Efficient trouble shooting of service failures with multi-tag data analysis

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What’s the trouble?

• Facing to the problem

• Troubles affecting partial traffic is prevalent
What’s the trouble?

- Descartes accumulation set of all dimensions
- Lots of searching branches (waste of time)
- Need to narrow down the search scope
- Prune — Depending on SRE’s experience
Ideal result

- We directly got the answer
Our solution

• Pick a key indicator
• Procedure
  • Feature extraction —— assigning tags
  • Unsupervised anomaly detection
  • Entropy-based dimension reduction
Assigning the tags

• Client-side tags
  • traffic location
  • browser type
  • access network standard
  • device type
  • ...

• Server-side tags
  • Service IDC
  • API Version
  • API type
  • ...

<table>
<thead>
<tr>
<th>Query Word</th>
<th>Source area</th>
<th>ANS</th>
<th>browser</th>
<th>device</th>
<th>ISP</th>
<th>IDC</th>
<th>…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driverless car</td>
<td>China</td>
<td>CDMA</td>
<td>Safari</td>
<td>Cell phone</td>
<td>CUCC</td>
<td>IDC-A</td>
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<tr>
<td>Sweater</td>
<td>Singapore</td>
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<td>Chrome</td>
<td>Cell phone</td>
<td>Singtel</td>
<td>IDC-B</td>
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<td>Chrome</td>
<td>pad</td>
<td>T-Mobile</td>
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<tr>
<td>Forbidden city</td>
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<td>Wi-Fi</td>
<td>Firefox</td>
<td>PC</td>
<td>CMCC</td>
<td>IDC-B</td>
<td>…</td>
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<tr>
<td>Pancake rolled with crisp fritter</td>
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<td>LTE</td>
<td>Safari</td>
<td>Cell phone</td>
<td>M1</td>
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</tbody>
</table>
Assigning the tags

- traffic location (country/province/city/etc…)
- browser type (chrome/safari/firefox/etc…)
- access network standard (Wi-Fi/CDMA/LTE/etc…)
- device type (PC/laptop/pad/cell phone/etc…)
- …

PV from China & ANS is Wi-Fi & device type is cell phone
Time series trend diagram
Unsupervised anomaly detection

- Each algorithm works very well for certain types of indicators
- Unsupervised training to get thresholds for all finest dimension combinations
  - why unsupervised? thousands of combinations
  - train thresholds based on history data
  - use latency as an example
Unsupervised anomaly detection

- e.g. Anomaly detection on service latency
  - KEY: how to determine an appropriate delay threshold
  - build a probability distribution for latency values
  - usually single-peak distribution on the histogram
Unsupervised anomaly detection

- Anomaly detection on service latency
  - Two/multi-peak distribution when failure happens
  - Maximize between-class scatter $\rightarrow$ Threshold
Entropy-based dimension reduction

- Error cube
Entropy-based dimension reduction

- anomaly detection usually provides tens/hundreds of error cubes
- need to combine relevant error cubes together
- select the dimension of which the anomalies are least uniformly distributed
- entropy describes the uniformity of the distribution

\[ \text{Entropy} (S) = - \sum_{i=1}^{n} P_i \log P_i \]

Source Area
- Germany
- Spain
- Italy
- France
- UK
- Japan
- Singapore
- USA
- China

Device Type
- Android
- iOS
- BlackBerry
- Windows

Access Network Standard
- GSM
- Wi-Fi
- TDS-CDMA
- WCDMA
- EVDO
- TD-LTE
- FDD-LTE
- CDMA1X
- CDMA2000
- Etc...

Entropy:
- Entropy=0
- Entropy=1
- Entropy=2
Entrophy-based dimension reduction

• Result of entropy

Access Network Standard

Device Type

Source Area

Entropy=0.2045

Entropy=5.5451

Entropy=0.2045

Entropy=4.0539

Entropy=4.0539

Unbalanced base distribution

- Mostly for metrics such as PV/PVLOST
- Givens transformation to convert base distribution to uniform

Sample vector

\[ Tx = |x|e_1 \]

Equilibrium surface

Equation:

\[
\begin{pmatrix}
\cos \theta & \sin \theta \\
-sin \theta & \cos \theta
\end{pmatrix}
\begin{pmatrix}
a \\
b
\end{pmatrix}
\]

- transform error distribution in the same way
Summary

- What’s the trouble?
- feature extraction
- unsupervised anomaly detection
- entropy-based dimension reduction

- Q & A
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THANK YOU!