DFT Analysis (5B)

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1/31/18

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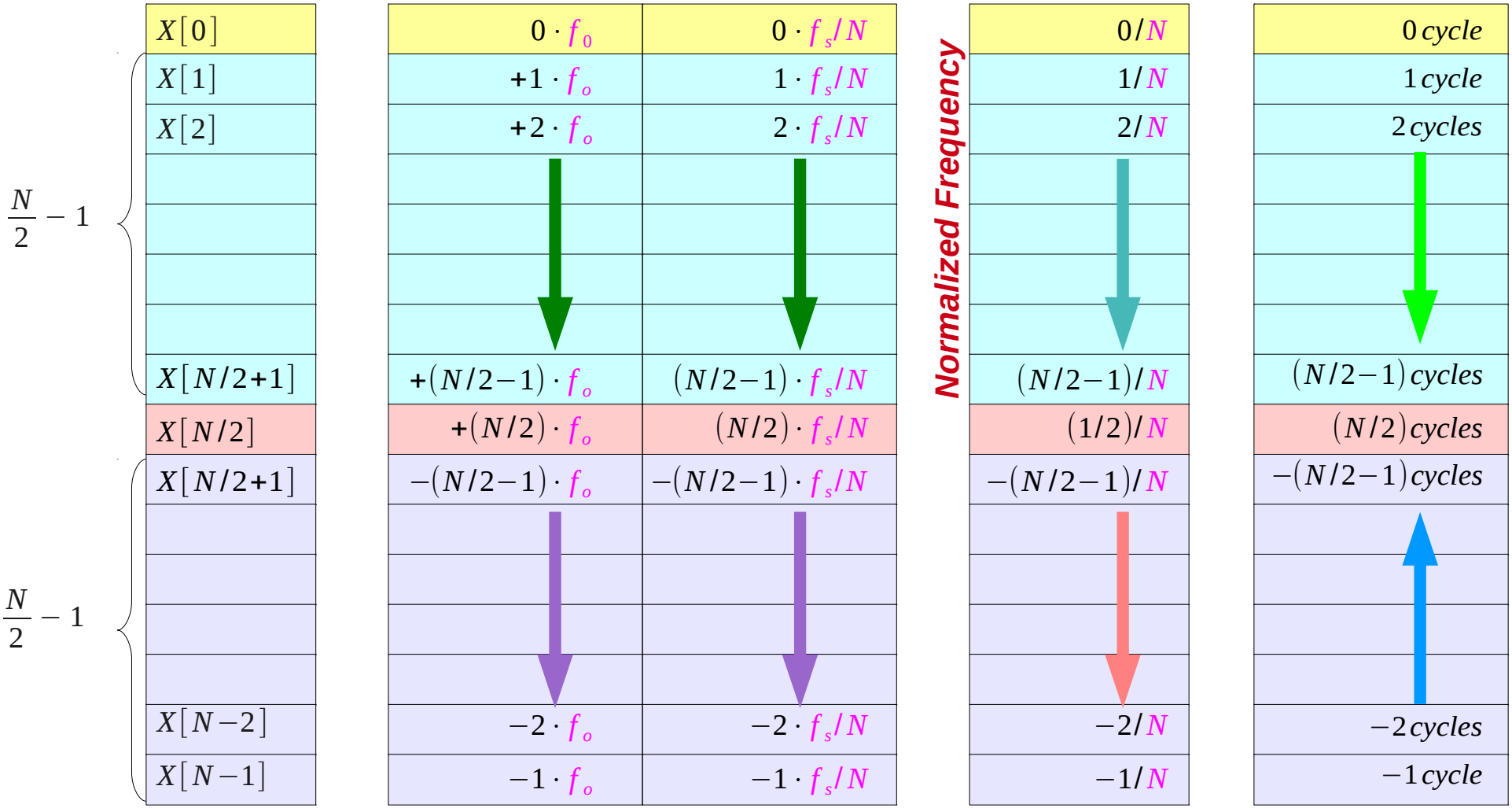
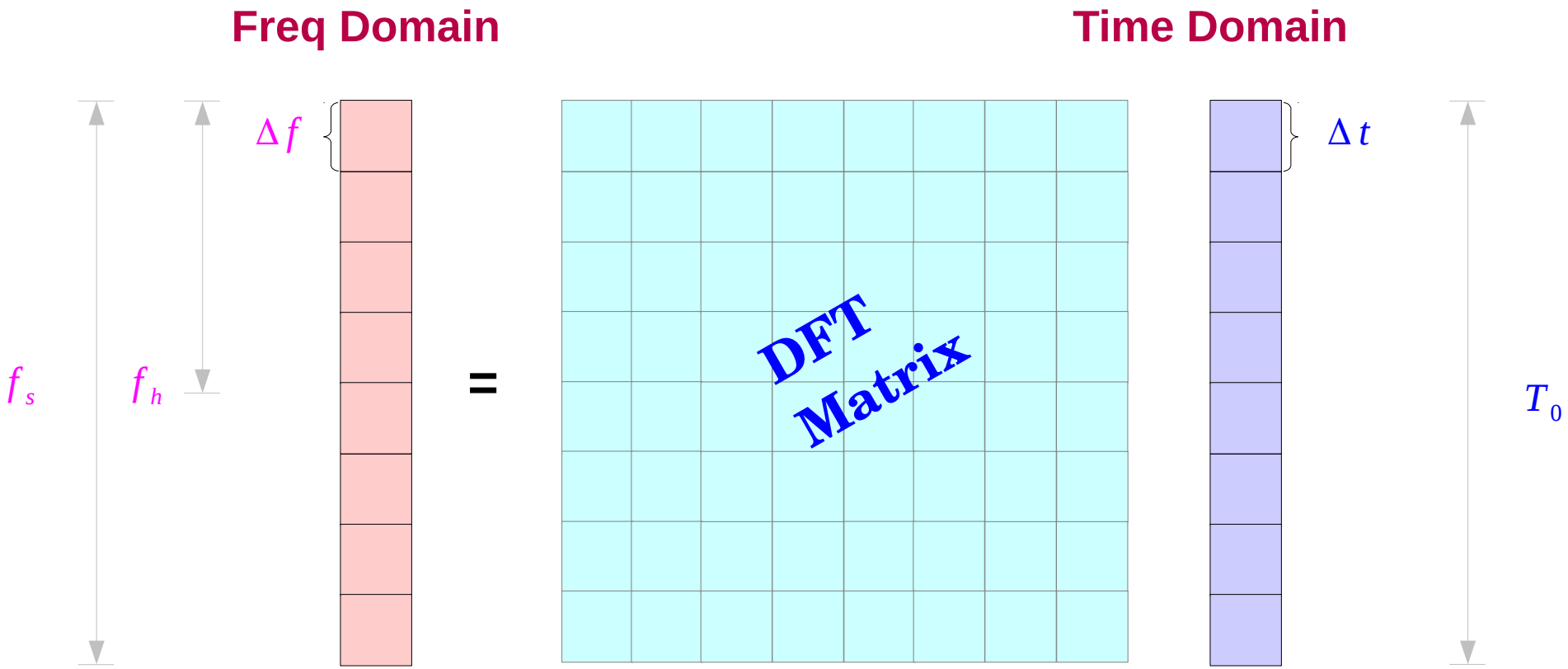
This document was produced by using LibreOffice and Octave.

Frequency View of a X[i] Vector



Resolutions of Frequency and Time Domains

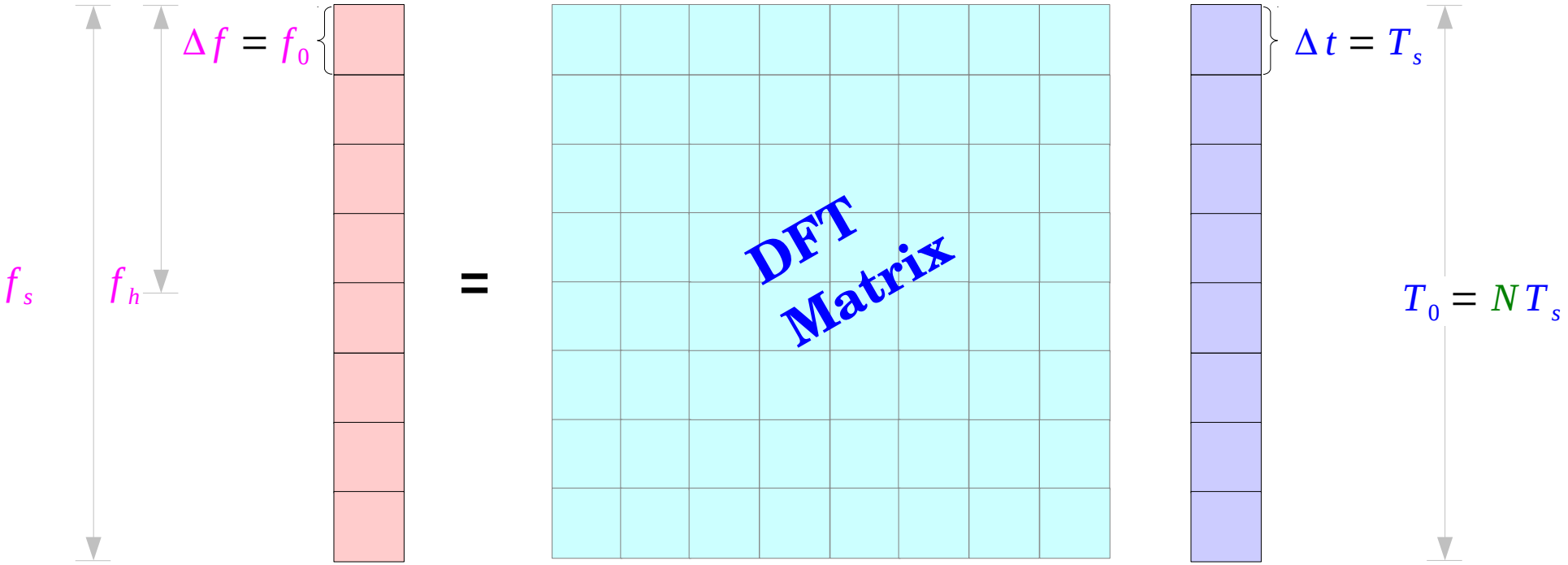


$$\Delta f = \frac{1}{T_0}$$

$$\Delta t = \frac{1}{f_s}$$

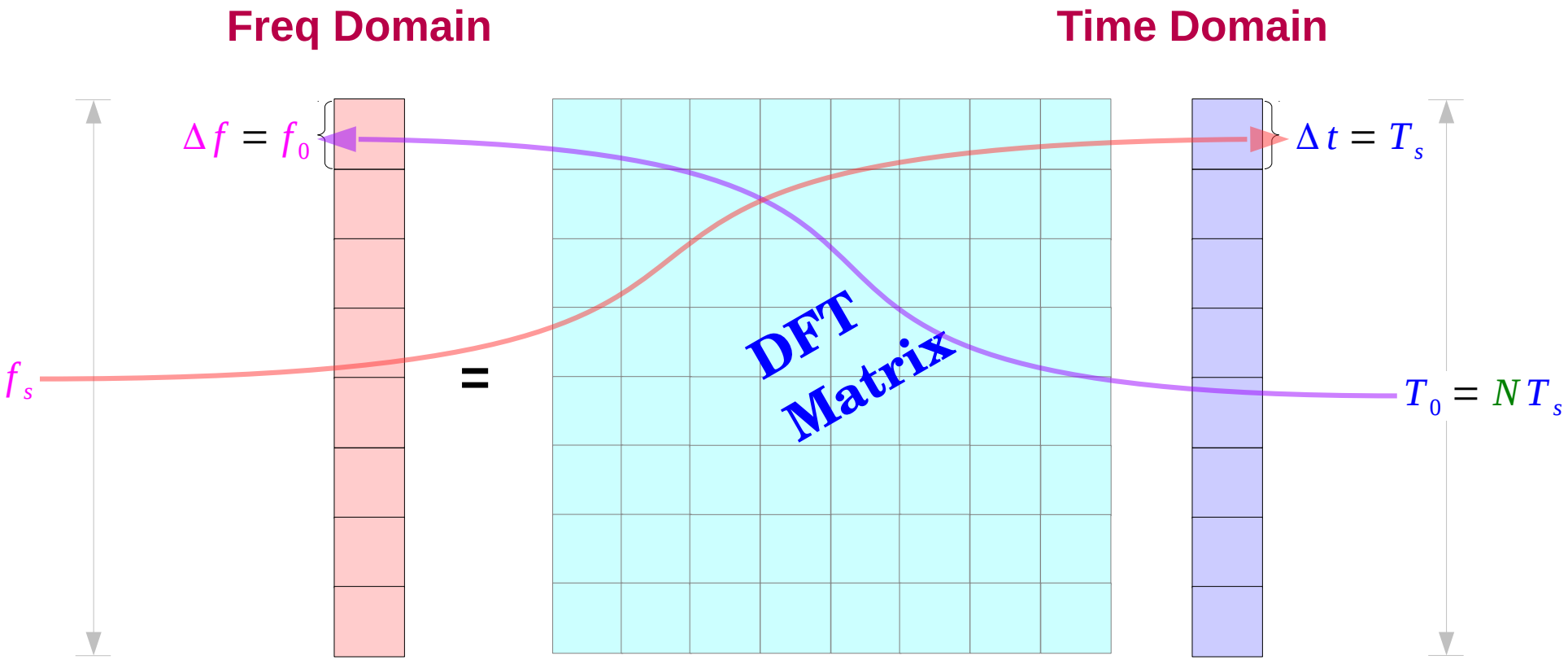
Using Sampling Frequency and Time

Freq Domain **Time Domain**



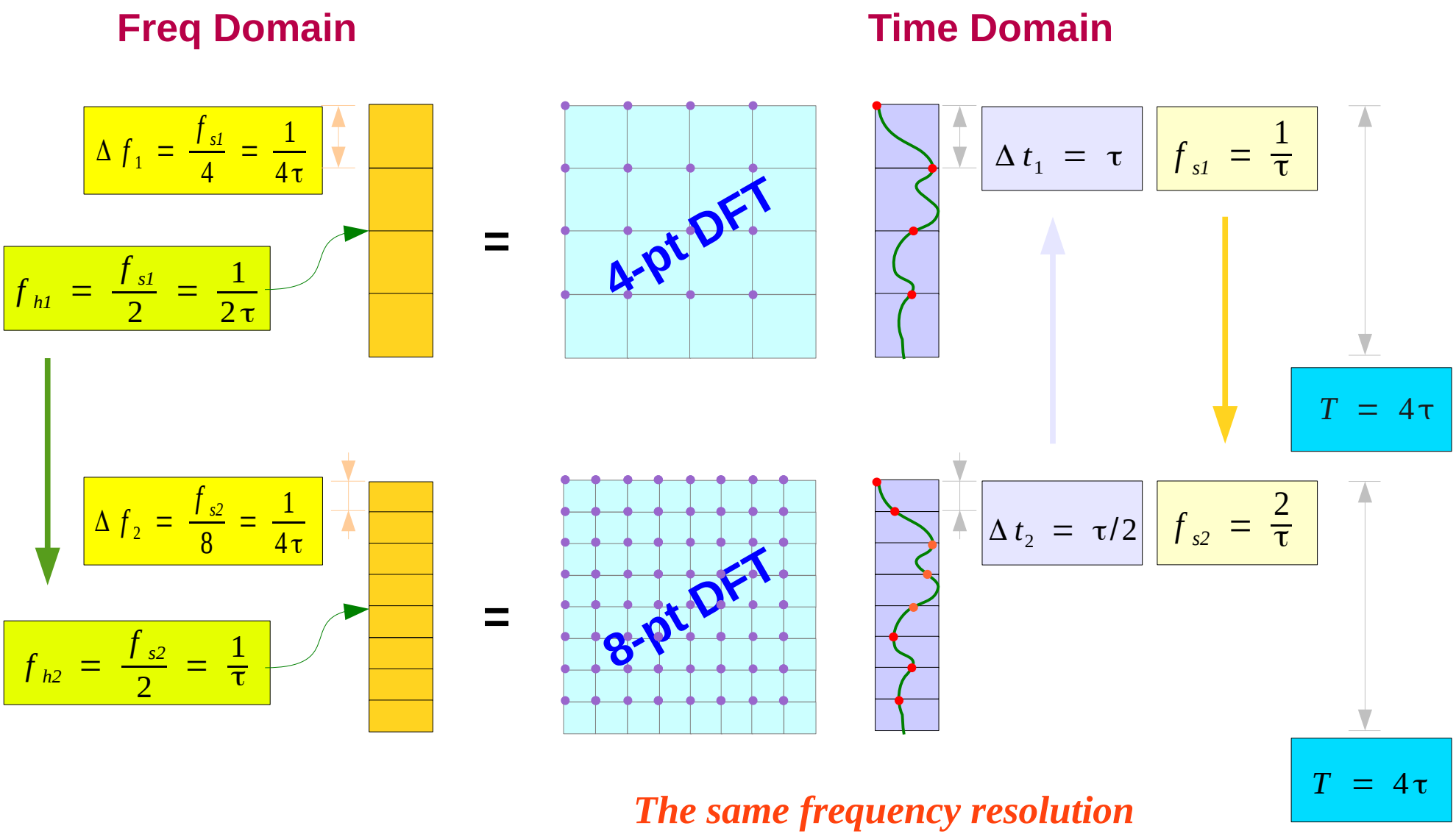
$$f_0 = \frac{1}{T_0} = \frac{1}{N T_s} \qquad f_s \geq \frac{2}{T_0} \qquad f_s \geq 2 f_0 \qquad T_s = \frac{1}{f_s}$$

Relations between Sampling Frequency and Time



$$f_0 = \frac{1}{T_0} = \frac{1}{N T_s} \qquad f_s \geq \frac{2}{T_0} \qquad f_s \geq 2 f_0 \qquad T_s = \frac{1}{f_s}$$

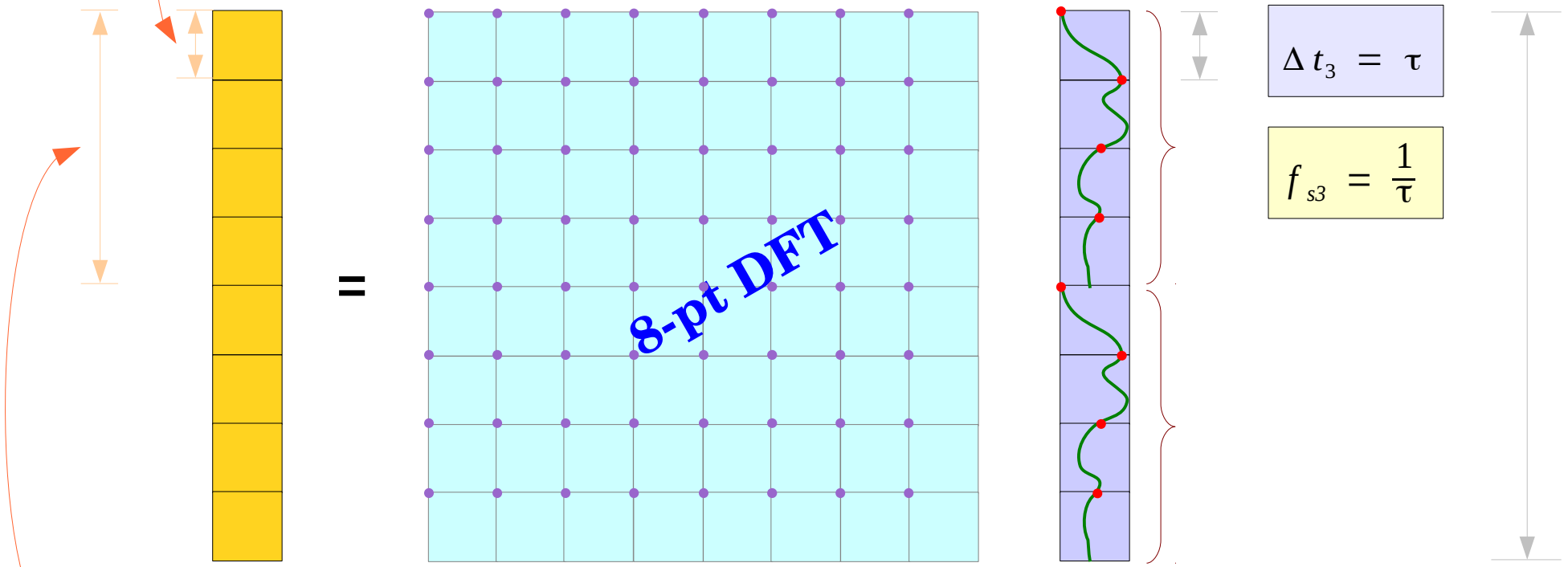
Frequency and Time Interval (1)



Frequency and Time Interval (2)

$$\Delta f_3 = \frac{f_{s3}}{8} = \frac{1}{8\tau}$$

The finer frequency resolution



$$\Delta t_3 = \tau$$

$$f_{s3} = \frac{1}{\tau}$$

$$f_{h3} = \frac{f_{s3}}{2} = \frac{1}{2\tau}$$

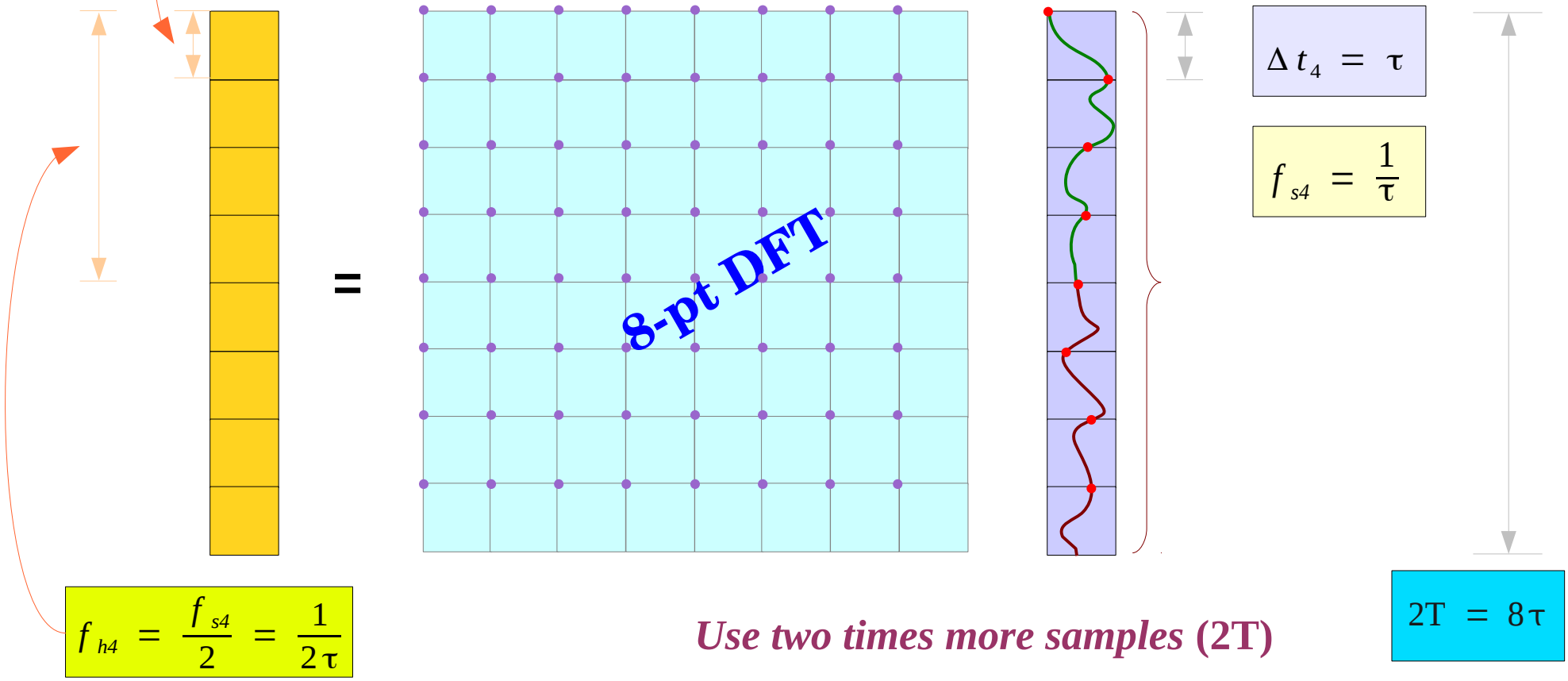
Repeating the time signal two times

$$2T = 8\tau$$

Frequency and Time Interval (3)

$$\Delta f_4 = \frac{f_{s4}}{8} = \frac{1}{8\tau}$$

The finer frequency resolution



$$\Delta t_4 = \tau$$

$$f_{s4} = \frac{1}{\tau}$$

$$f_{h4} = \frac{f_{s4}}{2} = \frac{1}{2\tau}$$

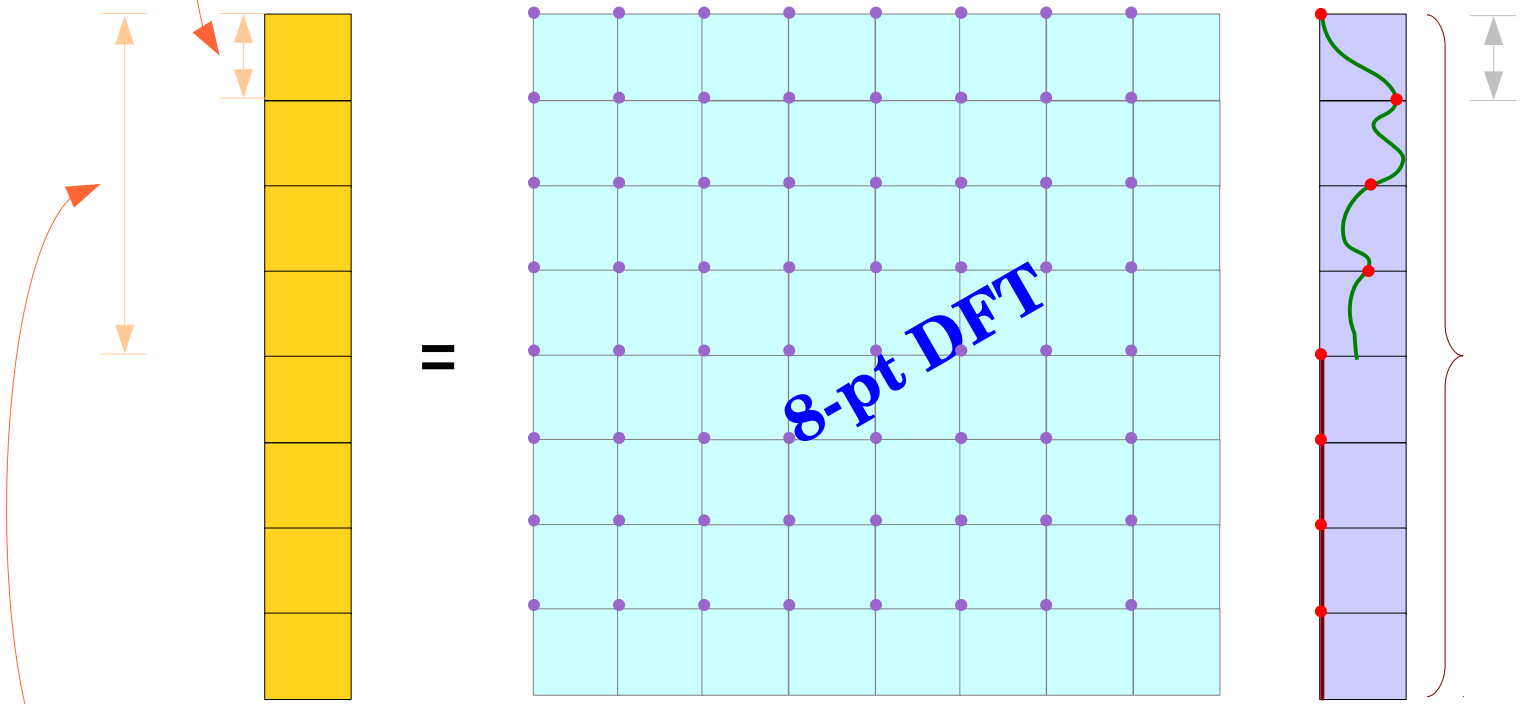
Use two times more samples (2T)

$$2T = 8\tau$$

Frequency and Time Interval (4)

$$\Delta f_5 = \frac{f_{s5}}{8} = \frac{1}{8\tau}$$

The finer frequency resolution



$$\Delta t_5 = \tau$$

$$f_{s5} = \frac{1}{\tau}$$

$$2T = 8\tau$$

$$f_{h5} = \frac{f_{s5}}{2} = \frac{1}{2\tau}$$

Use zero padding

References

[1] http://en.wikipedia.org/
[2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003
[3] A “graphical interpretation” of the DFT and FFT, by Steve Mann