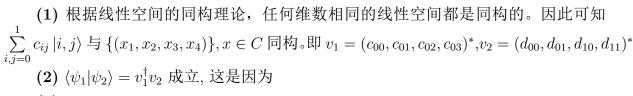
# The Answer of Assignment 2

## WEI SHUANG

# 31/8/2025

#### **Problem 1 Solution**



(3)

(4)

## Problem 2 Solution

(1)

(2)

(3)

**(4)** 

#### **Problem 3 Solution**

**(1)** 

**(2)** 

(3)

(4) how should the Pauli operators  $\sigma_i^+$  and  $\sigma_i^z$  can be written in terms of the f operators? we have the definition that:

$$f_i^{\dagger} = \left(\prod_{j < i} \sigma_j^z\right) \sigma_i^+$$

so from  $\langle \overline{n_{1'}n_{2'} \cdot n_{i'}} | f_i^{\dagger} | \overline{n_1n_2n_3 \cdot n_i} \rangle = \langle \overline{n_1n_2 \cdot n_i} | f_i | \overline{n_{1'}n_{2'} \cdot n_{i'}} \rangle^*$  we can get the relation between  $f_i$  and  $\sigma_i^+$ ,  $\sigma_i^z$  as follows:

$$f_i = \left(\prod_{j < i} \sigma_j^z\right) \sigma_i^-$$

then try to represent  $\sigma_i^z$  and  $\sigma_i^+$  in terms of  $f_i$ : we use the matrix representation of the Pauli operators:

$$\sigma_i^z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}, \quad \sigma_i^+ = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}, \quad \sigma_i^- = \begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix}$$

 $\sigma_i^z$  can be expressed as: $2\sigma_i^+\sigma_i^- - I$