What are Pages And Extents and their Architecture and Tracking Free Space (PFS)

What are Pages and Extents basics

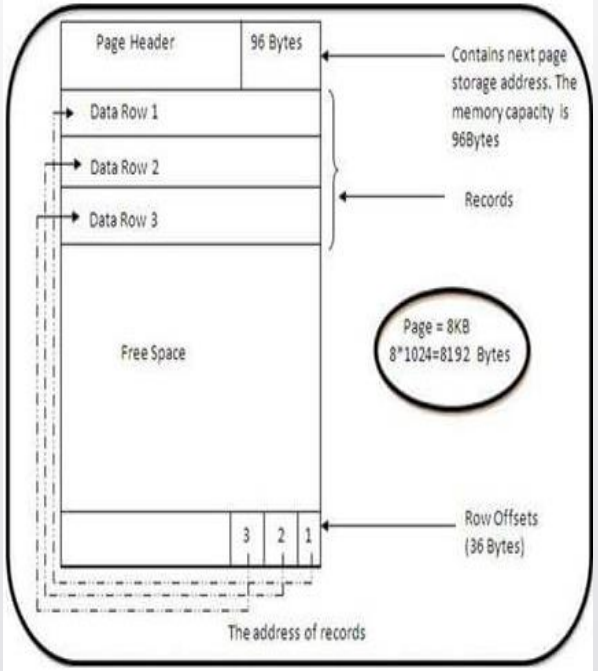
- The page is the fundamental unit of data storage in SQL Server.
- An extent is a collection of eight physically contiguous pages.
- Extents help efficiently manage pages.
- Understanding the architecture of pages and extents is important for designing and developing databases that perform efficiently.

What is a Page

- The fundamental unit of data storage in SQL Server is the page.
- The disk space allocated to a data file (.mdf or .ndf) in a database is logically divided into pages numbered contiguously from 0 to n.
- Disk I/O operations are performed at the page level. That is, SQL Server reads or writes whole data pages.
- In SQL Server all data pages are the same size - 8 kilobytes.
- Most pages contain actual rows of data which were stored by users; these are called Data pages and text/image pages (for special cases).
- The Index pages contain index references about where the data is
- There are system pages that store variety of metadata about the organization of the data (PFS, GAM, SGAM, IAM, DCM, BCM pages).

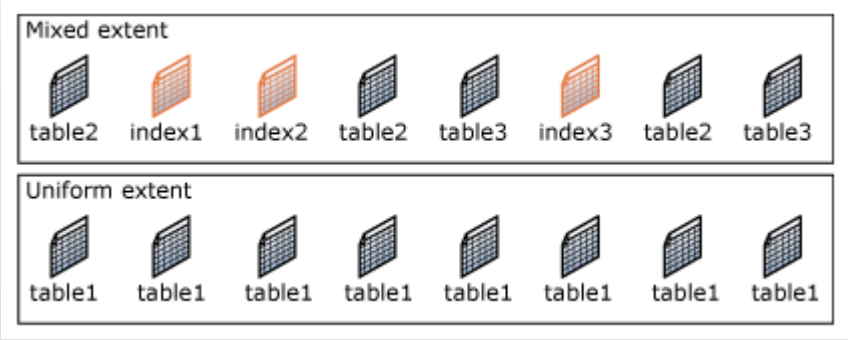
Page Architecture

- As mentioned, in SQL Server, the page size is 8-KB.
- This means SQL Server databases have 128 pages per megabyte.
- Each page begins with a 96-byte header that is used to store system information about the page.
- This information includes the page number, page type, the amount of free space on the page, and the allocation unit ID of the object that owns the page.
- Data rows are put on the page serially, starting immediately after the header.
- A row offset table starts at the end of the page, and each row offset table contains one entry for each row on the page.
- Each row offset entry records how far the first byte of the row is from the start of the page.
- Thus, the function of the row offset table is to help SQL Server locate rows on a page very quickly.
- The entries in the row offset table are in reverse sequence from the sequence of the rows on the page.



What is an Extent

- Extents are the basic unit in which space is managed.
- An extent is eight physically contiguous pages, or 64 KB.
- This means SQL Server databases have 16 extents per megabyte.
- SQL Server has two types of extents:
- **Uniform** extents are owned by a single object; all eight pages in the extent can only be used by the owning object.
- **Mixed** extents are shared by up to eight objects. Each of the eight pages in the extent can be owned by a different object.
- Starting with SQL Server 2016 (13.x), the default for most allocations in a user database and tempdb is to use uniform extents.



Tracking Free Space

- **Page Free Space (PFS)** pages record the allocation status of each page, whether an individual page has been allocated, and the amount of free space on each page.
- The PFS has 1-byte for each page, recording whether the page is allocated, and if so, whether it is empty, 1 to 50 percent full, 51 to 80 percent full, 81 to 95 percent full, or 96 to 100 percent full.
- After an extent has been allocated to an object, the SQL Server Database Engine uses the PFS pages to record which pages in the extent are allocated or free.
- This information is used when the SQL Server Database Engine has to allocate a new page.