

Capacity Monitoring Tool

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vodafone

Problem Statement

Vodafone has a crucial problem of monitoring the massive capacity of their network nodes in real time. The late response for such an issue might result in complete or partial shutdown of a major server or an active node.



Objectives

Developing a monitoring tool that collects data from vodafone servers to be analyzed, following that, sending alerts to the capacity management team. The analysis of data is intensive and runs through interconnected cycles of clustering, classification and data visualization.

Basic Functions

- **The capacity monitoring tool :**
 - Collect different files with different formats from different nodes on regular basis (daily, hourly...etc.).
 - Parse the received files from the node and insert the needed data into the database.
 - Notify the capacity management team when the capacity of a certain node is not enough.
 - Figures and analysis of data will be shown in the dashboard website.

Functional requirement

There are 32 functional requirements, but the most important functional requirements are the following:

Name	Classify
<i>Function Input</i>	selected Algorithm and selected data
<i>Function Output</i>	classified data
<i>Description</i>	classification for the collected data
<i>Expected risks</i>	data error, logical error
<i>Preconditions</i>	calling data from database
<i>Post-conditions</i>	store the classified data into database

Functional requirement

Name	Analyze Data
<i>Function Input</i>	selected Algorithm and selected data
<i>Function Output</i>	analyzed data
<i>Description</i>	data analysis for the selected data
<i>Expected risks</i>	data error, logical error
<i>Preconditions</i>	calling data from database
<i>Post-conditions</i>	store the classified data into database

Functional requirement

Name	Clustering
<i>Function Input</i>	selected Algorithm and selected data
<i>Function Output</i>	clustered data
<i>Description</i>	dividing the selected data for groups using clusters
<i>Expected risks</i>	gathering the data around one cluster and the rest nothing
<i>Preconditions</i>	calling data from database
<i>Post-conditions</i>	store the clusters data into database.

Non functional requirement

- Security

All files will be accessible only by Vodafone server.

- Portability

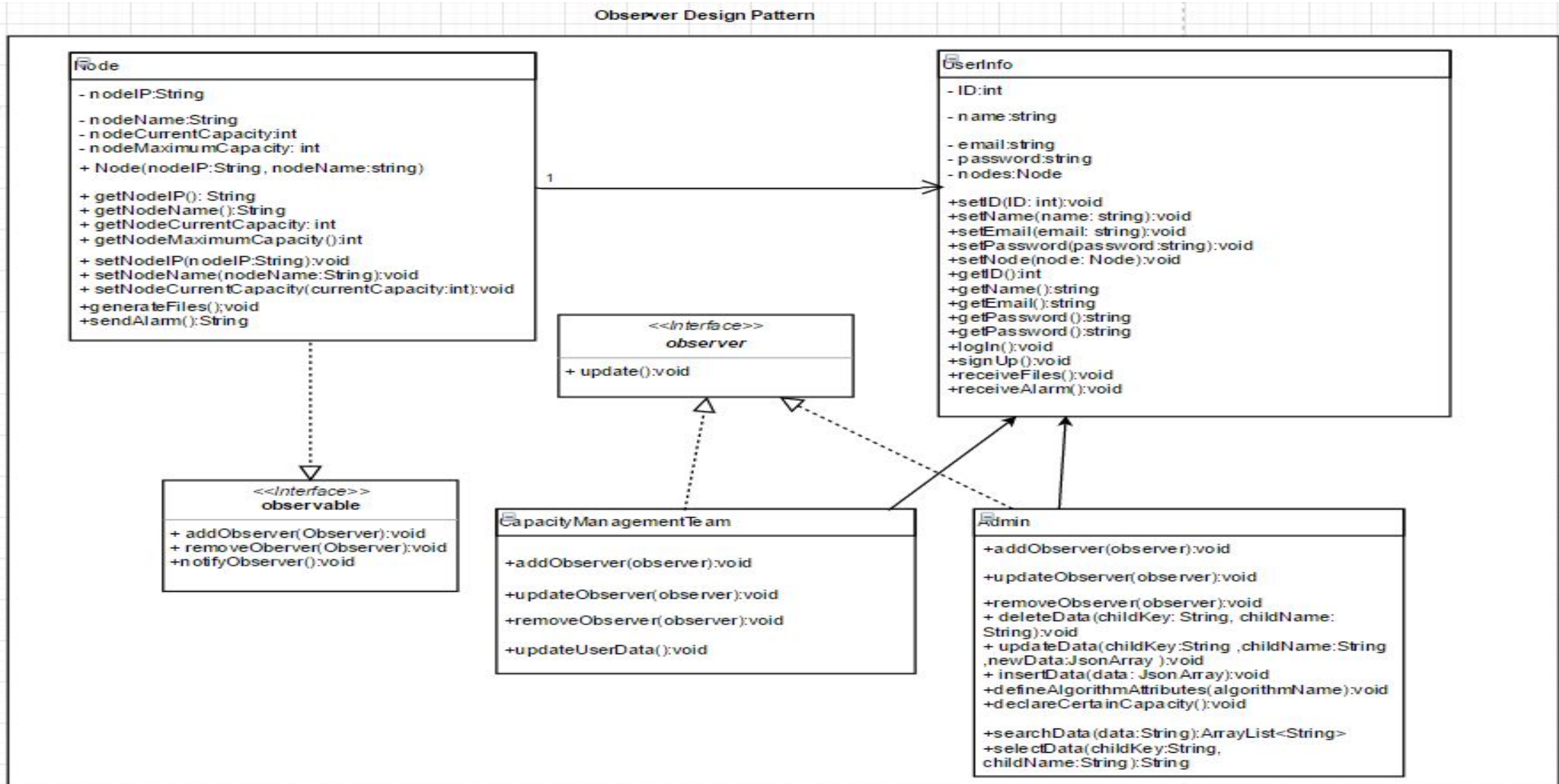
A mobile application will be made for receiving alarms in case of the capacity of a certain node is not enough either via sending an SMS or an e-mail. Also, the mobile application will display charts data, and a website for displaying the dashboards of the nodes viewed for the capacity team on the parsed files.

Usecase

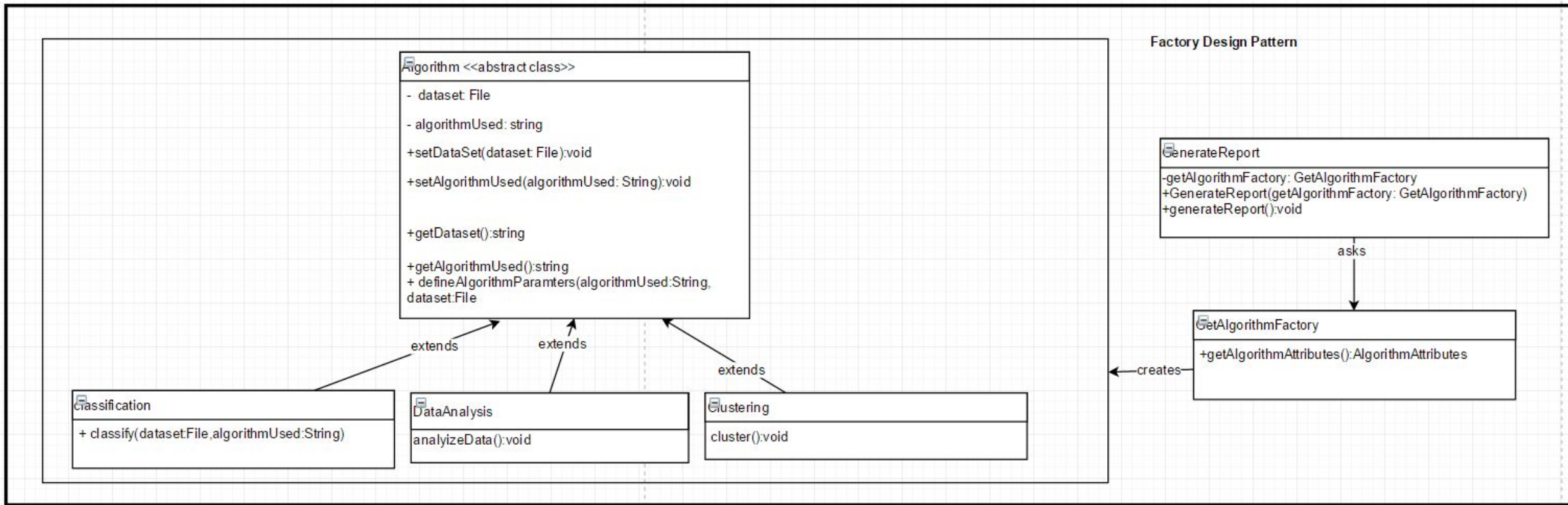
Database



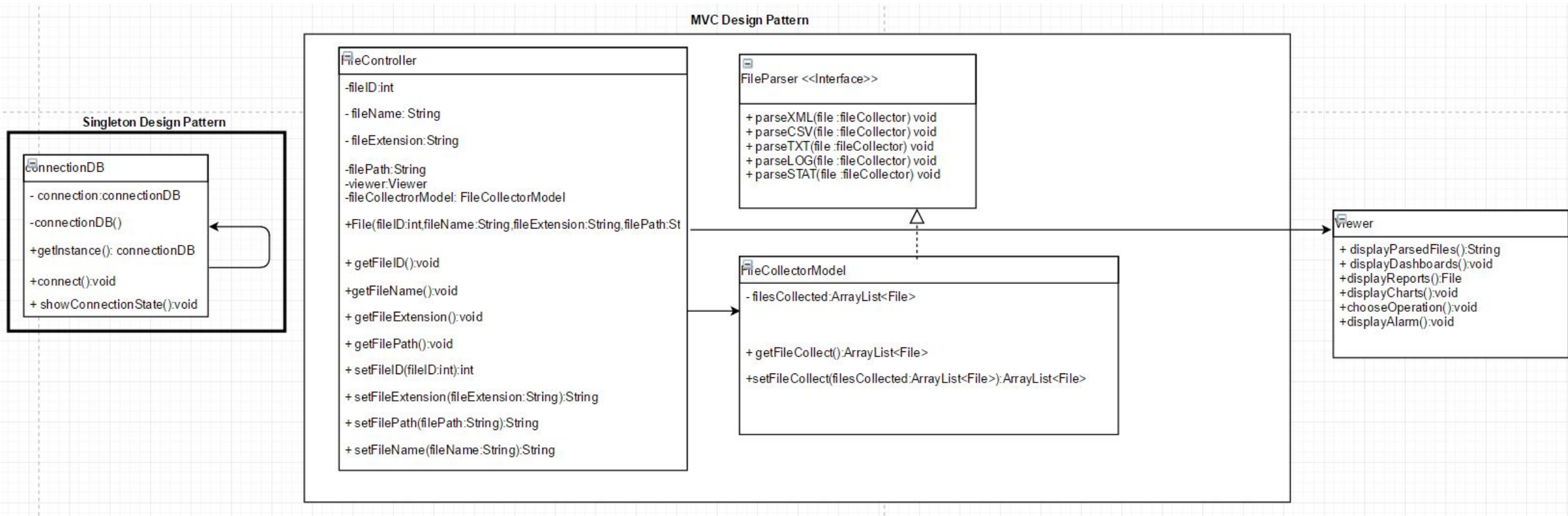
Primitive class diagram



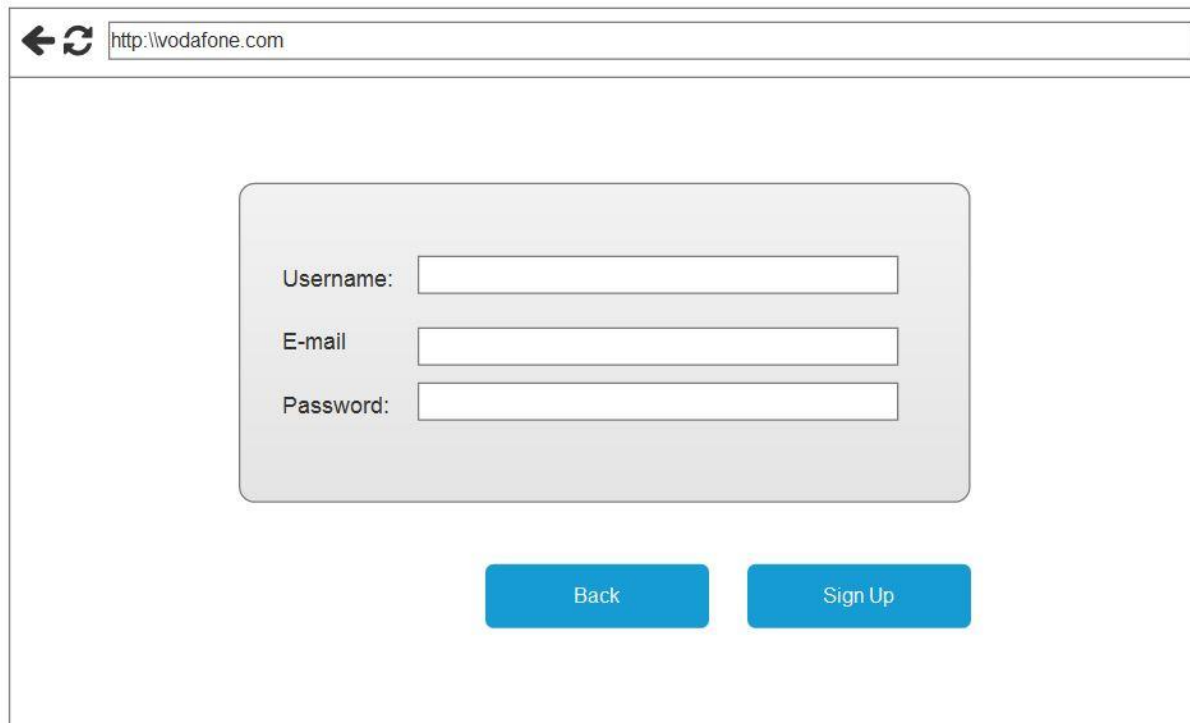
Primitive class diagram



Primitive class diagram



Web-based graphical interface tool



← ↻ http://vodafone.com

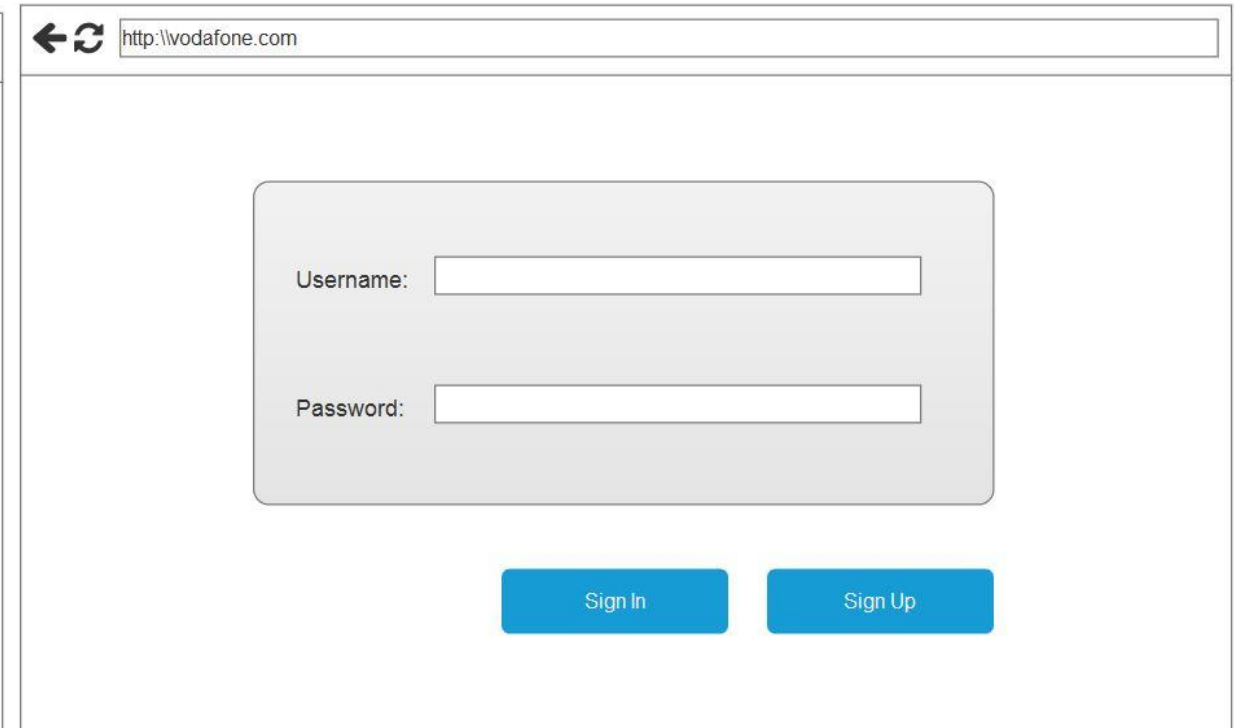
Username:

E-mail:

Password:

Back Sign Up

Sign Up



← ↻ http://vodafone.com

Username:

Password:


Sign In Sign Up

Sign In

Web-based graphical interface tool

← ↻ http://vodafone.com

Upload file



```

unsuccessful congestion (EXI)
Unsuccessful normal termination (INT)
Unsuccessful other reason (EXI)
Unsuccessful normal termination (EXT)
Community charging
Community indicator found
Subscriber not found
Internal error
Rating failed
CFT Charged Calls Unsuccessful Setup (EXT)
CFT Charged Calls Granted Time Expiry (EXT)
Test mode: 10-fold cross-validation

--- Classifier model (full training set) ---
Gaussian Processes
Kernel used:
Linear Kernel: K(x,y) = <x,y>

All values shown based on: Normalize training data
Average Target Value : 0.0
Inverted Covariance Matrix:
  Lowest Value = -0.11596147197525043
  Highest Value = 0.4025728178437053
Inverted Covariance Matrix * Target-value Vector:
  Lowest Value = 0.0
  Highest Value = 0.0

Time taken to build model: 0.02 seconds

--- Cross-validation ---
--- Summary ---

Correlation coefficient      NaN
Mean absolute error         NaN
Root mean squared error     NaN
Relative absolute error     NaN %
Root relative squared error NaN %
Unclassified instances      12
Total Number of Instances   100 %
          
```


Choose operation

-
- Cluster
- Classify
- Data Analysis
- Parse

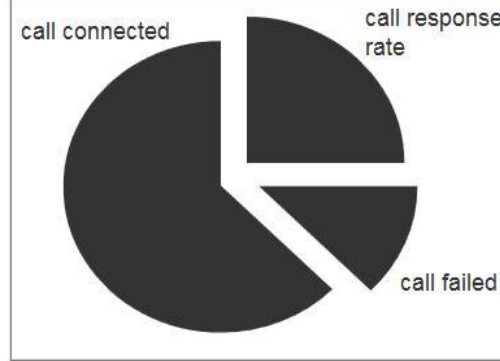
← ↻ http://vodafone.com

Overview dashboard

choose operation

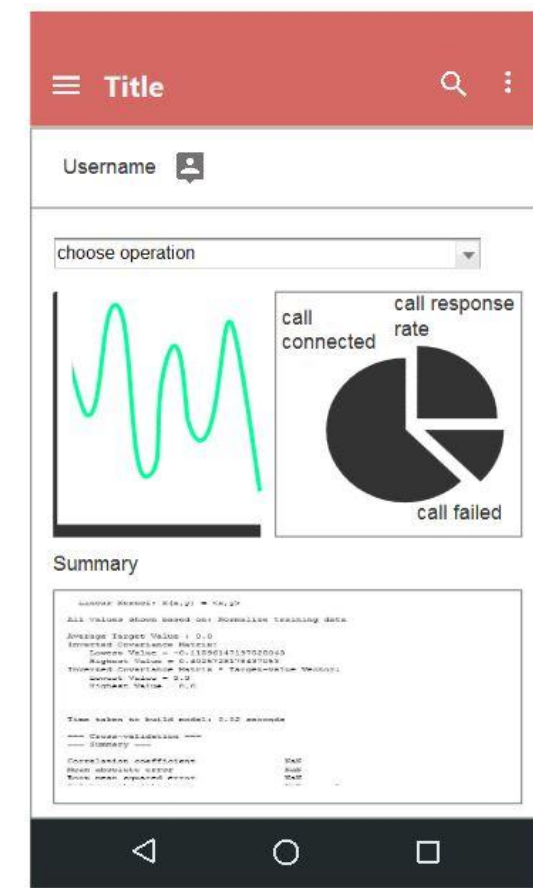
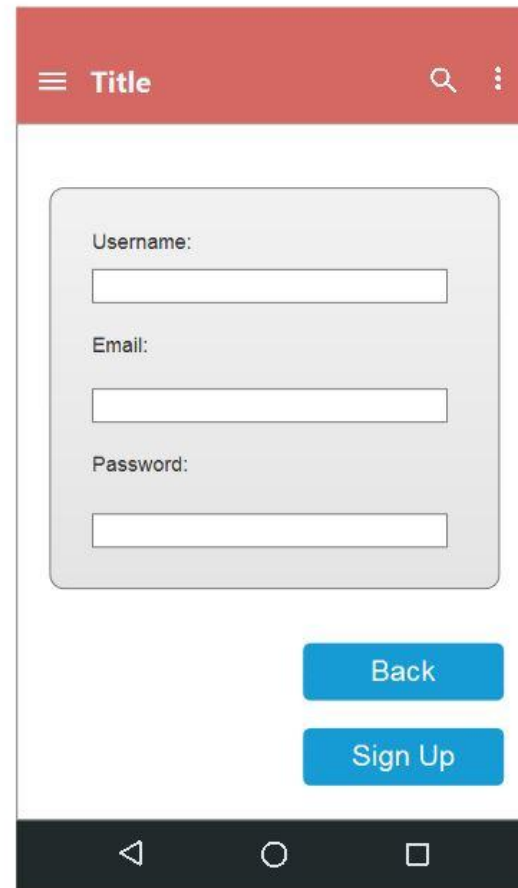
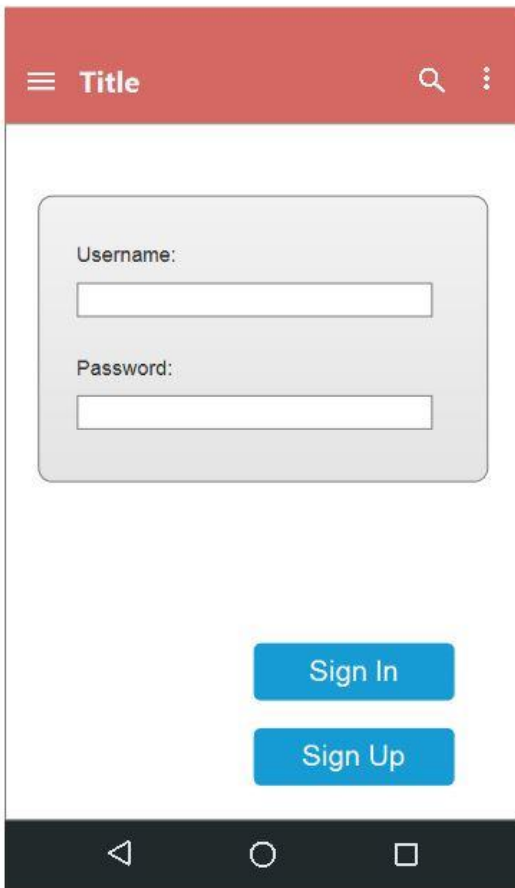


call response	connected	call failed



jan	<input type="text"/>	jul	<input type="text"/>
feb	<input type="text"/>	aug	<input type="text"/>
march	<input type="text"/>	sep	<input type="text"/>
april	<input type="text"/>	oct	<input type="text"/>
may	<input type="text"/>	nov	<input type="text"/>
june	<input type="text"/>	dec	<input type="text"/>

Mobile application



Row No.	Circle	Postpaid - O...	Postpaid - In...	Postpaid - T...	Postpaid - O...	Prepaid - Ou...	Prepaid - Inc...	Prepaid - To...	Prepaid - Ou...	Blended - O...	Blended - In...
1	Circle A	472	352	824	16	105	141	246	12	133	157
2	Circle B	655	398	1053	14	136	177	313	7	162	188
3	Circle C	804	395	1199	7	182	243	425	5	206	249
4	?	522	359	881	29	139	168	307	13	181	189

Classification Tool

Input :

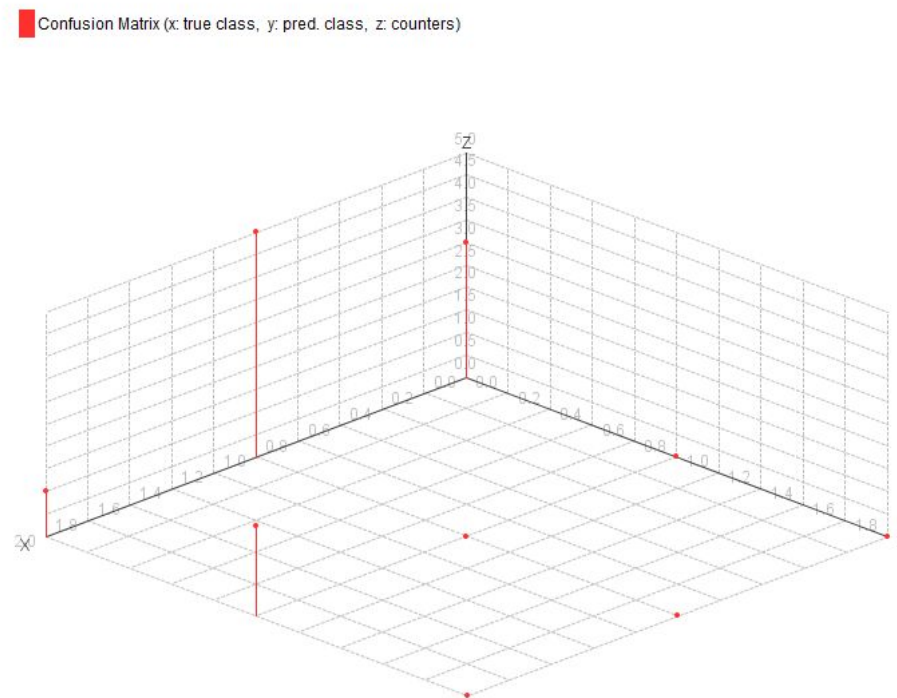
Blended - To...	Blended - O...
290	13
350	7
455	5
370	15

accuracy: 27.27%

	true Circle A	true Circle B	true Circle C	class precision
pred. Circle A	3	5	1	33.33%
pred. Circle B	0	0	2	0.00%
pred. Circle C	0	0	0	0.00%
class recall	100.00%	0.00%	0.00%	

Table View Plot View

Output :



Clustering Tool:

Cluto Tool:

Input File Sample:



Date	Originating	Forwarded	Terminating	Roaming originating	Roaming forwarded	Roaming t							
2016-12-22-1005	100943	543	342	29	2	74	0	27998	0	55605	0	0	0
2016-12-22-1010	102685	545	432	13	0	95	0	28849	0	57289	0	0	0
2016-12-22-1015	102833	567	315	25	0	83	0	29401	0	57483	0	0	0
2016-12-22-1020	104275	584	348	15	0	76	0	29540	0	58538	0	0	0
2016-12-22-1025	104724	541	319	13	0	84	0	29795	0	58723	0	0	0
2016-12-22-1030	107028	537	216	24	0	56	0	30258	0	60696	0	0	0
2016-12-22-1035	108264	553	148	36	0	76	0	30647	0	61274	0	0	0
2016-12-22-1040	108852	625	193	25	0	56	0	28495	0	61879	0	1	0
2016-12-22-1045	109882	671	180	15	0	53	0	27468	0	63053	0	0	0
2016-12-22-1050	112145	720	181	12	0	84	0	29239	0	64497	0	0	0
2016-12-22-1055	112087	675	184	6	0	69	0	27030	0	64681	0	0	0
2016-12-22-1100	114531	711	183	12	0	67	0	32865	0	66477	0	1	0

Results After Clustering:

- Number of clusters is **5**.
- **Similarity Function** used for clustering is **Cosine**.

gCluto - [solution 1]

File Project Solution Window Help

solution 1 - Solution Results

Clustering Options

Method: Repeated Bisection	Simfun: Cosine	#Clusters: 5
CRfun: I2	ColModel: None	Graph Model: Asymmetric-Direct
RowModel: None	EdgePrune: 0.000	VertexPrune: 0.000
ColPrune: 1.000	MinComponent: 1	CSType: Best
Nearest Neighbors: 4	#Iterations: 10	
#Trials: 10		

5-way clustering: [12 of 12]

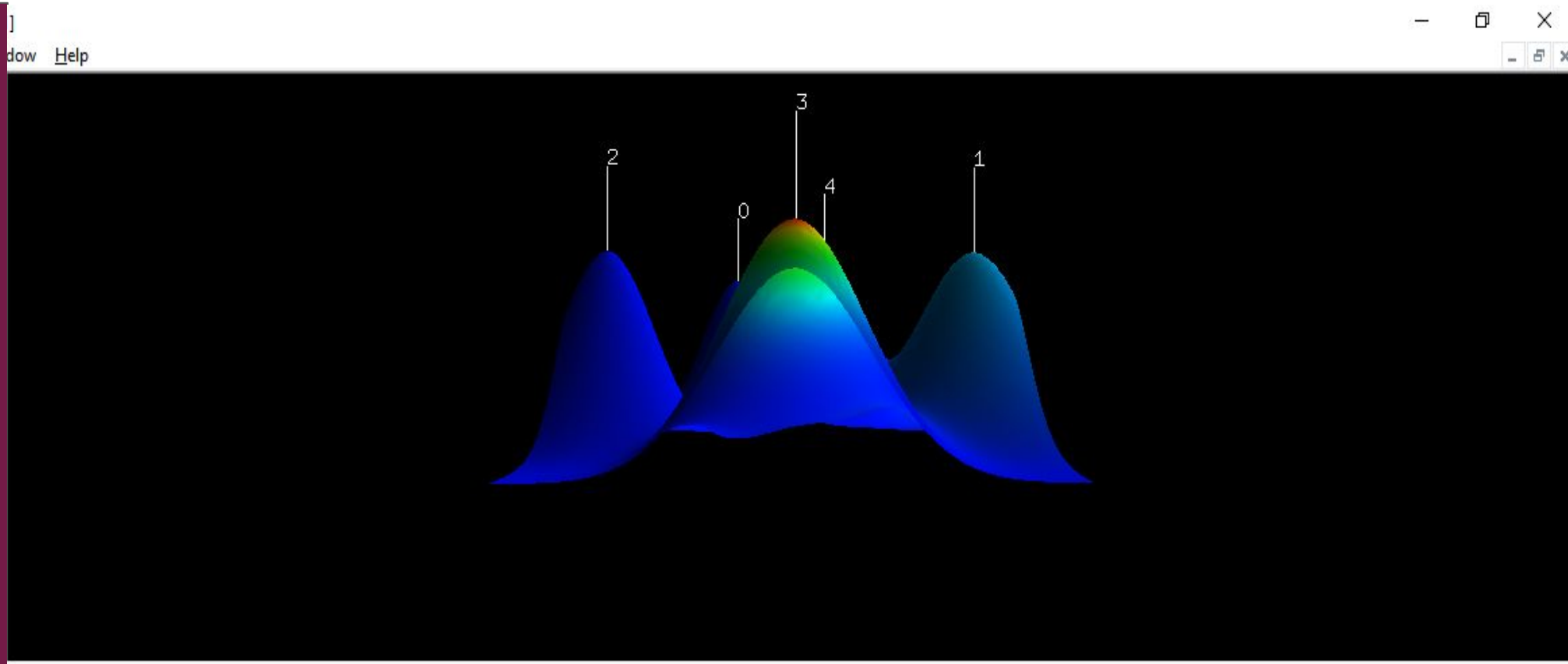
Cluster	Size	ISim	ISdev	ESim	ESdev
0	2	1.000	0.000	0.999	0.000
1	3	1.000	0.000	0.999	0.000
2	2	1.000	0.000	1.000	0.000
3	3	1.000	0.000	1.000	0.000
4	2	1.000	0.000	1.000	0.000

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Descriptive & Discriminating Features

Cluster	Size	ISim	ESim
Cluster 0	Size: 2	ISim: 1.000	ESim: 0.999
Descriptive:	Originating	35.2%	Successful setup
			23.7%
			Successful released by EXT network
			17.8%
			Voice
			11.7%
Discriminating:	Unsuccessful normal termination (INT)	29.4%	Content
			17.8%
			Originating service charging
			17.8%
			Successful released by EXT network
			12.1%
Cluster 1	Size: 3	ISim: 1.000	ESim: 0.999
Descriptive:	Originating	34.0%	Successful setup
			22.0%
			Successful released by EXT network
			19.6%
			Voice
			10.7%
Discriminating:	Unsuccessful normal termination (INT)	36.9%	Successful released by EXT network
			18.4%
			Successful setup
			11.5%
			Originating service charging
			8.9%
Cluster 2	Size: 2	ISim: 1.000	ESim: 1.000
Descriptive:	Originating	34.4%	Successful setup
			23.0%
			Successful released by EXT network
			18.9%
			Voice
			11.2%
Discriminating:	Originating service charging	37.3%	Content
			37.3%
			Successful setup
			11.1%
			Unsuccessful normal termination (INT)
			5.5%
Cluster 3	Size: 3	ISim: 1.000	ESim: 1.000
Descriptive:	Originating	33.9%	Successful setup
			22.5%
			Successful released by EXT network
			19.1%
			Voice
			11.1%
Discriminating:	Originating service charging	29.5%	Content
			29.5%
			Originating
			24.3%
			Unsuccessful normal termination (INT)
			9.5%

Mountain Visualization for the Result



Thank You!