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Lab -2

Task 1

```
a = complex(15.5, 3.175);
[xb, yb] = pol2cart(deg2rad(45), 5);
b = complex(xb, yb);

% a)
real(a)
```

```
ans =
15.5000
```

```
real(b)
```

```
ans =
3.5355
```

```
% b)
imag(a)
```

```
ans =
3.1750
```

```
imag(b)
```

```
ans =
3.5355
```

```
% c)
conj(a)
```

```
ans =
15.5000 - 3.1750i
```

```
conj(b)
```

```
ans =
3.5355 - 3.5355i
```

```
% d)
angle(a)
```

```
ans =
0.2020
```

```
angle(b)
```

```
ans =
```

```
0.7854
```

```
% e)
abs(a)
```

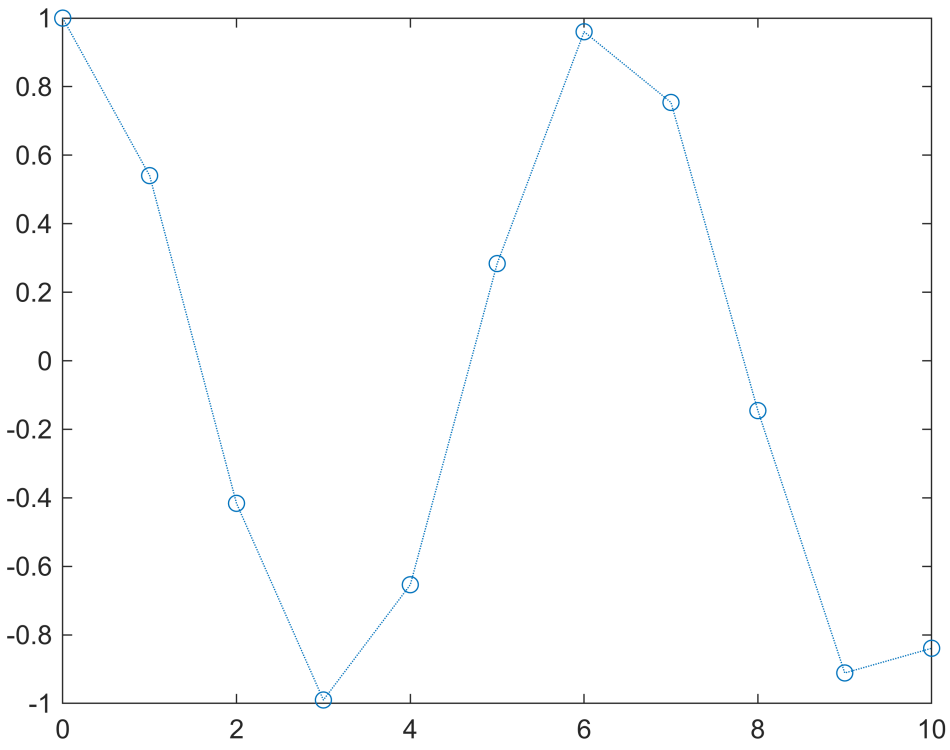
```
ans =
15.8218
```

```
abs(b)
```

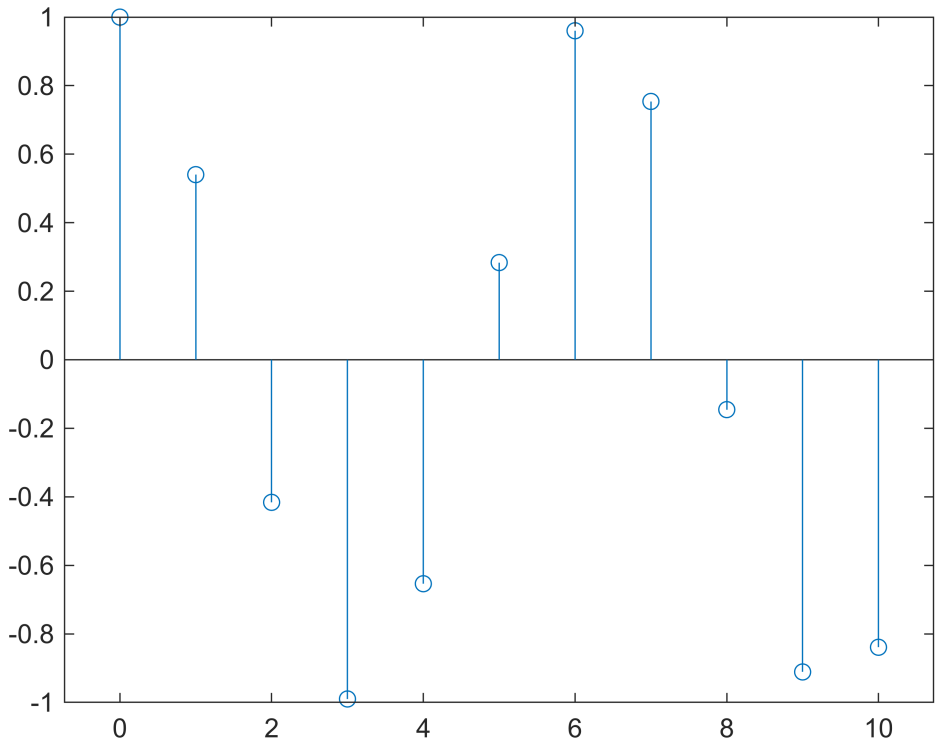
```
ans =
5
```

Try 1

```
n = 0:10;
y = cos(n);

figure;
plot(n, y, ':o');
```

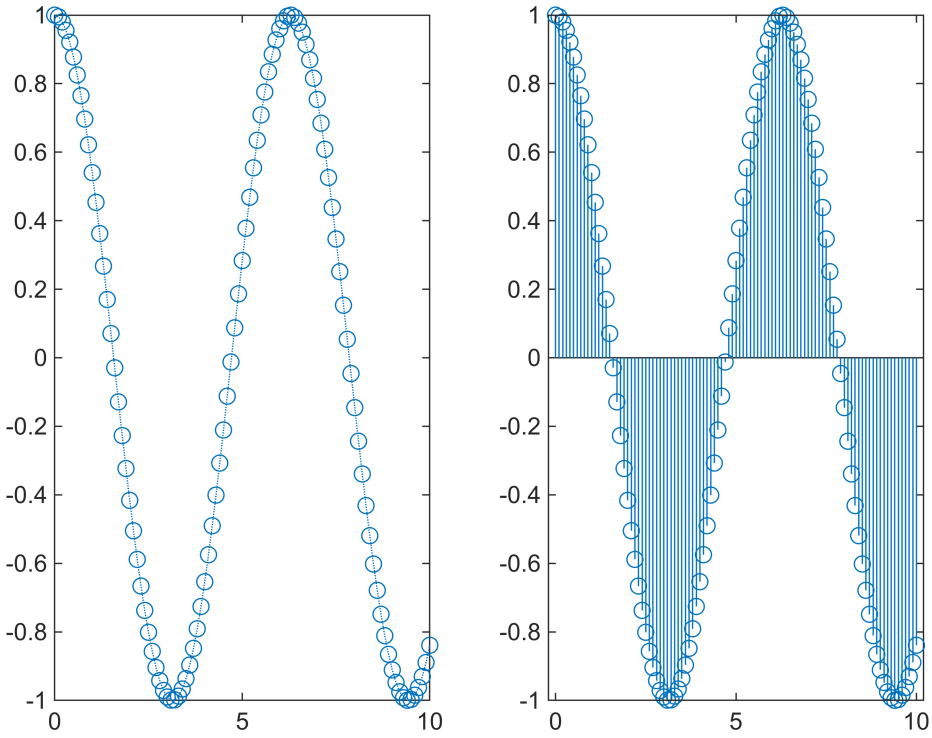



```
figure;
stem(n, y);
```



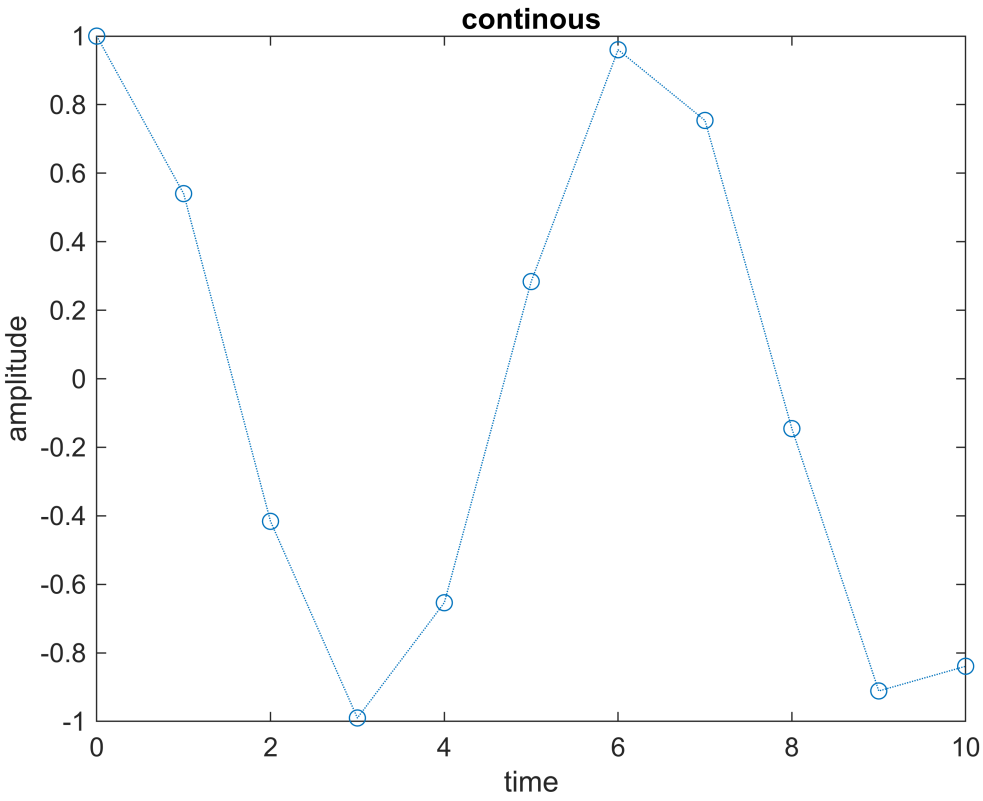
Try 2

```
Ts = 0.1;
t = 0:Ts:10;
y = cos(t);

figure;
subplot 121;
plot(t, y, ':o');

subplot 122;
stem(t, y);
```

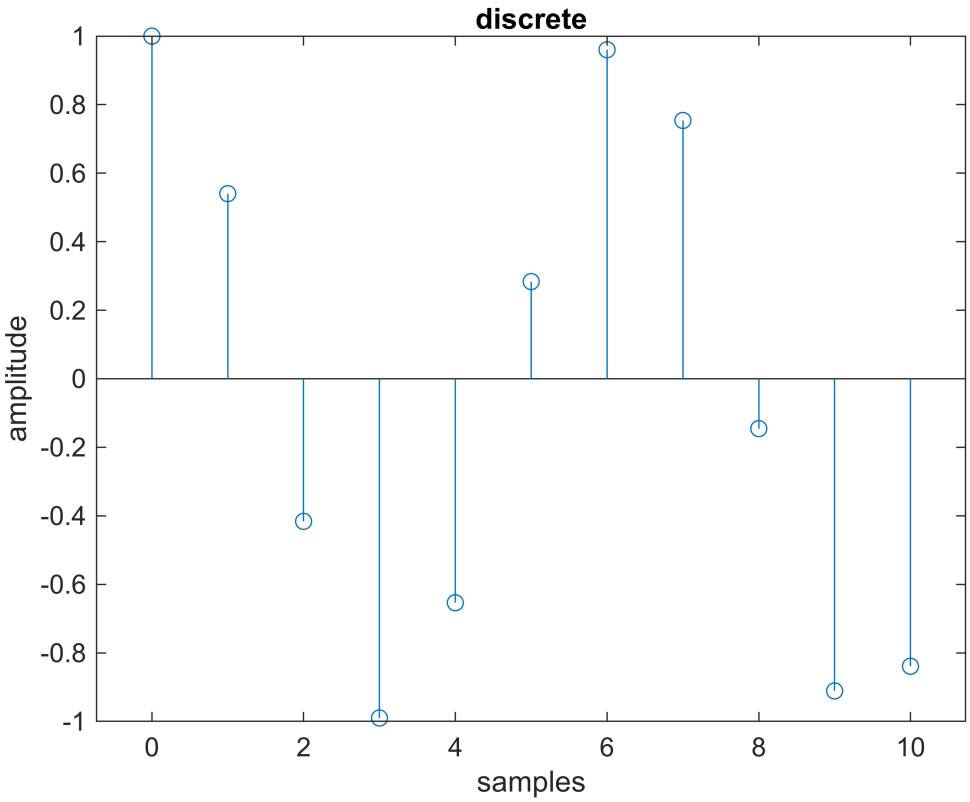


Task 2 (a)

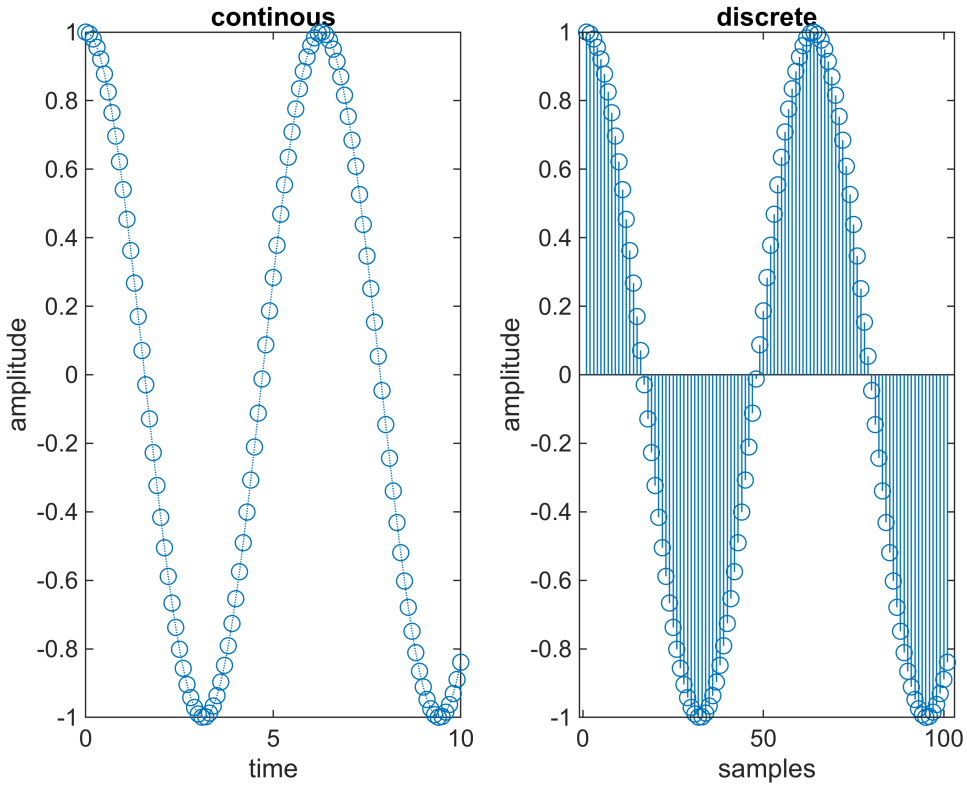
```
n = 0:10;
y = cos(n);

figure;
plot(n, y, ':o');
title("continous");
xlabel("time");
ylabel("amplitude");
```




```
figure;
stem(n, y);
title("discrete");
xlabel("samples");
ylabel("amplitude");
```

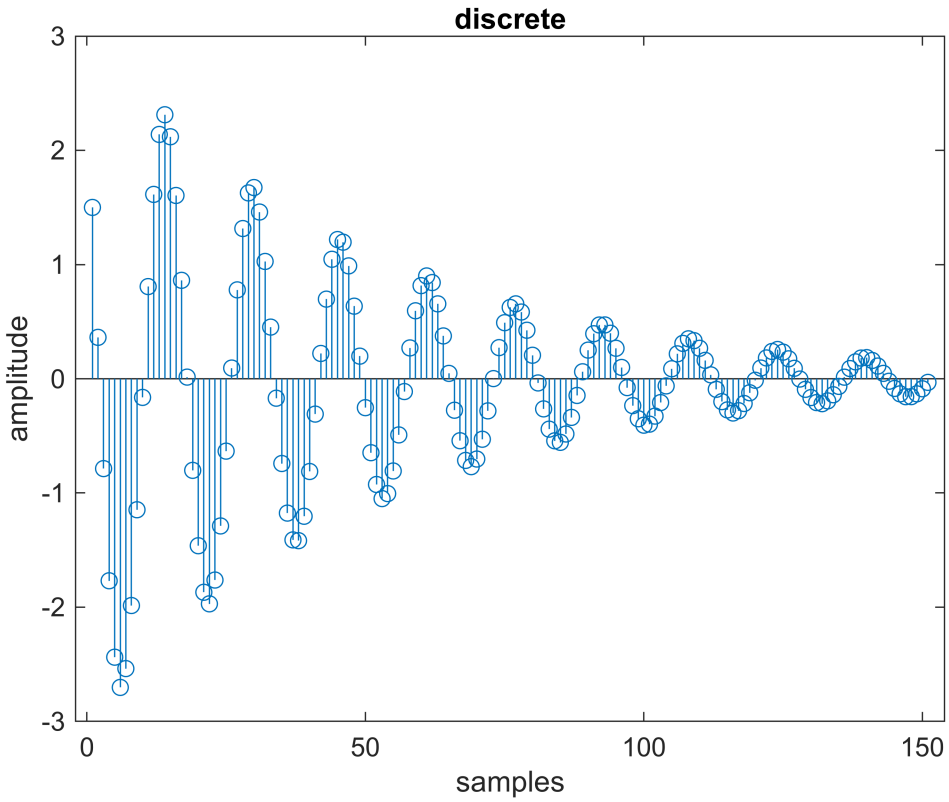



```
Ts = 0.1;
Fs = 1/Ts;
t = 0:Ts:10;
n=1:length(t);
y = cos(t);

figure;
subplot 121;
plot(t, y, ':o');
title("continous");
xlabel("time");
ylabel("amplitude");

subplot 122;
stem(n, y);
title("discrete");
xlabel("samples");
ylabel("amplitude");
```



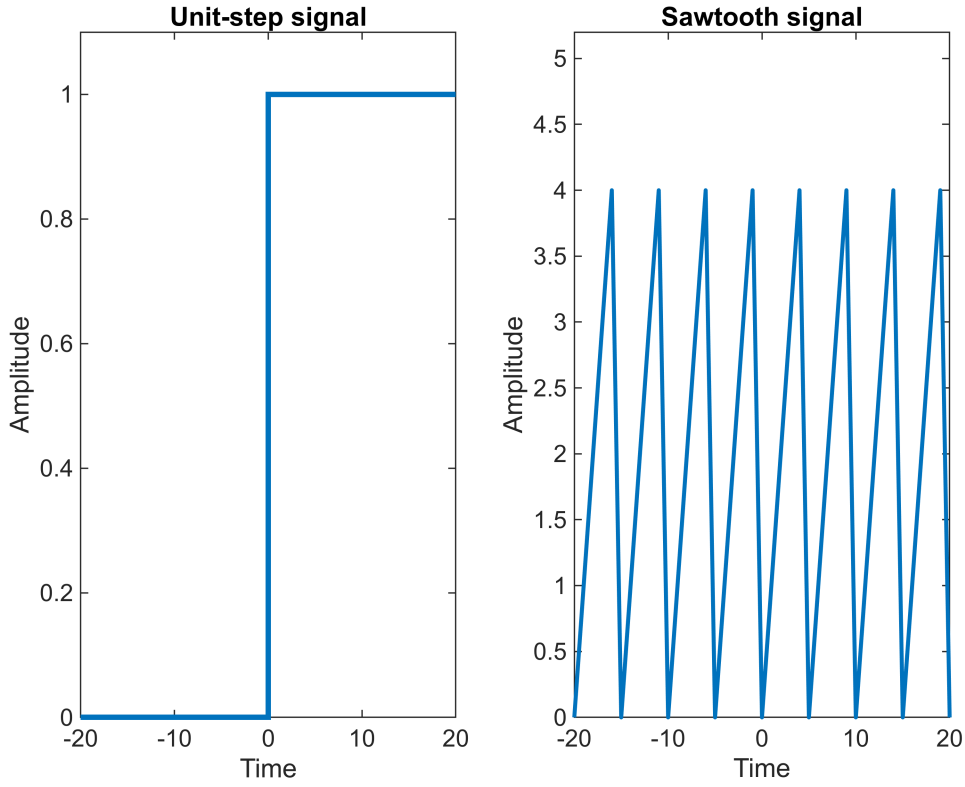
Task 2 (b)

```
fs = 50;
ts = 1/fs;
t = 0:ts:3;
func = 3 * exp(-t) .* cos(20 * t + pi / 3);
figure;
stem(1:length(t), func);
title("discrete");
xlabel("samples");
ylabel("amplitude");
```



Try 3

```
clc; clear
t = -20:1:20;
y = mod(t,5); % equivalent to t % 5
z = t>=0; % 0 for t<0, 1 for t >= 0

subplot(1,2,1); % a subplot of 1 row and 2 columns
stairs(t,z,'linewidth',2);
title('Unit-step signal');
xlabel('Time');
ylabel('Amplitude');
axis([-20 20 0 1.1]); % [min_x, max_x, min_y, max_y]

subplot(1,2,2);
plot(t,y,'linewidth',1.5);
title('Sawtooth signal');
xlabel('Time');
ylabel('Amplitude');
axis([-20 20 0 5.2]); % [min_x, max_x, min_y, max_y]
```

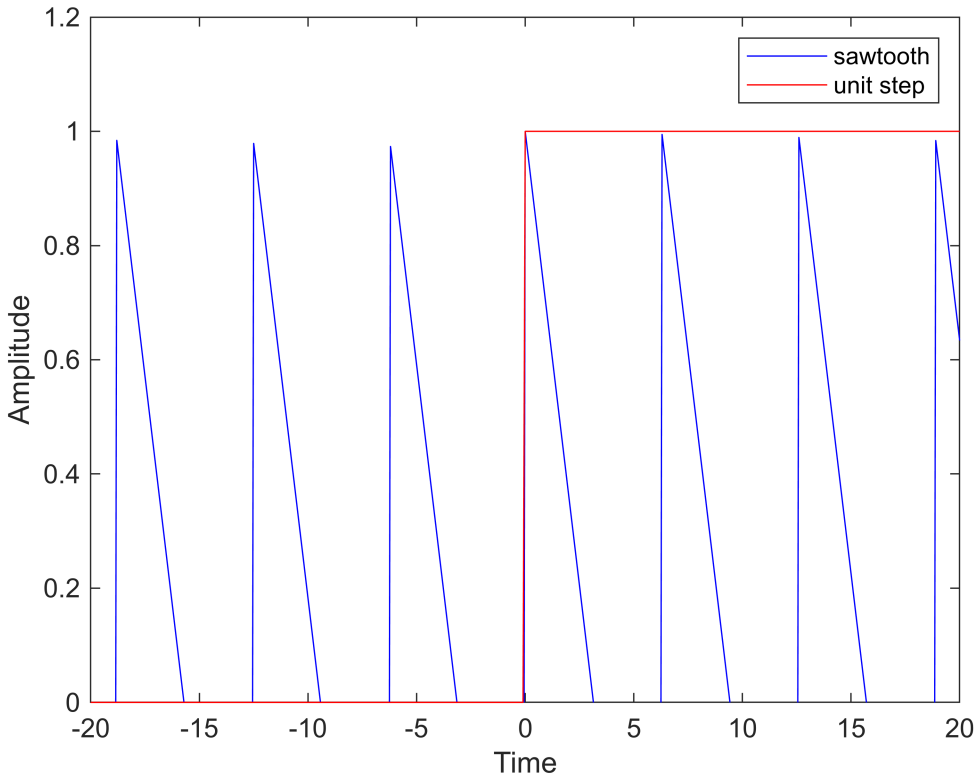


Task 3

```
t = -20:0.1:20;
y = sawtooth(t, 0); % bultin function for unit sawtooth
z = (t>=0) % 0 for t<0, 1 otherwise
```

```
z = 1×401 logical array
   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0 ···
```

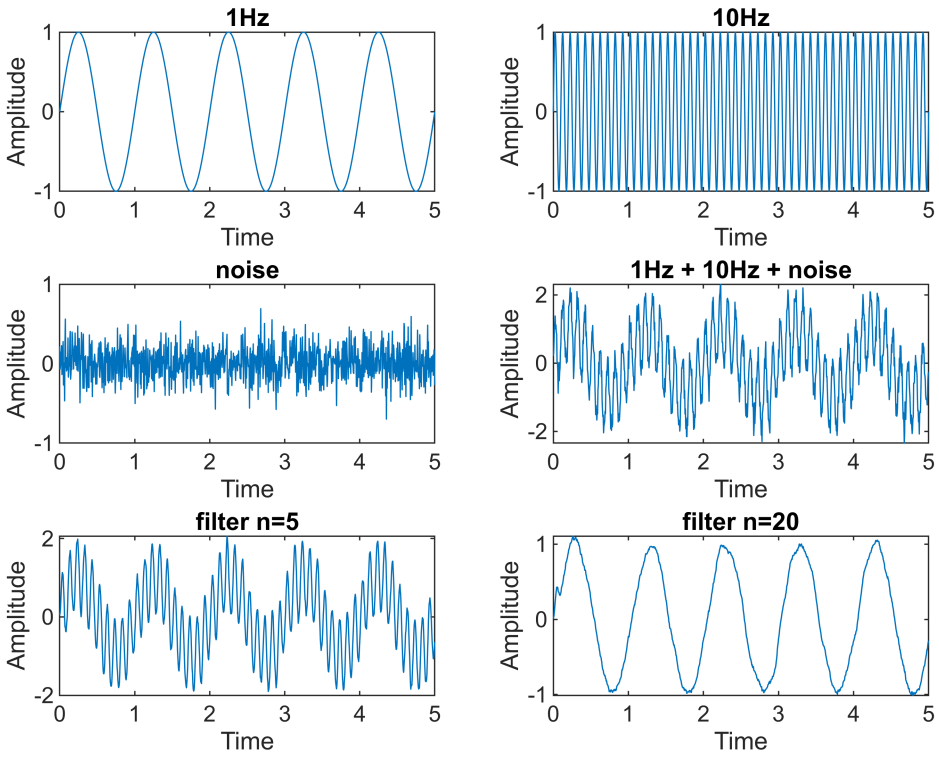
```
figure
plot(t, y, "blue");
hold on; % to plot boht signals on one figure
plot(t, z, "red");
xlabel('Time');
ylabel('Amplitude');
axis([-20 20 0 1.2]); % [min_x, max_x, min_y, max_y]
legend("sawtooth", "unit step");
```



Task 4

```
t = 0:0.005:5;
f1 = 1;
f2 = 10;
xt1 = sin(2*pi*f1*t);
xt2 = sin(2*pi*f2*t);
noise = 0.2 * randn(size(t));

yt = xt1 + xt2 + noise;
zt1 = filter(ones(1,5)/5 , 1, yt);
zt2 = filter(ones(1,20)/20 , 1, yt);

subplot 321;
plot(t, xt1);
title("1Hz")
xlabel('Time');
ylabel('Amplitude');

subplot 322;
plot(t, xt2);
title("10Hz")
xlabel('Time');
ylabel('Amplitude');
```

```
subplot 323;
plot(t, noise);
title("noise")
xlabel('Time');
ylabel('Amplitude');

subplot 324;
plot(t, yt);
title("1Hz + 10Hz + noise")
xlabel('Time');
ylabel('Amplitude');

subplot 325;
plot(t, zt1);
title("filter n=5")
xlabel('Time');
ylabel('Amplitude');

subplot 326;
plot(t, zt2);
title("filter n=20")
xlabel('Time');
ylabel('Amplitude');
```



Applying a moving average filter with n=5 reduces some noise but retains the 10Hz component, resulting in partial smoothing. In contrast, a filter with n=20 significantly suppresses high-frequency components and noise,

leaving primarily the 1Hz wave. This shows that a larger filter window provides better noise reduction and emphasizes low-frequency components, effectively acting as a low-pass filter.

<-------- Post Lab ---------->

Task 5

1 a)

```
a = complex(10.09, 55.3);
[b_r, b_i] = pol2cart(deg2rad(85.5) , 20)
```

```
b_r =
1.5692
b_i =
19.9383
```

```
b = complex(b_r, b_i);
x = a + b;

real(x)
```

```
ans =
11.6592
```

```
imag(x)
```

```
ans =
75.2383
```

```
conj(x)
```

```
ans =
11.6592 -75.2383i
```

```
angle(x)
```

```
ans =
1.4171
```

```
abs(x)
```

```
ans =
76.1364
```

1 b)

```
[a_r, a_i] = pol2cart(deg2rad(10), 15);
y = complex(a_r, a_i) + complex(-4, 10);
real(y)
```

```
ans =
10.7721
```

```
imag(y)
```

```
ans =
12.6047
```

```
conj(y)
```

```
ans =
10.7721 -12.6047i
```

```
angle(y)
```

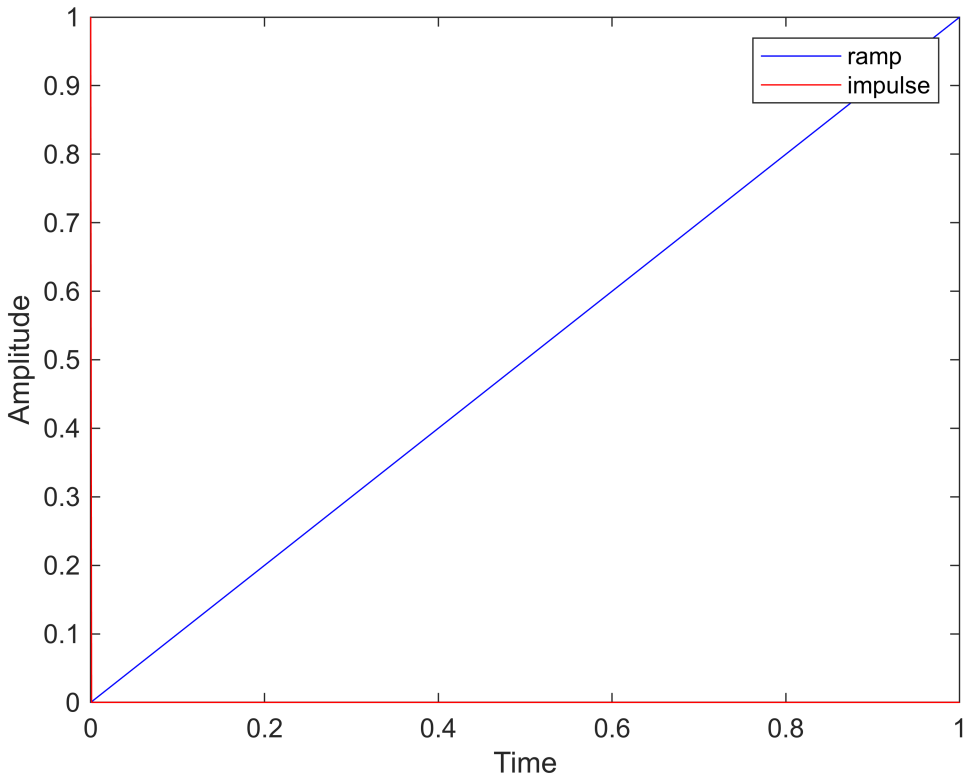
```
ans =
0.8636
```

```
abs(y)
```

```
ans =
16.5806
```

2)

```
t = 0:0.001:1;
ramp = t;
impulse = (t == 0);

figure;
plot(t, ramp, "blue");
hold on;
plot(t, impulse, "red");
xlabel('Time');
ylabel('Amplitude');
legend("ramp", "impulse");
```



Task 6

```
t = 0:1/150:6;
mt = sin(2 * pi * t);
ct = sin(2 * pi * 10 * t);
ft = (1 + 0.5 * mt) .* ct;

figure;

subplot 311;
plot(t, mt, "blue");
title("Message signal");
xlabel("time");
ylabel("amplitude");

subplot 312;
plot(t, ct, "green");
title("Carrier Signal");
xlabel("time");
ylabel("amplitude");

subplot 313;
plot(t, ft, "red");
title("Modulated Signal");
xlabel("time");
```

```
ylabel("amplitude");
```