
Capacity Monitoring Tool

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Capacity Monitoring Tool:

- Collects different files with different formats from different nodes on regular basis (daily, hourly...etc.).
- Parsing the received files from the node.
- Inserting the needed data into Firebase database.
- Notification system, via sending an SMS or an e-mail.
- Displaying charts and gauges.
- Data analysis.
- Classification
- Clustering

Purpose: To detect headache of network nodes.

Milano Dataset:

*More than 90 million records
covering 10,000 square-ids .*



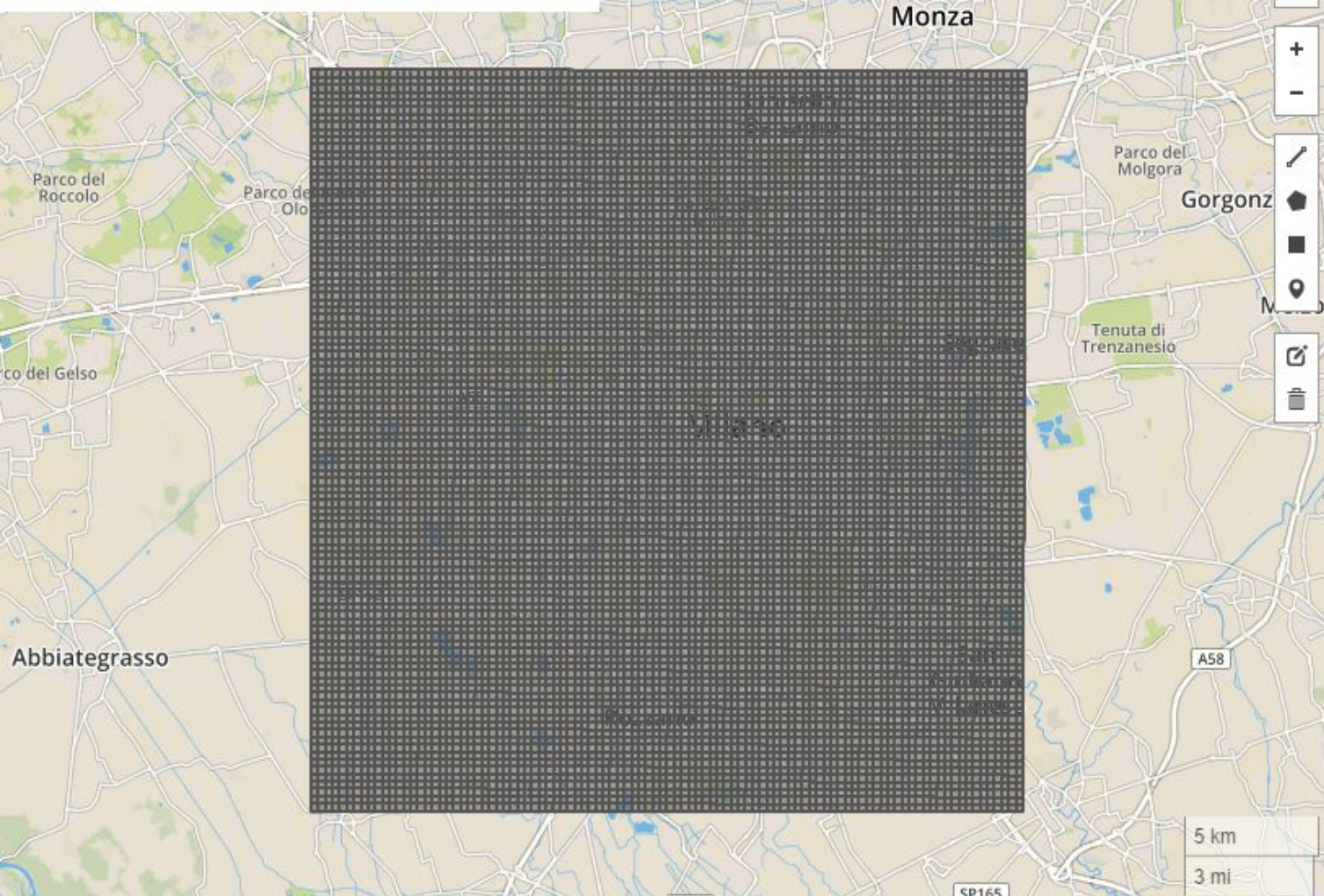
Dataset Details:



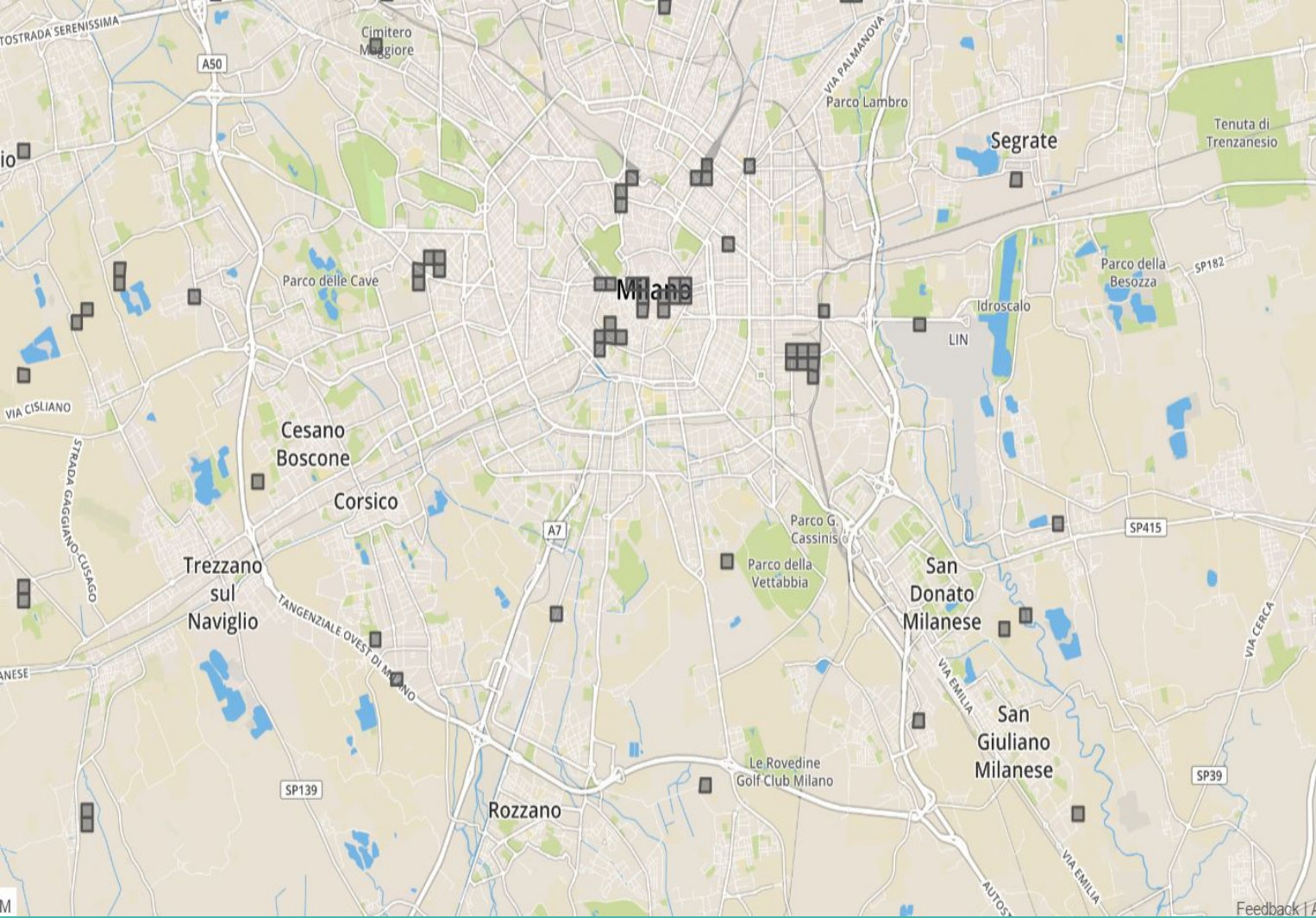
- **Square id** : identification string of a given square of Milan GRID.
- **SMS-in activity** : activity proportional to the amount of received SMSs inside a given Square id and during a given Time interval. The SMSs are sent from the nation identified by the Country code.
- **SMS-out activity** : activity proportional to the amount of sent SMSs inside a given Square id during a given Time interval. The SMSs are received in the nation identified by the Country code.
- **Call-in activity** : activity proportional to the amount of received calls inside the Square id during a given Time interval. The calls are issued from the nation identified by the Country code.
- **Call-out activity** : activity proportional to the amount of issued calls inside a given Square id during a given Time interval. The calls are received in the nation identified by the Country code.
- **Internet traffic activity** : number of CDRs generated inside a given Square id during a given Time interval. The Internet traffic is initiated from the nation identified by the Country code.

Dataset Details

SquareID	SmsInActivity	SmsOutActivity	CallInActivity	CallOutActivity	InternetTrafficActivity
1841	0.8792206688038322	0.2653983105742401	0.7050086449761563	0.34842404765535206	33.61191956822284
1841	0	0	0.2653983105742401	0	0
1841	0.08302573708111197	0	0	0.13269915528712006	0
1841	0.9288940870098404	0.13269915528712006	0.298750629449344	0.257237760908788	33.42883687451642
1841	0.17421202382767603	0	0	0	0
1841	0.4396103344019161	0	0.8792206688038322	0.5307966211484803	33.10631471628401
1841	0.39809746586136013	0	0	0	0
1841	0	0	0	0	0.13269915528712006
1841	0.6634957764356003	0.17421202382767603	0.5307966211484803	0.6634957764356003	40.04215347072925
1841	0	0	0	0	0.2653983105742401
1841	0	0	0	0	0.39809746586136013
1841	1.0615932422969605	0.7961949317227203	0.5307966211484803	0.34026349798989997	39.13703091250247
1841	0	0	0	0	0.04151286854055598
1841	0.6553352267701482	0.21572489236823203	0.21572489236823...	0.5307966211484803	37.708212935260164
1841	0.13269915528712006	0	0	0	0
1841	0.9704069555503965	0.5307966211484803	0.3069111791147961	0.48112320294247213	36.56004335481561
1841	0.2653983105742401	0	0	0	0
1841	0.5307966211484803	0.13269915528712006	0.13269915528712...	0.5641489400235841	31.857028831681653
1841	0.04151286854055598	0	0	0	0
1841	0.2653983105742401	0.13269915528712006	0.21572489236823...	1.1031061108375164	29.97120840759914
1841	0.13269915528712006	0	0	0	0
1841	0.5307966211484803	0.3069111791147961	0.3069111791147961	1.0119198240909524	42.64149231677257
1841	0.2653983105742401	0	0	0	0
1841	0	0	0	0	0.04151286854055598



GeoMaps 10,000 Square IDs



GeoMaps

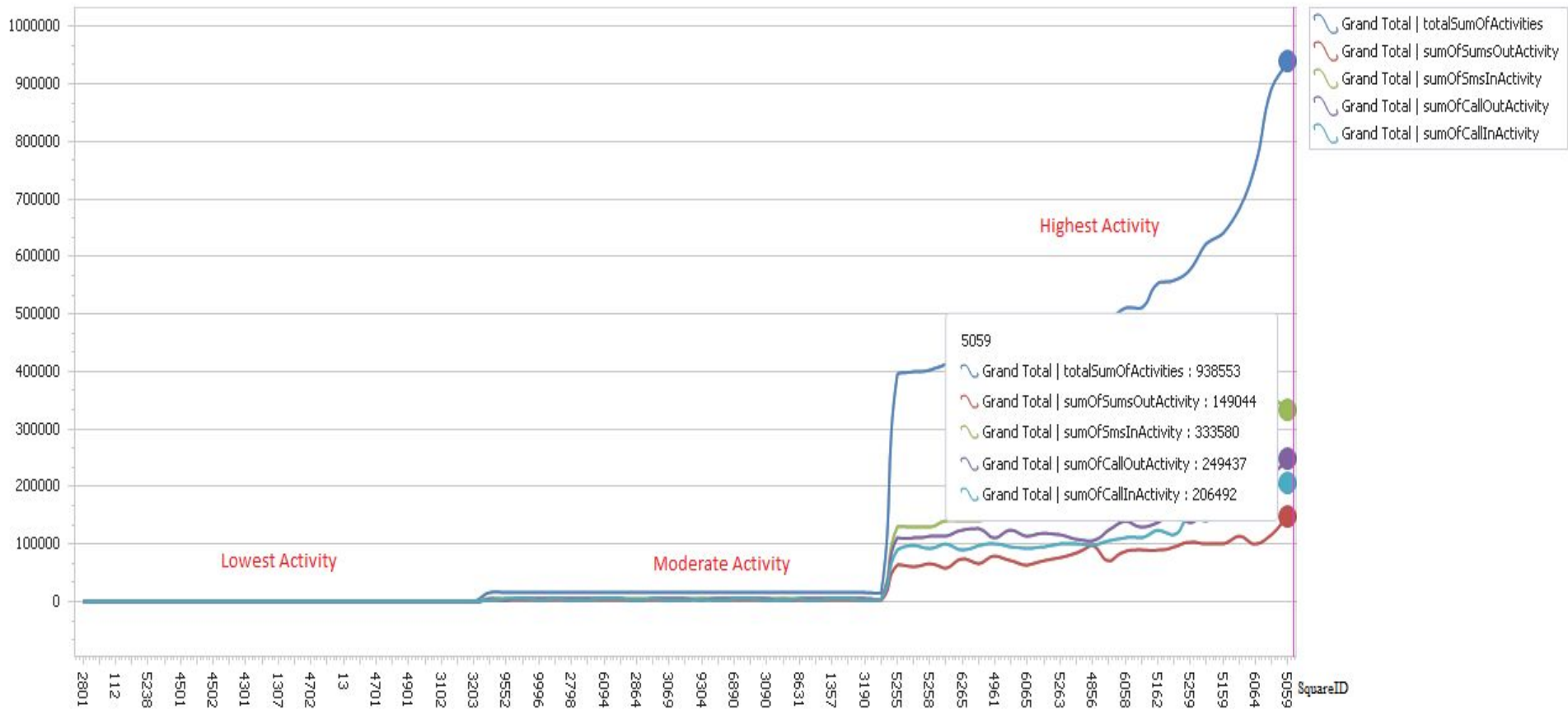
75

Distinct

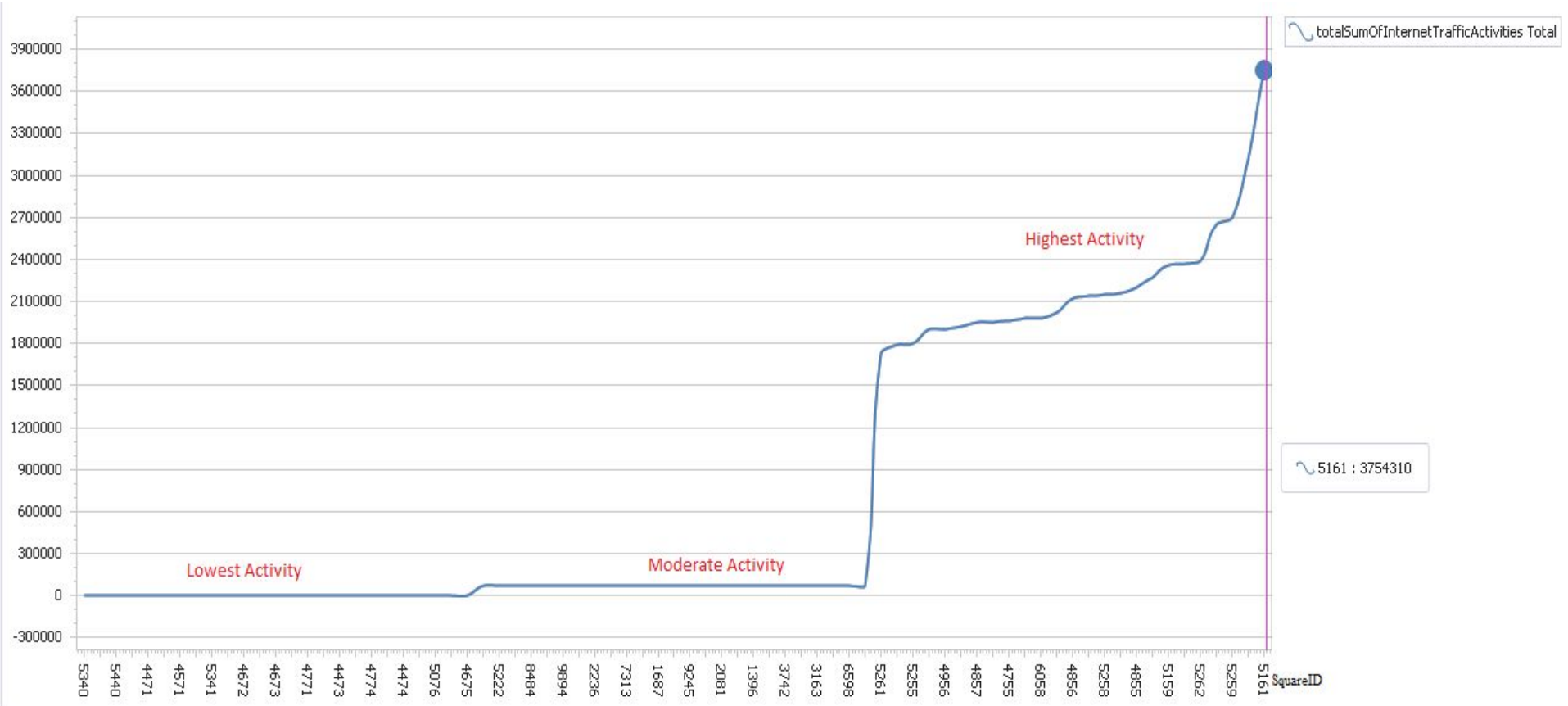
Square

IDs

Activity Level :



Internet Traffic Activity Level :



Classification

Support Vector Machines(SVM)

- Support Vector Machines (SVM) are supervised learning models with associated learning algorithms that analyze data used for classification, regression, and outliers detection.
- SVM builds a model forming an optimal hyperplane that separates the classes.
- The built model categorizes inputs into one of the classes.

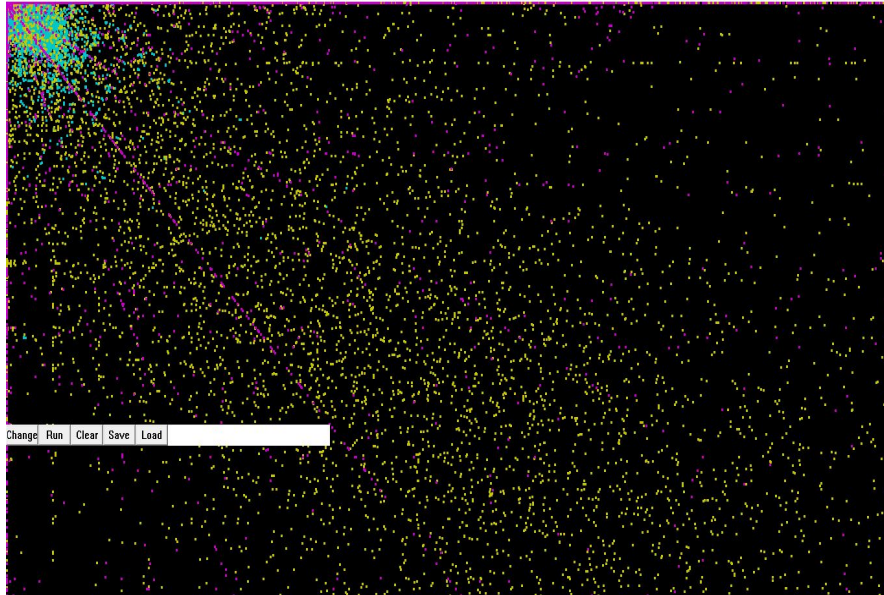
Using LIBSVM (SVM):

Kernel-Types	Linear	Polynomial	Radial Basis	Sigmoid
SVM-Types				
C-SVC (multi-class classification)	48.3035%	29.091%	65.8629%	35.957%
nu-SVC (multi-class classification)	46.1328%	40.7294%	65.3186%	43.2741%

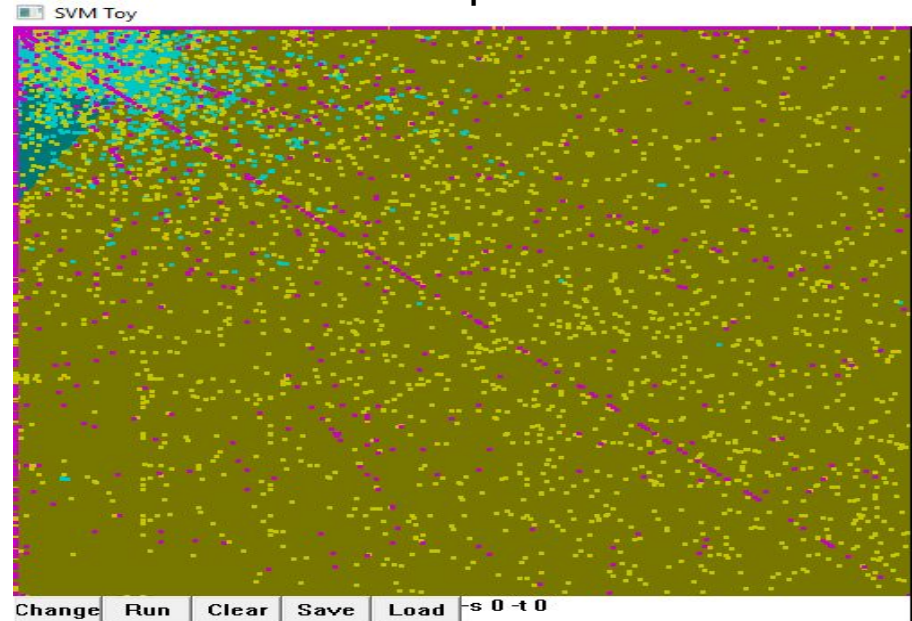
- Default parameters values are used for each kernel function.
- C and nu are parameters which help in increasing accuracy.
- C ranges from 0 to infinity and nu from 0 to 1.

Using LIBSVM:

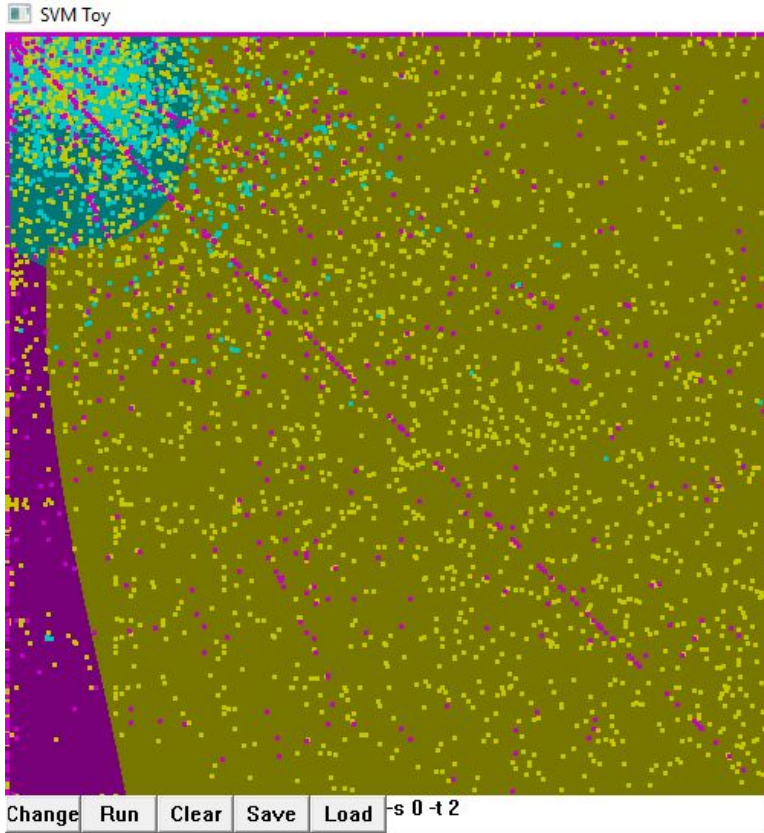
Data to be used for training(before classification).



Training data after classification with C-SVC(multi-class) and Linear Kernel function with default parameter values.

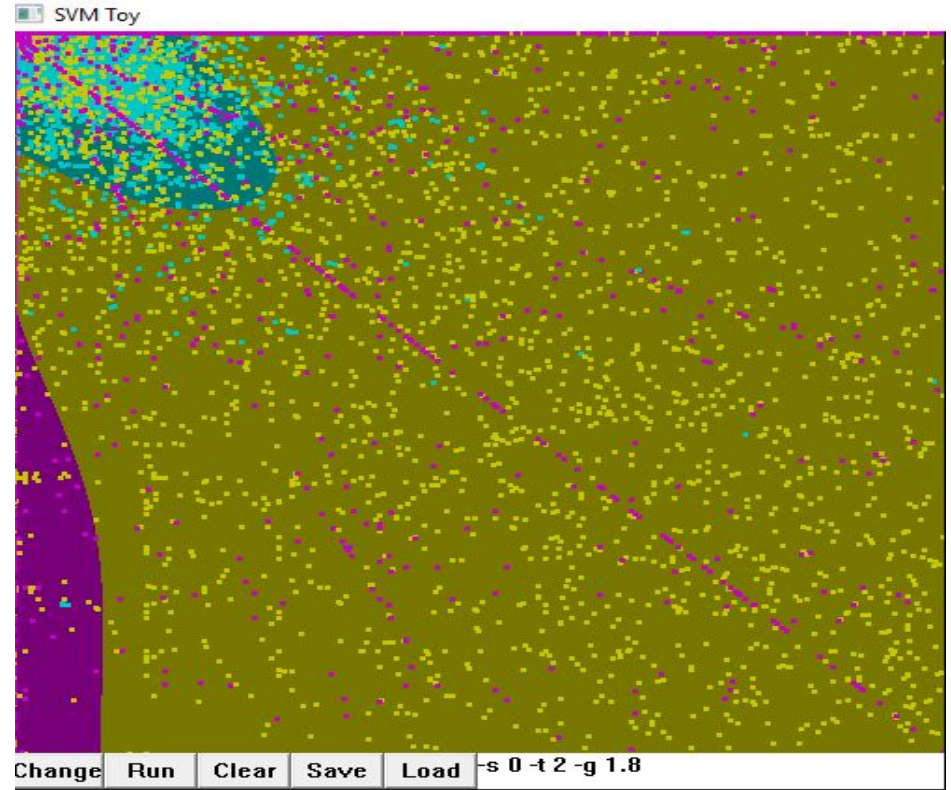


Training data after classification with C-SVC(multi-class) and Radial Basis Kernel function with default gamma parameter value.



Enhancement:

Radial Basis Kernel function with gamma of value 1.8



**After enhancement,
the following accuracies are achieved...**

C-SVC, Kernel-Types	Radial Basis Kernel Function
gamma= 0.2(default)	65.8269%
gamma= 0.3	66.3372%
gamma= 0.6	69.0255%
gamma= 0.98	70.4114%
gamma= 0.99	70.4415%
gamma= 1.3	70.5884%
gamma= 1.8	71.1027%

Classification Neural Network (NN):

- The used algorithm is Radial Basis Function (RBF).
- The selected column is activity level column with the other columns.

Type	Selected Algorithm	Classifier Accuracy Percentage
Train	RBF	71.20%
Test	RBF	72.35%

Index	Net. name	Training perf.	Test perf.	Validation perf.	Training algorithm	Error function	Hidden activation	Output activation
1	RBF 5-21-3	71.20111	72.35667		RBFT	Entropy	Gaussian	Softmax
2	RBF 5-25-3	73.31889	73.95667		RBFT	Entropy	Gaussian	Softmax
3	RBF 5-21-3	65.52444	66.23667		RBFT	Entropy	Gaussian	Softmax
4	RBF 5-24-3	80.60667	81.20333		RBFT	Entropy	Gaussian	Softmax
5	RBF 5-28-3	91.58111	91.49667		RBFT	Entropy	Gaussian	Softmax

Clustering

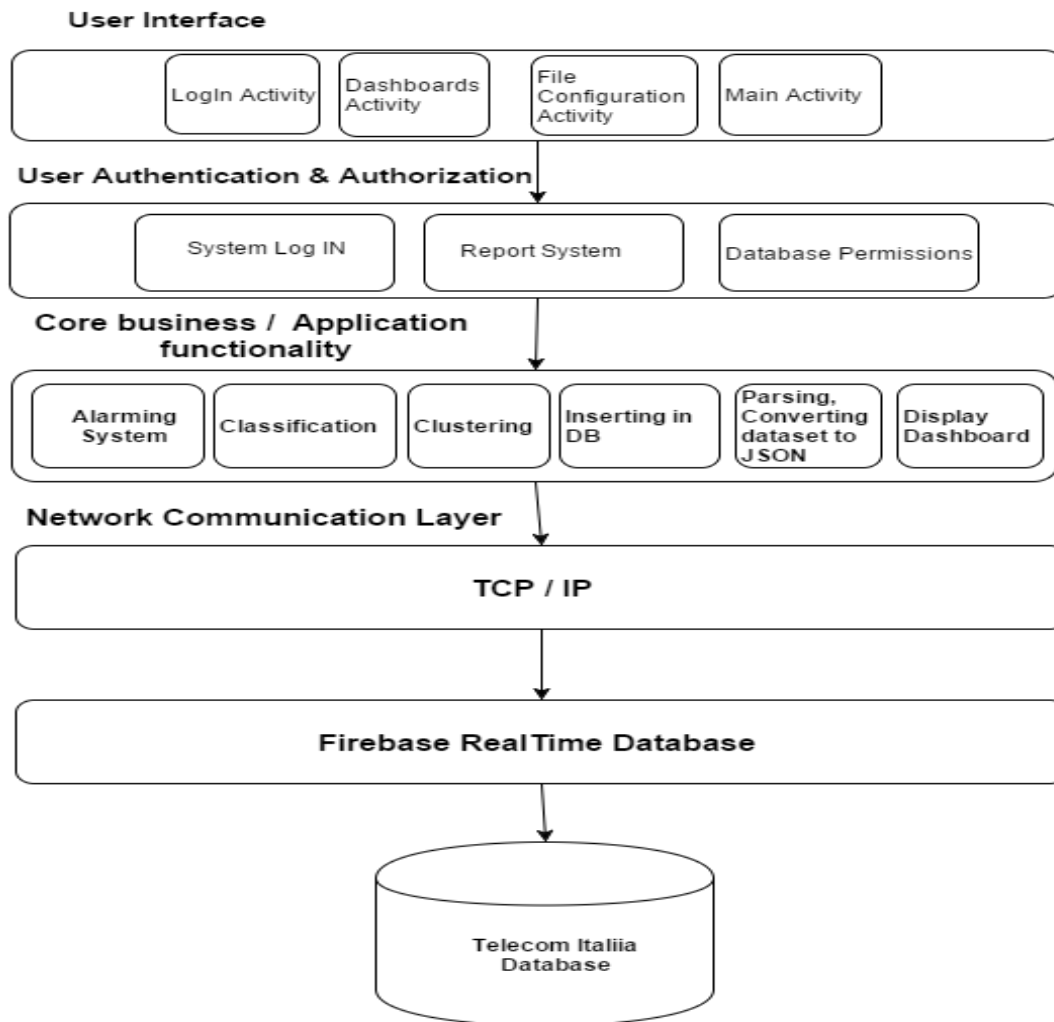
Clustering:

Number of clusters = 8

Row ID	D totalSum	D timeInHours
cluster_0	5,038.333	12.5
cluster_1	1,277.667	5.5
cluster_2	2,724.167	15.5
cluster_3	55,363.222	7.333
cluster_4	117,212.333	14
cluster_5	1,090,300.889	7.333
cluster_6	2,611,057.667	15.5
cluster_7	4,724,989.444	13

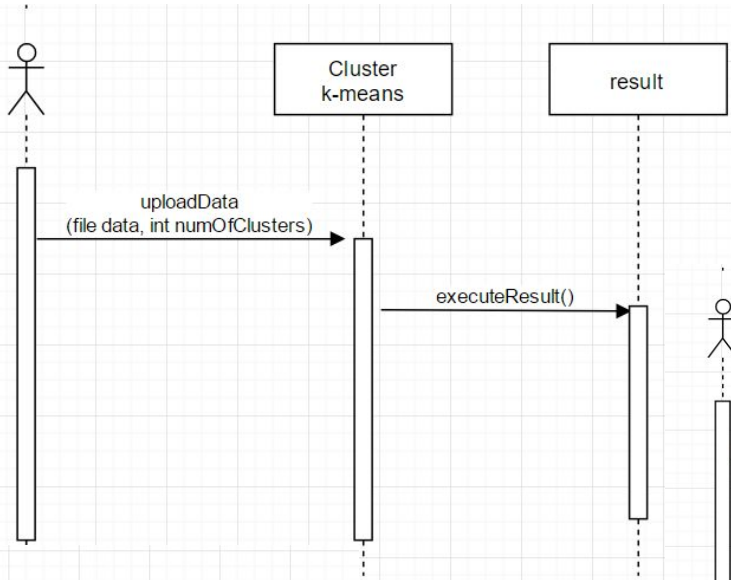
Problem Statement:

- Telecom operators have 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.

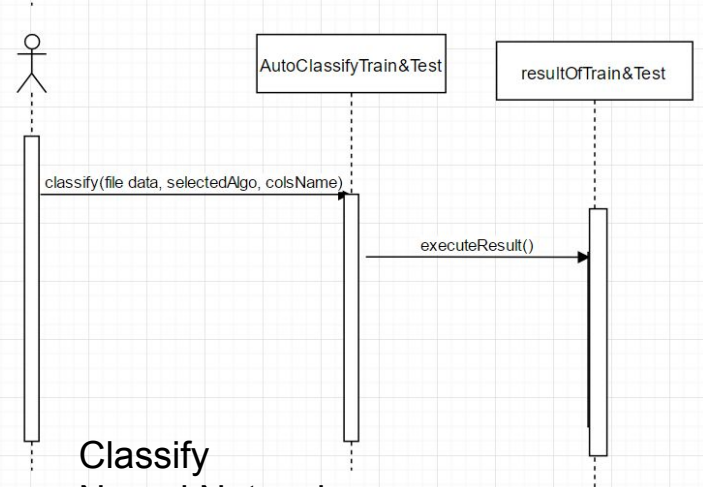


Architecture Diagram

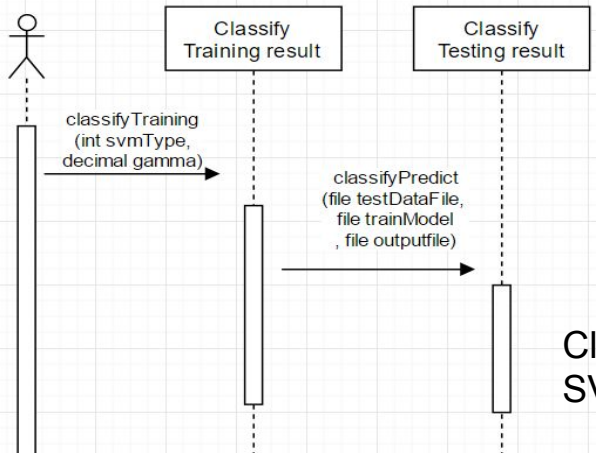
Clustering K-means



Classify Neural Network



Classify SVM

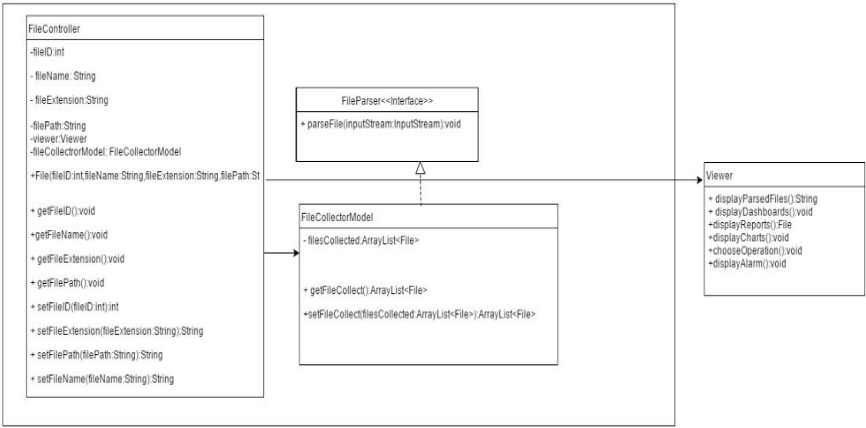


Main sequence diagram

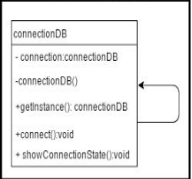
Class Diagram:



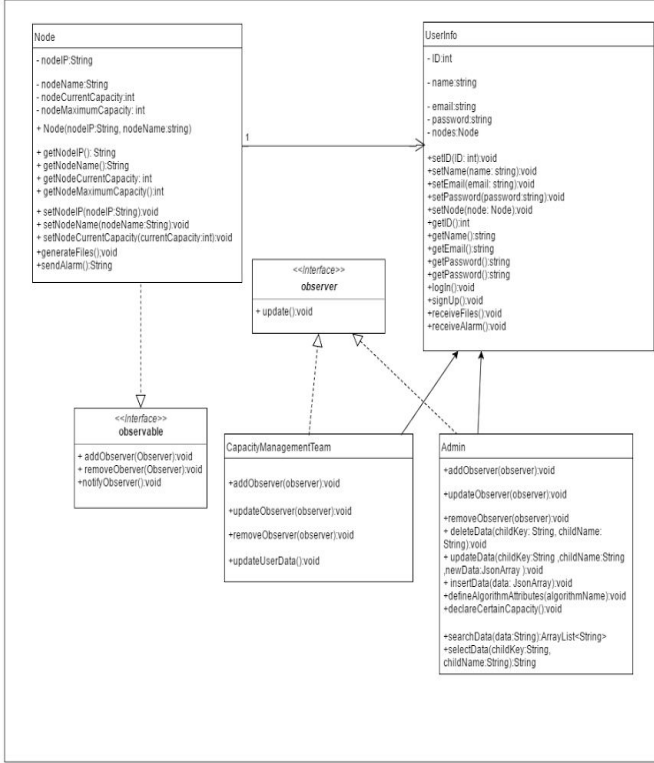
MVC Design Pattern



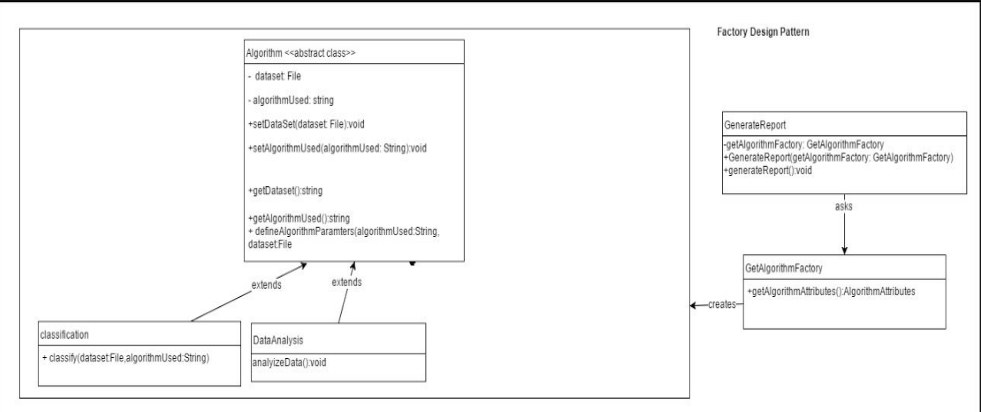
Singleton Design Pattern



Observer Design Pattern

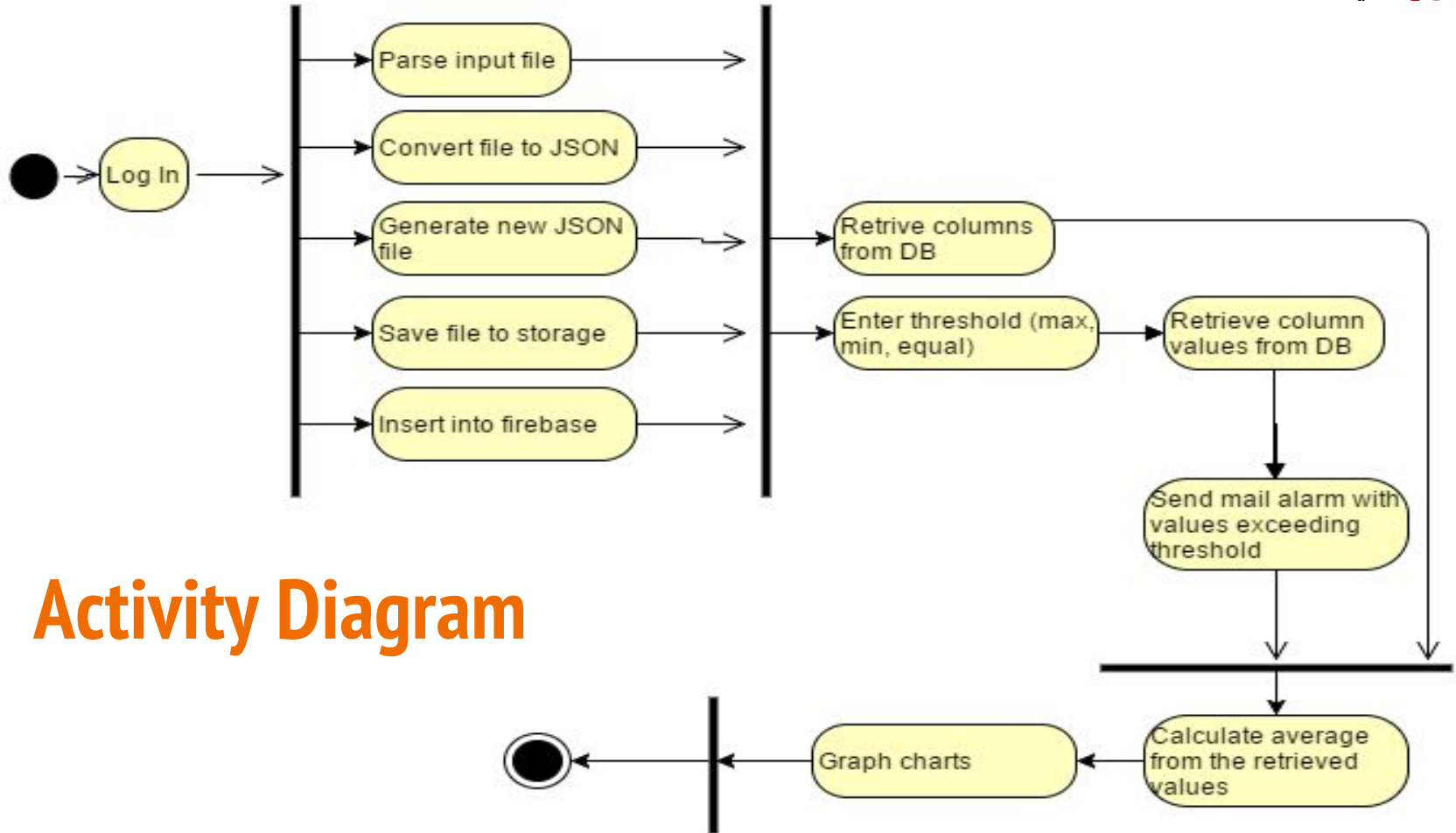


Factory Design Pattern





Database



Activity Diagram

Demo



Thank You