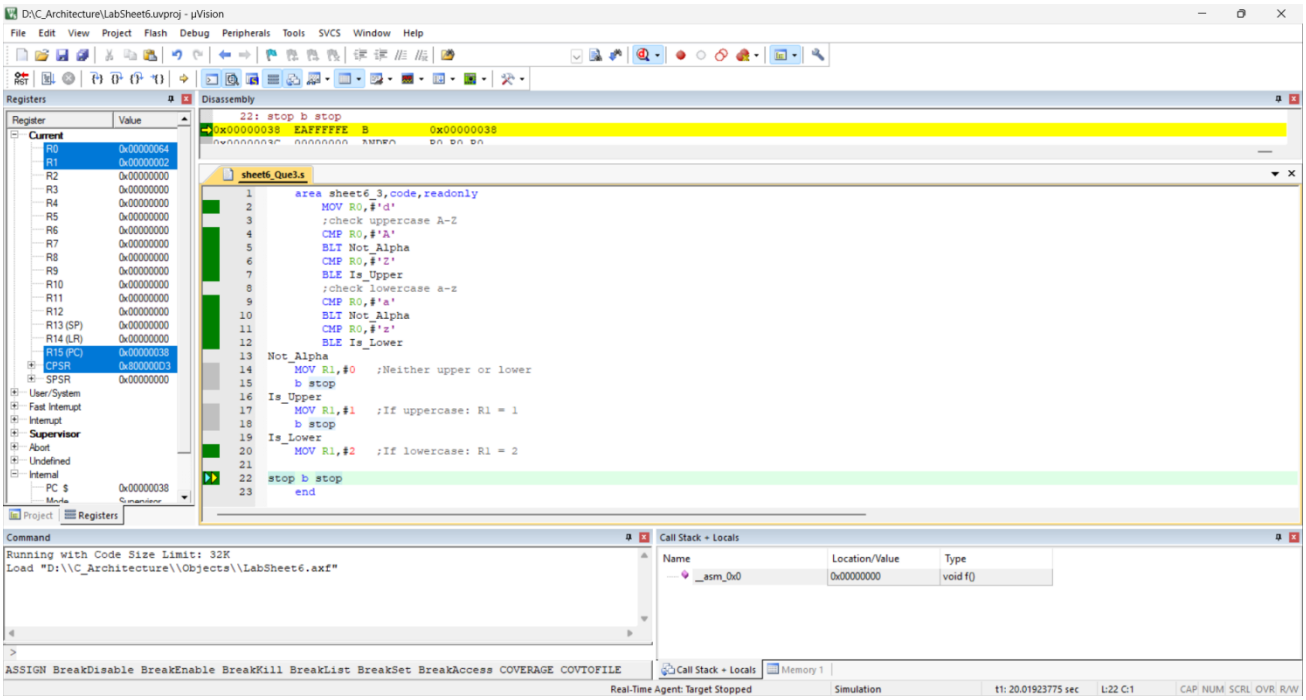
1) Compare two characters (equal or not)
   - If Equal MOV R2,#0
   - Else MOV R2,#1



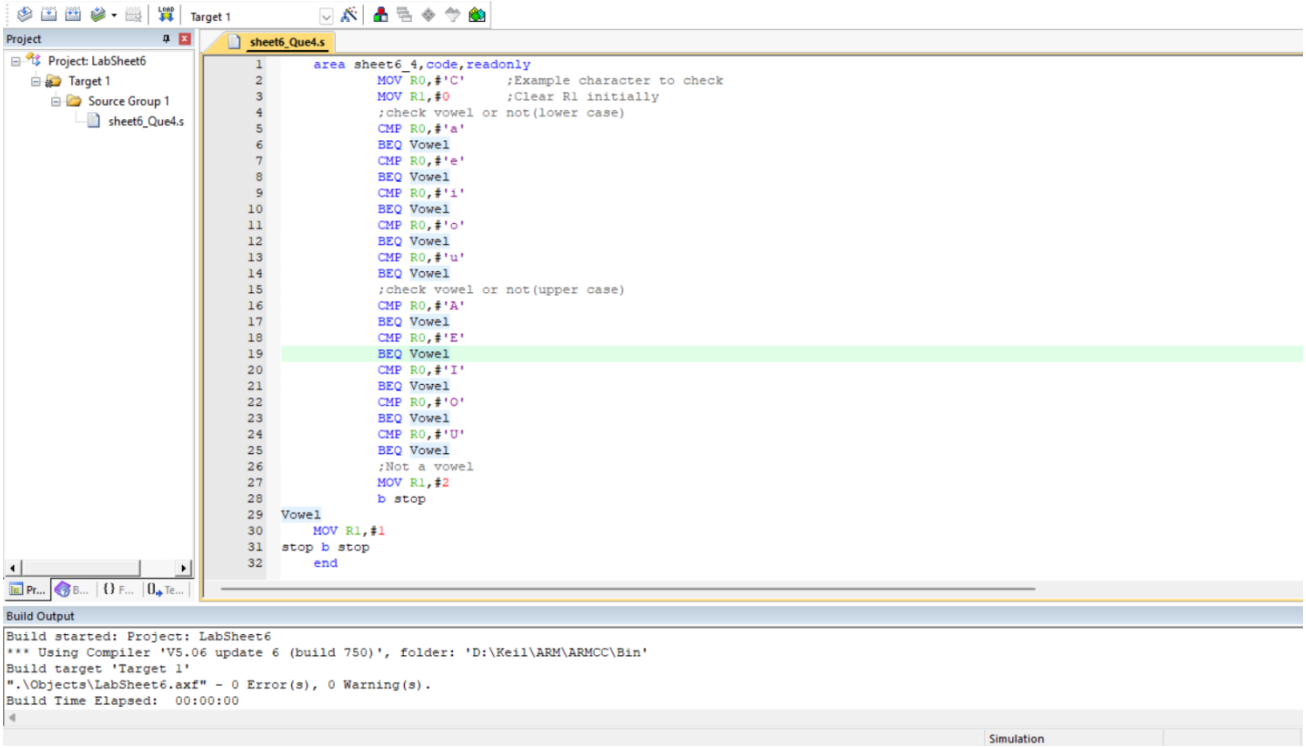
2) Check if a character is a digit (‘0’–’9’)
   - If digit mov R1,#1
   - If not a digit R1,#0

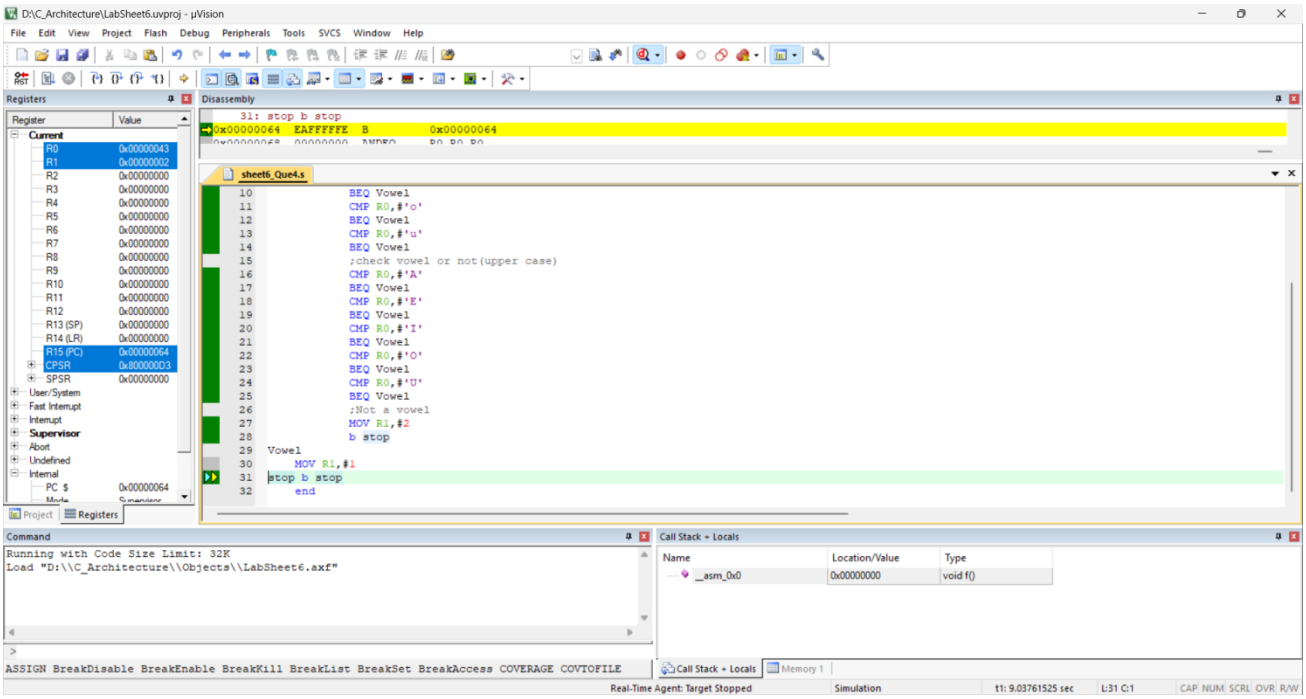


3) Check if a character is uppercase or lowercase:
   - If uppercase → R1 = 1
   - If lowercase → R1 = 2
   - Otherwise → R1 = 0



4) Check if a character is a vowel
   - If vowel mov R1,#1
   - If not a vowel R1,#2





Discussion:

This lab focused on character handling in ARM Assembly using ASCII values. Programs were written to compare characters, check for digits, uppercase or lowercase letters, and vowels. The CMP instruction and conditional branches were used to make decisions, and the results were stored in indicator registers. Keil debugger was used to observe how register values and condition flags change during execution.

Reference:

- Lecturer's Notes.