ENGR 451 - Lab 3

Convolution, Part II

```
test_lab3; % initialize test_lab3 function

% Problems #1-4
x = ones(1, 15);
h = ones(1, 3);
for lc = 5:5:15
 test_lab3(x, h, lc);
end
test_lab3(x, h, 50);

% Problems #5-7
for lx = 14:16
 x = ones(1, lx);
 test_lab3(x, h, 15);
end

% Problem #8-9
test_lab3(1, 1, 1);
test_lab3(1, 1, 10);

% Problem #10-12
% load lab2 % assumes you have 'seashell.wav'in your directory
x = seashell(:)';
test_lab3(x, fir_lp, 100);
test_lab3(x, fir_lp, 200);
test_lab3(x, fir_hp, 100);
```

```
Problem #1
   Your overlap-add function is correct
   Your overlap-save function is correct
Problem #2
   Your overlap-add function is correct
   Your overlap-save function is correct
Problem #3
   Your overlap-add function is correct
   Your overlap-save function is correct
Problem #4
   Your overlap-add function is correct
   Your overlap-save function is correct
Problem #5
   Your overlap-add function is correct
   Your overlap-save function is correct
Problem #6
   Your overlap-add function is correct
   Your overlap-save function is correct
Problem #7
   Your overlap-add function is correct
   Your overlap-save function is correct
Problem #8
```

```
   Your overlap-add function is correct
   Your overlap-save function is correct
Problem #9
   Your overlap-add function is correct
   Your overlap-save function is correct
Problem #10
   Your overlap-add function is correct
     Your elapsed time is 11207 usecs
     which is 86.5 times Matlab's elapsed time (129.56 usecs)
   Your overlap-save function is correct
     Your elapsed time is 1470.2 usecs
     which is 11.3 times Matlab's elapsed time (129.56 usecs)
Problem #11
   Your overlap-add function is correct
     Your elapsed time is 6551.02 usecs
     which is 29.7 times Matlab's elapsed time (220.22 usecs)
   Your overlap-save function is correct
     Your elapsed time is 1021.5 usecs
     which is 4.64 times Matlab's elapsed time (220.22 usecs)
Problem #12
   Your overlap-add function is correct
     Your elapsed time is 16706.6 usecs
     which is 78.3 times Matlab's elapsed time (213.4 usecs)
   Your overlap-save function is correct
     Your elapsed time is 2387.06 usecs
     which is 11.2 times Matlab's elapsed time (213.4 usecs)
```

Program Listings

```
disp(' ')
disp('--- overlap_add.m --------------------------------')
type('overlap_add')
disp('--- overlap_save.m --------------------------------')
type('overlap_save')
```

```
--- overlap_add.m --------------------------------

% lc - chunk length

% Rewrite with while loop not 'loop' var
function y = overlap_add(x,h,lc)
    xL = length(x);
    loop = ceil(xL/lc);
    x = [x zeros(1,lc*loop-xL)];
    ys = sequence([],0);
    for i=1:loop
        temp=x(1+lc*(i-1):lc*i);
        tempoffset = lc * (i-1);
        data = conv(temp,h);
        ts = sequence(data,tempoffset);
        ys = plus(ys,ts);
    end
```

```
    y = ys.data;
    y=ys.data(find(y,1,'first'):find(y,1,'last'));
end

--- overlap_save.m --------------------------------

function y = overlap_save(x,h,ls)

    lh = length(h);
    xChunkLength = ls+lh-1;
    yChunkLength = xChunkLength+lh-1;
    yLength = length(x)+lh-1;
    xPadLength = mod(ls-mod(length(x),ls),ls);
    x = [x zeros(1,xPadLength)];
    lx = length(x);

    xChunkPrev = zeros(1,xChunkLength);
    yChunkPrev = zeros(1,yChunkLength);
    y = zeros(1,yLength);

    c=0;
    startSampleIndex = c*ls+1;
    endSampleIndex = startSampleIndex+ls-1;

    % While end of current xSample is <= length of padded x.
    while( endSampleIndex <= lx )
        prevXChunkTail = xChunkPrev(end-lh+2:end);
        xSample = x(startSampleIndex:endSampleIndex);

        xChunk = [prevXChunkTail xSample];
        yChunk = conv(xChunk,h);
        newYData = yChunk(lh:end);
        startYIndex = c*ls+1;
        endYIndex = min(yLength,startYIndex+length(newYData)-1);

        y(startYIndex:endYIndex) = yChunk(lh:lh+endYIndex-
startYIndex);

        xChunkPrev = xChunk;
        yChunkPrev = yChunk;

        c=c+1;
        startSampleIndex = c*ls+1;
        endSampleIndex = startSampleIndex+ls-1;
    end

end

% Read audiofile file.wav
% [x,fs]=audioread('file.wav')
% Play sequence x convolved with sequence h
% h=sequence(sinc(t),0);soundsc(x.conv(h).data,fs)
```

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