Insurance Applications of Machine Learning

The 9th International Istanbul Insurance Conference

Emrah Gokmen

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Introduction to Insurance Consulting & Technology at Willis Towers Watson

Our client base is comprised mainly of insurance companies operating in global and domestic markets (including P&C, Life, A&H, captives and reinsurers), as well as corporate clients, regulators and other insurance-related entities. As well as advising more than three quarters of the world’s leading insurers, Insurance Consulting and Technology is the world’s largest provider of actuarial software and have over 1000 colleagues dedicated to technology solutions, including over 250 dedicated to (insurance) risk software.

Technology
We offer the most complete and advanced range of analytical and modeling software available for insurance companies. We are the world’s leading supplier of P&C actuarial software for insurers.

P&C Insurance
Our P&C consultancy delivers solutions in personal and commercial lines of business. Including reporting, mergers and acquisitions, products, pricing, business management, distribution, operational efficiency and strategy.

Life Insurance
We help companies to identify and deploy the metrics and methodologies for their risk and capital management needs, improve business performance and create sustainable competitive advantage.

Insurance Management Consultancy
We offer targeted consulting solutions to both enterprise wide and functional insurance challenges, whether our clients need to fix, grow or transform their business.
Agenda

- Big Data and New Opportunities
- Machine Learning Techniques
- Applications for Machine Learning
- How to make a successful implementation
Agenda

Big Data and New Opportunities

Applications for Machine Learning

Machine Learning Techniques

How to make a successful implementation
Big Data

“Big Data is the **frontier** of a firm’s ability to store, process, and access (SPA) *all* of the data it needs to operate, make decisions, reduce risks, and serve customers.”

**Big Data**

How do we see big data

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**Structured Data**

- Datenbank A
- Datenbank B
- Datenbank C
- Datenbank D

- „Single version of the truth“ (SVOTT)

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**Unstructured Data**

- Digitisation / Structuring

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Machine Learning
What is Machine Learning?

Arthur Samuel, 1959:

“Machine Learning is a field of study that gives computers the ability to learn without being explicitly programmed”.

Quote: https://www-cs.stanford.edu/memoriam/professor-arthur-samuel (from 31.08.2017)
Agenda

Big Data and New Opportunities

Machine Learning Techniques

Applications for Machine Learning

How to make a successful implementation
Applications for Machine Learning

Develop and refine strategies

Reinforcement Learning is a set of methods of machine learning where an agent independently learns a strategy to maximize the reward.

In doing so, the agent is not shown what action is the best in which situation, but receives a reward at certain times, which can also be negative.

Using these rewards, it approximates a utility function that describes the value of a particular state or action.

The concept is borrowed from psychology and has been used since the beginning of cybernetics.

Source:
https://de.wikipedia.org/wiki/Best%C3%A4rkendes_Lernen (from 01.09.2017)
Applications for Machine Learning
Recommendations (Amazon, LinkedIn, Netflix, Spotify, ...)

Content Based Recommendation (CBR): CBR provides personalized recommendation by matching user’s interests with description and attributes of items. For CBR, we can use standard ML techniques like Logistic Regression, Support Vector Machines, Decision tree etc. based on user and item features for making predictions for e.g.: extent of like or dislike. Then, we can easily convert the result to ranked recommendation.

Collaborative filtering (CF): Neighborhood models are heuristics based models which uses similarity metrics, for e.g. : Pearson similarity, cosine similarity, for finding similar users and items. It is based on, very reasonable, heuristic that a person will like the items that are similar to previously liked items.

Applications for Machine Learning
Speech Recognition, Handwriting Recognition, Face and Emotion Recognition

Google Word Error Rate

8.5%
6.8%
6.1%
4.9%

July 2016
Oct 2016
Dec 2016
Current
Applications for Machine Learning
Autopilot, Self-Driving Cars, Automation
Applications for Machine Learning
Machinery Breakdown prevention, Discovering fraud, Filtering email
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Choosing a method
Dimensions of choice

- Predictive power
- Interpretation
- Table implementation
- Stability
- Execution speed
- Analytical time and effort

Method
Generalized Linear Models
Gradient Boosted Machine or “GBM”

A tree

$$f_i(x)$$

A GBM

$$f(x) = \lambda \sum_{n=1}^{N} f_n(x)$$

$$\lambda + \lambda + \lambda + \lambda + \lambda$$

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$$\lambda + \lambda + \lambda$$

$$\lambda + \lambda + \lambda$$
What does a GBM look like?
What does a GBM look like?
What does a GBM look like?
Predictive power

Analytical time and effort

GBMs

Execution speed

Interpretation

Table Implementation

Stability
Micro-zoning using spatial smoothing

- Standard Policy Factors
- Random Noise
- External Geographical Factors
- Residual Spatial Variation
Micro-zoning using spatial smoothing (2)

Range of techniques available:
- Adjacency or distance smoothing
- Clustering based on risk, volume or both
Vehicle classification using spatial smoothing
Vehicle classification using spatial smoothing (2)

- Spatial smoothing requires a vehicle space to determine which vehicles are neighbours.

Adjacency table by # of doors
- 2 doors
- 3 doors
- 4 doors
- 5 doors

Adjacency table by chassis type
- Estates
- MPVs
- Saloons
- Hatchbacks
- Convertible
- Coupes
New vehicle data for new era

Five Levels of Vehicle Autonomy

- **Level 0**: No automation; the driver is in complete control of the vehicle at all times.
- **Level 1**: Driver assistance; the vehicle can assist the driver or take control of either the vehicle’s speed, through cruise control, or its lane position, through lane guidance.
- **Level 2**: Occasional self-driving; the vehicle can take control of both the vehicle’s speed and lane position in some situations, for example on limited-access freeways.
- **Level 3**: Limited self-driving; the vehicle is in full control in some situations, monitors the road and traffic, and will inform the driver when he or she must take control.
- **Level 4**: Full self-driving under certain conditions: the vehicle is in full control for the entire trip in these conditions, such as urban ride-sharing.
- **Level 5**: Full self-driving under all conditions: the vehicle can operate without a human driver or occupants.

Estimated Global Installed Base Of Cars With Self-Driving Features

*All Levels*

Source: SAE & NHTSA


New vehicle data for new era (2)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>BACK-UP CAMERA</td>
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</tr>
<tr>
<td>ANTI-LOCK BRAKING SYSTEM</td>
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<tr>
<td>BLIND SPOT MONITOR</td>
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<tr>
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<tr>
<td>LANE DEPARTURE WARNING</td>
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<td>TIRE PRESSURE MONITORING SYSTEM</td>
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<td>ADAPTIVE HEADLIGHTS</td>
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<td>AUTOMATIC REVERSE BRAKING</td>
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<td>LANE KEEPING ASSIST</td>
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<td>LEFT TURN CRASH AVOIDANCE</td>
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<td>PARKING SENSORS</td>
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<td>PUSH BUTTON START</td>
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<td>REAR CROSS TRAFFIC ALERT</td>
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<td>TEMPERATURE WARNING</td>
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<td>SIDEVIEW CAMERA</td>
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<td>TRACTION CONTROL</td>
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<td>BICYCLE DETECTION</td>
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<td>CURVE SPEED WARNING</td>
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<tr>
<td>HILL START ASSIST</td>
<td>✔️</td>
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</table>
New vehicle data for new era (3)

What is available today?

- Behavioural selection
- Accident prevention
- Damage mitigation

- Standard and optional features by make, model, year, variant, linked to Turkish association ID code.
- Historical options data enables assessment of:
  - the progressive risk reduction impact as features become more prevalent, moving from unavailable, through optional, to standard fit
  - the differential experience for specific claim types between model variants having different driver assist features
- We’re in the process of identifying the risk predictive items and wrapping these up into scores, potentially targeted to segments
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Possible Applications for Machine Learning in Insurance Companies
Where can we think about machine learning applications within P&C

- Risk modelling and identification of unknown relationships between variables
- Reduction of number of questions at the point of sale, or auto-filling of most likely responses.
- Client behaviour, such as conversion elasticities. And rapid reparameterisation
- Modelling of competitor quotations (since there is no noise or limited noise)
- Approximation of rank of competitiveness
- Reserve analysis run-off at a more detailed level to do claims triage and prioritisation (and more detailed reserves)
- Social Media Analysis:
  - Who is thinking of buying a car
  - Who has just left home
  - Who has bought a new house
  - Who is travelling abroad
  - Who is unhappy with our service?
  - Who is committing fraud?
- Analysis of public domain information, for reasons such as supply chain management.
- Fraud identification.
How to implement ML techniques in insurance?

Sophistication
- Emblem
- Radar Base or Optimiser

Accuracy
- PMML (Predictive Model Markup Language)

Operational Efficiency
- Speed to Market

Policy Admin System

Radar Live
Thank you.