# Izražava signalov s temeljnimi funkcijami

## Walsheve temeljne funkcije

### Definicija prvih štirih funkcij

$$W_0[t\_] := \begin{cases} 1 & 0 \le t \le 1 \\ 0 & \text{True} \end{cases}$$

$$W_1[t\_] := \begin{cases} 1 & 0 < t \le \frac{1}{2} \\ -1 & \frac{1}{2} < t \le 1 \\ 0 & \text{True} \end{cases}$$

$$W_2[t\_] := \begin{cases} 1 & 0 < t \le \frac{1}{4} \\ -1 & \frac{1}{4} < t \le \frac{3}{4} \\ 1 & \frac{3}{4} < t \le 1 \\ 0 & \text{True} \end{cases}$$

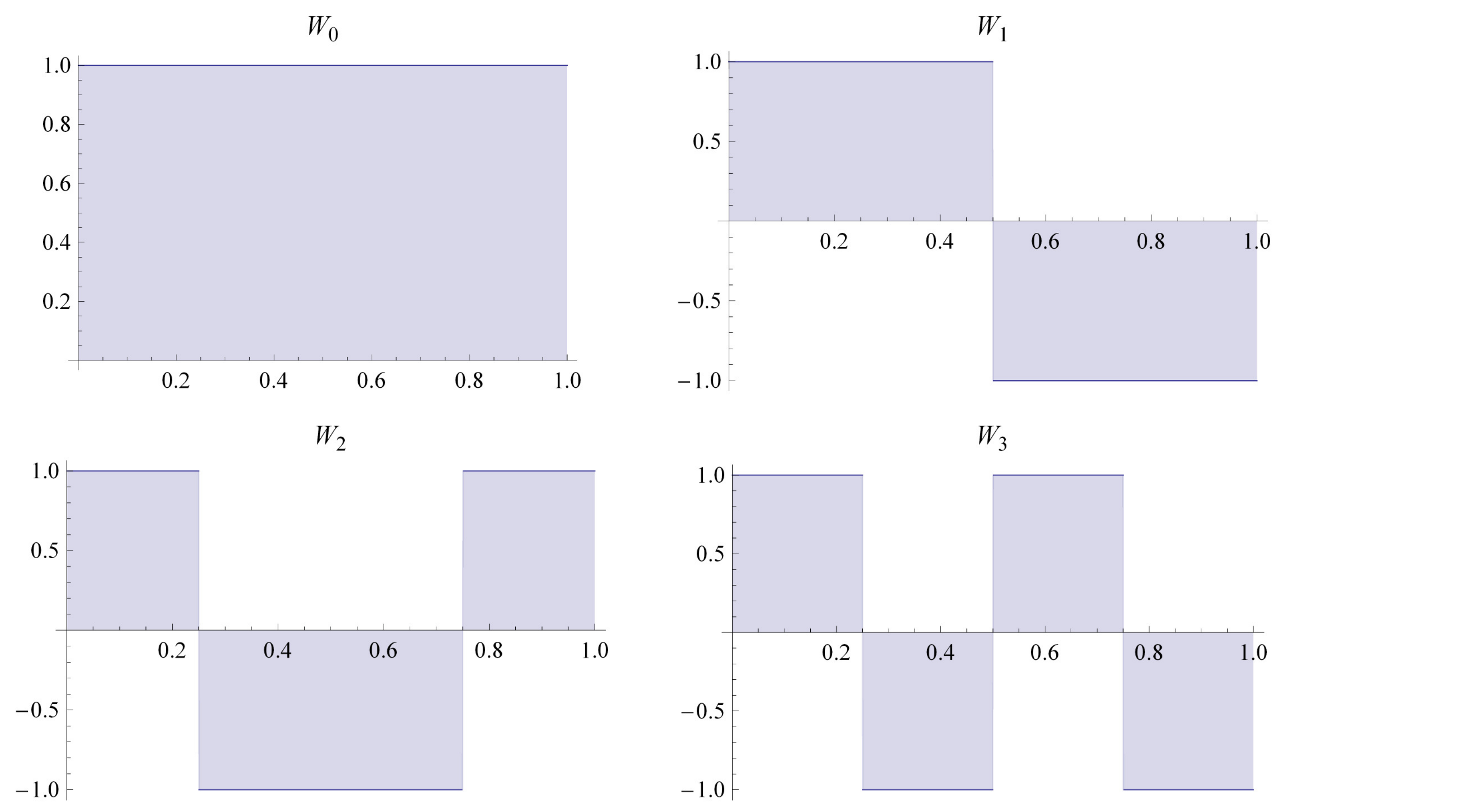
$$W_3[t\_] := \begin{cases} 1 & 0 < t \le \frac{1}{4} \\ -1 & \frac{1}{4} < t \le \frac{1}{2} \\ 1 & \frac{1}{2} < t \le \frac{3}{4} \\ -1 & \frac{3}{4} < t \le 1 \\ 0 & \text{True} \end{cases}$$

**Koeficienti:**

$K_0$ := 1;
$K_1$ := 1;
$K_2$ := 1;
$K_3$ := 1;

**Izris funkcij:**

```
gw0 = Plot[W0[t], {t, 0, 1}, PlotRange → All, PlotLabel → "W0", Filling → Axis];
gw1 = Plot[W1[t], {t, 0, 1}, PlotRange → All, PlotLabel → "W1", Filling → Axis];
gw2 = Plot[W2[t], {t, 0, 1}, PlotRange → All, PlotLabel → "W2", Filling → Axis];
gw3 = Plot[W3[t], {t, 0, 1}, PlotRange → All, PlotLabel → "W3", Filling → Axis];
GraphicsGrid[{{gw0, gw1}, {gw2, gw3}}]
```

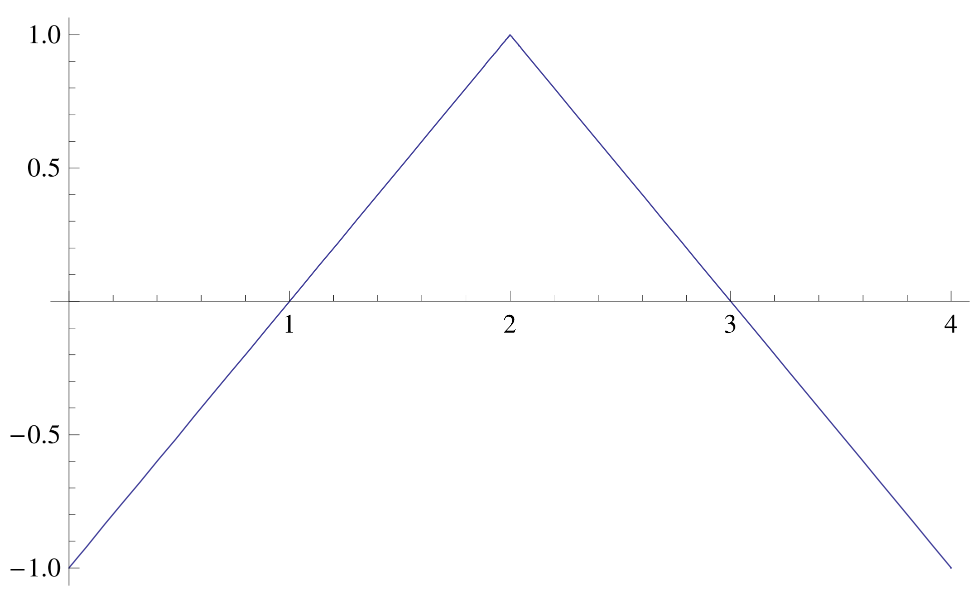



# Aproksimacija signala na premaknjenem intervalu (naloga 1)

**Naloga 1:**
Signal na sliki izrazite s približkom prvih štirih Walshevih temeljnih funkcij.
Aproksimacijo signala skiciraj.
Kakšna je razlika v napaki, če signal aproksimiramo samo s prvimi tremi Walshevimi funkcijami?

```
x[t_] := { t - 1    0 < t ≤ 2
           -t + 3   2 < t ≤ 4;
           0        True
```

```
Plot[x[t], {t, 0, 4}, PlotRange → All]
```



**Rešitev:**

## *Premaknjene Walsheve. t.f.*

Poiščemo preslikavo **u: [0,4] → [0,1]; u[t] = a*t+b**

$$u[t\_] := \frac{1}{4} * t;$$

$$\hat{W}_0[t\_] := W_0[u[t]];$$
$$\hat{W}_1[t\_] := W_1[u[t]];$$
$$\hat{W}_2[t\_] := W_2[u[t]];$$
$$\hat{W}_3[t\_] := W_3[u[t]];$$

$$a = \frac{1}{4};$$
$$\hat{K}_0 := \frac{K_0}{a}$$
$$\hat{K}_1 := \frac{K_1}{a}$$
$$\hat{K}_2 := \frac{K_2}{a}$$
$$\hat{K}_3 := \frac{K_3}{a}$$

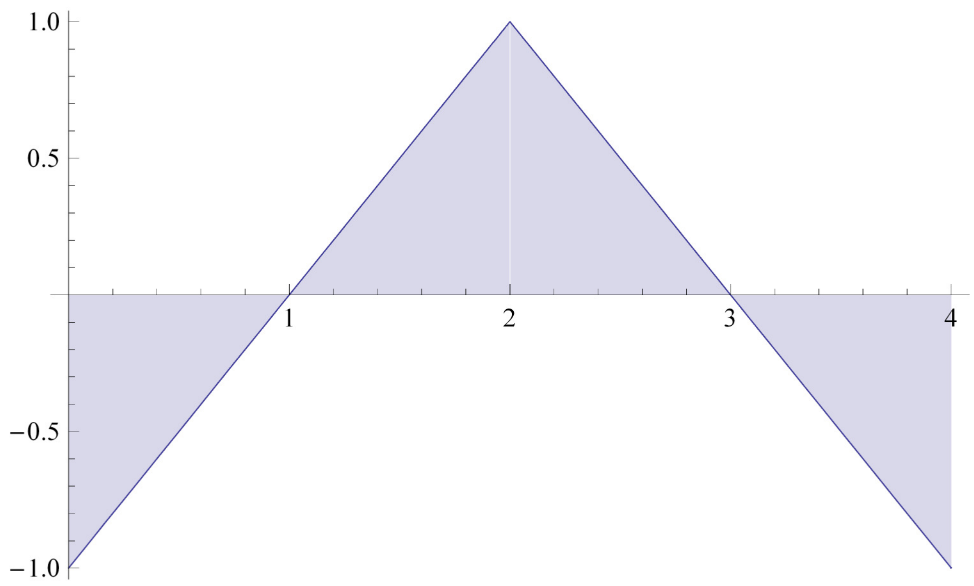
$$\{\hat{K}_0, \hat{K}_1, \hat{K}_2, \hat{K}_3\}$$

{4, 4, 4, 4}

$$C_0 = \frac{1}{\hat{K}_0} * \int_0^4 x[t] * \hat{W}_0[t]\, dt$$

0

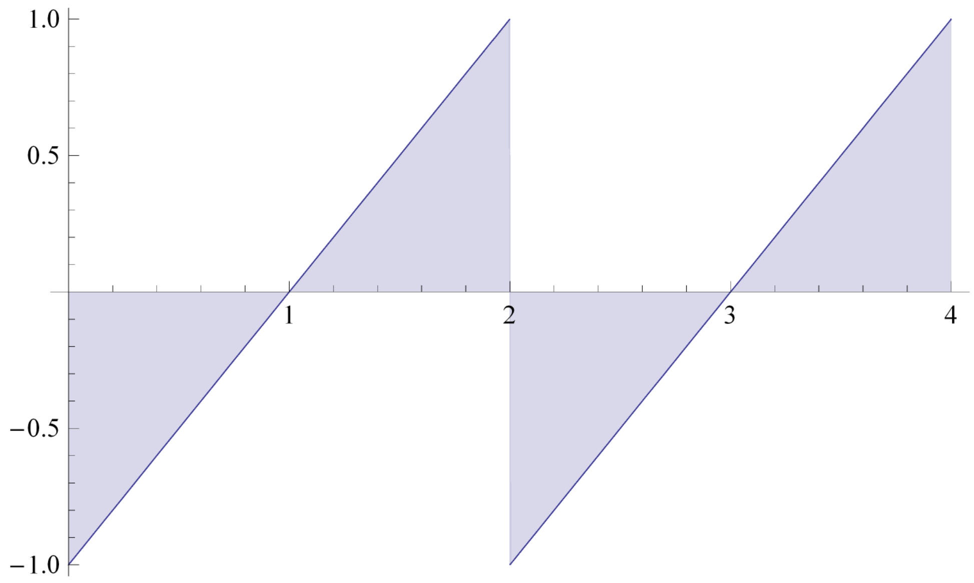
$$\text{Plot}[\{x[t] * \hat{W}_0[t]\}, \{t, 0, 4\}, \text{Filling} \to \text{Axis}]$$




$$C_1 = \frac{1}{\hat{K}_1} * \int_0^4 x[t] * \hat{W}_1[t]\, dt$$

0

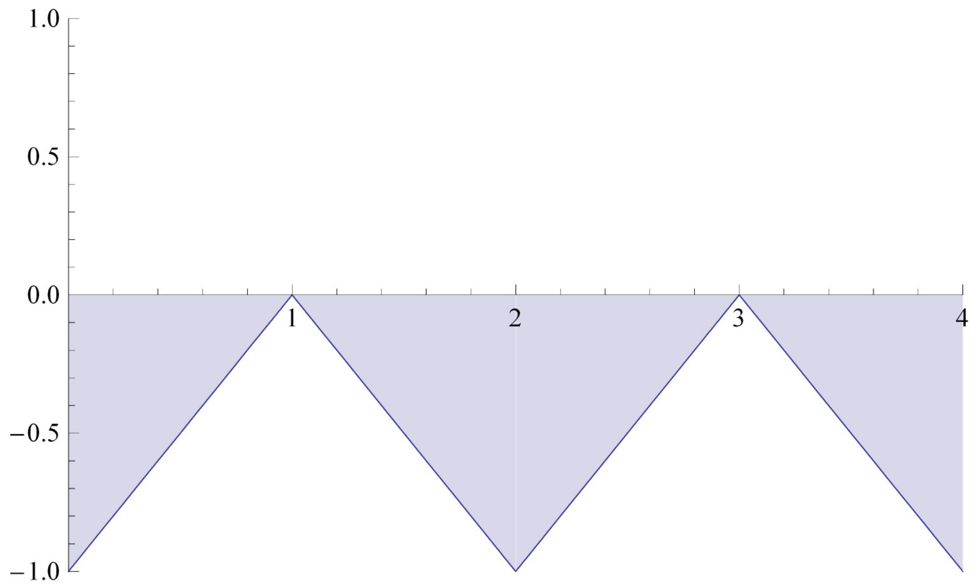
```
Plot[{x[t] * Ŵ1[t]}, {t, 0, 4}, Filling → Axis]
```




$$C_2 = \frac{1}{\hat{K}_2} * \int_0^4 x[t] * \hat{W}_2[t] \, dt$$

$-\frac{1}{2}$

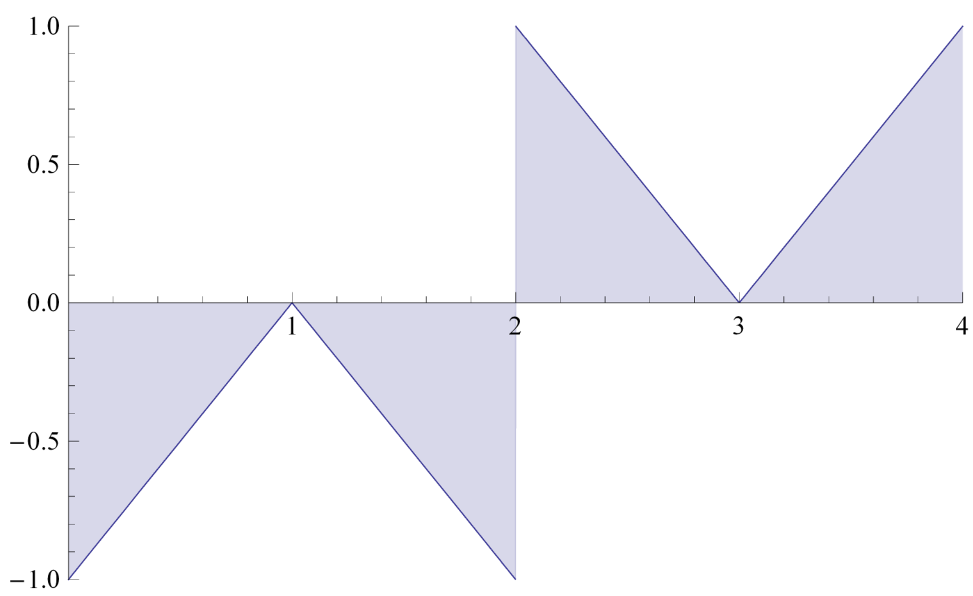
```
Plot[{x[t] * Ŵ2[t]}, {t, 0, 4}, Filling → Axis, PlotRange → {{0, 4}, {-1, 1}}]
```




$$C_3 = \frac{1}{\hat{K}_3} * \int_0^4 x[t] * \hat{W}_3[t] \, dt$$

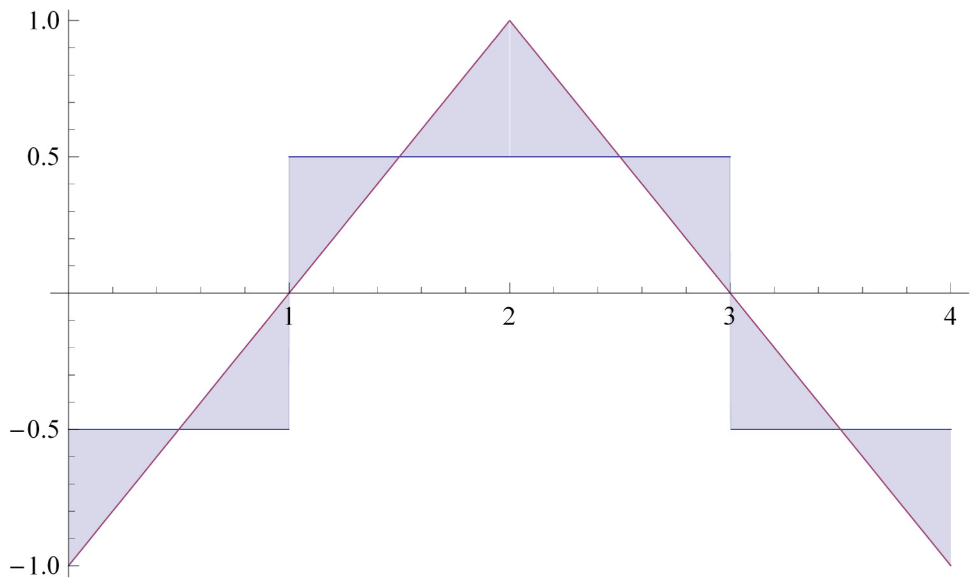
0

```
Plot[{x[t] * Ŵ3[t]}, {t, 0, 4}, Filling → Axis, PlotRange → {{0, 4}, {-1, 1}}]
```




- ***Izris aproksimiranega signala:***

```
Plot[{C0 Ŵ0[t] + C1 Ŵ1[t] + C2 Ŵ2[t] + C3 Ŵ3[t], x[t]}, {t, 0, 4}, Filling → {1 → {2}}]
```




- ***Izračun razlike napake, če aproksimiramo s prvimi 4-imi W.t.f. ali pa samo s 3-mi W.t.f.***

$$\Delta\epsilon = \epsilon 4 - \epsilon 3 = \frac{1}{t_2 - t_1} * K_3 * C_3 * C_3;$$

*V našem primeru:*

```
Δϵ = 1/4 * 4 * 0 * 0
```

```
0
```