



**Materialize**

# Timely Dataflow

# Differential

the 1990s, the number of people in the UK who are employed in the public sector has increased by 1.5 million, from 2.5 million in 1980 to 4 million in 1995 (Department of Health 1996).

There is a growing emphasis on the need to improve the efficiency of the public sector, and to ensure that the public sector is able to deliver the services that are required by the public. This has led to a number of initiatives, including the introduction of competition, the restructuring of public sector organisations, and the introduction of new management practices.

One of the key initiatives in the public sector is the introduction of competition. This has led to a number of public sector organisations being privatised, and to a number of public sector organisations being required to compete for contracts from the private sector.

Another key initiative is the restructuring of public sector organisations. This has led to a number of public sector organisations being merged, and to a number of public sector organisations being reorganised.

A third key initiative is the introduction of new management practices. This has led to a number of public sector organisations adopting new management practices, such as the introduction of performance indicators, and the introduction of new financial management practices.

These initiatives have led to a number of changes in the public sector, and to a number of improvements in the efficiency of the public sector. However, there are still a number of challenges that the public sector faces, and it is important that these challenges are addressed.

One of the key challenges that the public sector faces is the need to ensure that the public sector is able to deliver the services that are required by the public. This is a challenge that the public sector must continue to address.

Another key challenge that the public sector faces is the need to ensure that the public sector is able to deliver the services that are required by the public in a cost-effective manner. This is a challenge that the public sector must continue to address.

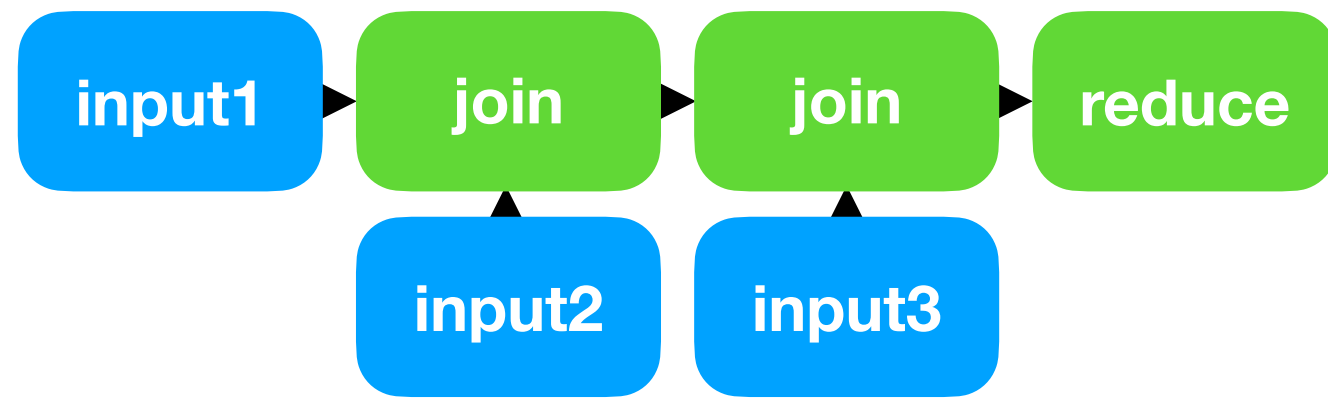
A third key challenge that the public sector faces is the need to ensure that the public sector is able to deliver the services that are required by the public in a sustainable manner. This is a challenge that the public sector must continue to address.

```
-- Aggregate the results of joins
SELECT input3.attr, SUM(val2), MAX(val3)
FROM input1, input2, input3
WHERE input1.fkey2 = input2.key
      AND input1.fkey3 = input3.key
GROUP BY input3.attr
```

---

```
// differential dataflow program
input1.join(input2, ...)
      .join(input3, ...)
      .reduce(...)
```

---



**Materialize**

-- Aggregate the results of joins  
**SELECT** input3.attr, **SUM**(val2), **MAX**(val3)  
**FROM** input1, input2, input3  
**WHERE** input1.fkey2 = input2.key  
      **AND** input1.fkey3 = input3.key  
**GROUP BY** input3.attr

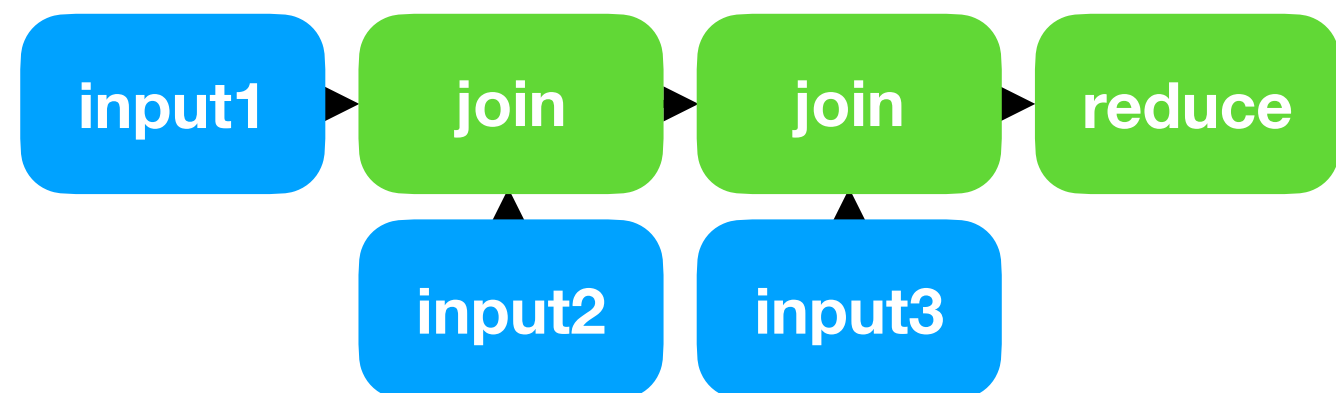
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**Differential**

// differential dataflow program  
input1.**join**(input2, ...)  
      **join**(input3, ...)  
      **reduce**(...)

---

**Timely Dataflow**



VLDB2020 paper on the DD implementation:

<http://www.vldb.org/pvldb/vol13/p1793-mcsherry.pdf>

Check out the code (and documentation):

<https://github.com/TimelyDataflow/differential-dataflow>

<https://github.com/TimelyDataflow/timely-dataflow>

Follow along with Materialize:

<https://materialize.io/docs/install/>

<https://materialize.io/blog/>