1) $\Delta f < 10\,Hz$

$$10\,Hz > \frac{r}{K} \Leftrightarrow K > \frac{r}{10\,Hz} = \frac{16000}{10} = 1600$$

50 spectra per second $\Rightarrow$ hopsize < 20 ms

$\Rightarrow$ windowsize = N = 2 · hopsize

$$\Rightarrow N < 2 \cdot 20\,ms \cdot \frac{16000\,\frac{1}{s}}{1000\,\frac{ms}{s}} = 2 \cdot 20 \cdot 16 = 640$$

$\Rightarrow$ setting $N = 640$ and $K = 1600$

$\Rightarrow$ zero padding is necessary.

$K = 1600 \Rightarrow$ 2 real valued coefficients

and $\frac{1600}{2} - 1 = 799$ complex valued coefficients

$\Rightarrow$ per spectrum $799 \cdot 8$ Byte + $2 \cdot 4$ Byte

= 6400 Bytes

3 s of recording and 50 spectra per second

$\Rightarrow$ 150 spectra

$\Rightarrow$ $150 \cdot 6400$ Bytes = 960000 Bytes of memory consumption

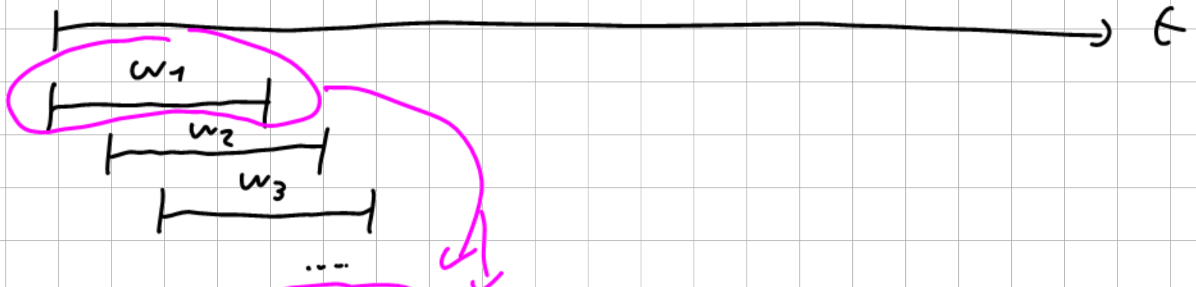
2) The smaller windowsize leads to better time resolution.

3) The greater windowsize leads to better frequency resolution.

$\Rightarrow$ time resolution and frequency resolution cannot be arbitrary good ↯.

4) $N = 100\,ms$

$\text{hopsize} = 25\,ms$ (→ due to 75% overlap)



$$\frac{5000\,ms - 100\,ms}{25\,ms} + 1 = 197 \text{ windows}$$

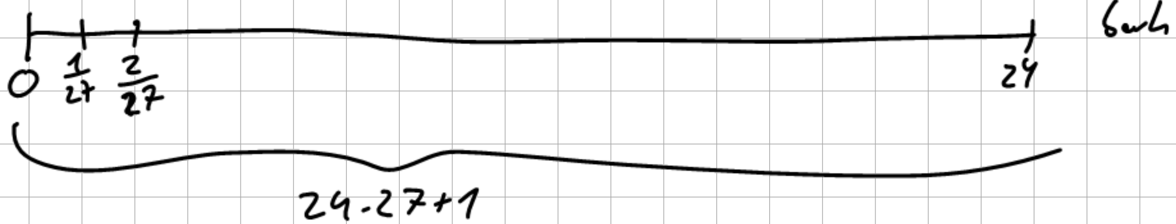
5) hopsize 1ms

frequency resolution $\approx \frac{1}{27}$ Bark (see also: jupyter notebook logarithmic frequency resolution)

$\frac{5000\,ms}{1\,ms} \Rightarrow 5000$ colums

$0 \ldots 24$ Bark in $\frac{1}{27}$ Bark steps lead to

$24 \cdot 27 + 1 = 649$ frequencies



$\Rightarrow$ spectogram holds $649 \cdot 5000 = 3245000$ values

6) hopsize = 1 sample leads to a constant overlap add regardless of the window.

$\alpha = 1$ corresponds to the Hann window.