Load Shedding on Data Streams

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Handling Overload with Load Shedding

- real-time data pushed from financial data feeds, sensors, and alike
- high and unpredictable data rates
- resource overload => growing queues and late results
- solution: “load shedding”
  - eliminate excess load by dropping data
Load Shedding by Inserting Drops

two types of drops:

Random Drop

Drop $k\%$

Semantic Drop

Filter $P(value)$

QoS

QoS
Quality of Service

- Value-based QoS
- Loss-tolerance QoS

- Latency-based QoS is handled by scheduler.
Problem Statement

- $N$: query network
- $I$: set of input streams
- $C$: processing capacity

when $Load(N(I)) > C$, transform $N$ to $N'$ such that

- $Load(N'(I)) < C$
- $Utility(N(I)) - Utility(N'(I))$ is minimized
Key Questions

- when to shed load?
- **where to shed load?**
- how much load to shed?
- which tuples to drop?
Where to shed load?

- Sharing in the network

- Maximize load gain and minimize utility loss
- Dropping at inputs is not always the best
Load Shedding vs. Admission Control

Excess Load vs. Utility Loss Ratio

shows how skewed the utilities are
### Materialized Load Shedding Plans

<table>
<thead>
<tr>
<th>Excess Load</th>
<th>Drop Insertion Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td><img src="Diagram" alt="Diagram" /></td>
</tr>
<tr>
<td>20%</td>
<td><img src="Diagram" alt="Diagram" /></td>
</tr>
<tr>
<td>...</td>
<td><img src="Diagram" alt="Diagram" /></td>
</tr>
<tr>
<td>300%</td>
<td><img src="Diagram" alt="Diagram" /></td>
</tr>
</tbody>
</table>

*The table shows different excess load percentages and their corresponding drop insertion plans.*

- **10%**: Drop less!
- **20%**: Drop more!
- **300%**: Drop significantly more!
Ongoing and Future Work

- Handling complex operators
  - Joins for the general case
  - Aggregates

- Other resource limitations
  - Memory - windowed operators
  - Bandwidth - Aurora*
  - Power - at sensor level

- Other techniques
  - adjusting window size
  - inserting aggregates
More Information

- come and see Aurora demo @ Sigmod’03
- paper to appear @ VLDB’03
- visit: http://www.cs.brown.edu/research/aurora
- email: tatbul@cs.brown.edu