



MONASH University

程序代写代做 CS 编程辅导

Information Technology

# FIT5202 (Week 1 - Introduction)



Week 2a – Introduction to Parallel Databases

Assignment Project Exam Help

**algorithm distributed systems database**

Email: tutorcs@163.com

systems **computation knowledge management**

QQ: 749389476

**design e-business model data mining intelligent**

**distributed systems database software engineering**

<https://tutorcs.com>

**computation knowledge management analysis**

程序代写代做 CS编程辅导

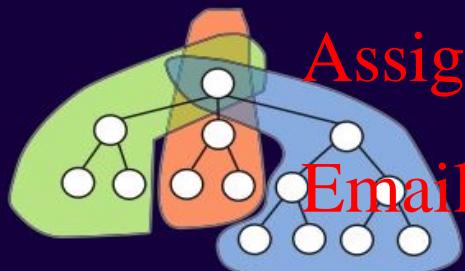
TANIAR  
LEUNG  
RAHAYU  
GOEL

Wiley Series on Parallel and Distributed Computi



High Performance  
Database Processing  
Grid Databases

WeChat: cstutorcs



QQ: 749389476

DAVID TANIAR, CLEMENT H.C. LEUNG,  
WENNY RAHAYU, and SUSHANT GOEL

<https://tutorcs.com>



WILEY

# Chapter 1 Introduction

## Assignment Project Exam Help

- 1.1 A Brief Overview - Parallel Databases and Grid Databases
- 1.2 Parallel Query Processing: Motivations
- 1.3 Parallel Query Processing: Objectives
- 1.4 Forms of Parallelism
- 1.5 Parallel Database Architectures
- 1.6 Grid Database Architecture
- 1.7 Structure of this Book
- 1.8 Summary
- 1.9 Bibliographical Notes
- 1.10 Exercises

# Revision

程序代写代做 CS编程辅导

## Exercise 1 (FLUX Quiz)

- Using the freeway analogy, what is the term for cars that can pass through the freeway (M1: Monash Freeway) during the peak hour from 7 to 9am is called:
  
- A. Throughput
- B. Response Time
- C. None of the above
- D. A and B



WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

# Revision

程序代写代做 CS编程辅导

## Exercise 2 (FLUX Quiz)

- Using the freeway analogy, what is the name given to the section of a freeway (say M1 Monash) between the Burke Road entrance to the Blackburn Road exit is called:

WeChat: cstutorcs

- A. Throughput
- B. Response Time
- C. None of the above
- D. A and B

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>



## 1.3. Objectives (cont'd)



### • Parallel Obstacles

- Start-up and Consolidation
- Interference and Communication
- Skew

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 1.3. Objectives (cont'd)

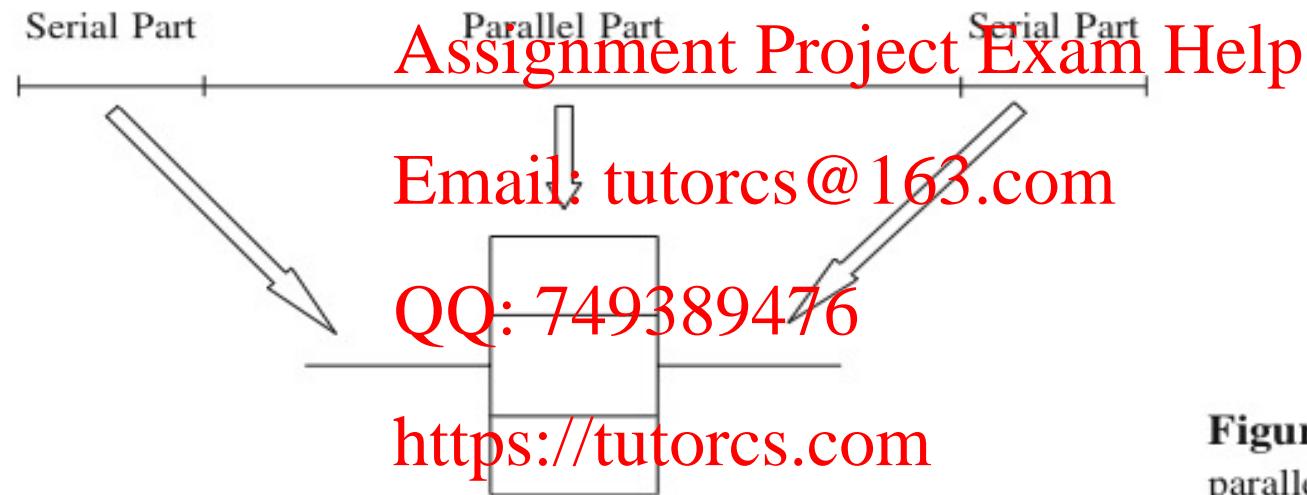
程序代写代做 CS编程辅导

### Start-up and Consolidation

- Start up: initiation of multiple parallel tasks
- Consolidation: the cost for collecting results obtained from each processor by a host processor



WeChat: cstutorcs



**Figure 1.3** Serial part vs. parallel part

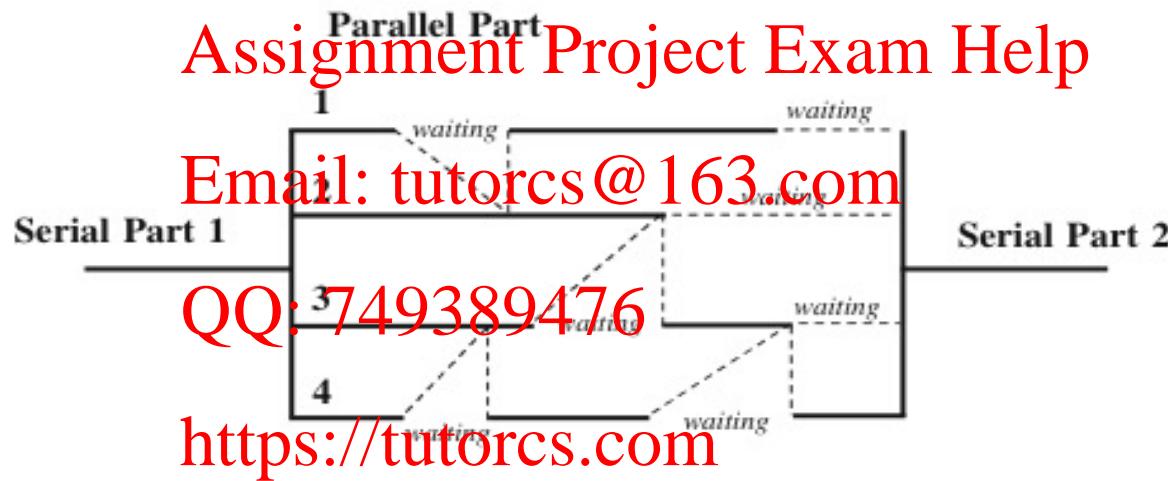
## 1.3. Objectives (cont'd)



### Interference and Communication

- Interference: competing for the same shared resources
- Communication: one process communicating with other processes, and often one has to wait for others to be ready for communication (i.e. waiting time).

WeChat: cstutorcs



**Figure 1.4** Waiting period

# 程序代写代做 CS编程辅导

## · Exercise 3 (Flux Quiz)

- There is a job that takes 1 hour to complete, if this is done by 1 processor.
- The serial part of this job is 10%
- There are 4 processors to use in this job, but each processor will have an overhead of 20% due to waiting time, communication time, etc.
- What type of speedup do we get?



WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 1.3. Objectives (cont'd)



### • Skew

- Unevenness of workload
- Load balancing is one of the factors to achieve linear speed up



**Figure 1.5** Balanced workload vs. unbalanced workload (skewed)

# 程序代写代做 CS编程辅导

## · Exercise 4 (FLUX Quiz)

- Pick a number (between 1 and 4)



- A. 1
- B. 2
- C. 3
- D. 4

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

# 程序代写代做 CS编程辅导

## · Exercise 5 (FLUX Quiz)

- Pick a number again (between 1 and 4)



- A. 1
- B. 2
- C. 3
- D. 4

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

# 程序代写代做 CS编程辅导

## · Exercise 6 (FLUX Quiz)

- Pick a number again (between 1 and 4)



- A. 1
- B. 2
- C. 3
- D. 4

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 1.3. Objectives (cont'd)

程序代写代做 CS 编程辅导

### • Skew

- Zipf distribution model to allocated to the processor



Measured in terms of different sizes of fragments

$$= \frac{|R|}{i^\theta \times \sum_{j=1}^N \frac{1}{j^\theta}} \quad \text{where } 0 \leq \theta \leq 1 \quad (2.1)$$

- The symbol  $\theta$  denotes the degree of skewness, where  $\theta = 0$  indicates no skew, and  $\theta = 1$  indicates highly skewed
- $|R|$  is number of records in the table,  $|R_i|$  is number of records in processor  $i$ , and  $N$  is number of processor ( $j$  is a loop counter, starting from 1 to  $N$ )
- Example:  $|R|=100,000$  records,  $N=8$  processors

Email: tutorcs@163.com

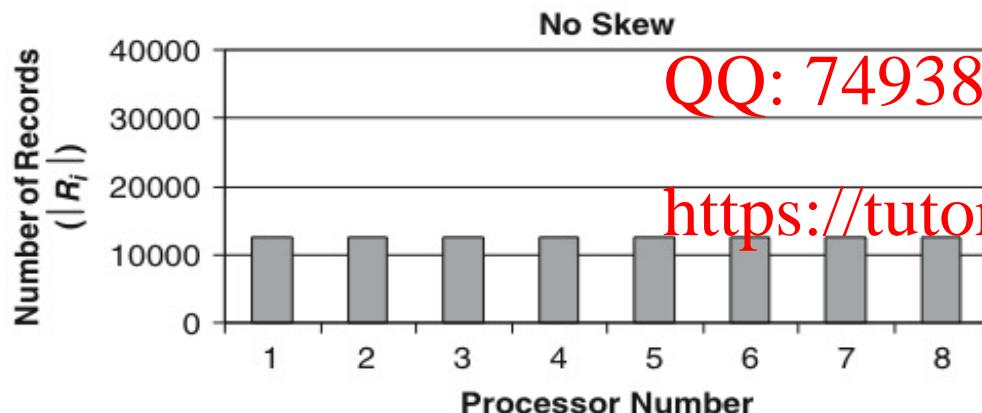


Figure 2.1 Uniform distribution (no skew)

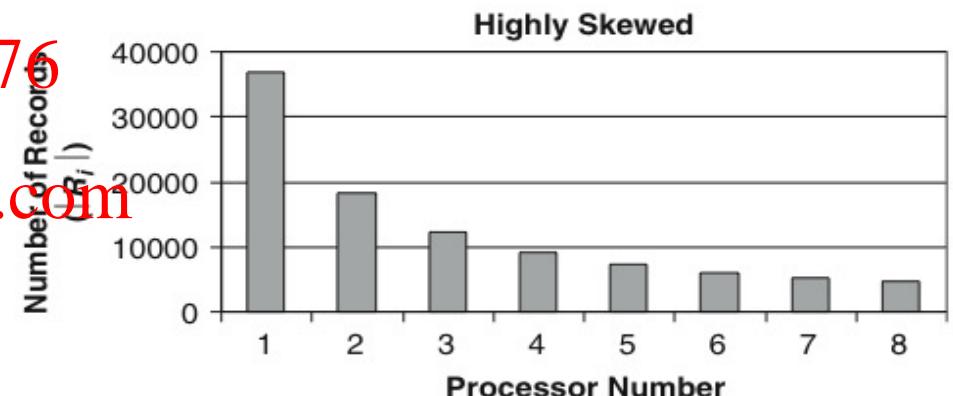


Figure 2.2 Highly skewed distribution

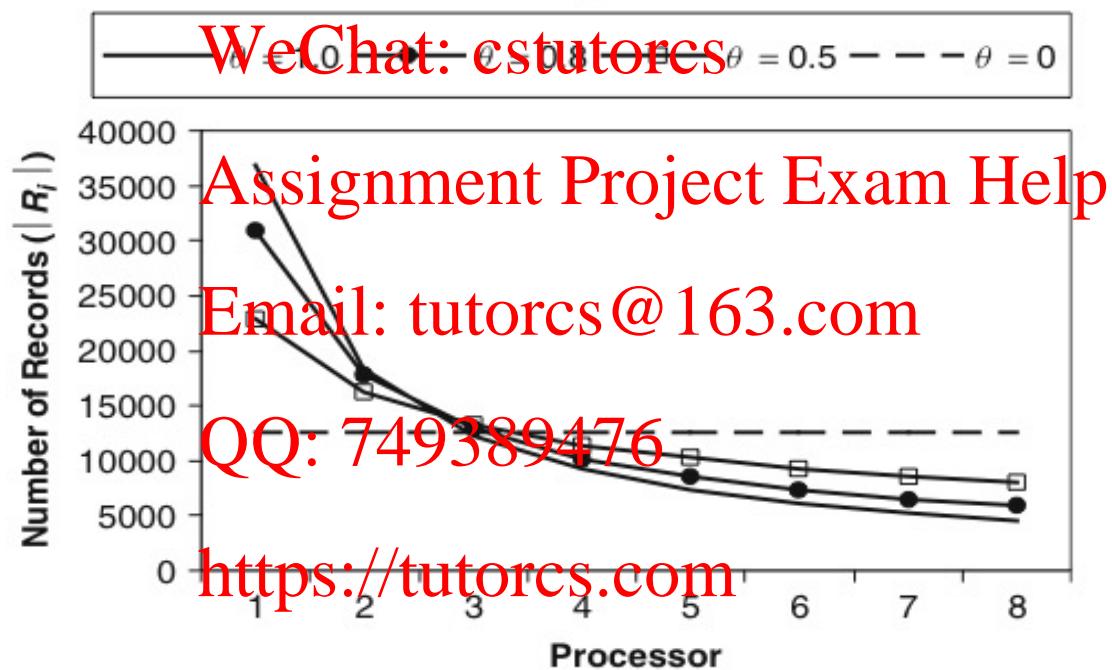
## 1.3. Objectives (cont'd)

程序代写代做 CS 编程辅导

- No skew vs. highly skewed



Comparison

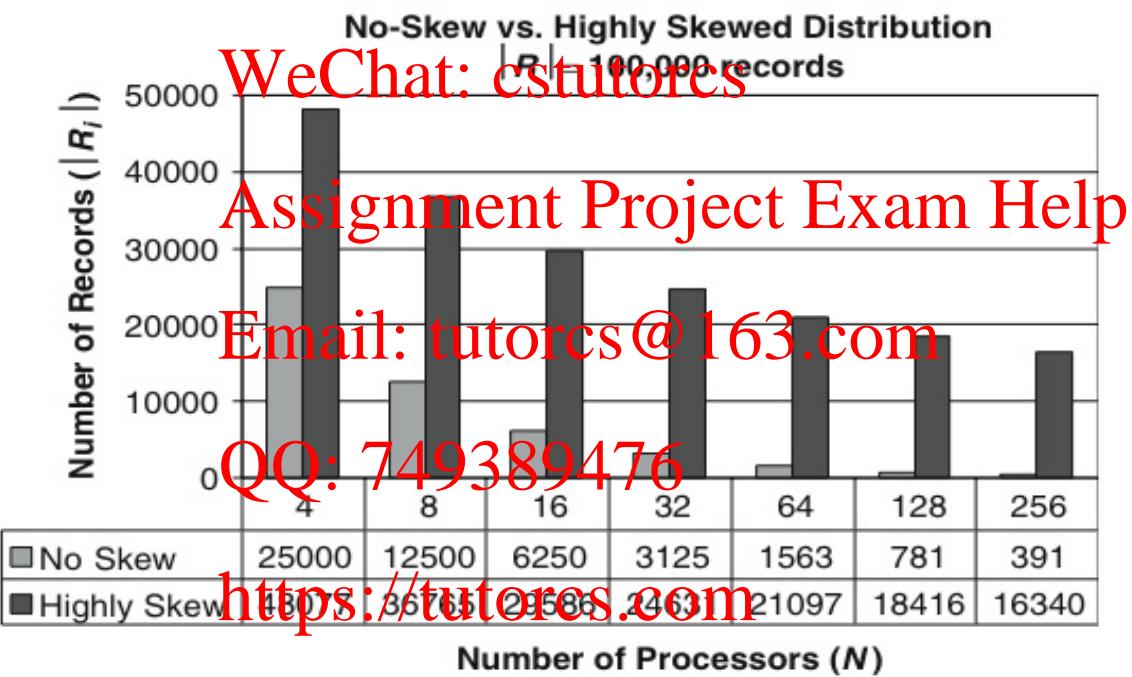


**Figure 2.3** Comparison between highly skewed, less skewed, and no-skew distributions

## 1.3. Objectives (cont'd)



- No skew vs. highly skew



**Figure 2.4** Comparison between the heaviest loaded processors using no-skew and highly skewed distributions

## 1.3. Objectives (cont'd)



- No skew vs. highly skewed

WeChat: cstutorcs

Table 2.2 Divisors (with vs. without skew)

$N$	4	8	16	32	64	128	256
<b>Divisor without skew</b>	4	8	16	32	64	128	256
<b>Divisor with skew</b>	2.08	2.72	3.38	4.06	4.74	5.43	6.12

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

# 程序代写代做 CS编程辅导

## • Exercise 7 (FLUX Quiz)

- There are 100,000 records in a table to be distributed to 32 processors. Assuming that the degree of parallelism is high ( $\theta = 1$ ), what is the estimated number of records in the heaviest processor?

WeChat: cstutorcs

- A. 48,000 records
- B. 29,000 records
- C. 24,000 records
- D. It is not possible to predict

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>



## 1.4. Forms of Parallelism

- Forms of parallelism for processing:
  - Interquery parallelism
  - Intraquery parallelism
  - Interoperation parallelism
  - Intraoperation parallelism
  - Mixed parallelism



WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 1.4. Forms of Parallelism (cont'd)

程序代写与代做CS编程辅导

### • Interquery Parallelism

- “Parallelism among queries”
- Different queries or transactions executed in parallel with one another
- Main aim: scaling up transaction processing systems

WeChat: cstutorcs

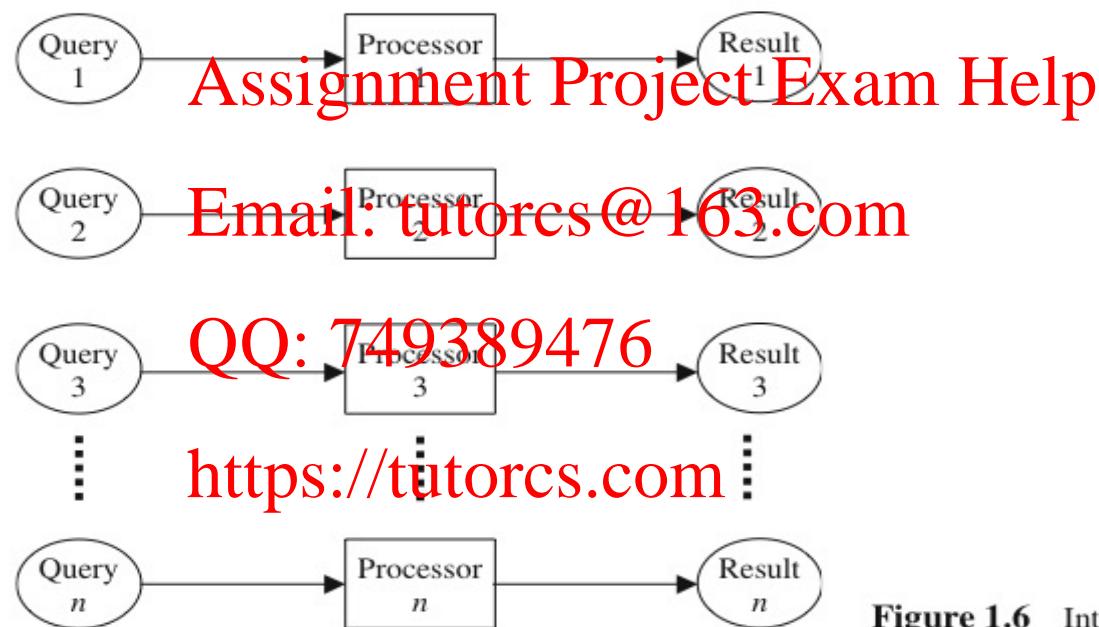


Figure 1.6 Interquery parallelism

## 1.4. Forms of Parallelism (cont'd)

程序代写代做CS编程辅导

### Intraquery Parallelism

- “Parallelism within a query”
- Execution of a single query on multiple processors and disks
- Main aim: speeding up long-running queries



WeChat: cstutorcs

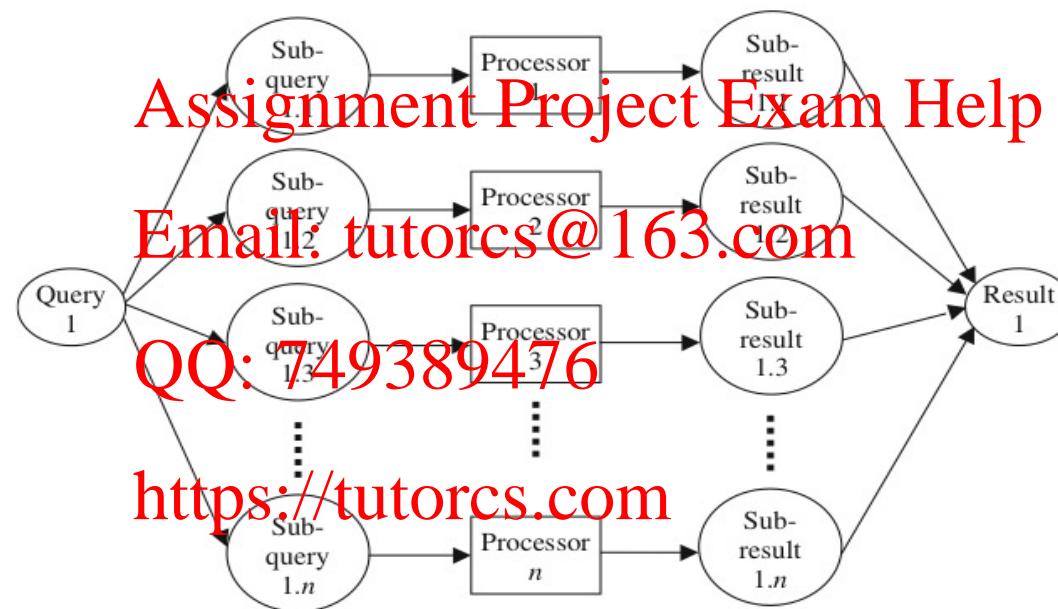


Figure 1.7 Intraquery parallelism

## 1.4. Forms of Parallelism (cont'd)

程序代写与代做CS编程辅导

- Execution of a single query can be parallelized in two ways:



- Intraoperation parallelism:** Speeding up the processing of a query by parallelizing the execution of each individual operation (e.g. parallel sort, parallel search, etc)
- Interoperation parallelism:** Speeding up the processing of a query by executing in parallel different operations in a query expression (e.g. simultaneous sorting or searching)

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 1.4. Forms of Parallelism (cont'd)

程序代写与代做CS编程辅导



### Intraoperation Parallelism

- “Partitioned parallelism”
- Parallelism due to the data being partitioned
- Since the number of records in a table can be large, the degree of parallelism is potentially enormous

WeChat: cstutores  
Assignment Project Exam Help  
Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

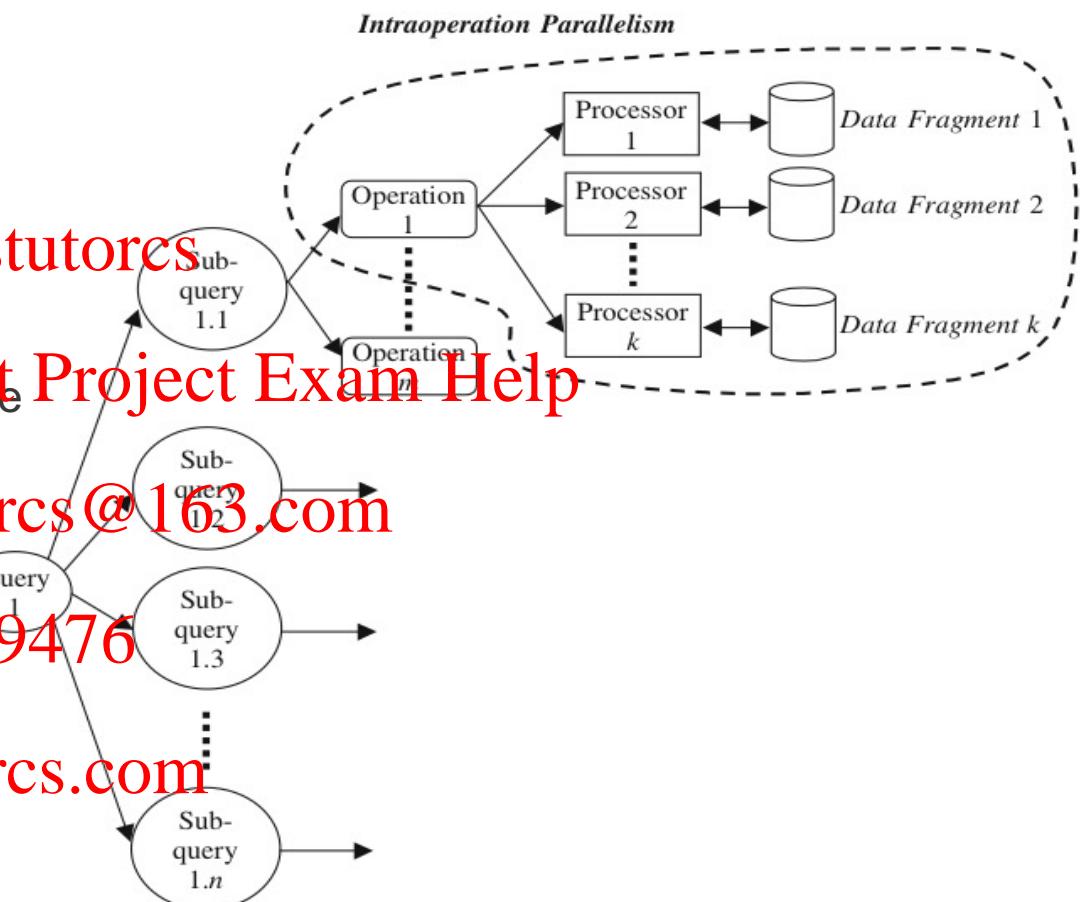


Figure 1.8 Intraoperation parallelism

## 1.4. Forms of Parallelism (cont'd)

程序代写与代做CS编程辅导

- **Interoperation parallelism**: Parallelism created by concurrently executing different operations within the same transaction



- Pipeline parallelism
- Independent parallelism

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 1.4. Forms of Parallelism (cont'd)

程序代写与代做CS编程辅导



### • Pipeline Parallel

- Output record of one operation  $A$  are consumed by a second operation  $B$ , even before the first operation has produced the entire set of records in its output

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

- Multiple operations form some sort of assembly line to manufacture the query results

- Useful with a small number of processors, but does not scale up well

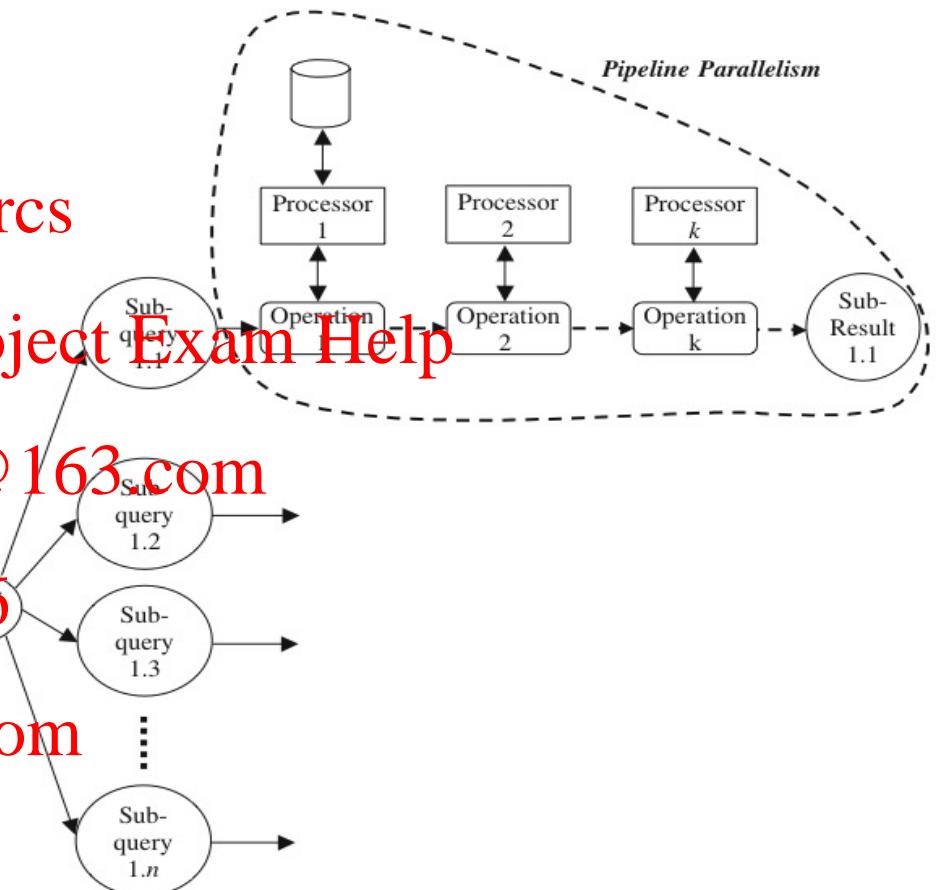


Figure 1.9 Pipeline parallelism

## 1.4. Forms of Parallelism (cont'd)

程序代写与代做CS编程辅导



### Independent Parallelism

- Operations in a query that do not depend on one another are executed in parallel
- Does not provide a high degree of parallelism

WeChat: cstutorcs

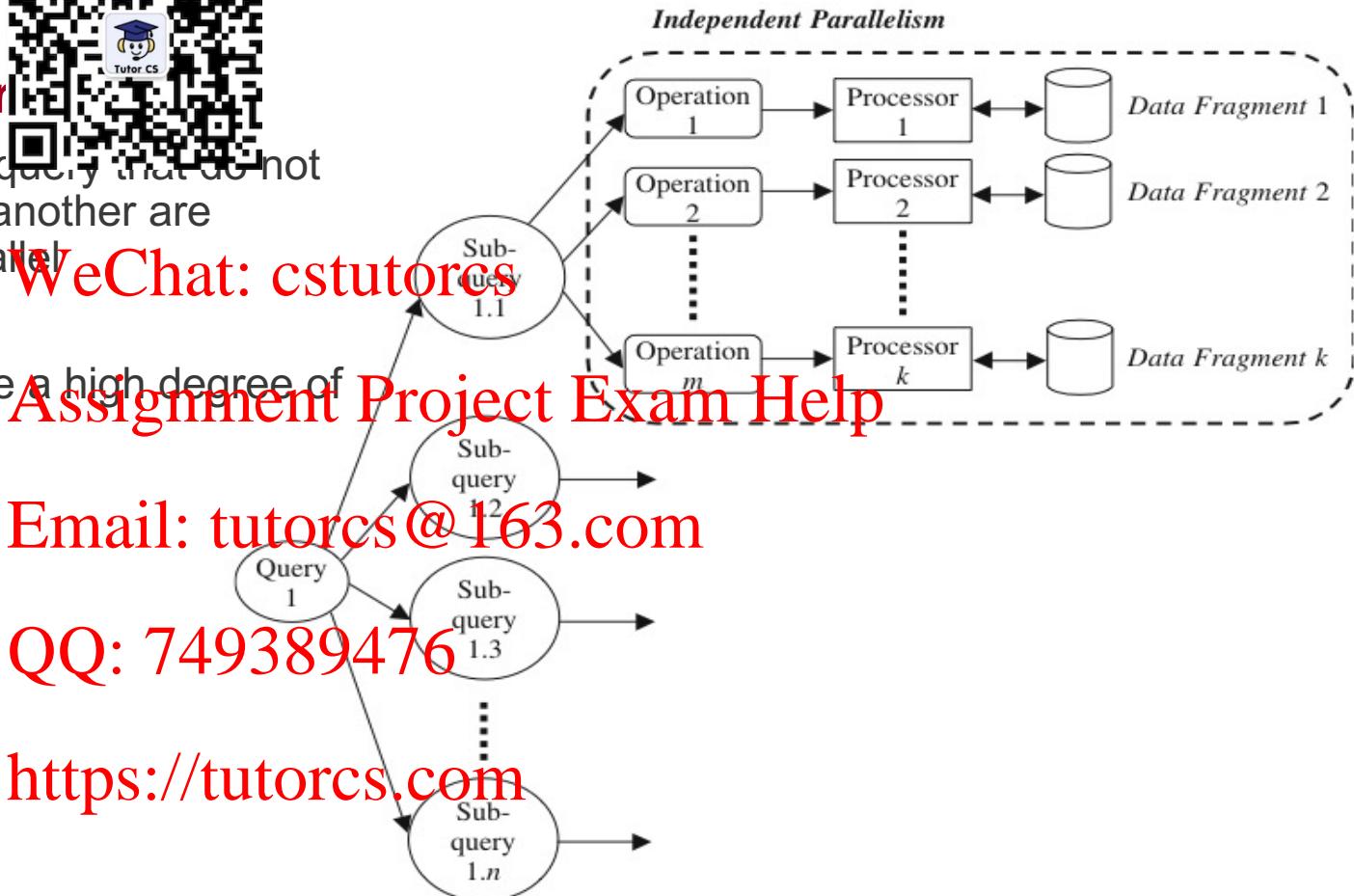
Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

Figure 1.10 Independent parallelism



## 1.4. Forms of Parallelism (cont'd)

程序代写与代做CS编程辅导

### Mixed Parallelism

- In practice, a mixture of all three parallelism forms is used.



Figure 1.11 Mixed parallelism

# 1.5. Parallel Database Architectures

- Parallel computers are revolutionizing the monopoly of supercomputers
- Parallel computers are available in many forms:
  - Shared-memory architecture
  - Shared-disk architecture
  - Shared-nothing architecture
  - Shared-something architecture



WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 1.5. Parallel Database Architectures (cont'd)

### Shared-Memory and Shared-Disk Architectures

- Shared-Memory: all processors share a common main memory and secondary memory
- Load balancing is relatively easy to achieve, but suffer from memory and bus contention
- Shared-Disk: all processors, each of which has its own local main memory, share the disks

WeChat: cstutorcs

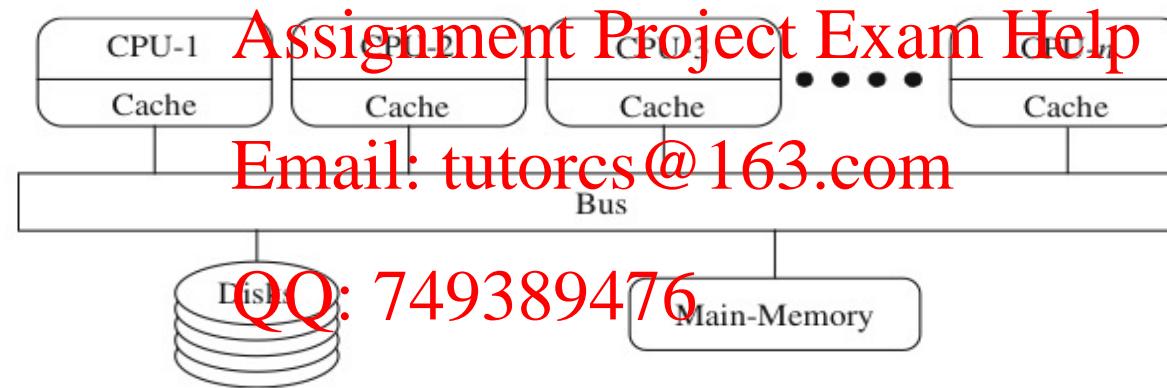
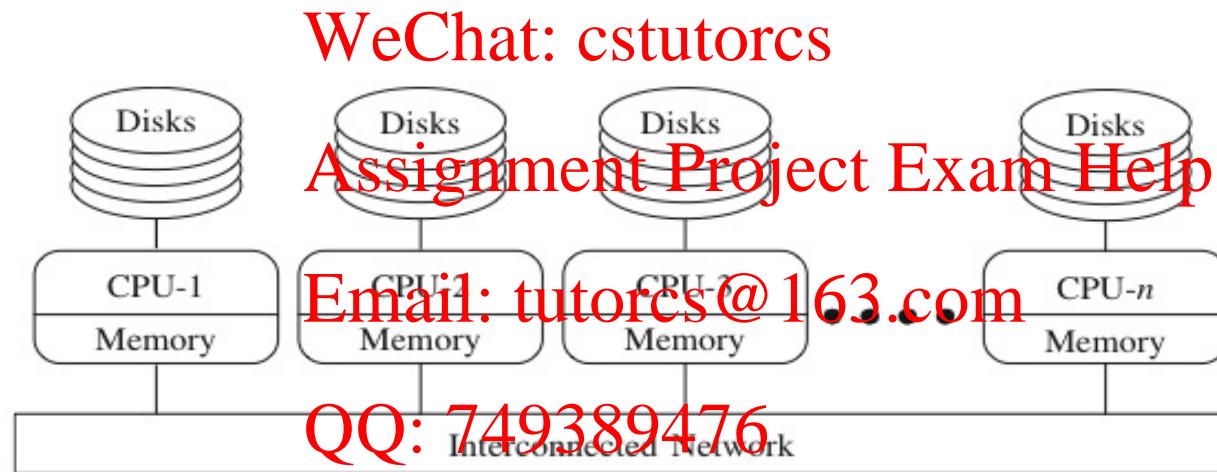


Figure 1.12 An SMP architecture

## 1.5. Parallel Database Architectures (cont'd)

### • Shared-Nothing Architecture

- Each processor has its own memory and disks
- Load balancing becomes easier



**Figure 1.13** A shared-nothing architecture  
<https://tutorcs.com>

## 1.5. Parallel Database Architectures (cont'd)

### • Shared-Something Architecture

- A mixture of shared-memory and shared-nothing architectures
- Each node is a shared-memory architecture connected to an interconnection network aka shared-nothing architecture

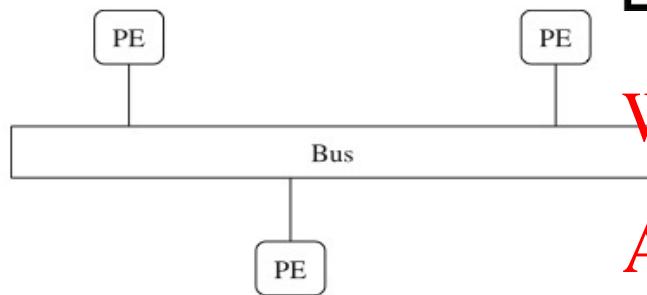


**Figure 1.14** Cluster of SMP architectures

## 1.5. Parallel Database Architectures (cont'd)

### Interconnection Networks

- Bus, Mesh, Hypercube



WeChat: cstutorcs

Figure 1.15 Bus interconnection network  
Assignment Project Exam Help

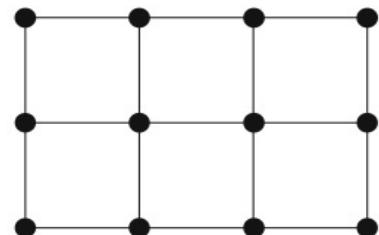


Figure 1.16 Mesh interconnection network

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

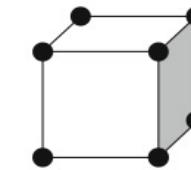
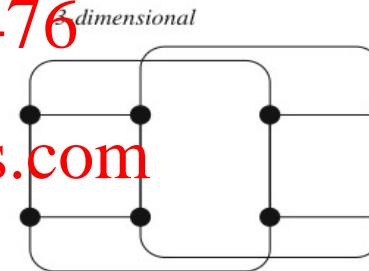


Figure 1.17 Hypercube interconnection network

## 1.7. Exercises (from the textbook)

程序代写代做 CS编程辅导

- **Q1.3:** Highlight the difference between **speed up** and **scale up**.
- **Q1.7:** Skewed workload distribution is generally undesirable. Under what conditions that parallelism (i.e. the workload is divided among all processors) is not desirable?



WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 1.8. Summary

程序代写代做 CS 编程辅导

- Why, What, and How of parallel query processing:



- Why is parallelism necessary in database processing?
- What can be achieved by parallelism in database processing?

WeChat: cstutorcs

Assignment Project Exam Help

- How parallelism performed in database processing?

Email: tutorcs@163.com

- What facilities of parallel computing can be used?

QQ: 749389476

<https://tutorcs.com>



MONASH University

程序代写代做 CS 编程辅导

Information Technology



# FIT5148 (Volume II - Search)

Week 2b – Parallel Search WeChat: cstutorcs

Assignment Project Exam Help

**algorithm distributed systems database**

Email: tutorcs@163.com

systems **computation knowledge management**

QQ: 749389476

**design e-business model data mining intelligent**

**distributed systems database software engineering**

<https://tutorcs.com>

**computation knowledge management analysis**

程序代写代做 CS编程辅导

# Chapter 3 Parallel Search

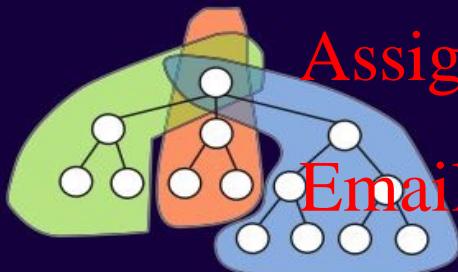
TANIA  
LEUNG  
RAHAYU  
GOEL

Wiley Series on Parallel and Distributed Computi



High Performan  
Database Processing  
Grid Databases

WeChat: cstutorcs



Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

DAVID TANIA, CLEMENT H.C. LEUNG,  
WENNY RAHAYU, and SUSHANT GOEL

<https://tutorcs.com>

High Performance Parallel Database  
Processing and Grid Databases



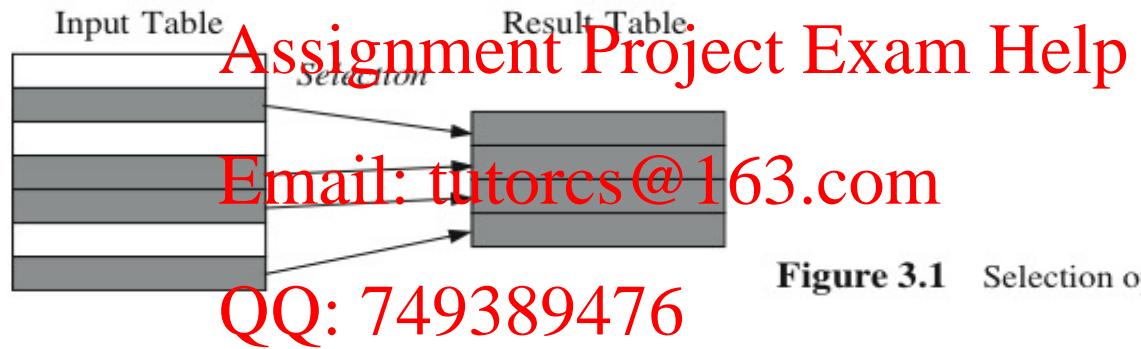
WILEY

- 3.1 Search Queries
- 3.2 Data Partitioning
- 3.3 Search Algorithms
- 3.4 Summary
- 3.5 Bibliographical Notes
- 3.6 Exercises

## 3.1. Search Queries



- Search is **selection** operation in database queries
- Selects specified records based on a given criteria
- The result is a horizontal subset (records) of the operand



**Figure 3.1** Selection operation

- Three kinds of search queries:  
<https://tutorcs.com>
  - Exact-match search
  - Range search
  - Multi attribute search

### 3.1. Search Queries (cont'd)

程序代写代做 CS 编程辅导



#### • Exact-Match Search

- Selection predicate on an attribute to check for an exact match between a search attribute and a given value
- Expressed by the WHERE clause in SQL

WeChat: cstutorcs

- Query 3.1 will produce a unique record (if the record is found), whereas Query 3.2 will likely produce multiple records

Email: tutorcs@163.com

**Query 3.1:**

```
Select *
From STUDENT
Where Sid = 23;
```

QQ: 749389476

**Query 3.2:**

```
Select *
From STUDENT
Where Slname = 'Robinson' ;
```

<https://tutorcs.com>

### 3.1. Search Queries (cont'd)

程序代写代做 CS 编程辅导



- **Range Search Query**

- The search covers a certain range
- **Continuous range search query**

WeChat: cstutorcs

Query 3.3:

```
Select *
From STUDENT
Where Sgpa > 3.50;
```

Assignment Project Exam Help

Email: tutorcs@163.com

- **Discrete range search query**

Query 3.4:

```
Select *
From STUDENT
Where Sdegree IN ('BCS', 'BInfSys');
```

QQ: 749389476

<https://tutorcs.com>

### 3.1. Search Queries (cont'd)

程序代写代做 CS 编程辅导



#### • Multiattribute Selection

- More than attribute is involved in the search
- Conjunctive (AND) or Disjunctive (OR)
- If both are used, it must be in a form of *conjunctive prenex normal form* (CPNF)

WeChat: cstutorcs  
Assignment Project Exam Help

Query 3.6:

```
Select *  
From STUDENT  
Where Slname = 'Robinson'  
And Sdegree IN ('MKT', 'BInfSys');
```

<https://tutorcs.com>

## 3.2. Data Partitioning



- Distributes data over a number of processing elements
- Each processing element is then executed simultaneously with other processing elements, thereby creating parallelism
- Can be physical or logical data partitioning
- In a shared-nothing architecture, data is placed permanently over several disks
- In a shared-everything (shared-memory and shared-disk) architecture, data is assigned logically to each processor
- Two kinds of data partitioning:
  - Basic data partitioning
  - Complex data partitioning

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导

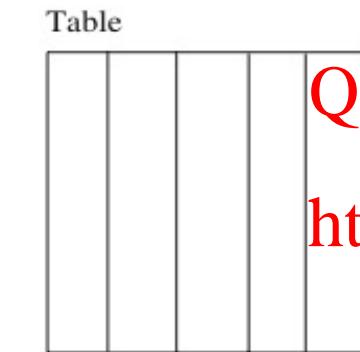


### • Basic Data Partitioning

- Vertical vs. Horizontal data partitioning
- Vertical partitioning partitions the data vertically across all processors. Each processor has a full number of records of a particular table. This model is more common in distributed database systems
- Horizontal partitioning is a model in which each processor holds a partial number of complete records of a particular table. It is more common in parallel relational database systems

Assignment Project Exam Help

Email: tutorcs@163.com



(a) Vertical Partitioning



(b) Horizontal Partitioning

**Figure 3.2** Vertical and horizontal data partitioning

## 3.2. Data Partitioning (cont'd)



### • Basic Data Partitioning

- Round-robin data partitioning
- Hash data partitioning
- Range data partitioning
- Random-unequal data partitioning

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

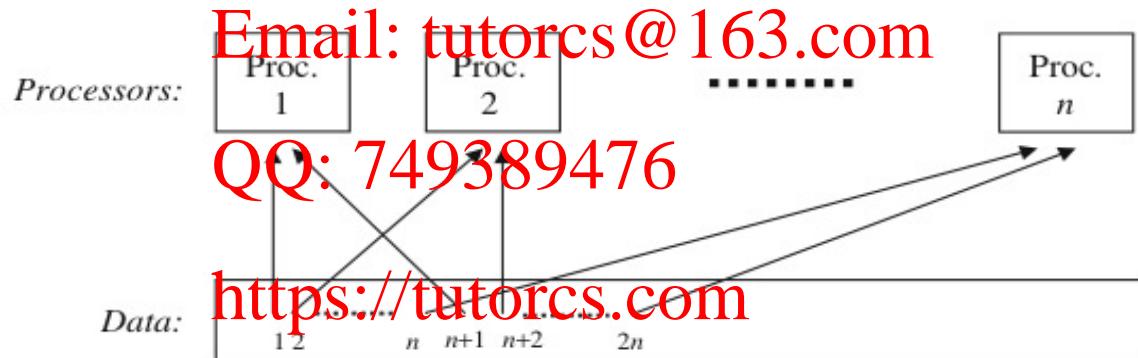
## 3.2. Data Partitioning (cont'd)



### • Round-robin data partitioning

- Each record in turn is allocated to a processing element in a clockwise manner
- “Equal partitioning” or “Random-equal partitioning”
- Data evenly distributed, hence supports load balance
- But data is not grouped semantically

WeChat: cstutorcs  
Assignment Project Exam Help



**Figure 3.3** Round-robin data partitioning

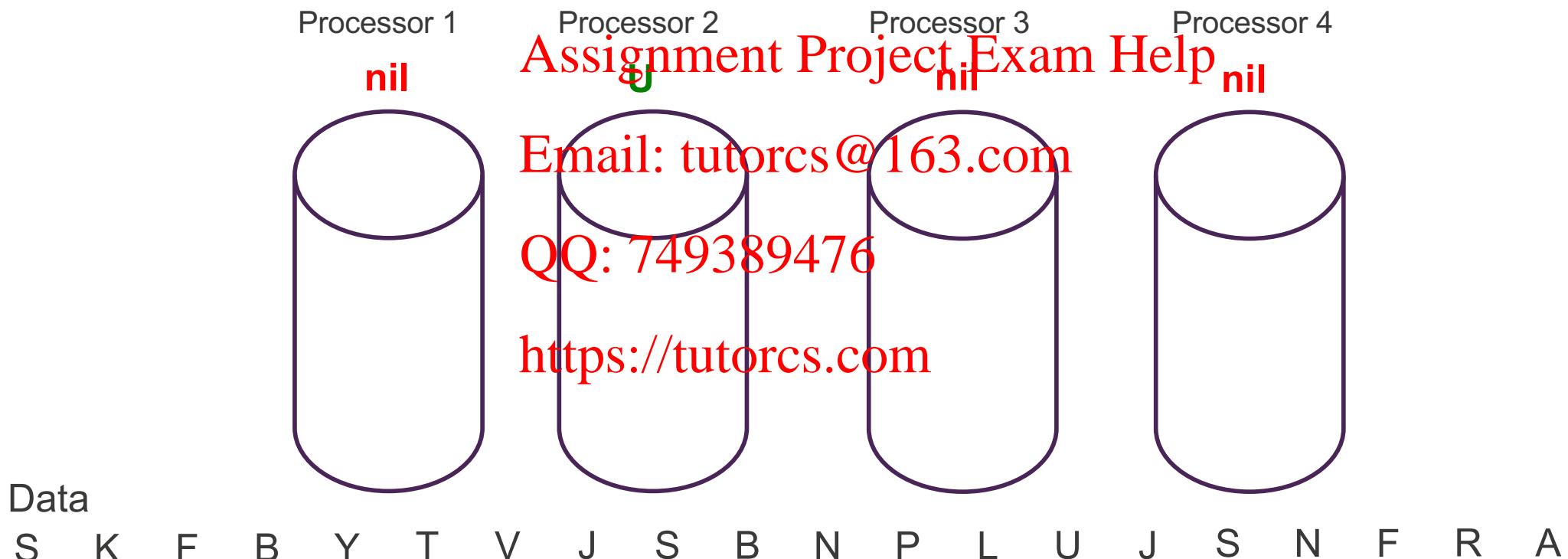
## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



- Round-robin data partitioning

Search U  
WeChat: cstutorcs



## 3.2. Data Partitioning (cont'd)



### • Hash data partitioning

- A hash function is used to partition the data
- Hence, data is grouped semantically, that is data on the same group shared the same hash value
- Selected processors may be identified when processing a search operation (exact-match search), but for range search (especially continuous range), all processors must be used
- Initial data allocation is not balanced either

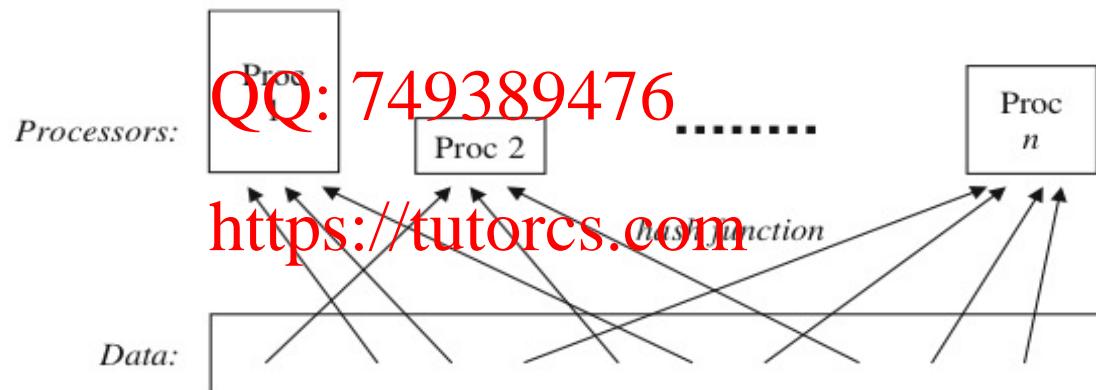


Figure 3.4 Hash data partitioning

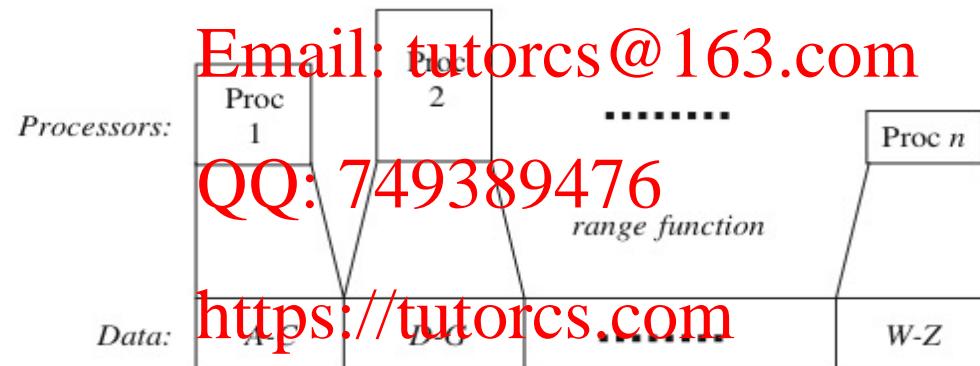
## 3.2. Data Partitioning (cont'd)



- **Range data partitioning**

- Spreads the records based on a given range of the partitioning attribute
- Processing records on a specific range can be directed to certain processors only
- Initial data allocation is skewed too

WeChat: cstutorcs  
Assignment Project Exam Help



**Figure 3.5** Range data partitioning

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



Search U

- Range data parti

WeChat: cstutorcs

Processor 1  
A-F

Processor 2  
G-L

Processor 3  
M-S

Processor 4  
T-Z

nil

nil

nil

U

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

Data

S K F B Y T V J S B N P L U J S N F R A

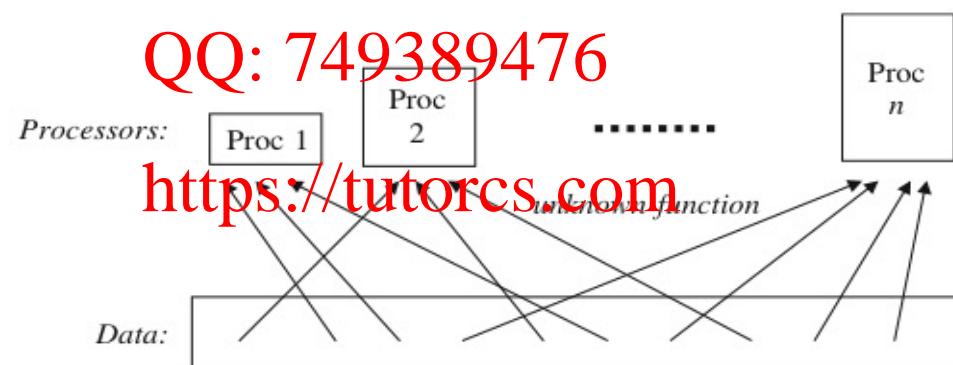
## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Random-unequal partitioning

- Partitioning is not based on the same attribute as the retrieval processing is based on a non retrieval processing attribute, or the partitioning method is unknown
- The size of each partitioning is likely to be unequal
- Records within each partition are not grouped semantically
- This is common especially when the operation is actually an operation based on temporary results obtained from the previous operations



QQ: 749389476

<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



Search 19

WeChat: cstutorcs

Processor 1  
A-F

nil

A 15

F 82

B 42

B 6

F 10

Processor 2  
G-L

nil

Email: tutorcs@163.com

QQ: 749389476

J 72

L 12

J 32

K 5

Processor 3  
M-S

nil

R 92

N 6

S 31

P 92

N 70

S 56

S 43

Processor 4  
T-Z

[U 19]

U 19

V 9

T 36

Y 88

## 3.2. Data Partitioning (cont'd)



### • Basic Data Partitioning

- Attribute-based data partitioning
- Non-attribute-based data partitioning

WeChat: csutorcs

**Assignment Project Exam Help**  
**Email: tutorcs@163.com**

Attribute-Based Partitioning	Non-Attribute-Based Partitioning
Based on a particular attribute	Not based on any attribute
Has grouping semantics	No grouping semantics
Skew	Balanced

**QQ: 749389476**

<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导

### Exercise 1 (Textbook)

- Given a data set  $D = \{55; 10; 22; 4; 49; 90; 34; 76; 82; 56; 31; 25; 78; 56; 38; 32; 88; 9; 44; 98; 11; 70; 66; 89; 99; 22; 23; 26\}$ , three processors, and a **random-equal data partitioning**, illustrate how the parallel searching of **data item 78** is carried out.



WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导

### Exercise 2 (Textbook)

- Given a data set  $D = \{55; 10; 22; 4; 49; 90; 34; 76; 82; 56; 31; 25; 78; 56; 38; 32; 88; 9; 44; 98; 11; 70; 66; 89; 99; 22; 23; 26\}$ , three processors, and a **range data partitioning**, illustrate how the parallel searching of data items **between 70 and 79** can be carried out.



WeChat: csutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导

### Exercise 3 (Textbook)

- Given a data set  $D = \{55; 10; 20; 30; 40; 49; 90; 34; 76; 82; 56; 31; 25; 78; 56; 38; 32; 88; 9; 44; 98; 11; 70; 66; 89; 99; 22; 23; 26\}$ , three processors, and a **hash data partitioning**, illustrate how the parallel searching of data items **10, 20, 30, ..., 90** can be carried out.



WeChat: csutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Complex Data Partitioning

- Basic data partitioning is based on a single attribute (or no attribute)
- Complex data partitioning is based on multiple attributes or is based on a single attribute but with multiple partitioning methods

WeChat: cstutorcs  
Assignment Project Exam Help

- Hybrid-Range Partitioning Strategy (HRPS)

- Multiattribute Grid Declustering (MAGIC)

- Bubba's Extended Range Declustering (BERB)

Email: tutorcs@163.com  
QQ: 749389476

<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Hybrid-Range Partitioning Strategy (HRPS)

- Partitions the table into many fragments using range, and the fragments are distributed to all processors using round-robin
- Each fragment contains approx  $FC$  records

WeChat: cstutorcs

$FC = \frac{RecordsPerQ_{Ave}}{M}$  (B.1)

Assignment Project Exam Help  
Email: tutorcs@163.com  
Where  $RecordsPerQ_{Ave}$  is the average number of records retrieved and processed by each query, and  $M$  is the number of processors that should participate in the execution of an average query

QQ: 749389476

- Each fragment contains a unique range of values of the partitioning attribute
- The table must be sorted on the partitioning attribute, then it is partitioned that each fragment contains  $FC$  records, and the fragments are distributed in round-robin ensuring that  $M$  adjacent fragments assigned to different processors

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Hybrid-Range Partitioning Strategy (HRPS)

- Example: 10000 student records, and the partitioning attribute is StudentID (PK) that ranges from 1 to 10000. Assume the average query retrieves a range of 500 records ( $RecordsPerQ=500$ ). Queries access students per year enrolment wth average results of 500 records. Assume the optimal performance is achieved when 5 processors are used ( $M=5$ )

WeChat: cstutorcs  
Assignment Project Exam Help

Email: tutorcs@163.com

$$FC = \frac{RecordsPerQ_{Ave}}{M} = 100$$

QQ: 749389476

- The table will be partitioned into 100 fragments
- Three cases:  $M = N$ ,  $M > N$ , or  $M < N$  (where  $N$  is the number of processors in the configuration and  $M$  is the number of processors participating in the query execution)

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Hybrid-Range Partitioning Strategy (HRPS)

- Case 1:  $M = N$
- Because the query will overlap with 5-6 fragments, all processors will be used (high degree of parallelism)
- Compared with hash partitioning: Hash will also use  $N$  processors, since it cannot localize the execution of a range query
- Compared with range partitioning: Range will only use 1-2 processors, and hence the degree of parallelism is small

HRPS	1-100	101-200	201-300	301-400	401-500
	...	...	...	...	...
	...	...	...	...	...
	9501-9600	9601-9700	9701-9800	9801-9900	9901-10000
Range	1-2000	2001-4000	4001-6000	6001-8000	8001-10000

QQ: 749389476  
<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Hybrid-Range Partitioning Strategy (HRPS)

- Case 2:  $M > N$  (e.g.  $M=5$ , and  $N=2$ )
- HRPS will still use all  $N$  processors, because it enforces the constraint that the  $M$  adjacent fragments be assigned to different processors whenever possible
- Compared with range partitioning: an increased probability that a query will use only one processor (in this example)

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

Figure 3.8 Case 2 ( $M > N$ ) and a comparison with the range partitioning method

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Hybrid-Range Partitioning Strategy (HRPS)

- Case 3:  $M < N$  (e.g.  $M=5$ , and  $N=10$ )
- HRPS distributes 100 fragments to all  $N$  processors. Since the query will overlap with only 5-6 fragments, each individual query is localized to almost the optimal number of processors
- Compared with hash partitioning: Hash will use all  $N$  processors, and hence less efficient due to start up, communication, and termination overheads
- Compared with range partitioning: The query will use 1-2 processors only, and hence less optimal

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

HRPS	1-100	101-200	201-300	301-400	401-500	501-600	601-700	701-800	801-900	901-1000
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
9001-9100	9101-9200	9201-9300	9301-9400	9401-9500	9501-9600	9601-9700	9701-9800	9801-9900	9901-10000	
Range	1-1000	1001-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000	8001-9000	9001-10000

Figure 3.9 Case 3 ( $M < N$  and a comparison with the range partitioning method

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Hybrid-Range Partitioning Strategy (HRPS)

- Support for Small Tables

If the number of fragments of a table is less than the number of processors, then the table will automatically be partitioned across a subset of the processors

WeChat: cstutorcs  
Assignment Project Exam Help

- Support for Tables with Nonuniform Distributions of the Partitioning Attribute Values  
Email: tutorcs@163.com

Because the cardinality of each fragment is not based on the value of the partitioning attribute value, once the HRPS determines the cardinality of each fragment, it will partition a table based on that value

QQ: 749389476  
<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Multiatribute Grid Partitioning (MAGIC)

- Based on multiple attributes - to support search queries based on either of data partitioning attributes
- Support range and exact match search on each of the partitioning attributes
- Example: Query 1 (one-half of the accesses) Slname='Roberts', and Query 2 (the other half) SID between 58555 and 58600. Assume both queries produce only a few records
- Create a two-dim grid with the two partitioning attributes (Slname and SID). The number of cells in the grid equal the number of processing elements
- Determine the range value for each column and row, and allocate a processor in each cell in the grid

QQ: 749389476

<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



### • Multiattribute Grouped Partitioning (MAGIC)

- Query 1 (exact match on Slname): Hash partitioning can localize the query processing on one processor. MAGIC will use 6 processors
- Query 2 (range on SID): if the hash partitioning uses Slname, whereas the query is on SID, the query must use all 36 processors. MAGIC on the other hand, will only use 6 processors
- Compared with range partitioning, suppose the partitioning is based on SID, then Q1 will use 36 processors whilst Q2 will use 1 processor

WeChat: cstutorcs  
Assignment Project Exam Help  
Email: tutorcs@163.com

Table 3.1 MAGIC data partitioning

Sid		Slname					
		A-D	E-H	I-L	M-P	Q-T	U-Z
98000-98200	1	2	3	4	5	6	
98101-98200	7	8	9	10	11	12	
98201-98300	13	14	15	16	17	18	
98301-98400	19	20	21	22	23	24	
98401-98500	25	26	27	28	29	30	
98501-98600	31	32	33	34	35	36	

QQ: 749389476  
<https://tutorcs.com>

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



- **Bubba's Extended Range-Based Declustering (BERB)**

- Another multiattribute partitioning method - used in the Bubba Database Machine
- Two levels of data partitioning: **primary** and **secondary** data partitioning
- Step 1: Partition the table based on the primary partitioning attribute and uses a range partitioning method

WeChat: cstutorcs  
Assignment Project Exam Help

Email: tutorcs@163.com

**Table 3.3** Primary partitioning in BERD

Sid	Slname	Sid	Slname	Sid	Slname
98001	Robertson	98105	Black	98250	Chan
98050	Williamson	98113	White	98270	Tan
98001–98100		98101–98200		98201–98300	

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



- **Bubba's Extended Declustering (BERB)**

- Step 2: Each fragment is scanned and an 'aux' table is created from the attribute value of the secondary partitioning attribute and a list of processors containing the original records
- Table 3.4 shows the 'aux' table (called Table *IndexB*)

WeChat: cstutorcs  
Assignment Project Exam Help

**Table 3.4** Auxiliary table in the secondary partitioning

Student	Processor
Robertson	1
Black	2
Chan	3
Williamson	1
White	2
Tan	3

## 3.2. Data Partitioning (cont'd)

程序代写与代做CS编程辅导



- **Bubba's Extended Range Declustering (BERB)**

- Step 3: The 'aux' table is range partitioned on the secondary partitioning attribute (e.g. Slname)
- Step 4: Place the fragments from steps 1 and 3 into multiple processors

### Assignment Project Exam Help

**Table 3.5** BERD partitioning combining the primary partitions and the secondary partitions

IndexB		IndexB		IndexB	
Black	2	Robertson	1	Williamson	1
Chan	3	Tan		White	2
Student		Student		Student	
98001	Robertson	98002	Black	98250	Chan
98050	Williamson	98113	White	98270	Tan

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

### 3.3. Search Algorithms



- **Serial** search algorithms

- Linear search
- Binary search

WeChat: cstutorcs

- **Parallel** search algorithms

- Processor activation or involvement
- Local searching methods
- Key comparison

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

### 3.3. Search Algorithms (cont'd)



- **Linear Search**

- Exhaustive search - search each record one by one until it is found or end of table is reached

WeChat: cstutorcs

- **Binary Search**

- Must be pre-sorted
  - The complexity is  $O(\log_2(n))$

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

### 3.3. Search Algorithms (cont'd)



- **Parallel** search a
- Processor activation or involvement
- Local searching method
- Key comparison

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

### 3.3. Search Algorithms (cont'd)



#### Processor activation or involvement

- The number of processors to be used by the algorithm
- If we know where the data to be sought are stored, then there is no point in activating all other processors in the searching process
- Depends on the data partitioning method used
- Also depends on what type of selection query is performed

Email: tutorcs@163.com

Table 3.6 Processor activation or involvement of parallel search algorithms

		Data Partitioning Methods			
		Random-Equal	Hash	Range	Random-Unequal
Exact Match		All	1	1	All
Range Selection	Continuous	All	All	Selected	All
	Discrete	All	Selected	Selected	All

### 3.3. Search Algorithms (cont'd)

程序代写代做CS编程辅导



#### • Local searching

- The searching method applied to the processor(s) involved in the searching process
- Depends on the data ordering, regarding the type of the search (exact match or range)

WeChat: cstutorcs

Assignment Project Exam Help

Table 3.7 Local searching method of parallel search algorithms

		Records Ordering	
		Ordered	Unordered
Exact Match		Binary Search	Linear Search
Range Selection	Continuous	Binary Search	Linear Search
	Discrete	Binary Search	Linear Search

QQ: 749389476

<https://tutorcs.com>

### 3.3. Search Algorithms (cont'd)

程序代写代做CS编程辅导



#### • Key comparison

- Compares the data from the table with the condition specified by the query
- When a match is found; continue to find other matches, or terminate
- Depends on whether the data in the table is unique or not

WeChat: cstutorcs  
Assignment Project Exam Help

Table 3.8 Key comparison of parallel search algorithms

		Search Attribute Values	
		Unique	Duplicate
Exact Match	Stop	Continue	Continue
	Continuous	Continue	Continue
Range Selection	Discrete	Continue	Continue

QQ: 749389476

<https://tutorcs.com>

## 3.4. Summary

程序代写代做 CS编程辅导

- Search queries in SQL use the WHERE clause
- Search predicates indicate the type of search operation
  - Exact-match, range (continuous or discrete), or multiattribute search
- Data partitioning is a basic mechanism of parallel search
  - Single attribute-based, no attribute-based, or multiattribute-based partitioning
- Parallel search algorithms have three main components
  - Processor involvement, local searching method, and key comparison

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

Homework: Read Chapter 5 for next week