EC　Assignment #1 (GA)

Report due on: 12:00am, Oct. 22, 2024

1. Please refer to the benchmark objective functions selected from Table I (from Adaptive Particle Swarm Optimization). There are 4 unimodal functions (f1,f2,f3,f4), and 4 multimodal functions (f7,f8,f10,f11), where f8 is replaced by the Schwefel function.
2. Please use GA to optimize at least one unimodal function and one multimodal function, according to bench mark problems assigned to you (see the allocation table below).
3. A total of 200,000 Function Evaluations (FE) can only be used to allow a fair comparison.
4. Prepare a report of no less than 6 pages, including experimental results, analysis, and discussions, including parameters used, accuracy, consistency of experimental results. Submit your report together with your source code before the deadline.
5. Submitting late work will be penalized by a deduction of 10% per day of the total mark awarded for each assignment.
   以 GA 同時處理 unimodal 函數與 multimodal 函數各一個，並繳交至少 6 頁之報告，討論其執行結果，包含: 各項使用的參數、精確度、所使用的 function evaluations (FE)、執行結果的一致性(每次都可以獲得好結果?)、可以獲致滿意結果的維度(D=10、D=30)等。作業需準時繳交，包含程式碼與書面報告，逾時成績逐日扣-10%。繳交期限為 3 週。
6. References
   - Nai-Jen Li, Wen-June Wang*, Chen-Chien Hsu, Wei Chang, Hao-Gong Chou, and Jun-Wei Chang, “Enhanced Particle Swarm Optimizer Incorporating a Weighted Particle,” Neurocomputing, Vol. 124, pp. 218-227, Jan., 2014.
   - Nai-Jen Li, Wen-June Wang, and Chen-Chien Hsu, “Hybrid Particle Swarm Optimization Incorporating Fuzzy Reasoning and Weighted Particle,” Neurocomputing, Vol. 167, pp. 488-501, April, 2015.

7. Assignment of benchmark problems

學號	姓名	班級		Assignment
1	81375003H	羅尹均	電機系（博）一	f1 & f7
2	813K0003C	朱家佑	AI 跨域所(博)一	f2 & f8
3	61170010H	李祥樂	工教系（碩）三	f3 & f10
4	61175005H	張廣億	電機系（碩）二	f4 & f11
5	61275002H	鄭詠孺	電機系（碩）二	f1 & f8
6	61275003H	張仲軒	電機系（碩）二	f2 & f10
7	61275014H	胡庭維	電機系（碩）二	f3 & f11
8	61275025H	何祐豪	電機系（碩）二	f4 & f7
9	61275036H	沈尚錡	電機系（碩）二	f1 & f10
10	61275072H	陳以秀	電機系（碩）二	f2 & f11
11	61375004H	彭柏凱	電機系（碩）一	f1 & f7
12	61375017H	陳昕佑	電機系（碩）一	f2 & f8
13	61375070H	黃柏瑜	電機系（碩）一	f3 & f11
14	61375075H	LE HOANG CONG	電機系（碩）一	f4 & f7
15	61375079H	李柏叡	電機系（碩）一	f1 & f7
16	612K0002C	張信中	AI 跨域所(碩)一	f2 & f8
17	612K0005C	鄧華予	AI 跨域所(碩)二	f3 & f11

18	612K0022C	陳柏序	AI 跨域所(碩)二	f4 & f7
19	612K0034C	黃宇彤	AI 跨域所(碩)一	f1 & f7
20	613K0003C	鄧聖叡	AI 跨域所(碩)一	f2 & f8
21	613K0004C	林品睿	AI 跨域所(碩)一	f3 & f11
22	613K0005C	蔡鎧仲	AI 跨域所(碩)一	f4 & f7
23	613K0007C	余品誼	AI 跨域所(碩)一	f1 & f8
24	613K0008C	王心泓	AI 跨域所(碩)一	f2 & f10
25	613K0010C	陳品妤	AI 跨域所(碩)一	f3 & f7
26	613K0015C	潘柏睿	AI 跨域所(碩)一	f4 & f8
27	41075002H	陳柏安	電機系（學）四	f1 & f10
28	41075005H	林志鴻	電機系（學）四	f2 & f11
29	41075008H	陳宥熏	電機系（學）四	f3 & f8
30	41075009H	李文浩	電機系（學）四	f4 & f10

F8 is replaced by the Schwefel function with dimension *d*=30 below:

$$f(\mathbf{x}) = 418.9829d - \sum_{i=1}^{d} x_i \sin(\sqrt{|x_i|})$$

Description:

Dimensions: d

The Schwefel function is complex, with many local minima. The plot shows the two-dimensional form of the function.

Input Domain:

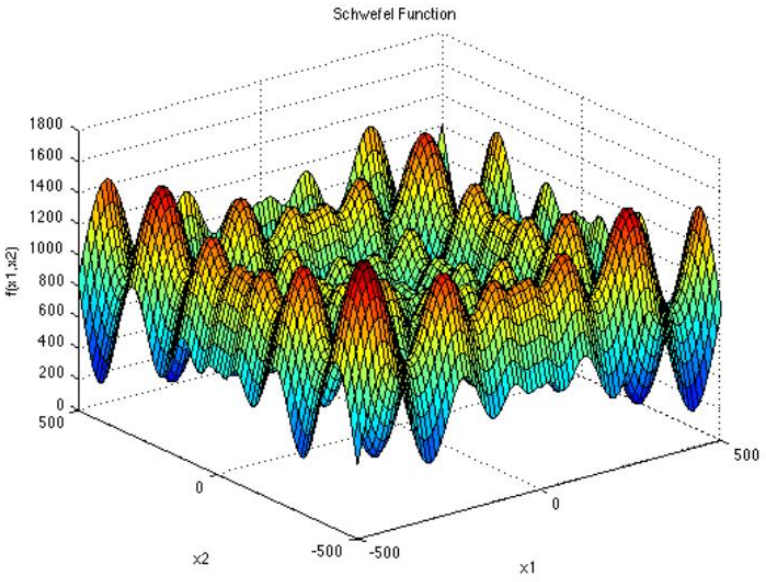
The function is usually evaluated on the hypercube $x_i \in [-500, 500]$, for all i = 1, …, d.

Global Minimum:

$f(\mathbf{x}^*) = 0$, at $\mathbf{x}^* = (420.9687, \ldots, 420.9687)$

https://www.sfu.ca/~ssurjano/schwef.html

SCHWEFEL FUNCTION



$$f(\mathbf{x}) = 418.9829d - \sum_{i=1}^{d} x_i \sin(\sqrt{|x_i|})$$

TABLE I

TWELVE TEST FUNCTIONS USED IN THIS PAPER, THE FIRST SIX BEING UNIMODAL AND THE REMAINING BEING MULTIMODAL

	Test function	D	Search Space	Global $f_{\min}$	Acceptance	Name of function
Unimodal	$f_1(x)=\sum_{i=1}^{D} x_i^2$	30	$[-100,100]^D$	0	0.01	Sphere [53]
	$f_2(x)=\sum_{i=1}^{D} \lvert x_i\rvert+\prod_{i=1}^{D} \lvert x_i\rvert$	30	$[-10,10]^D$	0	0.01	Schwefel's P2.22 [53]
	$f_3(x)=\sum_{i=1}^{D} (\sum_{j=1}^{i} x_j)^2$	30	$[-100,100]^D$	0	100	Quadric [53]
	$f_4(x)=\sum_{i=1}^{D-1} [100(x_{i+1}-x_i^2)^2+(x_i-1)^2]$	30	$[-10,10]^D$	0	100	Rosenbrock [53]
	$f_5(x)=\sum_{i=1}^{D} (\lfloor x_i+0.5\rfloor)^2$	30	$[-100,100]^D$	0	0	Step [53]
	$f_6(x)=\sum_{i=1}^{D} ix_i^4+random[0,1)$	30	$[-1.28,1.28]^D$	0	0.01	Quadric Noise [53]
Multimodal	$f_7(x)=\sum_{i=1}^{n} -x_i \cdot \sin\left(\sqrt{\lvert x_i\rvert}\right)$	30	$[-500,500]^D$	-12569.5	-10000	Schwefel [53]
	f8 is replaced by Schwefel function	30	$[-5.12,5.12]^D$	0	50	Rastrigin [53]
		30	$[-5.12,5.12]^D$	0	50	Noncontinuous Rastrigin [12]
	$f_{10}(x)=-20\exp(-0.2\sqrt{1/D\sum_{i=1}^{D} x_i^2})-\exp(1/D\sum_{i=1}^{D}\cos 2\pi x_i)+20+e$	30	$[-32,32]^D$	0	0.01	Ackley [53]
	$f_{11}(x)=1/4000\sum_{i=1}^{D} x_i^2-\prod_{i=1}^{D}\cos(x_i/\sqrt{i})+1$	30	$[-600,600]^D$	0	0.01	Griewank [53]
	$f_{12}(x)=\frac{\pi}{D}\{10\sin^2(\pi y_1)+\sum_{i=1}^{D-1}(y_i-1)^2[1+10\sin^2(\pi y_{i+1})]+(y_D-1)^2\}+\sum_{i=1}^{D} u(x_i,10,100,4)$ where $y_i=1+\frac{1}{4}(x_i+1)$, $u(x_i,a,k,m)=\begin{cases}k(x_i-a)^m, & x_i>a\\ 0, & -a\le x_i\le a\\ k(-x_i-a)^m, & x_i<-a\end{cases}$	30	$[-50,50]^D$	0	0.01	Generalized Penalized [53]