$$\begin{array}{c|cc} & 0 & 1 \\ \hline 0 & 0 & 1 \\ 1 & 0 & 0 \end{array} \quad \begin{bmatrix}0&1\\0&0\end{bmatrix} \qquad \begin{array}{c|cc} & 0 & 1 \\ \hline 0 & 0 & 0 \\ 1 & 0 & 1 \end{array}$$

$$\begin{array}{c|cc} & 1 & 0 \\ \hline 0 & & \end{array}$$

$$\begin{bmatrix}1&0\\0&0\end{bmatrix}+\begin{bmatrix}0&1\\0&0\end{bmatrix}-\begin{bmatrix}0&0\\0&1\end{bmatrix}$$

$$\begin{matrix}1&0\\0&0\end{matrix} - \begin{matrix}0&0\\0&1\end{matrix}$$

$$\begin{bmatrix}1&1\\1&-1\end{bmatrix}\begin{bmatrix}1&0\\0&-1\end{bmatrix}\begin{bmatrix}1&1\\1&-1\end{bmatrix}$$

$$\begin{bmatrix}1&-1\\1&1\end{bmatrix}\begin{bmatrix}1&1\\1&-1\end{bmatrix}$$

$$\frac{1}{2}\begin{bmatrix}0&2\\2&0\end{bmatrix}=\begin{bmatrix}0&1\\1&0\end{bmatrix}$$

$$\frac{1}{2^n}\sum_{a,b}(-1)^{a,b}|a\rangle\langle b|\cdot\sum_{x=0}^{2^n-1}(-1)^{x\alpha}|x\rangle\langle x|\cdot\sum_{a,b}(-1)^{a,b}|a\rangle\langle b|$$

$$\frac{1}{2^n}\sum_{a,b}^{2^n-1}\sum_{x=0}^{2^n-1}\sum_{c,d}^{2^n-1}(-1)^{a\cdot b+x\alpha+c\cdot d}\,|a\rangle\underbrace{\langle b|x\rangle\langle x|c\rangle}_{\neq 0}\langle d|$$

$$\sum_{x=0}^{2^n-1}(-1)^{x\alpha}|x\rangle\langle x|$$

$$|0\rangle\langle 1|+|1\rangle\langle 0|$$

$$H^{\otimes n}\left[2|0\rangle\langle 0|-I\right]H^{\otimes n}$$

$$|c\rangle\langle d|(-1)^{c,d}\; |x\rangle\langle x|\, x\oplus\alpha\rangle\langle x|(-1)^{a,b}\; |a\rangle\langle b|$$

$$(-1)^{a\cdot b + c\cdot d}\, |c\rangle\langle d|x\rangle\, \langle x|x\oplus\alpha\rangle\langle x|a\rangle\langle b|$$

$$\frac{1}{2^{3/2}}\Big(|000\rangle + |001\rangle + |010\rangle + |011\rangle + |100\rangle + |101\rangle + |110\rangle + |111\rangle\Big)$$

$$\frac{1}{2^{3/2}}\Big(|000\rangle + |001\rangle + |010\rangle + |011\rangle + |100\rangle - |101\rangle + |110\rangle + |111\rangle\Big)$$

$$\Downarrow$$

$$\Big(2|\psi\rangle\langle\psi| - I\Big) \qquad \Big(|\psi\rangle - \frac{2}{2\sqrt{2}}|101\rangle\Big)$$

$$\Big(2|\psi\rangle\overbrace{\langle\psi|\psi\rangle} - I|\psi\rangle - \frac{4}{2\sqrt{2}}|\psi\rangle\langle\psi|101\rangle + \frac{2I}{2\sqrt{2}}|101\rangle\Big)$$

$$2|\psi\rangle - |\psi\rangle - \frac{4}{2\sqrt{2}} \times \frac{1}{2\sqrt{2}} |\psi\rangle \quad 0 \; 0 \; 0 \; 0$$

$$+\frac{2}{2\sqrt{2}}|101\rangle \qquad \frac{1}{\sqrt{n}}$$

$$|\psi\rangle - \frac{4|\psi\rangle}{8} + |101\rangle \frac{2}{2\sqrt{2}}$$

$$\frac{4}{8}|\psi\rangle + \frac{2}{2\sqrt{2}}|101\rangle$$

$$\left(\frac{1}{2} \times \frac{1}{2\sqrt{2}} + \frac{2}{2\sqrt{2}}\right)^2 |101\rangle$$

$$\left(\frac{1}{4\sqrt{2}} + \frac{1}{\sqrt{2}}\right)^2 \qquad \left(\frac{5}{4\sqrt{2}}\right)^2 = \frac{25}{32}$$

$$-H^{\otimes n}\left[I - 2|0^{\otimes n}\rangle\langle 0^{\otimes n}|\right] H^{\otimes n}$$

$$-e\left[H^{\otimes n} + 2\, H^{\otimes n}|0^{\otimes n}\rangle\langle 0^{\otimes n}|\right] H^{\otimes n}$$

$$\left[-H^{\otimes n} + 2|0^{\otimes n}\rangle\langle 0|\right] H^{\otimes n}$$

$$\frac{1}{2}\begin{bmatrix}1 & 1\\ 1 & -1\end{bmatrix}\begin{bmatrix}1 & 1\\ 1 & -1\end{bmatrix} \qquad -H^{\otimes n} H^{\otimes n} + 2|0^{\otimes n}\rangle\langle 0^{\otimes n}| H^{\otimes n} \qquad \begin{matrix}1\\0\end{matrix} \times \begin{matrix}0\\1\end{matrix}$$

$$\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix} \qquad I \qquad + \qquad \begin{matrix}1 & 0\\0 & 0\\0 & 0\\0 & 1\end{matrix}$$

$$\begin{matrix}1\\0\end{matrix} \times \begin{matrix}1\\0\end{matrix}$$

$$\left.\begin{matrix}\phi^+ & |00\rangle + |11\rangle\\ \phi^- & |00\rangle - |11\rangle\\ \psi^+ & |01\rangle + |10\rangle\\ \psi^- & |01\rangle - |10\rangle\end{matrix}\right\} \frac{1}{\sqrt{2}} \qquad \begin{bmatrix}1 & 1 & 0 & 0\\ 0 & 0 & 1 & 1\\ 0 & 0 & 1 & -1\\ 1 & -1 & 0 & 0\end{bmatrix}$$

$$\left|\begin{bmatrix}1 & 0 & 0 & 1\\ 1 & 0 & 0 & -1\\ 0 & 1 & -1 & 0\end{bmatrix}\right| = 0$$

$$\begin{bmatrix}1&0&0&0\\0&1&0&0\\0&0&1&0\\0&0&0&1\end{bmatrix}$$

$$\begin{bmatrix}2\\3\end{bmatrix}$$

$0\ 1 \quad 1\ 0$

$$\begin{bmatrix}1&0&0&0\\1&0&0&-1\\0&1&+1&0\\0&1&-1&0\end{bmatrix}\begin{bmatrix}A_{11}&&\\&&\\&&\end{bmatrix}$$

$$2\begin{bmatrix}0\\1\end{bmatrix}+3\begin{bmatrix}1\\0\end{bmatrix} =$$

$$\begin{bmatrix}A_{11}+A_{41} & A_{12}+A_{42} & A_{13}+A_{43} & A_{14}+A_{44}\\ A_{11}-A_{41} & A_{12}-A_{42} & A_{13}-A_{43} & A_{14}-A_{44}\\ A_{21}+A_{31} & A_{22}+A_{32} & A_{23}+A_{33} & A_{24}+A_{34}\\ A_{21}-A_{31} & A_{22}-A_{32} & A_{23}-A_{33} & A_{24}-A_{34}\end{bmatrix}$$

$A_{12}=-A_{42} \qquad A_{11}=-A_{41} \qquad A_{22}=+A_{32}$

$A_{13}=A_{43}$.

$$A=\begin{bmatrix}a&b&0&0\\0&0&+c&d\\0&0&-c&-d\\a&-b&0&0\end{bmatrix}$$

$$e^{\frac{i\theta\sigma}{2}} = \sum_{k=0}^{n}\frac{1}{k!}\left(\frac{i\theta\sigma}{2}\right)^k$$

$$\begin{bmatrix}0&-i\\i&0\end{bmatrix}\begin{bmatrix}0&-i\\i&0\end{bmatrix}$$

$$= 1+\frac{i\theta\sigma}{2} + \frac{\frac{\theta^2\sigma^2}{2^2}}{2!} \mp \frac{\frac{i\theta^3\sigma^3}{2^3}}{3!}\cdots$$

$1\ 0$

$0\ 1$

X: $\begin{bmatrix}a&b\\c&d\end{bmatrix}\begin{bmatrix}0&1\\1&0\end{bmatrix}$

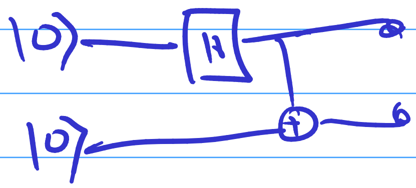
$$\Rightarrow 1+\frac{\frac{\theta^2\sigma^2}{2^2}}{2!}+\frac{\frac{\theta^4\sigma^4}{2^4}}{4!}\cdots = I\cos\left(\frac{\theta}{2}\right)$$

$\begin{bmatrix}1&0\\0&1\end{bmatrix}$ [

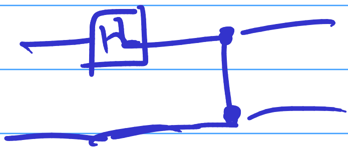
$\begin{bmatrix}1&0\\0&-1\end{bmatrix}$

$$\frac{i\theta\sigma}{2} - \frac{\frac{\theta^3\sigma^3}{2^3}}{3!}\cdots) = i\sin\left(\frac{\theta}{2}\right)\sigma$$

$$\cos\left(\frac{\theta}{2}\right) + i\sin\left(\frac{\theta}{2}\right)\sigma$$



$\frac{|0\rangle+|1\rangle}{2}$ $\frac{|00\rangle+|11\rangle}{2}$



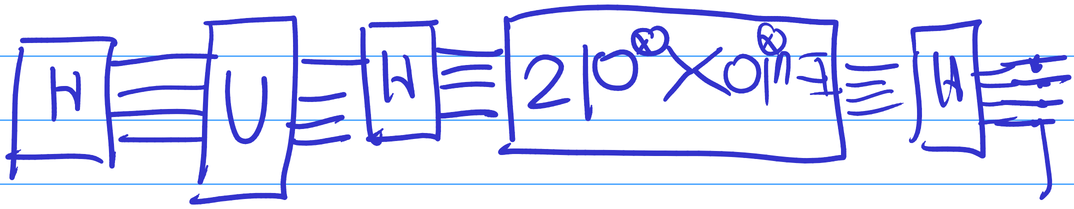
$$H^{\otimes n}\left[2|0^{\otimes n}\rangle\langle 0^{\otimes n}| - I_n\right] H^{\otimes n}$$

$$= 2|+\rangle\langle +| - I$$

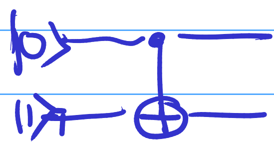
$$\frac{1}{2}\begin{bmatrix}1 & 1\\ 1 & -1\end{bmatrix}\begin{bmatrix}1 & 1\\ 1 & -1\end{bmatrix}$$

$$\left[2|\psi^{+}\rangle\langle 0^{\otimes n}| - H^{\otimes n}\right] H^{\otimes n}$$

$$\left[2|\psi^{+}\rangle\langle \psi^{+}| - I\right]$$



$\begin{array}{c} 0\\0\\1\\0 \end{array}\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & -1 & 0\\ 0 & 0 & 0 & -1\end{bmatrix}\begin{bmatrix}1 & 0\\ 0 & -1\end{bmatrix}$ $|01\rangle$



$\begin{array}{c} 0\\0\\-1\\0 \end{array}$ $\begin{bmatrix}-1 & 0\\ 0 & -1\end{bmatrix}\begin{bmatrix}1 & 0\\ 0 & -1\end{bmatrix}$ $\begin{bmatrix}-1 & 0\\ 0 & +1\end{bmatrix}$

$|0\rangle\ X$

$\begin{bmatrix}1\\0\end{bmatrix}\begin{bmatrix}0\\1\end{bmatrix}$

$\begin{matrix}1 & 0\\ 0 & -1\end{matrix}$

Z

$\begin{bmatrix}1\\0\end{bmatrix}$

Y
N
Y
Y

pride of one man requires. ~

Power requires Submission

men require pride

* → arguments that are not very sound
* →

(3) (a) * All criminals are unsavory
* No pioneers are unsavory
* therefore No criminals are ~~unsavory~~ pioneers

(b) * all mammals have lungs to breathe
* whales are mammals
⇒ whales have lungs to breathe

(4) No unemployed persons are excessive drinkers
All debtors are excessive drinkers
⇒ No debtors are unemployed persons

A All blue chip securities ...

I Some stocks are blue chip dividends

I Some stocks are safe

AII

M–P
S–M
S–P
1

G = (V,T,P,S)

Program -> begin SMove
SMove -> (left | right | fwd | bkwd)MMoves | end

MMoves -> (left | right | fwd | bkwd)MMoves | end

```
              Program
             /       \
         begin      SMove
                   /     \
                left    MMoves
                       /      \
                    right    MMoves
                            /      \
                     backward     MMoves
                                    |
                                   end
```

```
<SMove>.value -> <program>.value
<SMove> -> end
<SMove>.val = 0
|<MMoves1>.value
<MMoves1>.value = <SMove>.value

<Mmoves> -> end
<MMoves>.val = <MMoves>.val
|
left <MMoves2>
<MMoves2>.val = <MMoves1>.val -1
|
right <MMoves2>
<MMoves2>.val = <MMoves1>.val+1
|
forward<MMoves2>
<MMoves2>.val = <MMoves1>.val+1
|
backward<MMoves2>
<MMoves2>.val = <MMoves1>.val-1
```

{x = 9}

postcondition????

$$H[Y|X] = H[X|Y] - H[X] + H[Y]$$

$$= -\iint p(x,y) \log(p(y|x))\, dx\, dy$$

$=$

$$= -\left[\iint p(x,y) \log(p(x|y))\, dx\, dy + \iint p(x,y) \log(p(y)) - \iint p(x,y) \log(p(x))\right]$$

$$H(X|Y) + H(Y) - H(X)$$

$$L = \frac{1}{N} \Sigma \| y - XW \|^2$$

$$\min_W = \underset{N\times 1}{(y} - \underset{N\times D}{X}\,\underset{D\times 1}{W})^T (y - XW)$$

$$= (w^T x^T - y^T)(y - xw)$$

$$\min_W (w^T x^T y - w^T x^T x w - y^T y + y^T x w)$$

$$(2y^T x w - (xw)^T x w - y^T y)$$

$$0 = 2y^T x - 2x^T x w \qquad \cancel{2} x^T x w = \cancel{2} y^T x = x^T y$$

$$\cancel{(x^T x)} \qquad w = (x^T x)^{-1} (x^T y)$$

Ridge $\frac{1}{2}\sum\|xw-y\|^2 + \frac{\lambda}{2}\sum\|w\|^2$

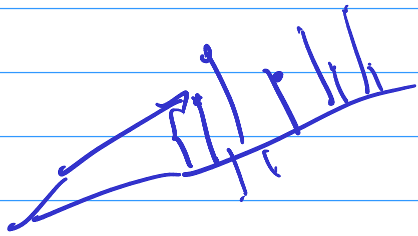
$\frac{1}{2}\sum\|xw-y\|^2 + \frac{\lambda}{2}\sum|w|$

$U(x|a,b) = \frac{1}{(b-a)}$ $a \le x \le b$

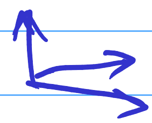
$$\int_a^b \frac{1}{b-a}\,dx = 1$$

PCA

3)(a)



~~min~~ max $\vec{u}\cdot\vec{v}$



min $\|\vec{u}\times\vec{v}\|$

(b)

$Ax = \lambda x$

$Ax_1 = 3x_1$

$[\quad]$ λx

$Sc_1 = 3c_1$

$Sx = \lambda x$

$Sc_2 = 1c_2$

$Sc_3 = 0.2c_3$

$S[c_1 c_2 c_3] = [3c_1 \;\; 1c_2 \;\; 0.2c_3]$

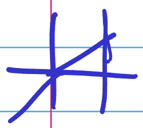
$[c_1 c_2 c_3] = S^{-1}[3c_1 \;\; c_2 \;\; 0.2c_3]$

$1-x^2-y^2$ $\qquad x+y-1=0$

$\max \quad (1-x^2-y^2)+\lambda(x+y-1)$

$x=0.5$
$y=0.5$

$-2x+\lambda=0$
$-2y+\lambda=0$ $\qquad x+y-1=0$



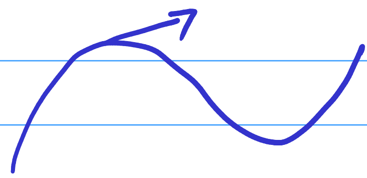
$x=+\frac{\lambda}{2}$ $\quad y=\frac{\lambda}{2}$ $\qquad \lambda-1=0$

$\lambda=1$

$x=y=1/2$

value $=\frac{1}{2}$

$f(x,y)=1$ $\quad \Delta x$



$f(x)$ $\qquad g_j(x)$ $\qquad j=1,2\ldots J$

$\nabla f(x)=\sum \lambda_k \nabla g_k(x)+\sum \mu_k \nabla h_k(x)$

Such that $\quad g_j(x)=0 \quad \forall j\in N, j\in[1,J]$

$h_k(x)=0 \quad \forall h\in N, h\in[1,N]$