The Architecture of a Churn Prediction System based on Stream Mining

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CCIA 2013, Vic, oct. 24th
Outline

1. Churn Prediction and Stream Mining
2. Goals of proof-of-concept
3. The system
4. Conclusions
On Data Stream Mining

- Data arrive as a sequence of items, at high speed
- Can’t store all of it, not even in secondary memory
- An item is processed and discarded
- Needs to provide accurate answers at all times
- Data distribution evolves over time
- Mined patterns must be created, revised, possibly dropped
Churn Prediction and Stream Mining

On Churning

Churning

Churn is the action of customers who discontinue a service or who leave a company

- Focus on Telcos
- **Getting a new customer is more expensive than keeping it**
  - Predict subscribers (customers) likely to leave
  - With enough time to take retention actions
Data Mining and Churn Prediction

- Approach via data mining:
  - Use data from the past to predict future behaviors
  - I.e., find patterns and subscriber profiles that precede churning

- Why stream mining?
  - Subscriber activity = high-speed stream
  - Highly volatile customer patterns: our and competitor moves, ad campaigns, external events, market changes, social trends, ... 
  - Need to detect emerging patterns ASAP
  - Need to keep prediction rules updated at all times
Goals of proof-of-concept

Goals

- Show potential of stream mining techniques in churn prediction scenarios:
  - Able to keep prediction rules updated at all times
  - Business value of fast reaction to changes
  - Show current churn patterns and profiles for detailed analysis
  - Ability to suggest optimal retention actions

- Not intended: final, tuned, scalable product
- Learned lessons towards a real product, particularly scalability
- Production system should be developed with churn experts and on real data
Model of the system
Details of the modules I

- **Generator** Generates stream of Events
  - Currently: “joins”, “calls”, “gets-bill”, “complains”, “churns”

- **Markov chain** with states “happy”, “neutral”, “angry”, “churn”, and user-specific values for “communicative” and “impulsive”

- **Integrator**: Reads the different incoming streams and creates a single stream of Events
Details of the modules II

- **Record generator**: Generates records:
  
  \[(\text{customer, attr}_1, \text{attr}_2, \ldots, \text{attr}_N, \text{churn?})\]
  
  with features useful for prediction, computed from past events and static info

- **Proactively** injects records for inactive subscribers
Details of the modules III

- **Prediction Manager:**
  - Based on the MOA (Massive Online Analysis) stream mining software
  - “Adaptive Hoeffding Tree” prediction method
  - Processes records from active customers (Events) and injects occasional records for inactive customers
  - Keeps queue of predictions pending to be verified
  - Current set of features, consistent with literature:
    - Age & sex
    - Income range
    - Average call duration
    - # calls last week
    - # calls last month
    - $\Delta$ # calls in last 2 weeks
    - $\Delta$ # calls in last 2 months
    - % in-company calls
    - # resolved complaints
    - # unresolved complaints
    - Average bill value
    - $\Delta$ between last 2 bills
Databases

- General info: Current rates, zip codes, special numbers (complaints, customer service, ...)
- Subscriber information, both static and dynamic
- Pending predictions. Large and the bottleneck
  - In RAM in latest stable version
  - Candidate for (key,value) NoSQL database
  - Preliminary experience with Cassandra
- About 10,000 records/second, 4Mb/1,000 subscribers
Threads

We implement this system with threads.

- **GUI App (client)**
  - Thread 1: Graphic user interface

- **Server App**
  - Thread 2: Synthetic data Generator
  - Thread 3: Integrator, Record generator
  - Thread 4: Proactive
  - Thread 5: Prediction Manager (MOA)
Conclusions

Prototype to illustrate potential advantages of stream mining
Indicates (but only partially implements) scalability
Some of the many lines for future work:
  - increase throughput
  - better subscriber profiling
  - deal with geographical distribution (centralization?)
  - use friends net (contact graph, peer-pressure)
  - use twitter, facebook information

But future work requires access to domain knowledge and real data
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I’m around for demo till tomorrow lunchtime