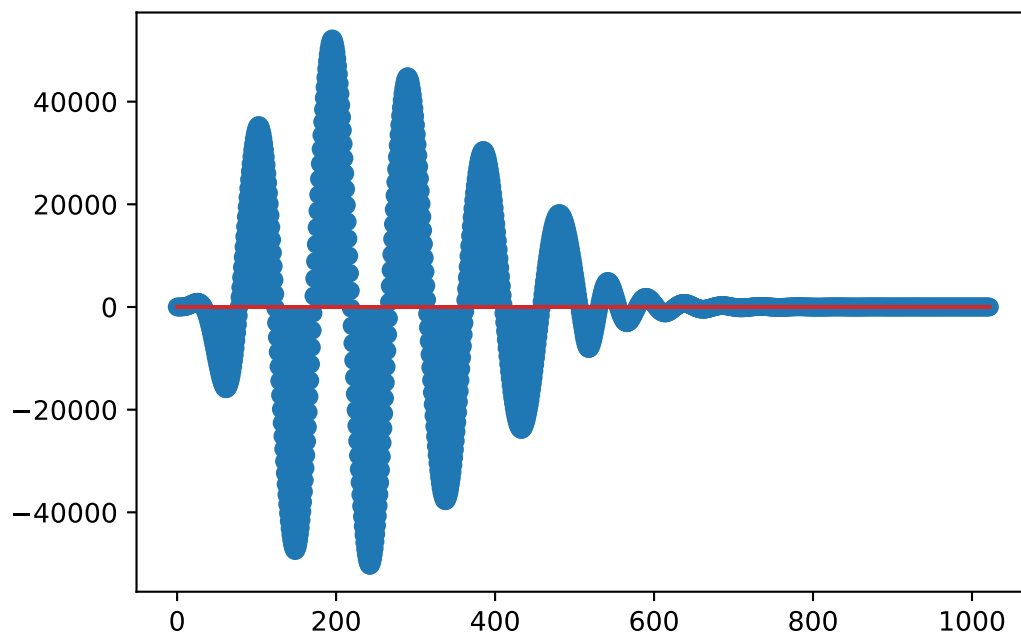


```
In [9]: import numpy as np
import matplotlib.pyplot as plt
```

```
In [14]: n=np.linspace(0,511,512)
hn=(.98**n)*(np.sin((np.pi*n)/24))
xn=(n**2)*(0.99**n)*(np.cos(np.pi*n/48))

ydir=np.convolve(xn,hn)
plt.stem(ydir)
plt.show()
```



```
In [35]: hzn=np.concatenate((hn,np.zeros(512)))
xzn=np.concatenate((xn,np.zeros(512)))

Hk=np.fft.fft(hzn)
Xk=np.fft.fft(xzn)

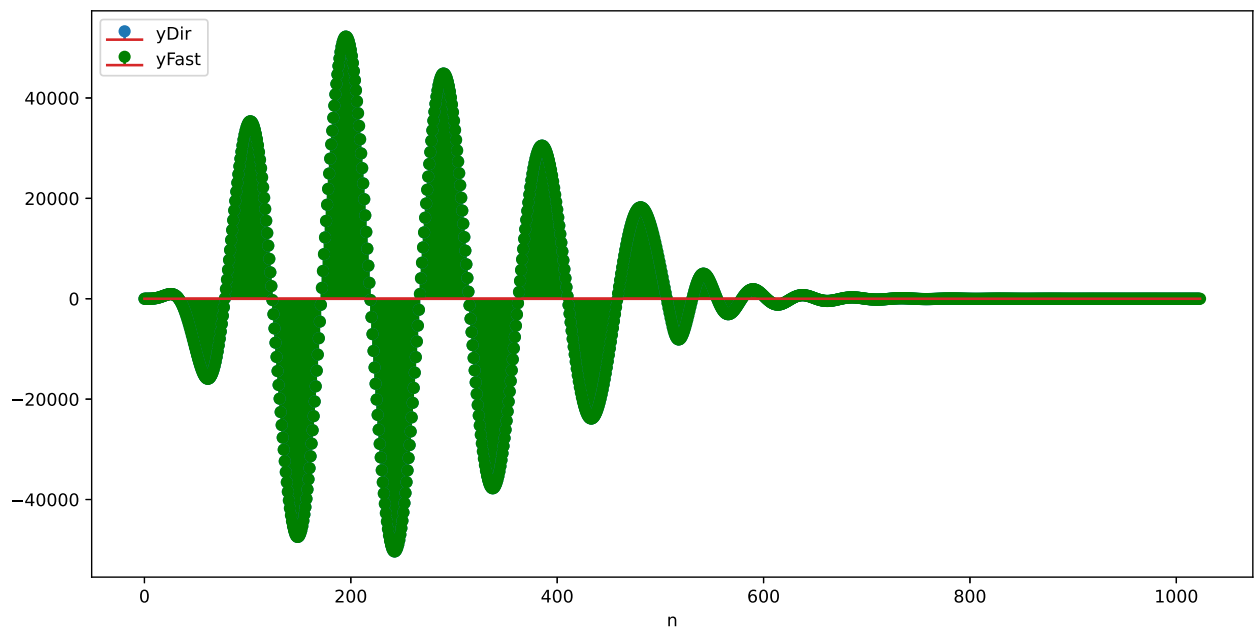
Yk=Hk*Xk

yfast=np.fft.ifft(Yk)

fig, ax = plt.subplots(figsize=(12, 6))
longn=np.linspace(0,1023,1024)

ax.stem(ydir,label='yDir')
ax.stem(longn, yfast,'g', markerfmt='go',label='yFast')

ax.set_xlabel('n')
plt.legend(loc=2)
plt.show()
```

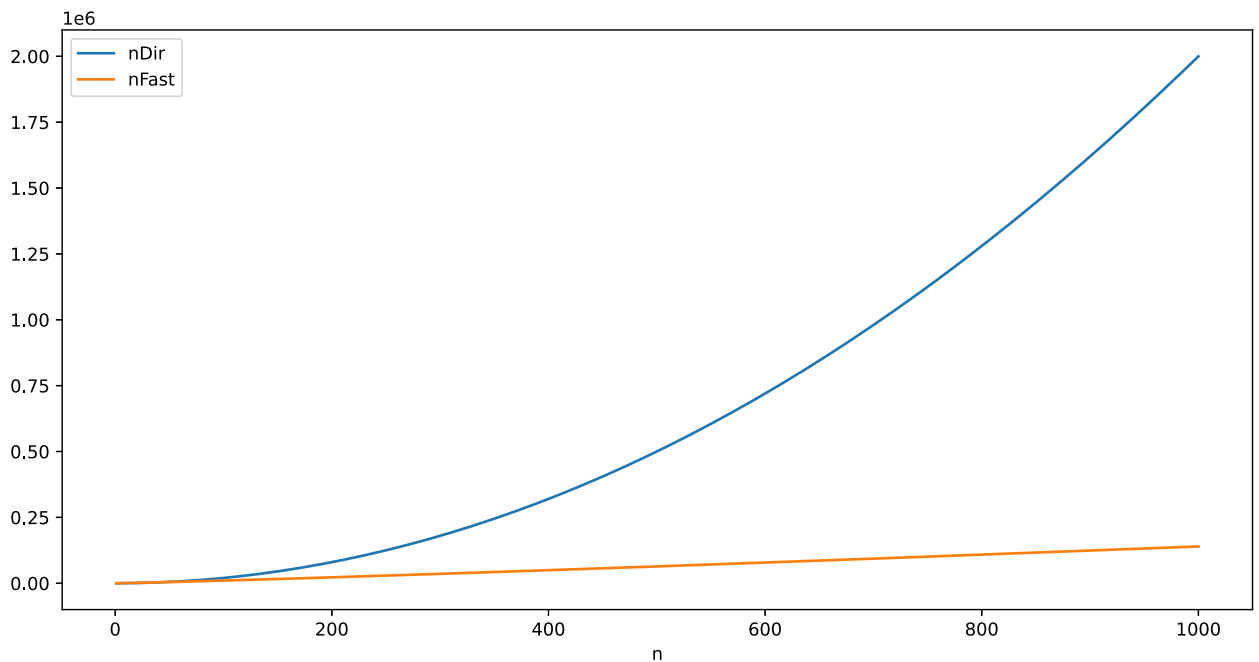


```
In [36]: L=np.linspace(1,1000,1000)
ndir=2*(L**2)
nfast=(12*L*np.log2(2*L))+(8*L)+4

fig, ax = plt.subplots(figsize=(12, 6))

ax.plot(L,ndir,label='nDir')
ax.plot(L, nfast,label='nFast')

ax.set_xlabel('n')
plt.legend(loc=2)
plt.show()
```



The ndir drastically increases in number of calulcations as n increases compare to nfast.