## Chapter 4.5 Two - Pass Algorithm based on Hash

***Basic Thought:***

* If the data is too much to be put into main memory block, then using an available ***hash - key*** to hash all tuples of one or more Operation Objects. For all normal operations, there exists one hash - key method, it enables us to assign all tuples into one same bucket when under consideration.
* Operate one bucket each time. *(Under the situation of Binary Operation, deal with a pair bucket with the same hash value.)* Actually, the size of Operation Object has been decreased, the ratio of decreasing equals to the number of bucket. Its size is M.

### Chapter 4.5.1 Divide Relation Through Hash

### Chapter 4.5.2 Remove Duplication Algorithm based on Hash

### Chapter 4.5.3 Grouping and Aggregation Algorithm based on Hash

### Chapter 4.5.4 Union, Intersection and Difference Algorithm based on Hash

### Chapter 4.5.5 Hash Join Algorithm

Chapter 4.5.6 Save Disk I/O

Chapter 4.5.7 Conclusion on Algorithm based on Hash