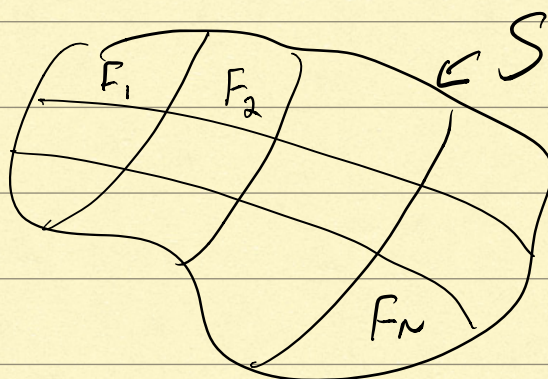


SUPPOSE A SAMPLE SPACE  $S$  CAN BE SPLIT  
 INTO SUBSETS  $F_1, F_2, \dots, F_N \leftarrow$  "PARTITION"

SUCH THAT

$$\bigcup F_i = S$$

$$F_i \cap F_j = \text{EMPTY} \quad \leftarrow$$



$$\begin{aligned} P(e) &= P(e \cap F_1) + P(e \cap F_2) + \dots + P(e \cap F_N) \\ &= P(e|F_1)P(F_1) + P(e|F_2)P(F_2) + \\ &\quad \dots + P(e|F_N)P(F_N) \end{aligned}$$

LAW OF TOTAL PROBABILITY

$X$  - RANDOM VARIABLE

$S$  - STATE SPACE

$S$  - DISCRETE  $(\{1, 2, 3\})$

CONTINUOUS  $([0, \infty))$

COLLECTION OF RANDOM VARIABLES

$X_t \leftarrow$  INDEX



$t$  IS IN A SET

IF  $t$  IS FROM A DISCRETE SET  
 $\{1, 2, 3, 4, \dots\}$  THEN

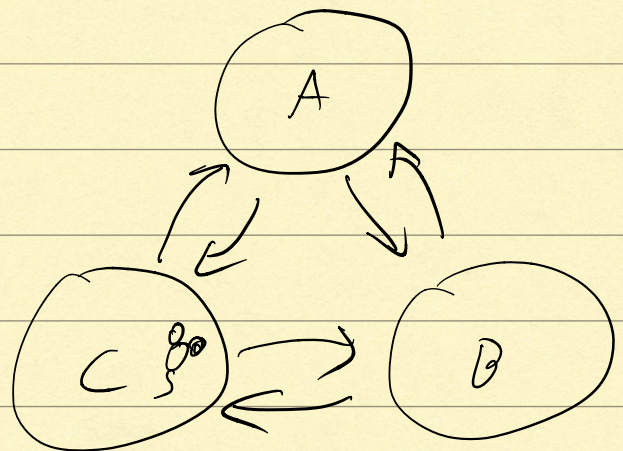
$X_t$  IS A DISCRETE-TIME STOCHASTIC  
PROCESS

IF  $t$  IS FROM A CONTINUOUS SET  
 $[0, \infty)$  THEN

$X_t$  IS A CONTINUOUS-TIME STOCHASTIC  
PROCESS

## MARKOV CHAINS

MOUSE CAN TRAVEL  
BETWEEN 3 ROOMS  
EACH MINUTE



ASSUMPTION

$$P(X_t = i \mid X_{t-1} = j, X_{t-2} = k, \dots)$$

$$= P(X_t = i \mid X_{t-1} = j)$$



$$M = \begin{bmatrix} p_{AA} & \cdot & p_{AC} \\ \vdots & \ddots & \vdots \\ \cdot & \cdot & p_{CC} \end{bmatrix}$$

TRANSITION  
MATRIX

$$p_{ij} = \mathbb{P}(X_t = i \mid X_{t-1} = j)$$

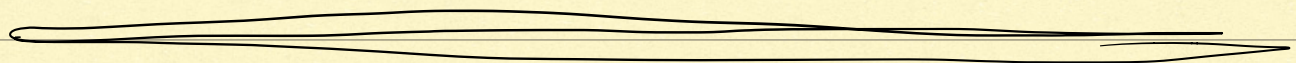
THEN

$$\begin{bmatrix} p_A(t+1) \\ p_B(t+1) \\ p_C(t+1) \end{bmatrix} = M \cdot \begin{bmatrix} p_A(t) \\ p_B(t) \\ p_C(t) \end{bmatrix}, \quad \begin{bmatrix} p_A(0) \\ p_B(0) \\ p_C(0) \end{bmatrix}$$

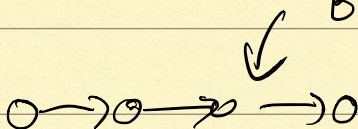
$$p_A(t+1) = \mathbb{P}(X_t = A \mid X_{t-1} = A) p_A(t) +$$

$$\mathbb{P}(X_t = A \mid X_{t-1} = B) p_B(t) +$$

$$\mathbb{P}(X_t = A \mid X_{t-1} = C) p_C(t)$$



BASEPAIRS



DNA

$X_t$  = BASEPAIR AT LOCATION  $t$



$$X_t \in S = \{A, C, T, G\}$$

PS 2

S	E1	E2	E3	I	END	
0	1	0	0	0	0	S
0	0	1	0	0	0	E1
0	0	0	1	0	0	E2
0		0	0			E3
0		0	0		0	I
0	0	0	0	0	1	END

