ENGR 451 - Lab 3

Convolution, Part II

```
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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 6001.53 usecs
     which is 56.1 times Matlab's elapsed time (106.916 usecs)
   Your overlap-save function is correct
     Your elapsed time is 9781.67 usecs
     which is 91.5 times Matlab's elapsed time (106.916 usecs)
Problem #11
   Your overlap-add function is correct
     Your elapsed time is 3070.22 usecs
     which is 31.2 times Matlab's elapsed time (98.4835 usecs)
   Your overlap-save function is correct
     Your elapsed time is 3341.63 usecs
     which is 33.9 times Matlab's elapsed time (98.4835 usecs)
Problem #12
   Your overlap-add function is correct
     Your elapsed time is 6003.22 usecs
     which is 80.2 times Matlab's elapsed time (74.8716 usecs)
   Your overlap-save function is correct
     Your elapsed time is 9764.93 usecs
     which is 130 times Matlab's elapsed time (74.8716 usecs)
```

Program Listings

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

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

function y = overlap_add(x, h, lc)
    % OVERLAP_ADD   Convolve x and h using overla-add method
    %               y = overlab_add(x, h, lc)
    %               x and h are arrays
    %               lc is the chunk size (default 50)

    N = lc;         % N is length of chunk
    M = length(h);  % M is impulse response length
    numOfChunks = ceil(length(x)/lc);

    if(N>length(x))
        N = length(x);
    end
```

```
    y = conv(x(1:N),h);
    x = x(N+1:end);

    for i = 1:numOfChunks-1
        if length(x) >= N
            xdiv = x(1:N);
        else
            xdiv = x(1:end);
        end

        next = conv(xdiv, h);
        overlap = y(end-(M-1)+1:end) + next(1:M-1);
        y = horzcat(y(1:end-(M-1)), overlap, next((M-1)+1:end));
        x = x(N+1:end);
    end

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

 function y = overlap_save(x, h, lc)
    % OVERLAP_SAVE Convolve x and h using overlap-save method
    %               y = overlap_save(x, h, lc)
    %               x and h are arrays,
    %               lc is the chunk size (default 50)

    N = lc;         % N is length of chunk
    M = length(h);  % M is impulse response length

    if(N>=length(x))
        N = length(x);
        y = conv(x(1:N),h);
    else

        y = conv(x(1:N),h);
        y = y(1:end-(M-1));
        x = x(N-(M-1)+1:end);

        while(length(x) > N)
            xdiv = x(1:N);
            next = conv(xdiv,h);
            y = horzcat(y(1:end), next(1+(M-1):end-(M-1)));
            x = x(N-(M-1)+1:end);
        end

        last = conv(x(1:end),h);
        y = horzcat(y(1:end), last(1+(M-1):end));
    end
 end
```

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