Assignment5

QS1

```
sys = zpk(-1, [0, -2, -3], 1)
```

```
sys =

      (s+1)
  -------------
  s (s+2) (s+3)

Continuous-time zero/pole/gain model.
```

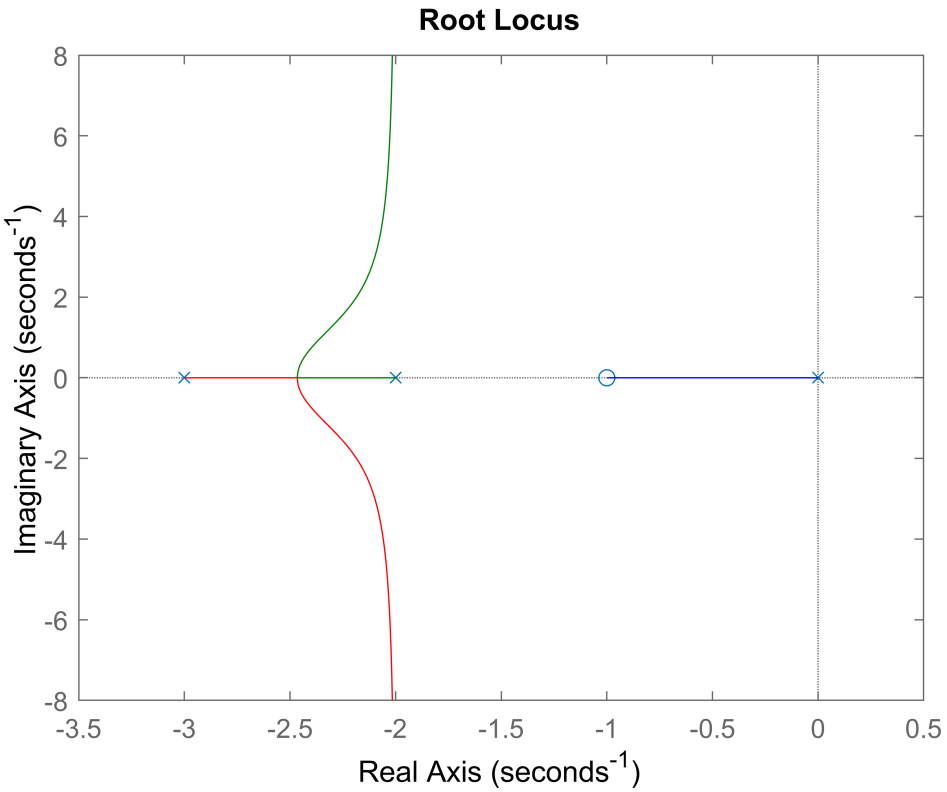
```
pole(sys)
```

```
ans = 3×1
     0
    -2
    -3
```

```
zero(sys)
```

```
ans = -1
```

```
figure;

rlocus(sys)
```



QS2

```
sys = zpk([], [0, -2, -1+1i, -1-1i], 1)
```

```
sys =

           1
  ----------------------
  s (s+2) (s^2 + 2s + 2)

Continuous-time zero/pole/gain model.
```

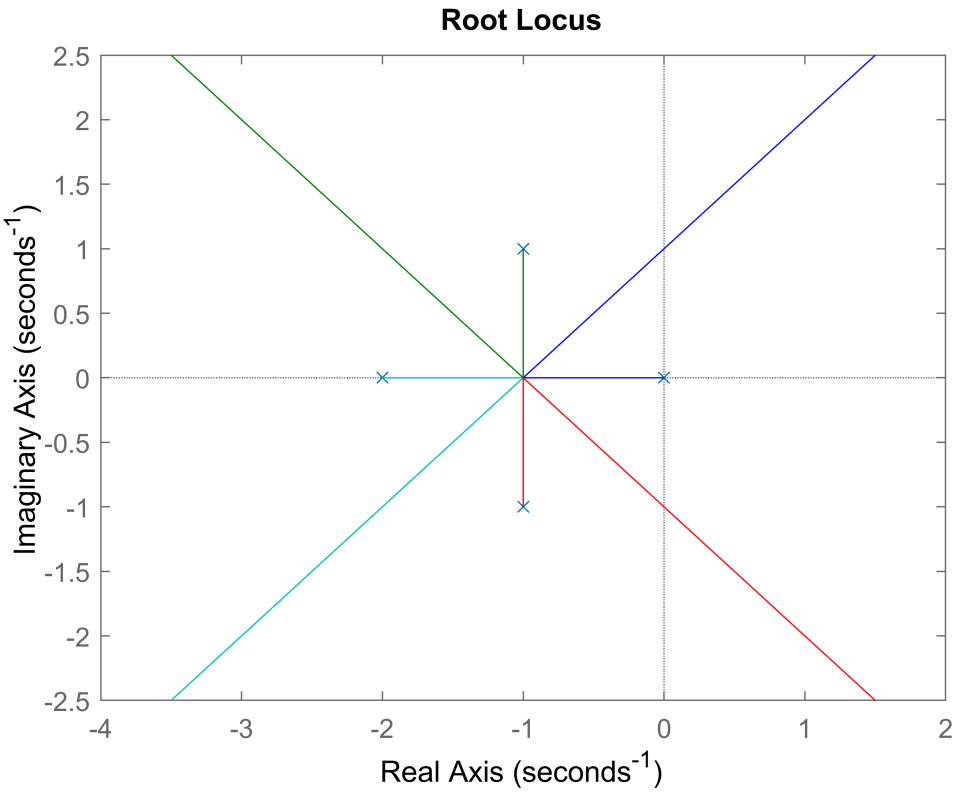
```
pole(sys)
```

```
ans = 4×1 complex
   0.0000 + 0.0000i
  -2.0000 + 0.0000i
  -1.0000 + 1.0000i
  -1.0000 - 1.0000i
```

```
zero(sys)
```

```
ans =

  0×1 empty double column vector
```

```
figure;
rlocus(sys)
```



QS3

```
sys = zpk(-1, [0, -4, -1+1i, -1-1i], 1)
```

```
sys =

          (s+1)
  ----------------------
  s (s+4) (s^2 + 2s + 2)

Continuous-time zero/pole/gain model.
```

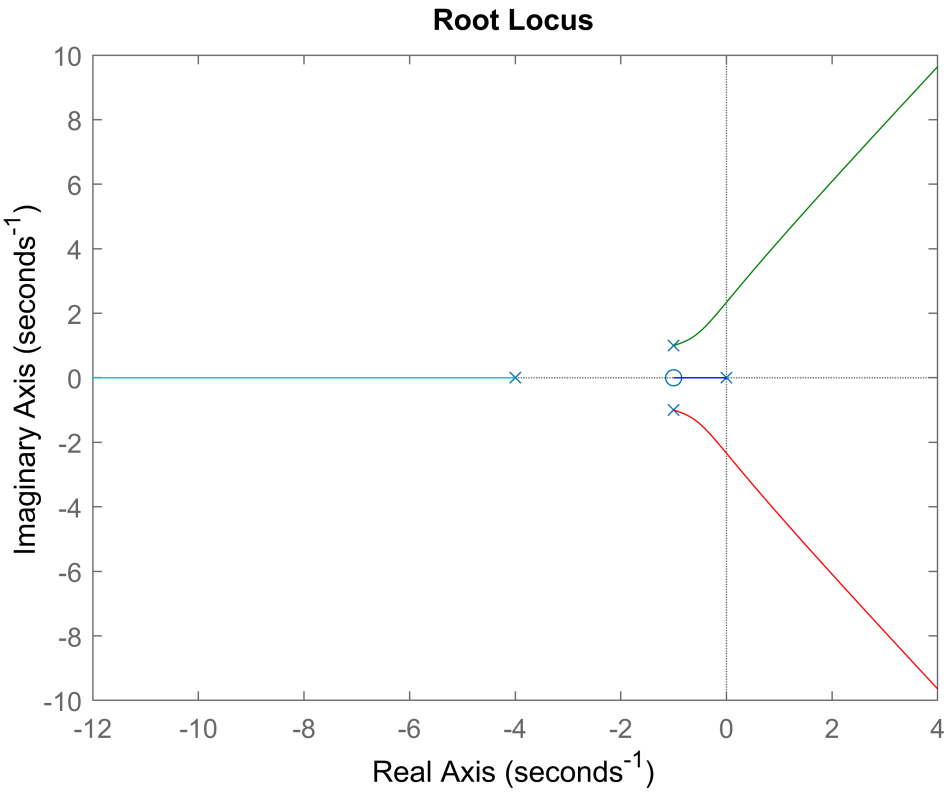
```
pole(sys)
```

```
ans = 4×1 complex
   0.0000 + 0.0000i
  -4.0000 + 0.0000i
  -1.0000 + 1.0000i
  -1.0000 - 1.0000i
```

```
zero(sys)
```

```
ans = -1
```

```
rlocus(sys)
```



QS4

```
sys = zpk([], [0, -3, -1+1i, -1-1i], 1)
```

```
sys =

           1
```

```
  ----------------------
  s (s+3) (s^2 + 2s + 2)

Continuous-time zero/pole/gain model.
```

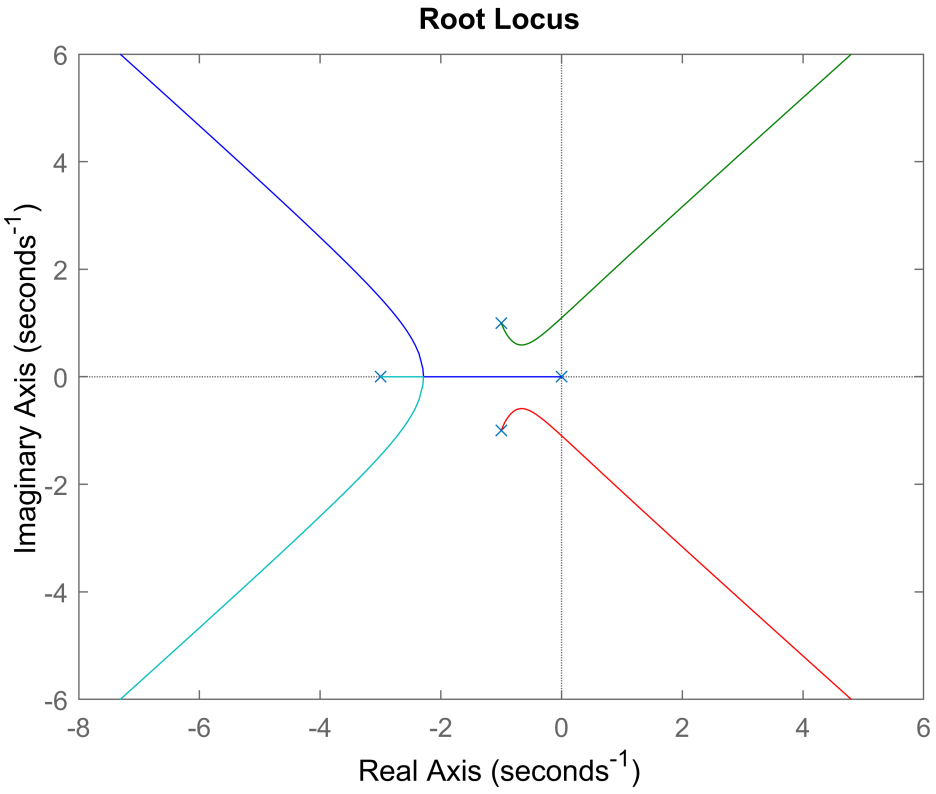
```
pole(sys)
```

```
ans = 4×1 complex
   0.0000 + 0.0000i
  -3.0000 + 0.0000i
  -1.0000 + 1.0000i
  -1.0000 - 1.0000i
```

```
zero(sys)
```

```
ans =

  0×1 empty double column vector
```

```
rlocus(sys)
```



QS5

```
sys = zpk([], [0, -4, -2+4i, -2-4i], 1)
```

```
sys =

            1
  ----------------------
  s (s+4) (s^2 + 4s + 20)
```

```
Continuous-time zero/pole/gain model.
```

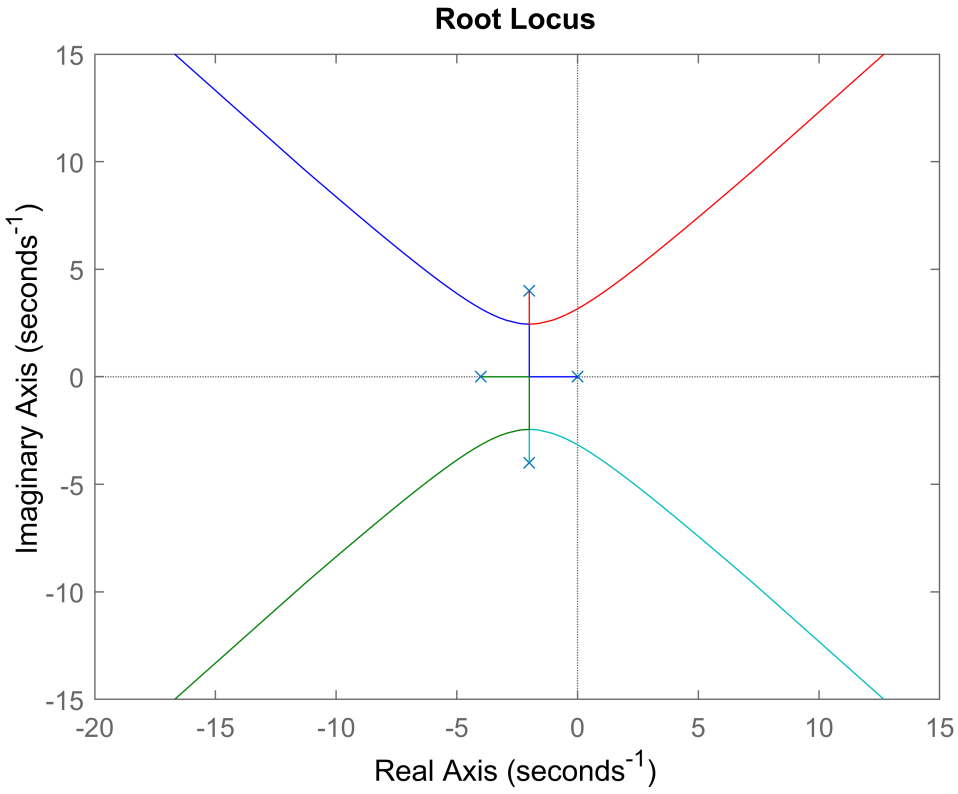
```
pole(sys)
```

```
ans = 4×1 complex
   0.0000 + 0.0000i
  -4.0000 + 0.0000i
  -2.0000 + 4.0000i
  -2.0000 - 4.0000i
```

```
zero(sys)
```

```
ans =

  0×1 empty double column vector
```

```
rlocus(sys)
```



QS6

```
sys = zpk(-3, [0, -5, -6, -1+1i, -1-1i], 1)
```

```
sys =

            (s+3)
  ----------------------------
  s (s+5) (s+6) (s^2 + 2s + 2)

Continuous-time zero/pole/gain model.
```

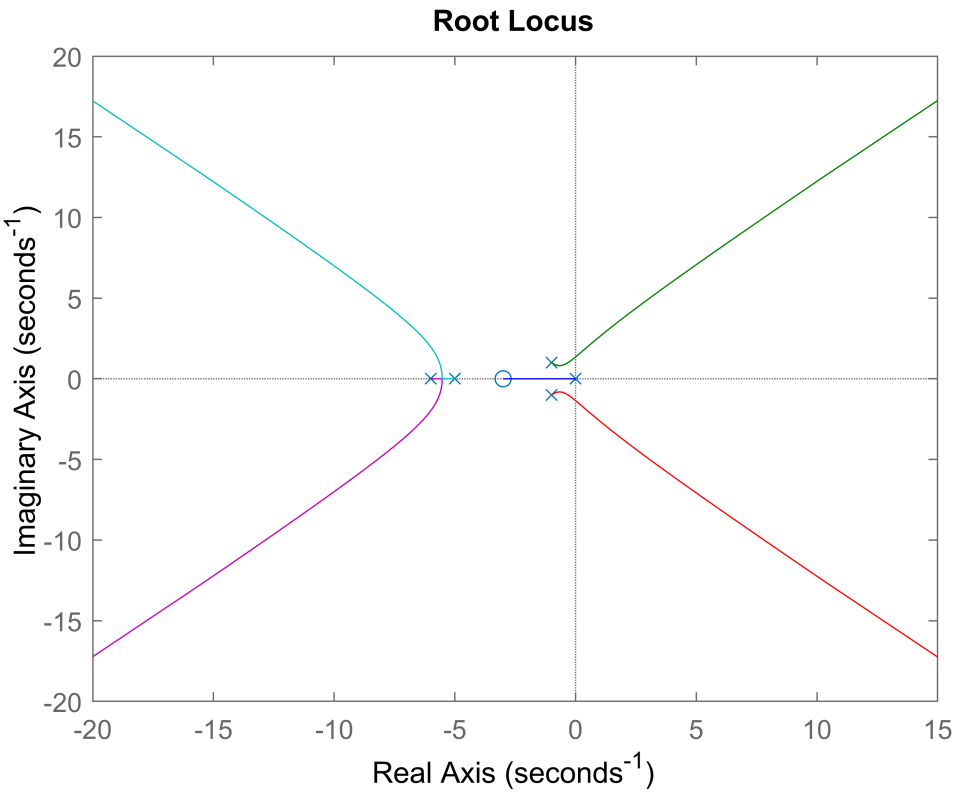
```
pole(sys)
```

```
ans = 5×1 complex
   0.0000 + 0.0000i
  -5.0000 + 0.0000i
  -6.0000 + 0.0000i
  -1.0000 + 1.0000i
  -1.0000 - 1.0000i
```

```
zero(sys)
```

```
ans = -3
```

```
rlocus(sys)
```



QS7

```
sys = zpk(-1, [0, 1, -2+sqrt(3)*2i, -2-sqrt(3)*2i], 1)
```

```
sys =

           (s+1)
  ----------------------
  s (s-1) (s^2 + 4s + 16)

Continuous-time zero/pole/gain model.
```

```
pole(sys)
```

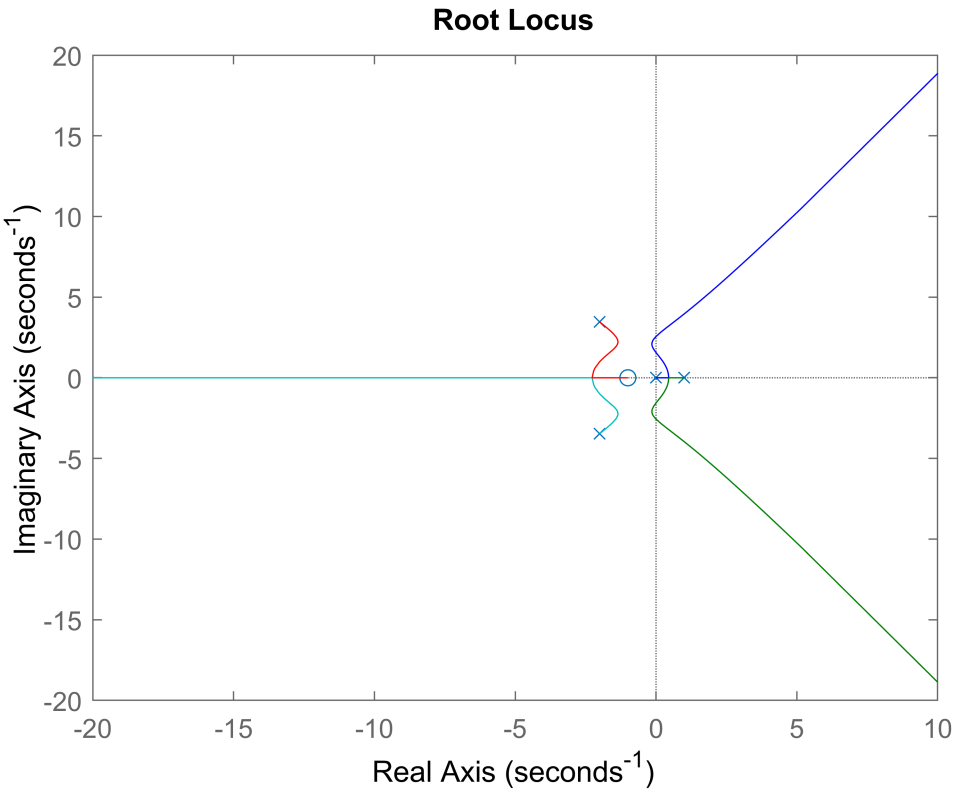
```
ans = 4×1 complex
   0.0000 + 0.0000i
```

```
   1.0000 + 0.0000i
  -2.0000 + 3.4641i
  -2.0000 - 3.4641i
```

```
zero(sys)
```

```
ans = -1
```

```
rlocus(sys)
```



QS8

```
% 1
sys1 = tf(1, [1, 6, 45, 0])
```

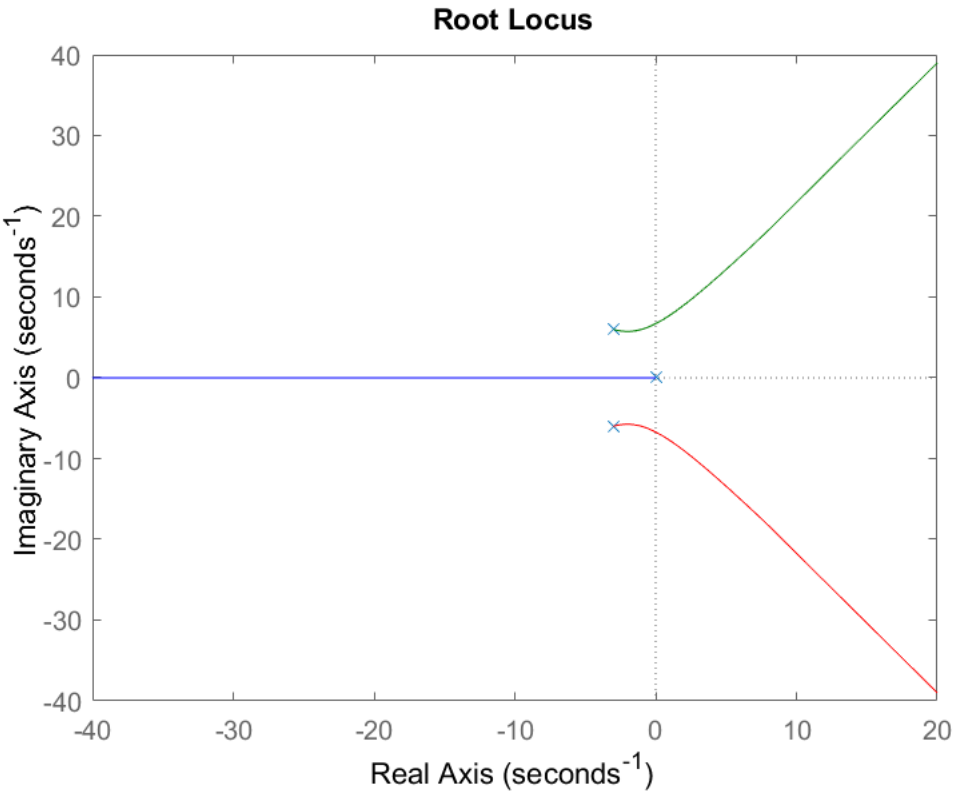
```
sys1 =

          1
  ------------------
  s^3 + 6 s^2 + 45 s

Continuous-time transfer function.
```

```
sys2 = tf([0.075, 1, 1], [1, 3, 5, 0])
```

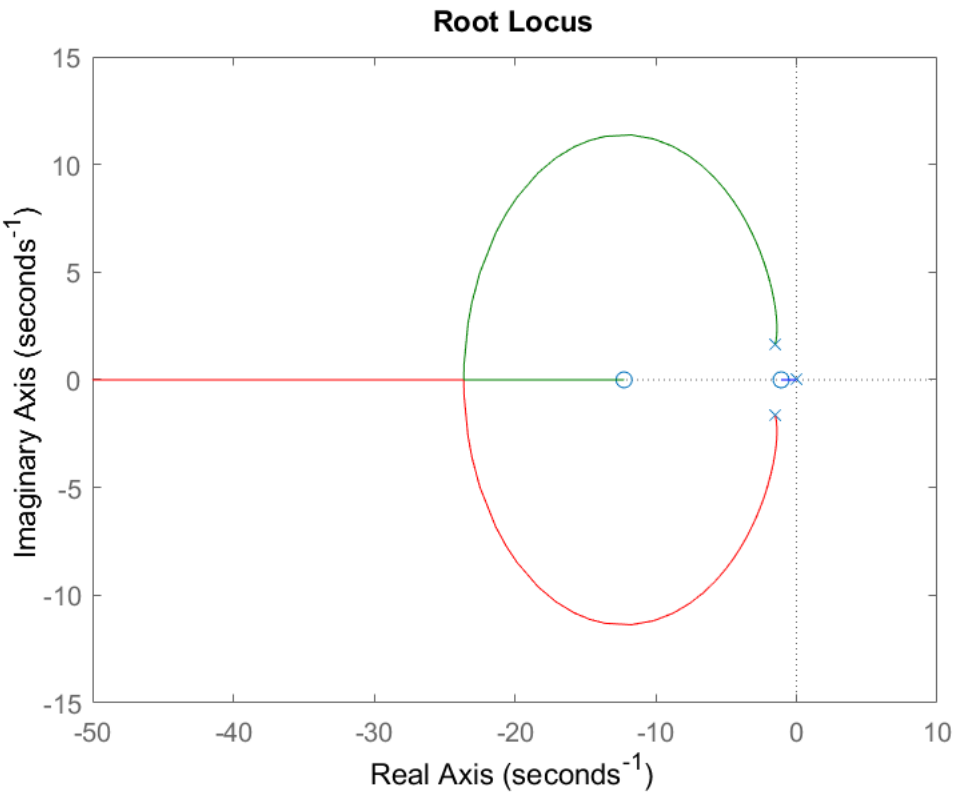
```
sys2 =

  0.075 s^2 + s + 1
  -----------------
  s^3 + 3 s^2 + 5 s
```

```
Continuous-time transfer function.
```

```
rlocus(sys1)
```




```
rlocus(sys2)
```




```
% 2



% 3
tf1 = tf(1, [1, 6, 45, 0])
```

```
tf1 =

         1
  ------------------
  s^3 + 6 s^2 + 45 s

Continuous-time transfer function.
```

```
tf2 = tf([0.075, 1, 1], [1, 3, 5, 0])
```

```
tf2 =

  0.075 s^2 + s + 1
  -----------------
  s^3 + 3 s^2 + 5 s

Continuous-time transfer function.
```

```
K = 40;

sys1 = (K* tf1)/(1 + K * tf1) %closed loop
```

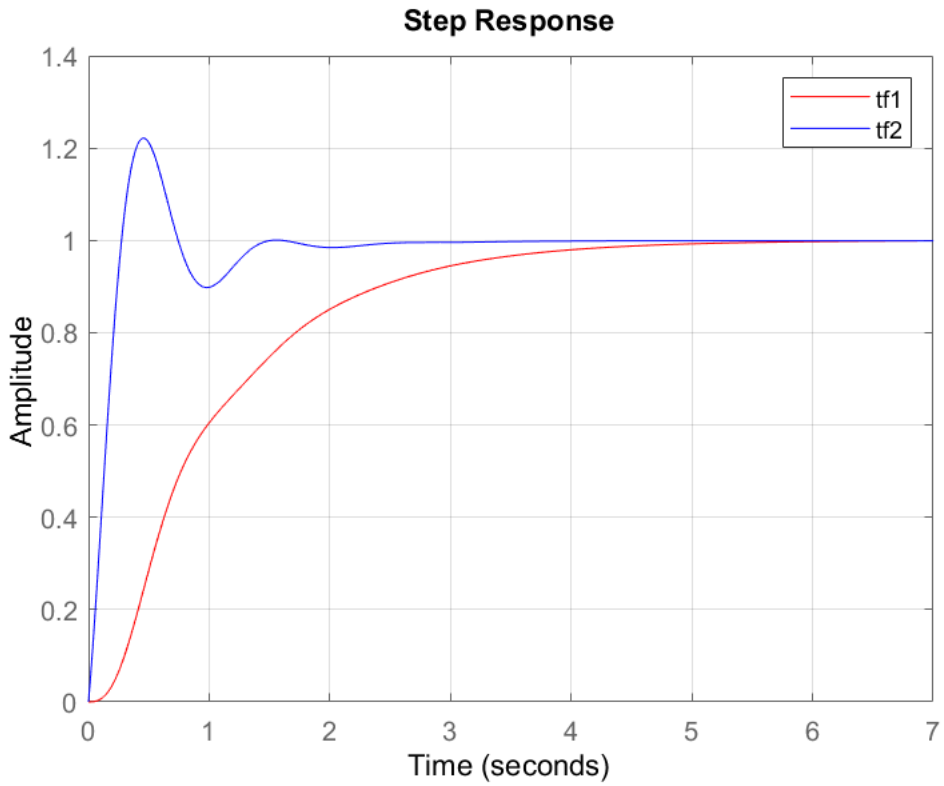
```
sys1 =
```

```
              40 s^3 + 240 s^2 + 1800 s
  ---------------------------------------------------
  s^6 + 12 s^5 + 126 s^4 + 580 s^3 + 2265 s^2 + 1800 s

Continuous-time transfer function.
```

```
sys2 = (K* tf2)/(1 + K * tf2) %closed loop
```

```
sys2 =

     3 s^5 + 49 s^4 + 175 s^3 + 320 s^2 + 200 s
  ------------------------------------------------
  s^6 + 9 s^5 + 68 s^4 + 205 s^3 + 345 s^2 + 200 s

Continuous-time transfer function.
```

```
step(sys1, 'r', sys2, 'b')
hold on;
legend('tf1','tf2');
grid on;
```




```
info1 = stepinfo(sys1)
```

```
info1 = struct with fields:
        RiseTime: 2.1128
    SettlingTime: 4.0172
     SettlingMin: 0.9020
     SettlingMax: 0.9997
       Overshoot: 0
      Undershoot: 0
            Peak: 0.9997
        PeakTime: 8.0683
```

```
info2 = stepinfo(sys2)
```

```
info2 = struct with fields:
        RiseTime: 0.2085
    SettlingTime: 1.3415
     SettlingMin: 0.8979
     SettlingMax: 1.2217
       Overshoot: 22.1650
      Undershoot: 0
            Peak: 1.2217
        PeakTime: 0.4605
```

QS9

```
sys = tf([1, -2, 2],[1, 5, 6])
```

```
sys =

  s^2 - 2 s + 2
  -------------
  s^2 + 5 s + 6

Continuous-time transfer function.
```

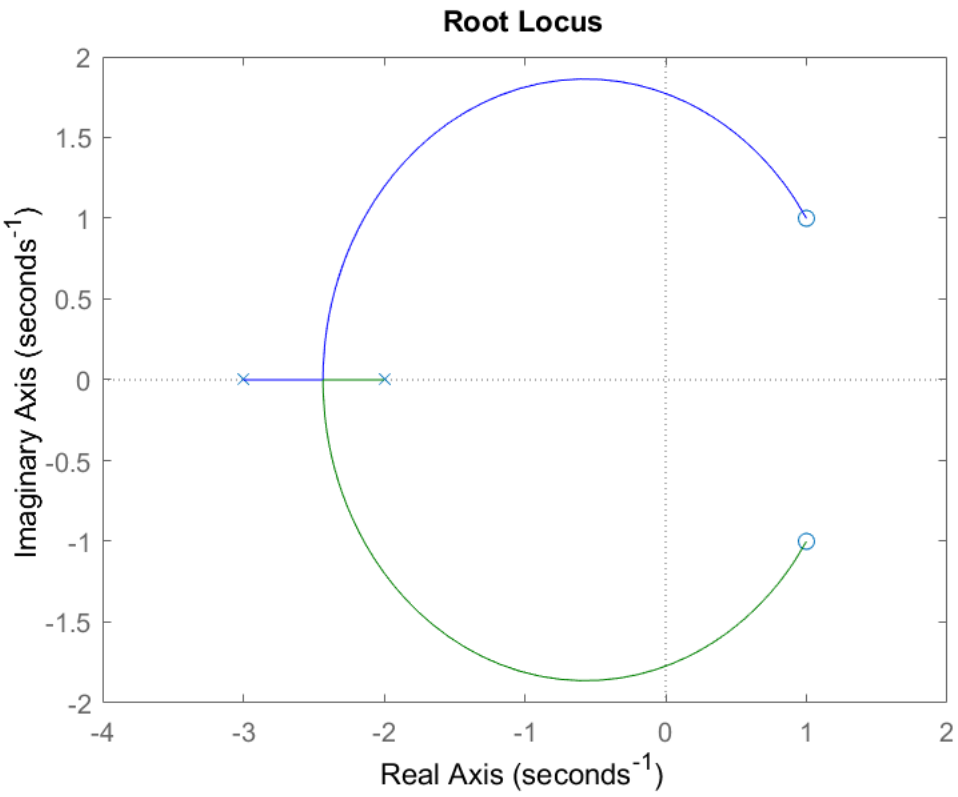
```
pole(sys)
```

```
ans = 2×1
   -3.0000
   -2.0000
```

```
zero(sys)
```

```
ans = 2×1 complex
   1.0000 + 1.0000i
   1.0000 - 1.0000i
```

```
figure
rlocus(sys)
```

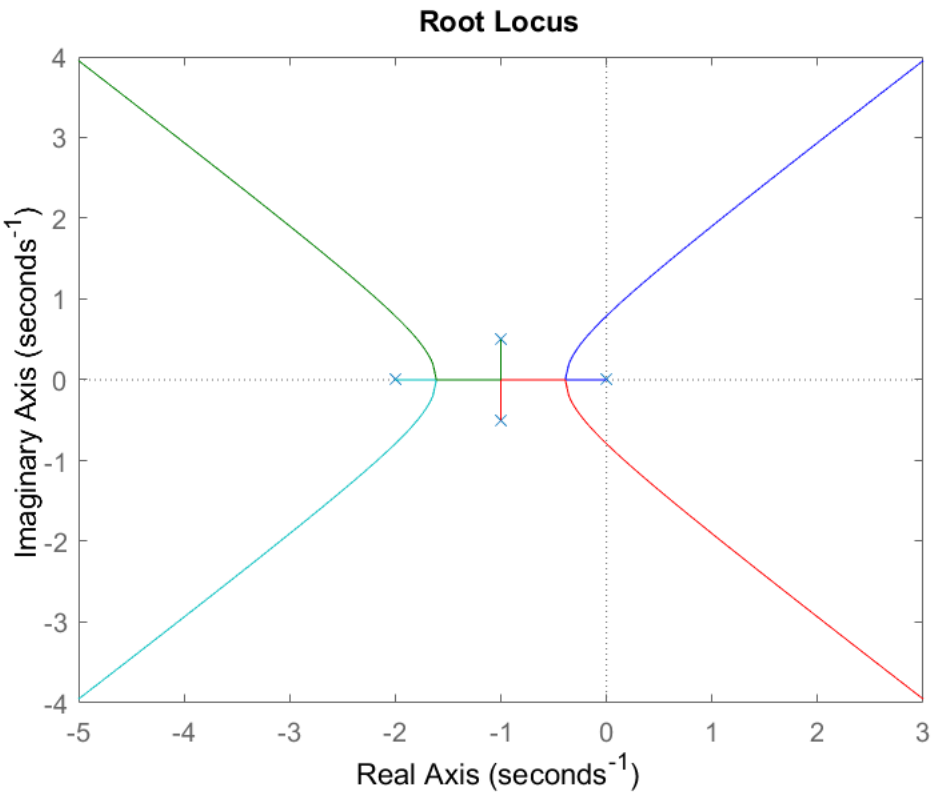


QS10

```
% a
sysa = zpk([], [0, -2, -1 + 0.5*1i, -1 - 0.5*1i], 1)
```

```
sysa =

             1
  -------------------------
  s (s+2) (s^2 + 2s + 1.25)

Continuous-time zero/pole/gain model.
```

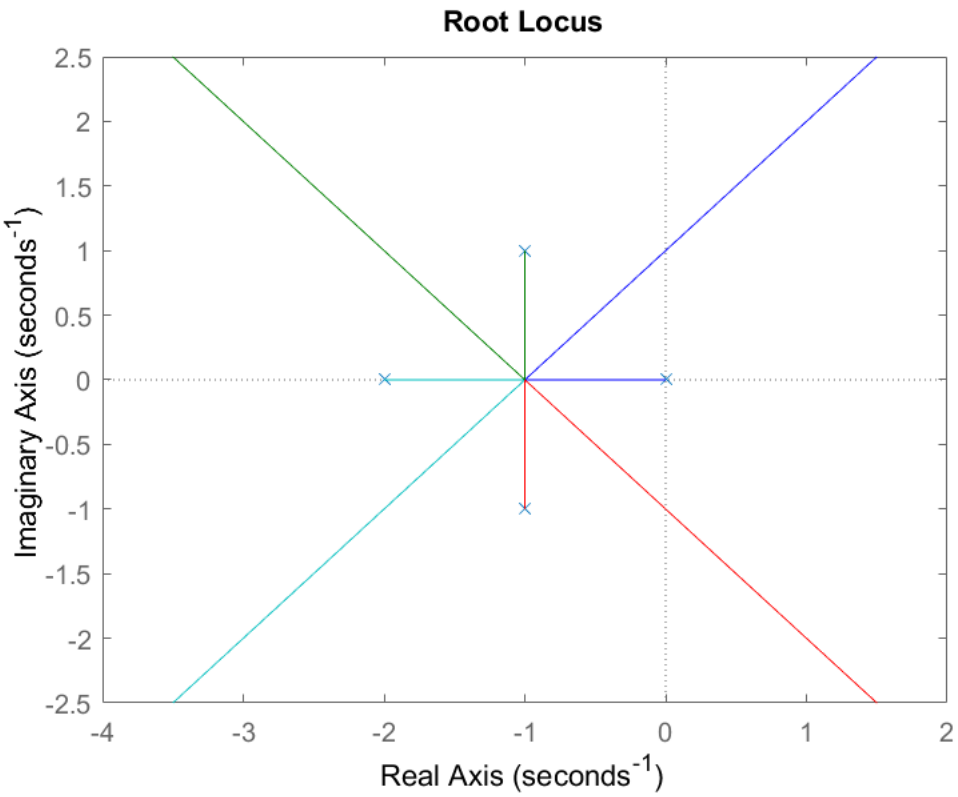
```
figure
rlocus(sysa)
```




```
% b
sysb = zpk([], [0, -2, -1 + 1i, -1 - 1i], 1)
```

```
sysb =

           1
  ----------------------
  s (s+2) (s^2 + 2s + 2)

Continuous-time zero/pole/gain model.
```

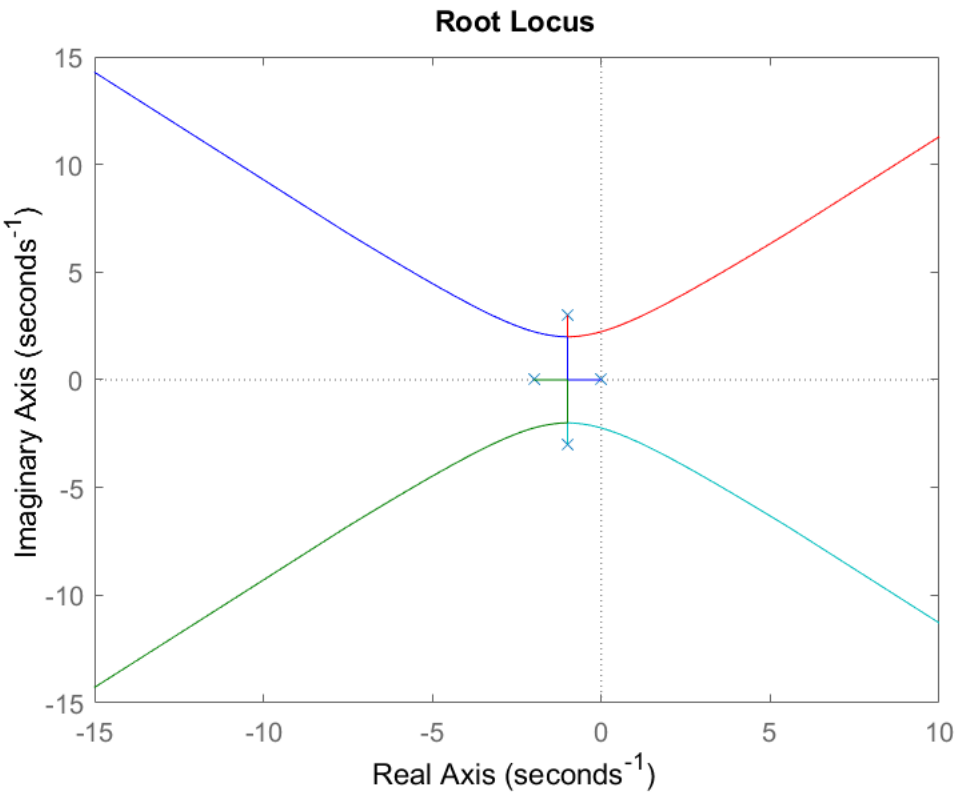
```
rlocus(sysb)
```




```
% c
sysc = zpk([], [0, -2, -1 + 3i, -1 - 3i], 1)
```

```
sysc =

            1
  ----------------------
  s (s+2) (s^2 + 2s + 10)

Continuous-time zero/pole/gain model.
```

```
rlocus(sysc)
```


Root Locus
Imaginary Axis (seconds-1)
Real Axis (seconds-1)
15
10
5
0
-5
-10
-15
-15
-10
-5
0
5
10