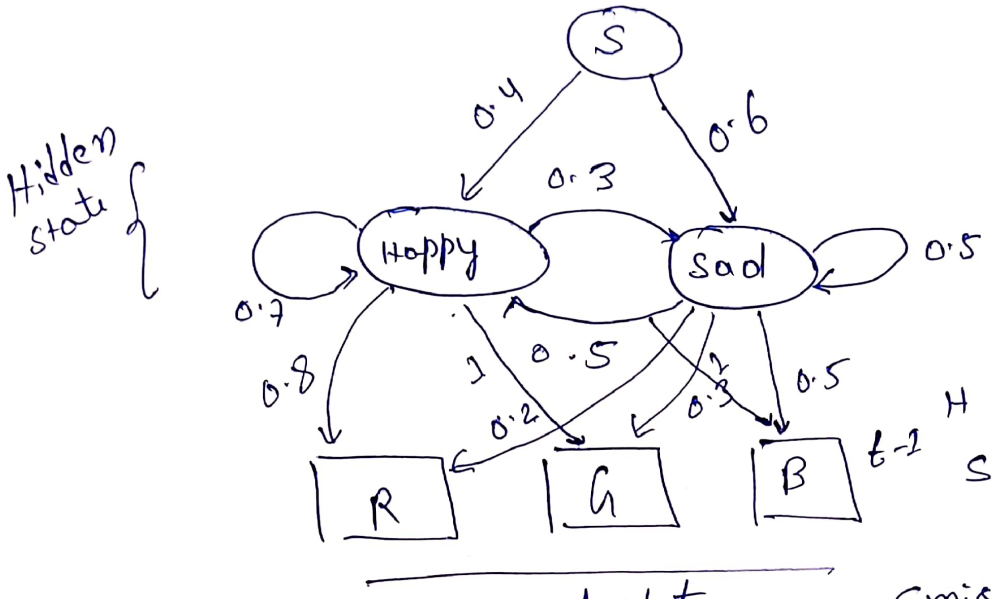
# Hidden markov model




transition probabi

t

| | H | S |
|---|---|---|
| H | 0.7 | 0.3 |
| S | 0.5 | 0.5 |

Emission probabilities

| | R | G | B |
|---|---|---|---|
| H | 0.8 | 0.1 | 0.1 |
| S | 0.2 | 0.3 | 0.5 |

Day 1 — $C_1 = G$

Day 2 — $C_2 = B$

Day 3 — $C_3 = R$

likelihood mood of professor.

Hidden. $\{m_1, m_2, m_3\} = ?$

$2^3 = 8$

$$\max_{m_1, m_2, m_3} P\left(\begin{matrix} C_1=G,\ C_2=B,\ C_3=R \\ m_1=m_1,\ m_2=m_2,\ m_2=m_3 \end{matrix}\right)$$

$P(C_3 | C_2, C_4, m_3, m_2, m_1) \times$

$P(C_2 | C_1\ m_3\ m_2\ m_1) \times$

$P(C_1 | m_3\ m_2, m_1) \times$

$P(m_3 | m_2\ m_1) \times$

$P(m_2 | m_1) \times$

$P(m_1) \times$

markov

$P(C_3 | m_3)$

$P(C_2 | m_2)$

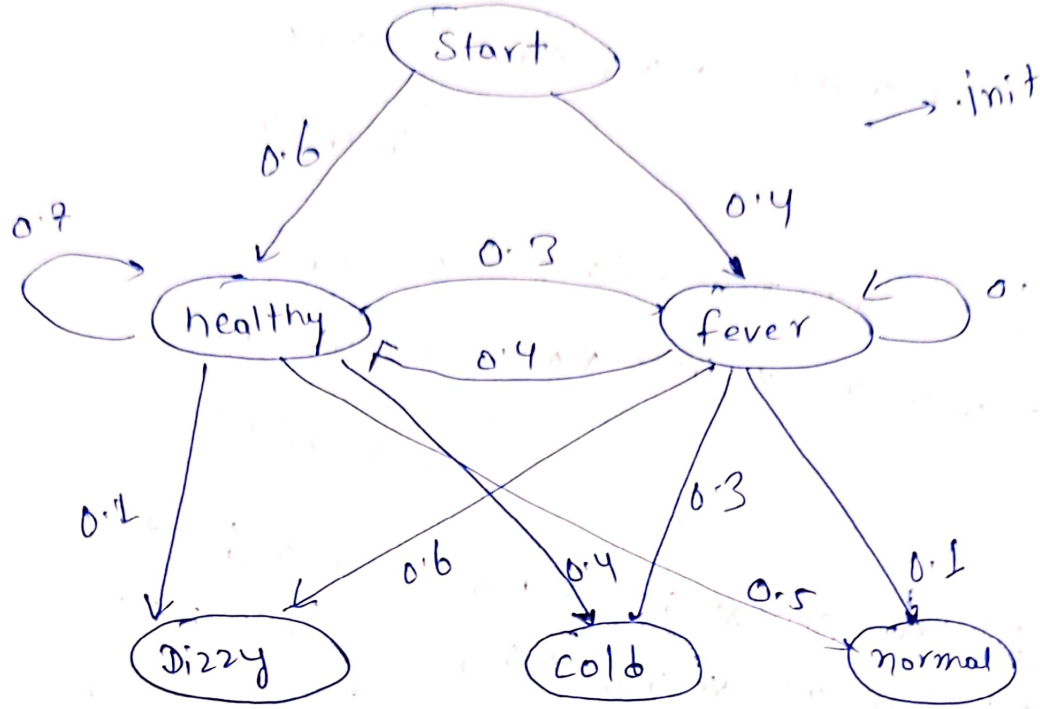
$P(C_1 | m_1)$

$P(m_3 | m_2)$

$P(m_2 | m_1)$

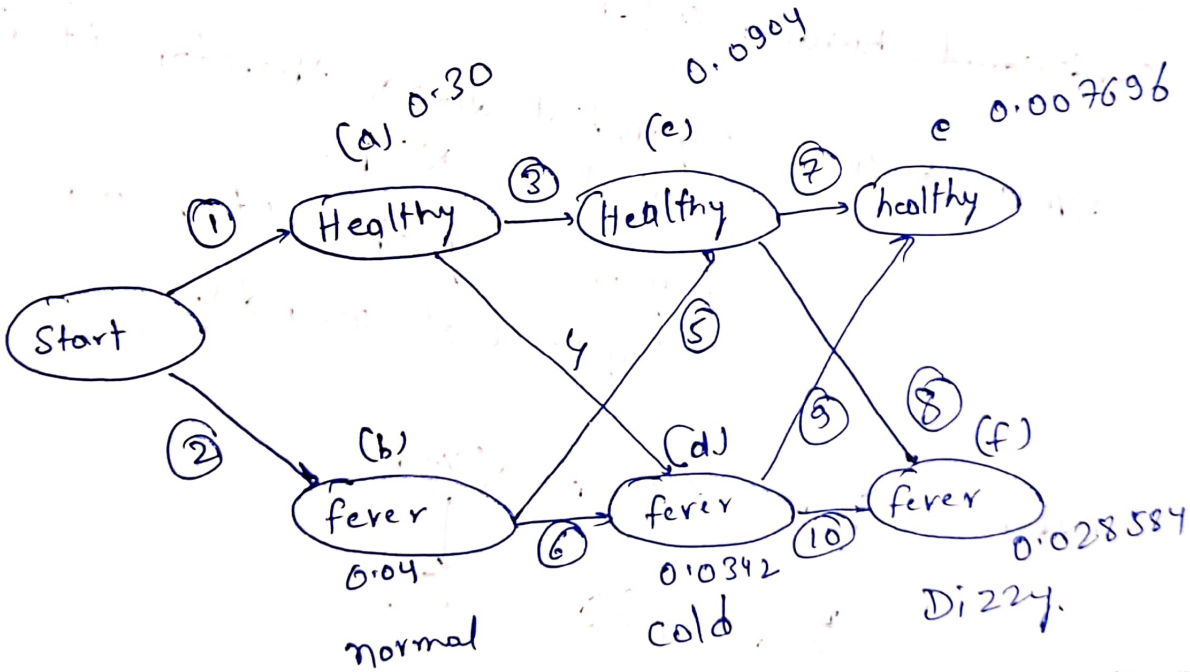
$P(m_1 | S)$

{S, S, H}




Start – healthy – Normal ⇒ 0.6 × 0.5
= 0.30

Start – fever – normal = 0.4 × 0.1 max
= 0.04




a, ① ⇒ 0.6 × 0.5 = 0.30

b ① ⇒ 0.4 × 0.1 ⇒ 0.04

c ③ 0.30 × 0.7 × 0.4 = 0.084
⑤ 0.04 × 0.4 × 0.4 = 0.0064
0.0904

d

(4) ⇒ 0.30 × 0.3 × 0.3 = 0.027

(6) ⇒ 0.04 × 0.6 × 0.3 = 0.0072

0.0342

(C)

7 = 0.0904 × 0.7 × 0.1 = 0.00632

9 = 0.0342 × 0.4 × 0.1 = 0.001368

0.007696.

(F)

(8) 0.0904 × 0.3 × 0.6 = 0.016272

(10) 0.0342 × 0.6 × 0.6 = 0.012312

0.028584

Viterbi max

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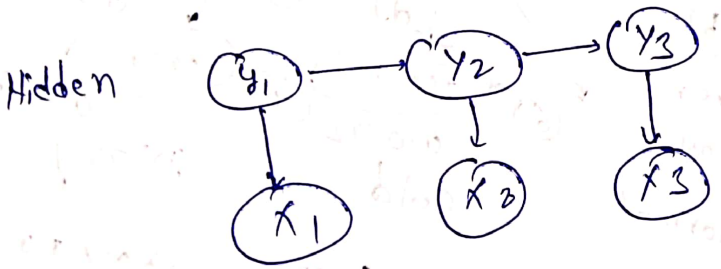
Conditional Random fields

HMM → uses sequential data therefore it is used in NLP.

Sequence of character or Sequence of words.




$$P(y, x) = \prod_{i=1}^{N} P(y_i | y_{i-1})\, P(x_i | y_i)$$

HMM

Generative model

— learns the underlying distribution of data.

— How data is generated.

Example Naive Bays

joint probabilities distribution.

Gaussian mixture model

HMM

variational Autoencoder

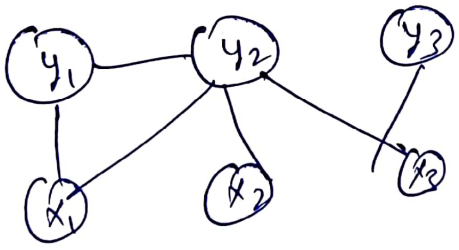
GAN → Generative Adversarial network

Limitation 1) static transmission & emission probabilities.

2) Limited Dependences.

Conditional Random field

CRF's are undirected so I should have been calling these connection instead of arrows




Discriminative model

Conditional probability.

directly learns the boundary

Example → logistic Regression

SVM, MLDA