

# 2016 HiPC Student's Programming Challenge – Problem Statement

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Updated: 02 October, 2016

## Background

Consider a 3-dimensional grid of points. Each point in the grid can be specified with 3 coordinates  $(x, y, z)$ . Where  $x$ ,  $y$  and  $z$  are integers. We call any two points on the grid *connected* to each other, if and only if they are separated by unit distance. For example, point  $(1, 1, 1)$  is connected to point  $(1, 2, 1)$ . On the other hand, points  $(1, 1, 1)$  and  $(2, 2, 1)$  are not connected to each other.

Similarly, a *connected partition* is a set of points with following properties,

1. If a point is included in the partition, then all the points connected to it must also be included in the partition.
2. Every point in the partition must be connected to at least one other point.

## Problem statement

You are given a set of points  $S$  on a grid and you need to find all the connected partitions in it. You should label each partition with a unique integer between 1 and total number of partitions.

The input data is given in the following format, in a csv file

```
x1, y1, z1  
x2, y2, z2  
....  
xN, yN, zN
```

The solution of the problem should be outputted in a ASCII file (*in the same order of the input data*) in following format,

```
<partition-label>  
<partition-label>
```

```
...
```

```
<partition-label>
```

## Example

Consider set  $S$  had 4 points  $\{(1, 1, 1), (1, 2, 1), (1, 2, 2), (1, 3, 3)\}$ . The connected points are  
 $(1, 1, 1)$  is connected to  $(1, 2, 1)$   
 $(1, 2, 2)$  is connected to  $(1, 2, 1)$

Therefore, we have two partitions one with points  $\{(1, 1, 1), (1, 2, 1), (1, 2, 2)\}$  and other with a single point  $\{(1, 3, 3)\}$ .

The content of comma separated output file would look like,

1  
1  
1  
2

#### Notes

1. For a given set  $S$ , the connected partitions are always unique.
2. You will be given 3 different data set .... small in KBs , medium in MBs, large in GBs
3. The solution for the small data set will be provided for functional testing of your code
4. Size of connected region can be between 1 and size of set  $S$ .
5. The submitted solution needs to produce accurate answer.
6. All the correct solutions will be compared against each other on the basis of performance (execution time).

Pseudo code for a possible solution can be found here:

ref: [http://www.algorithmist.com/index.php/Union\\_Find](http://www.algorithmist.com/index.php/Union_Find)

## Submission Packet Format

### Phase 1: Functional verification with medium dataset

Each participating team must submit a single zipped tarball with following contents:

- Name of Tarball: "<team name>\_phase1.tar.gz"
- Tarball contents:
  - "src" directory-- Contains all source code, makefiles etc.
  - compile.sh -- Shell script file with the compile command with all options used. Note we will be using this as is to compile your code
  - "<team name>\_medium\_phase1.csv" file -- ASCII file containing comma separated integers (see section below titled "Output File Format")

### Phase 2: Performance Benchmarking

Each participating team must submit a single zipped tarball with following contents:

- Name of Tarball: "<team name>\_phase2.tar.gz"
- Tarball contents:
  - "src" directory-- Contains all source code, makefiles etc.
  - compile.sh -- Shell script file with the compile command with all options used. Note we will be using this as is to compile your code
  - "<team name>\_medium\_phase1.csv" file -- ASCII file containing comma separated integers (see section below titled "Output File Format")
  - RESULTS.TXT: With following contents

Team Name:

Participant Names:

Registered Email: <email used for contest registration>

Dataset	Best Case Execution Time (End 2 End)	Best Case Execution Time (Algorithm)
Medium		
Large		

## Output file format

The solution of the problem should be outputted in a ASCII file (*in the same order of the input data*) in following format,

<partition-label>

<partition-label>

...

<partition-label>

For example,

1

2

1

4

4

3

....

1

### **Measuring Execution Time**

Script, stump code and other details will be provided soon.