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Introduction to Oracle Database In-Memory

Oracle Database In-Memory (Database In-Memory) is a suite of features that greatly improves performance for real-time analytics and mixed workloads. The In-Memory Column Store (IM column store) is the key feature of Database In-Memory.

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> **Note:**
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> Database In-Memory features require the Oracle Database In-Memory option. For the Database In-Memory Base Level, the IM column store size is limited to 16 GB at the CDB level. See *Oracle Database Licensing Information User Manual* for details on which features are supported for different editions and services.

1.1 Challenges for Analytic Applications

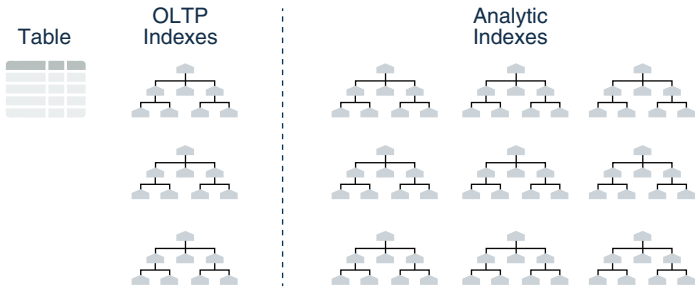
Traditionally, obtaining good performance for analytic queries meant satisfying several requirements.

In a typical data warehouse or mixed-use database, requirements include the following:

- You must understand user access patterns.
- You must provide good performance, which typically requires creating indexes, materialized views, and OLAP cubes.

For example, if you create 1 to 3 indexes for a table (1 primary key and 2 foreign key indexes) to provide good performance for an OLTP application, then you may need to create additional indexes to provide good performance for analytic queries.

Figure 1-1 Multiple Indexes



Meeting the preceding requirements creates manageability and performance problems. Additional access structures cause performance overhead because you must create, manage, and tune them. For example, inserting a single row into a table requires an update to all indexes on this table, which increases response time.

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In-Memory Column Store Architecture

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The **In-Memory Column Store** (IM column store) stores tables and partitions in memory using a **columnar format** optimized for rapid scans. Oracle Database uses a sophisticated architecture to manage data in columnar and row formats simultaneously.

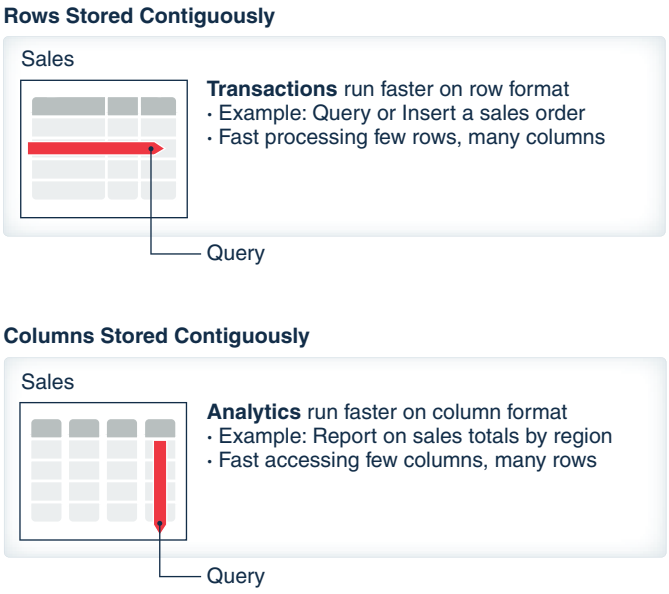
2.1 Dual-Format: Column and Row

When you enable an IM column store, the SGA manages data in separate locations: the In-Memory Area and the database buffer cache.

The IM column store encodes data in a columnar format: each column is a separate structure. The columns are stored contiguously, which optimizes them for analytic queries. The database buffer cache can modify objects that are also populated in the IM column store. However, the buffer cache stores data in the traditional row format. Data blocks store the rows contiguously, optimizing them for transactions.

The following figure illustrates the difference between row-based storage and columnar storage.

Figure 2-1 Columnar and Row-Based Storage



2.1.1 Columnar Data in the In-Memory Area

The **In-Memory Area** is an optional SGA component that contains the IM column store.