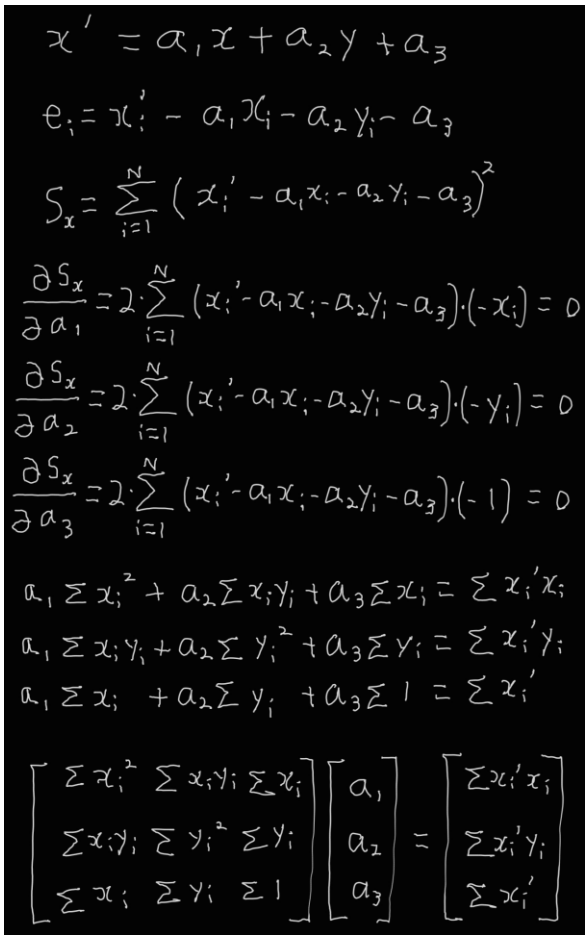
Homework #6

2019042497 송정명

이론적 배경



$$x' = a_1 x + a_2 y + a_3$$

$$e_i = x_i' - a_1 x_i - a_2 y_i - a_3$$

$$S_x = \sum_{i=1}^{N} (x_i' - a_1 x_i - a_2 y_i - a_3)^2$$

$$\frac{\partial S_x}{\partial a_1} = 2 \cdot \sum_{i=1}^{N} (x_i' - a_1 x_i - a_2 y_i - a_3) \cdot (-x_i) = 0$$

$$\frac{\partial S_x}{\partial a_2} = 2 \cdot \sum_{i=1}^{N} (x_i' - a_1 x_i - a_2 y_i - a_3) \cdot (-y_i) = 0$$

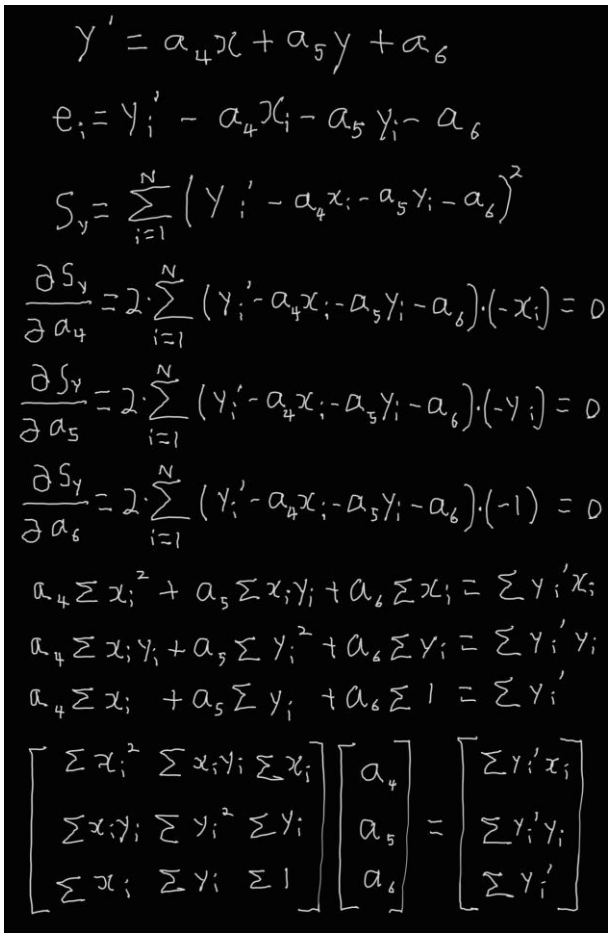
$$\frac{\partial S_x}{\partial a_3} = 2 \cdot \sum_{i=1}^{N} (x_i' - a_1 x_i - a_2 y_i - a_3) \cdot (-1) = 0$$

$$a_1 \Sigma x_i^2 + a_2 \Sigma x_i y_i + a_3 \Sigma x_i = \Sigma x_i' x_i$$

$$a_1 \Sigma x_i y_i + a_2 \Sigma y_i^2 + a_3 \Sigma y_i = \Sigma x_i' y_i$$

$$a_1 \Sigma x_i + a_2 \Sigma y_i + a_3 \Sigma 1 = \Sigma x_i'$$

$$\begin{bmatrix} \Sigma x_i^2 & \Sigma x_i y_i & \Sigma x_i \\ \Sigma x_i y_i & \Sigma y_i^2 & \Sigma y_i \\ \Sigma x_i & \Sigma y_i & \Sigma 1 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} = \begin{bmatrix} \Sigma x_i' x_i \\ \Sigma x_i' y_i \\ \Sigma x_i' \end{bmatrix}$$



$$y' = a_4 x + a_5 y + a_6$$

$$e_i = y_i' - a_4 x_i - a_5 y_i - a_6$$

$$S_y = \sum_{i=1}^{N} (y_i' - a_4 x_i - a_5 y_i - a_6)^2$$

$$\frac{\partial S_y}{\partial a_4} = 2 \cdot \sum_{i=1}^{N} (y_i' - a_4 x_i - a_5 y_i - a_6) \cdot (-x_i) = 0$$

$$\frac{\partial S_y}{\partial a_5} = 2 \cdot \sum_{i=1}^{N} (y_i' - a_4 x_i - a_5 y_i - a_6) \cdot (-y_i) = 0$$

$$\frac{\partial S_y}{\partial a_6} = 2 \cdot \sum_{i=1}^{N} (y_i' - a_4 x_i - a_5 y_i - a_6) \cdot (-1) = 0$$

$$a_4 \Sigma x_i^2 + a_5 \Sigma x_i y_i + a_6 \Sigma x_i = \Sigma y_i' x_i$$

$$a_4 \Sigma x_i y_i + a_5 \Sigma y_i^2 + a_6 \Sigma y_i = \Sigma y_i' y_i$$

$$a_4 \Sigma x_i + a_5 \Sigma y_i + a_6 \Sigma 1 = \Sigma y_i'$$

$$\begin{bmatrix} \Sigma x_i^2 & \Sigma x_i y_i & \Sigma x_i \\ \Sigma x_i y_i & \Sigma y_i^2 & \Sigma y_i \\ \Sigma x_i & \Sigma y_i & \Sigma 1 \end{bmatrix} \begin{bmatrix} a_4 \\ a_5 \\ a_6 \end{bmatrix} = \begin{bmatrix} \Sigma y_i' x_i \\ \Sigma y_i' y_i \\ \Sigma y_i' \end{bmatrix}$$

여기서 구한 식을 토대로 하여 제공된 파일에 주어진 (x_i, y_i, x'_i, y'_i)의 데이터들을 받아와서 다음을 계산해 (a_1, a_2, a_3, a_4, a_5, a_6)를 구하는 코드를 작성할 것입니다.

구현

```
for (int i = 0; i < 3; i++) {
    if (!(fp = fopen(data_arr[i],"r")))
        nrerror("Data file error");
    sum_x2 = 0, sum_xy = 0, sum_x = 0;
    sum_y2 = 0, sum_y = 0, sum_n = 0;
    sum_x_x = 0, sum_x_y = 0, sum_x_ = 0;
    sum_y_x = 0, sum_y_y = 0, sum_y_ = 0;
```

매번 파일을 열 때마다 sum 값들을 다 0으로 초기화하도록 해주었습니다.

```
printf("========== fitdata%d.dat ==========\n", i + 1);
while (1) {
    float x, y, x_, y_;
    fscanf(fp, "%f %f %f %f", &x, &y, &x_, &y_);
    if (feof(fp))
        break;
    sum_x2 += x * x;
    sum_xy += x * y;
    sum_x += x;
    sum_y2 += y * y;
    sum_y += y;
    sum_n += 1;
    sum_x_x += x_ * x;
    sum_x_y += x_ * y;
    sum_x_ += x_;
    sum_y_x += y_ * x;
    sum_y_y += y_ * y;
    sum_y_ += y_;
}
```

파일에서 (x_i, y_i, x'_i, y'_i)을 읽어 올 때마다 sum 변수에 다 더해주었습니다.

```
mat[1][1] = sum_x2;
mat[1][2] = sum_xy;
mat[1][3] = sum_x;
mat[2][1] = sum_xy;
mat[2][2] = sum_y2;
mat[2][3] = sum_y;
mat[3][1] = sum_x;
mat[3][2] = sum_y;
mat[3][3] = sum_n;
vec[1][1] = sum_x_x;
vec[2][1] = sum_x_y;
vec[3][1] = sum_x_;
gaussj(mat, 3, vec, 3);
printf("a1: %f\na2: %f\na3: %f\n", vec[1][1], vec[2][1], vec[3][1]);
mat[1][1] = sum_x2;
mat[1][2] = sum_xy;
mat[1][3] = sum_x;
mat[2][1] = sum_xy;
mat[2][2] = sum_y2;
mat[2][3] = sum_y;
mat[3][1] = sum_x;
mat[3][2] = sum_y;
mat[3][3] = sum_n;
vec[1][1] = sum_y_x;
vec[2][1] = sum_y_y;
vec[3][1] = sum_y_;
gaussj(mat, 3, vec, 3);
printf("a4: %f\na5: %f\na6: %f\n", vec[1][1], vec[2][1], vec[3][1]);
printf("==================================\n\n");
fclose(fp);
```

파일에서 데이터를 다 읽어왔다면 while()을 탈출하고, 이론적 배경에 소개한대로 mat와 vec에 값을 넣고, gaussj에 넣어서 나온 a 값들을 출력하도록 반복해주었습니다.

실행 결과

```
wjdaud@LAPTOP-1NG9U1J0:~/NA/homework6$ ./homework6
========== fitdata1.dat ==========
a1: 0.981888
a2: 0.002540
a3: -0.375178
a4: 0.001250
a5: 0.982163
a6: 1.157731
==================================

========== fitdata2.dat ==========
a1: 0.979907
a2: 0.000452
a3: -1.192226
a4: -0.001069
a5: 0.980346
a6: 0.491567
==================================

========== fitdata3.dat ==========
a1: 0.980806
a2: 0.000545
a3: -0.944462
a4: -0.000717
a5: 0.979108
a6: 0.428951
==================================
```

결과는 다음과 같이 나왔습니다.