Discrete Response and Z Transforms

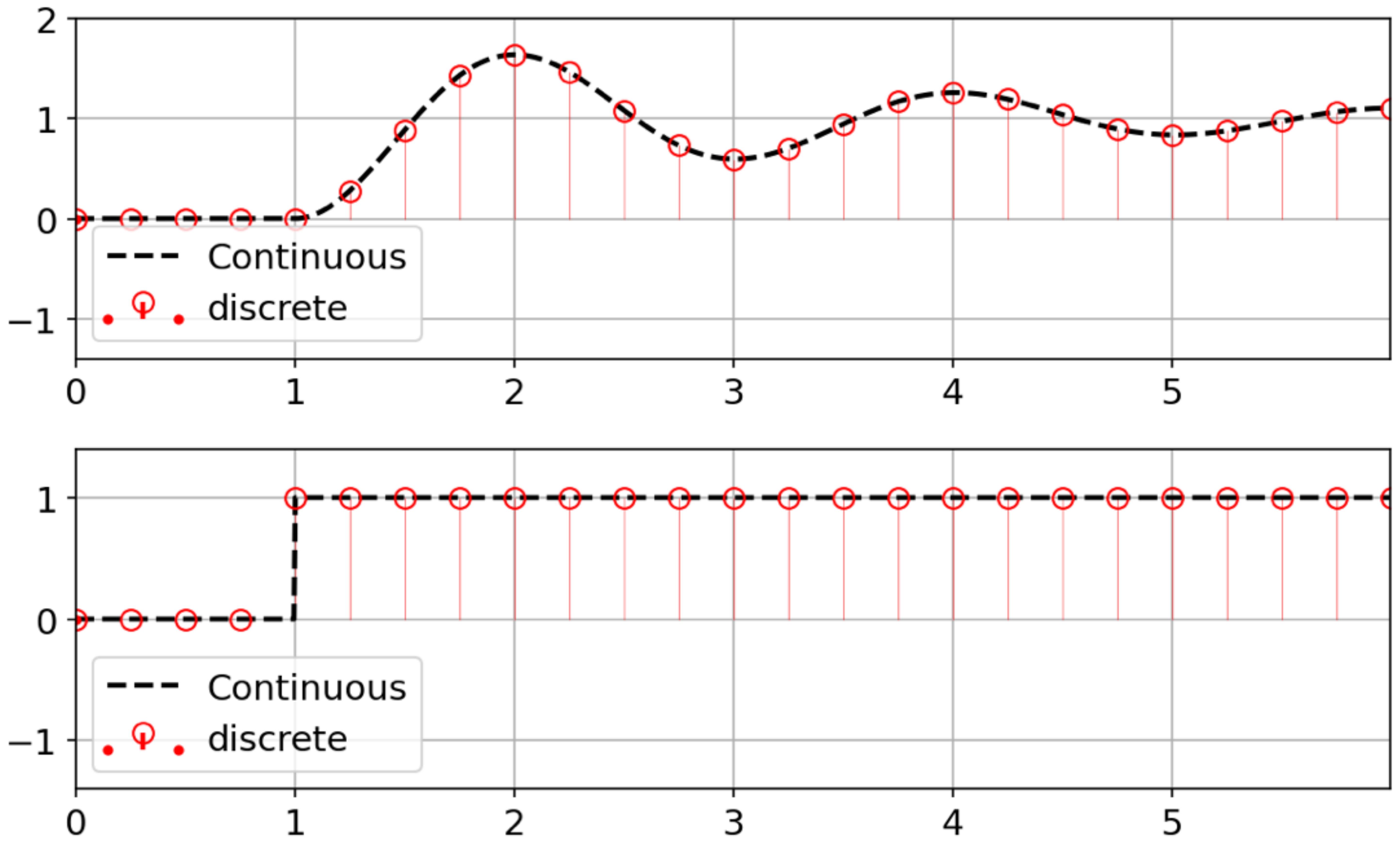
https://docs.scipy.org/doc/scipy/reference/generated/scipy.signal.cont2discrete.html

In [38]:

```
import matplotlib.pyplot as plt
from matplotlib.pyplot import figure, savefig
import numpy as np

plt.rcParams['figure.figsize'] = [8, 5.0]
plt.rcParams['figure.dpi'] = 150
plt.rcParams['lines.linewidth'] = 2
plt.rcParams['axes.xmargin'] = 0
plt.rcParams['axes.grid'] = True

SMALL_SIZE = 14
MEDIUM_SIZE = 24
BIGGER_SIZE = 32

plt.rc('font', size=SMALL_SIZE)          # controls default text sizes
plt.rc('axes', titlesize=SMALL_SIZE)     # fontsize of the axes title
plt.rc('axes', labelsize=SMALL_SIZE)    # fontsize of the x and y labels
plt.rc('xtick', labelsize=SMALL_SIZE)    # fontsize of the tick labels
plt.rc('ytick', labelsize=SMALL_SIZE)    # fontsize of the tick labels
plt.rc('legend', fontsize=SMALL_SIZE)    # legend fontsize
plt.rc('figure', titlesize=BIGGER_SIZE)  # fontsize of the figure title

def nicegrid(ax=plt):
    ax.grid(True, which='major', color='#666666', linestyle=':')
    ax.grid(True, which='minor', color='#999999', linestyle=':', alpha=0.2)
    ax.minorticks_on()

%matplotlib inline
```

In [39]:

```
from scipy.signal import cont2discrete, lti, dlti, dstep, dlsim, lsim
import random

Tstep = 1
Tf = 5

def my_stem(t,y,ax='ax1',lab='y'):
    markerline, stemline, baseline = ax.stem(t, y, label=lab,linefmt='r-',markerfmt='ro',basefmt='r.')
    plt.setp(stemline, linewidth = .25)
    plt.setp(markerline, markersize = 8)
    markerline.set_markerfacecolor('none')

# cts system
A = np.array([[0, 1],[-10., -.9]])
B = np.array([[0],[10.]])
C = np.array([[1., 0]])
D = np.array([[0.]])

l_system = lti(A, B, C, D)
#form discrete equivalent
dt = 0.25
d_system = cont2discrete((A, B, C, D), dt)

T=np.linspace(0, Tstep+Tf, 1000)
u = np.zeros(len(T))
#u = [np.cos(2*np.pi*(g-Tstep)) if g >= Tstep else 0 for g in T]
u = [1 if g >= Tstep else 0 for g in T]

T_d = np.arange(0,max(T)+1,dt)
u_d = np.zeros(len(T_d))
#ud = [np.cos(2*np.pi*(g-Tstep)) if g >= Tstep else 0 for g in T_d]
u_d = [1 if g >= Tstep else 0 for g in T_d]

t, y, x = lsim(l_system,u,T)
t_d, y_d, x_d = dlsim(d_system,u_d)

fig, (ax1,ax2) = plt.subplots(2,figsize=(8, 5),dpi=150)
ax1.plot(t, y, 'k--', label='Continuous', linewidth=2)
my_stem(t_d,y_d,ax1,lab='discrete')

ax1.axis([t[0], t[-2], -1.4, int(max(y))+1])
ax1.legend(loc='best')

ax2.plot(t, u, 'k--', label='Continuous', linewidth=2)
my_stem(t_d,u_d,ax2,lab='discrete')
ax2.axis([t[0], t[-2], -1.4, 1.4])
ax2.legend(loc='best')
fig.tight_layout()
plt.show()
```



In [ ]: