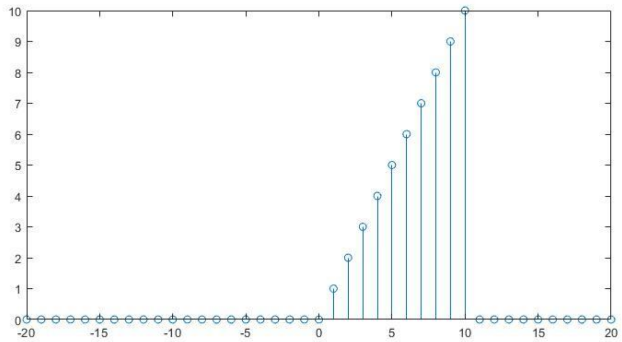
Gernot Polivka | 12009686 |

1. Übung

Aufgabe 1.1:

$$x[n] = \begin{cases} 0 & n < 0 \\ n & 0 \leq n \leq 10 \\ 0 & n > 10 \end{cases}$$

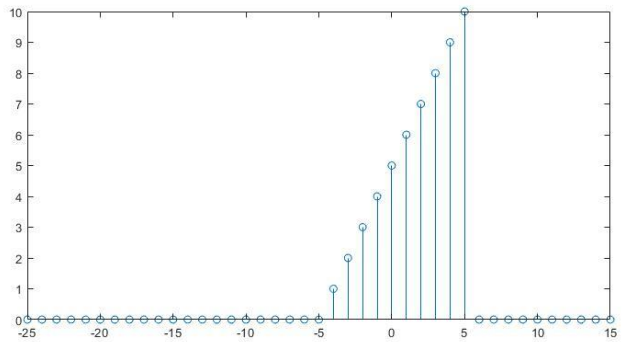
$$x[n]$$



```
n=-20:20;

x(0<= (-n+5) <=10) = (n);
x( (n) <0) = 0;
x( (n) >10) = 0;

stem(n,x);
```

a)

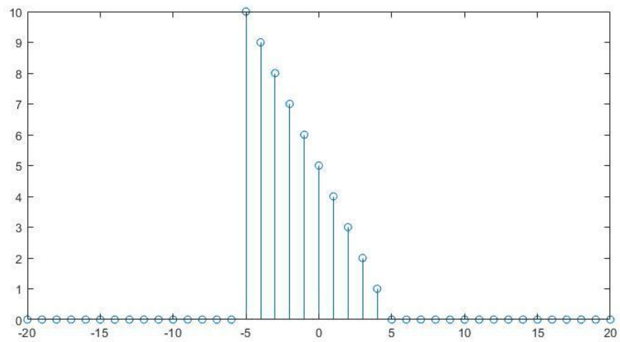
$$x[n+5]$$



```
n=-20:20;

x(0<= (n+5) <=10) = (n+5);
x( (n+5) <0) = 0;
x( (n+5) >10) = 0;

stem(n,x);
```

b)

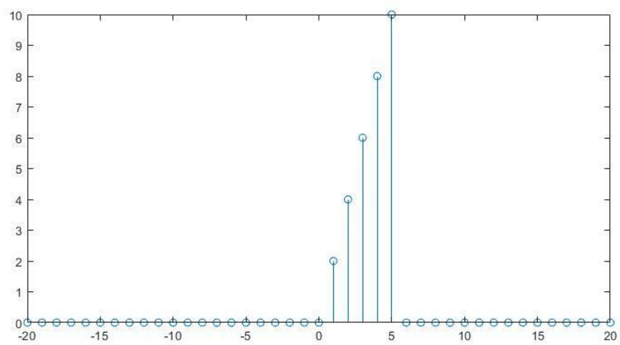
$$x[-n+5]$$



```
n=-20:20;

x(0<= (-n+5) <=10) = (-n+5);
x( (-n+5) <0) = 0;
x( (-n+5) >10) = 0;

stem(n,x);
```

c)

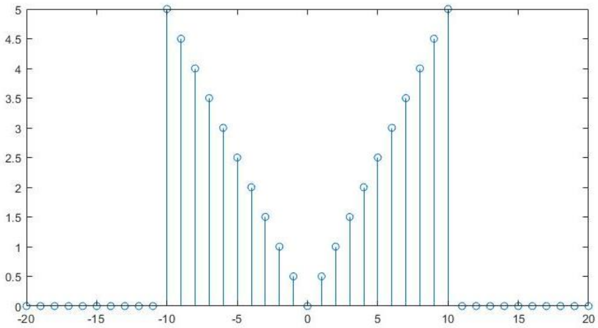
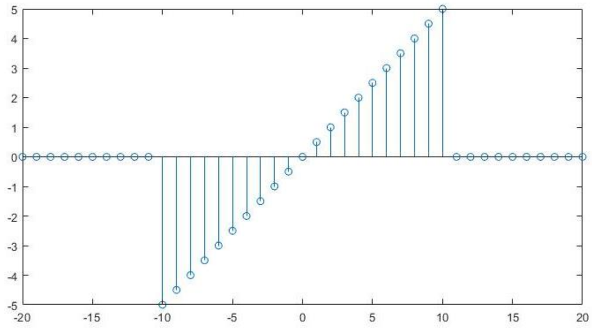
$$x[2n]$$



```
n=-20:20;

x(0<= (2*n) <=10) = (2*n);
x( (2*n) <0) = 0;
x( (2*n) >10) = 0;

stem(n,x);
```

d)

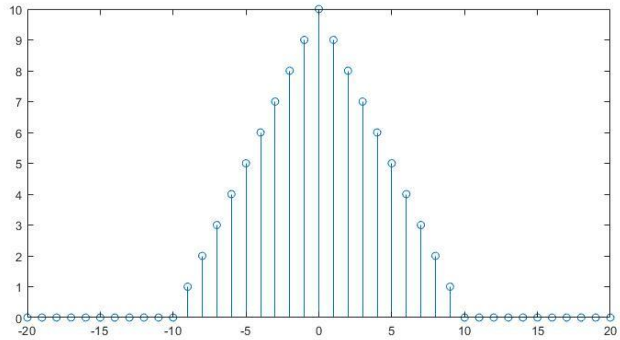
$$x[n] = x_g[n] + x_u[n]$$

```
n=-20:20;

x(0<= (n) <=10) = (n);
x( (n) <0) = 0;
x( (n) >10) = 0;

x_g = 0.5*(x + x(end:-1:1)); % even part
x_u = 0.5*(x - x(end:-1:1)); % odd part

stem(n,x_u);
```

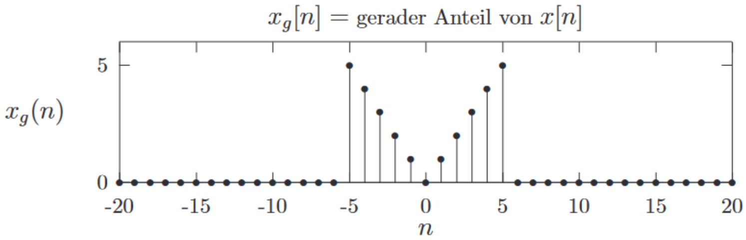
e)

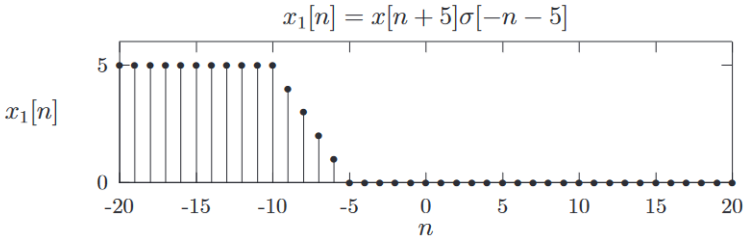
$$x[n+10] + x[-n+10] - 10\delta[n]$$



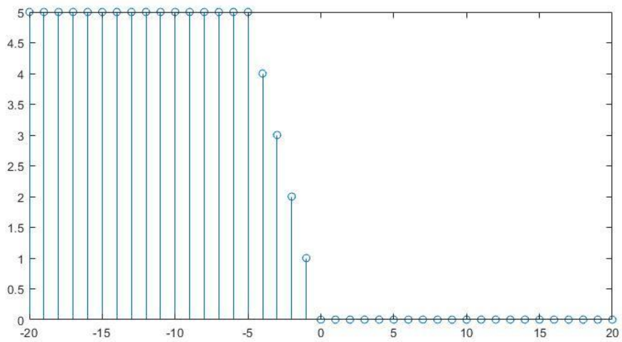
```
n=-20:20;

x_1(0<= (n+10) <=10) = (n+10);
x_1( (n+10) <0) = 0;
x_1( (n+10) >10) = 0;

x_2(0<= (-n+10) <=10) = (-n+10);
x_2( (-n+10) <0) = 0;
x_2( (-n+10) >10) = 0;

x_3(n==0) = 1;
x_3(n<0) = 0;
x_3(n>0) = 0;

stem(n,x_1+x_2-10*x_3);
```

Aufgabe 1.2:



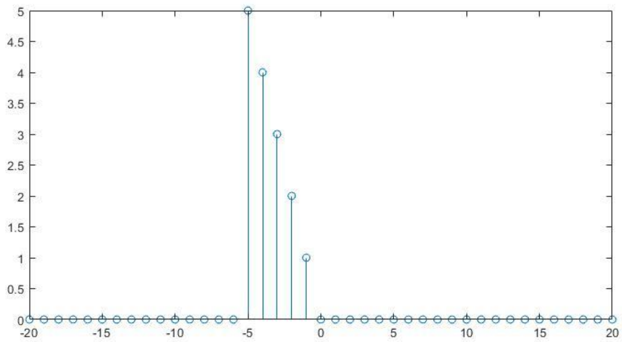


$$\boldsymbol{x[n]\sigma[-n]}$$



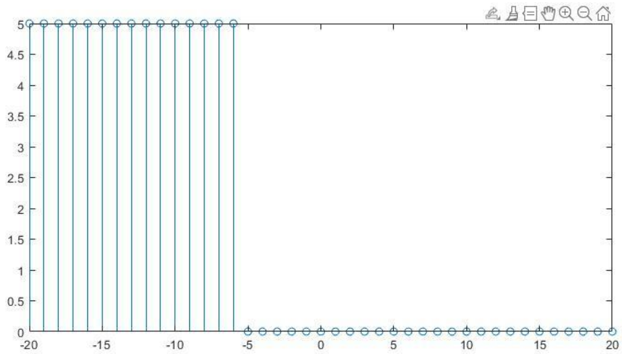
```
n=-20:20;

x(0<= (-n) <=5) = (-n);
x( (-n) <0) = 0;
x( (-n) >5) = 5;

stem(n,x);
```

$$\boldsymbol{x_g[n]\sigma[-n]}$$



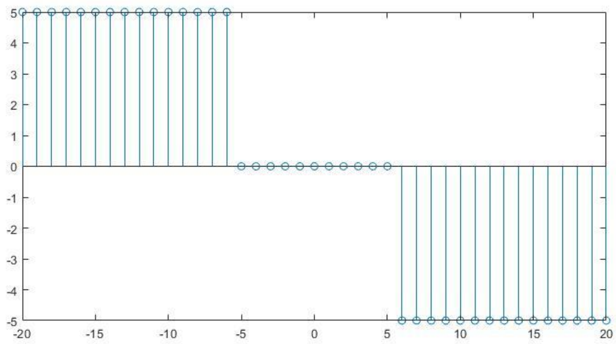
```
n=-20:20;

x_g(0<= (-n) <=5) = (-n);
x_g( (-n) <0) = 0;
x_g( (-n) >5) = 0;

stem(n,x_g);
```

$$x_u[n]\sigma[-n] = x[n]\sigma[-n] - x_g[n]\sigma[-n]$$



```
n=-20:20;

x(0<= (-n) <=5) = (-n);
x( (-n) <0) = 0;
x( (-n) >5) = 5;

x_g(0<= (-n) <=5) = (-n);
x_g( (-n) <0) = 0;
x_g( (-n) >5) = 0;

stem(n,x-x_g);
```

$$x_u[n]$$



```
n=-20:20;

x(-5 <= n <= 5) = 0;
x( n < -5) = 5;
x( n > 5) = -5;

stem(n,x);
```

Aufgabe 1.3:

a) Produkt von geradem und ungeradem Signal ergibt ungerades Signal

$$y[n] = x_g[n] \cdot x_u[n] = ungerade$$

↓ Annahme, dass es stimmt

$$y[-n] = x_g[-n] \cdot x_u[-n]$$

$$\downarrow x_g[-n] = x_g[n]$$

$$y[-n] = x_g[n] \cdot x_u[-n]$$

$$\downarrow x_u[-n] = -x_u[n]$$

$$y[-n] = x_g[n] \cdot (-x_u[n])$$

$$y[-n] = -x_g[n] \cdot x_u[n] = -y[n]$$

b) Summe eines ungeraden Signals $= 0$

$$\sum_{n=-\infty}^{\infty} x_u[n] = 0$$

$$\downarrow$$

$$x_u[n] = 0$$

$$x_u[-n] = -x_u[n]$$

$$0 = -0$$

$$\downarrow$$

$$\sum_{n=-\infty}^{0} x_u[n] = -\sum_{n=0}^{\infty} x_u[n]$$

$$\downarrow$$

$$\sum_{n=-\infty}^{\infty} x_u[n] = \sum_{n=-\infty}^{0} x_u[n] + \sum_{n=0}^{\infty} x_u[n] = 0$$

c) Signalenergie

$$\sum_{n=-\infty}^{\infty} \boldsymbol{x^2[n]} = \sum_{n=-\infty}^{\infty} \left(x_g[n] + x_u[n]\right)^2$$

$$= \sum_{n=-\infty}^{\infty} x_g^2[n] + \sum_{n=-\infty}^{\infty} x_u^2[n] + 2 \cdot \sum_{n=-\infty}^{\infty} x_g[n] \cdot x_u[n]$$

$$\downarrow$$

$$x_g[n] \cdot x_u[n] = ungerade$$

$$\sum_{n=-\infty}^{\infty} x_g[n] \cdot x_u[n] = 0$$

$$\downarrow$$

$$\sum_{n=-\infty}^{\infty} x^2[n] = \sum_{n=-\infty}^{\infty} x_g^2[n] + \sum_{n=-\infty}^{\infty} x_u^2[n]$$

Aufgabe 1.4:

$$x[n] = e^{j\frac{2\pi}{N}nk}$$

$$x[n + N'] = x[n]$$

Periode N'

$$e^{j2\pi n} \rightarrow N' = 1$$

$$e^{j2\pi \cdot \frac{n}{N}} \rightarrow N' = N$$

$$e^{j2\pi \cdot \frac{k}{N} \cdot n} \rightarrow N' = \frac{N}{k}$$

Kürzen

$$e^{j2\pi \cdot \frac{k/ggT(N,k)}{N/ggT(N,k)} \cdot n} \rightarrow N = \frac{N}{ggT(N,k)}$$

($\frac{N/ggT(N,k)}{k/ggT(N,k)}$ ist keine Lösung, weil es nicht immer ganzzahlig ist!)