

NAME: _____

GRADE: _____

EE442 / EE592 Real-Time Digital Signal Processing
Quiz #2
Due 1.30pm, Feb. 16, 2011

Honor statement: The solution to this quiz is due entirely to my own, individual effort. I have not discussed this quiz with any other student nor have I consulted with anyone other than (possibly) the instructor of this course in creating these answers.

Signature

Date

Each question is worth 10 points unless otherwise noted.

1. Consider the difference equation for the comb filter on p. 170. Draw the Direct Form I (DF I) and the Direct Form II (DF II) implementations of the filter. Show that by slightly rearranging your DF II implementation, you obtain Figure 5.6.

2. Assume two vectors, \mathbf{u} and \mathbf{v} are stored in memory as follows:

	X		Y
\$49	u_9		v_9
	⋮		⋮
	u_1		v_1
\$40	u_0		v_0

Write a short code to do the following:

- Initialize address registers to point to u_0 and v_0 (assume linear addressing not modulo)
- Compute the dot product (use the REP instruction) as

$$w = \sum_{k=0}^9 u_k v_k$$

- The result should be rounded at the end of the calculation.

3. Write a short code to compute the following equation

$$(0.4)^2 + 0.5$$

Three lines of correct code will yield full credit; four or more lines of correct code will yield half credit. Note that the solution does not involve parallel moves.

Write a code for the following *real-time* programming tasks (Questions 4 – 7), using the Modified Pass Pack (Appendix B in textbook) as a base code. Identify by file name (**pass.asm**, **pass.dat**, **proginit.asm**, and **procster.asm**) and line number where you would place your instructions. The first programming task is done as an example.

4. Write a code which multiplies the right channel by $g = 0.7$.

Solution:

In **pass.dat** insert after line 10 the following line:

```
g    equ    0.7
```

In **procster.asm** replace the NOP with the following line:

```
    mpyri    #g,x0,a    ;multiply right sample by g (immediate value) and round
```

In **pass.asm** replace line 75 with the following line:

```
    move    a,x:TX_BUFF_BASE    ;transmit right sample
```

5. Write a code which will create and zero out a circular queue (delay line) of length 500 samples. Create the circular queue in **pass.dat** and zero it out in **proginit.asm**. Point `r0` to the circular queue and set `m0` accordingly.

6. Using your code in Question 5, write additional code in **procster.asm** which computes

$$y[n] = x[n] + 0.4x[n-300] + 0.2x[n-500]$$

for *right-channel* input samples (your output should be sent to the right channel of the D/A). Suggested steps:

Step 1 move the right channel input sample $x[n]$ into register $x0$

Step 2 assume (from question 5) $r0$ points to the oldest sample in the queue, i.e. $x[n-500]$ and move this sample into register $x1$

Step 3 offset $r0$ and move $x[n-300]$ into register $y0$.

Step 4 compute the difference equation

Step 5 insert $x[n]$ into the queue by overwriting $x[n-500]$. Decrement $r0$ so it points to the new oldest sample for the next time

This page EE592 only

EE442 students: you may wish to try this problem, however, no additional points will be earned.

7. (20 points) Write a code which implements the Direct Form II (Canonical Form) of the following difference equation for the right channel

$$y(n) = -0.25y(n-1) + x(n) - 0.5x(n-2)$$