ML in Fundamental Physics

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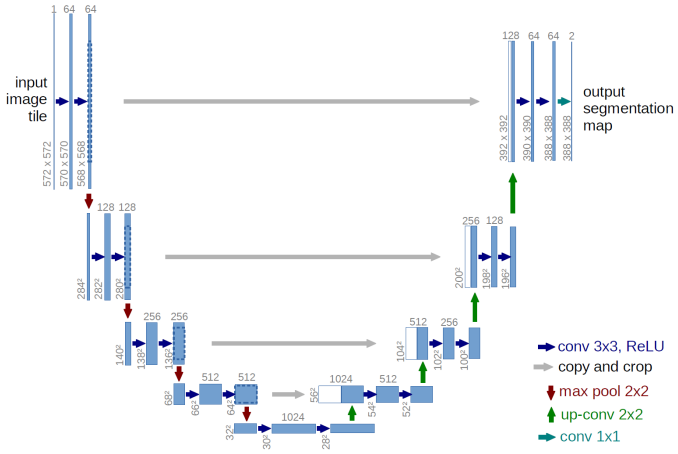
Exercise Sheet 6

Submission by Friday 19th 17:00 via Moodle.
Corrections due by Tuesday 23rd 16:00 via Moodle.
Format for all questions: individual Jupyter notebooks .ipynb.

1 U-Net (2 points)

Re-implementing networks which are discussed in the literature is a vital skill. Here you re-build the architecture from arXiv:1505.04597. A figure of the network is shown in Figure 1 of this paper.

You can check your results again via `model.compile()` and `model.summary()`.



2 AlexNet (2 points)

Again, the aim of this exercise is to build a network. In this exercise you should implement the network which is discussed in: ImageNet Classification with Deep Convolutional Neural Networks (Krizhevsky, Sutskever, Hinton). The network architecture is summarised in Figure 2 of that paper and more detailed descriptions are found in the text.

You only need to implement the architecture and check that your network is consistent. Note, that you can check your results by a) checking your model is compiling in Keras and b) by comparing your `model.summary()` with the desired dimensions.

3 PCA (3 points)

In the lecture we have discussed how to obtain the first principal component d as the eigenvector corresponding to the largest eigenvalue of $X^T X$. Show, using induction, that in general the matrix D is given by the l eigenvectors corresponding to the largest eigenvalues. (2 points)

Generate a numerical example to compare your data transformation with the transformation given by the implementation of PCA in sklearn. For instance, you can use an example based on a 2D-Gaussian as presented in the lectures. (1 point)