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DEEP LEARNING FOR ARTIFICIAL INTELLIGENCE — Midterm exam (2018) - solution

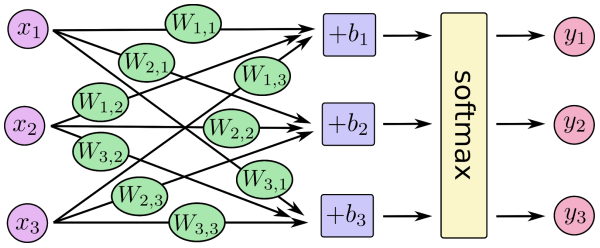
Master's degree in Telecommunications Engineetings (MET), ETSETB TelecomBCN, UPC — Coordinator: Xavier Giró

INSTRUCTIONS

- Write down now your name in the available header of all pages. Unnamed pages will be ignored.
- Time available: 50 minutes.
- Maximum grade is 10 points, and each question has a weight of 1 point.
- Answer in the provided sheets of paper, within the available space. Sheets are structured by instructor to facilitate grading.
- You can only use writing material. N information sources are allowed in this test.
- If you have any question, raise your hand and wait for instructions from the instructor.
- Any attempt of fraud will be persecuted and punished according to the school and university regulations.

D1L2 THE PERCEPTRON by Xavier Giró

Formulate the system in the figure as a matrix of operations and the *softmax(·)* function.



Source: "Get Started with TensorFlow"

Solution:

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \text{softmax}\left(\begin{bmatrix} W_{1,1} & W_{1,2} & W_{1,3} \\ W_{2,1} & W_{2,2} & W_{2,3} \\ W_{3,1} & W_{3,2} & W_{3,3} \end{bmatrix} \cdot \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} \right)$$

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D4L2 LEARNING WITHOUT ANNOTATIONS by Xavier Giró

a) What is the name of the system depicted in the figure ?

b) Draw the block-diagram of a system who could take advantage of the latent variables learned by this system.

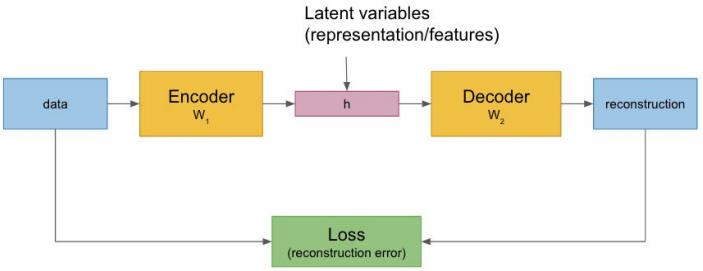
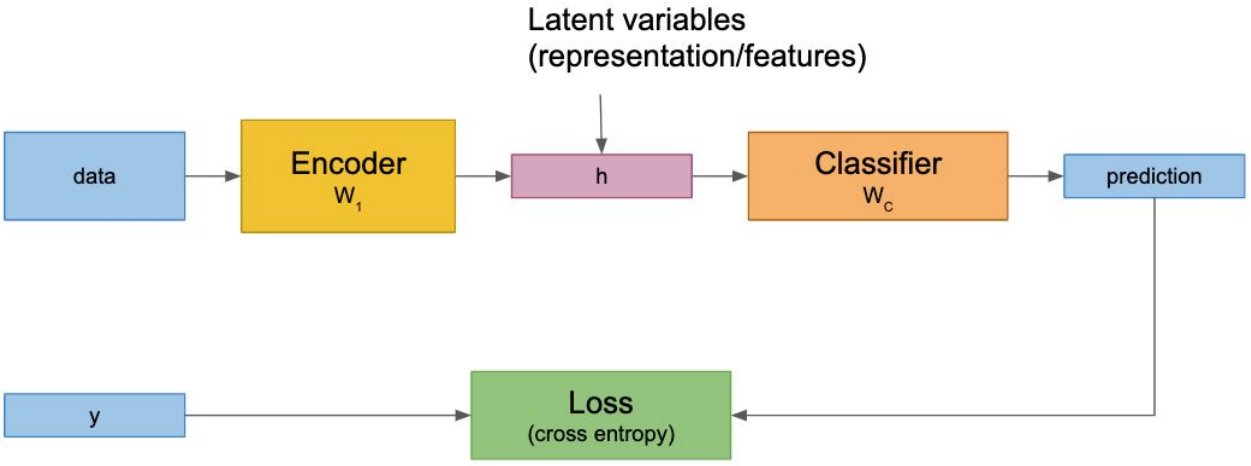


Figure: Kevin McGuinness (DCU)

Solution:

a) Autoencoder

b)



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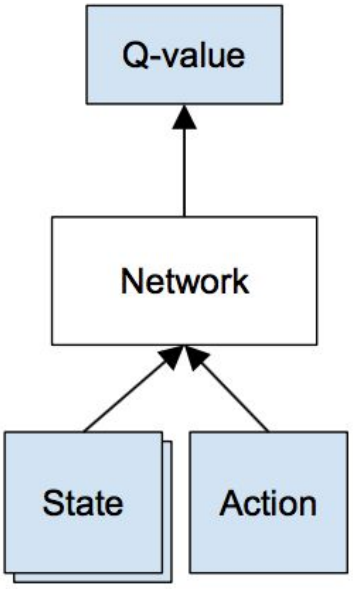
D5L2 REINFORCEMENT LEARNING by Xavier Giró

a) In Deep Q-learning, what is the output of the trained deep neural network ?
b) What is the motivation of predicting it ?
c) Draw a scheme of a DQN indicating the input and outputs

Solution:

a) The Q-value, Q(s,a), which corresponds to the expected return for the input pair of state-action if the optimal policy is followed .
b) Choosing the action with a maximum Q-value associated.
c)



D5L2 (homework) ALPHA GO DOCUMENTARY by Xavier Giró

Which city hosted the games between Lee Sedol and Alpha Go ?

Solution:

Seoul, South Korea.

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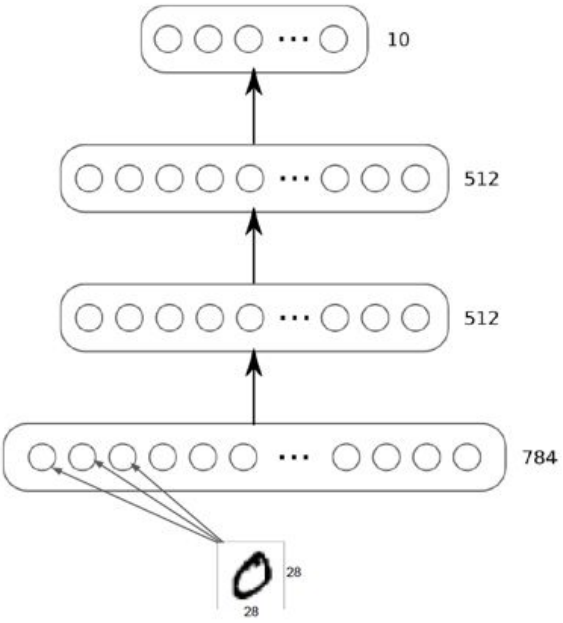
D2L1 MULTI-LAYER PERCEPTRON by Elisa Sayrol

Given the following multilayer perceptron used in the classical MNIST network:

How many parameters do you need to compute? (justify your answer, indicate the operation you have to carry out)

Why do you say that the layers of this network are fully connected? How many hidden layers are there?



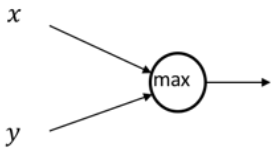
D2L2 BACKPROPAGATION by Elisa Sayrol

When applying Chain Rule when training and updating weights in a Neural Network, how do these gates backpropagate their values?

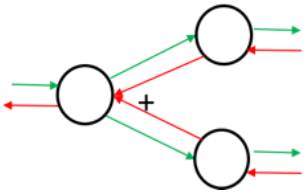
$\sigma(x) = \frac{1}{1+e^{-x}}$ *Sigmoid:*

$q = (x + y)$ *Sum:*

$f = qz$ *Product:*



Max:



Add branches

D3L2 OPTIMIZERS by Verónica Vilaplana

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1. What is early-stopping?
2. Compare and contrast (providing specific differences, advantages and disadvantages) the following optimization algorithms: Adagrad, RMSprop and Adam.

D4L1 CONVOLUTIONAL NEURAL NETWORKS by Verónica Vilaplana

Given the sizes ([width, height, depth]) of the first layers of a Convolutional Neural Network:

Input layer	[32, 32, 1]
Layer 1	[28, 28, 6]
Layer 2	[14, 14, 6]
Layer 3	[10, 10, 16]
Layer 4	[5, 5, 16]

1. For layers 1 to 4 specify if they are convolutional or pooling layers, the number and size of filters and amount of padding used for conv layers. Assume stride 1 for the conv layers and stride 2 for the pooling layers.
2. Compute the total number of parameters used.

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D3L1 LOSS FUNCTIONS by Javier Ruiz

Give two possible loss functions suitable to be used in a regression network. Enumerate a couple of advantages and disadvantages for both of them.

D5L1 TRANSFER LEARNING by Ramon Morros

Explain how unsupervised domain adaptation (i.e. no labels on the target domain) can be implemented using CNNs. (Explain concisely the idea, no math required in the answer)