Deep Learning

with No math

Philipp Gabler

2022-06-28

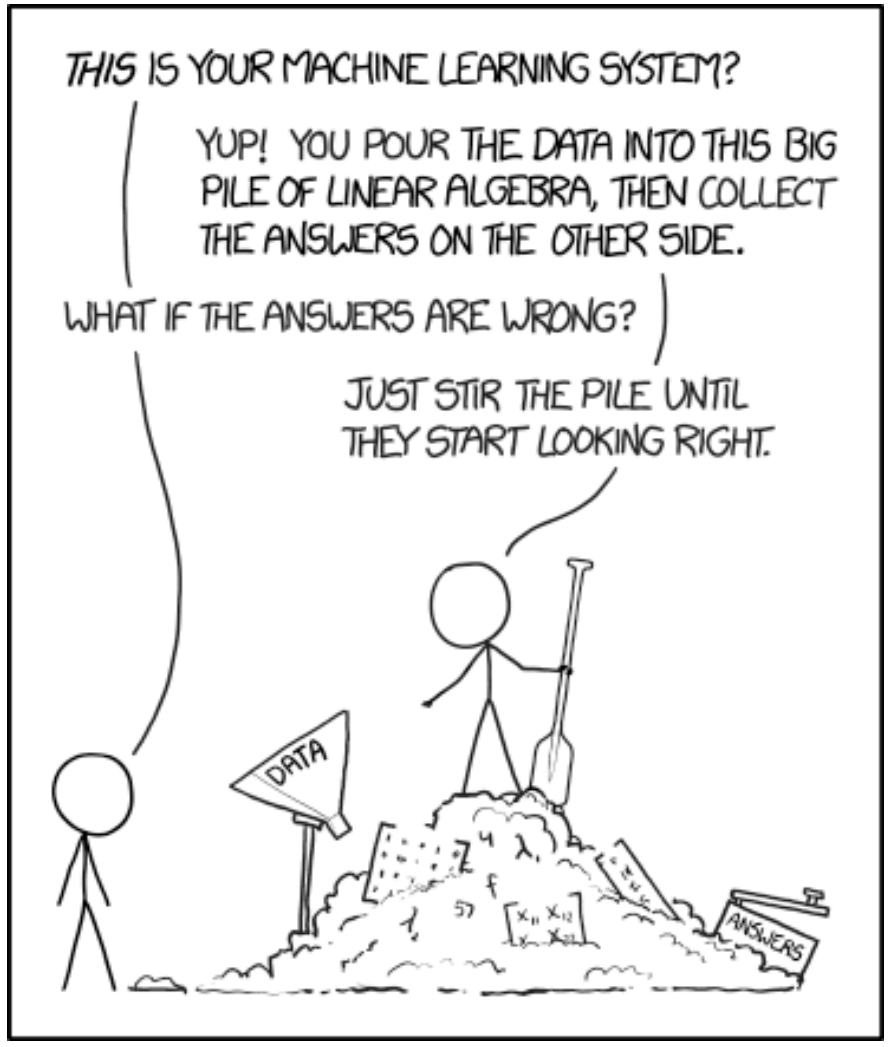
DEEP LEARNING

WITH ~~NO~~ MATH

AS LITTLE AS POSSIBLE

PHILIPP GABLER

2022-06-28



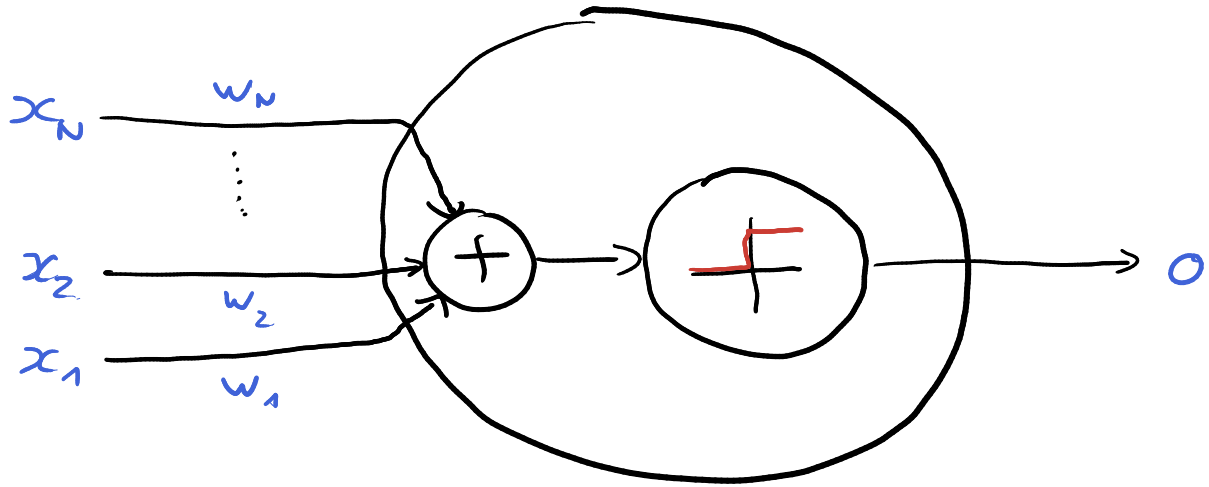
https://xkcd.com/1838/

OUTLINE

1. A BIT OF HISTORY
2. WHAT PROBLEM(S) DOES DL SOLVE? — COMPUTATIONAL
3. HOW DO SOLUTIONS LOOK LIKE? — ALGORITHMIC
4. HOW ARE SOLUTIONS IMPLEMENTED? — IMPLEMENTATIONAL
5. SOME LANGUAGE-RELATED USE CASES

Ἐν ἀρχῇ ἦν τὸ PERCEPTRON

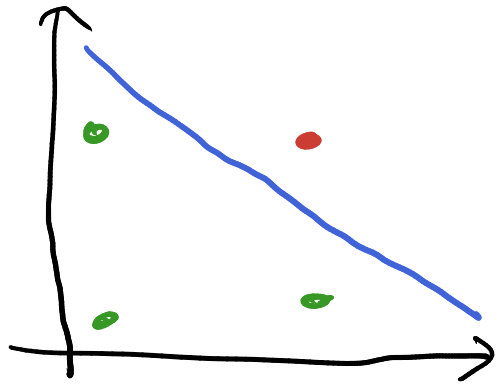
- McCULLOCH & PITTS, 1948: NEURON MODEL

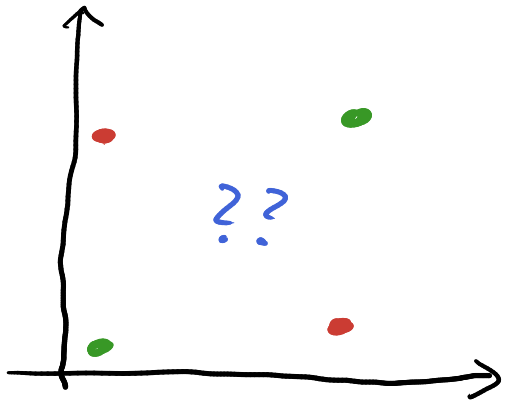


- ROSENBLATT, 1958: ENTHUSIASM

- MINSKY & PAPERT, 1969: SHOCK OF "PERCEPTRONS"

❄ AI WINTER ❄

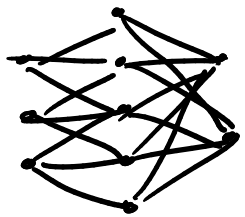




PROBLEM OF LINEAR SEPARABILITY

NEW SPRING

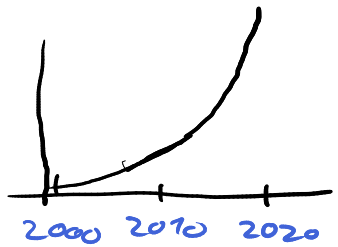
- RUMELHART & MCCLELLAND (1986): PDP
  - ↳ CONNECTIONISM
  - ↳ BACKPROPAGATION
  - ↳ SINGLE-LAYER → MULTI-LAYER

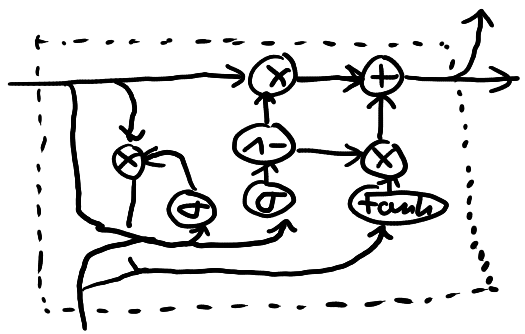


- STATISTICAL LEARNING / MACHINE LEARNING OVER (SYMBOLIC) AI

TOWARDS DEEP LEARNING

- MORE LAYERS
- MORE DATA
- MORE COMPUTE (MOORE'S LAW)
- BETTER TUNING & TRAINING





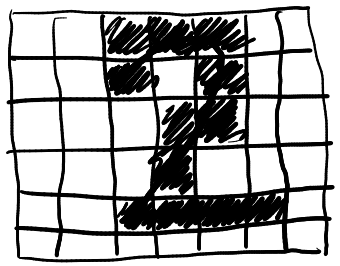
TAKE-AWAYS 1

- ARTIFICIAL – NO NEURONS ANYMORE!
- AI AND ML HAVE SPLIT – DL ≠ INTELLIGENCE
- GROWTH OF TECHNOLOGY IMPORTANT
- DL IS SUB SYMBOLIC (≃ CONNECTIONISM)

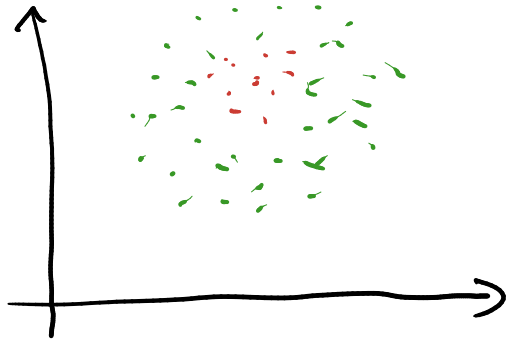
WHAT PROBLEMS DOES DEEP LEARNING SOLVE?

CHARACTERISTICS OF DEEP LEARNING

HIGH-DIMENSIONAL

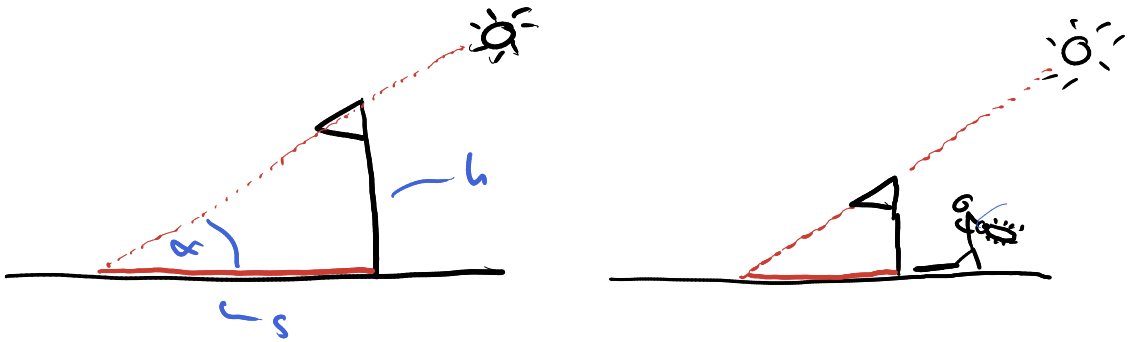


NON-LINEAR

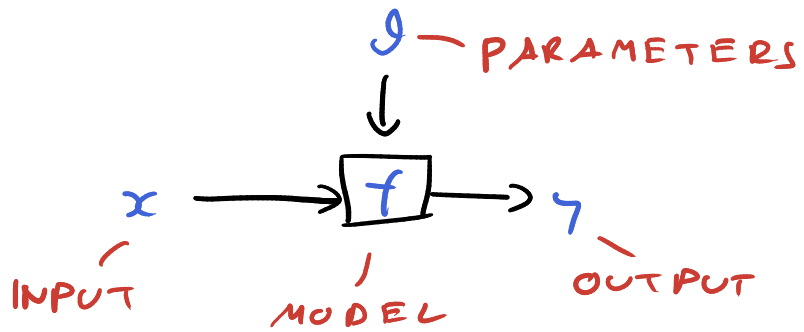


PREDICTION

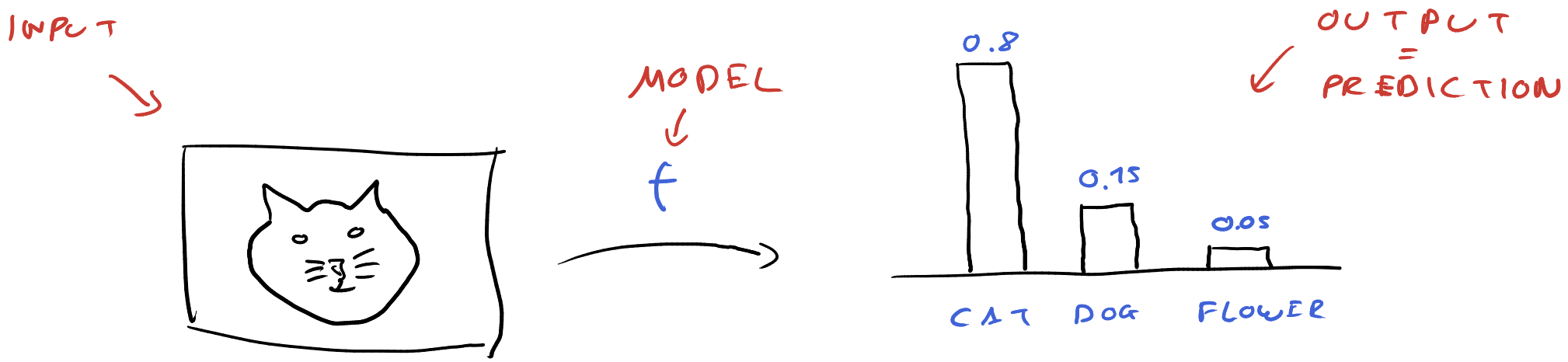
ASSOCIATIVE



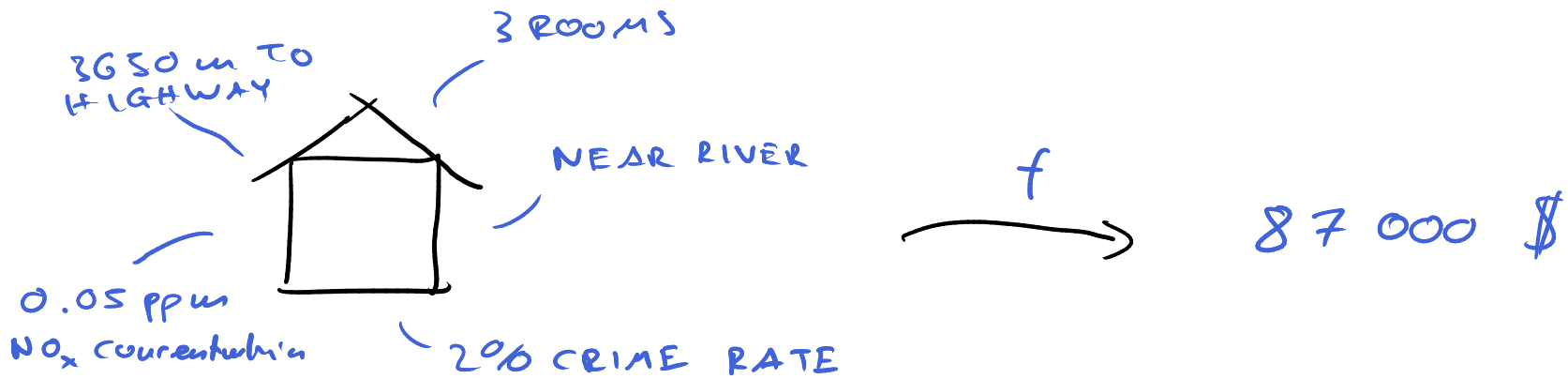
END-TO-END TRAINING, PARAMETRIC



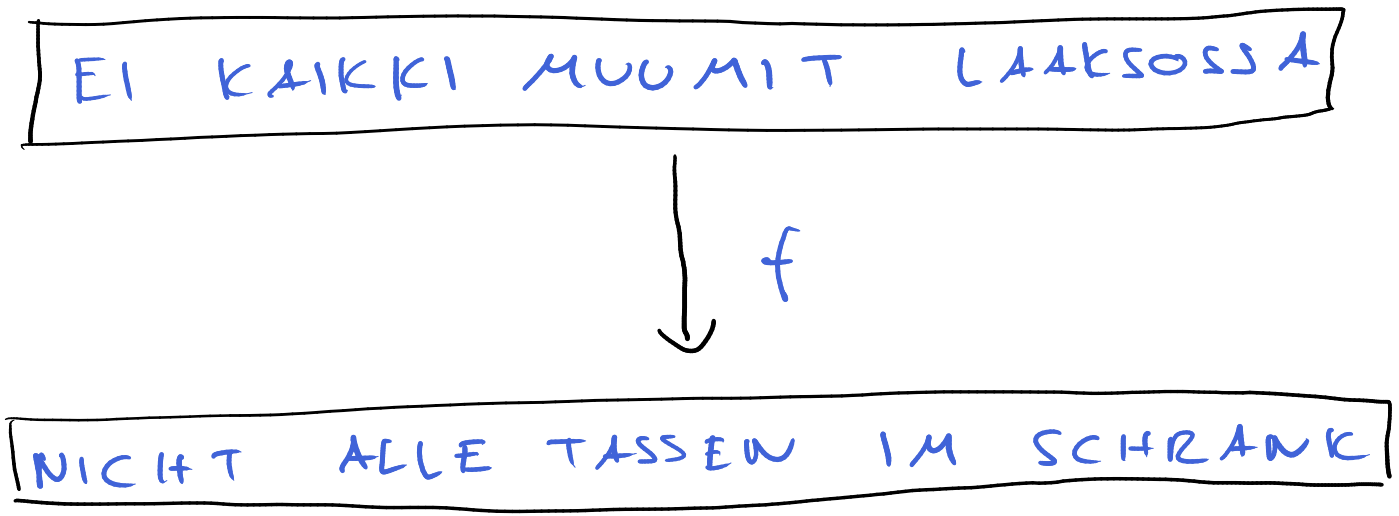
CLASSIFICATION



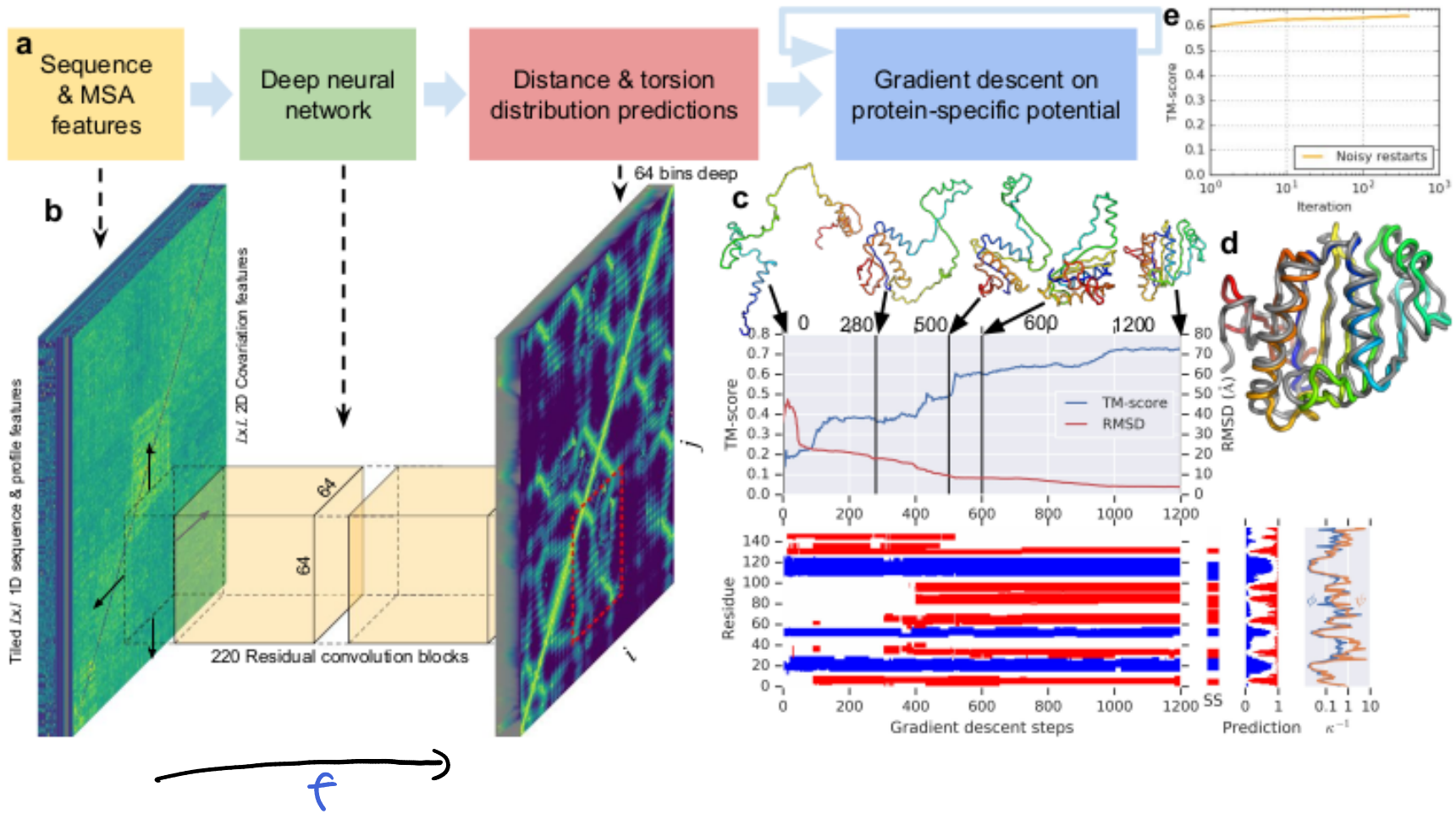
REGRESSION


3650 m TO HIGHWAY
3 ROOMS
NEAR RIVER
0.05 ppm
NO_x concentration
20% CRIME RATE
f
87 000 $

SEQUENCE PREDICTION



HIGH-DIMENSIONAL MODELLING



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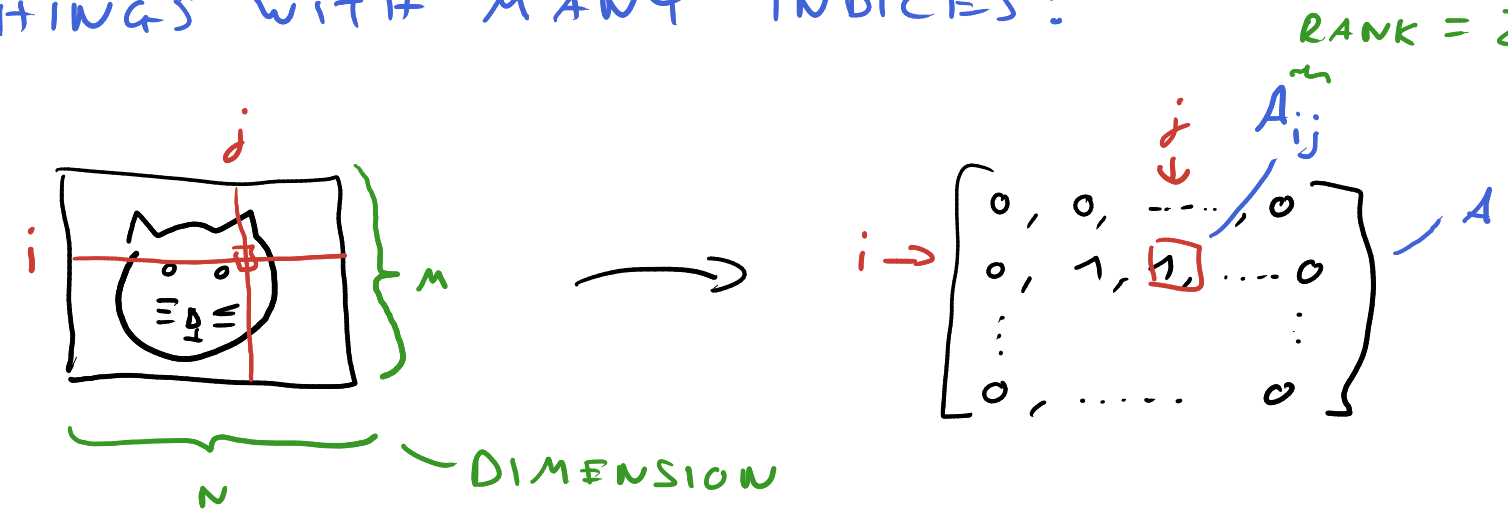
https://doi.org/10.1038/s41586-019-1923-7

TENSORS

TensorFlow

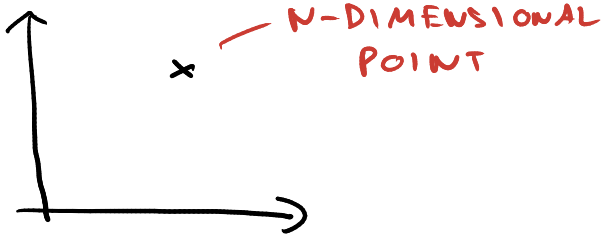
JUST THINGS WITH MANY INDICES:



EVERYTHING IS LINEAR ALGEBRA!

TENSOR SHAPES

RANK 1



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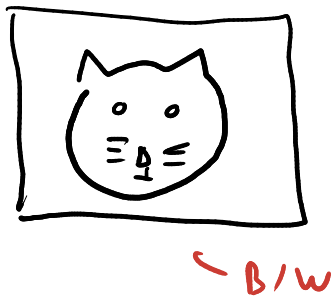
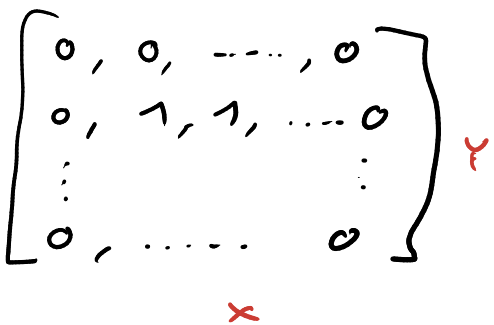
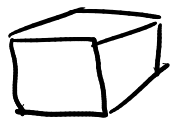
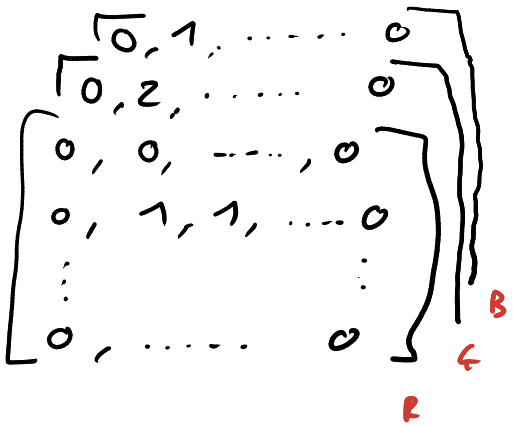
RANK 2





RANK 3





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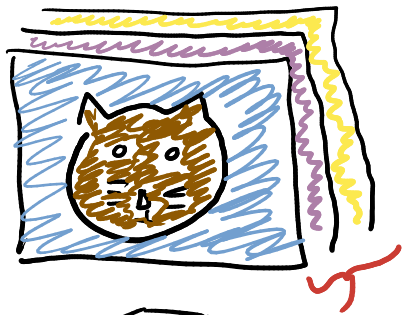
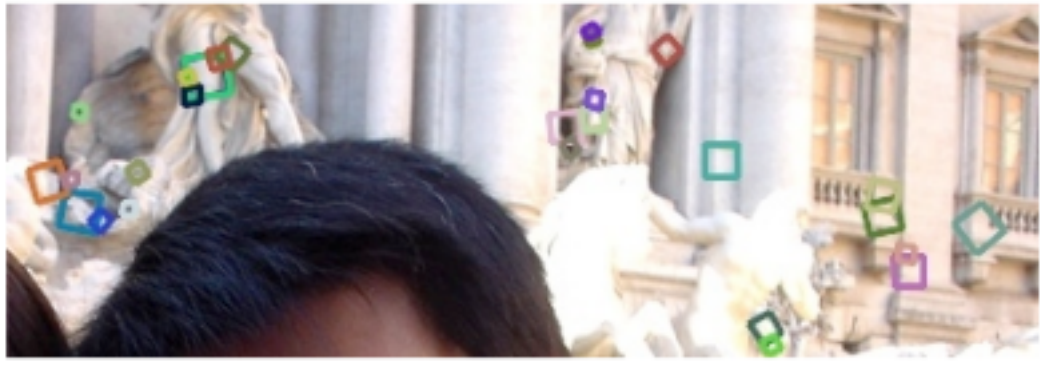
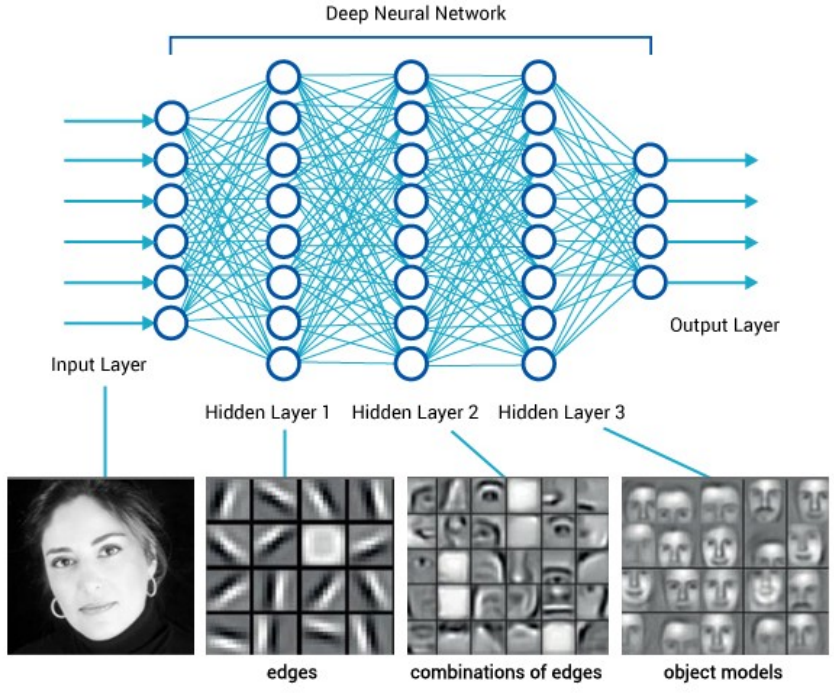


From Features to Layers

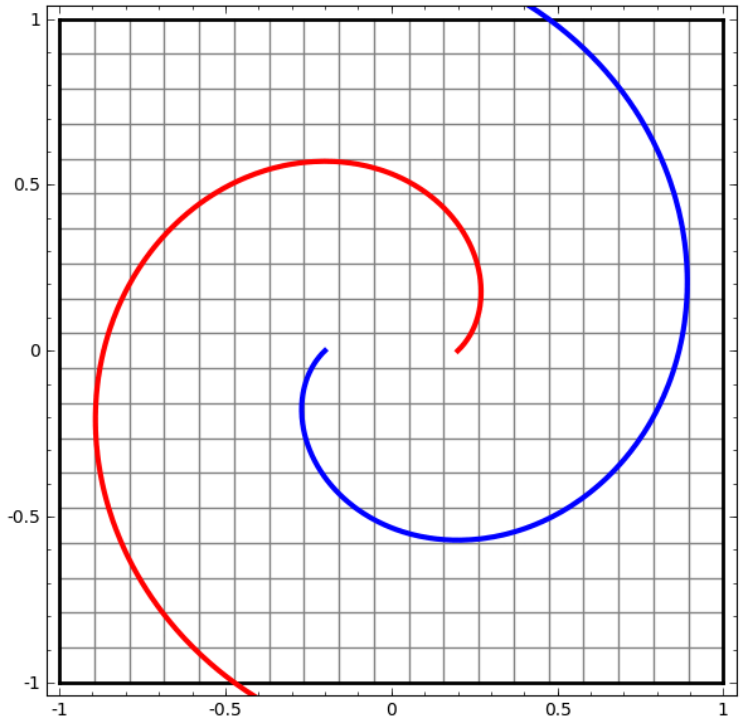
Traditional



Deep Learning



https://medium.com/diaryofawannapreneur/deep-learning-for-computer-vision-for-the-average-person-861661d8aa61


1
0.5
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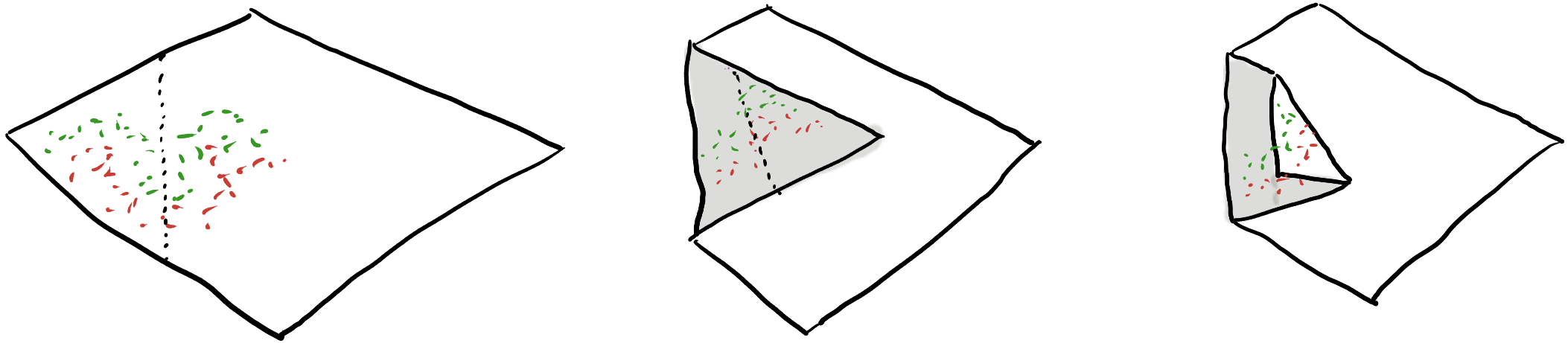
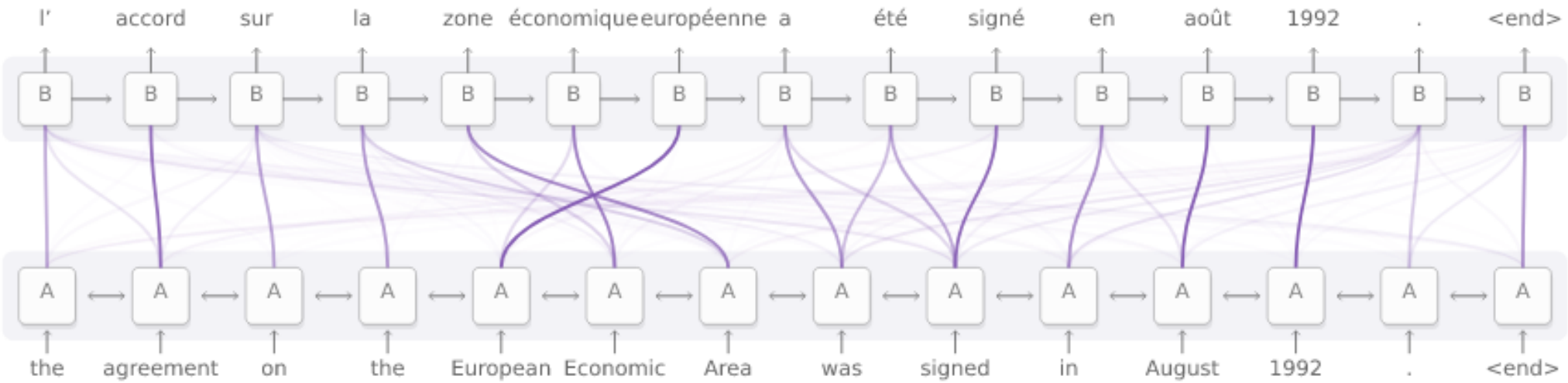
-0.5
-1
-1
-0.5
0
0.5
1

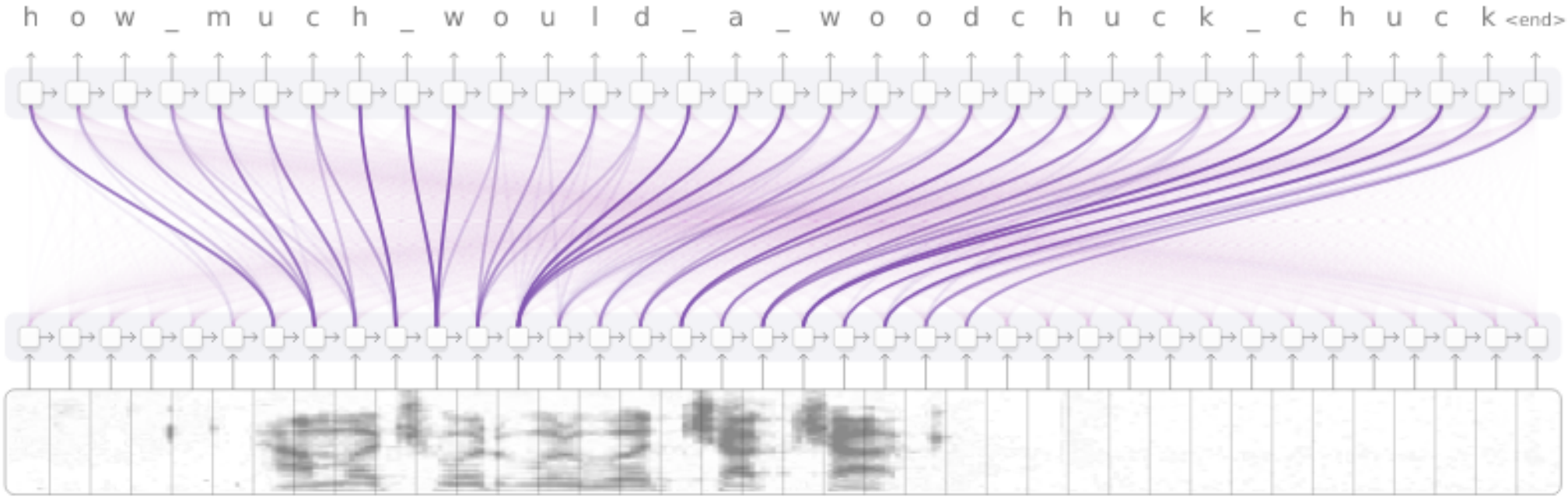
Space Folding



https://doi.org/10.48550/arXiv.1402.1869



distill.pub/2016/augmented-rnns/



distill.pub/2016/augmented-rnns/

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