## HU Extension Assignment 02 E89 Deep Learning

### Handed out: 09/09/2022 Due by 11:59 AM (noon) EST on Saturday, 09/17/2022

**Problem 1.** Create a computational graph for the following expression:

Calculate the forward values of all the nodes and function starting with. In the process of calculating every node and every intermediate value, record all partial derivatives of every intermediate value with respect to its inputs. Finally, determine the derivatives of with respect to x, y, and z. Please, present your results as a simple graph. You can draw your graph by any means you find convenient, including by hand. Please place forward values above the lines representing propagation of values and backpropagation values (derivatives) below the lines. List clearly the final values of partial derivatives of function with respect to x, y, and z. Do all calculation with pan and paper.

(25%)

**Problem 2**. Find partial derivatives of function as defined in the first problem, with respect to x, y and z by using . Compare those values with the ones obtained in Problem 1.

(25%)

**Problem 3.** Create a computational graph for the following expression:

+ y2

Where =

Calculate forward computational values of all nodes and the partial derivatives of function with respect to . Please, present your results as a simple graph. Please place forward values above the lines representing propagation of values and backpropagation values (derivatives) below the lines. Demonstrate that you are getting the same values using tf.GradientTape().

As values for use (2, -1). Draw your graph in any manner you find convenient including pan and paper. Include such graph in your submission as scan or phone photograph or in any other way you find convenient.

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**Problem 4**. Please create a synthetic set of 200 data points. Let the independent variable x has a range [0, 10]. Create dependent variable y by starting with a straight line Subsequently, add normal Gaussian noise of standard deviation equal to 0.2. Let us “solve” the regression problem. We want to find a straight line which has the minimal mean square error from the points in the data set. Formulate the problem as a training loop which adjusts its parameters by the gradient descend method and finds parameters of the best straight line. Please rely on tf.GradientTape() for calculations of your gradients. Please plot your synthetic data points and the discover best fit line on the same plot.

(25%)

When submitting Jupyter ipynb file, please submit an HTML image of that file as well. Make sure that your Jupyter notebook contains description of all the steps you have taken. Please, present all intermediate and the final results. Please note we prefer to receive a single Jupyter notebook.

If your notebook(s) contain(s) excessively long outputs please copy a meaningful and illustrative number of initial and/or final lines and paste those in a markdown (comment) cell. Then, delete the long output(s).