LECTURE 13: QUERY EXECUTION II
LECTURE 13 查询执行 II

BACKGROUND 背景

Our previous discussion of query execution did not specify how the DBMS would compute results. We are now going to discuss how to organize the system's internals on the CPU.

我们之前对查询执行的讨论没有具体说明 DBMS 将如何计算结果。我们现在将讨论在 CPU 上系统内部是怎么组织。

The main goal is to understand how to enable the DBMS to support parallel query execution. This provides several benefits:

我们的主要目标是了解如何使 DBMS 支持并行查询执行。它提供了以下好处：

• Increased performance in throughput and latency.

• 提高了吞吐和延时的性能

• Increased availability.

• 提高了可用性

• Potentially lower total cost of ownership (TCO). This cost includes both the hardware procurement and software license, as well as the labor overhead of deploying the DBMS and the energy needed to run the machines.

• 可以降低数据库系统的总体拥有成本 (TCO)。这一成本包括采购硬件以及软件许可，还有部署 DBMS 的人工开销，以及运行的机器所需要的能源开销。

The techniques discussed here are applicable to distributed DBMSs as well, so we first need to understand the differences between a parallel and distributed DBMS. These systems spread the database out across multiple "resources" to improve parallelism. These resources are either computational (e.g., CPU cores, CPU sockets, GPUs, additional machines) or storage (e.g., disks, memory).

这里讨论的技术也适用于分布式数据库系统，因此我们首先需要了解并行数据库管理系统和分布式数据库系统之间的区别。这些系统将数据库分散到多个"资源"中，用来提高并行性。这些资源要么是计算资源（例如 CPU 的核心，CPU 插槽，GPU, 其他的机器）或者存储设备（例如磁盘、内存）。

并行数据库系统

• Nodes are physically close to each other.
节点在物理上是接近的。

• Nodes are connected with high-speed LAN.
节点之间通过高速网络互联。

• Communication cost between nodes is assumed to be fast and reliable.
节点之间的通信成本被认为是快速并且可靠的。

分布式数据库

• Nodes can be far from each other.
节点之间可以相隔很远

• Nodes are connected using public network.
节点之间通过公共网络互联

• Communication costs between nodes is slower and failures cannot be ignored.
节点之间通信较慢，故障不能够被忽略

Even though the database may be physically divided over multiple resources, it still appears as a single logical database instance to the application. Thus, the SQL query for a single-node DBMS should generate the same result on a parallel or distributed DBMS.

即使数据库可以在物理上被划分为多个资源，但它对应用程序来说仍然是一个单一逻辑的数据库实例。因此，应用单节点数据库系统与并行或者分布式数据库系统执行相同的操作返回的结果是一样的。

并行类型

• Inter-Query: The DBMS executes different queries are concurrently. This increases throughput and reduces latency. Concurrency is tricky when queries are updating the database.

数据库系统同时执行不同的查询。这增加了吞吐量并减少了延迟。但是当查询更新数据库时处理并发比较棘手。

Intra-Query: The DBMS executes the operations of a single query in parallel. This decreases latency for long-running queries.

数据库并发的执行单个操作，这降低了长查询的延迟。