Let's walk through a numerical example to illustrate the steps in data cube computation. Suppose we have a small dataset with three dimensions: **Time**, **Location**, and **Product**, and one measure: **Sales**.

Sample Dataset

Time	Location	Product	Sales
Q1	East	A	100
Q1	East	B	150
Q1	West	A	200
Q1	West	B	250
Q2	East	A	120
Q2	East	B	180
Q2	West	A	220
Q2	West	B	270

Steps in Data Cube Computation

Step 1: Identify Dimensions and Measures

- **Dimensions**: Time, Location, Product
- **Measure**: Sales

Step 2: Data Aggregation

- We will compute the sum of Sales across different combinations of dimensions.

Step 3: Cuboid Computation

We need to compute all possible cuboids:

1. **0D Cuboid (Overall Total)**:
    - Aggregation of Sales across all dimensions.
    - $\text{Total Sales} = 100 + 150 + 200 + 250 + 120 + 180 + 220 + 270 = 1490$

2. **1D Cuboids** (Aggregating over individual dimensions):
    - **Time**:
        - Q1: $100 + 150 + 200 + 250 = 700$
        - Q2: $120 + 180 + 220 + 270 = 790$
        - Result: $(Q1, 700), (Q2, 790)$
    - **Location**:
        - East: $100 + 150 + 120 + 180 = 550$
        - West: $200 + 250 + 220 + 270 = 940$
        - Result: $(East, 550), (West, 940)$
    - **Product**:
        - A: $100 + 200 + 120 + 220 = 640$
        - B: $150 + 250 + 180 + 270 = 850$
        - Result: $(A, 640), (B, 850)$
3. **2D Cuboids** (Aggregating over pairs of dimensions):
    - **(Time, Location)**:
        - (Q1, East): $100 + 150 = 250$
        - (Q1, West): $200 + 250 = 450$
        - (Q2, East): $120 + 180 = 300$
        - (Q2, West): $220 + 270 = 490$
        - Result: $(Q1, East, 250), (Q1, West, 450), (Q2, East, 300), (Q2, West, 490)$
    - **(Time, Product)**:
        - (Q1, A): $100 + 200 = 300$
        - (Q1, B): $150 + 250 = 400$
        - (Q2, A): $120 + 220 = 340$
        - (Q2, B): $180 + 270 = 450$
        - Result: $(Q1, A, 300), (Q1, B, 400), (Q2, A, 340), (Q2, B, 450)$

- **(Location, Product)**:
  - (East, A): $100 + 120 = 220$
  - (East, B): $150 + 180 = 330$
  - (West, A): $200 + 220 = 420$
  - (West, B): $250 + 270 = 520$
  - Result: $(East, A, 220), (East, B, 330), (West, A, 420), (West, B, 520)$

4. **3D Cuboid** (All dimensions):
   - This is the original dataset:
   - (Q1, East, A): 100
   - (Q1, East, B): 150
   - (Q1, West, A): 200
   - (Q1, West, B): 250
   - (Q2, East, A): 120
   - (Q2, East, B): 180
   - (Q2, West, A): 220
   - (Q2, West, B): 270

Step 4: Materialization

- We decide which cuboids to store based on query patterns and storage capacity.
- For example, if queries frequently involve Time and Location, we may materialize the (Time, Location) cuboid.

Step 5: Optimization

- Techniques such as compression, partitioning, and indexing can be applied to optimize the storage and retrieval of the materialized cuboids.

Step 6: Query Processing

- If a query asks for total sales in Q1 at the East location, the system can quickly retrieve the value 250 from the (Time, Location) cuboid without recalculating from the base data.

This example illustrates how a simple dataset can be expanded into a data cube, enabling efficient multi-dimensional queries and analysis.