

SQL & Table API Ecosystem

Apache Flink SQL Training

<https://github.com/ververica/sql-training>

Benefits of using SQL

- Schema-awareness at all times
 - Including NULL support
- Smooth integration with catalogs, connectors, formats
 - Hive catalog integration coming soon
- Large set of built-in operations and functions
- Use the same query to process streaming and batch data



When not to use SQL

- Application that require evolution
 - Flink provides fault-tolerance and savepoint compatibility for SQL queries in the same version
 - Savepoint compatibility when migrating to a newer Flink version is not guaranteed yet
 - Modified queries cannot be loaded from a previous savepoint
- Applications that require access to state and time
 - Custom triggers and timers
 - Fine-grained state management



Embedding SQL & Table API in DataStream Programs

Embedding SQL in the DataStream API

```
val sensorData: DataStream[(String, Long, Double)] = ???
```

```
// register DataStream
```

```
tableEnv.registerDataStream("sensorData", sensorData, 'location, 'rowtime, 'tempF)
```

```
// query registered Table
```

```
val avgTempCTable: Table = tableEnv.sqlQuery("""  
    SELECT  
        TUMBLE_START(TUMBLE(time, INTERVAL '1' DAY) AS day,  
            location,  
            AVG((tempF - 32) * 0.556) AS avgTempC  
    FROM sensorData  
    WHERE location LIKE 'room%'  
    GROUP BY location, TUMBLE(time, INTERVAL '1' DAY)  
    """)
```

```
// go back to DataStream API
```

```
val avgTempC: DataStream[Row] = avgTempCTable.toAppendStream[Row]
```



Embedding Table API in the DataStream API

```
val sensorData: DataStream[(String, Long, Double)] = ???

// convert DataStream into Table
val sensorTable: Table = sensorData.toTable(tableEnv, 'location, 'rowtime, 'tempF)

// define query on Table
val avgTempCTable: Table = sensorTable

    .window(Tumble over 1.day on 'rowtime as 'w)

    .groupBy('location, 'w)

    .select('w.start as 'day, 'location, (('tempF.avg - 32) * 0.556) as 'avgTempC)

    .where('location like "room%")

// go back to DataStream API
val avgTempC: DataStream[Row] = avgTempCTable.toAppendStream[Row]
```



Ingesting a DataStream from a Table

```
val tEnv = TableEnvironment.getTableEnvironment(env)
tEnv.registerFunction("myParser", new MyParser())
```

// configure your data source and register as a table

```
tEnv
  .connect(new Kafka().topic("MyTopic") ...)
  .withFormat(new Json().deriveSchema())
  .withSchema(
    new Schema()
      .field("name", Types.STRING)
      .field("prefs", Types.STRING))
  .registerTableSource("customers")
```

// define your table program

```
val table: Table = tEnv.sqlQuery("SELECT LOWER(name), myParser(prefs) FROM customers")
val table: Table = tEnv.scan("customers").select('name.lowerCase(), myParser('prefs))
```

// convert

```
val ds: DataStream[Customer] = table.toAppendStream[Customer]
```



Defining Source & Sink Tables

Defining External Tables

- Tables are always stored in external systems
 - Systems have different properties and schema definitions
- Map schemas from external systems to Flink and vice-versa

Java/Scala

```
tableEnvironment  
  .connect(...)  
  .withFormat(...)  
  .withSchema(...)  
  .inAppendMode()  
  .registerTableSink("MyTable")
```

YAML

```
name: MyTable  
type: sink  
update-mode: append  
connector: ...  
format: ...  
schema: ...
```

See also: <https://ci.apache.org/projects/flink/flink-docs-stable/dev/table/connect.html>



Connect to Storage Systems - Connector

Java/Scala

```
.connect(  
  new Kafka()  
    .version("0.10")  
    .topic("test-input")  
    .startFromEarliest()  
    .property(  
      "zookeeper.connect",  
      "localhost:2181")  
    .property(  
      "bootstrap.servers",  
      "localhost:9092")  
)
```

YAML

```
connector:  
  type: kafka  
  version: "0.10"  
  topic: test-input  
  startup-mode: earliest-offset  
  properties:  
    - key: zookeeper.connect  
      value: localhost:2181  
    - key: bootstrap.servers  
      value: localhost:9092
```



Connect to Storage Systems - Format

Java/Scala

```
.withFormat(  
  new Avro()  
    .avroSchema("""  
    {  
      "namespace": "org.myorganization",  
      "type": "record",  
      "name": "UserMessage",  
      "fields": [  
        {"name": "user", "type": "long"},  
        {"name": "message", "type": "string"}  
      ]  
    }""")  
)
```

YAML

```
format:  
  type: avro  
  avro-schema: >  
    {  
      "namespace": "org.myorganization",  
      "type": "record",  
      "name": "UserMessage",  
      "fields": [  
        {"name": "ts", "type": "string"},  
        {"name": "user", "type": "long"},  
        {"name": "message", "type": "string"}  
      ]  
    }
```



Supported Connectors and Formats in Flink 1.7

- Connectors:
 - Kafka (starting from 0.8)
 - Elasticsearch 6
 - Filesystem
- Formats:
 - JSON
 - Avro
 - CSV
- API for custom connectors and formats (Java/Scala and SQL Client)



Hands On Exercises

Writing Query Results to External Tables

Continue with Session 6
"Writing Query Results to External Tables"
in the SQL training wiki:

<https://github.com/ververica/sql-training/wiki>

We are here to help!





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