1) $x(t) = \cos(7 \cdot t)^2$

$x(n) = x\left(\frac{n}{r}\right) = \cos\left(7 \cdot \frac{n}{10}\right)^2$ for $0 \leq n < 5$

$x(0) = 1$

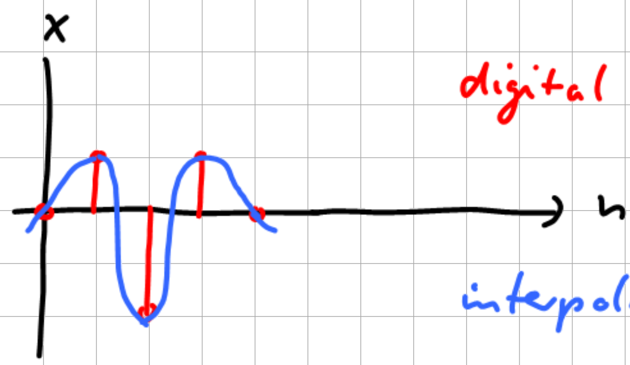
$x(1) = 0{,}585$

$x(2) = 0{,}029$

$x(3) = 0{,}255$

$x(4) = 0{,}888$

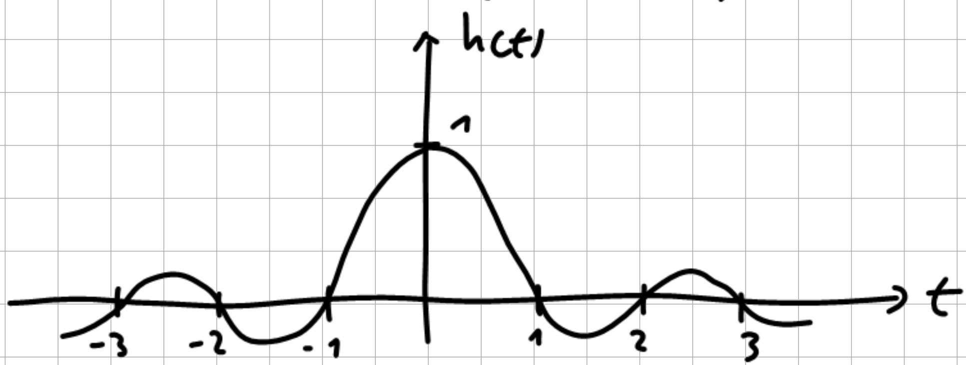
3)



digital signal x

interpolated signal $\hat{=}$ envelope of the signal

ideal lowpass: $h(t) = \text{sinc}(t)$



4)

$$r_{min} = 2 \cdot f_c = 6800 \text{ Hz}$$

$$\frac{r}{r_{min}} = \frac{32000}{6800} = 4{,}7$$

$\Rightarrow$ downsampling by factor 4   possible

$f_c = 3400$ Hz corresponds to Narrowband speech

5) - DC corresponds to the frequency $f = 0\,Hz$.

This frequency is outside the passband of the bandpass.

Therefore $z(n)$ has no DC component.

- Wideband speech has a frequency range of 50 Hz ... 7000 Hz.

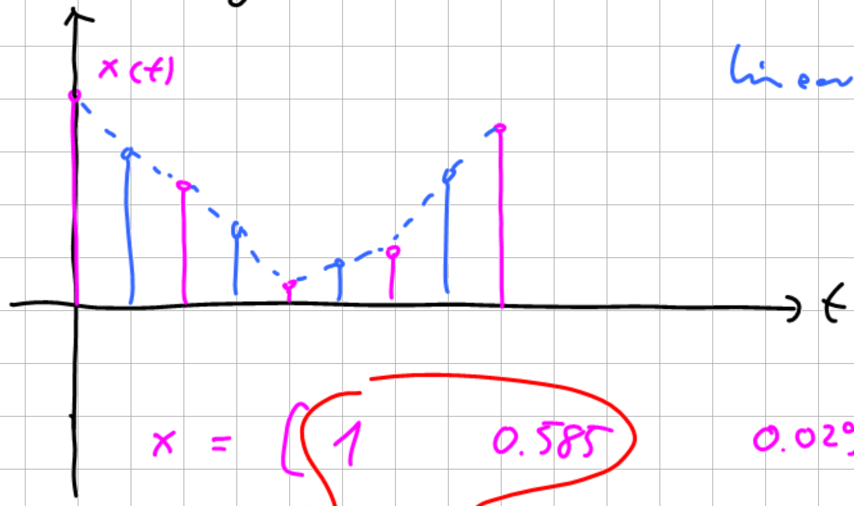
$\Rightarrow$ $z(n)$ has nearly all components of wideband speech.

$\Rightarrow$ Human voices are understandable in $z(n)$

- $y(n)$: $f_{max} = 24\,kHz$ (sampling theorem)

$z(n)$: $f_{max} = 7\,kHz$

2) Sampling rate is doubled



linear interpolation

$x = [1 \quad 0.585 \quad 0.029 \quad 0.255 \quad 0.888]$

$x_{upsampled} = [1 \quad 0.793 \quad 0.585 \quad 0.307 \quad 0.029 \quad 0.142 \quad 0.255 \quad 0.571 \quad 0.888]$

linear interpolation:

$$0.793 = \frac{1 + 0.585}{2}$$