hw3_sol Haoyuan Du

1 & 2.

1. ① For V_h

$$\frac{\partial E}{\partial V_h} = \sum \frac{\partial E}{\partial y^t} \frac{\partial y^t}{\partial V_h^t}$$

$$= \sum_t -(r^t - y^t) \cdot z_h^t$$

$$\therefore \Delta V_h = \eta \sum_t (r^t - y^t) \cdot z_h^t$$

② For W_{hj}

$$\frac{\partial E}{\partial W_{hj}} = \sum_t \frac{\partial E}{\partial y^t} \frac{\partial y^t}{\partial z_h^t} \frac{\partial z_h^t}{\partial W_{hj}}$$ assume $w_h^T x^t + w_{h0} > 0$

$$= \sum_t -(r^t - y^t) \cdot V_h \cdot 1 \cdot x^t + 2W_{hj}$$

$$\Delta W_{hj} = -\eta \frac{\partial E}{\partial W_{hj}}$$

$$= \eta \left(\sum_t (r^t - y^t) \cdot V_h \cdot x^t - 2W_{hj} \right)$$

if $w_h^T x^t + w_{h0} < 0$, $\Delta W_{hj} = 0$

2. a. Figure 2 : $w = [1, 1, 0]^T$

Figure 3: $w = [-1, -1, -1]^T$, since shaded area is 1, for every w_i, positive becomes negative and vice versa.

b. $w = \begin{bmatrix} 1, 1, 0 \\ -1, -1, -1 \end{bmatrix}^T$ $V = [-1, 1, 1]^T$

~~$z_1 = s(\cdot x_1 + x_2 + 0)$~~

$z_1 = s(1 + x_1)$

$z_2 = s(-1 * - x_1 - x_2)$

AND: $y = s(z_1 + z_2 - 1)$

3.

a.

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Validation accuracy for 4 hidden units is 0.851
Validation accuracy for 8 hidden units is 0.909
Validation accuracy for 16 hidden units is 0.914
Validation accuracy for 20 hidden units is 0.919
Validation accuracy for 24 hidden units is 0.911
Test accuracy with 20 hidden units is 0.908
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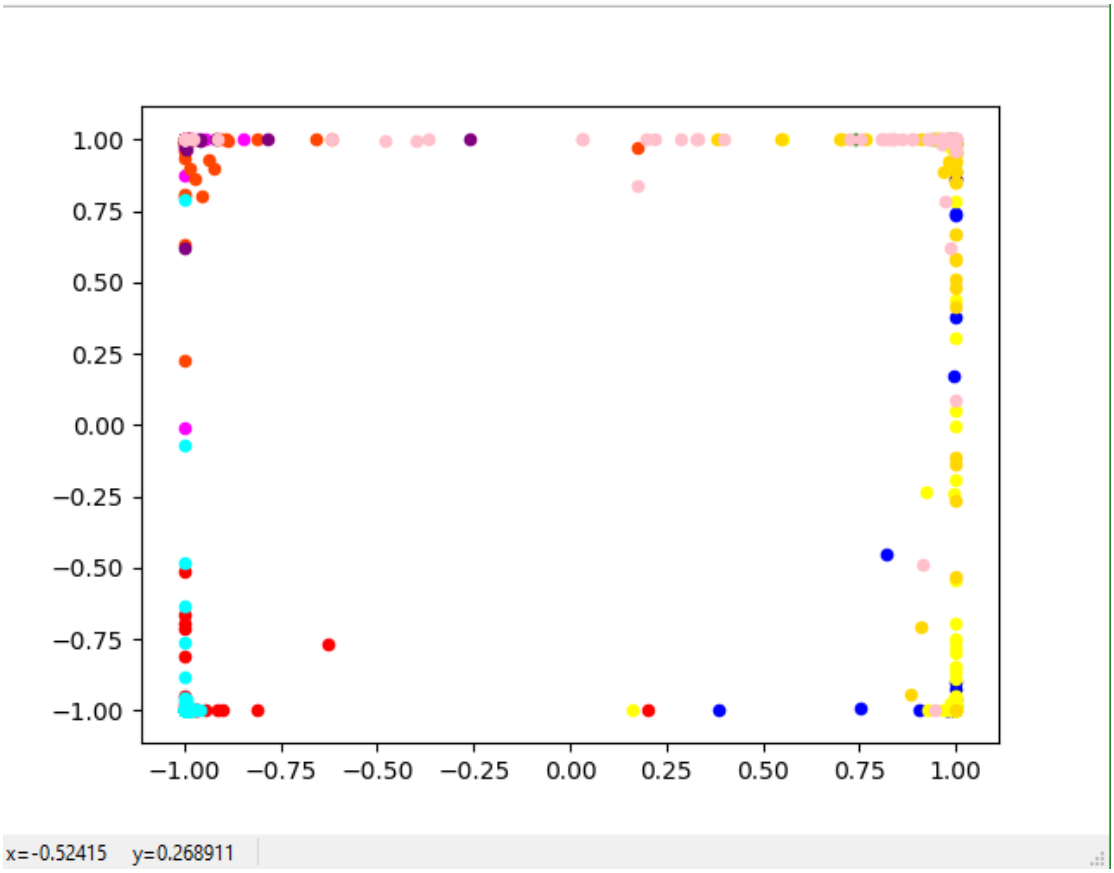
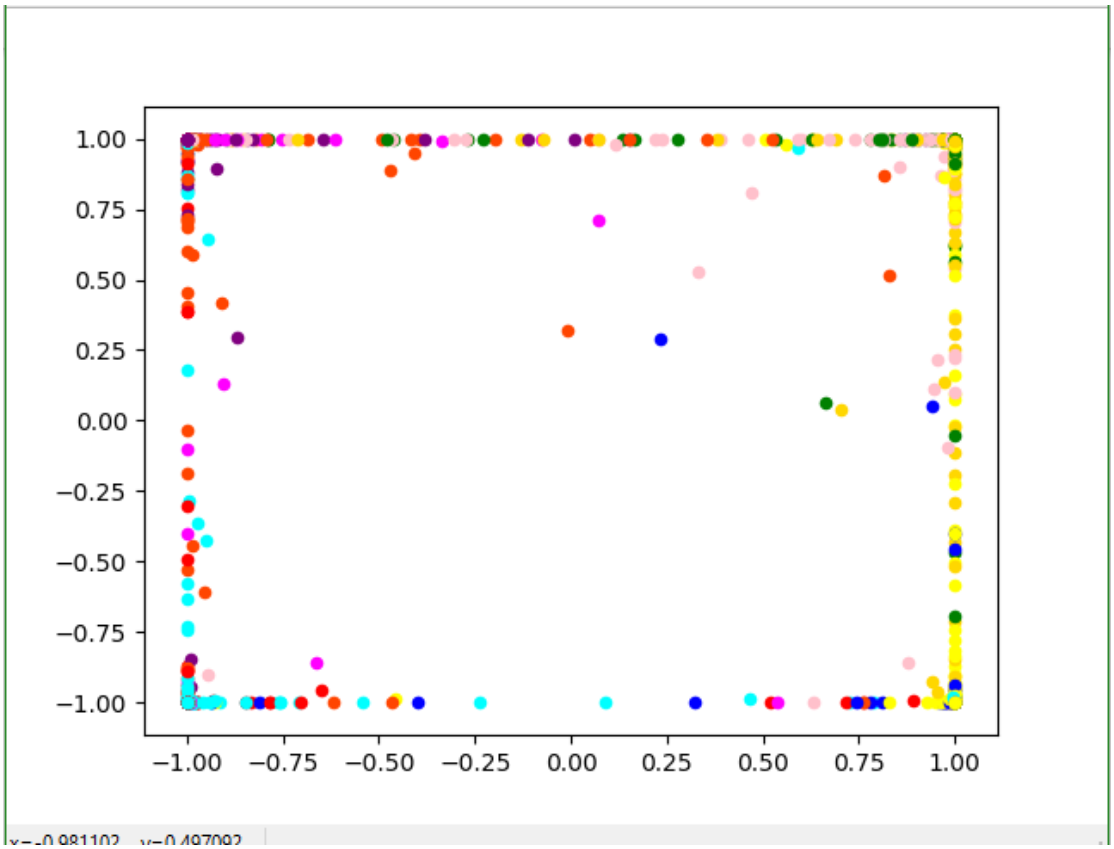
b.

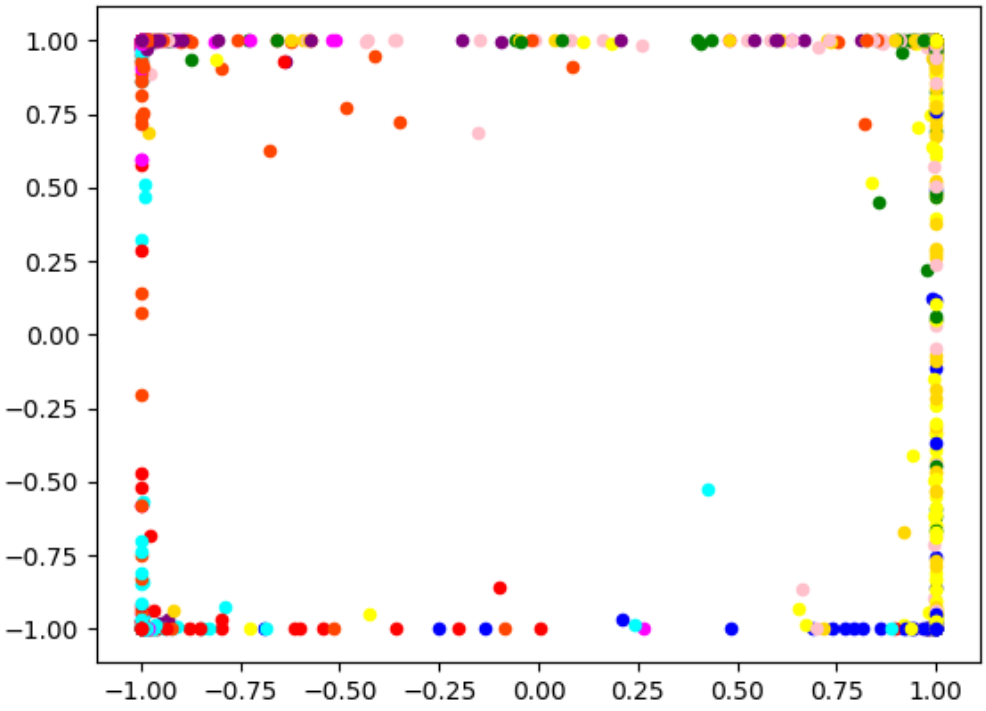
train:



valid:

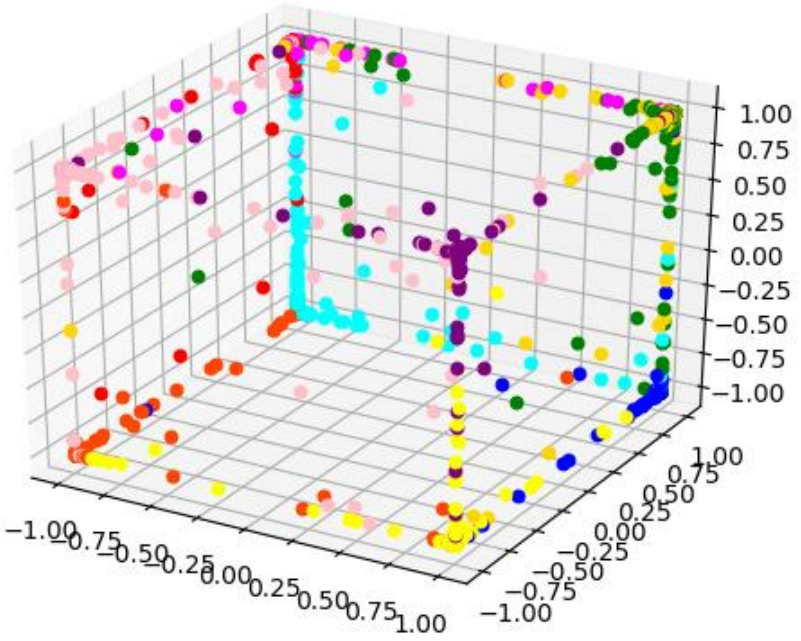

1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
−1.00 −0.75 −0.50 −0.25 0.00 0.25 0.50 0.75 1.00

test:

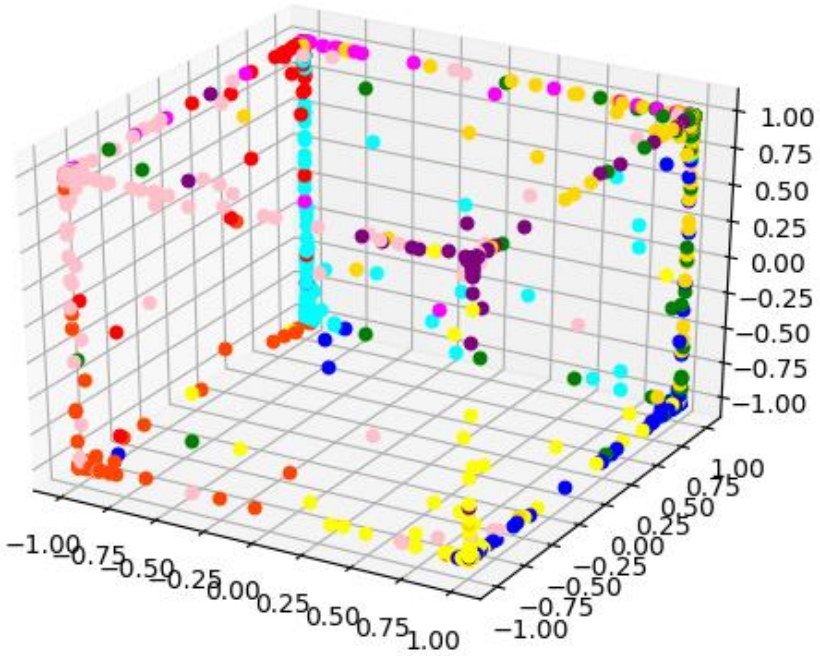

1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
−1.00 −0.75 −0.50 −0.25 0.00 0.25 0.50 0.75 1.00

c.

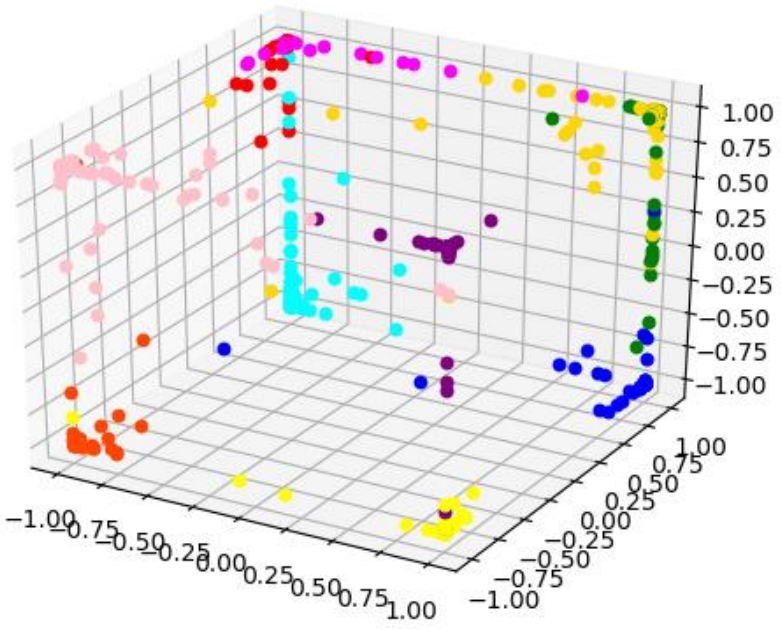
train:


1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
−1.00 −0.75 −0.50 −0.25 0.00 0.25 0.50 0.75 1.00
1.00 0.75 0.50 0.25 0.00 −0.25 −0.50 −0.75 −1.00

valid:


1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
−1.00 −0.75 −0.50 −0.25 0.00 0.25 0.50 0.75 1.00
1.00 0.75 0.50 0.25 0.00 −0.25 −0.50 −0.75 −1.00

test:



According to the 2D and 3D plots, the data points in 2D figure have a very high density at the corners so that it's difficult to distinguish the points by colors. On the contrary, 3D plots are clearer that each corner of the cube has a dominant color of points (Ex. -1,-1,-1 is red, etc.). We can also see some noises from the figures when we trained the model.