HW1

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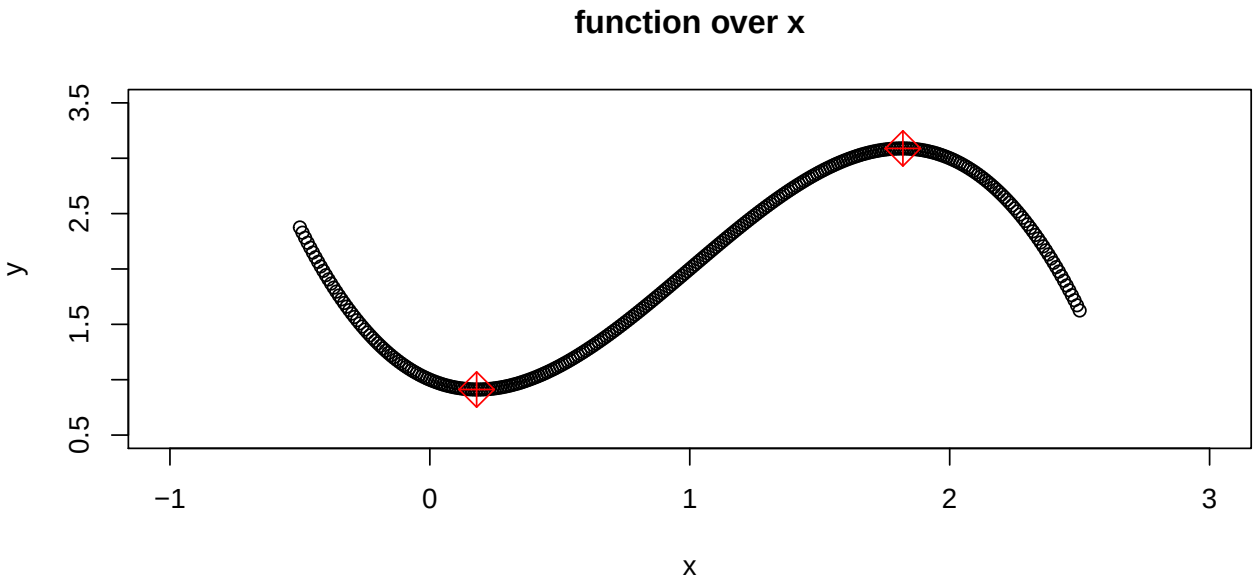
Problem 3

Figure 1 shows the plot of function over x. The critical points are pointed out in red.

From the calculus, when the first order gradient of function is set as 0, the solution is $1+\sqrt{\frac{2}{3}}$ and $1-\sqrt{\frac{2}{3}}$. Written in decimals they are 1.816 and 0.1835. Based on the second order gradient of function, the maximum point is (1.816, 3.0886615), the minimum point is (0.1835,0.9113379). This result is confirmed after comparing with the points at the boundary.



The R function nlminb is used to find the optimal value.

part 1. the minimum of the function

the result is:

```
res$convergence
```

```
## [1] 0
```

```
res$par
```

```
## [1] 0.1835032
```

```
res$objective
```

```
## [1] 0.9113379
```

The number iterations used is:

```
res$iterations
```

```
## [1] 5
```

Based on the variable count value, the number of function usage during the optimization is

```
cnt
```

```
## [1] 15
```

Repeat the process 10 times by different initials, the optimal x valus are:

```
##  [1] 0.1835034 0.1835032 0.1835034 0.1835036 0.1835034 0.1835034 0.1835034
##  [8] 0.1835036 0.1835036 0.1835034
```

The results are pretty consistent. The result agrees with the truth.

part 2. the maximum of the function

the result is:

```
res$convergence
```

```
## [1] 1
```

```
res$par
```

```
## [1] -3.614178e+54
```

```
-(res$objective)
```

```
## [1] 4.720943e+163
```

The number iterations used is:

```
res$iterations
```

```
## [1] 103
```

Based on the variable count value, the number of function usage during the optimization is

```
cnt
```

```
## [1] 287
```

Repeat the process 10 times by different initials, the optimal x valus are:

```
##  [1] -9.483233e+54  1.816496e+00 -8.721764e+54 -5.787125e+54  1.816497e+00
##  [6]  1.816497e+00  1.816497e+00  1.816497e+00 -6.778060e+54  1.816497e+00
```

Notice that in some trials, the optimal x value is too large/small to be reliable. The result agrees with the truth.