



FACULTY  
OF INFORMATICS  
Masaryk University

# Alert Prediction in Metric Data Based on Time Series Analysis

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Hawkular Data Mining

Bc. Pavol Loffay

# Hawkular

- Univerzálny monitorovací systém
- „Nezávyslé“ moduly – Inventory, Metrics, Alerts, Accounts...
- RESTful APIs – Java Messaging Services
- JBoss Wildfly

# Ciele

- Predikcia výstrah pre monitorovací systém Hawkular
- Rôzne typy metrík/dát
- Online učenie
- Výpočetne nenáročný algoritmus –  $10^3$  metrik od jedného agenta
- Možnosť použiť ako samostatnú aplikáciu

# Postup riešenia

1. Konkurencia/Knižnice
2. Analýza časových radov, experimentovanie v R
3. Návrh riešenia
4. Implementácia
5. Testy prediktívnych schopností

# Knížnice a Konkurencia

- IBM Tivoli
- Knížnice:
  - OpenForecast – chyby, pomalé, neudržiavane
  - R – Rengin, RCallar, JRI

# Modely časových radov

- Exponenciálne vyrovnanie
- ARIMA – Autoregressive Moving Averages
- Neurónové siete
- Adaptívne filtrovanie

# Implementácia

- Java 8
- JMS, JAX-RS
- CDI, Wildfly
- (Apache Spark)

# Výsledky testov

- Rýchlosť [s]
  - Triple ex. - OpenForecast(6.45), R(0.209), Data Mining(0.023)
- Presnosť – pomery MSE oproti R knižnici forecast
  - Jednoduché ex – 93% rozdiel do 5%
  - Dvojité ex – 78% rozdiel do 5%
  - Trojité ex – 73% rozdiel do 5%
  - V celkovom +2%
- Väčšia trénovacia množina nemá vplyv na presnosť

# Retrospektíva

- Analýza časových radov
- Rýchlosť projektu - zmeny API
- Komunikácia
- RHQ -> Hawkular -> ManageIQ

# Otázky

Heiko Rupp

- How could Hawkular-Dataminig be used to get lower alert threshold on weekends, where e.g. the use of an intranet application is lower than during work days?

# Jabberwocky

*Lewis Carroll*



'Twas brillig, and the slithy toves  
Did gyre and gimble in the wabe;  
All mimsy were the borogoves,  
And the mome raths outgrabe.

“Beware the Jabberwock, my son!  
The jaws that bite, the claws that catch!  
Beware the Jubjub bird, and shun  
The frumious Bandersnatch!”

# Lists and locales

*Lorem ipsum dolor sit amet*

- Nulla nec lacinia odio.  
Curabitur urna tellus.
  - Fusce id sodales dolor. Sed id metus dui.
    - » Cupio virtus licet mi vel feugiat.
- 1. Donec porta, risus porttitor egestas scelerisque video.
  - 1.1 Nunc non ante fringilla, manus potentis cario.
  - 1.1.1 Pellentesque servus morbi tristique.

Nechť již hříšné saxofony d'áblů rozzvučí sín úděsnými tóny waltzu, tanga a quickstepu! Nezvyčajné krdle šťastných figliarskych ďatľov učia pri kótovanom ústí Váhu mŕkveho koňa Waldemara obžierat' väčšie kusy exkluzívnej kôry. The quick, brown fox jumps over a lazy dog. DJs flock by when MTV ax quiz prog. "Now fax quiz Jack!"

# Text blocks

*In plain, example, and alert flavour*

This text is highlighted.

## A plain block

This is a plain block containing some highlighted text.

## An example block

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## An alert block

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# Definitions, theorems, and proofs

*All integers divide zero*

## Definition

$$\forall a, b \in \mathbb{Z} : a \mid b \iff \exists c \in \mathbb{Z} : a \cdot c = b$$

## Theorem

$$\forall a \in \mathbb{Z} : a \mid 0$$

## Proof

$$\forall a \in \mathbb{Z} : a \cdot 0 = 0$$

□

# Numerals and Mathematics

*Formulae, equations, and expressions*

$$1234567890 \quad 1234567890 \quad \hat{x}, \check{x}, \tilde{a}, \bar{a}, \dot{y}, \ddot{y} \quad \int \int f(x, y, z) \, dx dy dz$$

$$\frac{1}{1 + \frac{1}{2 + \frac{1}{3+x}}} + \frac{1}{1 + \frac{1}{2 + \frac{1}{3+x}}} \quad F : \begin{vmatrix} F''_{xx} & F''_{xy} & F'_x \\ F''_{yx} & F''_{yy} & F'_y \\ F'_x & F'_y & 0 \end{vmatrix} = 0$$

$$\iint_{x \in \mathbb{R}^2} \langle x, y \rangle \, dx \quad \overline{a\bar{\alpha}^2 + b\beta + d\delta} \quad ]0, 1[ + \lceil x \rceil - \langle x, y \rangle$$

$$e^x \approx 1 + x + x^2/2! + \dots + x^3/3! + x^4/4!$$
$$\binom{n+1}{k} = \binom{n}{k} + \binom{n}{k-1}$$

# Figures

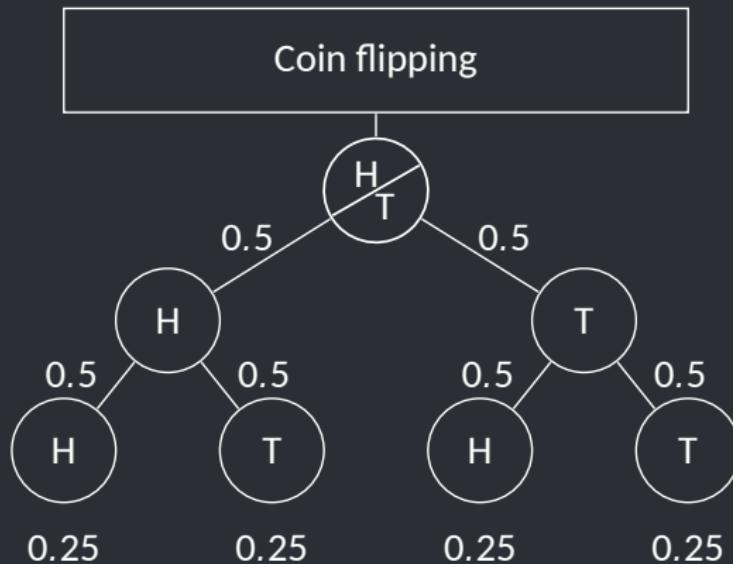
*Tables, graphs, and images*

Faculty	With $\text{\TeX}$	Total	%
Faculty of Informatics	1 716	2 904	59.09
Faculty of Science	786	5 275	14.90
Faculty of Economics and Administration	64	4 591	1.39
Faculty of Arts	69	10 000	0.69
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Tabuľka: The distribution of theses written using  $\text{\TeX}$  during 2010–15 at MU

# Figures

Tables, graphs, and images



Obrázok: Tree of probabilities – Flipping a coin<sup>1</sup>

<sup>1</sup>A derivative of a diagram from [texexample.net](http://texexample.net) by cis, CC BY 2.5 licensed

# Code listings

*An example source code in C*

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#include <stdio.h>
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#include <sys/types.h>
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    sleep(c = atoi(v[c]));
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# Citations

## $\text{\TeX}$ , $\text{\LaTeX}$ , and Beamer

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# Bibliography

## *T<sub>E</sub>X, L<sub>A</sub>T<sub>E</sub>X, and Beamer*

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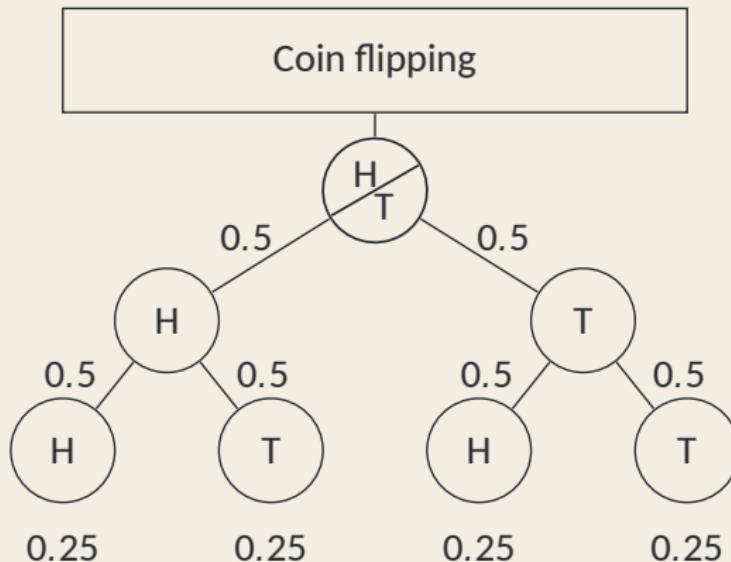
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