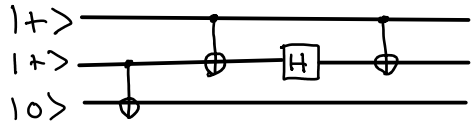
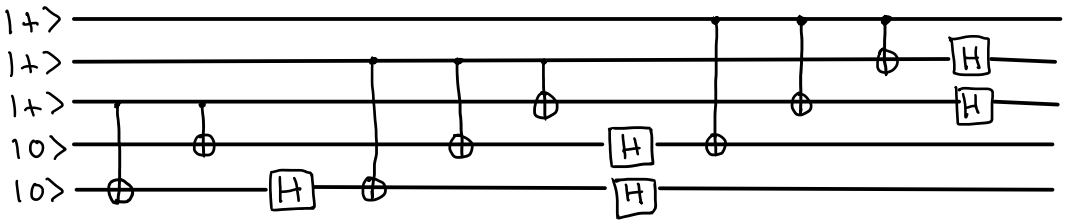
EE 599 Homework 2 - Neema Badihian

Thursday, September 22, 2022

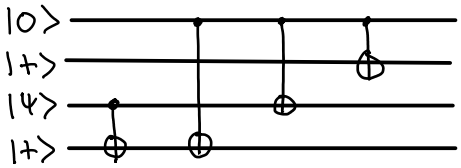
1. a)



b)



c)



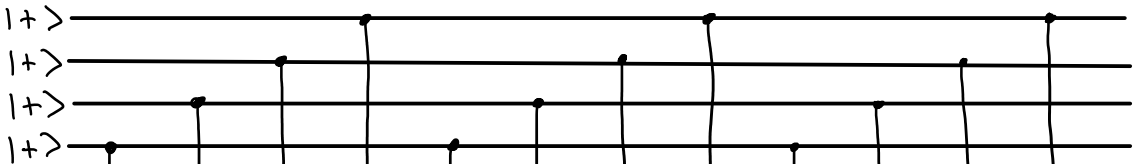
2.

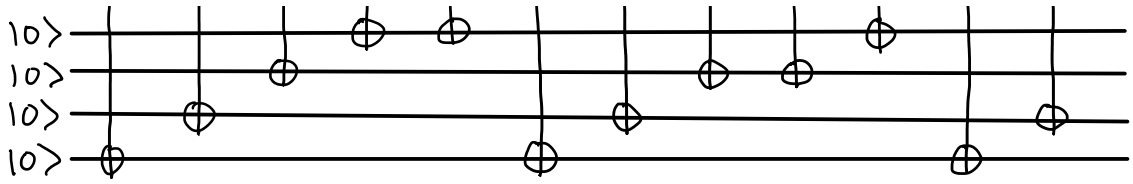
$$\begin{pmatrix} Z & I & I & I & Z & Z & Z & I \\ I & Z & I & I & I & Z & Z & Z \\ I & I & Z & I & Z & I & Z & Z \\ I & I & I & Z & Z & Z & I & Z \end{pmatrix}$$

$$\begin{pmatrix} X & I & I & I & X & X & X & I \\ I & X & I & I & I & X & X & X \\ I & I & X & I & X & I & X & X \\ I & I & I & X & X & X & I & X \end{pmatrix}$$

a) The stabilizers commute and are independent because $P \times P^T = 0$ and P is upper triangular.

b)





3.

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In[2]:= Id = {{1, 0}, {0, 1}}
Out[2]= {{1, 0}, {0, 1}}

In[3]:= X = {{0, 1}, {1, 0}}
Out[3]= {{0, 1}, {1, 0}}

In[4]:= Y = {{0, -i}, {i, 0}}

In[5]:= Z = {{1, 0}, {0, -1}}

In[6]:= rho = (1 / 2) (Id + (x * X) + (x * Z))

In[7]:= rhoTens = KroneckerProduct[rho, rho]

In[8]:= rhoTens = KroneckerProduct[rhoTens, rho]

In[9]:= rhoTens = KroneckerProduct[rhoTens, rho]

In[10]:= rhoTens = KroneckerProduct[rhoTens, rho]

In[11]:= rhoTens = KroneckerProduct[rhoTens, rho]

In[12]:= rhoTens = KroneckerProduct[rhoTens, rho]

In[16]:= IdStab = IdentityMatrix[128]

In[17]:= sA = KroneckerProduct[KroneckerProduct[KroneckerProduct[
           KroneckerProduct[KroneckerProduct[KroneckerProduct[Id, Id], Id], Z], Z], Z], Z]

In[18]:= Dimensions[sA]
Out[18]=
         {128, 128}

In[19]:= sB = KroneckerProduct[KroneckerProduct[KroneckerProduct[
           KroneckerProduct[KroneckerProduct[KroneckerProduct[Id, Z], Z], Id], Id], Z], Z]

In[20]:= sC = KroneckerProduct[KroneckerProduct[KroneckerProduct[
           KroneckerProduct[KroneckerProduct[KroneckerProduct[Z, Id], Z], Id], Z], Id], Z]

In[21]:= sD = KroneckerProduct[KroneckerProduct[KroneckerProduct[
           KroneckerProduct[KroneckerProduct[KroneckerProduct[Id, Id], Id], X], X], X], X]
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In[22]:= sE = KroneckerProduct[KroneckerProduct[KroneckerProduct[
            KroneckerProduct[KroneckerProduct[KroneckerProduct[Id, X], X], Id], Id], X], X]

In[23]:= sF = KroneckerProduct[KroneckerProduct[KroneckerProduct[
            KroneckerProduct[KroneckerProduct[KroneckerProduct[X, Id], X], Id], X], Id], X]

In[24]:= rhoOne = (1 / 2) * ((IdStab + sA).rhoTens.(ConjugateTranspose[IdStab + sA])) /
           (Tr[(IdStab + sA).rhoTens])

In[25]:= Dimensions[rhoOne]
Out[25]=
         {128, 128}
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In[26]:= rhoTwo = (1 / 2) * ((IdStab + sB).rhoOne.(ConjugateTranspose[IdStab + sB])) /
           (Tr[(IdStab + sB).rhoOne])

In[27]:= rhoThree = (1 / 2) * ((IdStab + sC).rhoTwo.(ConjugateTranspose[IdStab + sC])) /
           (Tr[(IdStab + sC).rhoTwo])

In[28]:= Dimensions[rhoThree]
Out[28]=
         {128, 128}

In[29]:= rhoFour = (1 / 2) * ((IdStab + sD).rhoThree.(ConjugateTranspose[IdStab + sD])) /
           (Tr[(IdStab + sD).rhoThree])

In[32]:= Expand[rhoFour]

In[33]:= rhoFive = (1 / 2) * ((IdStab + sE).rhoFour.(ConjugateTranspose[IdStab + sE])) /
           (Tr[(IdStab + sE).rhoFour])

In[34]:= rhoFive = Expand[rhoFive]

In[35]:= rhoSix = (1 / 2) * ((IdStab + sF).rhoFive.(ConjugateTranspose[IdStab + sF])) /
           (Tr[(IdStab + sF).rhoFive])

         XL = KroneckerProduct[KroneckerProduct[KroneckerProduct[
             KroneckerProduct[KroneckerProduct[KroneckerProduct[X, X], X], X], X], X], X]

         ZL = KroneckerProduct[KroneckerProduct[KroneckerProduct[
             KroneckerProduct[KroneckerProduct[KroneckerProduct[Z, Z], Z], Z], Z], Z], Z]

         YL = KroneckerProduct[KroneckerProduct[KroneckerProduct[
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    KroneckerProduct[KroneckerProduct[KroneckerProduct[Y, Y], Y], Y], Y], Y], Y]

xCoord = Tr[XL.rhoSix]

zCoord = Tr[ZL.rhoSix]

yCoord = Tr[YL.rhoSix]
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