2.2.6 compare the three types of cache memory, i.e. Level-1 (L1) cache, Level-2 (L2) cache and Level-3 (L3) cache;

Here's a comparison of the three types of cache memory: Level-1 (L1) cache, Level-2 (L2) cache, and Level-3 (L3) cache.

Feature	Level-1 (L1) Cache	Level-2 (L2) Cache	Level-3 (L3) Cache
Location	On the CPU chip	On the CPU chip or nearby	Usually shared among multiple cores, on the CPU chip or in close proximity
Size	Smallest (16 KB to 128 KB)	Larger (256 KB to several MB)	Largest (2 MB to 64 MB or more)
Speed	Fastest access time	Slower than L1 but faster than RAM	Slower than L1 and L2, but faster than RAM
Purpose	Stores frequently accessed data and instructions for immediate use	Holds data that is not currently in L1 but is likely to be needed soon	Acts as a buffer for data that may be used by multiple cores or threads
Access Time	Typically around 1 cycle	3 to 10 cycles	10 to 20 cycles
Cost	Most expensive per bit	Less expensive per bit than L1	Least expensive per bit among the three

Key Differences:

1. **Location**:
   - **L1 Cache**: Directly integrated into the CPU core, allowing for the quickest access.
   - **L2 Cache**: Can be located on the CPU chip or very close to it, providing a balance between speed and size.
   - **L3 Cache**: Usually shared across multiple CPU cores, providing data access to all cores.
2. **Size**:
   - **L1 Cache**: Smallest in size, designed for speed and immediate data access.
   - **L2 Cache**: Larger than L1, providing additional storage for frequently accessed data.
   - **L3 Cache**: The largest, designed to handle data for multiple cores efficiently.
3. **Speed and Access Time**:
   - **L1 Cache**: Fastest access, crucial for the CPU's immediate performance.
   - **L2 Cache**: Slower than L1 but still much faster than main memory (RAM).

    - **L3 Cache**: Slowest among the three, but still faster than accessing RAM.
4. **Purpose**:
    - **L1 Cache**: Primarily holds the most critical and frequently used data.
    - **L2 Cache**: Acts as a secondary storage for data that may soon be needed but isn't currently in L1.
    - **L3 Cache**: Serves as a shared resource for data needed by multiple cores, reducing access times for shared data.

Summary:

- **L1 cache** is the fastest and most expensive per bit, ideal for immediate data needs. **L2 cache** provides additional storage for the CPU, while **L3 cache** offers larger, shared memory space for multiple cores, balancing speed, size, and cost effectively. Each cache level plays a vital role in improving CPU performance by reducing latency and providing quick access to frequently used data.