In[43]:=
```
Z = PauliMatrix[3]
```
Out[43]=
```
{{1, 0}, {0, -1}}
```
In[44]:=
```
X = PauliMatrix[1]
```
Out[44]=
```
{{0, 1}, {1, 0}}
```
In[45]:=
```
Z0 = KroneckerProduct[Z, IdentityMatrix[2^8]];
```
In[46]:=
```
Z1 = KroneckerProduct[IdentityMatrix[2], Z, IdentityMatrix[2^7]];
```
In[47]:=
```
Z2 = KroneckerProduct[IdentityMatrix[2^2], Z, IdentityMatrix[2^6]];
```
In[48]:=
```
Z3 = KroneckerProduct[IdentityMatrix[2^3], Z, IdentityMatrix[2^5]];
```
In[49]:=
```
Z4 = KroneckerProduct[IdentityMatrix[2^4], Z, IdentityMatrix[2^4]];
```
In[50]:=
```
Z5 = KroneckerProduct[IdentityMatrix[2^5], Z, IdentityMatrix[2^3]];
```
In[51]:=
```
Z6 = KroneckerProduct[IdentityMatrix[2^6], Z, IdentityMatrix[2^2]];
```
In[52]:=
```
Z7 = KroneckerProduct[IdentityMatrix[2^7], Z, IdentityMatrix[2^1]];
```
In[53]:=
```
Z8 = KroneckerProduct[IdentityMatrix[2^8], Z];
```
In[54]:=
```
H = (12 * 3 IdentityMatrix[2^9] -
      (Z0.Z1 + Z0.Z3 + Z1.Z2 + Z1.Z3 + Z2.Z4 + Z3.Z4 + Z4.Z5 + Z4.Z8 + Z5.Z6 + Z7.Z8 +
        Z6.Z7 + Z6.Z8) - ( 2 Z0 + 3 Z1 + 2 Z2 + 3 Z3 + 4 Z4 + 2 Z5 + 3 Z6 + 2 Z7 + 3 Z8 )) / 4;
```
In[55]:=
```
UP = {{1}, {0}};
```
In[56]:=
```
DW = {{0}, {1}};
```
In[57]:=
```
Test = KroneckerProduct[DW, DW, DW, DW, DW, DW, DW, DW, DW];
```
In[58]:=
```
TestUp = KroneckerProduct[UP, UP, UP, UP, UP, UP, UP, UP, UP];
```
In[59]:=
```
TestDw = KroneckerProduct[DW, DW, DW, DW, DW, DW, DW, DW, DW];
```
In[60]:=
```
CostOfTest = Transpose[TestUp].H.Test;
```
In[61]:=
```
X0 = KroneckerProduct[X, IdentityMatrix[2^8]];
```
In[62]:=
```
X1 = KroneckerProduct[IdentityMatrix[2], X, IdentityMatrix[2^7]];
```
In[63]:=
```
X2 = KroneckerProduct[IdentityMatrix[2^2], X, IdentityMatrix[2^6]];
```
In[64]:=
```
X3 = KroneckerProduct[IdentityMatrix[2^3], X, IdentityMatrix[2^5]];
```
In[65]:=
```
X4 = KroneckerProduct[IdentityMatrix[2^4], X, IdentityMatrix[2^4]];
```
In[66]:=
```
X5 = KroneckerProduct[IdentityMatrix[2^5], X, IdentityMatrix[2^3]];
```
In[67]:=
```
X6 = KroneckerProduct[IdentityMatrix[2^6], X, IdentityMatrix[2^2]];
```
In[68]:=
```
X7 = KroneckerProduct[IdentityMatrix[2^7], X, IdentityMatrix[2^1]];
```
In[69]:=
```
X8 = KroneckerProduct[IdentityMatrix[2^8], X];
```
In[70]:=

In[71]:=
```
ExpCost = MatrixExp[-I * A * H];
```
In[72]:=

In[73]:=
```
Rx = MatrixExp[-I * B * PauliMatrix[1]];
```

In[74]:=
```
ExpRot = KroneckerProduct[Rx, Rx, Rx, Rx, Rx, Rx, Rx, Rx, Rx];
```

In[75]:=
```
ExpRotT = Refine[ConjugateTranspose[ExpRot], {Element[B, Reals]}];
```

In[76]:=
```
ExpCostT = Refine[ConjugateTranspose[ExpCost], {Element[A, Reals]}];
```

In[77]:=
```
PM = HadamardMatrix[2^9].KroneckerProduct[UP, UP, UP, UP, UP, UP, UP, UP, UP];
```

In[78]:=
```
Result = Transpose[PM].ExpCostT.ExpRotT.H.ExpRot.ExpCost.PM
```

Out[78]=

$$\left\{\left\{\frac{-12\,i\,\text{Sin}[B]^9\left(\frac{e^{12\,i\,A}\,\text{Cos}[B]^9}{16\sqrt{2}}+\cdots 44\cdots+\frac{e^{2\,i\,A}\,\text{Cos}[B]\,\text{Sin}[B]^8}{4\sqrt{2}}+\frac{e^{3\,i\,A}\,\text{Cos}[B]\,\text{Sin}[B]^8}{4\sqrt{2}}+\frac{e^{4\,i\,A}\,\text{Cos}[B]\,\text{Sin}[B]^8}{16\sqrt{2}}+\frac{i\,\text{Sin}[B]^9}{16\sqrt{2}}\right)+\cdots 405\cdots}{16\sqrt{2}}+\right.\right.$$

$$\frac{e^{-4\,i\,A}\left(12\,i\,\text{Cos}[B]^2\,\text{Sin}[B]^7\left(\frac{e^{12\,i\,A}\,\text{Cos}[B]^9}{16\sqrt{2}}+\cdots 45\cdots+\frac{e^{3\,i\,A}\,\text{Cos}[B]\,\text{Sin}[B]^8}{4\sqrt{2}}+\frac{e^{4\,i\,A}\,\text{Cos}[B]\,\text{Sin}[B]^8}{16\sqrt{2}}+\frac{i\,\text{Sin}[B]^9}{16\sqrt{2}}\right)+\cdots 405\cdots\right)}{16\sqrt{2}}+$$

$$\frac{e^{-4\,i\,A}\left(\cdots 1\cdots\right)}{16\sqrt{2}}+\frac{e^{-3\,i\,A}\left(\cdots 1\cdots\right)}{8\sqrt{2}}+\frac{e^{-3\,i\,A}\left(12\,\text{Cos}[B]\,\cdots 1\cdots^8\left(\frac{\cdots 1\cdots}{16\sqrt{2}}+\cdots 48\cdots\right)+\cdots 597\cdots\right)}{8\sqrt{2}}+$$

$$\frac{e^{\cdots 1\cdots}\left(\cdots 1\cdots\right)}{8\sqrt{2}}+\cdots 260\cdots+\frac{e^{\cdots 1\cdots}\,\cdots 1\cdots}{8\sqrt{2}}+$$

$$\frac{e^{\cdots 1\cdots}\left(\cdots 1\cdots\right)}{8\sqrt{2}}+\frac{e^{-12\,i\,A}\left(\cdots 1\cdots\right)}{8\sqrt{2}}+\frac{e^{-12\,i\,A}\left(\cdots 1\cdots\right)}{16\sqrt{2}}+$$

$$\left.\frac{e^{-12\,i\,A}\left(\cdots 405\cdots+4\,\cdots 2\cdots\left(\frac{e^{2\,i\,A}\,\text{Cos}[B]^9}{16\sqrt{2}}+\frac{\cdots 1\cdots}{16\sqrt{2}}+\cdots 61\cdots+\frac{\cdots 1\cdots}{16\,\cdots 1\cdots}+\frac{i\,e^{\cdots 1\cdots}\,\text{Sin}\,\cdots 1\cdots\,\cdots 1\cdots^9}{16\sqrt{2}}\right)\right)}{16\sqrt{2}}+\right.$$

$$\frac{1}{8\sqrt{2}}e^{-12\,i\,A}\left(-12\,i\,\text{Cos}[B]^8\,\text{Sin}[B]\left(\frac{e^{12\,i\,A}\,\text{Cos}[B]^9}{16\sqrt{2}}+\cdots 44\cdots+\frac{e^{2\,i\,A}\,\text{Cos}[B]\,\text{Sin}[B]^8}{4\sqrt{2}}+\right.\right.$$

$$\left.\left.\left.\frac{e^{3\,i\,A}\,\text{Cos}[B]\,\text{Sin}[B]^8}{4\sqrt{2}}+\frac{e^{4\,i\,A}\,\text{Cos}[B]\,\text{Sin}[B]^8}{16\sqrt{2}}+\frac{i\,\text{Sin}[B]^9}{16\sqrt{2}}\right)+\cdots 597\cdots\right)\right\}\right\}$$

large output | show less | show more | show all | set size limit...

In[82]:=
```
F1 = Simplify[Result]
```

Out[82]=

$$\left\{\left\{\frac{1}{512}e^{-6\,i\,A}\left(1+11\,e^{i\,A}+46\,e^{2\,i\,A}+55\,e^{3\,i\,A}+31\,e^{4\,i\,A}-66\,e^{5\,i\,A}+4452\,e^{6\,i\,A}-\right.\right.\right.$$

$$66\,e^{7\,i\,A}+31\,e^{8\,i\,A}+55\,e^{9\,i\,A}+46\,e^{10\,i\,A}+11\,e^{11\,i\,A}+e^{12\,i\,A}-\left(-1+e^{2\,i\,A}\right)^2$$

$$\left(1+11\,e^{i\,A}+48\,e^{2\,i\,A}+77\,e^{3\,i\,A}+126\,e^{4\,i\,A}+77\,e^{5\,i\,A}+48\,e^{6\,i\,A}+11\,e^{7\,i\,A}+e^{8\,i\,A}\right)\text{Cos}[4\,B]-$$

$$16\,i\,e^{2\,i\,A}\left(1+e^{i\,A}\right)^3\left(-1-7\,e^{i\,A}-8\,e^{2\,i\,A}+8\,e^{3\,i\,A}+7\,e^{4\,i\,A}+e^{5\,i\,A}\right)\text{Sin}[2\,B]+$$

$$8\,i\,e^{2\,i\,A}\,\text{Sin}[4\,B]+64\,i\,e^{3\,i\,A}\,\text{Sin}[4\,B]+112\,i\,e^{4\,i\,A}\,\text{Sin}[4\,B]-64\,i\,e^{5\,i\,A}\,\text{Sin}[4\,B]+$$

$$\left.\left.64\,i\,e^{7\,i\,A}\,\text{Sin}[4\,B]-112\,i\,e^{8\,i\,A}\,\text{Sin}[4\,B]-64\,i\,e^{9\,i\,A}\,\text{Sin}[4\,B]-8\,i\,e^{10\,i\,A}\,\text{Sin}[4\,B]\right)\right\}\right\}$$

In[90]:=
```
Cost = Simplify[ 1/512 (Cos[6 A] - I Sin[6 A])
    (1 + 11 (Cos[A] + I Sin[A]) + 46 (Cos[2 A] + I Sin[2 A]) + 55 (Cos[3 A] + I Sin[3 A]) +
      31 (Cos[4 A] + I Sin[4 A]) - 66 (Cos[5 A] + I Sin[5 A]) + 4452 (Cos[6 A] + I Sin[6 A]) -
      66 (Cos[7 A] + I Sin[7 A]) + 31 (Cos[8 A] + I Sin[8 A]) + 55 (Cos[9 A] + I Sin[9 A]) +
      46 (Cos[10 A] + I Sin[10 A]) + 11 (Cos[11 A] + I Sin[11 A]) + (Cos[12 A] + I Sin[12 A]) -
      (-1 + (Cos[2 A] + I Sin[2 A]))^2 (1 + 11 (Cos[A] + I Sin[A]) + 48 (Cos[2 A] + I Sin[2 A]) +
         77 (Cos[3 A] + I Sin[3 A]) + 126 (Cos[4 A] + I Sin[4 A]) + 77 (Cos[5 A] + I Sin[5 A]) +
         48 (Cos[6 A] + I Sin[6 A]) + 11 (Cos[7 A] + I Sin[7 A]) + (Cos[8 A] + I Sin[8 A]))
       Cos[4 B] - 16 i (Cos[2 A] + I Sin[2 A]) (1 + (Cos[A] + I Sin[A]))^3
       (-1 - 7 (Cos[A] + I Sin[A]) - 8 (Cos[2 A] + I Sin[2 A]) + 8 (Cos[3 A] + I Sin[3 A]) +
         7 (Cos[4 A] + I Sin[4 A]) + (Cos[5 A] + I Sin[5 A])) Sin[2 B] +
      8 i (Cos[2 A] + I Sin[2 A]) Sin[4 B] + 64 i (Cos[3 A] + I Sin[3 A]) Sin[4 B] +
      112 i (Cos[4 A] + I Sin[4 A]) Sin[4 B] - 64 i (Cos[5 A] + I Sin[5 A]) Sin[4 B] +
      64 i (Cos[7 A] + I Sin[7 A]) Sin[4 B] - 112 i (Cos[8 A] + I Sin[8 A]) Sin[4 B] -
      64 i (Cos[9 A] + I Sin[9 A]) Sin[4 B] - 8 i (Cos[10 A] + I Sin[10 A]) Sin[4 B])]
```

Out[90]=
$$\frac{1}{512}\left(4452 - 132\cos[A] + 62\cos[2A] + 110\cos[3A] + 92\cos[4A] + 22\cos[5A] + 2\cos[6A] + 2\cos[A-4B] + 9\cos[3A-4B] - 11\cos[5A-4B] - \cos[6A-4B] + 608\cos[A-2B] + 81\cos\left[2\left(A-2B\right)\right] + 160\cos[3A-2B] + 16\cos[4A-2B] + 512\cos[2(A-B)] - 38\cos[4(A-B)] + 156\cos[4B] - 512\cos[2(A+B)] - 54\cos[4(A+B)] - 16\cos\left[2\left(2A+B\right)\right] - 608\cos[A+2B] - 143\cos\left[2\left(A+2B\right)\right] - 160\cos[3A+2B] + 130\cos[A+4B] - 119\cos[3A+4B] - 11\cos[5A+4B] - \cos[6A+4B]\right)$$

In[91]:=
```
SolutionCord[A_, B_] = Cost
```

Out[91]=
$$\frac{1}{512}\left(4452 - 132\cos[A] + 62\cos[2A] + 110\cos[3A] + 92\cos[4A] + 22\cos[5A] + 2\cos[6A] + 2\cos[A-4B] + 9\cos[3A-4B] - 11\cos[5A-4B] - \cos[6A-4B] + 608\cos[A-2B] + 81\cos\left[2\left(A-2B\right)\right] + 160\cos[3A-2B] + 16\cos[4A-2B] + 512\cos[2(A-B)] - 38\cos[4(A-B)] + 156\cos[4B] - 512\cos[2(A+B)] - 54\cos[4(A+B)] - 16\cos\left[2\left(2A+B\right)\right] - 608\cos[A+2B] - 143\cos\left[2\left(A+2B\right)\right] - 160\cos[3A+2B] + 130\cos[A+4B] - 119\cos[3A+4B] - 11\cos[5A+4B] - \cos[6A+4B]\right)$$

In[92]:=
```
FindMaximum[{SolutionCord[A, B], 0 < A < 3.14 && 0 < B < 3.14}, {A, B}]
```

Out[92]=
$$\{9.26982, \{A \to 2.26383, B \to 2.85107\}\}$$