Assignment #2
Memory

24 November 2014

This is an individual assignment and will contribute 10% of your final mark for CS1021.

You must submit your solutions using Blackboard no later than 23:59 on Wednesday 21st December 2016. Late submissions without a satisfactory explanation will receive zero marks. You will not be asked to demonstrate your solution, however, you should expect someone grading your programs to execute them. It will be assumed that programs that do not build without errors do not work.

Submit your `.s` assembly language source files and your report **in PDF format** as attachments to "Assignment #2" in Blackboard.

Your `.s` assembly language source files must be suitably commented.

Solutions will be checked for plagiarism.

1 Sets – Closure

Assume a mathematical *set*, *A*, containing 32-bit signed integers is stored in memory. The following ARM Assembler directives illustrate how the set is arranged in memory.

```
1 ASize   DCD   8                          ; Number of elements in Set A
2 AElems  DCD   +4,-6,-4,+3,-8,+6,+8,-3    ; Elements in Set A
```

Design and write an ARM Assembly Language program that will determine whether the set is closed under the negation operation. In other words, your program should determine whether, for every integer in the set, the set also contains the negation of that integer.

The set *A* in the example above **is** closed under the negation operation as it contains both +3 and -3, +4 and -4, +6 and -6 and +8 and -8.

Use the **Closure** µVision project to develop your solution. Your program should store 1 in `R0` if the set is closed under negation and zero otherwise.

2 Sets – Symmetric Difference

Assume two mathematical *sets*, A and B, containing 32-bit unsigned integers are stored in memory. The following ARM Assembler directives illustrate how the sets are arranged.

```
1 ASize   DCD     8                       ; Number of elements in Set A
2 AElems  DCD     4,6,2,13,19,7,1,3       ; Elements in Set A
3
4 BSize   DCD     6                       ; Number of elements in Set B
5 BElems  DCD     13,9,1,20,5,8           ; Elements in Set B
```

Design and write an ARM Assembly Language program that will create a third set, C, that is the *symmetric difference* of A and B.

Use the **SymmDiff** µVision project to develop your solution. Your program should store the size and elements of set C in memory using the memory set aside in the template project.

3 Anagrams

Two strings are anagrams of each other if one string can be formed by rearranging the characters of the other. Each letter of one string may only be used once to form the other string. For example, *"tacos"* is an anagram of *"coats"*. The string *"bests"* is not, however, an anagram of *"beets"* because although they contain the same characters, each character does not occur the same number of times.

Design and write an ARM Assembly Language program to determine if one string is an anagram of another string.

Use the **Anagram** µVision project to develop your solution. The template code in the project stores the start address of string A in `R1` and the start address of string B in `R2`. Your program should store 1 in `R0` if the string is an Anagram and zero otherwise.

Evaluation

The following broad marking scheme will be used for the assignment:

- Closure – 25%
- Symmetric Difference – 25%
- Anagrams – 25%
- Documentation – 25%

Note that marks will be awarded for both the content and presentation of your report document. Solutions that are merely working will not automatically attract 100% of the marks available. Marks will also be awarded for the quality of the solution.