**CS 271 Computer Architecture and Assembly Language**

**– Assignment 1 –**

**This assignment is designed to test your understanding of basic MASM assembly language programming as well as program execution on the IA32 architecture. Please submit your .asm and .docx files on CANVAS.**

**Program Execution Section**

**Objectives:**

This exercise aims to help you understand which and how hardware components change while Assembly code gets executed and translates to the circuits.

1. Observe and understand how the code outputs on the screen data stored in memory
2. Observe and understand how the code stores data in memory
3. Get familiar with the CPU circuits that each instruction changes
4. Get familiar with the pre-assigned roles of each circuit.

**Description:**

Below is the code that calculates the user’s age in dog years. Given that,

* The .**data** segment starts at the address **0x1000** **in main memory**
* The **.code** segment start at the address **0x2000 in cache memory**
* The age the user types in when they are prompted is 20

write down the changes in variables and registers for each instruction. Assume that when the “OFFSET” operator in used, only the address of the variable is fetched, **NOT** the data. The first 4 instructions are given. You can stop after the instruction “exit”

TITLE Dog years (demo1.asm)

; Description: This program gets the age of the user and calculates their age in dog years (age x 7).

INCLUDE Irvine32.inc

.data

age DWORD ? ; User's age

hi\_there BYTE "Hi there, this is John",0 ; Greeting the user

prompt1 BYTE "Can I have your age please?",0 ; Gets age

output BYTE "So, your age in dog years is: ",0 ; Reposts dog age

byebye BYTE "Thanks for passing by, have a great day!",0 ; Bye bye

.code

main PROC

; Greet the user

mov EDX, OFFSET hi\_there ; Set up for call to WriteString and greet the user

call WriteString

call Crlf

; Gets the user's age

mov EDX, OFFSET prompt1 ; Asks the user's age

call WriteString

call Crlf

call ReadInt ; Reads the users age. Age in EAX

call Crlf

; Calculate the dog years and stores the dog age

mov EBX, 7

mul EBX

mov age, EAX ; Stores the users dog age. Dog age also in EAX

; Reports the dog years and says bye

mov EDX, OFFSET output

call WriteString

mov EAX, age

call WriteDec

call Crlf

mov EDX, OFFSET byebye

call WriteString

call Crlf

exit ;exit to operating system

main ENDP

END main

| **Address** | **Instruction** | **EIP** | **EIR** | **EID** | **MDR** | **MAR** | **EAX** | **EBX** | **ECX** | **EDX** | **age** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0x2000 | main PROC | 0x2004 | main PROC | main PROC | ? | ? | ? | ? | ? | ? | ? |
| 0x2004 | mov EDX,  OFFSET hi\_there | 0x2008 | mov EDX,  OFFSET hi\_there | mov EDX,  OFFSET hi\_there | ? | 0x1004 | ? | ? | ? | 0x1004 | ? |
| 0x2008 | call WriteString | 0x200C | call WriteString | call WriteString | 0 | 0x101A | ? | ? | ? | 0x1004 | ? |
| 0x200C | call Crlf | 0x2010 | call Crlf | call Crlf | 0 | 0x101A | ? | ? | ? | 0x1004 | ? |
| 0x2010 | mov EDX OFFSET prompt1 | 0x2014 | mov EDX OFFSET prompt1 | mov EDX OFFSET prompt1 | 0 | 0x101B | ? | ? | ? | 0x101B | ? |
| 0x2014 | Call WriteString | 0x2018 | Call WriteString | Call WriteString | 0 | 0x1036 | ? | ? | ? | 0x101B | ? |
| 0x2018 | call Crlf | 0x201C | call Crlf | call Crlf | 0 | 0x1036 | ? | ? | ? | 0x101B | ? |
| 0x201C | call ReadInt | 0x2020 | call ReadInt | call ReadInt | 20 | @EAX | 20 | ? | ? | 0x101B | ? |
| 0x2020 | call Crlf | 0x2024 | call Crlf | call Crlf | 20 | @EAX | 20 | ? | ? | 0x101B | ? |
| 0x2022 | mov EBX, 7 | 0x2028 | mov EBX, 7 | mov EBX, 7 | 20 | @EAX | 20 | 7 | ? | 0x101B | ? |
| 0x2028 | mul EBX | 0x202C | mul EBX | mul EBX | 20 | @EAX | 140 | 7 | ? | 0 | ? |
| 0x202C | mov age, EAX | 0x2030 | mov age, EAX | mov age, EAX | 140 | 0x1003 | 140 | 7 | ? | 0 | 140 |
| 0x2030 | mov EDX, OFFSET output | 0x2034 | mov EDX, OFFSET output | mov EDX, OFFSET output | 140 | 0x1037 | 140 | 7 | ? | 0x1037 | 140 |
| 0x2034 | call WriteString | 0x2038 | Call WriteString | Call WriteString | 0 | 0x1055 | 140 | 7 | ? | 0x1037 | 140 |
| 0x2038 | mov EAX, age | 0x203C | mov EAX, age | mov EAX, age | 140 | 0x1003 | 140 | 7 | ? | 0x1037 | 140 |
| 0x203C | call WriteDec | 0x2040 | call WriteDec | call WriteDec | 140 | 0x1003 | 140 | 7 | ? | 0x1037 | 140 |
| 0x2040 | call Crlf | 0x2044 | call Crlf | call Crlf | 140 | 0x1003 | 140 | 7 | ? | 0x1037 | 140 |
| 0x2044 | mov EDX, OFFSET byebye | 0x2048 | mov EDX, OFFSET byebye | mov EDX, OFFSET byebye | 140 | 0x1056 | 140 | 7 | ? | 0x1056 | 140 |
| 0x2048 | call WriteString | 0x204C | Call WriteString | Call WriteString | 0 | 0x107F | 140 | 7 | ? | 0x1056 | 140 |
| 0x204C | call Crlf | 0x2050 | call Crlf | call Crlf | 0 | 0x107F | 140 | 7 | ? | 0x1056 | 140 |
| 0x2050 | exit | 0x2054 | exit | exit | 0 | 0x107F | 140 | 7 | ? | 0x1056 | 140 |
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