Security Intelligence
Data Mining

University of Amsterdam
System & Network Engineering (MSc)

Research Project 1

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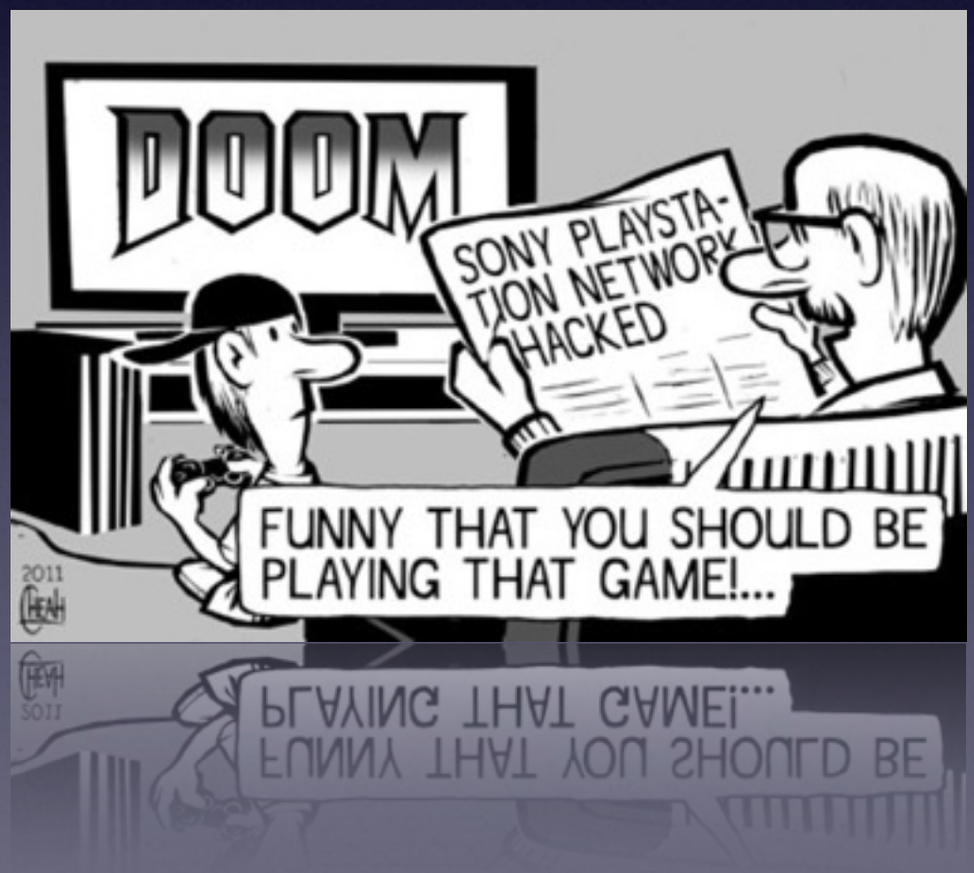
Research Question

- How can we effectively use public sources to obtain real time information about security incidents?

Why?

- Critical company infrastructure & confidential data protection
- Recent events…



What?

- A way to use public sources to collect security intelligence
- A system that collects, processes and analyses data to create security incident alerts

System Outline

- Modular and pipelined configurable system
- Data aggregation, preprocessing, analytics, alerting, assessment
- Let’s take a look at each part

Configuration

- Define list of common security threats
- List of clients
- List of Software/Hardware vendors, models, tools
- Attach list of keywords with associated importance (weight) to each threat as well as a list of sources

Example

- DDoS:
  keywords: {[DDoS,1.5], [Attack, 0.2], [Holland, 0.1], [Strawberries, 0.8]}
- Phishing:
  keywords: {[Phishing, 2], [Site, 0.2], [Nicolas Cage, 0.1], [Jazz, 0.8]}
- Malware
  keywords: {[Virus, 2], [Worm, 1.5], [Trojan, 1.2], [Punk, 0.1]}
- Exploits:
  keywords: {[Exploit, 2], [Bug, 2], [Vulnerability, 1.5], [Nachos, 0.3]}
-Etc.

Example

- DDoS
sources: {[www.alltheddosdiscussion.nl, targeted], [www.pastebin.com, general]}

- Phishing

sources: {[www.phishtank.com, targeted], [www.pastebin.com, general]}

- Malware

sources: {[www.aplacethatviriilivein.org, targeted], [www.pastebin.com, general]}

- Exploits:

sources: {[www.allthecves.gov, targeted], [www.reddit.com/r/blackhat, general]}

-Etc.

Example

Vendors: {Oracle, IBM, HP, Microsoft, Apple, Canonical, Ubuntu}

Clients: {Deloitte, ING, AMRO, Rabobank, DUWO}

Aggregation

- Extensible plugin oriented module
- Configurable to include authentication keys, execution intervals, source files, etc.
- Must perform initial cleaning of the data (surrounding HTML, profile pics, etc.)

Demo

- Twitter, Reddit, Pastebin, Phishtank
- Scrapy, Tweepy, Standard Python libs
- RESTful/Streaming APIs, traditional scraping
- 1078827 tweets,23050 pastes, 6325 reddit posts, 25051 phishing websites

Preprocessing & Warehousing

- Deflate raw data according to the specified keywords
- Score each document according to the occurrence of important words
- Apply certain threshold to store only interesting data to warehouse

Demo

- Input: Bull***t data
- Output:

-DDoS:

{keywords: [[DDoS,4],[Attack,10],[Holland:1]], vendors:[], clients: [[ING,2]], doc_id:1, score: 17}

Mining & Analytics

- Data Mining Tasks
  - Anomaly Detection
  - Association Rule
  - Classification
  - Clustering
  - Regression
  - Summarisation

Association Rule

- Finding relationships between different subsets in the database
- Apriori algorithm

Demo

- Orange Library

Clustering

- Discovering previously unknown structures or groups of subsets that present similarities within the dataset
- k-means algorithm

Demo

- SKlearn Library

Cluster 13: paris charlie hebdo attack http mayor nypd rt victims french honor visited nyc france terror muslim bolsters security jewish cover

Cluster 15: photos leaked upton kate jennifer lawrence nude victoria justice megan fox http seen rt hilarious kardashian kim

Cluster 18: attack http rt titan panic bus hotel tel aviv killed terror amp deadly anxiety people terrorist tripoli video uses

Classification

- Generalising known structures and applying them to new data.
- Requires training set (supervised learning)

Demo

- SKlearn Library
- Support Vector Machine

Anomaly Detection

- Identifying unusual data records that might imply unusual behaviour in the dataset
- Requires training set (supervised learning)
- Example: Unusually high mention of company name in DDoS database

Regression

- Defining a function which models the data with the least error

Summarisation

- Providing a more compact representation of the data set, including visualisation and report generation
- Extracting information and alerting

Example

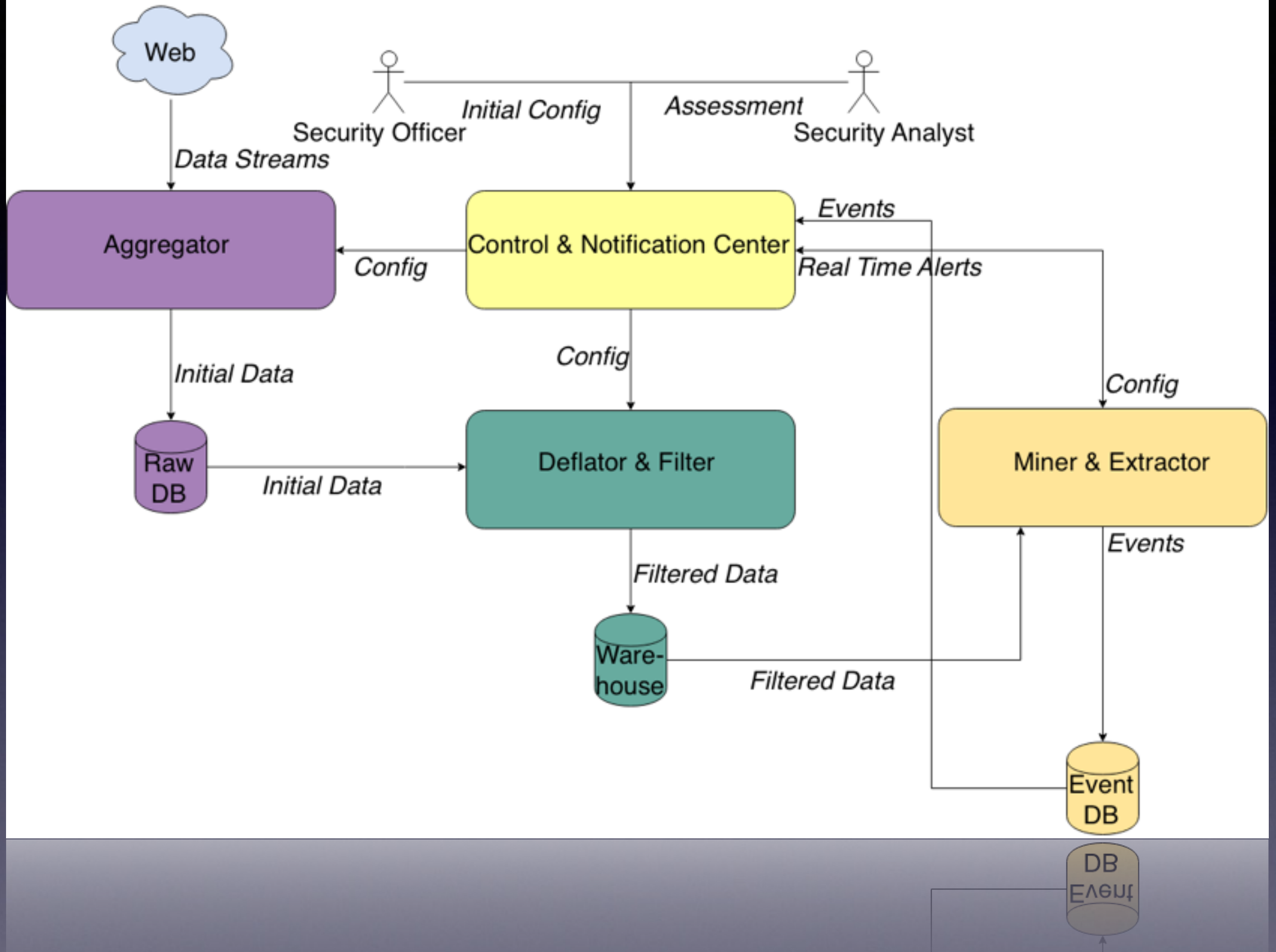
{alert_id: 00001, subject: "Something is rotten in the state of Denmark", importance: Red, backing_documents:[1,3,4,6]}

Feedback & Reconfiguration

- Assessment provided by Security Analysts to determine the actual threat level
- Calculate the divergence from the estimated threat level
- Propagate to the adjustable parts of the system and reconfigure

Conclusions

- Aggregated Data from 4 sources (~2GB)
- Designed and tested a deflation and scoring model
- Tested some Data Mining tasks and algorithms that produced promising results
- Proposed alerting and feedback extensions
- Each submodule can be integrated in one Software Suite
- We believe that this attempt is feasible


Web
Security Officer
Initial Config
Assessment
Security Analyst
Data Streams
Aggregator
Config
Control & Notification Center
Events
Real Time Alerts
Initial Data
Config
Config
Raw DB
Initial Data
Deflator & Filter
Miner & Extractor
Events
Filtered Data
Ware-house
Filtered Data
Event DB
DB

Future Work

- System Implementation
- Integration with CTI-portal
- Testing the algorithms with real world data
- Build training sets
- Implement more Data Mining algorithms
- Explore NLP capabilities

Future Work

- System Extensions:
  - Real Time Alerting
  - Sentiment Analysis
  - Support for non Latin alphabets
  - Automatic Learning & Adjustment

Tools & Sources

- http://www.toonpool.com/user/5624/files/sony_playstation_hack_attack_1262435.jpg
- http://www.scrapy.org
- http://www.tweepy.org
- http://www.python.org
- http://docs.orange.biolab.si/reference/rst/index.html
- http://scikit-learn.org/stable/

Thx!

Qs?