Machine Learning Assists the Classification of Reports by Citizens on Disease-Carrying Mosquitoes

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Overview

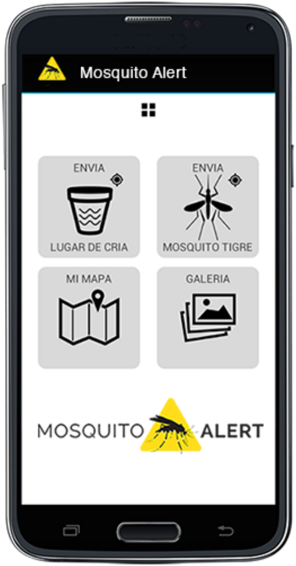
1. Introduction
2. Methodology
3. Project development
    - Exploratory data analysis
    - Data cleaning and pre-processing
    - Classifier training, evaluation and selection
    - Real-time classification system design
4. Discussion
5. Future work

Introduction - Mosquito Alert

MOSQUITO ALERT

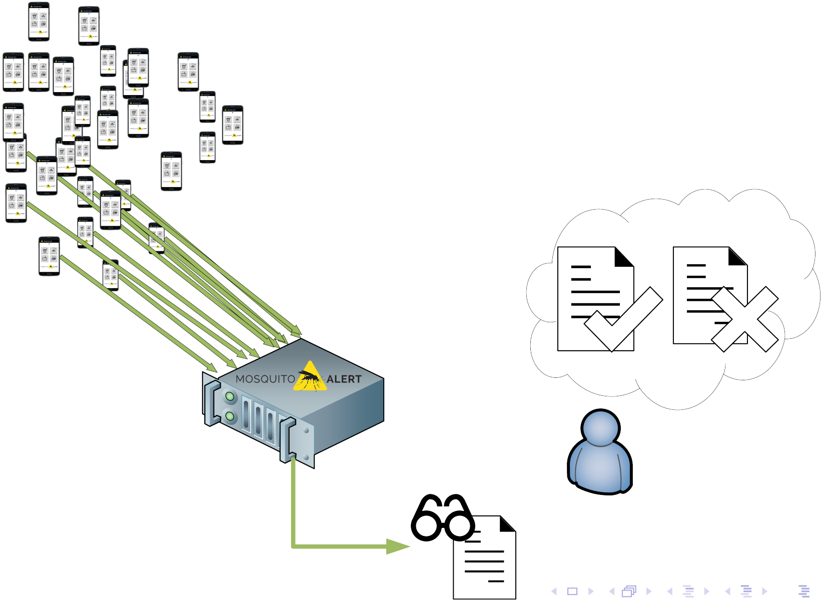
- Citizen Science Platform
- Mobile application
- Growing fast
  - Various mosquito species
  - Worldwide localizations

Introduction - Mobile App

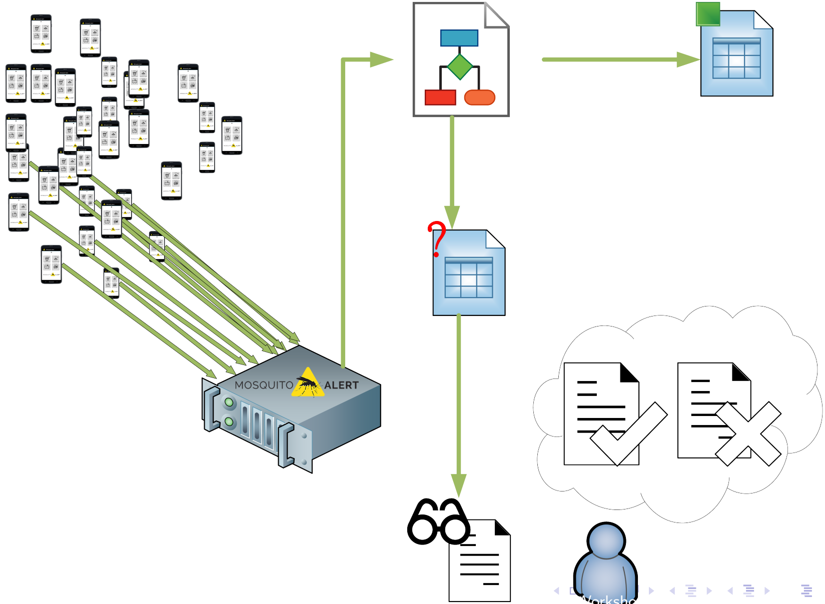


- Send breeding site
- Send specimen report
- Small questionnaire
- Geolocated!

Introduction - Mosquito Alert System



Introduction - Classification system



Methodology

1. Exploratory data analysis
2. Data cleaning and pre-processing
3. Classifiers
    - training
    - evaluation
    - selection
4. Real-time classification system design

Exploratory data analysis - Raw files

users 16967 observations of 10 variables

- userID
- userRegistTimeOriginal
- userRegistDatetime
- userRegistDate
- userRegistMonthNum
- userRegistMonthString
- userRegistWeekdayString
- userRegistWeekdayNum
- userSyst
- userDaysSystRelease

Exploratory data analysis - Raw files

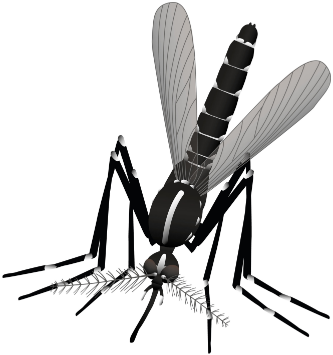
reports 10618 observations of 23+1 variables

- reportVersionID
- reportVersionNum
- userID
- reportID
- reportType
- reportNote
- os
- hide
- reportCreationDatetime
- reportCreationDate
- reportVersionDatetime
- reportVersionDate
- reportCreationMonthNum
- reportCreationMonthString
- reportCreationWeekdayString
- reportCreationWeekdayNum
- reportLong
- reportLat
- missionNum
- missionName
- tiger_q1_response
- tiger_q2_response
- tiger_q3_response
- **class**

Questionnaire variables

Questions

- Is small, black and has white stripes?
- Has a white stripe in both head and thorax?
- Has white stripes in both abdomen and legs?



Response values

-1	No
0	Not sure
1	Yes

The **class** variable

-2 The report is definitely not a valid specimen.

-1 The report doesn't seem to be a valid specimen. But it is not sure.

0 There isn't enough information to classify the report.

1 The report seems to be a valid specimen. But it is not sure.

2 The report is definitely a valid specimen.

Instance variables

Added

- reportNote
- reportTimeOfDay.
- newUser
- userNumReports
- userAccuracy
- userTimeForFirstReport
- userTimeSinceLastReport
- userMeanTimeBetweenReports
- userNumActionAreas
- userMobilityIndex
- reports1kmLast* (4)
- validReports1kmLast* (4)

Preserved

- os
- reportMonth
- reportQ*Answ (3)
- **class**

Generated instances

- 2094 instances from usable reports

Class	2	1	−1	−2
Frequency	47%	46%	2%	5%

- Class-imbalanced problem: positive instances over 7 times as frequent as negative ones.

Studied classifiers

- Naive Bayes
- k-nearest neighbors
- Decision trees
- Random Forests

Classifiers - Considerations

- Most classifiers have trouble dealing with imbalanced classes
- Merged “unsure” (-1,1) classes into “sure” ones (-2,2)
- Replication of minority class performed
- . . . but testing still on original proportion

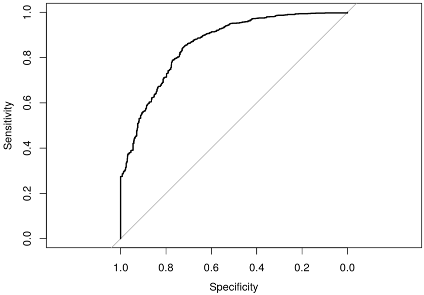
Classifiers - Selected classifier

	Positive	Negative
Accuracy	0,380	
Precision	0,983	0,086
Recall	0,344	0,912
F-measure (F1)	0,51	0,157

Table: Evaluation metrics, Naive Bayes

- Naive Bayes
- Training conditions:
  - Aggregated instances
  - Replicated (x10) negatives in training
- High positive *Precision*
- High negative *Recall*
- *can detect approximately 1 third of the valid reports with a precision near 98%*

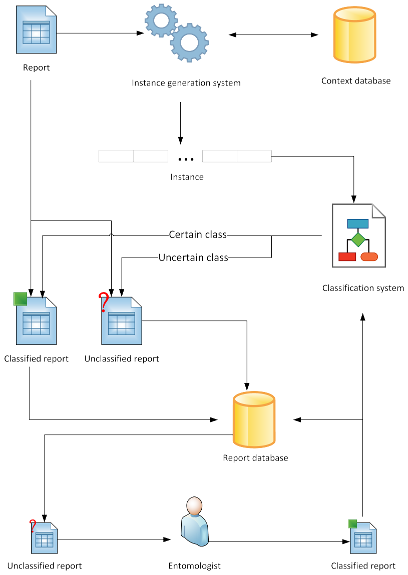
ROC curve and variable importance



Variable name	Importance
reportQ2Answ	0.7424
reportQ3Answ	0.7038
reports1kmLastMonth	0.6623
reportQ1Answ	0.6615
userNumReports	0.6405
userNumActionAreas	0.6348
validReports1kmLastMonth	0.6216
userTimeForFirstReport	0.6197
reports1kmLastWeek	0.6158
userAccuracy	0.6085

Table: Variable importance in the NB classifier. Numbers are the values of the model coefficients after standarization.

Real-time classification system design



- Two subsystems:
  - Instance generation system
    - Instance creation script
    - Environment
  - Classification system
    - Training script
    - Classifier
    - Classification script

Future work

Scalability

- Code modifications
- GIS enabled database
- Approximately the same computational resources

Improvements

- Classifier tuning
- Priority system
- Another classifier: Random Forest

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