

# DFT Matrix Examples (DFT.2.A)

---

Copyright (c) 2009, 2010 Young W. Lim.

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled "GNU Free Documentation License".

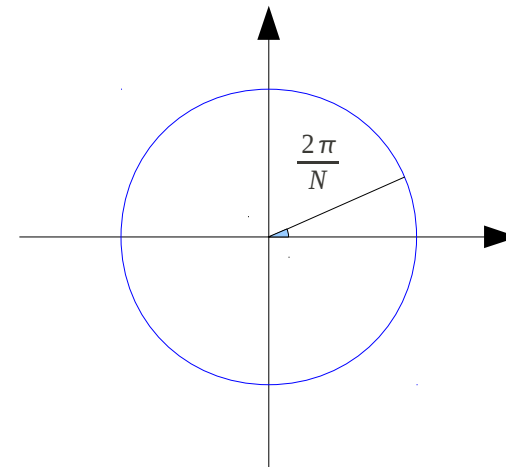
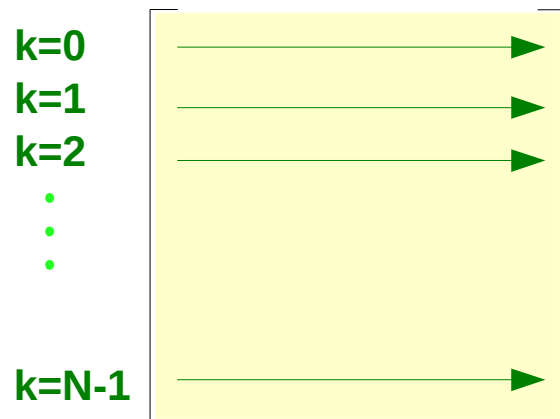
Please send corrections (or suggestions) to [youngwlim@hotmail.com](mailto:youngwlim@hotmail.com).

This document was produced by using OpenOffice and Octave.



# Rows of a DFT Matrix

$$e^{-j\left(\frac{2\pi}{N}\right)kn} \in \left\{ e^{-j\left(\frac{2\pi}{N}\right)\cdot 0}, e^{-j\left(\frac{2\pi}{N}\right)\cdot 1}, e^{-j\left(\frac{2\pi}{N}\right)\cdot 2}, \dots, e^{-j\left(\frac{2\pi}{N}\right)(N-1)} \right\}$$



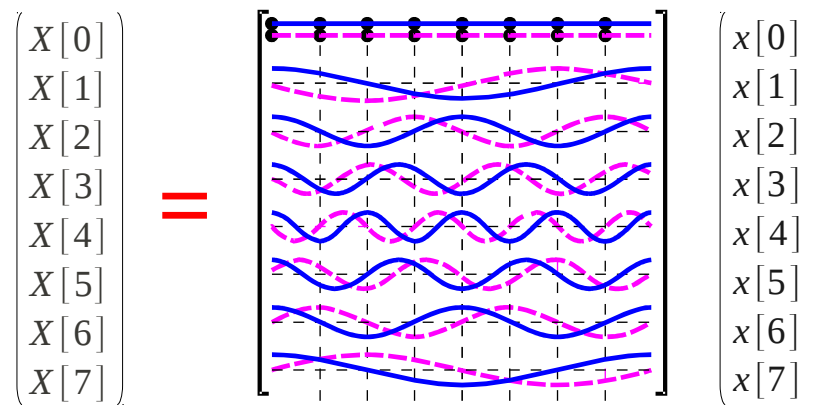
N samples when	$k=0$	→	0 round	→	0 cycle
N samples when	$k=1$	→	1 round	→	1 cycles
N samples when	$k=2$	→	2 rounds	→	2 cycles
$\vdots$	$\vdots$		$\vdots$		$\vdots$
N samples when	$k=N-2$	→	N-2 rounds	→	2 cycles*
N samples when	$k=N-1$	→	N-1 rounds	→	1 cycles*

*complex conjugate*

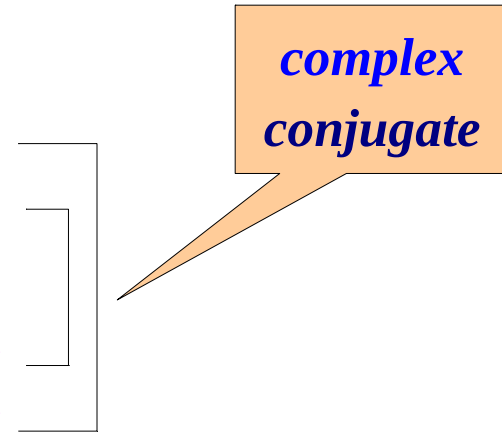
# Graphical Representation of a DFT Matrix

$$X[k] = \sum_{n=0}^7 W_8^{kn} x[n]$$

$$W_8^{kn} = e^{-j\left(\frac{2\pi}{8}\right)kn}$$



- 0 cycle
- 1 cycles
- 2 cycles
- ⋮
- 2 cycles\*
- 1 cycles\*



—————  $Re\left\{e^{-j\frac{2\pi}{8}kn}\right\} = \cos\left(\frac{2\pi}{8}kn\right)$

- - - - -  $Im\left\{e^{-j\frac{2\pi}{8}kn}\right\} = \sin\left(\frac{2\pi}{8}kn\right)$

## References

[1] <http://en.wikipedia.org/>

[2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003