數值分析 2D Gaussian

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Requirement A

由 matlab 所積分出來的值為 0.160429671237858

```
format long
f = @(x , y) (sin(2 .* pi .* x) ./ (2 .* pi .* x)) .* (sin(3 .* pi .* y) ./ (3 .* pi .* y))
integral2(f , -1 , 1 , -1 , 1) % integral2(fun,xmin,xmax,ymin,ymax)
```

```
f = function_handle with value:
    @(x,y)(sin(2.*pi.*x)./(2.*pi.*x)).*(sin(3.*pi.*y)./(3.*pi.*y))
ans =
   0.160429671237858
```

Requirement B

Interval = 1 ~ 16 , N = 2 ~ 4

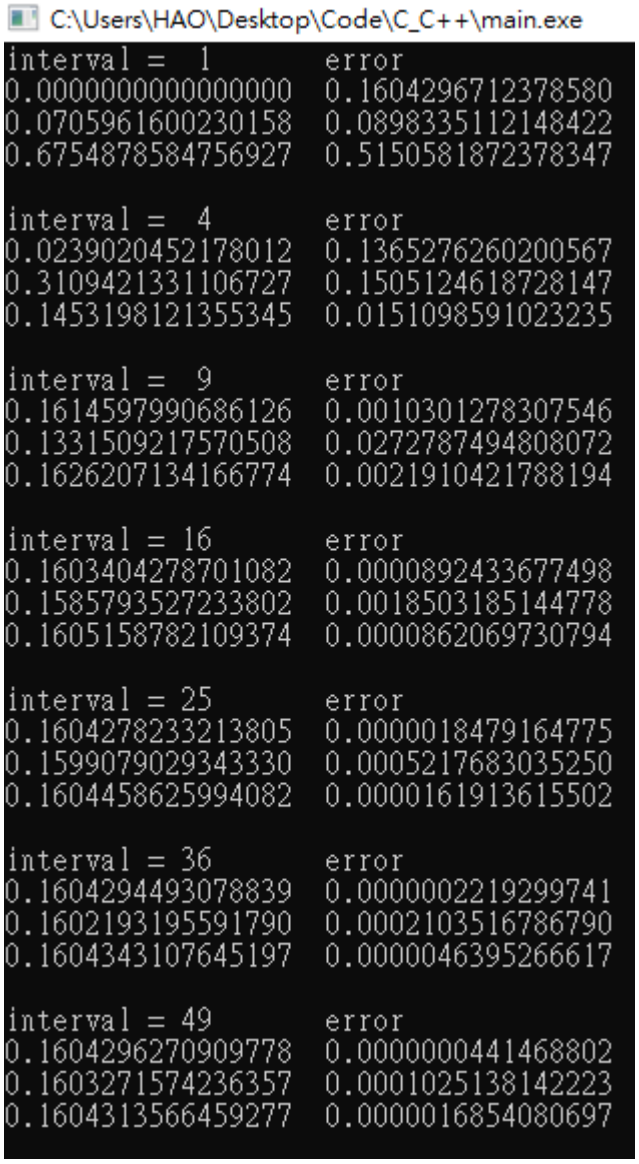
左邊是積出來的值，右邊是左邊減 matlab 的值取絕對值

```
C:\Users\HAO\Desktop\Code\C_C++\main.exe
interval =  1       error
0.0000000000000000  0.1604296712378580
0.0705961600230158  0.0898335112148422
0.6754878584756927  0.5150581872378347

interval =  4       error
0.0239020452178012  0.1365276260200567
0.3109421331106727  0.1505124618728147
0.1453198121355345  0.0151098591023235

interval =  9       error
0.1614597990686126  0.0010301278307546
0.1331509217570508  0.0272787494808072
0.1626207134166774  0.0021910421788194

interval = 16       error
0.1603404278701082  0.0000892433677498
0.1585793527233802  0.0018503185144778
0.1605158782109374  0.0000862069730794

請按任意鍵繼續 . . .
```

Requirement C

Interval = 1 ~ 49 , N = 2 ~ 4

可以透過增加 interval 的數量，讓積出來的值更快的接近正解，收斂得更快。

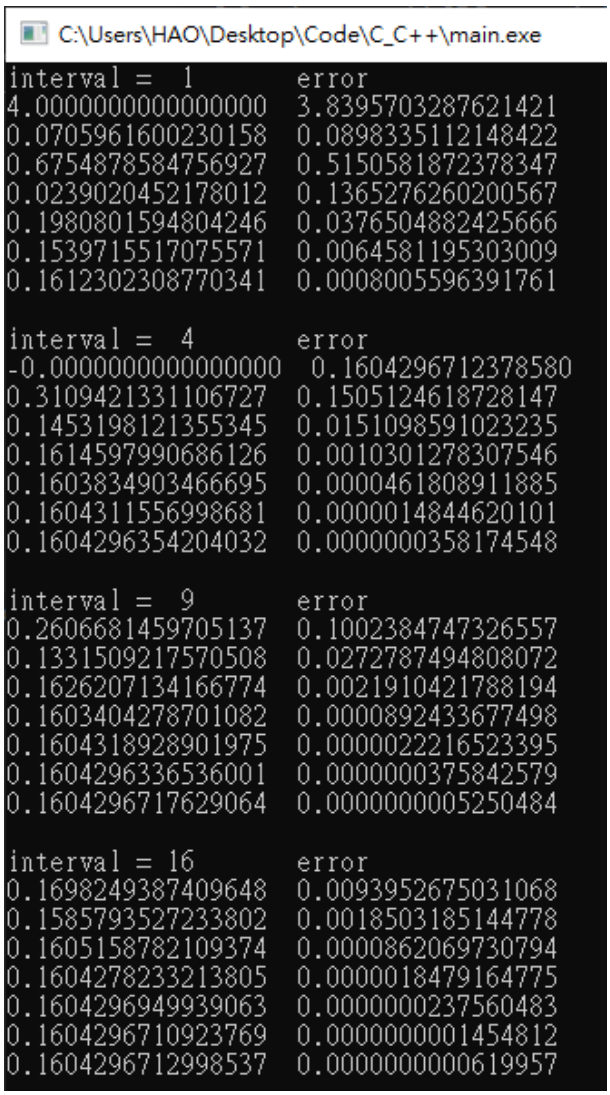


Requirement D

Interval = 1 ~ 49 , N = 1 ~ 7

在增加 interval 的數量，並且也增加 sample points 的數量的情況下，可以看

出來誤差明顯減少，interval 和 sample points 的數量越多收斂越快。



Requirement E

sample points 和 interval 哪個比較重要? sample points 的數量

情況一 N = 3 ， interval = 1 , 49 :

N = 3 , interval = 1 , error = 0.5150581872378347

N = 3 , interval = 49 , error = 0.0000016854080697

情況二 interval = 9 ， N = 2 , 7 :

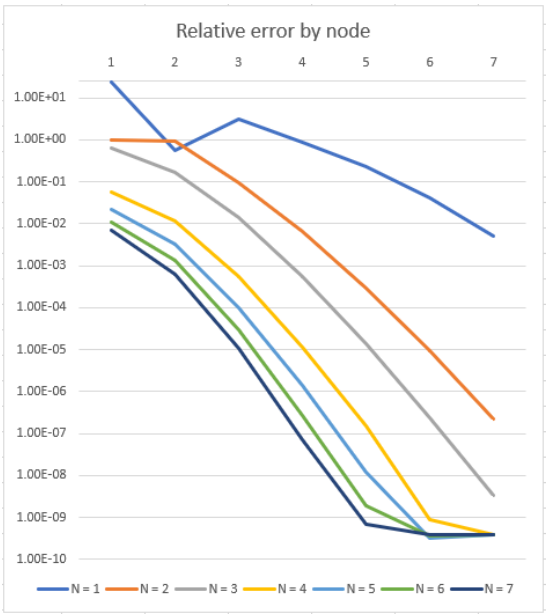
N = 2 , interval = 9 , error = 0.0272787494808072

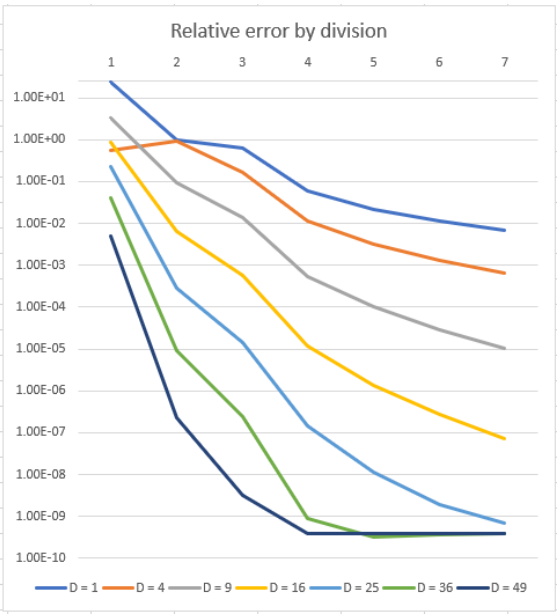
N = 7 , interval = 9 , error = 0.0000000005250484

可以看出來在 sample points 數量增加情況下，error 收斂了 8 個位數，而在 interval 數量增加情況下，error 只收斂了 5 個位數。

根據下面 Requirement F 的兩張圖中可以看出來，以 sample points 為主的折線圖，它們的斜率都對應到 interval 為主的折線斜率還要更大(ex : N = 5 對上 D = 25)。

Requirement F





interval	1	4	9	16	25	36	49
N = 1	23.93304	0.559956	3.210492	0.851012	0.234685	0.040255	0.00499
N = 2	1	0.938183	0.094184	0.006421	0.000288	9.25E-06	2.23E-07
N = 3	0.624813	0.170036	0.013657	0.000556	1.38E-05	2.34E-07	3.27E-09
N = 4	0.058563	0.011534	0.000537	1.15E-05	1.48E-07	9.07E-10	3.86E-10
N = 5	0.021713	0.003252	0.000101	1.38E-06	1.16E-08	3.16E-10	3.79E-10
N = 6	0.011246	0.001311	2.89E-05	2.75E-07	1.93E-09	3.72E-10	3.78E-10
N = 7	0.006902	0.000639	1.05E-05	7.32E-08	6.82E-10	3.77E-10	3.78E-10

node	1	2	3	4	5	6	7
D = 1	23.93304	1	0.624813	0.058563	0.021713	0.011246	0.006902
D = 4	0.559956	0.938183	0.170036	0.011534	0.003252	0.001311	0.000639
D = 9	3.210492	0.094184	0.013657	0.000537	0.000101	2.89E-05	1.05E-05
D = 16	0.851012	0.006421	0.000556	1.15E-05	1.38E-06	2.75E-07	7.32E-08
D = 25	0.234685	0.000288	1.38E-05	1.48E-07	1.16E-08	1.93E-09	6.82E-10
D = 36	0.040255	9.25E-06	2.34E-07	9.07E-10	3.16E-10	3.72E-10	3.77E-10
D = 49	0.00499	2.23E-07	3.27E-09	3.86E-10	3.79E-10	3.78E-10	3.78E-10