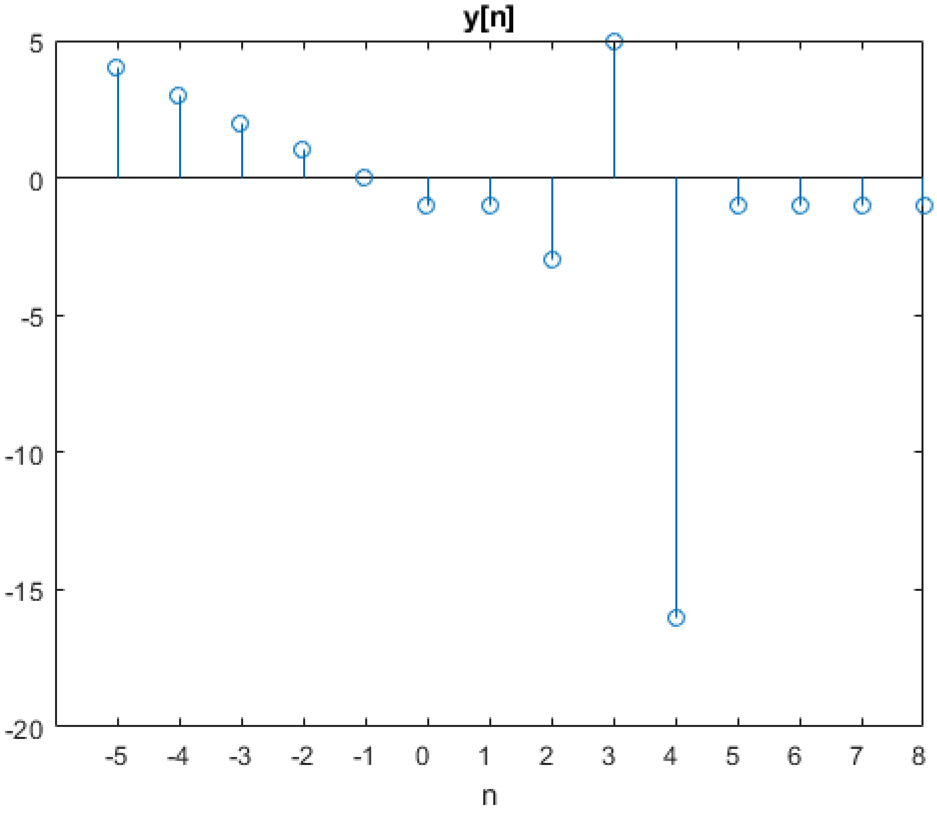
ENGR 451 - Chapter 2 Laboratory

Matlab tutorial

```
clear
x = sequence([1 2 3 4 5], 1);
y = sequence([5 3 1 -1 3 -2 2 3], -1);

% test plus
test_lab1('plus(x, y)')
test_lab1('plus(y, x)')
test_lab1('plus(1, x)')
test_lab1('plus(x, 1)')

y = sequence([5 3 1 0 3 -2 2 3], -4);
test_lab1('plus(x, y)')
test_lab1('plus(y, x)')

% test minustract
test_lab1('minus(x, y)')
test_lab1('minus(y, x)')
test_lab1('minus(1, x)')
test_lab1('minus(x, 1)')

% test timesiplication
test_lab1('times(x, y)')
test_lab1('times(3, x)')
test_lab1('times(x, 3)')

% test flip
test_lab1('flip(x)')

% test shift
test_lab1('shift(y, 2)')

%combinations
test_lab1('flip(minus(shift(plus(x, 2), 4), y))')
test_lab1('plus(flip(plus(x, y)), shift(y, -5))')
test_lab1('minus(plus(times(shift(flip(x), 4), shift(y, 3)), flip(y)),
 x)')

% test stem
set(clf, 'Position', [200 200 400 200])
stem(flip(2+(x-shift(y, -4).*y-3)))
title('y[n]');

% Program Listings
fprintf('\n\n')
disp('--- sequence.m --------------------------------')
type sequence
```

```
plus(x, y): sequence O.K.
plus(y, x): sequence O.K.
plus(1, x): sequence O.K.
plus(x, 1): sequence O.K.
plus(x, y): sequence O.K.
plus(y, x): sequence O.K.
minus(x, y): sequence O.K.
minus(y, x): sequence O.K.
minus(1, x): sequence O.K.
minus(x, 1): sequence O.K.
times(x, y): sequence O.K.
times(3, x): sequence O.K.
times(x, 3): sequence O.K.
flip(x): sequence O.K.
shift(y, 2): sequence O.K.
flip(minus(shift(plus(x, 2), 4), y)): sequence O.K.
plus(flip(plus(x, y)), shift(y, -5)): sequence O.K.
minus(plus(times(shift(flip(x), 4), shift(y, 3)), flip(y)), x):
 sequence O.K.


--- sequence.m --------------------------------

classdef sequence
 properties
  data
  offset
    end

    methods(Static)

        function [a,b] = padData(x,y)
            Lx = length(x.data) + x.offset;
            Ly = length(y.data) + y.offset;
            a = [zeros(1,x.offset-y.offset), x.data, zeros(1,Ly-Lx)];
            b = [zeros(1,y.offset-x.offset), y.data, zeros(1,Lx-Ly)];
        end

%         % My Original Implementation
%         %
%         % Pads the input sequences so that they are of the same
 length.
%         % Sequence with the lower offset will not have front
 padding. This
%         % returns the data portion of the sequences only.
%         function [a,b] = padData(x,y)
%             % Find which sequencce has the lower offset (furthest to
 the
%             % left).
%             lo = sequence([],0);
%             hi = sequence([],0);
%             if(x.offset<y.offset)
%                 lo = x;
%                 hi = y;
%             else
%                 lo = y;
%                 hi = x;
%             end
%             % Define ints for left and right padding of zeros.
%             leftPad = hi.offset-lo.offset;
%             rightPad = (length(lo.data)+lo.offset)-
(length(hi.data)+hi.offset);
%             % Padding the left side of the sequence with the higher
 offset
%             % is easiest.
%             hi.data = [zeros(1,leftPad),hi.data];
%             % Pad the right side of either the lower or higher
 offset
%             % sequence depending on whether rightPad is
%             % positive or negative.
%             if(rightPad>0)
%                 hi.data = [hi.data, zeros(1,rightPad)];
%             elseif(rightPad<0)
%                 lo.data = [lo.data, zeros(1,abs(rightPad))];
%             end
%             % Map lo and hi back to the order in which they came
 i.e. a = x
%             % and b = y.
%             if(x.offset<y.offset)
%                 a=lo.data;
%                 b=hi.data;
%             else
%                 a=hi.data;
%                 b=lo.data;
%             end
%         end
    end

 methods
  function s = sequence(data, offset)
   % SEQUENCE   Sequence object
   %            S = SEQUENCE(DATA, OFFSET) creates sequence S
   %            using DATA and OFFSET
   %
   %            Your Name  1 Jan 2014
   s.data = data;
   s.offset = offset;
  end

  function display(s)
   var = inputname(1);
   if (isempty(var))
    disp('ans =');
   else
    disp([var '=']);
   end
   switch length(s.data)
    case 0
     disp('   data: []')
    case 1
     disp(['    data: ', num2str(s.data)])
    otherwise
     disp(['    data: [' num2str(s.data) ']'])
   end
   disp(['  offset: ' num2str(s.offset)])
  end

  function y = flip(x)
            ofs = -(x.offset+length(x.data)-1);
   y = sequence(x.data(end:-1:1),ofs);
  end

  function y = shift(x, n0)
   y = sequence(x.data, x.offset+n0);
        end

  function z = plus(x, y)
            if(isa(x,'double'))
                z = sequence(x+y.data,y.offset);
            elseif(isa(y,'double'))
                z = sequence(x.data+y,x.offset);
            else
                [a, b] = sequence.padData(x,y);
                z = sequence(a+b,min(x.offset,y.offset));
            end
            %trim(z);
        end

  function z = minus(x, y)
            if(isa(x,'double'))
                z = sequence(x-y.data,y.offset);
            elseif(isa(y,'double'))
                z = sequence(x.data-y,x.offset);
            else
                [a, b] = sequence.padData(x,y);
                z = sequence(a-b,min(x.offset,y.offset));
            end
            %trim(z);
  end

  function z = times(x, y)
            if(isa(x,'double'))
                z = sequence(x.*y.data,y.offset);
            elseif(isa(y,'double'))
                z = sequence(x.data.*y,x.offset);
            else
                [a, b] = sequence.padData(x,y);
                z = sequence(a.*b,min(x.offset,y.offset));
            end
            %trim(z);
        end

        function x = trim(x)
```

```
            while(x.data(1) == 0 && length(x.data)>1)
                x.data(1) = [];
            end
            while(x.data(end) == 0 && length(x.data)>1)
                x.data(end) = [];
            end
        end

  function stem(x)
   % STEM Display a Matlab sequence, x, using a stem plot.
            data_length = length(x.data);
            n_axis_indeces = linspace(1,data_length,data_length);
            n_axis_vals = n_axis_indeces
+linspace(x.offset,x.offset,data_length)-1;

            figure()
            stem(x.data)

            xlabel('n'); title('x');

            set(gca,'XTick', n_axis_indeces );
            set(gca,'XTickLabel', n_axis_vals );

  end
 end
end

% When finished: publish Lab1 'pdf' or 'doc'
```



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