

# LECTURE 13: QUERY EXECUTION II

## LECTURE 13 查询执行 II

### INTER-QUERY PARALLELISM 查询间的并行性

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The goal of this type of parallelism is to improve the DBMS's overall performance by allowing multiple queries to execute simultaneously.

这种并行性的目标是通过同时允许执行多个查询来提高 DBMS 的整体性能。在后续讨论并发控制协议的时候，我们将会更加详细的介绍这一点。

### INTRA-QUERY PARALLELISM 查询内的并行性

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The goal of this type of parallelism is to improve the performance of a single query by executing its operators in parallel. There are parallel algorithms for every relational operator.

这种并行性的目标是通过并行执行单个查询的运算符来提高性能的，每个运算符都有对应的并行算法。

#### Intra-Operator Parallelism 算子内并行

The query plan's operators are decomposed into independent instances that perform the same function on different subsets of data.

查询计划的运算被分解为独立的实例，这些实例对不同的数据子集执行相同的操作。

The exchange operator prevents the DBMS from executing operators above it in the plan until it receives all of the data from the children.

exchange 运算符阻止 DBMS 在计划中执行其上方的运算符，直到它从子系统收到所有数据。

In general, there are three types of exchange operators:

一般来说有 3 种 exchange 运算符。

- Gather: Combine the results from multiple workers into a single output stream. This is the most common type used in parallel DBMSs.

聚集：将多个 worker 的工作结果写入到一个输出流中，这是并行 DBMS 中最常见的类型。

- Repartition: Reorganize multiple input streams across multiple output streams. This allows the DBMS take inputs that are partitioned one way and then redistribute them in another way.

重新分区：跨越多个输出流重新组织输入流。这允许 DBMS 以一种方式对输入进行分区，然后以另一种方式重新分配他们。

- Distribute: Split a single input stream into multiple output streams.

分发：将单个输入流拆分成多个输出流。

#### Inter-Operator Parallelism 算子间并行

The DBMS overlaps operators in order to pipeline data from one stage to the next without materialization. This is sometimes called pipelined parallelism.

为了将数据从一个阶段输送到下一个阶段，DBMS 的操作符重叠，无需具体化。这通常被叫做流水线并行。

This approach is widely used in stream processing systems, systems that continually execute a query over a stream of input tuples.

这种方法广泛应用于流处理系统中，这些系统通过输入元组流持续进行查询操作。

#### Bushy Parallelism 浓密并行

Extension of inter-operator parallelism where workers execute multiple operators from different segments of a query plan at the same time.

运算符间并行性的扩展，其中 worker 同时执行来自一个查询计划的不同的操作运算。

The DBMS still uses exchange operators to combine intermediate results from these segments.

DBMS 仍然使用 exchange 运算符来组合这些段的中间结果。