Chapter 3

Optimization

3.1 Optimization Problems

Problem 3.1

$$\begin{aligned} f(x,y) &= (1-y)^2 + 100 * (x-y^2)^2 \\ (x_0,y_0) &= [-0.5,-1.5]; \\ Interval &\quad -2:0.01:2; y = -2:0.01:2; \\ \alpha_g &= 0.001; \quad \alpha_n = 0.5; \end{aligned} \tag{3.1}$$

Problem 3.2

$$\begin{aligned} f(x,y) &= x^2 + x * y + 3 * y^2 \\ (x_0,y_0) &= [-0.5,-1.5]; \\ Interval &\quad x = -3:0.1:3; y = -3:0.1:3; \\ \alpha_g &= 0.1; \quad \alpha_n = 0.5; \end{aligned} \tag{3.2}$$

Problem 3.3

$$\begin{aligned} f(x,y) &= sin(0.5 * x^2 - 0.25 * y^2 + 3) * cos(2 * x + 1 – exp(y)); \\ (x_0,y_0) &= [-0.2,0.2]; \\ Interval &\quad x = -2:0.01:2; y = -2:0.01:2; \\ \alpha_g &= 0.1; \quad \alpha_n = 0.5; \end{aligned} \tag{3.3}$$

Problem 3.4

$$\begin{aligned} f(x,y) &= x^2 - x + sin(y); \\ (x_0,y_0) &= [3,-1]; \\ Interval &\quad x = -5:0.1:5; y = -5:0.1:5; \\ \alpha_g &= 0.1; \quad \alpha_n = 0.5; \end{aligned} \tag{3.4}$$

Problem 3.5

$$\begin{aligned} f(x,y) &= x * e^{(-x^2/0.25 - y^2/0.25)}; \\ (x_0,y_0) &= [-0.2,0.1]; \\ Interval &\quad x = -1:0.01:1; y = -1:0.01:1; \\ \alpha_g &= 0.1; \quad \alpha_n = 0.5; \end{aligned} \tag{3.5}$$

Problem 3.6

$$\begin{aligned} f(x,y) &= (x-y)^4 + 2*x^2 + y^2 - x + 2*y; \\ (x_0,y_0) &= [1,1]; \\ Interval &\quad x = -1:0.01:1; y = -1:0.01:1; \\ \alpha_g &= 0.1; \quad \alpha_n = 0.5; \end{aligned} \tag{3.6}$$

Problem 3.7

$$\begin{aligned} f(x,y) &= -ln(1-x-y) - ln(x) - ln(y); \\ (x_0,y_0) &= [0.1,0.1]; \\ Interval &\quad x = 0.01:0.001:0.5; y = 0.01:0.001:0.5; \\ \alpha_g &= 0.01; \quad \alpha_n = 0.5; \end{aligned} \tag{3.7}$$

Problem 3.8

$$\begin{aligned} f(x,y) &= x*y*e^{(16*x^2+9*y^2)/288} \\ (x_0,y_0) &= [2,2]; \\ Interval &\quad x = -3:0.1:3; y = -3:0.1:3; \\ \alpha_g &= 0.01; \quad \alpha_n = 0.5; \end{aligned} \tag{3.8}$$

Problem 3.9

$$\begin{aligned} f(x,y) &= e^{(x^2+y^2-6y)}; \\ (x_0,y_0) &= [1.25,4.5]; \\ Interval &\quad x = -1.5:0.1:1.5; y = 1:0.1:5; \\ \alpha_g &= 0.5; \quad \alpha_n = 0.5; \end{aligned} \tag{3.9}$$

Problem 3.10

$$\begin{aligned} f(x,y) &= -x*ln(y^2/x) - 3*x + x*y^2; \\ (x_0,y_0) &= [2.5,1.25]; \\ Interval &\quad x = 1.5:0.1:4; y = -1:0.1:5; \\ \alpha_g &= 0.1; \quad \alpha_n = 0.5; \end{aligned} \tag{3.10}$$

Problem 3.11

$$\begin{aligned} f(x,y) &= \frac{x}{(x^2+y^2+4)} \\ (x_0,y_0) &= [-1.0,-0.5]; \\ Interval &\quad x = -3:0.1:3; y = -3:0.1:3; \\ \alpha_g &= 0.5; \quad \alpha_n = 0.5; \end{aligned} \tag{3.11}$$

Problem 3.12

$$\begin{aligned} f(x,y) &= \frac{-(2xy)}{(x^2+y^2+4)^2} \\ (x_0,y_0) &= [0.5,0.75]; \\ Interval &\quad x = -2:0.1:2; y = -2:0.1:2; \\ \alpha_g &= 0.5; \quad \alpha_n = 0.5; \end{aligned} \tag{3.12}$$

Problem 3.13

$$\begin{aligned} f(x,y) &= \frac{-1}{(x^2+y^2+3x-2y+1)} \\ (x_0,y_0) &= [-1.8, 1.6]; \\ Interval \quad & x = -2 : 0.01 : -1.0; y = 0.0 : 0.01 : 2.0; \\ \alpha_g &= 0.5; \quad \alpha_n = 0.5; \end{aligned} \tag{3.13}$$

Problem 3.14

$$\begin{aligned} f(x,y) &= \frac{1}{(\sqrt{x}+\sqrt{y}-x-y)} \\ (x_0,y_0) &= [0.6, 0.6]; \\ Interval \quad & x = -0.0 : 0.01 : 1; y = -0.0 : 0.01 : 1; \\ \alpha_g &= 0.15; \quad \alpha_n = 0.5; \end{aligned} \tag{3.14}$$

Problem 3.15

$$\begin{aligned} f(x,y) &= x * exp(-(x^2+y^2)) \\ (x_0,y_0) &= [-1.0, 0.45]; \\ Interval \quad & x = -2.0 : 0.1 : 2.0; y = -2.0 : 0.1 : 2.0; \\ \alpha_g &= 0.5; \quad \alpha_n = 0.5; \end{aligned} \tag{3.15}$$

Problem 3.16

$$\begin{aligned} f(x,y) &= 3(1-x)^2 e^{-x^2-(y+1)^2} - 10(\frac{x}{5} - x^3 - y^5)e^{-x^2-y^2} - \frac{1}{3}e^{-y^2-(x+1)^2} \\ (x_0,y_0) &= [0.75, -1.25]; \\ Interval \quad & x = -2.5 : 0.1 : 2.5; y = -3.0 : 0.1 : 3.0; \\ \alpha_g &= 0.015; \quad \alpha_n = 0.1; \end{aligned} \tag{3.16}$$

3.2 Matlab

$$S_e = \sum_{i=1}^{n} (y - y_o)^2$$

$$S_e = \sum_{i=1}^{n} \left(y - \sum_{j=0}^{m} a_j x^j \right)^2$$

3.3 Example

A neural network with two inputs, two hidden neurons, two output neurons. Additionally, the hidden and output neurons will include a bias. The input and target values for this network are $i_1 = 0.05$, $i_2 = 0.10$, $t_1 = 0.01$ and $t_2 = 0.99$ respectively:

3.3.1 Forward Pass

First Layer

$$\begin{aligned} net_{h_1} &= \omega_1 \cdot i_1 + \omega_2 \cdot i_2 + b_1 \cdot 1 \\ net_{h_1} &= 0.15 \cdot 0.05 + 0.2 \cdot 0.1 + 0.35 \cdot 1 = 0. \\ h_1 &= \frac{1}{1+e^{-net_{h_1}}} = \frac{1}{1+e^{-0.}} = 0. \end{aligned}$$