

1. Laat  $\{|0\rangle, |1\rangle\}$  'n ortonormale basis in  $\mathbb{C}^2$  wees. Met ander woorde

$$\langle 0|1\rangle = \langle 1|0\rangle = 0, \quad \langle 0|0\rangle = \langle 1|1\rangle = 1.$$

Laat  $a, b \in \mathbb{C}$  met

$$|a|^2 + |b|^2 = 1$$

en

$$|0'\rangle := a|0\rangle + b|1\rangle, \quad |1'\rangle := \bar{a}|1\rangle - \bar{b}|0\rangle.$$

(a) Wys dat  $\{|0'\rangle, |1'\rangle\}$  'n ortonormale basis in  $\mathbb{C}^2$  is.

(b) Definieer

$$P := |0\rangle\langle 0| \otimes |0\rangle\langle 0| + |1\rangle\langle 0| \otimes |0\rangle\langle 1| + |0\rangle\langle 1| \otimes |1\rangle\langle 0| + |1\rangle\langle 1| \otimes |1\rangle\langle 1|$$

en

$$P' := |0'\rangle\langle 0'| \otimes |0'\rangle\langle 0'| + |1'\rangle\langle 0'| \otimes |0'\rangle\langle 1'| + |0'\rangle\langle 1'| \otimes |1'\rangle\langle 0'| + |1'\rangle\langle 1'| \otimes |1'\rangle\langle 1'|.$$

Herskryf  $P'$  in terme van  $P$ .

2. Verwys na hoofstuk 3, probleem 6 in die handboek

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

Vind die singulierewaarde dekomposisie van

(a)  $\begin{pmatrix} 1 \\ -1 \end{pmatrix}$

(b)  $\begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$

(c)  $\begin{pmatrix} 1 \\ -1 \end{pmatrix} \otimes \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$

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1. Let  $\{|0\rangle, |1\rangle\}$  denote an orthonormal basis in  $\mathbb{C}^2$ . In other words

$$\langle 0|1\rangle = \langle 1|0\rangle = 0, \quad \langle 0|0\rangle = \langle 1|1\rangle = 1.$$

Let  $a, b \in \mathbb{C}$  with

$$|a|^2 + |b|^2 = 1$$

and

$$|0'\rangle := a|0\rangle + b|1\rangle, \quad |1'\rangle := \bar{a}|1\rangle - \bar{b}|0\rangle.$$

(a) Show that  $\{|0'\rangle, |1'\rangle\}$  is an orthonormal basis in  $\mathbb{C}^2$ .

(b) Define

$$P := |0\rangle\langle 0| \otimes |0\rangle\langle 0| + |1\rangle\langle 0| \otimes |0\rangle\langle 1| + |0\rangle\langle 1| \otimes |1\rangle\langle 0| + |1\rangle\langle 1| \otimes |1\rangle\langle 1|$$

and

$$P' := |0'\rangle\langle 0'| \otimes |0'\rangle\langle 0'| + |1'\rangle\langle 0'| \otimes |0'\rangle\langle 1'| + |0'\rangle\langle 1'| \otimes |1'\rangle\langle 0'| + |1'\rangle\langle 1'| \otimes |1'\rangle\langle 1'|.$$

Express  $P'$  in terms of  $P$ .

2. Refer to chapter 3, problem 6 in the textbook

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

Find the singular value decomposition of

(a)  $\begin{pmatrix} 1 \\ -1 \end{pmatrix}$

(b)  $\begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$

(c)  $\begin{pmatrix} 1 \\ -1 \end{pmatrix} \otimes \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$

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