

# Homework 3 – Deep Learning (CS/DS541, Whitehill, Fall 2024)

## Devesh Bhangale, Ashwin Disa

b) Gradient check discrepancy: 0.000002

C) Epoch 1/100 - Test loss: 0.6082, Accuracy: 0.7899

Epoch 2/100 - Test loss: 0.5258, Accuracy: 0.8179

Epoch 3/100 - Test loss: 0.4929, Accuracy: 0.8262

Epoch 4/100 - Test loss: 0.4714, Accuracy: 0.8333

Epoch 5/100 - Test loss: 0.4561, Accuracy: 0.8390

Epoch 6/100 - Test loss: 0.4437, Accuracy: 0.8430

Epoch 7/100 - Test loss: 0.4341, Accuracy: 0.8456

Epoch 8/100 - Test loss: 0.4260, Accuracy: 0.8484

Epoch 9/100 - Test loss: 0.4195, Accuracy: 0.8504

Epoch 10/100 - Test loss: 0.4129, Accuracy: 0.8530

Epoch 11/100 - Test loss: 0.4068, Accuracy: 0.8549

Epoch 12/100 - Test loss: 0.4018, Accuracy: 0.8569

Epoch 13/100 - Test loss: 0.3972, Accuracy: 0.8584

Epoch 14/100 - Test loss: 0.3937, Accuracy: 0.8601

Epoch 15/100 - Test loss: 0.3900, Accuracy: 0.8612

Epoch 16/100 - Test loss: 0.3871, Accuracy: 0.8619

Epoch 17/100 - Test loss: 0.3844, Accuracy: 0.8623

Epoch 18/100 - Test loss: 0.3820, Accuracy: 0.8637

Epoch 19/100 - Test loss: 0.3797, Accuracy: 0.8647

Epoch 20/100 - Test loss: 0.3775, Accuracy: 0.8657

Epoch 21/100 - Test loss: 0.3762, Accuracy: 0.8667

Epoch 22/100 - Test loss: 0.3737, Accuracy: 0.8681

Epoch 23/100 - Test loss: 0.3712, Accuracy: 0.8682

Epoch 24/100 - Test loss: 0.3694, Accuracy: 0.8690

Epoch 25/100 - Test loss: 0.3677, Accuracy: 0.8701

Epoch 26/100 - Test loss: 0.3659, Accuracy: 0.8706

Epoch 27/100 - Test loss: 0.3647, Accuracy: 0.8705

Epoch 28/100 - Test loss: 0.3635, Accuracy: 0.8708

Epoch 29/100 - Test loss: 0.3619, Accuracy: 0.8724

Epoch 30/100 - Test loss: 0.3605, Accuracy: 0.8729

Epoch 31/100 - Test loss: 0.3591, Accuracy: 0.8729

Epoch 32/100 - Test loss: 0.3580, Accuracy: 0.8733

Epoch 33/100 - Test loss: 0.3570, Accuracy: 0.8738

Epoch 34/100 - Test loss: 0.3554, Accuracy: 0.8748

Epoch 35/100 - Test loss: 0.3550, Accuracy: 0.8753

Epoch 36/100 - Test loss: 0.3544, Accuracy: 0.8753

Epoch 37/100 - Test loss: 0.3537, Accuracy: 0.8768

Epoch 38/100 - Test loss: 0.3527, Accuracy: 0.8768

Epoch 39/100 - Test loss: 0.3518, Accuracy: 0.8777

Epoch 40/100 - Test loss: 0.3510, Accuracy: 0.8780

Epoch 41/100 - Test loss: 0.3503, Accuracy: 0.8788

Epoch 42/100 - Test loss: 0.3497, Accuracy: 0.8789

Epoch 43/100 - Test loss: 0.3490, Accuracy: 0.8793

Epoch 44/100 - Test loss: 0.3484, Accuracy: 0.8800

Epoch 45/100 - Test loss: 0.3484, Accuracy: 0.8798

Epoch 46/100 - Test loss: 0.3474, Accuracy: 0.8799

Epoch 47/100 - Test loss: 0.3472, Accuracy: 0.8800

Epoch 48/100 - Test loss: 0.3466, Accuracy: 0.8813

Epoch 49/100 - Test loss: 0.3459, Accuracy: 0.8816

Epoch 50/100 - Test loss: 0.3454, Accuracy: 0.8820

Epoch 51/100 - Test loss: 0.3448, Accuracy: 0.8823

Epoch 52/100 - Test loss: 0.3447, Accuracy: 0.8821

Epoch 53/100 - Test loss: 0.3451, Accuracy: 0.8831

Epoch 54/100 - Test loss: 0.3451, Accuracy: 0.8829  
Epoch 55/100 - Test loss: 0.3447, Accuracy: 0.8836  
Epoch 56/100 - Test loss: 0.3446, Accuracy: 0.8836  
Epoch 57/100 - Test loss: 0.3440, Accuracy: 0.8842  
Epoch 58/100 - Test loss: 0.3441, Accuracy: 0.8833  
Epoch 59/100 - Test loss: 0.3438, Accuracy: 0.8827  
Epoch 60/100 - Test loss: 0.3436, Accuracy: 0.8832  
Epoch 61/100 - Test loss: 0.3438, Accuracy: 0.8830  
Epoch 62/100 - Test loss: 0.3442, Accuracy: 0.8822  
Epoch 63/100 - Test loss: 0.3440, Accuracy: 0.8826  
Epoch 64/100 - Test loss: 0.3445, Accuracy: 0.8831  
Epoch 65/100 - Test loss: 0.3447, Accuracy: 0.8829  
Epoch 66/100 - Test loss: 0.3443, Accuracy: 0.8839  
Epoch 67/100 - Test loss: 0.3443, Accuracy: 0.8832  
Epoch 68/100 - Test loss: 0.3449, Accuracy: 0.8827  
Epoch 69/100 - Test loss: 0.3449, Accuracy: 0.8832  
Epoch 70/100 - Test loss: 0.3453, Accuracy: 0.8824  
Epoch 71/100 - Test loss: 0.3455, Accuracy: 0.8825  
Epoch 72/100 - Test loss: 0.3463, Accuracy: 0.8832  
Epoch 73/100 - Test loss: 0.3462, Accuracy: 0.8841  
Epoch 74/100 - Test loss: 0.3463, Accuracy: 0.8840  
Epoch 75/100 - Test loss: 0.3466, Accuracy: 0.8837  
Epoch 76/100 - Test loss: 0.3470, Accuracy: 0.8826  
Epoch 77/100 - Test loss: 0.3470, Accuracy: 0.8835  
Epoch 78/100 - Test loss: 0.3473, Accuracy: 0.8834  
Epoch 79/100 - Test loss: 0.3477, Accuracy: 0.8832  
Epoch 80/100 - Test loss: 0.3479, Accuracy: 0.8826  
Epoch 81/100 - Test loss: 0.3484, Accuracy: 0.8824  
Epoch 82/100 - Test loss: 0.3485, Accuracy: 0.8834  
Epoch 83/100 - Test loss: 0.3488, Accuracy: 0.8825  
Epoch 84/100 - Test loss: 0.3491, Accuracy: 0.8829  
Epoch 85/100 - Test loss: 0.3496, Accuracy: 0.8829  
Epoch 86/100 - Test loss: 0.3500, Accuracy: 0.8828  
Epoch 87/100 - Test loss: 0.3504, Accuracy: 0.8838  
Epoch 88/100 - Test loss: 0.3513, Accuracy: 0.8834  
Epoch 89/100 - Test loss: 0.3514, Accuracy: 0.8837  
Epoch 90/100 - Test loss: 0.3523, Accuracy: 0.8834  
Epoch 91/100 - Test loss: 0.3520, Accuracy: 0.8836  
Epoch 92/100 - Test loss: 0.3528, Accuracy: 0.8839  
Epoch 93/100 - Test loss: 0.3532, Accuracy: 0.8838  
Epoch 94/100 - Test loss: 0.3546, Accuracy: 0.8831  
Epoch 95/100 - Test loss: 0.3541, Accuracy: 0.8838  
Epoch 96/100 - Test loss: 0.3549, Accuracy: 0.8841  
Epoch 97/100 - Test loss: 0.3557, Accuracy: 0.8829  
Epoch 98/100 - Test loss: 0.3555, Accuracy: 0.8840  
Epoch 99/100 - Test loss: 0.3560, Accuracy: 0.8833  
Epoch 100/100 - Test loss: 0.3565, Accuracy: 0.8846

d) Visualization of the first layer of weights  $W(1)$

