

Project- ARM Coding Project (100 points)

**NOTE 1:** The project is for individual work. No collaboration is allowed. No help giving/receiving is allowed from/to whatsoever and whosoever. If you need help, get help from the instructor.

**NOTE 2:** In writing the project code, use only the following instructions and their variations for conditional branching (such as BEQ, BNE, etc), conditional execution (such as ADDEQ, etc) , size designation (such as LDRH, etc) , and flagging (such as SUBS etc): **ADD, AND, B, BL, BX, CMP, EOR, LDR, LSL, LSR, MOV, ORR, PUSH, POP, ROR, RRX, STR, and SUB.** No other instructions are allowed. Use of not-allowed instructions results in 0 point.

A. Problem

For a DE1-SoC system, write an ARM assembly code which down counts from a decimal number to 0 by 1 while displaying the numbers on the HEX3-HEX0 7-segments (and, optionally, at the same time on the VGA screen to earn extra 20 points. See Note 3 below for details of this option). The starting number is determined by the positions of SW3-SW0, SW3 being the 1000's position, SW2 being 100s position, SW1 for 10s, and SW0 for units. The following example clarifies a decimal number obtained from SW positions:

Number	SW3	SW2	SW1	SW0
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1000	1	0	0	0
1101	1	1	0	1
0100	0	1	0	0

Once the SW3-SW0 position determines the starting number, they are used no more. The counting down process pauses when SW9 is pressed (i.e., SW9 = 1) and resumes when SW9 is released (SW9 = 0). When testing your project code, after compilation, configure SW3-SW0 first, before running the code.



**Note 3:** On the screen with background colored by the pixel color determined by the last four-digits of your Howard ID, display the numbers horizontally at (1, 1) location of the monitor. This option, if successfully implemented, earns extra 20 points.

B. Coding instruction

(i) Start with your general coding design with figures, writings, etc. which show your thinking process. Scan and save as **416ProjectDesign\_YourLastName.yyy** (yyy being pdf, jpg, png, etc). Need to submit this !!!!

(ii) Do not get help from others. Write your own code yourself. Remember “Howard student code of conduct” and 0 point for borrowed and lending works.

C. Score Distribution and Rubric: Total points = 100 (with possible extra 20 points)

	Coding Design	Code for 7-Seg display	Code for VGA screen display
80 pts		The code works.	
50		The code works in part, but	

pts		not completely	
20 pts	Coding design with figures and texts is provided		The code works completely
0 pts	No coding design is provided	(a)The code does not work at all. (b) <b>If two or more codes are almost identical with same register allocation and/or the same order of code sequence, etc. (c) Use of instructions not allowed (See NOTE above).</b>	The code does not work. Two or more codes are almost identical. Use of the instructions not allowed.

**D. Submission Requirement:** Write your code in the CPULator and test it, and save the code file as **416Project\_yourLastName.s**. Submit (a) coding design and (b) the code file via email.

**E. Submission due:** (M) Dec 11 5:00pm

**F. Point Deduction on Late Submission (or Maximum score by submission time)**

Submission Time/Date	Maximum score
By 5:00pm submission date (MON)	100
By 5:00pm submission date + 1 (Tue)	70
After the above	0

G. Inquiry on the project: Use the medium of in-person, email, or slack.