Avtokorelacija periodičnih signalov

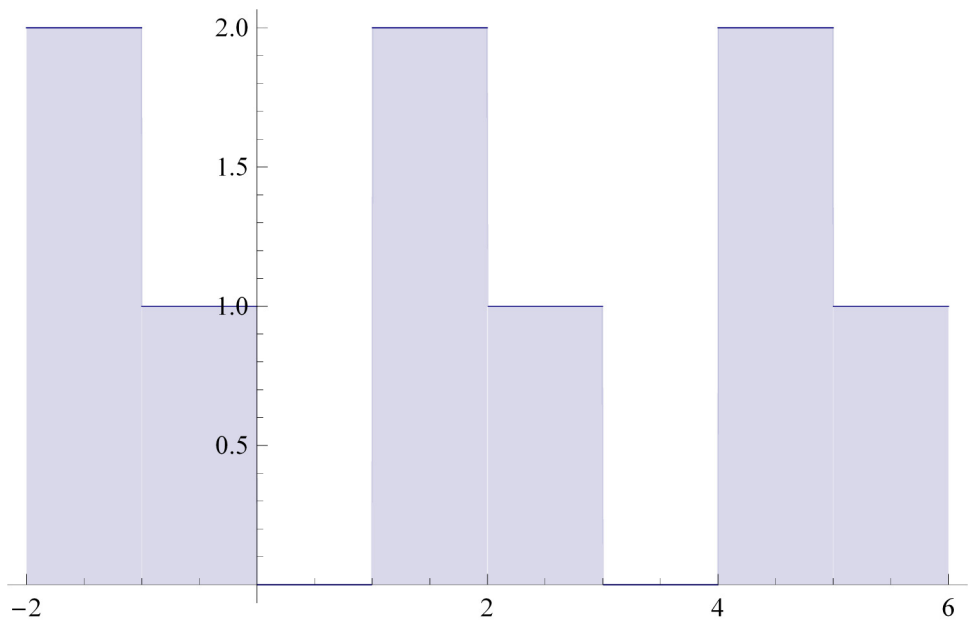
$$\varphi_{ii}[\tau] = \frac{1}{T}\int_{t_0}^{t_0+T} f_i[t] * f_i[t+\tau]\, dt$$

Naloga 1:

Naloga:
Za periodični signal $f_1(t)$ določi avtokorelacijo in skiciraj nejen potek.

Signal:

```
Plot[f1[t] + f1[t + 3] + f1[t + 6] + f1[t - 3] + f1[t - 6], {t, -2, 6}, PlotRange → All,
 Filling → Axis]
```




```
f1[t_] := { 2   1 < t ≤ 2
          { 1   2 < t ≤ 3
          { 0   True
```

Rešitev

Zaradi periodičnosti avtokorelacije računamo za premike samo ene periode.

```
T = 3;
```

```
0 ≤ τ ≤ 1
```

$$\varphi_{11} = \frac{1}{3} * \left(\int_1^{2-\tau} 2*2\, dt + \int_{2-\tau}^{2} 2*1\, dt + \int_2^{3-\tau} 1*1\, dt\right)$$

$$\frac{1}{3}(1 + 4(1-\tau) + \tau)$$

$$\frac{1}{3}(5 - 3\tau)$$

```
1 ≤ τ ≤ 2
```

$$\varphi_{11} = \frac{1}{3} * \left(\int_{1-\tau}^{0} 1 * 2 \, dt + \int_{1}^{3-\tau} 2 * 1 \, dt \right)$$

$$\frac{1}{3} (2 (2 - \tau) + 2 (-1 + \tau))$$

$$\frac{2}{3}$$

$$2 \leq \tau \leq 3$$

$$\varphi_{11} = \frac{1}{3} * \left(\int_{1-\tau}^{-1} 2 * 2 \, dt + \int_{-1}^{2-\tau} 1 * 2 \, dt + \int_{2-\tau}^{0} 1 * 1 \, dt \right)$$

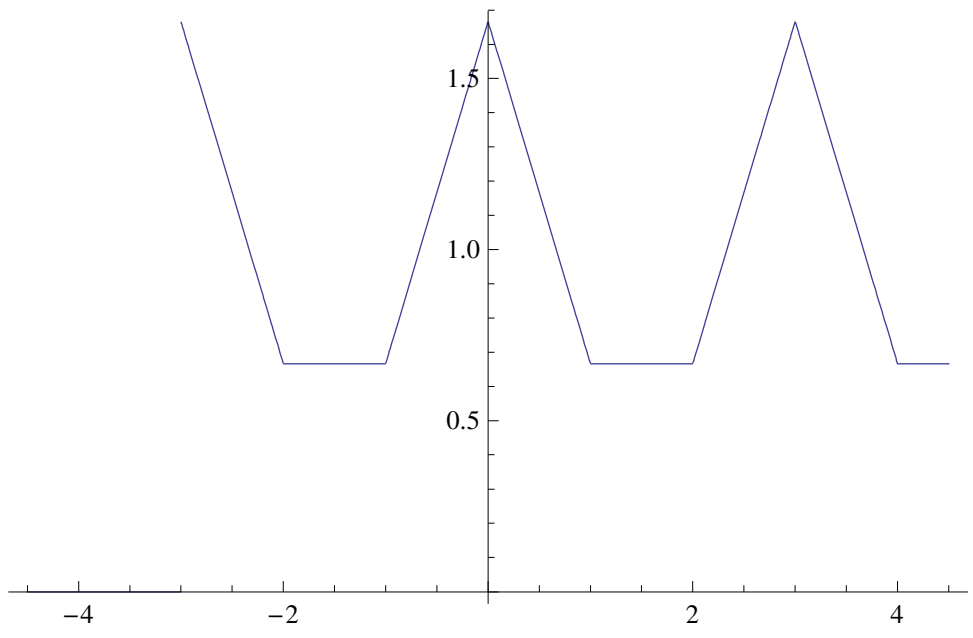
$$\frac{1}{3} (-2 + 2 (3 - \tau) + 4 (-2 + \tau) + \tau)$$

$$\frac{1}{3} (-4 + 3 \tau)$$

Narišemo. *Avtokorelacija mora biti zvezna in periodična funkcija!!!*

$$\varphi_{11}[\tau\_] := \begin{cases} \frac{1}{3} (5 - 3 \tau) & 0 \leq \tau \leq 1 \\ \frac{2}{3} & 1 \leq \tau \leq 2 \\ \frac{1}{3} (-4 + 3 \tau) & 2 \leq \tau \leq 3 \\ 0 & \text{True} \end{cases}$$

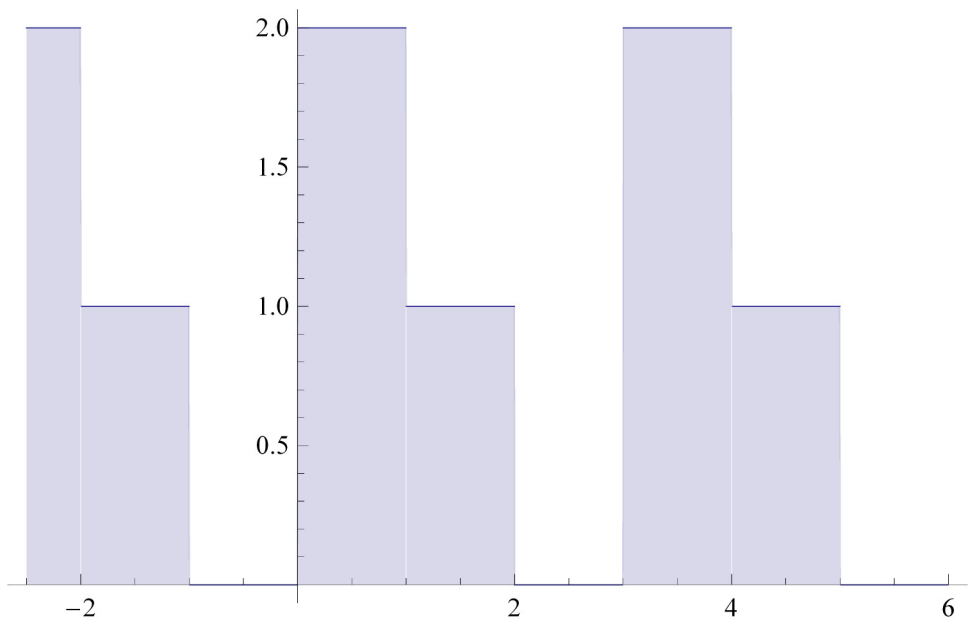
```
Plot[φ11[τ] + φ11[τ + 3] + φ11[τ - 3], {τ, -4.5, 4.5}]
```



Izračun avtokorelacije premaknjenega signala

```
f2[t_] := f1[t + 1]
```

```
Plot[f2[t] + f2[t + 3] + f2[t + 6] + f2[t - 3] + f2[t - 6], {t, -2.5, 6}, PlotRange → All,
 Filling → Axis]
```



$$0 \le \tau \le 1$$

$$\varphi_{11} = \frac{1}{3} * \left(\int_0^{1-\tau} 2 * 2 \, dt + \int_{1-\tau}^{1} 2 * 1 \, dt + \int_1^{2-\tau} 1 * 1 \, dt \right)$$

$$\frac{1}{3} (1 + 4 (1 - \tau) + \tau)$$

$$\frac{1}{3} (5 - 3 \tau)$$

$$1 \le \tau \le 2$$

$$\varphi_{11} = \frac{1}{3} * \left(\int_{-\tau}^{-1} 1 * 2 \, dt + \int_0^{2-\tau} 2 * 1 \, dt \right)$$

$$\frac{1}{3} (2 (2 - \tau) + 2 (-1 + \tau))$$

$$\frac{2}{3}$$

$$2 \le \tau \le 3$$

$$\varphi_{11} = \frac{1}{3} * \left(\int_{-\tau}^{-2} 2 * 2 \, dt + \int_{-2}^{1-\tau} 1 * 2 \, dt + \int_{1-\tau}^{-1} 1 * 1 \, dt \right)$$

$$\frac{1}{3} (-2 + 2 (3 - \tau) + 4 (-2 + \tau) + \tau)$$

$$\frac{1}{3} (-4 + 3 \tau)$$

Avtokorelacija je enaka kot zgoraj.