

## Differential evolution algorithm

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# Chapter 1

## Namespace Index

### 1.1 Namespace List

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## Chapter 2

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### 2.1 Class List

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## Chapter 3

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### 3.1 File List

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## Chapter 4

# Namespace Documentation

### 4.1 func Namespace Reference

18 functions

#### Functions

- float [schwefel](#) (vector< float > &x)
- float [firstDeJong](#) (vector< float > &x)
- float [rosenbrock](#) (vector< float > &x)
- float [rastrigin](#) (vector< float > &x)
- float [griewangk](#) (vector< float > &x)
- float [sineEnvelopeSineWave](#) (vector< float > &x)
- float [stretchedVSineWave](#) (vector< float > &x)
- float [ackleysOne](#) (vector< float > &x)
- float [ackleysTwo](#) (vector< float > &x)
- float [eggHolder](#) (vector< float > &x)
- float [rana](#) (vector< float > &x)
- float [pathological](#) (vector< float > &x)
- float [michalewicz](#) (vector< float > &x)
- float [mastersCosineWave](#) (vector< float > &x)
- float [quartic](#) (vector< float > &x)
- float [levy](#) (vector< float > &x)
- float [step](#) (vector< float > &x)
- float [alpine](#) (vector< float > &x)

#### 4.1.1 Detailed Description

18 functions

#### 4.1.2 Function Documentation

##### 4.1.2.1 ackleysOne()

```
float func::ackleysOne (
    vector< float > & x )
```

Function 8, Implementation of Ackley's One function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

**4.1.2.2 ackleysTwo()**

```
float func::ackleysTwo (
    vector< float > & x )
```

Function 9, Implementation of Ackley's Two function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

**4.1.2.3 alpine()**

```
float func::alpine (
    vector< float > & x )
```

Function 18, Implementation of Alpine function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

**4.1.2.4 eggHolder()**

```
float func::eggHolder (
    vector< float > & x )
```

Function 10, Implementation of Egg Holder function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

#### 4.1.2.5 firstDeJong()

```
float func::firstDeJong (
    vector< float > & x )
```

Function 2, Implementation of 1st De Jong's function

##### Parameters

x	descriptionx Vector of float
---	------------------------------

#### 4.1.2.6 griewangk()

```
float func::griewangk (
    vector< float > & x )
```

Function 5, Implementation of Griewangk function

##### Parameters

x	descriptionx Vector of float
---	------------------------------

#### 4.1.2.7 levy()

```
float func::levy (
    vector< float > & x )
```

Function 16, Implementation of Levy function

##### Parameters

x	descriptionx Vector of float
---	------------------------------

#### 4.1.2.8 mastersCosineWave()

```
float func::mastersCosineWave (
    vector< float > & x )
```

Function 14, Implementation of Masters Cosine Wave function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

**4.1.2.9 michalewicz()**

```
float func::michalewicz (  
    vector< float > & x )
```

Function 13, Implementation of Michalewicz function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

**4.1.2.10 pathological()**

```
float func::pathological (  
    vector< float > & x )
```

Function 12, Implementation of Pathological function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

**4.1.2.11 quartic()**

```
float func::quartic (  
    vector< float > & x )
```

Function 15, Implementation of Quartic function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

#### 4.1.2.12 rana()

```
float func::rana (
    vector< float > & x )
```

Function 11, Implementation of Rana function

##### Parameters

x	descriptionx Vector of float
---	------------------------------

#### 4.1.2.13 rastrigin()

```
float func::rastrigin (
    vector< float > & x )
```

Function 4, Implementation of Rastrigin's function

##### Parameters

x	descriptionx Vector of float
---	------------------------------

#### 4.1.2.14 rosenbrock()

```
float func::rosenbrock (
    vector< float > & x )
```

Function 3, Implementation of Rosenbrock's function

##### Parameters

x	descriptionx Vector of float
---	------------------------------

#### 4.1.2.15 schwefel()

```
float func::schwefel (
    vector< float > & x )
```

Function 1, Implementation of Schwefel's function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

**4.1.2.16 sineEnvelopeSineWave()**

```
float func::sineEnvelopeSineWave (  
    vector< float > & x )
```

Function 6, Implementation of Sine Envelope Sine Wave function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

**4.1.2.17 step()**

```
float func::step (  
    vector< float > & x )
```

Function 147 Implementation of Step function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------

**4.1.2.18 stretchedVSineWave()**

```
float func::stretchedVSineWave (  
    vector< float > & x )
```

Function 7, Implementation of Stretched V Sine Wave function

**Parameters**

<i>x</i>	descriptionx Vector of float
----------	------------------------------



## Chapter 5

# Class Documentation

### 5.1 DataStats Class Reference

#### Public Member Functions

- void [run](#) ()  
*Generate analytical data.*

#### Public Attributes

- float **mean** = INT\_MAX
- float **median** = INT\_MAX
- float **stand** = INT\_MAX
- float **range** [2]
- float **time** = 0
- vector< float > **data**

The documentation for this class was generated from the following files:

- src/[data\\_stats.h](#)
- src/data\_stats.cpp

### 5.2 DE Class Reference

#### Public Member Functions

- [DE](#) ([DEStrategy](#) s, float(\*f)(vector< float > &), float l, float u)
- vector< float > [run](#) ()

#### 5.2.1 Constructor & Destructor Documentation

### 5.2.1.1 DE()

```
DE::DE (
    DEStrategy s,
    float(*) (vector< float > &) f,
    float l,
    float u )
```

Initialize differential evolution algorithm to run for one function

## Parameters

<i>f</i>	function
<i>l</i>	low bound for x
<i>u</i>	high bound for x

## 5.2.2 Member Function Documentation

### 5.2.2.1 run()

```
vector< float > DE::run ( )
```

run differential evolution algorithm

## Parameters

<i>i</i>	ith individual
<i>j</i>	jth element in individual

## Returns

history values of best function value achieved

The documentation for this class was generated from the following files:

- [src/differential\\_evolution.h](#)
- [src/differential\\_evolution.cpp](#)

## 5.3 DEStrategy Struct Reference

### Public Attributes

- string **perturbed\_vector**
- int [difference\\_vector](#)  
*x: string denoting the vector to be perturbed, choosing from best, rand or rand-to-best*
- string [crossover\\_type](#)  
*y: number of difference vector considered for perturbation of x, 1 or 2*

The documentation for this struct was generated from the following file:

- [src/differential\\_evolution.h](#)

## 5.4 Individual Class Reference

[Individual](#) for population.

```
#include <population.h>
```

### Public Member Functions

- **Individual** (float(\*f)(vector< float > &), vector< float > numbers)

### Public Attributes

- vector< float > **data**
- float(\* **function** )(vector< float > &)
- float **cost**

#### 5.4.1 Detailed Description

[Individual](#) for population.

The documentation for this class was generated from the following files:

- src/[population.h](#)
- src/population.cpp

## 5.5 Population Class Reference

[Population](#) for genetic algorithm.

```
#include <population.h>
```

### Public Member Functions

- void [init](#) (int s, int d, float(\*f)(vector< float > &), float l, float u)
- void [reset](#) ()

*reset the population for new run*

### Public Attributes

- vector< [Individual](#) > **data**  
*Initialize a population.*
- int **individual\_best**

## 5.5.1 Detailed Description

[Population](#) for genetic algorithm.

## 5.5.2 Member Function Documentation

### 5.5.2.1 init()

```
void Population::init (
    int s,
    int d,
    float (*) (vector< float > &) f,
    float l,
    float u )
```

Initialize a population

#### Parameters

<i>s</i>	population size
<i>d</i>	population dimension
<i>low</i>	x low bound
<i>high</i>	x high bound

The documentation for this class was generated from the following files:

- [src/population.h](#)
- [src/population.cpp](#)



## Chapter 6

# File Documentation

### 6.1 src/data\_stats.h File Reference

data analysis

```
#include <vector>
```

#### Classes

- class [DataStats](#)

#### 6.1.1 Detailed Description

data analysis

##### Author

Cheng Su ( [csu@cwu.edu](mailto:csu@cwu.edu) )

##### Version

1.0

##### Date

2020-02-11

### 6.2 src/differential\_evolution.h File Reference

differential evolution algorithm

```
#include <string>
#include <vector>
#include "population.h"
```

## Classes

- struct [DEStrategy](#)
- class [DE](#)

### 6.2.1 Detailed Description

differential evolution algorithm

Author

Cheng Su ( [csu@cwu.edu](mailto:csu@cwu.edu) )

Version

1.0

Date

2020-02-11

## 6.3 src/func.h File Reference

Math functions.

```
#include <stdio.h>
#include <vector>
```

## Namespaces

- [func](#)  
*18 functions*

## Functions

- float [func::schwefel](#) (vector< float > &x)
- float [func::firstDeJong](#) (vector< float > &x)
- float [func::rosenbrock](#) (vector< float > &x)
- float [func::rastrigin](#) (vector< float > &x)
- float [func::griewangk](#) (vector< float > &x)
- float [func::sineEnvelopeSineWave](#) (vector< float > &x)
- float [func::stretchedVSineWave](#) (vector< float > &x)
- float [func::ackleysOne](#) (vector< float > &x)
- float [func::ackleysTwo](#) (vector< float > &x)
- float [func::eggHolder](#) (vector< float > &x)
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- float [func::pathological](#) (vector< float > &x)
- float [func::michalewicz](#) (vector< float > &x)
- float [func::mastersCosineWave](#) (vector< float > &x)
- float [func::quartic](#) (vector< float > &x)
- float [func::levy](#) (vector< float > &x)
- float [func::step](#) (vector< float > &x)
- float [func::alpine](#) (vector< float > &x)



### 6.3.1 Detailed Description

Math functions.

Author

Cheng Su ( [csu@cwu.edu](mailto:csu@cwu.edu) )

Version

0.1

Date

2020-02-05

## 6.4 src/population.h File Reference

[Population](#) generation.

```
#include <stdio.h>
#include <vector>
```

### Classes

- class [Individual](#)  
*Individual for population.*
- class [Population](#)  
*Population for genetic algorithm.*

### 6.4.1 Detailed Description

[Population](#) generation.

Author

Cheng Su ( [csu@cwu.edu](mailto:csu@cwu.edu) )

Version

1.0

Date

2020-02-1

## 6.5 src/run.h File Reference

run

```
#include <vector>
#include "data_stats.h"
#include "differential_evolution.h"
```

### Functions

- void [setSeed](#) ()  
*Set seed for [Mersenne Twister](#)*
- [DataStats runFunc](#) (int experiment, string func\_name, float(\*f)(vector< float > &), float l, float u)
- [DataStats runStrategy](#) ([DEStrategy](#) strat, int experiment, float(\*f)(vector< float > &), float l, float u)  
*Run genetic algorithm for a certain function.*
- void [output\\_func](#) (string func\_name, vector< [DataStats](#) > result)
- void [output\\_all](#) (vector< [DataStats](#) > result\_best)

### 6.5.1 Detailed Description

run

Author

Cheng Su ( [csu@cwu.edu](mailto:csu@cwu.edu) )

Version

1.0

Date

2020-02-11

### 6.5.2 Function Documentation

#### 6.5.2.1 output\_all()

```
void output_all (
    vector< DataStats > result_best )
```

write best result for every function

## Parameters

<i>result_best</i>	best result for each function
--------------------	-------------------------------

## 6.5.2.2 output\_func()

```
void output_func (
    string func_name,
    vector< DataStats > result )
```

write result for one function for all strategies

## Parameters

<i>func_name</i>	function name
<i>result</i>	result of all strategies

## 6.5.2.3 runFunc()

```
DataStats runFunc (
    int experiment,
    string func_name,
    float(*) (vector< float > &) f,
    float l,
    float u )
```

Run genetic algorithm for a certain function

## Parameters

<i>experiment</i>	experiment size
<i>func_name</i>	function name
<i>min</i>	low bound for x
<i>max</i>	high bound for x

## Returns

best result among 10 strategies

strategy 1 best/1/exp

strategy 2 rand/1/exp

strategy 3 rand-to-best/1/exp

strategy 4 best/2/exp

strategy 5 rand/2/exp

strategy 6 best/1/bin

strategy 7 rand/1/bin

strategy 8 rand-to-best/1/bin

strategy 9 best/2/bin

strategy 10 rand/2/bin

#### 6.5.2.4 runStrategy()

```
DataStats runStrategy (
    DEStrategy strat,
    int experiment,
    float(*) (vector< float > &) f,
    float l,
    float u )
```

Run genetic algorithm for a certain function.

run one strategy for a function

##### Parameters

<i>strat</i>	strategy
<i>experiment</i>	number of experiment
<i>f</i>	function
<i>l</i>	low x bound
<i>u</i>	up x bound

##### Returns

return result analysis

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