BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE

ARTIFICIALLY BLOCKED AND CHAINED INTILLEGENCE

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GLOBAL BLOCKCHAIN LEADER

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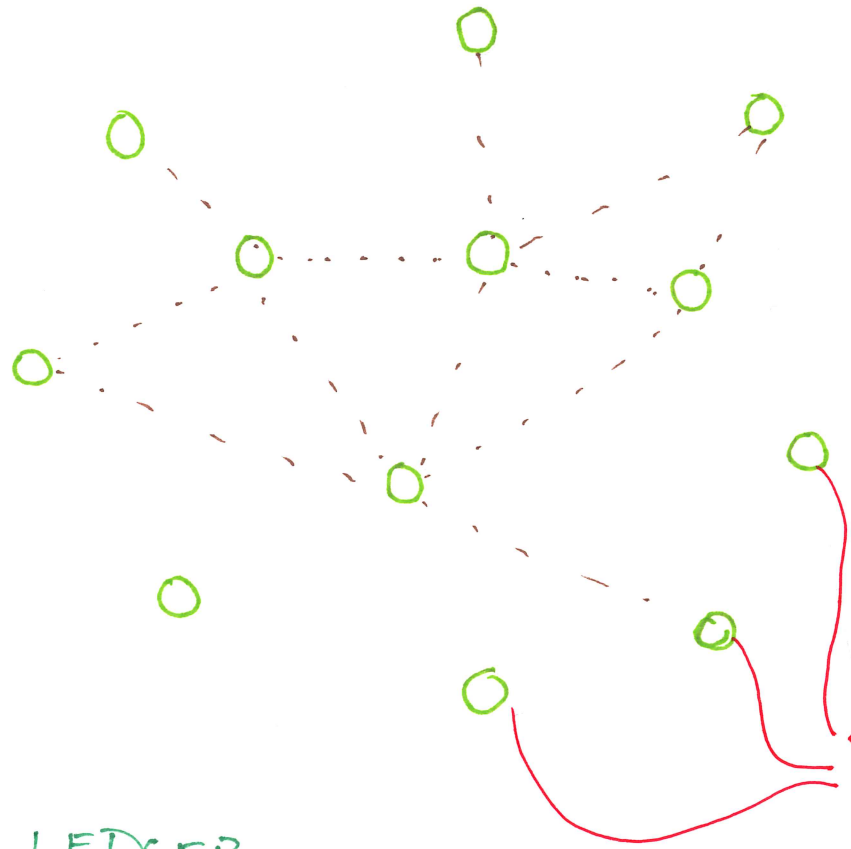
BLOCKCHAIN COMPUTING MODEL

A BLOCKCHAIN COMPUTING MODEL CONSISTS OF:

- A SEQUENCE OR ORDERED SET OF TRANSACTIONS
- SUBMITTED BY ONE OR MORE IDENTITIES
- OVER ONE OR MORE CHANNELS — MISSING IN CRYPTO CURRENCY WORLD
- THAT SATISFY SOME CONSTRAINTS OR LOGIC EXPRESSED AS SMART CONTRACTS
- AGREED UPON USING SOME DISTRIBUTED CONSENSUS APPROACH BY ONE OR MORE CONSENSUSER — PROBABILITE — MINER
- SO THAT THE SEQUENCES OF TRANSACTIONS CAN BE COMMITTED OR RECORDED ON A SHARED LEDGER
- AND ONCE THE SEQUENCE OF TRANSACTIONS ARE COMMITTED
- THE CANNOT BE EASILY MODIFIED OR TAMPERED — TRANSPARENT MODIFICATION

WHY DISTRIBUTED SYSTEM IS HARD?

① ASYCHRONY ② LOCAL KNOWLEDGE ③ FAILURE



- PERFORM ACTION USING LOCAL KNOWLEDGE
- COMPUTE FUNCTION USING LOCAL KNOWLEDGE
- FINITE STATE MACHINE REPLICATION
- SOLVE CRYPTO GAME OR PUZZLE
  - MINING
- SMART CONTRACT

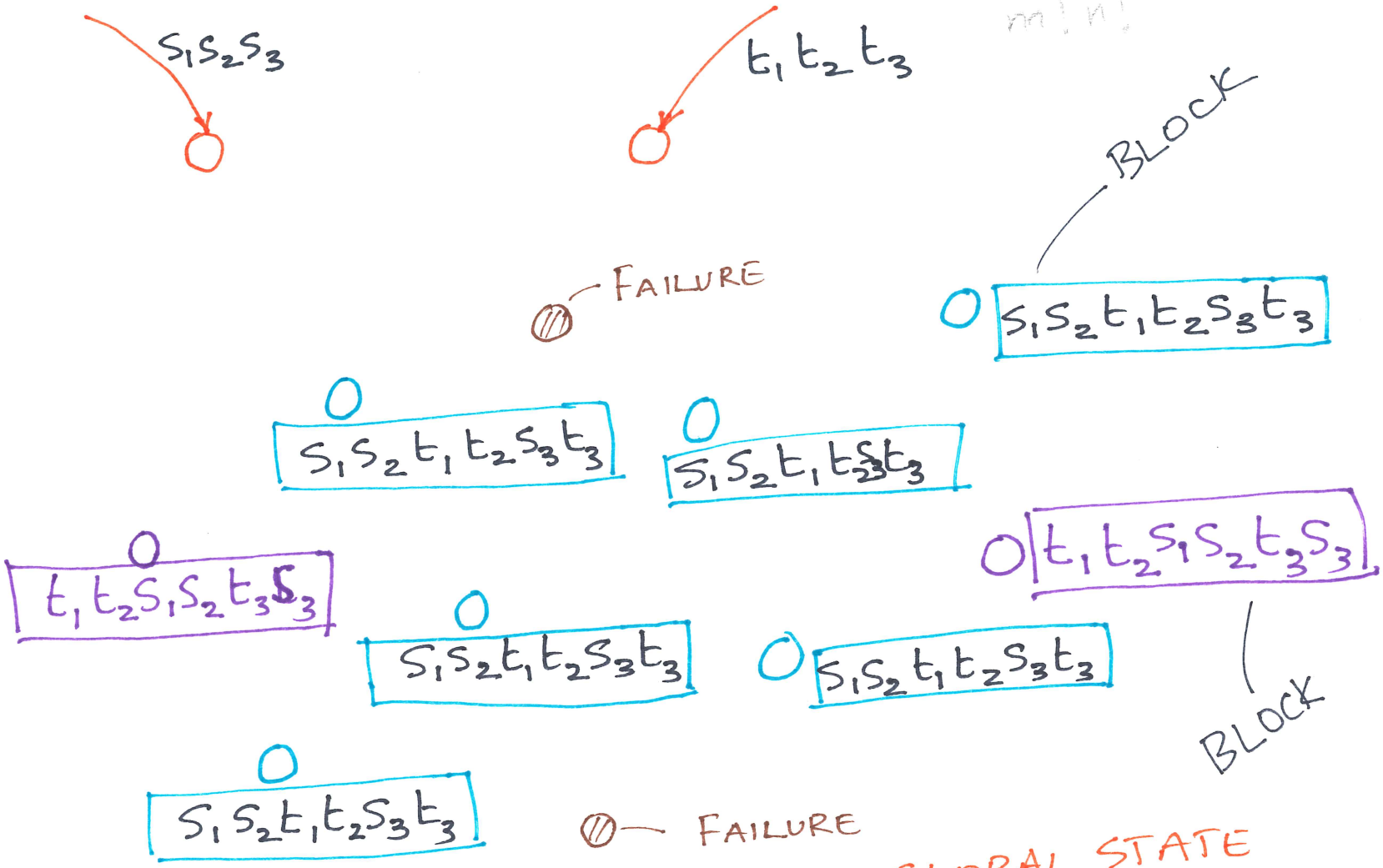
SHARED LEDGER

≡

GLOBAL STATE OR KNOWLEDGE

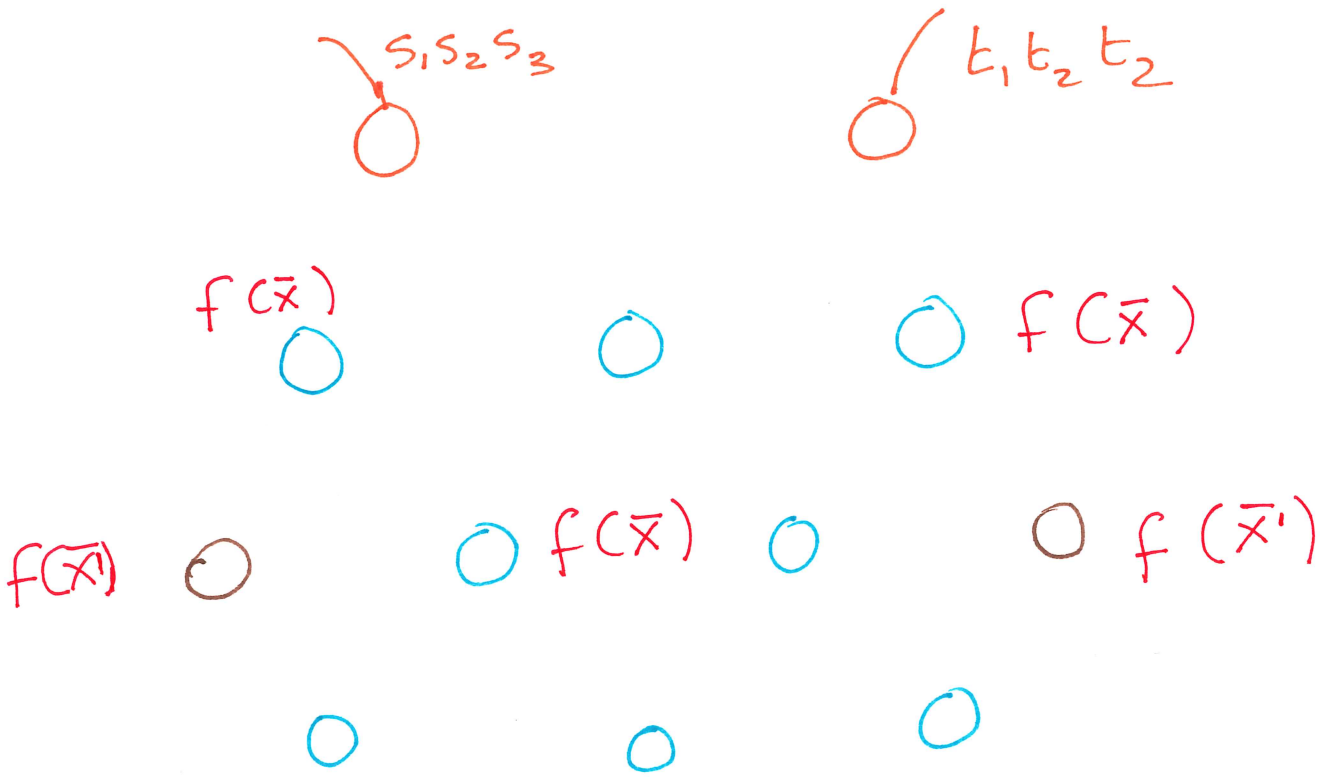
BLOCKCHAIN MODEL

$$\frac{(m+n)!}{m!\,n!}$$



- WHICH BLOCK? → AGREED FINAL BLOCK = GLOBAL STATE
- DEMOCRACY Vs FACISM? → HOW TO AGREE?
- HOW TO HANDLE FAILURE?

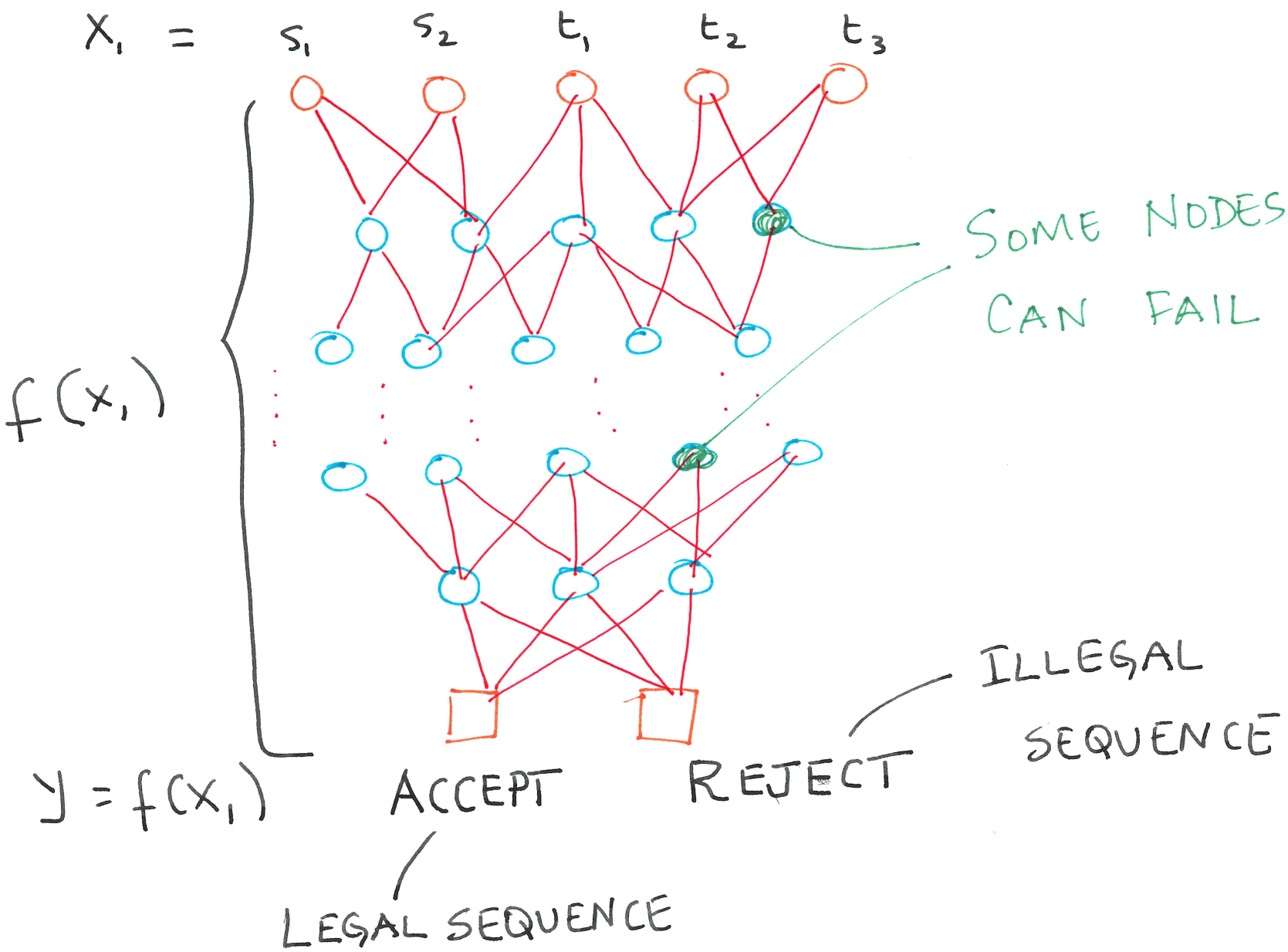
CONSENSUS AS COMPUTATION



$$y = f(\bar{x}) = \begin{cases} \text{- EVERY NODE PERFORM/COMPUTES } f(\bar{x}) \\ \text{- SOLVES A PUZZLE} \\ \text{- } \vdots \end{cases}$$

$$y = \begin{cases} \text{- AGREE/ACCEPT} \\ \text{- DISAGREE/REJECT} \end{cases}$$

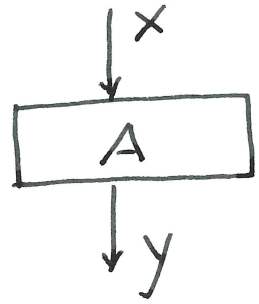
COMPUTATION MODEL



MATRICES AND TENSORS

MATRIX A IS A LINEAR TRANSFORMATIO

$y = Ax$



LU, QR,
NMF,

MATRIX DECOMPOSITION OR FACTORIZATION

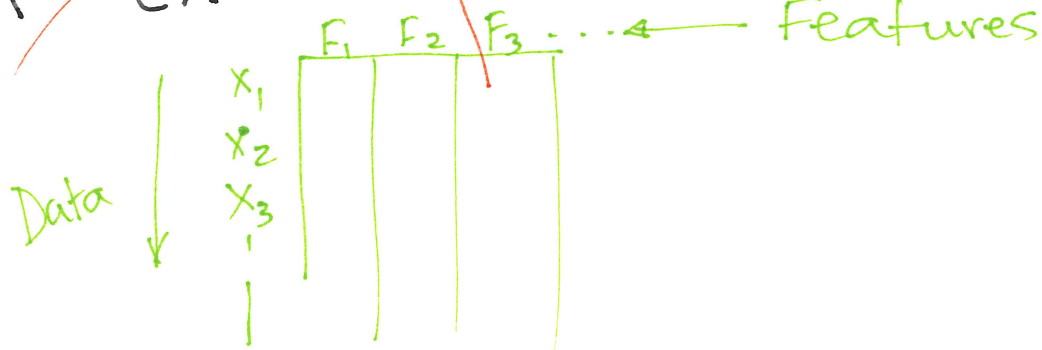
$A = UV$

RECOMMENDATION SYSTEM

MANY ML $\equiv$ MATRIX DECOMPOSITION

CURSE OF DIMENSION

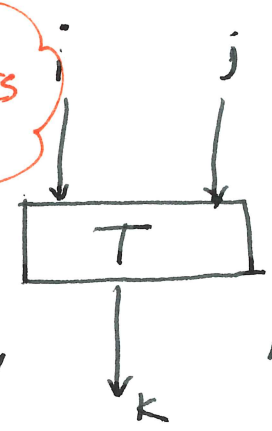
MANY DATA CAN BE FLATTENED
TO MATRIX



TENSORS

tensors $\neq$ matrices

T = TENSOR = (t_{ijk})



MULTILINEAR TRANSFORMATION

$U \otimes V \longrightarrow W$

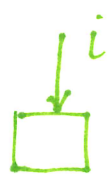
$U \otimes W \longrightarrow V$

$\vdots$

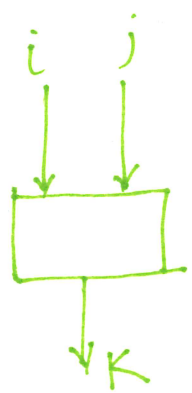
MULTI LINEAR FUNCTIONS OF VECTORS

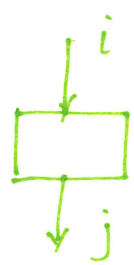
PENROSE GRAPHICAL MODEL

MANY "NICE PROPERTIES" DO NOT GENERALIZE TO TENSOR WORLD



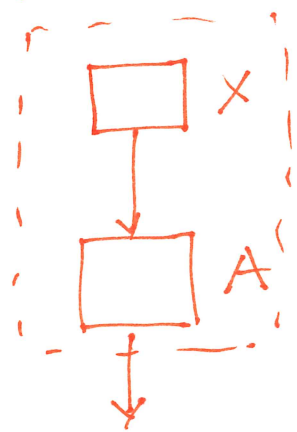
VECTOR



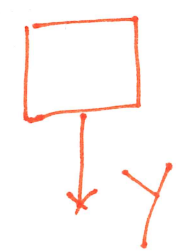


MATRICE

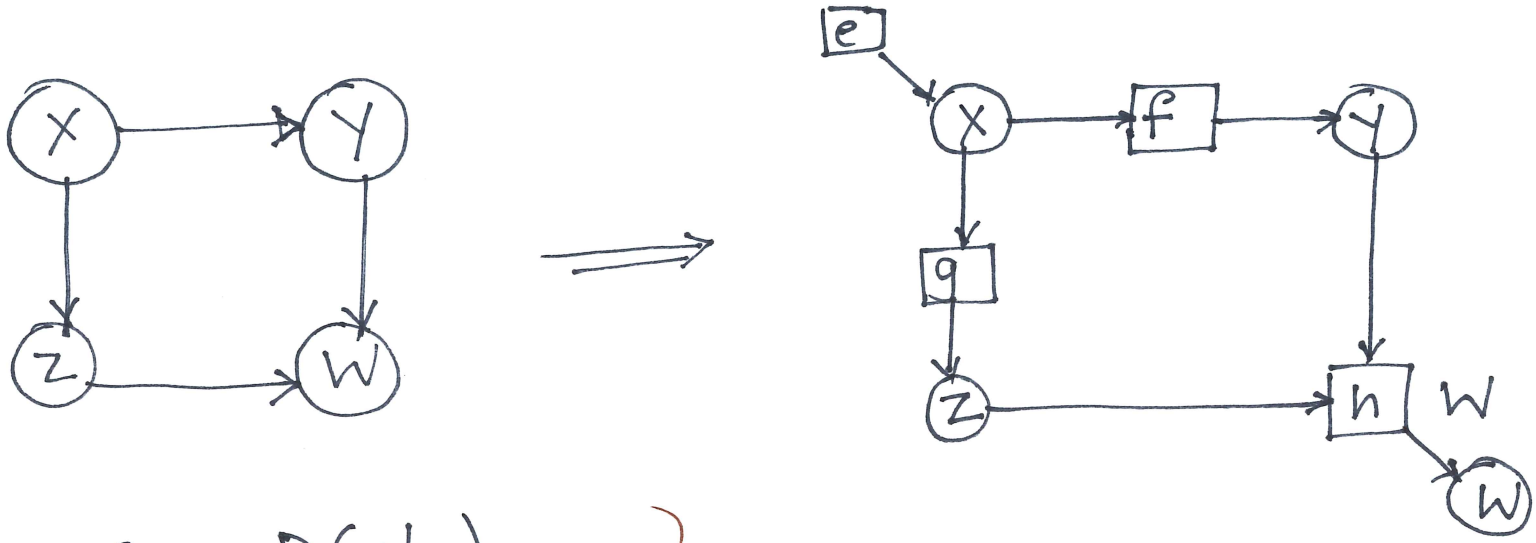
TENSOR



Monoidal Category



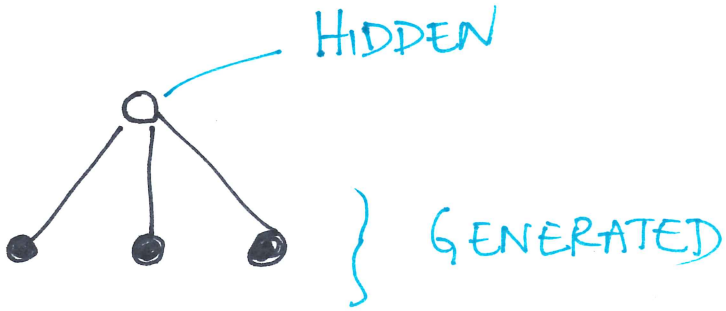
BELIEF / BAYESIAN NETWORK



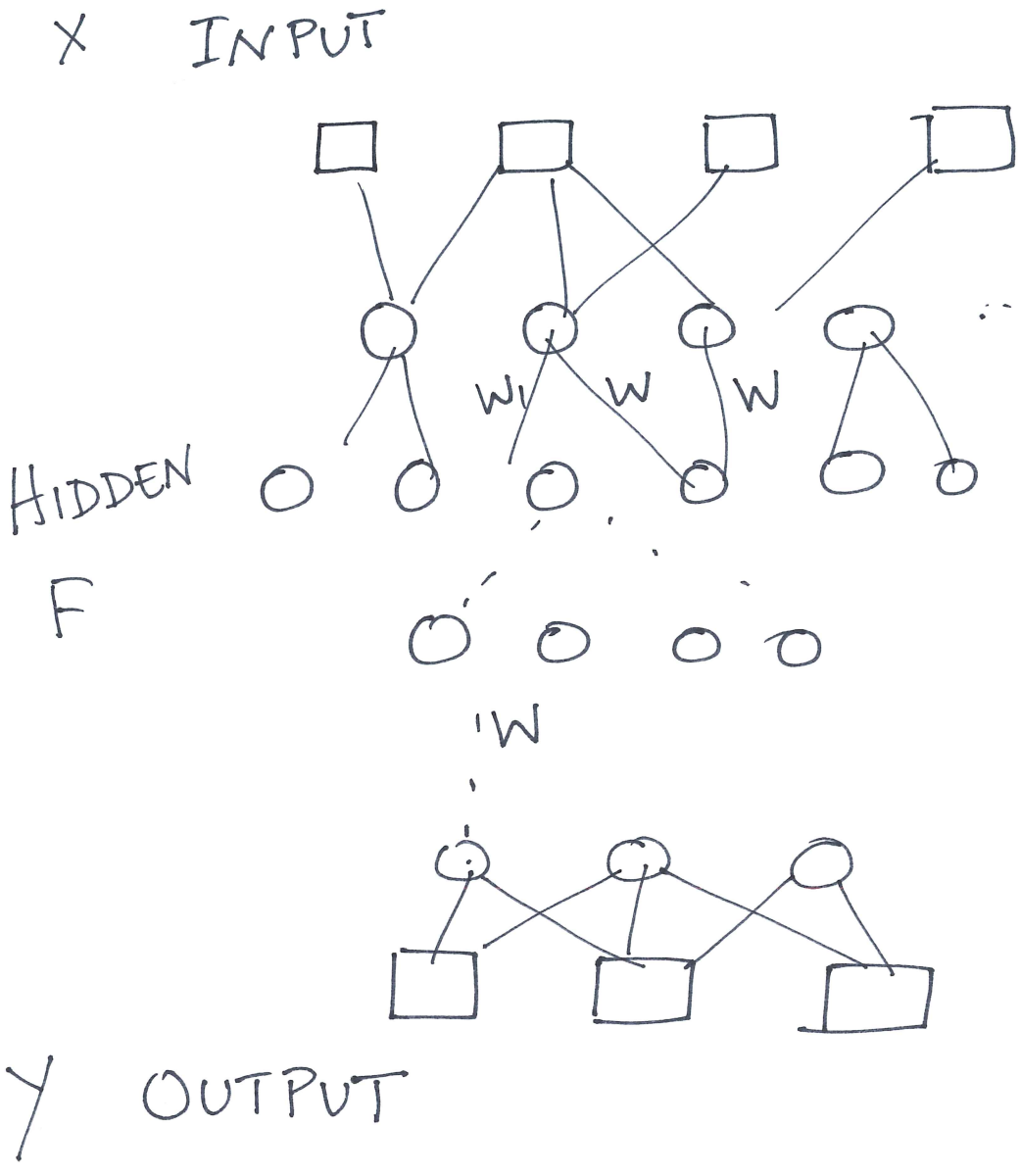
$$f = P(y|x)$$
$$g = P(z|x)$$
$$h = P(w|z,y)$$

CONDITIONAL DISTRIBUTION

NAIVE BAYES



DEEP LEARNING 101



THERE ONLY 3 THINGS IN DL

1. INPUT
2. WEIGHTS
3. OUTPUT

PROBLEM

GIVEN ANY TWO OF THE THREE FIND THE THIRD

$$y = F(x)$$

THREE THINGS

1. GIVEN INPUT + WEIGHTS FIND OUTPUT → PREDICTION / DISCRIMINATIVE

2. GIVEN INPUT + OUTPUT FIND WEIGHTS → LEARNING

3. GIVEN OUTPUT + WEIGHTS FING INPUT → GENERATIVE

LEARNING AS COMPUTATION

$$y = f(x)$$

Learning $\equiv$ estimating f as $\tilde{f}$
or
approximating

f is regular or rational or no jumps

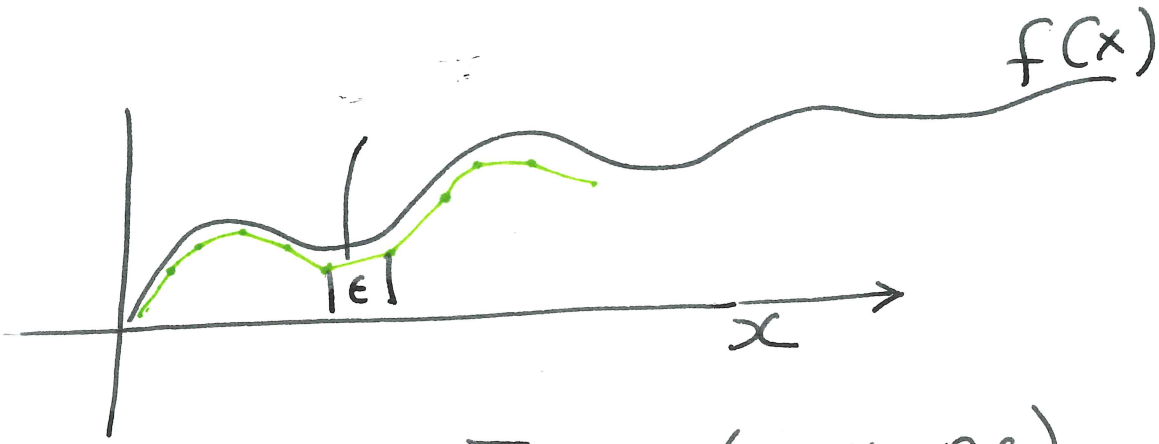
RIDGE FUNCTION

$$y = P(x w_n + b_n)$$

$$\tilde{f}_M(x) = \sum_{n=1}^{M} \alpha_n P(w_n x + b_n)$$

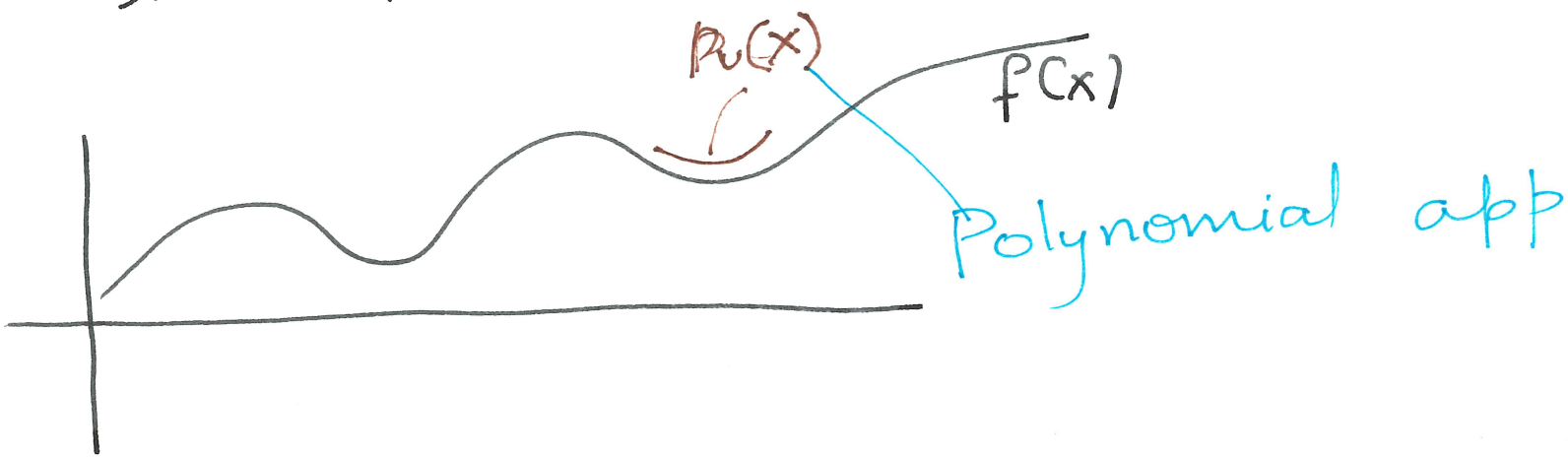
$$\lim_{M \to \infty} \| f - f_M \| = 0$$

PIECEWISE LINEAR APPROXIMATION



$$\tilde{f}(x) = \sum_n a_n \rho(w_n x - n\epsilon)$$

SAMPLING DISTANCE ϵ : $|f(x) - \tilde{f}(x)| \leq C\epsilon$



CONSENSUS AS LEARNING

SEQUENCE OF TRANSACTIONS

$$y = f(x)$$

ACCEPT — LEGAL

OR

REJECT — NOT LEGAL

SEQUENCE

CAN WE USE CONVOLUTION NEURAL NETWORK?

RECURRENT NEURAL NETWORK

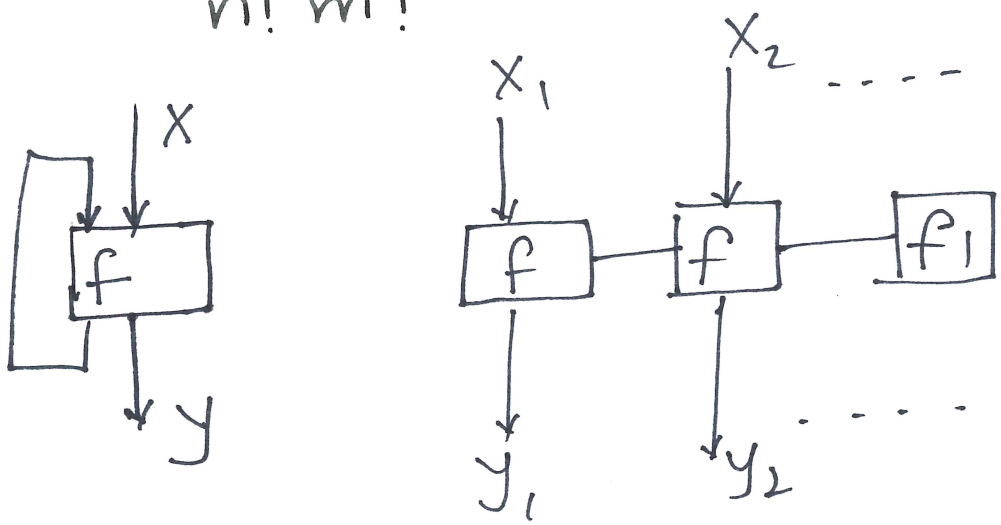
$X_1 = S_1 \cdots S_n$

$X_2 = t_1 \cdots t_m$

LSTM = LONG SHORT TERM MEMORY

OF POSSIBLE LEGAL MERGE

$$\frac{(n+m)!}{n!\,m!}$$



CALCULATING WEIGTS

$\equiv$

CONSENSUS

RECURRENT NEURAL NETWORK

RNN DYNAMIC STATE EVOLUTION DEPENDS ON INPUT + WHAT IT DID IN THE PAST (INCLUDING CURRENT STATE)

$$Y(t+1) = y(t) + X(t)$$

RNN = HMM + DISTRIBUTED STATE

$$Y(t+1) = y(t) + g(\alpha)\, X(t)$$

RNN CAN EASILY HANDLE VARIABLE LENGTH STRUCTURES

RECURRENT NEURAL NET

RNN ARE TURING COMPLETE — SIMULATE ARBITRARY PROCEDURES

↓

ALGORITHMIC TASK

TURING MACHINE = FSM + INFINITE TAPE

TURING NN = RNN + ADDRESSABLE MEMORY

↓

DIFFERENTIABLE COMPUTERS

↓

EASY TO TRAIN

DIFFERENTIABLE CONSENSUS

- NO IDEA :)
- BUT CONSENSUS ARE LEARNING PROCEDURES
- JURY DUTY
- CREATING PPT FOR CEO
- EXPLORING ALGEBRAIC TOPOLOGY AND GEOMETRY
- CATEGORY THEORY
  DIFFERENTIABLE GEOMETRY

LOCK THEM IN A ROOM :)

EXPERIMENTAL RESEARCH + MATHEMATICAL RESEARCH

WORLD CLASS DEVELOPERS

WORLD CLASS MATHEMATICIANS

WHY MATHEMATICS IS IMPORTANT ??