fft 函数

```
function Y = fftNew(X)
%自己实现的 MATLAB 中的 fft 程序。
if length(X) == 3
    Y = zeros(1,3);
    Y(1) = X(1)+X(2)+X(3);
    Y(2) = X(1)+exp(-1j*2*pi/3)*X(2)+exp(-1j*4*pi/3)*X(3);
    Y(3) = X(1)+exp(-1j*4*pi/3)*X(2)+exp(-1j*8*pi/3)*X(3);
else
    N = 3^floor(log(length(X))/log(3));
    X = X(1:N);

    X1 = X([1:3:N]);
    X2 = X([2:3:N]);
    X3 = X([3:3:N]);
    Y1 = fftNew(X1);
    Y2 = fftNew(X2);
    Y3 = fftNew(X3);

    Y = zeros(1,N);
    for k = 2:N/3
        Y2(k) = Y2(k)*exp(-1j*2*pi*(k-1)/N);
    end
    for k = 2:N/3
        Y3(k) = Y3(k)*exp(-1j*4*pi*(k-1)/N);
    end
    for k = 1:N/3
        Y(k) = Y1(k) + Y2(k) + Y3(k);
        Y(k+N/3) = Y1(k) + exp(-1j*2*pi/3)*Y2(k) + exp(-1j*4*pi/3)*Y3(k);
        Y(k+2*N/3) = Y1(k) + exp(-1j*4*pi/3)*Y2(k) + exp(-1j*8*pi/3)*Y3(k);
    end
end
```

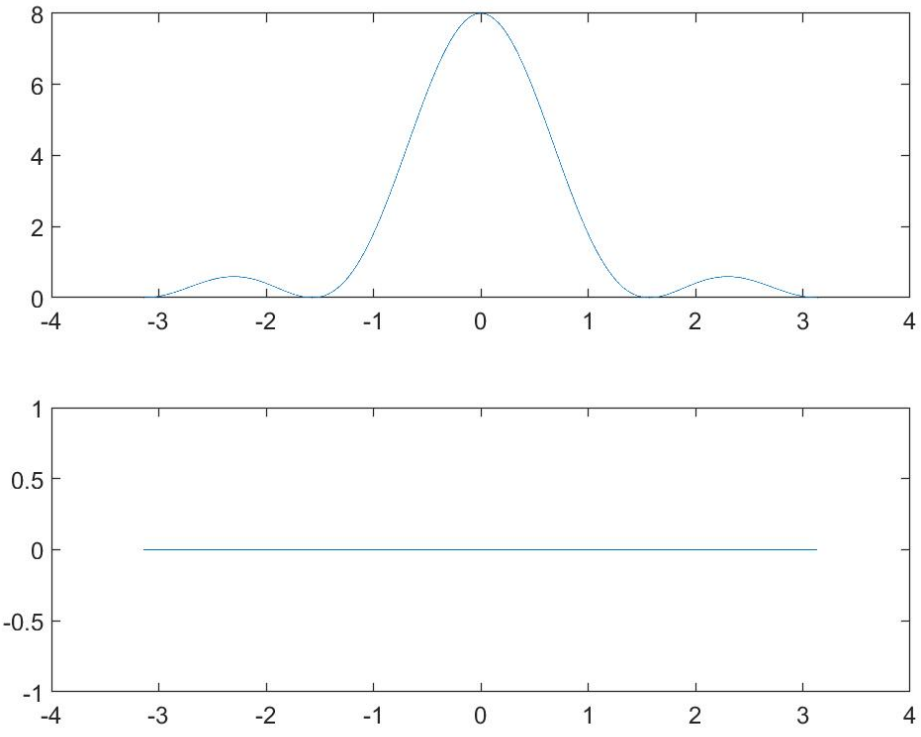
ifft 函数

```
function Y = ifftNew(X)
%自己实现的 MATLAB 中的 ifft 程序。
N = 3^floor(log(length(X))/log(3));
X = X(1:N);
if length(X) == 3
    Y = zeros(1,3);
    Y(1) = X(1)+X(2)+X(3);
    Y(2) = X(1)+exp(1j*2*pi/3)*X(2)+exp(1j*4*pi/3)*X(3);
    Y(3) = X(1)+exp(1j*4*pi/3)*X(2)+exp(1j*8*pi/3)*X(3);
else
    X1 = X([1:3:N]);
    X2 = X([2:3:N]);
    X3 = X([3:3:N]);
    Y1 = ifftNew(X1);
    Y2 = ifftNew(X2);
    Y3 = ifftNew(X3);

    Y = zeros(1,N);
    for k = 2:N/3
        Y2(k) = Y2(k)*exp(1j*2*pi*(k-1)/N);
    end
    for k = 2:N/3
        Y3(k) = Y3(k)*exp(1j*4*pi*(k-1)/N);
    end
    for k = 1:N/3
        Y(k) = Y1(k) + Y2(k) + Y3(k);
        Y(k+N/3) = Y1(k) + exp(1j*2*pi/3)*Y2(k) + exp(1j*4*pi/3)*Y3(k);
        Y(k+2*N/3) = Y1(k) + exp(1j*4*pi/3)*Y2(k) + exp(1j*8*pi/3)*Y3(k);
    end
end
Y= Y/3;
```

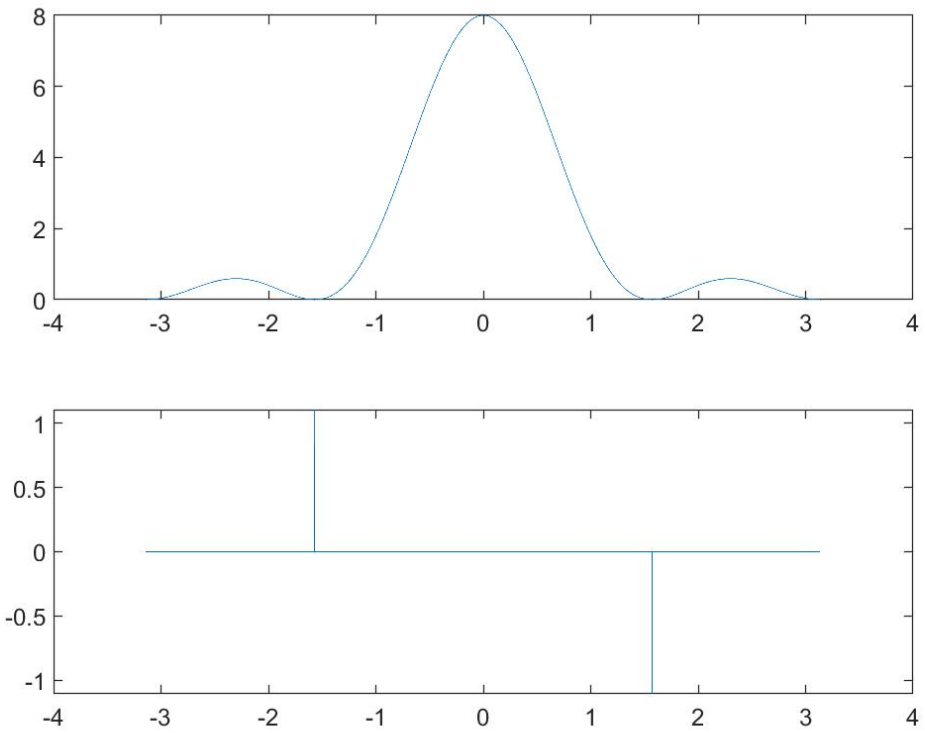
直接做图法画幅度谱和相位谱

```
N = 50;
w = [-pi:0.001:pi];
y = zeros(1,length(w));
p = zeros(1,length(w));
for i = 1:length(w)
    y(i) = cos(3*w(i)) + 2*cos(2*w(i)) + 3*cos(w(i)) + 2;
end
subplot(2,1,1);
plot(w,y);
subplot(2,1,2);
plot(w,p);
```



fft 法画幅度谱和相位谱

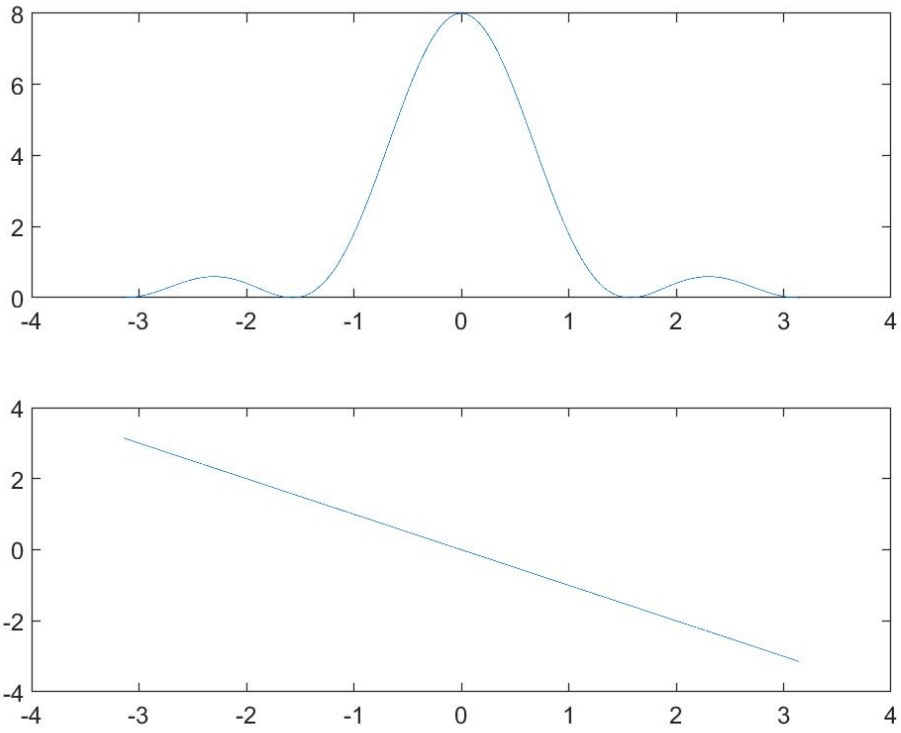
```
N = 7;
x  = [1/2, 1, 3/2, 2, 3/2, 1, 1/2, zeros(1,length(w)-N)];
y = fft(x);
for i = 1:length(y)
    y(i) = y(i)*exp(1j*2*pi*(i-1)*3/length(y));
end
y =fftshift(y);
for i = 1:length(y)
    p(i)=atan(imag(y(i))/real(y(i)));
end
for i = 1:length(y)
    y(i)=(real(y(i))^2+imag(y(i))^2)^0.5;
end
subplot(2,1,1);
plot(w,y);
subplot(2,1,2);
plot(w,p);
```



第三题图得到结果

直接做图法

```
N = 50;
w = [-pi:0.001:pi];
y = zeros(1,length(w));
p = -w;
for i = 1:length(w)
    y(i) = cos(3*w(i)) + 2*cos(2*w(i)) + 3*cos(w(i)) + 2;
end
subplot(2,1,1);
plot(w,y);
subplot(2,1,2);
plot(w,p);
```



fft 法

```
N = 7;
x  = [1/2, 1, 3/2, 2, 3/2, 1, 1/2, zeros(1,length(w)-N)];
y = fft(x);
for i = 1:length(y)
    y(i) = y(i)*exp(1j*2*pi*(i-1)*2/length(y));
end
y =fftshift(y);
for i = 1:length(y)
    p(i)=atan(imag(y(i))/real(y(i)));
end
for i = 1:length(y)
    y(i)=(real(y(i))^2+imag(y(i))^2)^0.5;
end
subplot(2,1,1);
plot(w,y);
subplot(2,1,2);
plot(w,p);
```