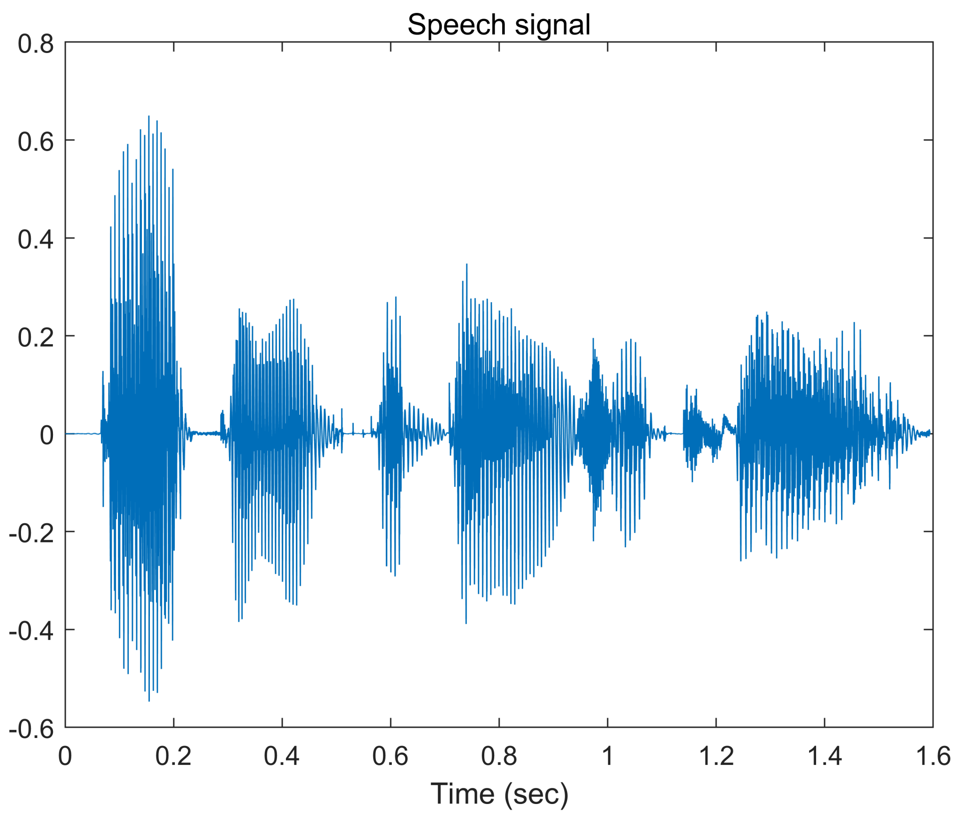
wave_filter_matlab.m

Load wave file

```
% [x, Fs] = audioread('author.wav');
[x, Fs] = audioread('author.wav');

N = length(x);
n = 1:N;
t = n/Fs;

figure(1)
clf
plot(t, x)
xlabel('Time (sec)')
title('Speech signal')
```

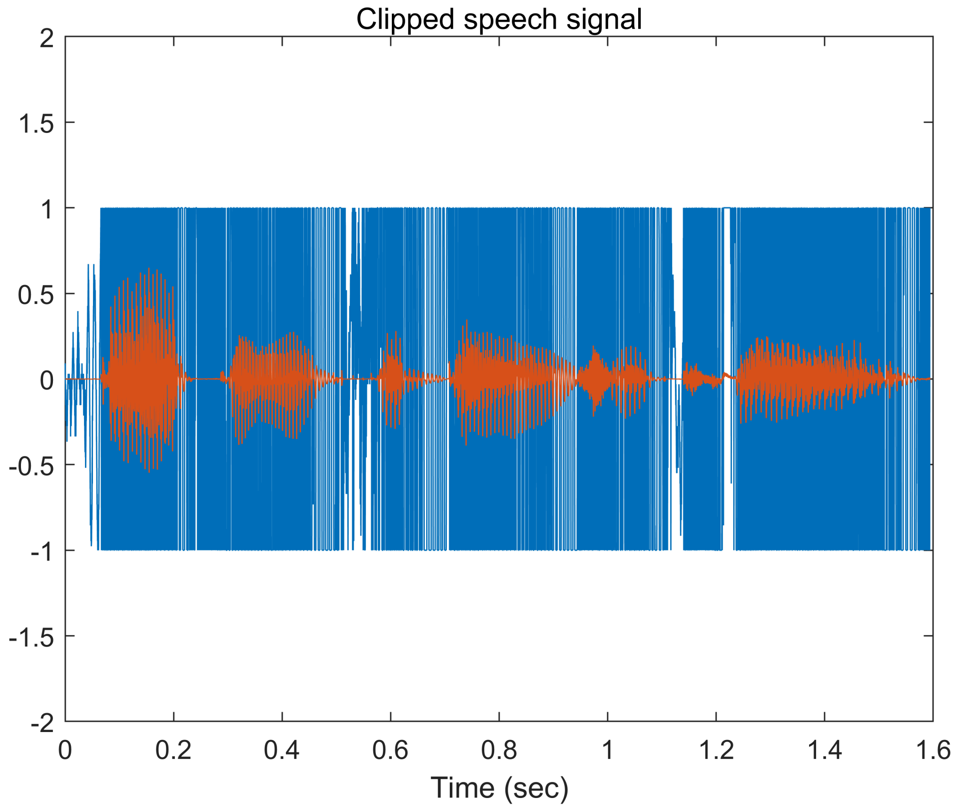


Simulate a clipped signal

Just to hear what it sounds like

```
x_clipped =  min(1, max(-1, x*1000));

figure(1)
clf
```

```
plot(t, x_clipped, t, x)
xlabel('Time (sec)')
title('Clipped speech signal')
ylim([-2 2])
```



Make filter

band-pass filter

```
a = [1.0, zeros(1,799) 0.8]
```

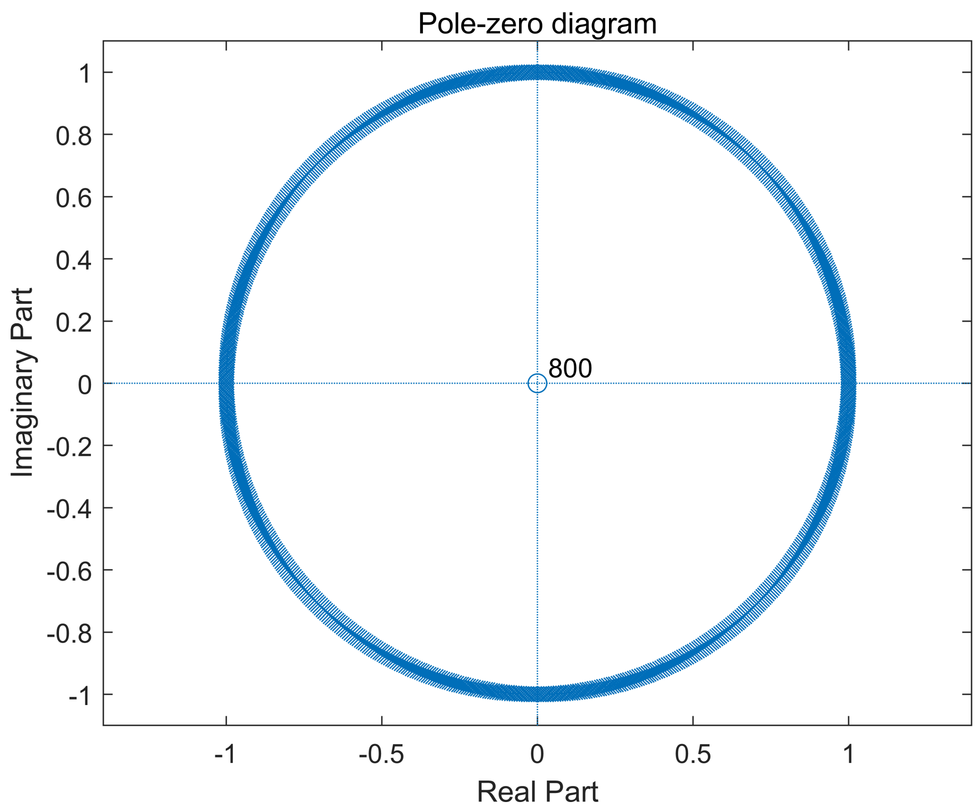
```
a = 1×801
     1     0     0     0     0     0     0     0     0     0     0     0     0···
```

```
b = 1
```

```
b = 1
```

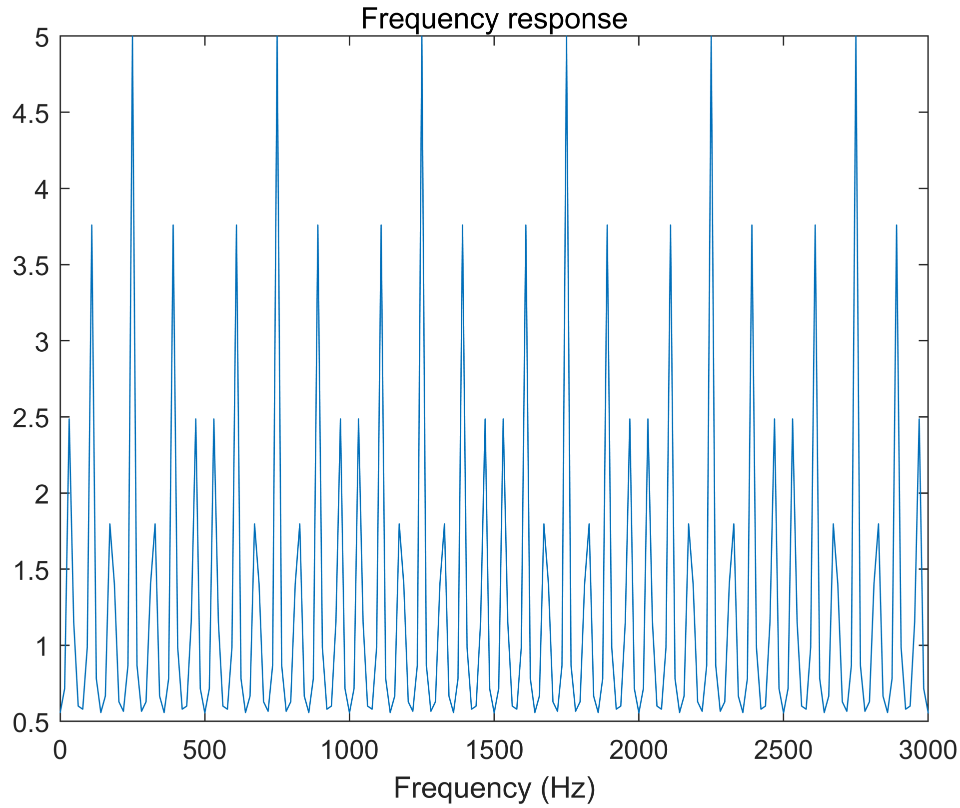
Pole-zero diagram

```
figure(1)
clf
zplane(b, a)
title('Pole-zero diagram')
```



Frequency response

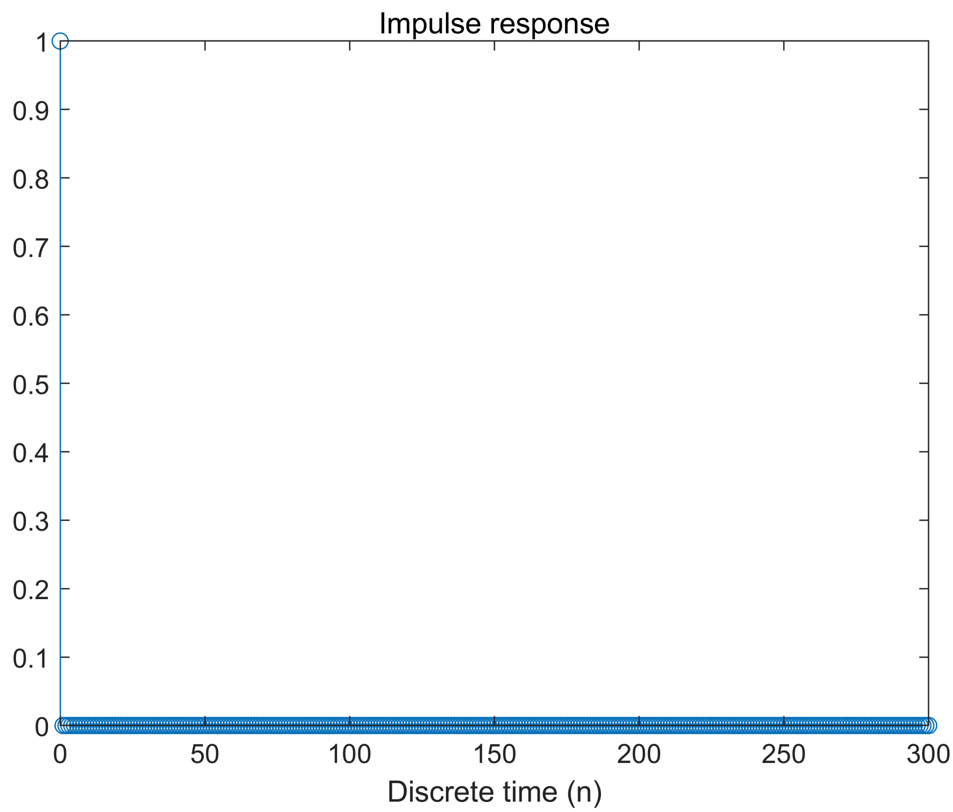
```
[H, om] = freqz(b, a);
f = om*Fs/(2*pi);
figure(1)
clf
plot(f, abs(H))
xlabel('Frequency (Hz)')
xlim([0 3000])
title('Frequency response')
```



Impulse response

discrete-time plot

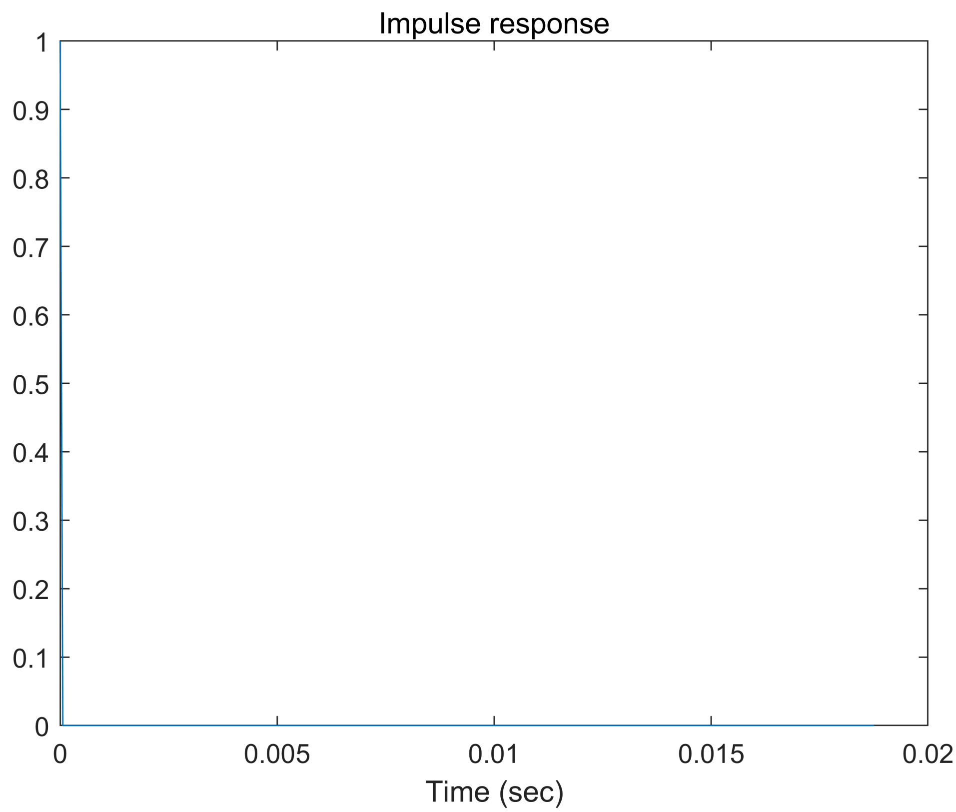
```
L = 300;
imp = [1 zeros(1, L)];
h = filter(b, a, imp);

figure(1)
clf
stem(0:L, h)
xlabel('Discrete time (n)')
title('Impulse response')
```



Impulse response

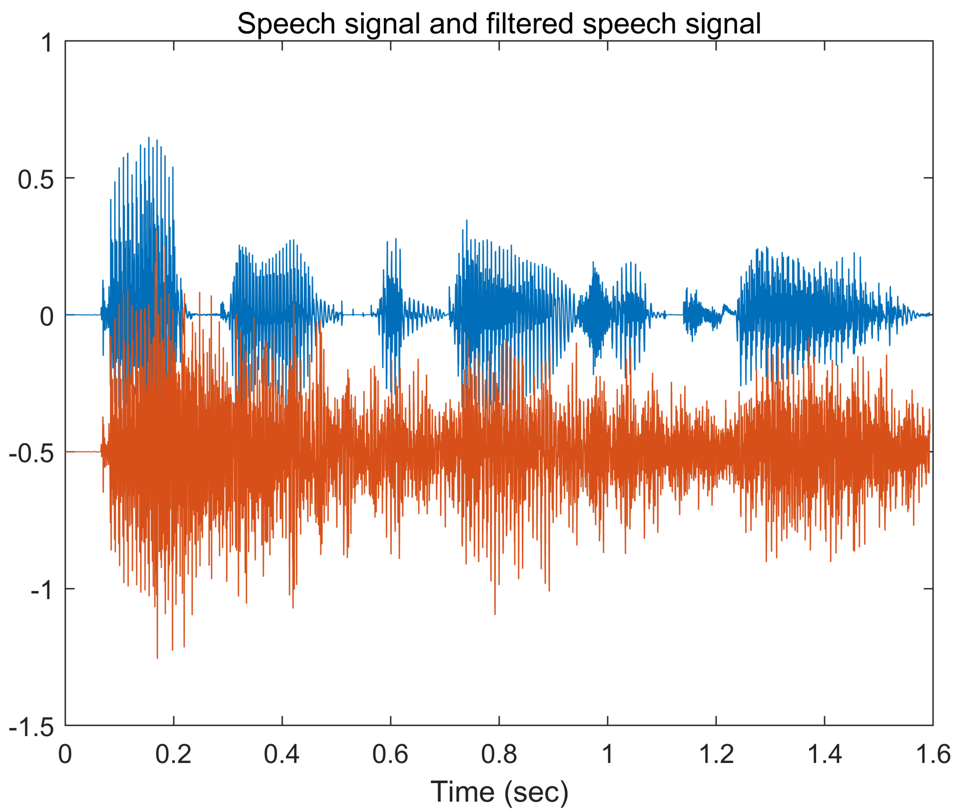
continuous-time plot

```
figure(1)
clf
plot((0:L)/Fs, h)
xlabel('Time (sec)')
title('Impulse response')
```



Apply filter to speech signal

```
y = filter(b, a, x);   % implement difference equation

figure(1)
clf
plot(t, x, t, y - 0.5)
xlabel('Time (sec)')
title('Speech signal and filtered speech signal')
zoom xon
```



Write output signal to wave file

```
% audiowrite('output_matlab.wav', y, Fs);
audiowrite('output_matlab_f.wav',y, Fs);
```

```
sound(x, Fs)
```

```
sound(y, Fs)
```

Filter coefficients

Copy these coefficients into Python program to implement the same filter. Display in long format for higher accuracy.

```
format long
b'
```

```
ans =
     1
```

```
a'
```

```
ans = 801×1
     1
     0
     0
     0
     0
     0
     0
     0
     0
     0
     ⋮
```