MATLAB Code

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%Experiment 3                Date: 4th February 2020
%Aim: Computation of DFT, IDFT and Linear & Circular Convolution

%dft.m
function X = dft(x,N)
L = length(x);
if(L<N)
    for i=1:N-L
        x(L+i) = 0;
        i=i+1;
    end
elseif(L>N)
    for i=1:N
        x1(i) = x(i);
    end
    x = x1;
end
X = zeros(1,N);
for i=1:N
    for j=1:N
        X(i) = X(i) + x(j)*exp(-2i*pi*(i-1)*(j-1)/N);
    end
end

%idft.m
function x = idft(X,N)
L = length(X);
if(L<N)
    for i=1:N-L
        X(L+i) = 0;
        i=i+1;
    end
elseif(L>N)
    for i=1:N
        x1(i) = X(i);
    end
    X = x1;
end
x = zeros(1,N);
for i = 1:N
    for j = 1:N
        x(i) = x(i)+X(j)*exp(2i*pi*(i-1)*(j-1)/N);
    end
end
x = x/N;

%main.m

clc;
clear all;
close all;
N = 200;
x1 = zeros(1,N);
x2 = zeros(1,N);
for n=1:N
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    x1(n) = 2*cos(2*pi*n/10) + cos(2*pi*n/5);
    x2(n) = n;
end
figure();
subplot(231);
stem(x1);
title("x1[n] = 2cos(2PIn/10) + cos(2PIn/5)");
xlabel n;
ylabel x[n];
subplot(234);
stem(x2);
title("x2[n] = n");
xlabel n;
ylabel x2[n];

%Finding the N-point DFT
X1 = dft(x1,N);
X2 = dft(x2,N);
subplot(232);
stem(X1);
title ("DFT of x1[n]");
xlabel n;
ylabel X1[n];
subplot(235);
stem(X2)
title ("DFT of x2[n]");
xlabel n;
ylabel X2[n];

%Finding the IDFT of the above
y1 = idft(X1,N);
y2 = idft(X2,N);
subplot(233);
stem(y1);
title ("IDFT of X1[n]");
xlabel n;
ylabel x1[n];
ylim([-2,3]);
subplot(236);
stem(y2);
title ("IDFT of X2[n]");
xlabel n;
ylabel x2[n];
ylim([0,200]);

%Linear and circular  convolution using dft and idft
a1 = [1 3 -2 4 7];
h1 = [3 1 21 -3];
n1 = length(a1);
m1 = length(h1);
N1 = n1 + m1 -1;
A1 = dft(a1,N1);
H1 = dft(h1,N1);
B1 = A1.*H1;
b1 = idft(B1,N1)
if(round(b1) == conv(a1,h1))
    disp("Linear Convolution correct")
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end
cA1 = dft(a1,n1);
cH1 = dft(h1,n1);
cB1 = cA1.*cH1;
cb1 = idft(cB1,n1)
if(round(cb1) == round(cconv(a1,h1,n1)))
    disp("Circular convolution correct");
end

a2 = zeros(1,10);
h2 = zeros(1,10);
n2 = length(a2);
m2 = length(h2);
for i=1:n2
    a2(i) = i;
end
for i=1:m2
    h2(i) = power(0.5,i);
end
N2 = n2 + m2 -1;
A2 = dft(a2,N2);
H2 = dft(h2,N2);
B2 = A2.*H2;
b2 = idft(B2,N2)
if(round(b2,4) == round(conv(a2,h2),4))
    disp("Linear Convolution correct")
end
cA2 = dft(a2,n2);
cH2 = dft(h2,n2);
cB2 = cA2.*cH2;
cb2 = idft(cB2,n2)
if(round(cb2,4) == round(cconv(a2,h2,n2),4))
    disp("Circular convolution correct");
end

a3 = zeros(1,20);
h3 = zeros(1,20);
n3 = length(a3);
m3 = length(h3);
for i=1:n3
    a3(i) = sin(pi*i/20);
end
for i=1:m3
    h3(i) = power(0.25,i);
end
N3 = n3 + m3 -1;
A3 = dft(a3,N3);
H3 = dft(h3,N3);
B3 = A3.*H3;
b3 = idft(B3,N3)
if(round(b3,4) == round(conv(a3,h3),4))
    disp("Linear Convolution correct")
end
cA3 = dft(a3,n3);
cH3 = dft(h3,n3);
cB3 = cA3.*cH3;
cb3 = idft(cB3,n3)
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if(round(cb3,4) == round(cconv(a3,h3,n3),4))
    disp("Circular convolution correct");
end
```

RESULT

```
b1 =

   1.0e+02 *

  Columns 1 through 3

   0.0300 - 0.0000i   0.1000 - 0.0000i   0.1800 - 0.0000i

  Columns 4 through 6

   0.7000 - 0.0000i  -0.2600 - 0.0000i   0.9700 - 0.0000i

  Columns 7 through 8

   1.3500 + 0.0000i  -0.2100 + 0.0000i

Linear Convolution correct

cb1 =

   1.0e+02 *

  Columns 1 through 3

   1.0000 + 0.0000i   1.4500 + 0.0000i  -0.0300 - 0.0000i

  Columns 4 through 5

   0.7000 - 0.0000i  -0.2600 - 0.0000i

Circular convolution correct

b2 =

  Columns 1 through 3

   0.5000 - 0.0000i   1.2500 - 0.0000i   2.1250 - 0.0000i

  Columns 4 through 6

   3.0625 + 0.0000i   4.0313 - 0.0000i   5.0156 + 0.0000i

  Columns 7 through 9

   6.0078 - 0.0000i   7.0039 + 0.0000i   8.0020 + 0.0000i

  Columns 10 through 12

   9.0010 - 0.0000i   4.5000 + 0.0000i   2.2490 + 0.0000i

  Columns 13 through 15
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    1.1230 + 0.0000i   0.5596 + 0.0000i   0.2773 - 0.0000i

  Columns 16 through 18

    0.1357 + 0.0000i   0.0645 + 0.0000i   0.0283 - 0.0000i

  Column 19

    0.0098 + 0.0000i

Linear Convolution correct

cb2 =

  Columns 1 through 3

    5.0000 + 0.0000i   3.4990 + 0.0000i   3.2480 - 0.0000i

  Columns 4 through 6

    3.6221 - 0.0000i   4.3086 + 0.0000i   5.1514 - 0.0000i

  Columns 7 through 9

    6.0723 - 0.0000i   7.0322 + 0.0000i   8.0117 + 0.0000i

  Column 10

    9.0010 - 0.0000i

Circular convolution correct

b3 =

  Columns 1 through 3

    0.0391 - 0.0000i   0.0870 + 0.0000i   0.1353 - 0.0000i

  Columns 4 through 6

    0.1808 - 0.0000i   0.2220 - 0.0000i   0.2577 - 0.0000i

  Columns 7 through 9

    0.2872 - 0.0000i   0.3096 - 0.0000i   0.3243 + 0.0000i

  Columns 10 through 12

    0.3311 + 0.0000i   0.3297 + 0.0000i   0.3202 - 0.0000i

  Columns 13 through 15

    0.3028 - 0.0000i   0.2780 + 0.0000i   0.2463 - 0.0000i

  Columns 16 through 18
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   0.2085 - 0.0000i   0.1656 + 0.0000i   0.1187 + 0.0000i

  Columns 19 through 21

   0.0688 + 0.0000i   0.0172 + 0.0000i   0.0043 + 0.0000i

  Columns 22 through 24

   0.0011 + 0.0000i   0.0003 + 0.0000i   0.0001 + 0.0000i

  Columns 25 through 27

   0.0000 + 0.0000i   0.0000 - 0.0000i   0.0000 - 0.0000i

  Columns 28 through 30

   0.0000 + 0.0000i   0.0000 + 0.0000i   0.0000 - 0.0000i

  Columns 31 through 33

   0.0000 + 0.0000i   0.0000 - 0.0000i   0.0000 + 0.0000i

  Columns 34 through 36

   0.0000 - 0.0000i   0.0000 - 0.0000i   0.0000 - 0.0000i

  Columns 37 through 39

   0.0000 + 0.0000i   0.0000 + 0.0000i   0.0000 + 0.0000i

Linear Convolution correct

cb3 =

  Columns 1 through 3

   0.0434 - 0.0000i   0.0881 - 0.0000i   0.1355 - 0.0000i

  Columns 4 through 6

   0.1808 - 0.0000i   0.2220 - 0.0000i   0.2578 - 0.0000i

  Columns 7 through 9

   0.2872 - 0.0000i   0.3096 + 0.0000i   0.3243 + 0.0000i

  Columns 10 through 12

   0.3311 + 0.0000i   0.3297 + 0.0000i   0.3202 - 0.0000i

  Columns 13 through 15

   0.3028 - 0.0000i   0.2780 + 0.0000i   0.2463 + 0.0000i

  Columns 16 through 18

   0.2085 + 0.0000i   0.1656 + 0.0000i   0.1187 + 0.0000i
  Columns 19 through 20

   0.0688 + 0.0000i   0.0172 + 0.0000i

Circular convolution correct
```