Exercise2

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(a)

The pre-activation of the hidden unit is

$$z_1 = w_1 x + b_1 = (-2)(1) + 2 = 0.$$

Applying the logistic function,

$$h = \sigma(z_1) = \sigma(0) = \frac{1}{2}.$$

The output unit is linear, hence

$$y = w_2 h + b_2 = 4 \cdot 0.5 + 0 = 2.$$

(b) Loss for this training case

$$E = \frac{1}{2}(t - y)^2 = \frac{1}{2}(1 - 2)^2 = 0.5.$$

(c) Derivative of the loss with respect to w_2

Using the chain rule,

$$\frac{\partial E}{\partial w_2} = \frac{\partial E}{\partial y} \cdot \frac{\partial y}{\partial w_2}.$$

We compute

$$\frac{\partial E}{\partial y} = y - t = 2 - 1 = 1, \quad \frac{\partial y}{\partial w_2} = h = 0.5.$$

Thus,

$$\frac{\partial E}{\partial w_2} = 1 \cdot 0.5 = 0.5.$$

(d) Derivative of the loss with respect to w_1

Applying the chain rule through the hidden unit,

$$\frac{\partial E}{\partial w_1} = \frac{\partial E}{\partial y} \cdot \frac{\partial y}{\partial h} \cdot \frac{\partial h}{\partial z_1} \cdot \frac{\partial z_1}{\partial w_1}.$$

The individual terms are

$$\frac{\partial E}{\partial y} = 1, \quad \frac{\partial y}{\partial h} = w_2 = 4,$$

$$\frac{\partial h}{\partial z_1} = h(1-h) = 0.5(1-0.5) = 0.25, \quad \frac{\partial z_1}{\partial w_1} = x = 1.$$

Therefore,

$$\frac{\partial E}{\partial w_1} = 1 \cdot 4 \cdot 0.25 \cdot 1 = 1.$$

Task 3

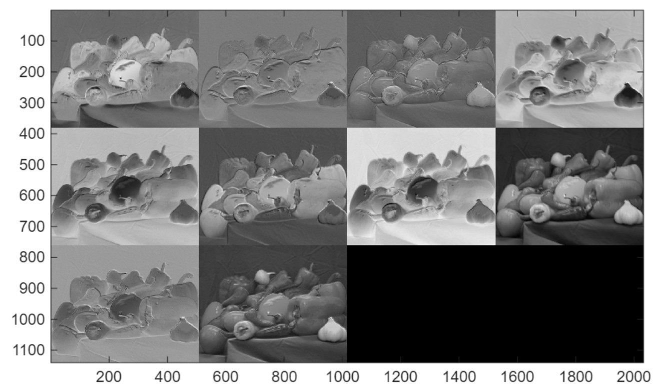
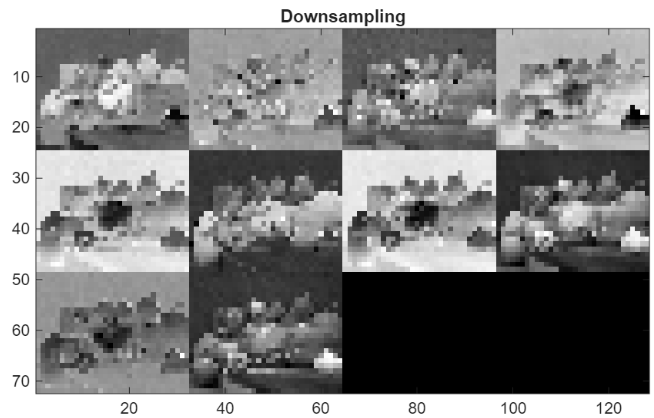
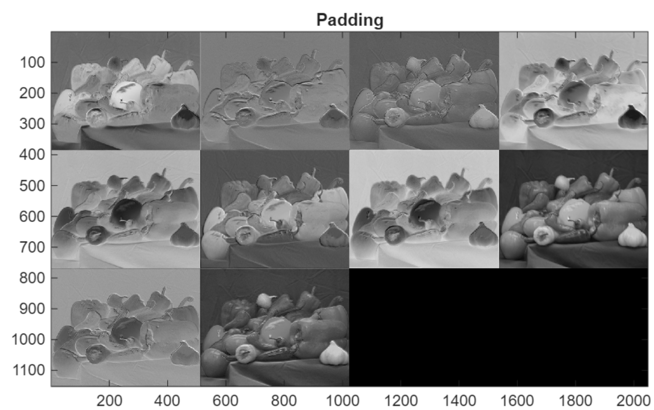
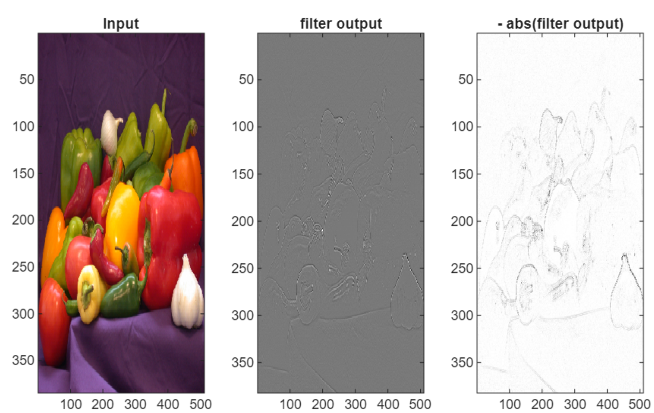
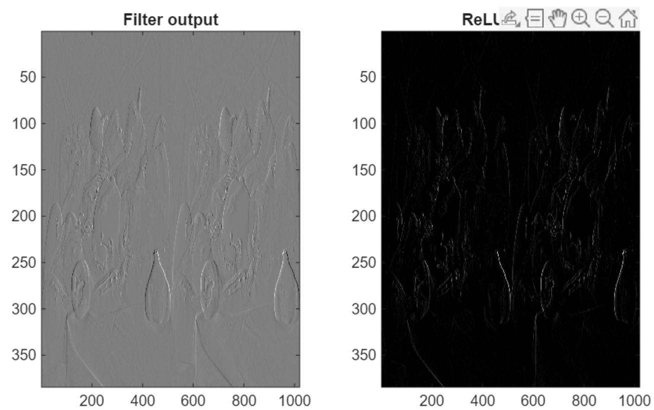


Figure 1: Random filter


Downsampling
10
20
30
40
50
60
70
20
40
60
80
100
120


Padding
100
200
300
400
500
600
700
800
900
1000
1100
200
400
600
800
1000
1200
1400
1600
1800
2000


Input
filter output
- abs(filter output)
50
100
150
200
250
300
350
100 200 300 400 500



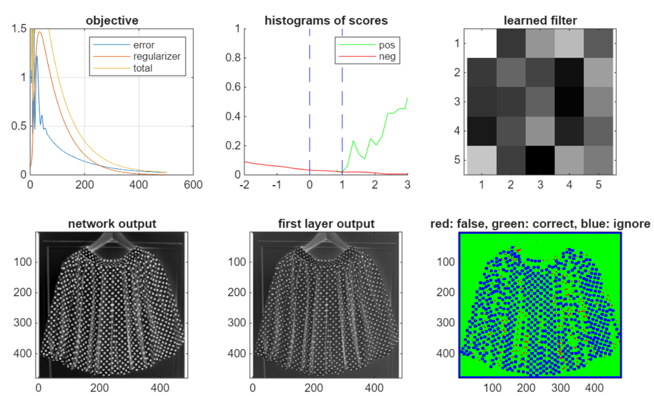


Figure 2: with pre-processing