NAME: _____ GRADE: _____

EE442 / EE592 Real-Time Digital Signal Processing
Quiz #3
Allowed: Textbook, Calculator only
(no data book, handouts, notes, etc...)

Each question is worth 10 points unless otherwise noted.

1. The architect, Frank Gehry designed a recently-completed concert hall that was the subject of one of the handouts. What was the name of the concert hall?

2. In the project1.dat file on p. 176, lines 75 – 93, allocate and initialize memory for the tapped delay line parameters. Using these parameters, very carefully sketch the ideal impulse response, $h(t)$ vs. t.

3. In the project1.dat file on p. 176, lines 116 – 119, allocate memory for filter state queues for the second, third, and fourth comb filters as well as the tapped delay line, i.e. CF2, CF3, CF4, and TDL. The comments for those lines give the number of words in the queue and their starting addresses. Show with your own calculations, how to arrive at these numbers.

Fill in the missing instructions and comments denoted with '?' for the following *non-real-time* codes (Questions 4 – 5). The first is done as an example.

4. Compute the following inner product

$$y = \mathbf{h}^T \mathbf{x}$$
$$= \begin{bmatrix} 0.4 & 0.3 \end{bmatrix} \begin{bmatrix} 0.2 \\ 0.1 \end{bmatrix}$$

using the following code:

```
org   p:$100
move  ?,?          ;?
mpy   #0.2,x0,?    ;?
move  ?,x0         ;?
mac   #0.3,?,a     ;a = 0.4*0.2 + 0.3*0.1 (ANSWER IN a)
```

Solution:

```
org   p:$100
move  #0.4,x0      ;x0 = 0.4
mpy   #0.2,x0,a    ;a = 0.4*0.2
move  #0.1,x0      ;x0 = 0.1
mac   #0.3,x0,a    ;a = 0.4*0.2 + 0.3*0.1 (ANSWER IN a)
```

5. Compute the following equation

$$b = (0.3)^3 + (0.2)^2$$

using the following code:

```
org   p:$100
move  ?,x0         ;?
mpyr  ?,?,?        ;?
move  ?,x1         ;?
?     x0,x1,?      ;?
move  ?,x0         ;?
?     ?,?,b        ;b = (0.3)^3 + (0.2)^2
```

Solution:

Write a code for the following programming tasks (Questions 6 - 8), assuming the Modified Pass Pack beginning on p. 317 of the text. 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.

6. 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
```

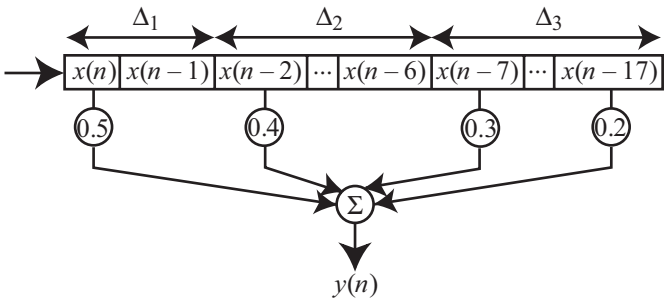
In **`procster.asm`** replace the NOP the following line:

```
   mpyr   #g,x0,a   ;multiply right sample by g and round
```

In **`pass.asm`** replace line 74 with the following line:

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

7. Consider the tapped delay line where Δ indicates a *relative* tap spacing (τ indicates absolute spacing).



Write a code which filters the right channel through the tapped delay line using Δ values . Assume the following in **`pass.dat`**

```
      org x:$00000a
DELTA dsm   3
      org x:DELTA
      dc    2, 5, 11
TDL   dsm   18

      org y:$000000
GAIN  dsm   4
      org y:GAIN
      dc    0.5, 0.4, 0.3, 0.2
```

Hint: Consider moving Δ into an offset register and use of the post-increment by offset addressing mode,

```
      move x:(r0)+n0,x0
```

(next page please)

7. *Solution:*

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8. Equations (5.4) – (5.6) on p. 167 of the textbook give the state equations for the comb filter. Write a code which implements right channel filtering assuming comb filter parameters, $g = 0.46$ and $m = 2400$.