

# Artificial Neural Networks and Deep Learning - 15/07/2020 Exam (270 Points)

During the whole exam you should have only one screen active connected to the Zoom meeting that you can access from the POLIMI portal. No external monitors or virtual screens are allowed.

You should only have a browser open and no other application besides a text editor open next to the browser to keep a safety copy of your answers. The browser should have only the exam tabs open. The exam is saved into the browser cookies so if you close it and reopen it nothing should happen, but we cannot guarantee.

Do not maximize the window of your browser.

You do not need to work on paper so keep your eyes on the browser and do not look around you. You cannot go out of sight. Your microphone should be on all the time.

You will have a fixed amount of time, after which the Form is automatically closed and there will be no possibility to submit your answers any more. You will be notified 15' in advance by the teacher not to miss the delivery time. Exams which are not submitted within the given time will be considered as RITIRATO.

In case you do not see the IMAGES try to reload the page.

## Section 1

### QUESTION 1: MACHINE LEARNING / DEEP LEARNING

Deep learning uses very complex models rich in parameters. Keeping this in mind answer the following.

1

Why Deep Learning?  
(10 Points)

Enter your answer

2

What is overfitting? What it is due to?  
(20 Points)

Enter your answer

3

How do you avoid overfitting when training deep neural networks?  
(30 Points)

Enter your answer

## QUESTION 2: NEURAL NETWORKS TRAINING

Training a neural networks can give you joys and pains! There are so many details you have to keep in mind when setting up a deep neural network! Discuss some of them providing the pain, i.e., a description of the problem and its origin, and the relief, i.e., a possible solution or mitigation strategy!

4

What is the pain behind weight initialization? What is the relief?  
(20 Points)

Enter your answer

5

What is the pain behind vanishing gradient? What is the relief?  
(20 Points)

Enter your answer

6

What is the pain behind text encoding? What is the relief?  
(20 Points)

Enter your answer

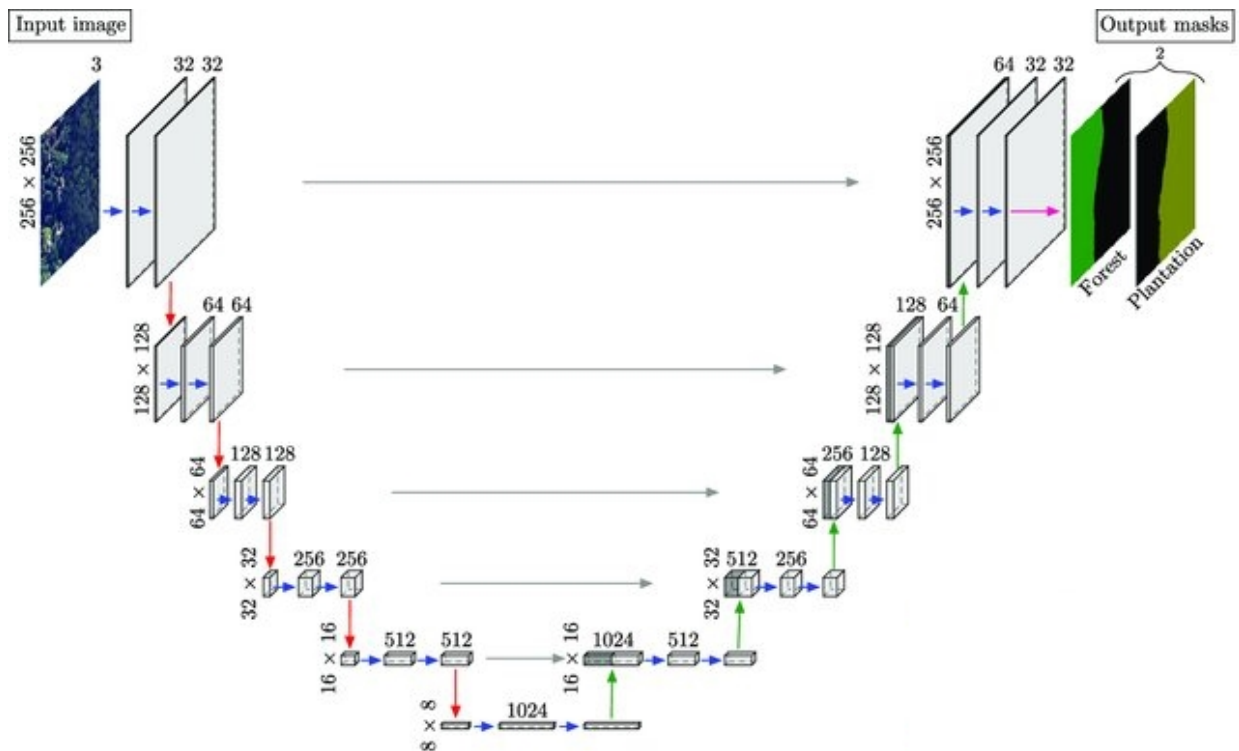
What is the pain behind the input of variable sized images in CNNs? What is the relief?  
(20 Points)

Enter your answer

### Section 3

#### QUESTION 3: CONVOLUTIONAL NEURAL NETWORKS

With reference to the deep neural network in the image below, answer the following questions.



8

Enumerate the building blocks of this networks as if you were going to implement it, and for each block report the overall number of parameters, together with a short description on how you compute them, e.g.,  $3 \times 5 \times 5 = 45$  (not just 45!).

Consider that blue arrows refer to convolutions having a spatial extent  $3 \times 3$ , while the magenta one does not perform spatial averages

You can use the calculator, but we are more interested in the formulas than on numbers! (Note: for some of the blocks you might need to infer the number of channels or the size from the preceding/following blocks)  
(40 Points)

Enter your answer

9

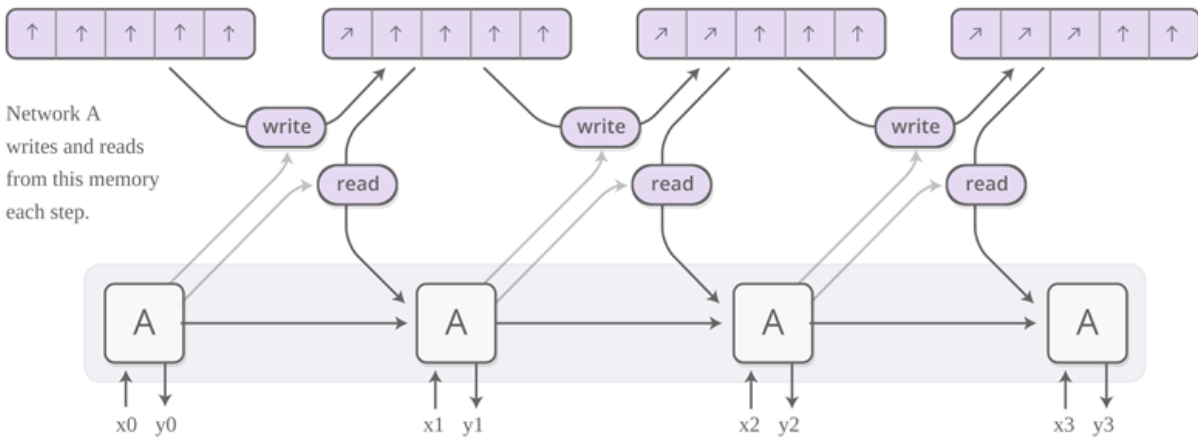
What is the task this network is expected to solve? What is the rationale behind this architecture and which loss function would you would use to train the network? Justify all your statements.  
(30 Points)

Enter your answer

## QUESTION 5

The model in the picture describes the functioning of a Neural Turing Machine from a high level perspective. With reference to this model answer the following.

Memory is an array of vectors.



10

How does a Neural Turing Machine work?  
(10 Points)

Enter your answer

11

How does the WRITE mechanism works in a Neural Turing Machine?  
(10 Points)

Enter your answer

12

How does the READ mechanism work in a Neural Turing Machine?  
(10 Points)

Enter your answer

13

How is attention used in Neural Turing Machines?  
(10 Points)

Enter your answer

14

What is sequence to sequence modeling? How does the attention mechanism is used in sequence to sequence modeling?  
(20 Points)