Overview

NebulaStream is a scalable, adaptive, and efficient data management platform for the Internet-of-Things.

Research Goals:
- Efficient execution for thousands of concurrently running queries.
- Fast deployment to massive and dynamic topologies combining edge and cloud.
- Full utilization of heterogeneous hardware resources and accelerators.
- Support for complex analytical workloads involving stateful operators and UDFs.

Distributed Query Deployment Flow in NebulaStream

How to optimize query plans?

Concurrently-running streaming queries often consume the same sources or perform similar tasks.

We use Semantic Stream Query Merging:
- To derive semantic operator signatures.
- To identify sharing opportunities via constraint solving even for syntactically different queries.

Query 1

```
Query 1:
Op1

Op2

Sr1
Sr2
```

Query 2

```
Query 2:
Op3

Op4

Sr3
Sr4
```

Common Signature

Enable resource-efficient execution of semantically-equivalent queries

Where to place operators?

Unified edge/cloud environments consist of heterogeneous nodes with very different resources.

We explore different operator placement strategies:

Constructive Approach:
- Bottom Up
- Top Down

Cost-based Approach:
- Random Search
- Integer Linear Programming
- Genetic Algorithm

Challenges:
- Millions of devices
- Resource heterogeneity
- Hierarchical infrastructure
- Geo-distributed data sources
- Changing data-characteristics and statistics

Enable user to make trade-offs to speed-up query deployment

How to leverage heterogeneous resources?

State-of-the-art SPSs do not fully utilize available hardware resources.

We rely on adaptive query compilation to specialize the execution to data and hardware characteristics.

Evaluation

NebulaStream combines the performance of research prototypes with the generality of mature SPSs.

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