Home Work #3

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1 Question 1

$z = f(x, y) = y\sin(x + y) - x\sin(x - y)$
Gradient of f(x, y):

$$\vec{\nabla} f = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix}$$

$$\vec{\nabla} f = \begin{bmatrix} y\cos(x + y) - \sin(x - y) - x\cos(x - y) \\ y\cos(x + y) + \sin(x + y) + x\cos(x - y) \end{bmatrix}$$

1.1 part a

1.1.1 figures

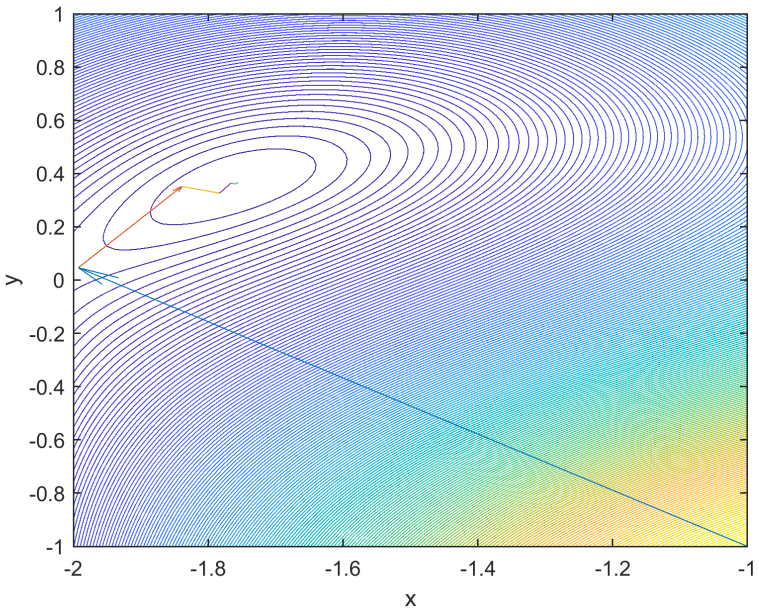
$$\vec{X}_0 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$$

Tolerance is:10^{-7}
Answer is:

$$\vec{X}_{ans} = \begin{bmatrix} -1.7556 \\ 0.3655 \end{bmatrix}$$

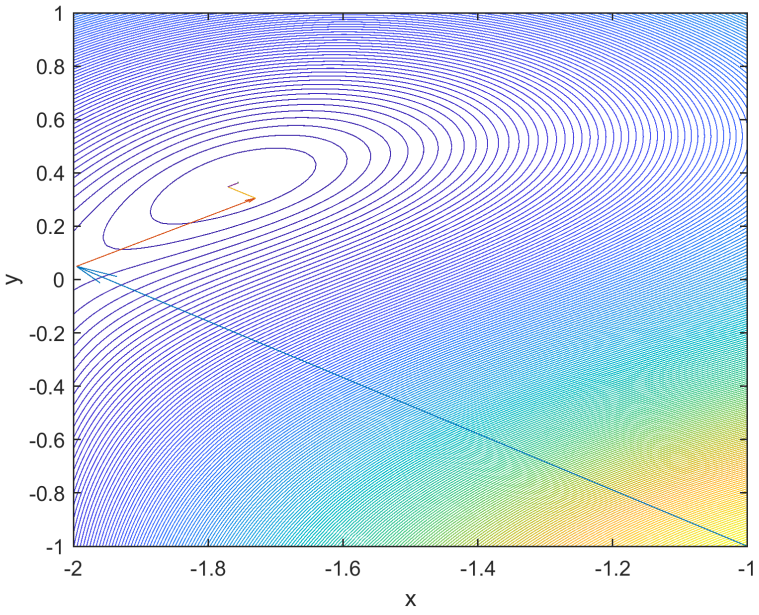
- Steepest Descent
  - Quadratic Interpolation

Figure 1: Steepest Descent and Quadratic Interpolation



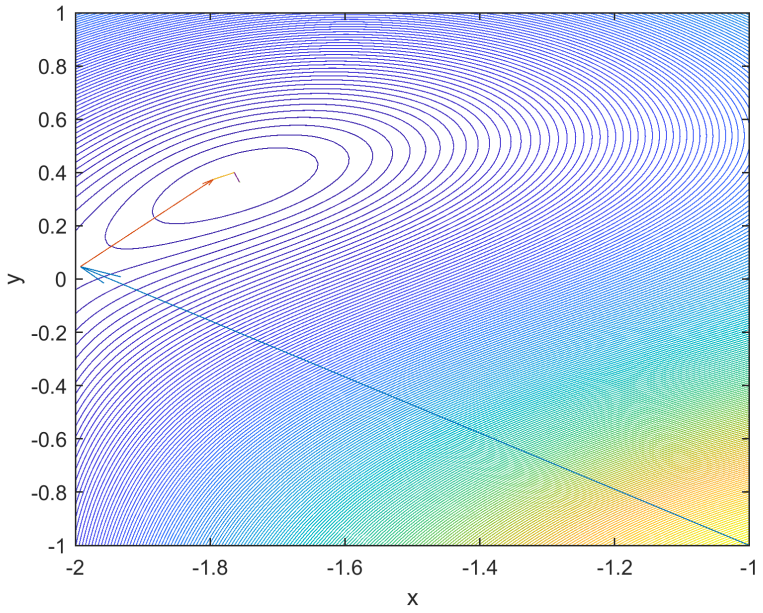
  - Golden Section

Figure 2: Steepest Descent and Golden Section



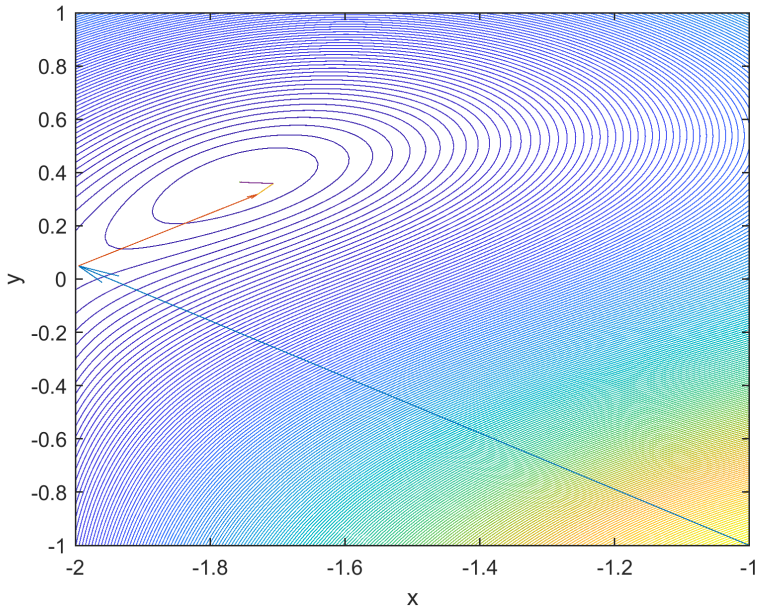
- BFGS
  - Quadratic Interpolation

Figure 3: BFGS and Quadratic Interpolation



  - Golden Section

Figure 4: BFGS and Golden Section



1.1.2 result

- Time

Table 1: Time compare between four methods

Steepest Descent		BFGS	
Quadratic Interpolation	Golden Section	Quadratic Interpolation	Golden Section
0.238 sec	0.183 sec	0.164 sec	0.102 sec

- Number of Cost calculation

Table 2: Number of Cost calculation compare between four methods

Steepest Descent		BFGS	
Quadratic Interpolation	Golden Section	Quadratic Interpolation	Golden Section
360	336	242	213

- Number of Gradient calculation

Table 3: Number of Gradient calculation compare between four methods

Steepest Descent		BFGS	
Quadratic Interpolation	Golden Section	Quadratic Interpolation	Golden Section
19	13	13	9

1.2 part b

1.2.1 figures

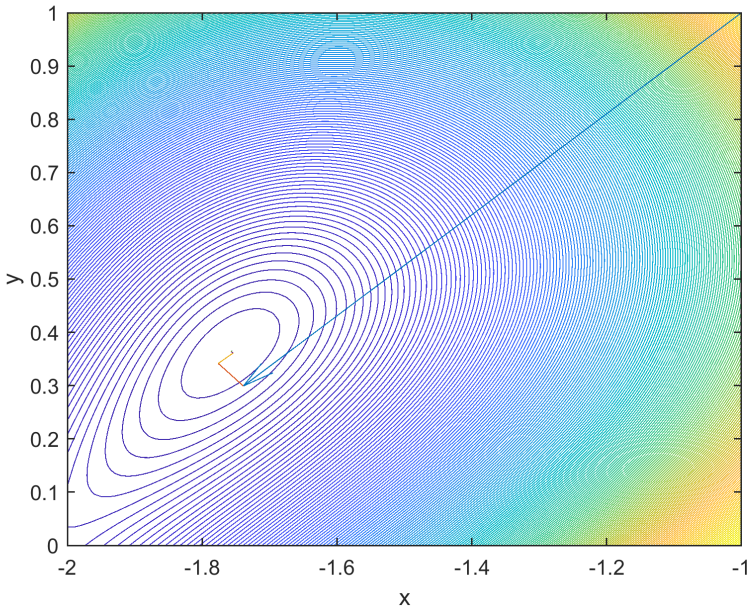
$$\vec{X}_0 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$$

Tolerance is:10^{-7}

$$\vec{X}_{ans} = \begin{bmatrix} -1.7556 \\ 0.3655 \end{bmatrix}$$

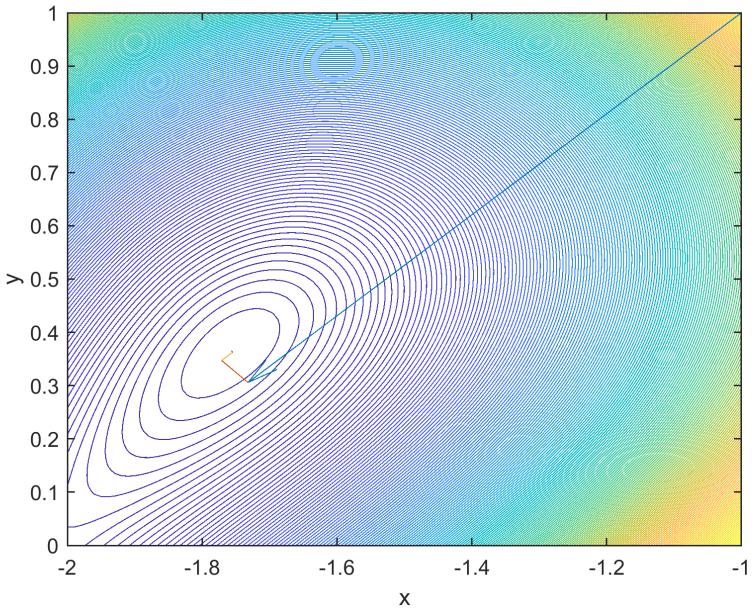
- Steepest Descent
  - Quadratic Interpolation

Figure 5: Steepest Descent and Quadratic Interpolation



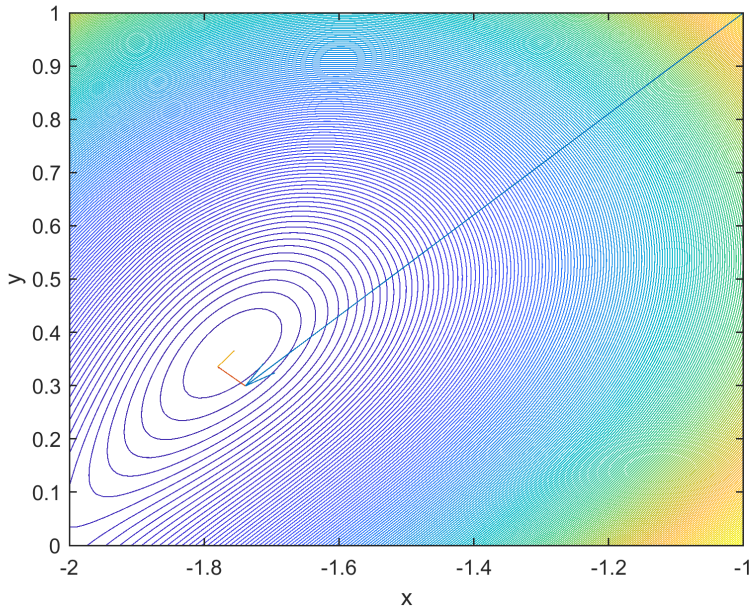
  - Golden Section

Figure 6: Steepest Descent and Golden Section



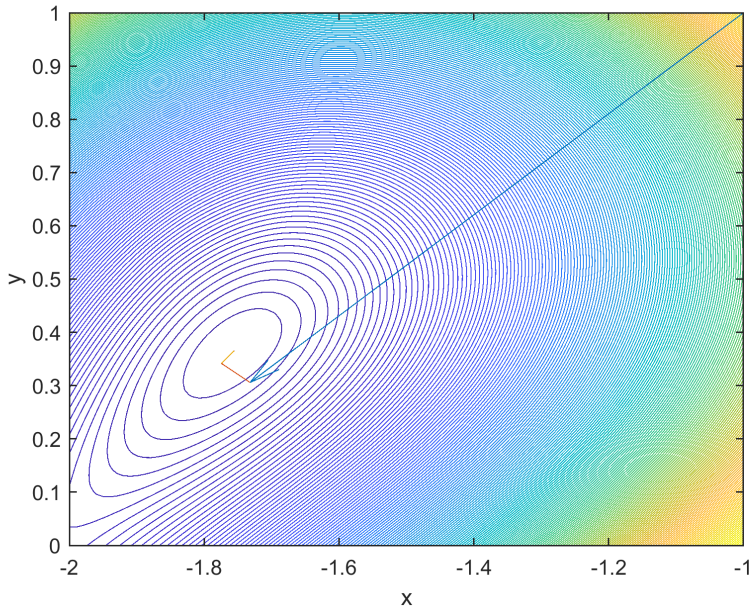
- BFGS
  - Quadratic Interpolation

Figure 7: BFGS and Quadratic Interpolation



  - Golden Section

Figure 8: BFGS and Golden Section



1.2.2 result

- Time

Table 4: Time compare between four methods

Steepest Descent		BFGS	
Quadratic Interpolation	Golden Section	Quadratic Interpolation	Golden Section
0.208 sec	0.146 sec	0.106 sec	0.142 sec

- Number of Cost calculation

Table 5: Number of Cost calculation compare between four methods

Steepest Descent		BFGS	
Quadratic Interpolation	Golden Section	Quadratic Interpolation	Golden Section
246	285	142	142

- Number of Gradient calculation

Table 6: Number of Gradient calculation compare between four methods

Steepest Descent		BFGS	
Quadratic Interpolation	Golden Section	Quadratic Interpolation	Golden Section
14	12	7	7

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