```
% ENGR 451 - Signals and Systems Laboratory

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

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

% test time
test_lab1('times(x, y)')
test_lab1('times(2, x)')
test_lab1('times(x, -2)')

% 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, -1))')
test_lab1('minus(plus(times(shift(flip(x), 3), shift(y, 2)), flip(y)), x)')

% test stem
set(clf, 'Position', [200 200 400 200])
stem(flip(1+(x-shift(y, 2).*y-3)))
title('y[n]');

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

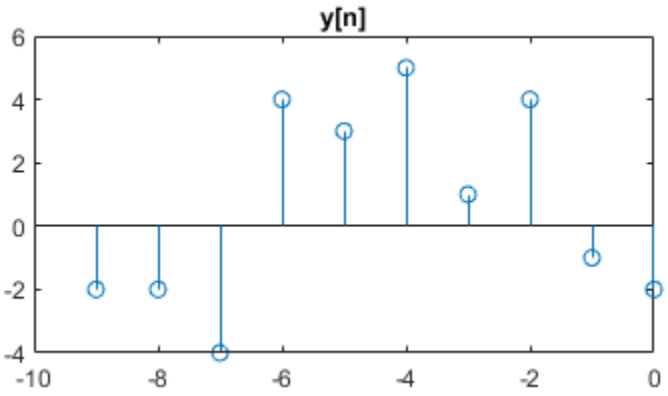
```
plus(x, y): sequence O.K.
plus(y, x): sequence O.K.
plus(1, x): sequence O.K.
plus(x, 1): sequence O.K.
```

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


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

classdef sequence
 properties
  data
  offset
 end

 methods
  function s = sequence(dat, off)
   % SEQUENCE   Sequence object
   %            S = SEQUENCE(DATA, OFFSET) creates sequence S
   %            using DATA and OFFSET
   s.data = dat;
   s.offset = off;
  end

  function y = flip(x)
   % FLIP Flip a Matlab sequence structure x so y = x[-n]
   dat = x.data;
   off = x.offset;
   len = length(dat)-1;

   % Flipping array and changing the offset
   flipoff = (off + len) * -1;
   fliparr = x.data(end:-1:1);
   y = sequence(fliparr, flipoff);
  end

  function y = shift(x, n0)
   % SHIFT Shift a Matlab sequence structure x by integer amount n0 so that
 y[n] = x[n - n0]
   dat  = x.data;
   off = x.offset;

   y = sequence(dat, off+n0);
  end
```

```
 function z = plus(x, y)
  % PLUS  Add x and y. Either x and y will both be sequence structures, or
one of them may be a number.
  if (isa(x, 'sequence') && isa(y, 'double')) % only x is a sequence
   % do something;
   zdat = x.data + y;
   z = sequence(zdat, x.offset);
  elseif  (isa(y, 'sequence') && isa(x, 'double')) % only y is a sequence
   % do something else
   zdat = y.data + x;
   z = sequence(zdat, y.offset);
  else % both x and y are sequences
   % do something
   xdat = x.data;
   ydat = y.data;
   xoff = x.offset;
   yoff = y.offset;
   xlen = length(xdat);
   ylen = length(ydat);

   % Get the array of whole size, min and max of arr
   temparr1 = [1:xlen] + xoff;
   minarr1 = min(temparr1);
   maxarr1 = max(temparr1);
   temparr2 = [1:ylen] + yoff;
   minarr2 = min(temparr2);
   maxarr2 = max(temparr2);
   fullsize = min(min(temparr1), min(temparr2)) : max(max(temparr1),
max(temparr2));

   % Convert into new array with the new size
   newx = zeros(1,length(fullsize));
   newy = zeros(1,length(fullsize));

   % Finding indeces and replacing the values
   newx((fullsize >= minarr1) & (fullsize <= maxarr1)) = xdat;
   newy((fullsize >= minarr2) & (fullsize <= maxarr2)) = ydat;

   zdat = newx + newy;
   zoff = min([xoff yoff]);
   z = sequence(zdat, zoff);
  end
 end

 function z = minus(x, y)
  % MINUS Subtract x and y. Either x and y will both be sequence structures,
or one of them may be a number.
  if(isa(x, 'sequence') && isa(y, 'double'))
   zdat = x.data - y;
   z = sequence(zdat, x.offset);
  elseif (isa(y, 'sequence') && isa(x, 'double'))
   zdat = x - y.data;
   z = sequence(zdat, y.offset);
  else
```

```
    xdat = x.data;
    ydat = y.data;
    xoff = x.offset;
    yoff = y.offset;
    xlen = length(xdat);
    ylen = length(ydat);

    % Get the array of whole size, min and max of arr
    temparr1 = [1:xlen] + xoff;
    minarr1 = min(temparr1);
    maxarr1 = max(temparr1);
    temparr2 = [1:ylen] + yoff;
    minarr2 = min(temparr2);
    maxarr2 = max(temparr2);
    fullsize = min(min(temparr1), min(temparr2)) : max(max(temparr1),
max(temparr2));

    % Convert into new array with the new size
    newx = zeros(1,length(fullsize));
    newy = zeros(1,length(fullsize));

    % Finding indeces and replacing the values
    newx((fullsize >= minarr1) & (fullsize <= maxarr1)) = xdat;
    newy((fullsize >= minarr2) & (fullsize <= maxarr2)) = ydat;
    zdat = newx - newy;

    zoff = min([xoff yoff]);
    z = sequence(zdat, zoff);
   end
  end

  function z = times(x, y)
   % TIMES Multiply x and y (i.e. .*) Either x and y will both be sequence
structures, or one of them may be a number.
   if(isa(x, 'sequence') && isa(y, 'double'))
    zdat = x.data .* y;
    z = sequence(zdat, x.offset);
   elseif (isa(y, 'sequence') && isa(x, 'double'))
    zdat = y.data .* x;
    z = sequence(zdat, y.offset);
   else
    xdat = x.data;
    ydat = y.data;
    xoff = x.offset;
    yoff = y.offset;
    xlen = length(xdat);
    ylen = length(ydat);

    % Get the array of whole size, min and max of arr
    temparr1 = [1:xlen] + xoff;
    minarr1 = min(temparr1);
    maxarr1 = max(temparr1);
    temparr2 = [1:ylen] + yoff;
    minarr2 = min(temparr2);
```

```
    maxarr2 = max(temparr2);
    fullsize = min(min(temparr1), min(temparr2)) : max(max(temparr1),
 max(temparr2));

    % Convert into new array with the new size
    newx = zeros(1,length(fullsize));
    newy = zeros(1,length(fullsize));

    % Finding indeces and replacing the values
    newx((fullsize >= minarr1) & (fullsize <= maxarr1)) = xdat;
    newy((fullsize >= minarr2) & (fullsize <= maxarr2)) = ydat;

    zdat = newx .* newy;
    zoff = min([xoff yoff]);
    z = sequence(zdat, zoff);
   end
  end

  function stem(x)
   % STEM Display a Matlab sequence x using a stem plot.
   dat = x.data;
   off = x.offset;

   len = length(dat);
   offArr = [0:len-1]+off;

   stem(offArr, dat);
  end
 end
end
```



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