Monday, November 7, 2022 5:51 PM

```
model = hmm.CategoricalHMM()
model.n_components   = 2     # two states: hot and cold days
model.startprob_     = [ 0.8,0.2 ]
model.transmat_      = [ [0.6,0.4] , [0.5,0.5] ]
model.emissionprob_  = [ [0.2,0.4,0.4] , [0.5,0.4,0.1] ]
```

day 1 : 3

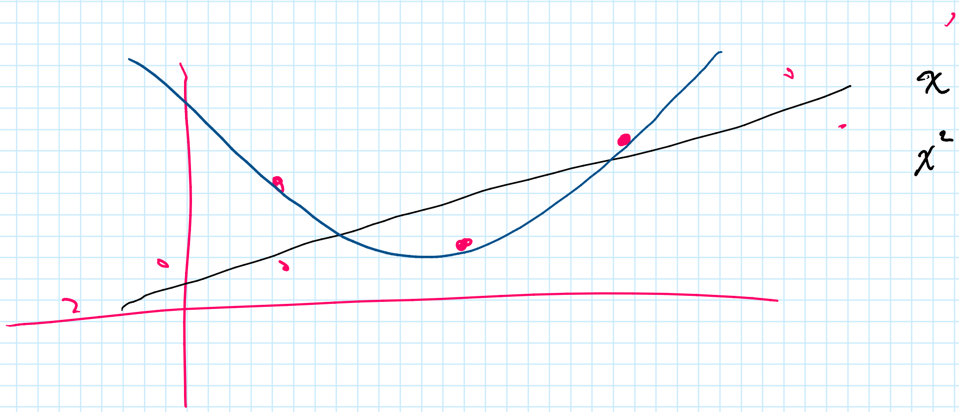
$0.8 \times 0.4$ vs $0.2 \times 0.1$

$pr(D1H \mid 3) = 94\%$

day 2 : 1

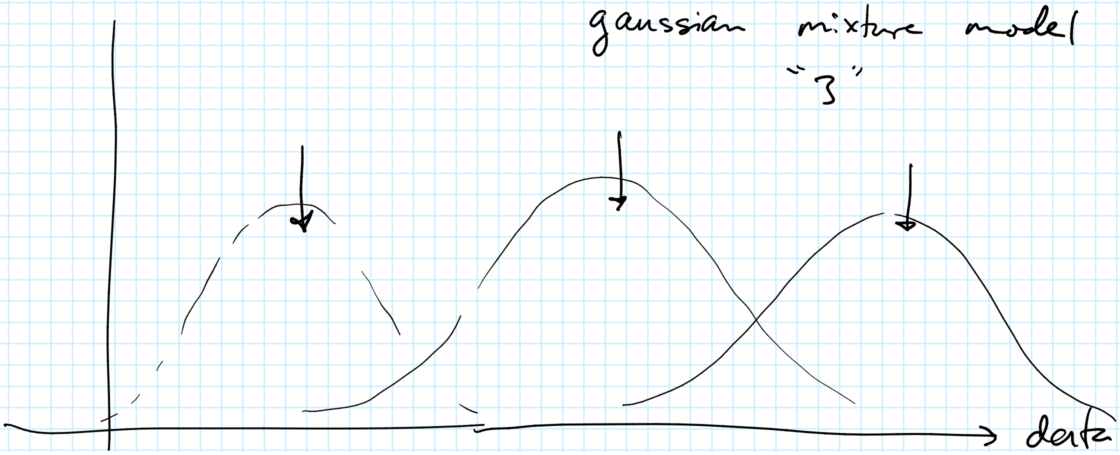
$0.4(0.6 \times 0.2 + 0.4 \times 0.5)$     $0.8$

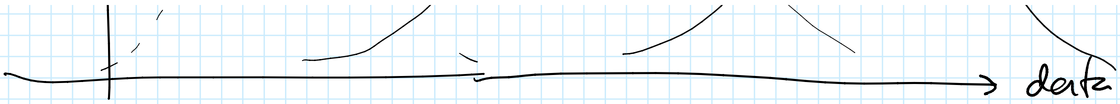
$$pr(D1H \mid 31) = \frac{pr(31 \mid D1H) \times pr(D1H)}{Pr(3,1)}$$



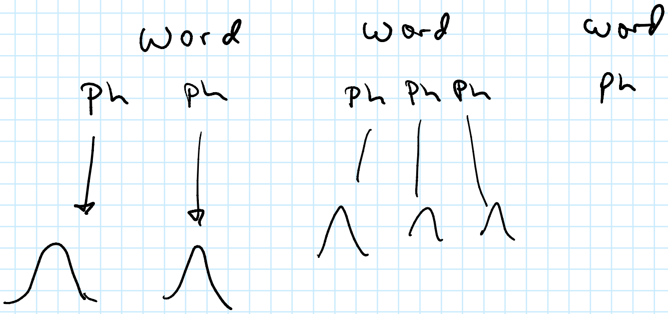

gaussian mixture model

"3"






Hidden markov model

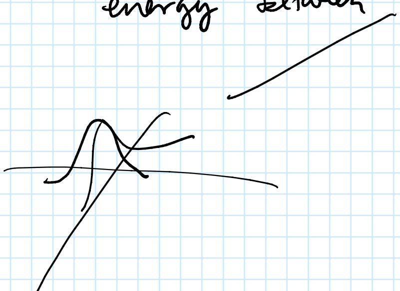



features

energy between 20 & 30Hz

30 & 50Hz

⋮



entropy : property of a random variable

surprise

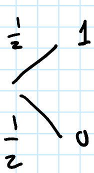
$pr = 1$

$$\log\left(\frac{1}{pr}\right)$$

$$-\log(pr)$$

$$H = -\sum p \log_2(p)$$

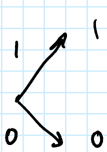
expected surprise




$$H = -\frac{1}{2}\log_2\left(\frac{1}{2}\right) - \frac{1}{2}\log_2\left(\frac{1}{2}\right) = \underline{\underline{1 \text{ bit}}}$$

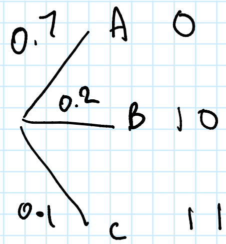
$\boxed{0}$

$\boxed{1}$



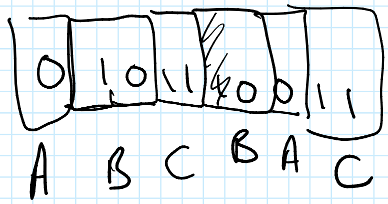

$$\left.\begin{aligned} H = &-1\log_2(1) \\ &-0\log_2(0) \end{aligned}\right\} 0 \text{ bits}$$

Claude Shannon




$H = 1.1$ bits

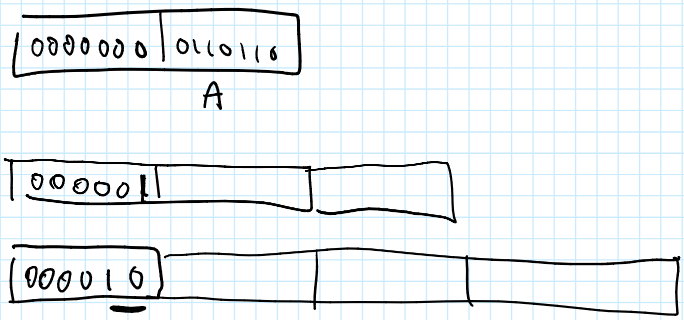
$(70\%)\,1 + (30\%)(2) = 1.3$ bits




error correction

127

1 byte

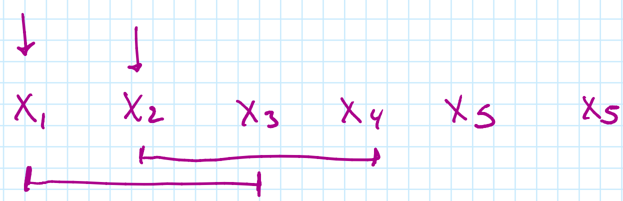



Wide Sense Stationarity vs Stationarity

$E[X[n]]$ doesn't depend on time (constant)

probabilities fixed with respect to time

correlation between points only depends on time difference




white noise

$X[n] = N(0, \sigma^2)$

IID
Samples are Independent and Identically Distributed

1 is this a WSS signal?

① is this a WSS signal?

Samples are Independent
and Identically Distributed

$X_0 \quad X_1 \quad X_2 \quad X_3 \quad X_4 \quad \cdots$

$E[x[n]] = 0$

lag

correlation between $x[n]$ and $x[n+k]$

$\text{corr}(\omega, y) = E(\omega \cdot y) - E(\omega) \cdot E(y)$

$E[x[n] * x[n+k]] - E[x\underset{0}{\cancel{[n]}}] * E[x\underset{0}{\cancel{[n+k]}}]$

if $k = 0$ $\qquad$ $Var(x) = E(x^2) - E^2(x)$

$E[x[n] \cdot x[n]] = E[x^2[n]] = \sigma^2 + \cancel{E^2[x]}$
$= \sigma^2$

if $k \neq 0$

$E[\underset{0}{\cancel{x[n]}}] \cdot E[\underset{0}{\cancel{x[n+k]}}]$

$$\text{corr}(x[n] \;\&\; x[n+k]) = \begin{cases} \sigma^2 & k = 0 \\ 0 & k \neq 0 \end{cases}$$

# Auto correlation Sequence

$\text{corr}(x[n] \;\&\; x[n+k]) = \text{func}(k)$

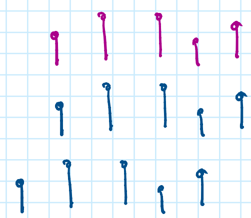
$r_x[k] = E[x[n] \cdot x[n+k]]$

$N(0, \sigma^2)$

How is this useful?

$x[n] + N[n]$

Estimating how related each sample is to itself and its neighbors



$k=0$

$k=1$