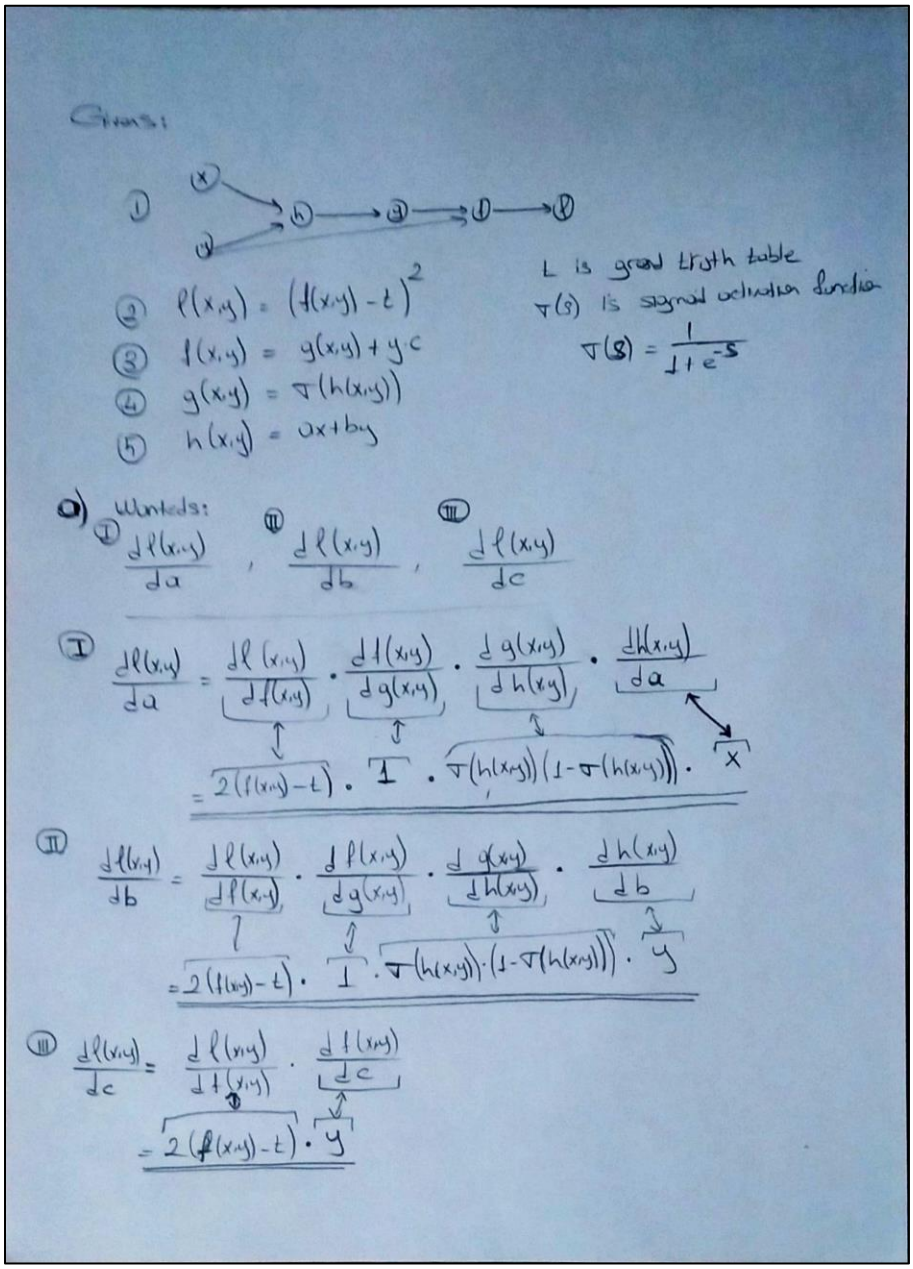
M. Yusa Erguven - 19260

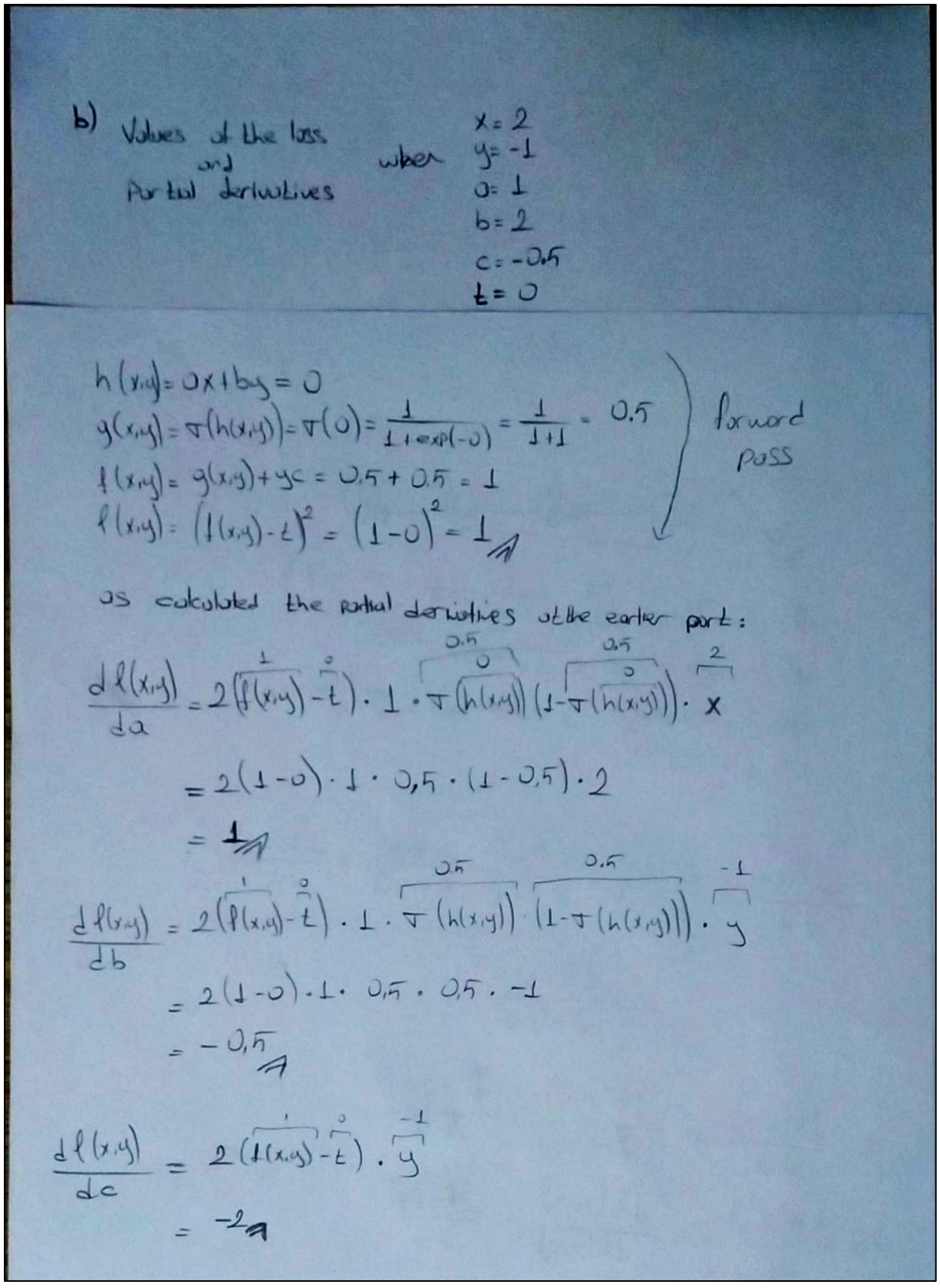
Machine Learning HW3

Question 1 – Neural Networks

I made my calculations on paper, so that I am putting the scanned versions.



For the b part:



b) Values of the loss and Partial derivatives when $x=2$, $y=-1$, $a=1$, $b=2$, $c=-0.5$, $t=0$

$h(x,y) = ax + by = 0$

$g(x,y) = \sigma(h(x,y)) = \sigma(0) = \frac{1}{1+\exp(-0)} = \frac{1}{1+1} = 0.5$

$f(x,y) = g(x,y) + yc = 0.5 + 0.5 = 1$

$l(x,y) = (f(x,y) - t)^2 = (1-0)^2 = 1$

Forward pass

As calculated the partial derivatives at the earlier part:

$$\frac{dl(x,y)}{da} = 2\underbrace{(f(x,y)}_{1} - \underbrace{t}_{0}) \cdot 1 \cdot \underbrace{\sigma(h(x,y))}_{0.5} \underbrace{(1-\sigma(h(x,y)))}_{0.5} \cdot \underbrace{x}_{2}$$

$$= 2(1-0) \cdot 1 \cdot 0{,}5 \cdot (1-0{,}5) \cdot 2$$

$$= 1$$

$$\frac{dl(x,y)}{db} = 2\underbrace{(f(x,y)}_{1} - \underbrace{t}_{0}) \cdot 1 \cdot \underbrace{\sigma(h(x,y))}_{0.5} \underbrace{(1-\sigma(h(x,y)))}_{0.5} \cdot \underbrace{y}_{-1}$$

$$= 2(1-0) \cdot 1 \cdot 0{,}5 \cdot 0{,}5 \cdot -1$$

$$= -0{,}5$$

$$\frac{dl(x,y)}{dc} = 2\underbrace{(f(x,y)}_{1} - \underbrace{t}_{0}) \cdot \underbrace{y}_{-1}$$

$$= -2$$

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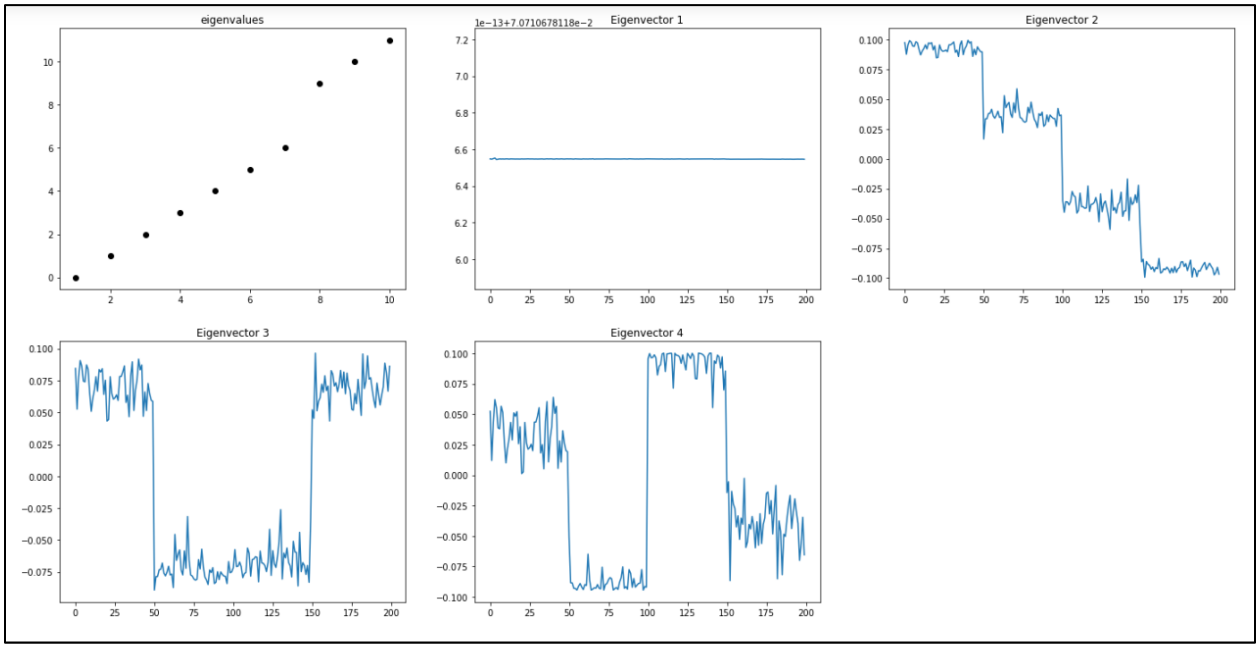
Question 2 - Spectral Clustering

I attach the code I wrote as python notebook with the name **HW3.ipynb**.

For the b part I generated the following graphs:



The code of the graphs is also in the python notebook.