UNIVERSITEIT VAN JOHANNESBURG

Toegepaste Wiskunde 3B

Taak #7 **7:30, 15 September 2009**

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1. Die diskrete Fouriertransformasie oor n punte kan in matriks vorm geskryf word

$$F_n := \begin{pmatrix} 1 & 1 & 1 & \dots & 1 \\ 1 & w & w^2 & \dots & w^{n-1} \\ 1 & w^2 & w^4 & \dots & w^{2(n-1)} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & w^{n-1} & w^{2(n-1)} & \dots & w^{(n-1)^2} \end{pmatrix}$$

waar $w = e^{2\pi i/n}$ is die n-te wortel van 1. Die diskrete Fourier transformasie is

$$(\hat{x}_1, \hat{x}_2, \dots, \hat{x}_n)^T = F_n(x_1, x_2, \dots, x_n)^T.$$

Bereken

$$F_6 \begin{pmatrix} \cos(\omega) \\ \cos(2\omega) \\ \cos(3\omega) \\ \cos(4\omega) \\ \cos(5\omega) \\ \cos(6\omega) \end{pmatrix} \quad \text{en} \quad F_6 \begin{pmatrix} \sin(\omega) \\ \sin(2\omega) \\ \sin(3\omega) \\ \sin(4\omega) \\ \sin(5\omega) \\ \sin(6\omega) \end{pmatrix}$$

waar $\omega = 2\pi/3$. Interpreteer die resultate om die onderliggende periodisiteit te vind.

2. Verwys na hoofstuk 15, probleem 1 in die handboek

Problems and Solutions in Quantum Computing and Quantum Information, 2de uitgawe.

Gebruik die metode wat beskryf is om die twee nie triviale faktore van 21 te vind met $a = 5$ en $a = 8$. Kan die metode gebruik word om die faktore van 21 te vind met $a = 4$?

UNIVERSITY OF JOHANNESBURG

Applied Mathematics 3B

Assignment #7 **7:30, 15 September 2009**

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1. The discrete Fourier transform over n points can be written in matrix form

$$F_n := \begin{pmatrix} 1 & 1 & 1 & \dots & 1 \\ 1 & w & w^2 & \dots & w^{n-1} \\ 1 & w^2 & w^4 & \dots & w^{2(n-1)} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & w^{n-1} & w^{2(n-1)} & \dots & w^{(n-1)^2} \end{pmatrix}$$

where $w = e^{2\pi i/n}$ is the n-th root of unity. We obtain the discrete Fourier transform from

$$(\hat{x}_1, \hat{x}_2, \dots, \hat{x}_n)^T = F_n(x_1, x_2, \dots, x_n)^T.$$

Calculate

$$F_6 \begin{pmatrix} \cos(\omega) \\ \cos(2\omega) \\ \cos(3\omega) \\ \cos(4\omega) \\ \cos(5\omega) \\ \cos(6\omega) \end{pmatrix} \quad \text{and} \quad F_6 \begin{pmatrix} \sin(\omega) \\ \sin(2\omega) \\ \sin(3\omega) \\ \sin(4\omega) \\ \sin(5\omega) \\ \sin(6\omega) \end{pmatrix}$$

where $\omega = 2\pi/3$. Interpret the results to find the underlying periodicity.

2. Refer to chapter 15, problem 1 in the textbook

Problems and Solutions in Quantum Computing and Quantum Information, 2nd edition.

Use the method described to find the two nontrivial factors of 21 using $a = 5$ and $a = 8$.
Can the method be applied to find the factors of 21 when $a = 4$?
