SWINBURNE UNIVERSITY OF TECHNOLOGY

Faculty of Business and Enterprise

Assignment Cover Sheet for Undergraduate Courses

(for individual and group assignments)

This cover sheet is to be attached to all assignments, both hard copy and electronic format.

STUDENT(S) DETAILS

	Student 1	Student 2	Student 3	Student 4	Student 5
Student ID Number(s)	700513X				
Family Name(s)	Bunawan				
Given name (s)	Jonas				

SUBJECT DETAILS

Subject Code	INF30010	**Subject Title**	Database Administration	
Lecturer's/Supervisor's Name	Irene Moser	**Tute/Lab day & time**	Lab 1 (1)	Tuesday, 11:30 – 12:30

ASSIGNMENT DETAILS

Title or Topic Addressed	Assignment1 – Query Optimisation		
Due Date	Monday, 21st September 2015	**Date Received**	Friday, 18 September 2015 7:33:05 PM

DECLARATION

1. I/We hold a photocopy or electronic copy of this assignment which can be produced if the original is lost/damaged;
2. To the best of my/our belief, no part of this assignment has been copied from any other student's work or from any other source except where acknowledgement is made in the text;
3. No part of this assignment has been written for me/us by any other person except where such collaboration has been authorised by the lecturer concerned and where acknowledgement is made in the text;
4. No part of this assignment has been previously submitted as an assessable item, except where authorised by the lecturer concerned and where acknowledgement is made in the text;
5. **SAFE ASSIGN: For units where Safe Assign facility is available in the Blackboard site**

   1/we declare that this assignment has been submitted to Safe Assign (as specified in the unit outline) and all identified matches and referencing have been checked and corrected.

☒ I / We accept that electronic submission of this cover sheet will be taken as consent to the terms outlined in Points 1 to 5 of the above declaration by the student/s submitting this assignment.

Student Signature(s)					

MARKER'S MAIN COMMENTS

Marker's Signature	**Date**	**Grade/Mark**	

18 September 2015

FACULTY OF BUSINESS AND ENTERPRISE
INF300010 DATABASE ADMINISTRATION
ASSIGNMENT 1 – QUERY OPTIMISATION

Database Administration

Query Optimisation

INF30010_A02_T003

Author:

Jonas Bunawan – BICT (Business Systems) – 700513X

Date: 18/9/2015

I hold a copy of this assignment that can be produced if the original is lost/damaged. To the best of my belief, no part of this assignment has been copied from any other student's work or from any other source except where due acknowledgement is made in the text. No part has been written for me/us by any other person, except where such collaboration has been authorised by the lecturer concerned.

Executive Summary

This report is made as part of the requirements in passing INF30010 Database Administration subject at Swinburne University of Technology. I did the assignment all by myself by hoping that I could learn more since I could go through every single task that is required in this assignment 1. I am actually aiming for a D/HD grade for this subject, albeit I have never really had in my mind to take this subject as part of my degree at the early stage. However, since I like database and want to know more about it, I chose this subject so that I could get more technical knowledge which is believed to be a good start to be engaged in real IT industry.

I was enrolled for Database Implementation for last semester, but due to certain condition that required me to withdraw the subject, I had to choose another database related unit to take in this semester (since it's not offered in last semester of my degree studies). I have tried to finish all of the required sections thus giving me the chance to get higher grade. However, since I know that my knowledge is still limited, I hope that this report can at least be a proof that I have done my learning. At last, my expectation is that I still have the chance to get higher grade through my work on this assignment. Thank you.

Table of Contents

1. Pass Grade – Index Usage Observation

1.1 Block Size 4K

Observed query:

```
select vintage, wine_no, wname, pctalc, grade, price, wine.vid,
vname, wine.cid, cname
from vineyard, class, wine
where wine.vid = vineyard.vid
and wine.cid = class.cid
and wine.cid = 'SHIRAZ' and grade = 'A' ;
```

1.1.1 Results

File Name **For Results**	**Index Case**	**All rows plan**	**Cost**	**First rows(1) plan**	**Cost**
PLANA4K/PLANA4KFR	PK Indexes only	PLANA4K	26	PLANA4KFR	5
PLANA4K/PLANB4KFR	Wine(CID)	PLANA4K	26	PLANB4KFR	5
PLANA4K/PLANC4KFR	Wine(grade)	PLANA4K	26	PLANC4KFR	5
PLANA4K/PLANA4KFR	Wine(VID)	PLANA4K	26	PLANA4KFR	5
PLANA4K/PLAND4KFR	Wine(CID), Wine(grade)	PLANA4K	26	PLAND4KFR	5
PLANA4K/PLANE4KFR	Wine(grade), Wine(CID)	PLANA4K	26	PLANE4KFR	5
PLANA4K/PLANF4KFR	Wine(CID), Wine(VID)	PLANA4K	26	PLANF4KFR	5
PLANA4K/PLANA4KFR	Wine(VID), Wine(CID)	PLANA4K	26	PLANA4KFR	5
PLANA4K/PLANG4KFR	Wine(grade), Wine(VID)	PLANA4K	26	PLANG4KFR	5
PLANA4K/ PLANA4KFR	Wine(VID), Wine(grade)	PLANA4K	26	PLANA4KFR	5
PLANA4K/PLANH4KFR	Wine(CID), Wine(grade), Wine(VID)	PLANA4K	26	PLANH4KFR	5

PLANA4K/PLANI4KFR	Wine(CID), Wine(VID), Wine(grade)	PLANA4K	26	PLANI4KFR	5
PLANA4K/PLANJ4KFR	Wine(grade), Wine(VID), Wine(CID)	PLANA4K	26	PLANJ4KFR	5
PLANA4K/PLANK4KFR	Wine(grade), Wine(CID), Wine(VID)	PLANA4K	26	PLANK4KFR	5
PLANA4K/PLANA4KFR	Wine(VID), Wine(CID), Wine(grade)	PLANA4K	26	PLANA4KFR	5
PLANA4K/PLANA4KFR	Wine(VID), Wine(grade), Wine(CID)	PLANA4K	26	PLANA4KFR	5

Table 1.1.1.1: Results Table For Block Size 4096

1.1.2 Query Plans

1.1.2.1 All_Rows

1.1.2.1.1 PLANA4K

```
Plan hash value: 300875179

--------------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    25 |  4325 |    26   (4)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    25 |  4325 |    26   (4)| 00:00:01 |

|*  2 |   TABLE ACCESS FULL          | WINE         |    25 |  1875 |    19   (0)| 00:00:01 |

|   3 |  NESTED LOOPS                |              |   160 | 15680 |     6   (0)| 00:00:01 |

|   4 |   TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    48 |     1   (0)| 00:00:01 |

|*  5 |    INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   6 |   TABLE ACCESS FULL          | VINEYARD     |   160 |  8000 |     5   (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   2 - filter("WINE"."CID"='SHIRAZ' AND "GRADE"='A')
   5 - access("CLASS"."CID"='SHIRAZ')
```

1.1.2.2 First_Rows(1)

1.1.2.2.1 PLANA4KFR
Plan hash value: 3073342178

```
--------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                |               |       |       |            |          |

|   2 |   NESTED LOOPS               |               |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS              |               |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS       |     1 |    46 |     1   (0)| 00:00:01
|

|*  5 |      INDEX UNIQUE SCAN       | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|*  6 |     TABLE ACCESS FULL        | WINE          |     1 |    67 |     3   (0)| 00:00:01 |

|*  7 |    INDEX UNIQUE SCAN         | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |

|   8 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD    |     1 |    48 |     1   (0)|
00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')

   6 - filter("WINE"."CID"='SHIRAZ' AND "GRADE"='A')

   7 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.2 PLANB4KFR
Plan hash value: 1937987770

```
--------------------------------------------------------------------------------------------
| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
--------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |              |     1 |   161 |     5   (0)| 00:00:01 |
|   1 |  NESTED LOOPS                |              |       |       |            |          |
|   2 |   NESTED LOOPS               |              |     1 |   161 |     5   (0)| 00:00:01 |
|   3 |    NESTED LOOPS              |              |     1 |   113 |     4   (0)| 00:00:01 |
|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01
|
|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |
|*  6 |     TABLE ACCESS BY INDEX ROWID| WINE         |     1 |    67 |     3   (0)| 00:00:01
|
|*  7 |      INDEX RANGE SCAN          | WCIDX        |     4 |       |     1   (0)| 00:00:01 |
|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |
|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD     |     1 |    48 |     1   (0)|
00:00:01 |
--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')
   6 - filter("GRADE"='A')
   7 - access("WINE"."CID"='SHIRAZ')
   8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.3 PLANC4KFR

```
Plan hash value: 3111738954

--------------------------------------------------------------------------------------------
| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |              |     1 |   161 |     5   (0)| 00:00:01 |
|   1 |  NESTED LOOPS                 |              |       |       |            |          |
|   2 |   NESTED LOOPS                |              |     1 |   161 |     5   (0)| 00:00:01 |
|   3 |    NESTED LOOPS               |              |     1 |   113 |     4   (0)| 00:00:01 |
|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01
|
|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |
|*  6 |     TABLE ACCESS BY INDEX ROWID| WINE         |     1 |    67 |     3   (0)| 00:00:01
|
|*  7 |      INDEX RANGE SCAN          | WGIDX        |    15 |       |     1   (0)| 00:00:01 |
|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |
|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD     |     1 |    48 |     1   (0)|
00:00:01 |
-------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')
   6 - filter("WINE"."CID"='SHIRAZ')
   7 - access("GRADE"='A')
   8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.4 PLAND4KFR

Plan hash value: 1757148306

```
-------------------------------------------------------------------------------------------------
| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |              |     2 |   322 |     5   (0)| 00:00:01 |
|   1 |  NESTED LOOPS                  |              |      |       |            |          |

|   2 |   NESTED LOOPS                 |              |    2 |   322 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS                |              |    2 |   226 |     3   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS        |    1 |    46 |     1   (0)| 00:00:01
|

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188704 |    1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE         |    2 |   134 |     3   (0)| 00:00:01
|

|*  7 |      INDEX RANGE SCAN          | WCGIDX       |    2 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188721 |    1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD     |    1 |    48 |     1   (0)|
00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')

   7 - access("WINE"."CID"='SHIRAZ' AND "GRADE"='A')

   8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.5 PLANE4KFR

```
Plan hash value: 1618794452

---------------------------------------------------------------------------------------------

| Id  | Operation                      | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT               |              |    2 |   322 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                  |              |      |       |            |          |

|   2 |   NESTED LOOPS                 |              |    2 |   322 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS                |              |    2 |   226 |     3   (0)| 00:00:01 |
|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01
|

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE         |     2 |   134 |     3   (0)| 00:00:01
|

|*  7 |      INDEX RANGE SCAN          | WGCIDX        |     2 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD      |     1 |    48 |     1   (0)|
00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')

   7 - access("GRADE"='A' AND "WINE"."CID"='SHIRAZ')

   8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.6 PLANF4KFR

```
Plan hash value: 1014991871

--------------------------------------------------------------------------------------------

| Id  | Operation                      | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT               |               |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                  |               |       |       |            |          |

|   2 |   NESTED LOOPS                 |               |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS                |               |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01
|

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |
|*  6 |     TABLE ACCESS BY INDEX ROWID| WINE         |     1 |    67 |     5   (0)| 00:00:01
|

|*  7 |      INDEX RANGE SCAN          | WCVIDX       |     4 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD     |     1 |    48 |     1   (0)|
00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')

   6 - filter("GRADE"='A')

   7 - access("WINE"."CID"='SHIRAZ')

   8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.7 PLANG4KFR

```
Plan hash value: 339016774

---------------------------------------------------------------------------------------------

| Id  | Operation                      | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT               |              |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                  |              |       |       |            |          |

|   2 |   NESTED LOOPS                 |              |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS                |              |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01
|

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|*  6 |     TABLE ACCESS BY INDEX ROWID| WINE         |     1 |    67 |    10   (0)|
00:00:01 |

|*  7 |      INDEX RANGE SCAN          | WGVIDX       |    15 |       |     1   (0)| 00:00:01 |
|*  8 |    INDEX UNIQUE SCAN          | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |

|  9 |  TABLE ACCESS BY INDEX ROWID  | VINEYARD      |     1 |    48 |     1   (0)|
00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')

   6 - filter("WINE"."CID"='SHIRAZ')

   7 - access("GRADE"='A')

   8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.8 PLANH4KFR

```
Plan hash value: 1296056825

--------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                |               |       |       |            |          |

|   2 |   NESTED LOOPS               |               |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS              |               |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS         |     1 |    46 |     1   (0)| 00:00:01
|

|*  5 |      INDEX UNIQUE SCAN       | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE          |     1 |    67 |     3   (0)| 00:00:01 |

|*  7 |      INDEX RANGE SCAN        | WCGVIDX       |     1 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN         | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD      |     1 |    48 |     1   (0)|
00:00:01 |
-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')

   7 - access("WINE"."CID"='SHIRAZ' AND "GRADE"='A')

   8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.9 PLANI4KFR

```
Plan hash value: 256588960

-------------------------------------------------------------------------------------------

| Id  | Operation                      | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT               |              |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                  |              |       |       |            |          |

|   2 |   NESTED LOOPS                 |              |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS                |              |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01
|

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE         |     1 |    67 |     3   (0)| 00:00:01 |

|*  7 |      INDEX RANGE SCAN          | WCVGIDX      |     1 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD     |     1 |    48 |     1   (0)|
00:00:01 |

-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')

   7 - access("WINE"."CID"='SHIRAZ' AND "GRADE"='A')
```

```
     filter("GRADE"='A')

  8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.10 PLANJ4KFR

```
Plan hash value: 1824202701


-----------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                |               |       |       |            |          |

|   2 |   NESTED LOOPS               |               |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS              |               |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS       |     1 |    46 |     1   (0)| 00:00:01
|

|*  5 |      INDEX UNIQUE SCAN       | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE        |     1 |    67 |     3   (0)| 00:00:01 |

|*  7 |      INDEX RANGE SCAN        | WGVCIDX       |     1 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN         | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD    |     1 |    48 |     1   (0)|
00:00:01 |

-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

  5 - access("CLASS"."CID"='SHIRAZ')

  7 - access("GRADE"='A' AND "WINE"."CID"='SHIRAZ')

     filter("WINE"."CID"='SHIRAZ')

  8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.1.2.2.11 PLANK4KFR

```
Plan hash value: 1200239092

-----------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                |               |       |       |            |          |

|   2 |   NESTED LOOPS               |               |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS              |               |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS       |     1 |    46 |     1   (0)| 00:00:01 
|

|*  5 |      INDEX UNIQUE SCAN       | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE        |     1 |    67 |     3   (0)| 00:00:01 |

|*  7 |      INDEX RANGE SCAN        | WGCVIDX       |     1 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN         | SYS_C00188721 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD    |     1 |    48 |     1   (0)| 
00:00:01 |

-----------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')

   7 - access("GRADE"='A' AND "WINE"."CID"='SHIRAZ')

   8 - access("WINE"."VID"="VINEYARD"."VID")
```

1.2 Block Size 2K

Observed query:

```
select vintage, wine_no, wname, pctalc, grade, price, wine.vid,
vname, wine.cid, cname
```

```
from vineyard, class, wine
where wine.vid = vineyard.vid
and wine.cid = class.cid
and wine.cid = 'SHIRAZ' and grade = 'A' ;
```

1.2.1 Results

File Name **For Results**	**Index Case**	**All rows plan**	**Cost**	**First rows(1) plan**	**Cost**
PLANA2K/PLANA2KFR	PK Indexes only	PLANA2K	71	PLANA2KFR	6
PLANA2K/PLANB2KFR	Wine(CID)	PLANA2K	71	PLANB2KFR	6
PLANA2K/PLANC2KFR	Wine(grade)	PLANA2K	71	PLANC2KFR	6
PLANA2K/PLANA2KFR	Wine(VID)	PLANA2K	71	PLANA2KFR	6
PLANB2K/PLAND2KFR	Wine(CID), Wine(grade)	PLANB2K	62	PLAND2KFR	6
PLANC2K/PLANE2KFR	Wine(grade), Wine(CID)	PLANC2K	62	PLANE2KFR	6
PLANA2K/PLANF2KFR	Wine(CID), Wine(VID)	PLANA2K	71	PLANF2KFR	6
PLANA2K/PLANA2KFR	Wine(VID), Wine(CID)	PLANA2K	71	PLANA2KFR	6
PLANA2K/PLANG2KFR	Wine(grade), Wine(VID)	PLANA2K	71	PLANG2KFR	6
PLANA2K/PLANA2KFR	Wine(VID), Wine(grade)	PLANA2K	71	PLANA2KFR	6
PLAND2K/PLANH2KFR	Wine(CID), Wine(grade), Wine(VID)	PLAND2K	38	PLANH2KFR	5
PLANE2K/PLANI2KFR	Wine(CID), Wine(VID), Wine(grade)	PLANE2K	38	PLANI2KFR	5
PLANF2K/PLANJ2KFR	Wine(grade), Wine(VID), Wine(CID)	PLANF2K	39	PLANJ2KFR	5
PLANG2K/	Wine(grade), Wine(CID),	PLANG2K	38	PLANK2KFR	5

PLANK2KFR	Wine(VID)				
PLANA2K/PLANA2KFR	Wine(VID), Wine(CID), Wine(grade)	PLANA2K	71	PLANA2KFR	6
PLANA2K/PLANA2KFR	Wine(VID), Wine(grade), Wine(CID)	PLANA2K	71	PLANA2KFR	6

Table 2.2.3.1: Results Table For Block Size 2048

1.2.2 Query Plans

1.2.2.1 All_Rows

1.2.2.1.1 PLANA2K

```
Plan hash value: 3905111740

-------------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    25 |  4025 |    71   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    25 |  4025 |    71   (2)| 00:00:01 |

|*  2 |   TABLE ACCESS FULL          | WINE2        |    25 |  1675 |    59   (0)| 00:00:01 |

|   3 |  NESTED LOOPS                |              |   160 | 15040 |    11   (0)| 00:00:01 |

|   4 |   TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01 |

|*  5 |    INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   6 |   TABLE ACCESS FULL          | VINEYARD2    |   160 |  7680 |    10   (0)| 00:00:01 |

-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   2 - filter("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   5 - access("CLASS2"."CID"='SHIRAZ')
```

1.2.2.1.2 PLANB2K

```
Plan hash value: 1968890202

-----------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |    62   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |    62   (2)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE2        |    52 |  3484 |    50   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WCGIDX       |    52 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |              |   160 | 15040 |    11   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD2    |   160 |  7680 |    10   (0)| 00:00:01 |

-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   3 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

1.2.2.1.3 PLANC2K

```
Plan hash value: 1101411327

-----------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |    62   (2)| 00:00:01 |
|*  1 |  HASH JOIN                    |              |    52 |  8372 |    62   (2)| 00:00:01 |
|   2 |   TABLE ACCESS BY INDEX ROWID | WINE2        |    52 |  3484 |    50   (0)|
00:00:01 |
|*  3 |    INDEX RANGE SCAN          | WGCIDX       |    52 |       |     1   (0)| 00:00:01 |
|   4 |   NESTED LOOPS                |              |   160 | 15040 |    11   (0)| 00:00:01 |
|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|
|*  6 |     INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |
|   7 |    TABLE ACCESS FULL          | VINEYARD2    |   160 |  7680 |    10   (0)| 00:00:01 |
--------------------------------------------------------------------------------------------
Predicate Information (identified by operation id):
---------------------------------------------------
   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")
   3 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')
   6 - access("CLASS2"."CID"='SHIRAZ')
```

1.2.2.1.4 PLAND2K

```
Plan hash value: 1662823781
--------------------------------------------------------------------------------------------
| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
--------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |              |    25 |  4025 |    38   (3)| 00:00:01 |
|*  1 |  HASH JOIN                    |              |    25 |  4025 |    38   (3)| 00:00:01 |
|   2 |   NESTED LOOPS                |              |    25 |  2825 |    27   (0)| 00:00:01 |
|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|
|*  4 |     INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |
|  5 |    TABLE ACCESS BY INDEX ROWID| WINE2         |    25 |  1675 |    26   (0)|
00:00:01 |

|*  6 |     INDEX RANGE SCAN          | WCGVIDX       |    25 |       |     1   (0)| 00:00:01 |

|  7 |   TABLE ACCESS FULL           | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

-----------------------------------------------------------------------------------------
```

Predicate Information (identified by operation id):

```
---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID")

   4 - access("CLASS2"."CID"='SHIRAZ')

   6 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')
```

1.2.2.1.5 PLANE2K

Plan hash value: 3667028219

```
-----------------------------------------------------------------------------------------

| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------

|  0 | SELECT STATEMENT              |               |    25 |  4025 |    38   (3)| 00:00:01 |

|*  1 |  HASH JOIN                    |               |    25 |  4025 |    38   (3)| 00:00:01 |

|  2 |   NESTED LOOPS                |               |    25 |  2825 |    27   (0)| 00:00:01 |

|  3 |    TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)| 00:00:01
|

|*  4 |     INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|  5 |    TABLE ACCESS BY INDEX ROWID| WINE2         |    25 |  1675 |    26   (0)|
00:00:01 |

|*  6 |     INDEX RANGE SCAN          | WCVGIDX       |    25 |       |     1   (0)| 00:00:01 |

|  7 |   TABLE ACCESS FULL           | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

-----------------------------------------------------------------------------------------
```

Predicate Information (identified by operation id):

```
---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID")

   4 - access("CLASS2"."CID"='SHIRAZ')

   6 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

       filter("GRADE"='A')
```

1.2.2.1.6 PLANF2K

```
Plan hash value: 1614332579

-----------------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    25 |  4025 |    39   (3)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    25 |  4025 |    39   (3)| 00:00:01 |

|   2 |   NESTED LOOPS               |              |    25 |  2825 |    28   (0)| 00:00:01 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|

|*  4 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| WINE2        |    25 |  1675 |    27   (0)|
00:00:01 |

|*  6 |     INDEX RANGE SCAN         | WGVCIDX      |    25 |       |     2   (0)| 00:00:01 |

|   7 |   TABLE ACCESS FULL          | VINEYARD2    |   160 |  7680 |    10   (0)| 00:00:01 |

-----------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID")

   4 - access("CLASS2"."CID"='SHIRAZ')

   6 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')

       filter("WINE2"."CID"='SHIRAZ')
```

1.2.2.1.7 PLANG2K

```
Plan hash value: 1923419256

---------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    25 |  4025 |    38   (3)| 00:00:01 |

|*  1 |  HASH JOIN                   |               |    25 |  4025 |    38   (3)| 00:00:01 |

|   2 |  NESTED LOOPS                |               |    25 |  2825 |    27   (0)| 00:00:01 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|

|*  4 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| WINE2        |    25 |  1675 |    26   (0)|
00:00:01 |

|*  6 |     INDEX RANGE SCAN         | WGCVIDX       |    25 |       |     1   (0)| 00:00:01 |

|   7 |  TABLE ACCESS FULL           | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID")

   4 - access("CLASS2"."CID"='SHIRAZ')

   6 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')
```

1.2.2.2 First_Rows(1)

1.2.2.2.1 PLANA2KFR

```
Plan hash value: 2048002736

---------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |
--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |              |     1 |   161 |     6   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                 |              |       |       |            |          |

|   2 |   NESTED LOOPS                |              |     1 |   161 |     6   (0)| 00:00:01 |

|   3 |    NESTED LOOPS               |              |     1 |   113 |     5   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|*  6 |     TABLE ACCESS FULL         | WINE2        |     1 |    67 |     4   (0)| 00:00:01 |

|*  7 |    INDEX UNIQUE SCAN          | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|   8 |   TABLE ACCESS BY INDEX ROWID | VINEYARD2    |     1 |    48 |     1   (0)|
00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   6 - filter("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   7 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.2 PLANB2KFR

```
Plan hash value: 738754965

--------------------------------------------------------------------------------------------

| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |              |     1 |   161 |     6   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                 |              |       |       |            |          |

|   2 |   NESTED LOOPS                |              |     1 |   161 |     6   (0)| 00:00:01 |

|   3 |    NESTED LOOPS               |              |     1 |   113 |     5   (0)| 00:00:01 |
|  4 |     TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|*  6 |     TABLE ACCESS BY INDEX ROWID| WINE2        |     1 |    67 |     5   (0)|
00:00:01 |

|*  7 |      INDEX RANGE SCAN          | WCIDX        |     4 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN          | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|  9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2    |     1 |    48 |     1   (0)|
00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   6 - filter("GRADE"='A')

   7 - access("WINE2"."CID"='SHIRAZ')

   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.3 PLANC2KFR

```
Plan hash value: 333276067

--------------------------------------------------------------------------------------------

| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |               |     1 |   161 |     6   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                 |               |       |       |            |          |

|   2 |   NESTED LOOPS                |               |     1 |   161 |     6   (0)| 00:00:01 |

|   3 |    NESTED LOOPS               |               |     1 |   113 |     5   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |
|*  6 |     TABLE ACCESS BY INDEX ROWID| WINE2        |     1 |    67 |     7   (0)|
00:00:01 |

|*  7 |      INDEX RANGE SCAN          | WGIDX        |    15 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2    |     1 |    48 |     1   (0)|
00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   6 - filter("WINE2"."CID"='SHIRAZ')

   7 - access("GRADE"='A')

   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.4 PLAND2KFR

```
Plan hash value: 913317054

---------------------------------------------------------------------------------------------

| Id  | Operation                      | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT               |               |     2 |   322 |     6   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                  |               |       |       |            |          |

|   2 |   NESTED LOOPS                 |               |     2 |   322 |     6   (0)| 00:00:01 |

|   3 |    NESTED LOOPS                |               |     2 |   226 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE2         |     2 |   134 |     3   (0)|
00:00:01 |

|*  7 |      INDEX RANGE SCAN          | WCGIDX        |     2 |       |     1   (0)| 00:00:01 |
|*  8 |    INDEX UNIQUE SCAN          | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2     |     1 |    48 |     1   (0)|
00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   7 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.5 PLANE2KFR

```
Plan hash value: 346152677

---------------------------------------------------------------------------------------------

| Id  | Operation                      | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT               |               |     2 |   322 |     6   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                  |               |       |       |            |          |

|   2 |   NESTED LOOPS                 |               |     2 |   322 |     6   (0)| 00:00:01 |

|   3 |    NESTED LOOPS                |               |     2 |   226 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE2         |     2 |   134 |     3   (0)|
00:00:01 |

|*  7 |      INDEX RANGE SCAN          | WGCIDX        |     2 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2     |     1 |    48 |     1   (0)|
00:00:01 |

---------------------------------------------------------------------------------------------
```

```
Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   7 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')

   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.6 PLANF2KFR

```
Plan hash value: 1115395574

-----------------------------------------------------------------------------------------------

| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |              |     1 |   161 |     6   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                 |              |       |       |            |          |

|   2 |   NESTED LOOPS                |              |     1 |   161 |     6   (0)| 00:00:01 |

|   3 |    NESTED LOOPS               |              |     1 |   113 |     5   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|*  6 |     TABLE ACCESS BY INDEX ROWID| WINE2        |     1 |    67 |     5   (0)|
00:00:01 |

|*  7 |      INDEX RANGE SCAN         | WCVIDX       |     4 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN          | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2    |     1 |    48 |     1   (0)|
00:00:01 |

-----------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')
   6 - filter("GRADE"='A')

   7 - access("WINE2"."CID"='SHIRAZ')

   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.7 PLANG2KFR

```
Plan hash value: 2765253840

---------------------------------------------------------------------------------------------

| Id  | Operation                      | Name           | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT               |                |     1 |   161 |     6   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                  |                |       |       |            |          |

|   2 |   NESTED LOOPS                 |                |     1 |   161 |     6   (0)| 00:00:01 |

|   3 |    NESTED LOOPS                |                |     1 |   113 |     5   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2         |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|*  6 |     TABLE ACCESS BY INDEX ROWID| WINE2          |     1 |    67 |    11   (0)|
00:00:01 |

|*  7 |      INDEX RANGE SCAN          | WGVIDX         |    15 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2      |     1 |    48 |     1   (0)|
00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   6 - filter("WINE2"."CID"='SHIRAZ')

   7 - access("GRADE"='A')
   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.8 PLANH2KFR

```
Plan hash value: 963497978

-------------------------------------------------------------------------------------------

| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |              |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                 |              |       |       |            |          |

|   2 |   NESTED LOOPS                |              |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS               |              |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE2        |     1 |    67 |     3   (0)| 00:00:01
|

|*  7 |      INDEX RANGE SCAN         | WCGVIDX      |     1 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN          | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2    |     1 |    48 |     1   (0)|
00:00:01 |

-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   7 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.9 PLANI2KFR

```
Plan hash value: 3435525928
```

```
-----------------------------------------------------------------------------------------------

| Id  | Operation                     | Name           | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |                |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                 |                |       |       |            |          |

|   2 |   NESTED LOOPS                |                |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS               |                |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE2         |     1 |    67 |     3   (0)| 00:00:01
|

|*  7 |      INDEX RANGE SCAN         | WCVGIDX       |     1 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN          | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2     |     1 |    48 |     1   (0)|
00:00:01 |

-----------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   7 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

       filter("GRADE"='A')

   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.10 PLANJ2KFR

```
Plan hash value: 2492060485

-----------------------------------------------------------------------------------------------

| Id  | Operation                     | Name           | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |               |     1 |   161 |     5   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                 |               |       |       |            |          |

|   2 |   NESTED LOOPS                |               |     1 |   161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS               |               |     1 |   113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE2         |     1 |    67 |     3   (0)| 00:00:01
|

|*  7 |      INDEX RANGE SCAN          | WGVCIDX       |     1 |       |     1   (0)| 00:00:01 |

|*  8 |    INDEX UNIQUE SCAN           | SYS_C00188753 |     1 |       |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2     |     1 |    48 |     1   (0)|
00:00:01 |

-------------------------------------------------------------------------------------------
```

Predicate Information (identified by operation id):

```
---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   7 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')

       filter("WINE2"."CID"='SHIRAZ')

   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.2.2.2.11 PLANK2KFR

Plan hash value: 3838535368

```
-------------------------------------------------------------------------------------------

| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |               |     1 |   161 |     5   (0)| 00:00:01 |
|   1 |  NESTED LOOPS                  |              |      |      |            |          |

|   2 |   NESTED LOOPS                 |              |    1 |  161 |     5   (0)| 00:00:01 |

|   3 |    NESTED LOOPS                |              |    1 |  113 |     4   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS2       |    1 |   46 |     1   (0)|
00:00:01 |

|*  5 |      INDEX UNIQUE SCAN         | SYS_C00188736 |    1 |      |     0   (0)| 00:00:01 |

|   6 |     TABLE ACCESS BY INDEX ROWID| WINE2        |    1 |   67 |     3   (0)| 00:00:01
|

|*  7 |      INDEX RANGE SCAN          | WGCVIDX      |    1 |      |     1   (0)| 00:00:01 |

|*  8 |     INDEX UNIQUE SCAN          | SYS_C00188753 |    1 |      |     0   (0)| 00:00:01 |

|   9 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD2    |    1 |   48 |     1   (0)|
00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   5 - access("CLASS2"."CID"='SHIRAZ')

   7 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')

   8 - access("WINE2"."VID"="VINEYARD2"."VID")
```

1.3 Conclusion

By observing both 4K blocksize & 2K blocksize results table, it can be told that tablespace size, that is allocated in a database, determines how the dbms access the data. In 4K blocksize tablespace, there is not so much different in how the optimizer execute the query before & after creating certain index(es). My best guess for having that condition is 4K blocksize tablespace has less blocks to store data since each block can contain more data compared to 2K blocksize tablespace, i.e.: WINE table in 4K blocksize table has 65 blocks whereas in 2K blocksize table has 298 blocks with the same amount of data. So, the dbms, which in this case is Oracle, optimizer does not really need to go through a lot of scanning to grab the expected data in a bigger blocksize tablespace.

It seems that Oracle does not use the created index(es) in 4K blocksize tablespace since the cost for each plan is basically same, but when we look down to the query plan, there is difference in the way of how Oracle access the data. (That is why we are having a lot of plans that are similar in cost and steps, but technically there is difference in involved steps for each of the plan). Optimizer choose to use the index as part of the table scan, which is RANGE SCAN in this case, although it can't really be told by looking at the cost for each of the plan.

On the other hand, in 2K blocksize tablespace the difference on how Oracle uses the created index(es) can be told by observing the cost of each plan. It can be actually referred back to the statement of "tablespace size determines how optimizer uses the index(es) as the bigger tablespace size is, the more blocks are needed to store data and the dbms needs to go through more blocks which requires optimizer to cost more I/O". Although, not all part of index(es) are being used by optimizer to run the query and access the expected data (it can be distinguished by observing the section at the bottom of each plan, "Predicate Information").

The way of creating the index(es) also determines on how the optimizer will use up the index. (which created index should be used and in what sequence, index should be created in column that has more variant in data, etc.)

In conclusion, index(es) will be more useful if it is used in lower blocksize that has more blocks to contain same amount of data that is in bigger blocksize. Additionally, index that is created in column that contain more unique data will be more considerable to be implemented since the index will usually be used by the dbms optimizer to get expected result more efficiently and more effectively. Overuse of Index(es) will also slow down the process of data insertion and deletion, so choosing the right columns to be indexed in a database will be a good anticipation.

2. Credit Grade – Index Hint Force

2.1 Block Size 4K

2.1.1 Index Hint Results

File Name For Results	Index Case	Cost
PLANA4K	PK Indexes only	26
PLANB4K	Wine(CID)	57
PLANC4K	Wine(grade)	56
PLAND4K	Wine(VID)	658
PLANE4K	Wine(CID), Wine(grade)	43
PLANF4K	Wine(grade), Wine(CID)	43
PLANG4K	Wine(CID), Wine(VID)	108
PLANH4K	Wine(VID), Wine(CID)	114
PLANI4K	Wine(grade), Wine(VID)	231
PLANJ4K	Wine(VID), Wine(grade)	235
PLANK4K	Wine(CID), Wine(grade), Wine(VID)	60
PLANL4K	Wine(CID), Wine(VID), Wine(grade)	60
PLANM4K	Wine(grade), Wine(VID), Wine(CID)	61
PLANN4K	Wine(grade), Wine(CID), Wine(VID)	60
PLANO4K	Wine(VID), Wine(CID), Wine(grade)	67
PLANP4K	Wine(VID), Wine(grade), Wine(CID)	67

Table 2.1.1.1: Results Table For Block Size 4096

2.1.2 Query Plans

2.1.2.1PLANA4K

```
Plan hash value: 300875179

-------------------------------------------------------------------------------------------

| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |               |    52 |  8372 |    26   (4)| 00:00:01 |

|*  1 |  HASH JOIN                    |               |    52 |  8372 |    26   (4)| 00:00:01 |

|*  2 |   TABLE ACCESS FULL           | WINE          |    52 |  3484 |    19   (0)| 00:00:01 |

|   3 |  NESTED LOOPS                 |               |   160 | 15040 |     6   (0)| 00:00:01 |

|   4 |   TABLE ACCESS BY INDEX ROWID| CLASS          |     1 |    46 |     1   (0)| 00:00:01 |

|*  5 |    INDEX UNIQUE SCAN          | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   6 |   TABLE ACCESS FULL           | VINEYARD      |   160 |  7680 |     5   (0)| 00:00:01 |

-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   2 - filter("WINE"."CID"='SHIRAZ' AND "GRADE"='A')

   5 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.2PLANB4K

```
Plan hash value: 3827954562

-------------------------------------------------------------------------------------------

| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |               |    52 |  8372 |    57   (2)| 00:00:01 |

|*  1 |  HASH JOIN                    |               |    52 |  8372 |    57   (2)| 00:00:01 |
|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE         |    52 |  3484 |    50   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WCIDX        |   100 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |              |   160 | 15040 |     6   (0)| 00:00:01 |

|   5 |   TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01 |

|*  6 |    INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   7 |   TABLE ACCESS FULL          | VINEYARD     |   160 |  7680 |     5   (0)| 00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   2 - filter("GRADE"='A')

   3 - access("WINE"."CID"='SHIRAZ')

   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.3PLANC4K

```
Plan hash value: 4269942405

---------------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |    56   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |    56   (2)| 00:00:01 |

|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE         |    52 |  3484 |    49   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WGIDX        |   375 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |              |   160 | 15040 |     6   (0)| 00:00:01 |

|   5 |   TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01 |

|*  6 |    INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |
|  7 |    TABLE ACCESS FULL          | VINEYARD      |  160 |  7680 |     5   (0)| 00:00:01 |
--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   2 - filter("WINE"."CID"='SHIRAZ')

   3 - access("GRADE"='A')

   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.4PLAND4K

Plan hash value: 646132179

```
--------------------------------------------------------------------------------------------

| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |               |    52 |  8372 |   658   (1)| 00:00:08 |

|*  1 |  HASH JOIN                    |               |    52 |  8372 |   658   (1)| 00:00:08 |

|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE          |    52 |  3484 |   651   (0)| 00:00:08 |

|   3 |    INDEX FULL SCAN            | WVIDX         |  1500 |       |     6   (0)| 00:00:01 |

|   4 |   NESTED LOOPS                |               |   160 | 15040 |     6   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS         |     1 |    46 |     1   (0)| 00:00:01 |

|*  6 |     INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL          | VINEYARD      |   160 |  7680 |     5   (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   2 - filter("WINE"."CID"='SHIRAZ' AND "GRADE"='A')
   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.5PLANE4K

Plan hash value: 2848602449

```
-----------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |    43   (3)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |    43   (3)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE         |    52 |  3484 |    36   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WCGIDX       |    52 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |              |   160 | 15040 |     6   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01 |

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD     |   160 |  7680 |     5   (0)| 00:00:01 |

-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   3 - access("WINE"."CID"='SHIRAZ' AND "GRADE"='A')

   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.6PLANF4K

Plan hash value: 215704565

```
-----------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------
```

```
|   0 | SELECT STATEMENT             |             |    52 |  8372 |    43   (3)| 00:00:01 |

|*  1 |  HASH JOIN                   |             |    52 |  8372 |    43   (3)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE        |    52 |  3484 |    36   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WGCIDX      |    52 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |             |   160 | 15040 |     6   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS       |     1 |    46 |     1   (0)| 00:00:01 |

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD    |   160 |  7680 |     5   (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   3 - access("GRADE"='A' AND "WINE"."CID"='SHIRAZ')

   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.7PLANG4K

```
Plan hash value: 930590655

--------------------------------------------------------------------------------------------

| Id  | Operation                    | Name        | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |             |    52 |  8372 |   108   (1)| 00:00:02 |

|*  1 |  HASH JOIN                   |             |    52 |  8372 |   108   (1)| 00:00:02 |

|   2 |   NESTED LOOPS               |             |    52 |  5876 |   102   (0)| 00:00:02 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS       |     1 |    46 |     1   (0)| 00:00:01 |

|*  4 |     INDEX UNIQUE SCAN        | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|*  5 |    TABLE ACCESS BY INDEX ROWID| WINE        |    52 |  3484 |   101   (0)|
00:00:02 |
|*  6 |     INDEX RANGE SCAN          | WCVIDX       |   100 |       |     1   (0)| 00:00:01 |
|   7 |   TABLE ACCESS FULL           | VINEYARD     |   160 |  7680 |     5   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID")
   4 - access("CLASS"."CID"='SHIRAZ')
   5 - filter("GRADE"='A')
   6 - access("WINE"."CID"='SHIRAZ')
```

2.1.2.8PLANH4K

```
Plan hash value: 3741907347

-------------------------------------------------------------------------------------------
| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |              |    52 |  8372 |   114   (1)| 00:00:02 |
|*  1 |  HASH JOIN                    |              |    52 |  8372 |   114   (1)| 00:00:02 |
|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE         |    52 |  3484 |   107   (0)| 00:00:02 |
|*  3 |    INDEX FULL SCAN            | WVCIDX       |   100 |       |     7   (0)| 00:00:01 |
|   4 |   NESTED LOOPS                |              |   160 | 15040 |     6   (0)| 00:00:01 |
|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01 |
|*  6 |     INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |
|   7 |    TABLE ACCESS FULL          | VINEYARD     |   160 |  7680 |     5   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")
```

```
  2 - filter("GRADE"='A')

  3 - access("WINE"."CID"='SHIRAZ')

      filter("WINE"."CID"='SHIRAZ')

  6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.9PLANI4K

```
Plan hash value: 4059849333

--------------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |   231   (1)| 00:00:03 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |   231   (1)| 00:00:03 |

|   2 |   NESTED LOOPS               |              |    52 |  5876 |   225   (0)| 00:00:03 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01 |

|*  4 |     INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|*  5 |    TABLE ACCESS BY INDEX ROWID| WINE         |    52 |  3484 |   224   (0)|
00:00:03 |

|*  6 |     INDEX RANGE SCAN          | WGVIDX       |   375 |       |     2   (0)| 00:00:01 |

|   7 |   TABLE ACCESS FULL          | VINEYARD     |   160 |  7680 |     5   (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

  1 - access("WINE"."VID"="VINEYARD"."VID")

  4 - access("CLASS"."CID"='SHIRAZ')

  5 - filter("WINE"."CID"='SHIRAZ')

  6 - access("GRADE"='A')
```

2.1.2.10PLANJ4K

Plan hash value: 2809650395

```
-----------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |   235   (1)| 00:00:03 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |   235   (1)| 00:00:03 |

|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE         |    52 |  3484 |   228   (0)|
00:00:03 |

|*  3 |    INDEX FULL SCAN           | WVGIDX       |   375 |       |     6   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |              |   160 | 15040 |     6   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01 |

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD     |   160 |  7680 |     5   (0)| 00:00:01 |

-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   2 - filter("WINE"."CID"='SHIRAZ')

   3 - access("GRADE"='A')

       filter("GRADE"='A')

   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.11PLANK4K

Plan hash value: 2314075526

```
-----------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------
```

```
|   0 | SELECT STATEMENT              |                |    52 |  8372 |    60   (2)| 00:00:01 |

|*  1 |  HASH JOIN                    |                |    52 |  8372 |    60   (2)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE           |    52 |  3484 |    53   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN           | WCGVIDX        |    52 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS                |                |   160 | 15040 |     6   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS          |     1 |    46 |     1   (0)| 00:00:01 |

|*  6 |     INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL          | VINEYARD       |   160 |  7680 |     5   (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   3 - access("WINE"."CID"='SHIRAZ' AND "GRADE"='A')

   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.12PLANL4K

```
Plan hash value: 2600116168

--------------------------------------------------------------------------------------------

| Id  | Operation                     | Name           | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |                |    52 |  8372 |    60   (2)| 00:00:01 |

|*  1 |  HASH JOIN                    |                |    52 |  8372 |    60   (2)| 00:00:01 |

|   2 |   NESTED LOOPS                |                |    52 |  5876 |    54   (0)| 00:00:01 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS          |     1 |    46 |     1   (0)| 00:00:01 |

|*  4 |     INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| WINE           |    52 |  3484 |    53   (0)|
00:00:01 |
|*  6 |     INDEX RANGE SCAN          | WCVGIDX      |    52 |       |     1   (0)| 00:00:01 |
|   7 |   TABLE ACCESS FULL           | VINEYARD     |   160 |  7680 |     5   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID")
   4 - access("CLASS"."CID"='SHIRAZ')
   6 - access("WINE"."CID"='SHIRAZ' AND "GRADE"='A')
       filter("GRADE"='A')
```

2.1.2.13PLANM4K

```
Plan hash value: 4118739766

-------------------------------------------------------------------------------------------
| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |              |    52 |  8372 |    61   (2)| 00:00:01 |
|*  1 |  HASH JOIN                    |              |    52 |  8372 |    61   (2)| 00:00:01 |
|   2 |   NESTED LOOPS                |              |    52 |  5876 |    55   (0)| 00:00:01 |
|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    46 |     1   (0)| 00:00:01 |
|*  4 |     INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |
|   5 |    TABLE ACCESS BY INDEX ROWID| WINE         |    52 |  3484 |    54   (0)|
00:00:01 |
|*  6 |     INDEX RANGE SCAN          | WGVCIDX      |    52 |       |     2   (0)| 00:00:01 |
|   7 |   TABLE ACCESS FULL           | VINEYARD     |   160 |  7680 |     5   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID")
   4 - access("CLASS"."CID"='SHIRAZ')

   6 - access("GRADE"='A' AND "WINE"."CID"='SHIRAZ')

       filter("WINE"."CID"='SHIRAZ')
```

2.1.2.14PLANN4K

Plan hash value: 2664789577

```
-------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    52 |  8372 |    60   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |               |    52 |  8372 |    60   (2)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE          |    52 |  3484 |    53   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WGCVIDX       |    52 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |               |   160 | 15040 |     6   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS         |     1 |    46 |     1   (0)| 00:00:01 |

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD      |   160 |  7680 |     5   (0)| 00:00:01 |

-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   3 - access("GRADE"='A' AND "WINE"."CID"='SHIRAZ')

   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.15PLANO4K

Plan hash value: 2765962227

```
-------------------------------------------------------------------------------------------
```

```
| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    52 |  8372 |    67   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |               |    52 |  8372 |    67   (2)| 00:00:01 |

|   2 |  TABLE ACCESS BY INDEX ROWID | WINE          |    52 |  3484 |    60   (0)|
00:00:01 |

|*  3 |    INDEX FULL SCAN           | WVCGIDX       |    52 |       |     8   (0)| 00:00:01 |

|   4 |  NESTED LOOPS                |               |   160 | 15040 |     6   (0)| 00:00:01 |

|   5 |   TABLE ACCESS BY INDEX ROWID| CLASS         |     1 |    46 |     1   (0)| 00:00:01 |

|*  6 |    INDEX UNIQUE SCAN         | SYS_C00188704 |     1 |       |     0   (0)| 00:00:01 |

|   7 |   TABLE ACCESS FULL          | VINEYARD      |   160 |  7680 |     5   (0)| 00:00:01 |

-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")

   3 - access("WINE"."CID"='SHIRAZ' AND "GRADE"='A')

       filter("WINE"."CID"='SHIRAZ' AND "GRADE"='A')

   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.2.16PLANP4K

```
Plan hash value: 3309611213

-------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    52 |  8372 |    67   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |               |    52 |  8372 |    67   (2)| 00:00:01 |

|   2 |  TABLE ACCESS BY INDEX ROWID | WINE          |    52 |  3484 |    60   (0)|
00:00:01 |
|*  3 |    INDEX FULL SCAN           | WVGCIDX        |    52 |       |     8   (0)| 00:00:01 |
|   4 |   NESTED LOOPS               |                |   160 | 15040 |     6   (0)| 00:00:01 |
|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS         |     1 |    46 |     1   (0)| 00:00:01 |
|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188704  |     1 |       |     0   (0)| 00:00:01 |
|   7 |    TABLE ACCESS FULL         | VINEYARD       |   160 |  7680 |     5   (0)| 00:00:01 |
--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")
   3 - access("GRADE"='A' AND "WINE"."CID"='SHIRAZ')
       filter("WINE"."CID"='SHIRAZ' AND "GRADE"='A')
   6 - access("CLASS"."CID"='SHIRAZ')
```

2.1.3 Results & Calculation

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 26	0
1___ HASH JOIN Cost = 26	1
2_____ TABLE ACCESS FULL WINE Cost = 19	19
3_____ NESTED LOOPS Cost = 6	0
4_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
5__________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
6_______ TABLE ACCESS FULL VINEYARD Cost = 5	3

Table 3.1.2.1: Results & Calculation Table of Query Plan PLANA4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 57	0
1___ HASH JOIN Cost = 57	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 50	49
3_______ INDEX RANGE SCAN WCIDX Cost = 1	1
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.2: Results & Calculation Table of Query Plan PLANB4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 56	0
1___ HASH JOIN Cost = 56	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 49	48

3_______ INDEX RANGE SCAN WGIDX Cost = 1	1
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.3: Results & Calculation Table of Query Plan PLANC4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 658	0
1___ HASH JOIN Cost = 658	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 651	645
3_______ INDEX FULL SCAN WVIDX Cost = 6	6
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.4: Results & Calculation Table of Query Plan PLAND4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 43	0
1___ HASH JOIN Cost = 43	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 36	35
3_______ INDEX RANGE SCAN WCGIDX Cost = 1	1
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.5: Results & Calculation Table of Query Plan PLANE4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 43	0
1___ HASH JOIN Cost = 43	1
2_____ TABLE ACCESS BY INDEX ROWID WINE	35

Cost = 36	
3_______ INDEX RANGE SCAN WGCIDX Cost = 1	1
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.6: Results & Calculation Table of Query Plan PLANF4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 108	0
1___ HASH JOIN Cost = 108	1
2_____ NESTED LOOPS Cost = 102	0
3_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
4_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
5_______ TABLE ACCESS BY INDEX ROWID WINE Cost = 101	100
6_________ INDEX RANGE SCAN WCVIDX Cost = 1	1
7_____ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.7: Results & Calculation Table of Query Plan PLANG4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 114	0
1___ HASH JOIN Cost = 114	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 107	100
3_______ INDEX FULL SCAN WVCIDX Cost = 7	7
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.8: Results & Calculation Table of Query Plan PLANH4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 231	0
1___ HASH JOIN Cost = 231	1

2_____ NESTED LOOPS Cost = 225	0
3_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
4_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
5_______ TABLE ACCESS BY INDEX ROWID WINE Cost = 224	222
6_________ INDEX RANGE SCAN WGVIDX Cost = 2	2
7_____ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.9: Results & Calculation Table of Query Plan PLANI4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 235	0
1___ HASH JOIN Cost = 235	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 228	222
3_______ INDEX FULL SCAN WVGIDX Cost = 6	6
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0

7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.10: Results & Calculation Table of Query Plan PLANJ4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 60	0
1___ HASH JOIN Cost = 60	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 53	52
3_______ INDEX RANGE SCAN WCGVIDX Cost = 1	1
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.11: Results & Calculation Table of Query Plan PLANK4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 60	0

1___ HASH JOIN Cost = 60	1
2_____ NESTED LOOPS Cost = 54	0
3_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
4_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
5_______ TABLE ACCESS BY INDEX ROWID WINE Cost = 53	52
6_________ INDEX RANGE SCAN WCVGIDX Cost = 1	1
7_____ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.12: Results & Calculation Table of Query Plan PLANL4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 61	0
1___ HASH JOIN Cost = 61	1
2_____ NESTED LOOPS Cost = 55	0
3_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
4_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
5_______ TABLE ACCESS BY INDEX ROWID WINE Cost = 54	52

6__________ INDEX RANGE SCAN WGVCIDX Cost = 2	2
7_____ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.13: Results & Calculation Table of Query Plan PLANM4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 60	0
1___ HASH JOIN Cost = 60	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 53	52
3_______ INDEX RANGE SCAN WGCVIDX Cost = 1	1
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6__________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.14: Results & Calculation Table of Query Plan PLANN4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 67	0
1___ HASH JOIN Cost = 67	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 60	52
3_______ INDEX FULL SCAN WVCGIDX Cost = 8	8
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.15: Results & Calculation Table of Query Plan PLANO4K For Block Size 4096

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 67	0
1___ HASH JOIN Cost = 67	1
2_____ TABLE ACCESS BY INDEX ROWID WINE Cost = 60	52
3_______ INDEX FULL SCAN WVCGIDX Cost = 8	8
4_____ NESTED LOOPS Cost = 6	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS Cost = 1	1

6__________ INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
7________ TABLE ACCESS FULL VINEYARD Cost = 5	5

Table 3.1.2.16: Results & Calculation Table of Query Plan PLANP4K For Block Size 4096

2.2 Block Size 2K

2.2.1 Index Hint Results

File Name **For Results**	**Index Case**	**Cost**
PLANA2K	PK Indexes only	71
PLANB2K	Wine(CID)	99
PLANC2K	Wine(grade)	154
PLAND2K	Wine(VID)	770
PLANE2K	Wine(CID), Wine(grade)	62
PLANF2K	Wine(grade), Wine(CID)	62
PLANG2K	Wine(CID), Wine(VID)	113
PLANH2K	Wine(VID), Wine(CID)	119
PLANI2K	Wine(grade), Wine(VID)	259
PLANJ2K	Wine(VID), Wine(grade)	263
PLANK2K	Wine(CID), Wine(grade), Wine(VID)	65
PLANL2K	Wine(CID), Wine(VID), Wine(grade)	65
PLANM2K	Wine(grade), Wine(VID), Wine(CID)	66
PLANN2K	Wine(grade), Wine(CID), Wine(VID)	65
PLANO2K	Wine(VID), Wine(CID), Wine(grade)	72
PLANP2K	Wine(VID), Wine(grade), Wine(CID)	72

Table 2.2.1.1: Results Table For Block Size 2048

2.2.2 Query Plans

2.2.2.1 PLANA2K

Plan hash value: 3905111740

```
-------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    25 |  4025 |    71   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |               |    25 |  4025 |    71   (2)| 00:00:01 |

|*  2 |   TABLE ACCESS FULL          | WINE2         |    25 |  1675 |    59   (0)| 00:00:01 |

|   3 |  NESTED LOOPS                |               |   160 | 15040 |    11   (0)| 00:00:01 |

|   4 |   TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)| 00:00:01 
|

|*  5 |    INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   6 |   TABLE ACCESS FULL          | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND 
"WINE2"."CID"="CLASS2"."CID")

   2 - filter("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   5 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.2PLANB2K

Plan hash value: 342653289

```
-------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    52 |  8372 |    99   (2)| 00:00:02 |

|*  1 |  HASH JOIN                   |               |    52 |  8372 |    99   (2)| 00:00:02 |

|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE2         |    52 |  3484 |    87   (0)| 
00:00:02 |
|*  3 |    INDEX RANGE SCAN           | WCIDX2        |   100 |        |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS                 |               |   160 | 15040 |    11   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |        |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL          | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   2 - filter("GRADE"='A')

   3 - access("WINE2"."CID"='SHIRAZ')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.3PLANC2K

```
Plan hash value: 3573057831

---------------------------------------------------------------------------------------------

| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |               |    52 |  8372 |   154   (1)| 00:00:02 |

|*  1 |  HASH JOIN                    |               |    52 |  8372 |   154   (1)| 00:00:02 |

|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE2         |    52 |  3484 |   142   (0)|
00:00:02 |

|*  3 |    INDEX RANGE SCAN           | WGIDX2        |   375 |        |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS                 |               |   160 | 15040 |    11   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |        |     0   (0)| 00:00:01 |
|   7 |    TABLE ACCESS FULL          | VINEYARD2     |   160 |  7680 |     10   (0)| 00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   2 - filter("WINE2"."CID"='SHIRAZ')

   3 - access("GRADE"='A')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.4PLAND2K

```
Plan hash value: 2656919243

---------------------------------------------------------------------------------------------

| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |               |    52 |  8372 |   770   (1)| 00:00:10 |

|*  1 |  HASH JOIN                    |               |    52 |  8372 |   770   (1)| 00:00:10 |

|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE2         |    52 |  3484 |   758   (0)|
00:00:10 |

|   3 |    INDEX FULL SCAN            | WVIDX2        |  1500 |       |     6   (0)| 00:00:01 |

|   4 |   NESTED LOOPS                |               |   160 | 15040 |    11   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL          | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------
```

```
   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   2 - filter("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.5PLANE2K

```
Plan hash value: 4165277677

--------------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |    62   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |    62   (2)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE2        |    52 |  3484 |    50   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WCGIDX2      |    52 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |              |   160 | 15040 |    11   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD2    |   160 |  7680 |    10   (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   3 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.6PLANF2K

Plan hash value: 589001005

```
-------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    52 |  8372 |    62   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |               |    52 |  8372 |    62   (2)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE2         |    52 |  3484 |    50   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WGCIDX2       |    52 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |               |   160 | 15040 |    11   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   3 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.7PLANG2K

Plan hash value: 359372559

```
-------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    52 |  8372 |   113   (1)| 00:00:02 |
|*  1 |  HASH JOIN                    |             |    52 |  8372 |   113   (1)| 00:00:02 |
|   2 |   NESTED LOOPS                |             |    52 |  5876 |   102   (0)| 00:00:02 |
|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS2      |     1 |    46 |     1   (0)| 00:00:01
|
|*  4 |     INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |
|*  5 |    TABLE ACCESS BY INDEX ROWID| WINE2       |    52 |  3484 |   101   (0)|
00:00:02 |
|*  6 |     INDEX RANGE SCAN          | WCVIDX2     |   100 |       |     1   (0)| 00:00:01 |
|   7 |   TABLE ACCESS FULL           | VINEYARD2   |   160 |  7680 |    10   (0)| 00:00:01 |
--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID")
   4 - access("CLASS2"."CID"='SHIRAZ')
   5 - filter("GRADE"='A')
   6 - access("WINE2"."CID"='SHIRAZ')
```

2.2.2.8PLANH2K

```
Plan hash value: 549145912

--------------------------------------------------------------------------------------------
| Id  | Operation                     | Name        | Rows  | Bytes | Cost (%CPU)| Time     |
--------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |             |    52 |  8372 |   119   (1)| 00:00:02 |
|*  1 |  HASH JOIN                    |             |    52 |  8372 |   119   (1)| 00:00:02 |
|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE2       |    52 |  3484 |   107   (0)|
00:00:02 |
|*  3 |    INDEX FULL SCAN            | WVCIDX2     |   100 |       |     7   (0)| 00:00:01 |
|   4 |   NESTED LOOPS                |             |   160 | 15040 |    11   (0)| 00:00:01 |
|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL          | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   2 - filter("GRADE"='A')

   3 - access("WINE2"."CID"='SHIRAZ')

       filter("WINE2"."CID"='SHIRAZ')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.9PLANI2K

Plan hash value: 3081062965

```
 --------------------------------------------------------------------------------------------

| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT              |               |    52 |  8372 |   259   (1)| 00:00:04 |

|*  1 |  HASH JOIN                    |               |    52 |  8372 |   259   (1)| 00:00:04 |

|   2 |  NESTED LOOPS                 |               |    52 |  5876 |   248   (0)| 00:00:03 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS2        |     1 |    46 |     1   (0)| 00:00:01
|

|*  4 |     INDEX UNIQUE SCAN         | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|*  5 |    TABLE ACCESS BY INDEX ROWID| WINE2         |    52 |  3484 |   247   (0)|
00:00:03 |

|*  6 |     INDEX RANGE SCAN          | WGVIDX2       |   375 |       |     2   (0)| 00:00:01 |

|   7 |   TABLE ACCESS FULL           | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID")

   4 - access("CLASS2"."CID"='SHIRAZ')

   5 - filter("WINE2"."CID"='SHIRAZ')

   6 - access("GRADE"='A')
```

2.2.2.10PLANJ2K

```
Plan hash value: 3307119547

-----------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |   263   (1)| 00:00:04 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |   263   (1)| 00:00:04 |

|*  2 |   TABLE ACCESS BY INDEX ROWID | WINE2        |    52 |  3484 |   251   (0)|
00:00:04 |

|*  3 |    INDEX FULL SCAN           | WVGIDX2      |   375 |       |     6   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |              |   160 | 15040 |    11   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD2    |   160 |  7680 |    10   (0)| 00:00:01 |

-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")
```

```
   2 - filter("WINE2"."CID"='SHIRAZ')

   3 - access("GRADE"='A')

       filter("GRADE"='A')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.11PLANK2K

```
Plan hash value: 3667973123

---------------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |    65   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |    65   (2)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE2        |    52 |  3484 |    53   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WCGVIDX2     |    52 |       |     1   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |              |   160 | 15040 |    11   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD2    |   160 |  7680 |    10   (0)| 00:00:01 |

---------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   3 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.12PLANL2K

```
Plan hash value: 400353268

--------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    52 |  8372 |    65   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |               |    52 |  8372 |    65   (2)| 00:00:01 |

|   2 |   NESTED LOOPS               |               |    52 |  5876 |    54   (0)| 00:00:01 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|

|*  4 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| WINE2        |    52 |  3484 |    53   (0)|
00:00:01 |

|*  6 |     INDEX RANGE SCAN         | WCVGIDX2      |    52 |       |     1   (0)| 00:00:01 |

|   7 |   TABLE ACCESS FULL          | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID")

   4 - access("CLASS2"."CID"='SHIRAZ')

   6 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

       filter("GRADE"='A')
```

2.2.2.13PLANM2K

```
Plan hash value: 2278637258

--------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------
```

```
|   0 | SELECT STATEMENT             |              |    52 |  8372 |    66   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |    66   (2)| 00:00:01 |

|   2 |   NESTED LOOPS               |              |    52 |  5876 |    55   (0)| 00:00:01 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|

|*  4 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| WINE2        |    52 |  3484 |    54   (0)|
00:00:01 |

|*  6 |     INDEX RANGE SCAN         | WGVCIDX2     |    52 |       |     2   (0)| 00:00:01 |

|   7 |   TABLE ACCESS FULL          | VINEYARD2    |   160 |  7680 |    10   (0)| 00:00:01 |

--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID")

   4 - access("CLASS2"."CID"='SHIRAZ')

   6 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')

       filter("WINE2"."CID"='SHIRAZ')
```

2.2.2.14PLANN2K

```
Plan hash value: 3629231817

--------------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    52 |  8372 |    65   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    52 |  8372 |    65   (2)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE2        |    52 |  3484 |    53   (0)|
00:00:01 |

|*  3 |    INDEX RANGE SCAN          | WGCVIDX2     |    52 |       |     1   (0)| 00:00:01 |
|  4 |  NESTED LOOPS               |              |  160 | 15040 |    11   (0)| 00:00:01 |
|  5 |   TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01 |
|*  6 |    INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |
|  7 |   TABLE ACCESS FULL         | VINEYARD2    |   160 |  7680 |    10   (0)| 00:00:01 |
--------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND "WINE2"."CID"="CLASS2"."CID")
   3 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')
   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.15PLANO2K

```
Plan hash value: 587734858

--------------------------------------------------------------------------------------------
| Id  | Operation                   | Name          | Rows  | Bytes | Cost (%CPU)| Time     |
--------------------------------------------------------------------------------------------
|  0 | SELECT STATEMENT             |               |    52 |  8372 |    72   (2)| 00:00:01 |
|*  1 |  HASH JOIN                  |               |    52 |  8372 |    72   (2)| 00:00:01 |
|  2 |  TABLE ACCESS BY INDEX ROWID | WINE2         |    52 |  3484 |    60   (0)| 00:00:01 |
|*  3 |   INDEX FULL SCAN           | WVCGIDX2      |    52 |       |     8   (0)| 00:00:01 |
|  4 |  NESTED LOOPS               |               |   160 | 15040 |    11   (0)| 00:00:01 |
|  5 |   TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01 |
|*  6 |    INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |
|  7 |   TABLE ACCESS FULL         | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |
--------------------------------------------------------------------------------------------
```

```
Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   3 - access("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

       filter("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

   6 - access("CLASS2"."CID"='SHIRAZ')
```

2.2.2.16PLANP2K

```
Plan hash value: 1599175081

-----------------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |    52 |  8372 |    72   (2)| 00:00:01 |

|*  1 |  HASH JOIN                   |               |    52 |  8372 |    72   (2)| 00:00:01 |

|   2 |   TABLE ACCESS BY INDEX ROWID | WINE2        |    52 |  3484 |    60   (0)|
00:00:01 |

|*  3 |    INDEX FULL SCAN           | WVGCIDX2      |    52 |       |     8   (0)| 00:00:01 |

|   4 |   NESTED LOOPS               |               |   160 | 15040 |    11   (0)| 00:00:01 |

|   5 |    TABLE ACCESS BY INDEX ROWID| CLASS2       |     1 |    46 |     1   (0)| 00:00:01
|

|*  6 |     INDEX UNIQUE SCAN        | SYS_C00188736 |     1 |       |     0   (0)| 00:00:01 |

|   7 |    TABLE ACCESS FULL         | VINEYARD2     |   160 |  7680 |    10   (0)| 00:00:01 |

-----------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE2"."VID"="VINEYARD2"."VID" AND
"WINE2"."CID"="CLASS2"."CID")

   3 - access("GRADE"='A' AND "WINE2"."CID"='SHIRAZ')
```

filter("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')

6 - access("CLASS2"."CID"='SHIRAZ')

2.2.3 Results & Calculation

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 71	0
1___ HASH JOIN Cost = 71	1
2_____ TABLE ACCESS FULL WINE2 Cost = 59	59
3_____ NESTED LOOPS Cost = 11	0
4_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
5_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
6_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.1: Results & Calculation Table of Query Plan PLANA2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 99	0
1___ HASH JOIN Cost = 99	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2	86

Cost = 87	
3_______ INDEX RANGE SCAN WCIDX2 Cost = 1	1
4_____ NESTED LOOPS Cost = 11	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.2: Results & Calculation Table of Query Plan PLANB2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 154	0
1___ HASH JOIN Cost = 154	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 142	141
3_______ INDEX RANGE SCAN WGIDX2 Cost = 1	1
4_____ NESTED LOOPS Cost = 11	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0

7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.3: Results & Calculation Table of Query Plan PLANC2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 770	0
1___ HASH JOIN Cost = 770	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 758	752
3_______ INDEX FULL SCAN WVIDX2 Cost = 6	6
4_____ NESTED LOOPS Cost = 11	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.4: Results & Calculation Table of Query Plan PLAND2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 62	0
1___ HASH JOIN Cost = 62	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 50	49
3_______ INDEX RANGE SCAN WGCIDX2 Cost = 1	1
4_____ NESTED LOOPS Cost = 11	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.5: Results & Calculation Table of Query Plan PLANE2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 62	0
1___ HASH JOIN Cost = 62	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 50	49
3_______ INDEX RANGE SCAN WGCIDX2 Cost = 1	1
4_____ NESTED LOOPS Cost = 11	0
5_______ TABLE ACCESS BY INDEX ROWID	1

CLASS2 Cost = 1	
6__________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.6: Results & Calculation Table of Query Plan PLANF2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 113	0
1___ HASH JOIN Cost = 113	1
2_____ NESTED LOOPS Cost = 102	0
3_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
4__________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
5_______ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 101	100
6__________ INDEX RANGE SCAN WCVIDX2 Cost = 1	1
7_____ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.7: Results & Calculation Table of Query Plan PLANG2K For Block Size 2048

	Cost

	of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 119	0
1___ HASH JOIN Cost = 119	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 107	100
3_______ INDEX FULL SCAN WVCIDX2 Cost = 7	7
4_____ NESTED LOOPS Cost = 11	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.8: Results & Calculation Table of Query Plan PLANH2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 259	0
1___ HASH JOIN Cost = 259	1
2_____ NESTED LOOPS Cost = 248	0
3_______ TABLE ACCESS BY INDEX ROWID	1

CLASS2 Cost = 1	
4__________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
5________ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 247	245
6__________ INDEX RANGE SCAN WGVIDX2 Cost = 2	2
7______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.9: Results & Calculation Table of Query Plan PLANI2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 263	0
1___ HASH JOIN Cost = 263	1
2______ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 251	245
3________ INDEX FULL SCAN WVGIDX2 Cost = 6	6
4______ NESTED LOOPS Cost = 11	0
5________ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6__________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7________ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.10: Results & Calculation Table of Query Plan PLANJ2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 65	0
1___ HASH JOIN Cost = 65	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 53	52
3_______ INDEX RANGE SCAN WCGVIDX2 Cost = 1	1
4_____ NESTED LOOPS Cost = 11	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.11: Results & Calculation Table of Query Plan PLANK2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 65	0
1___ HASH JOIN Cost = 65	1

2_____ NESTED LOOPS Cost = 54	0
3_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
4_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
5_______ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 53	52
6_________ INDEX RANGE SCAN WCVGIDX2 Cost = 1	1
7_____ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.12: Results & Calculation Table of Query Plan PLANL2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 66	0
1___ HASH JOIN Cost = 66	1
2_____ NESTED LOOPS Cost = 55	0
3_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
4_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
5_______ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 54	52
6_________ INDEX RANGE SCAN WGVCIDX2 Cost =	2

2	
7_____ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.13: Results & Calculation Table of Query Plan PLANM2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 65	0
1___ HASH JOIN Cost = 65	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 53	52
3_______ INDEX RANGE SCAN WGCVIDX2 Cost = 1	1
4_____ NESTED LOOPS Cost = 11	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.14: Results & Calculation Table of Query Plan PLANN2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 72	0
1___ HASH JOIN Cost = 72	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 60	52
3_______ INDEX FULL SCAN WVCGIDX2 Cost = 8	8
4_____ NESTED LOOPS Cost = 11	0
5_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.15: Results & Calculation Table of Query Plan PLANO2K For Block Size 2048

	Cost of step
QUERY_PLAN	

0_ SELECT STATEMENT Cost = 72	0
1___ HASH JOIN Cost = 72	1
2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 60	52
3_______ INDEX FULL SCAN WVGCIDX2 Cost = 8	8
4_____ NESTED LOOPS Cost = 11	0

5_______ TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
6_________ INDEX UNIQUE SCAN SYS_C00188736 Cost = 0	0
7_______ TABLE ACCESS FULL VINEYARD2 Cost = 10	10

Table 2.2.3.16: Results & Calculation Table of Query Plan PLANP2K For Block Size 2048

2.3 Conclusion

Since most plans have similar steps that are involved in each, so I decide to give explanation of cost calculation in this part, one explanation for all involved plans. Systematically, cost of step can be calculated by subtracting the accumulated cost that is produced by dbms (which in this case is Oracle) optimizer. For example:

…..

1___ HASH JOIN   Cost = 72

2_____ TABLE ACCESS BY INDEX ROWID WINE2 Cost = 60

3_______ INDEX FULL SCAN WVGCIDX2 Cost = 8

…..

That query plan means that hash join cost, which is 72, includes the cost for sub-step(full table access for wine2 table) cost, which is 60, and shown table access cost includes the cost for its sub-step(index full scan WVGCIDX2) cost, which is 8. So, cost of formerly mentioned tables access step can be calculated as 60-8=52. However, cost of hash join step cannot be calculated as 72-60=12 since there are actually more steps involved.

Apart from the calculation by observing the accumulated system cost, we can calculate the involved steps in the plans by:

- HASH JOIN: cost 1 I/O
- FULL TABLE ACCESS: *total_blocks_in_table*/8blocks + 1 for header.

- TABLE ACCESS BY ROWID: cost can be vary based on index(es) that are used, generally 1 I/O

- INDEX FULL SCAN: similar to table full scan(full table access)

- INDEX UNIQUE SCAN: I/O cost=INDEX BLEVEL + 1 for the data. i.e.: if the index is in BLEVEL 1, so the I/O cost for that index is 2 (1+1).

- INDEX RANGE SCAN: I/O cost=1 for each INDEX BLEVEL + 1 for each block (well clustered table)

Or

I/O cost=1 for each INDEX BLEVEL + 1 for each row of data (poorly clustered table)

- NESTED LOOP: includes the cost for involved sub-steps in it

By comparing the results of running the **explain plan for** that we got from previous section with what we got in this section, total cost of each plan based on the combination of involved index(es) is different. Since we forced the optimizer to use all of the created index(es) in this section, no matter if it is the best path or not, the **explain plan for** will force the optimizer to use the indexes and from the generated results we can tell why index(es) are not always useful. In conclusion, the optimizer has been designed and smart enough to choose the best path with least cost in running the query to get the expected result.

3. Distinction / High Distinction Grade – Interfile Clustering

Query(s) being used:

Extended Query

```
select vintage, wine_no, wname, pctalc, grade, price,
wine.vid, vname, wine.cid, cname
from vineyard, class, wine
where wine.vid = vineyard.vid
and wine.cid = class.cid
and wine.cid = 'SHIRAZ' and grade = 'A' AND pctalc = 12.6;
```

Query1

```
select vintage, wine_no, wname, pctalc , grade
from wine
where wine.cid = 'SHIRAZ' and grade = 'A' ;
```

Query2

```
select * from class
where colour='RED';
```

Query3

```
select * from vineyard where pid='PEN';
```

Cluster

```
CREATE CLUSTER WINEV(VID CHAR(08));
CREATE INDEX WINEVIDX ON CLUSTER WINEV;

CREATE CLUSTER WINEC(CID CHAR(06));
CREATE INDEX WINECIDX ON CLUSTER WINEC;
```

3.1 Overview Table

Query	PLAN	Cluster & Cluster Index	Cost
ExtendedQuery	ExtendedQueryA	N/A	11
	ExtendedQueryB	WINEV, WINEVIDX	70
	ExtendedQueryC	WINEC, WINECIDX	8
Query1	Query1A	N/A	19
	Query1B	WINEV, WINEVIDX	68
	Query1C	WINEC, WINECIDX	2
Query2	Query2A	N/A	3
	Query2A	WINEV, WINEVIDX	3
	Query2B	WINEC, WINECIDX	22

Query3	Query3A	N/A	5
	Query3B	WINEV, WINEVIDX	68
	Query3A	WINEC,WINECIDX	5

Table 3.1.1.1: Results Table for Block Size 4096

3.2 Query Plans

3.2.1 ExtendedQueryA

Plan hash value: 3954078144

```
-------------------------------------------------------------------------------------------

| Id  | Operation                  | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |     1 |   217 |    11   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                |              |       |       |            |          |

|   2 |   NESTED LOOPS               |              |     1 |   217 |    11   (0)| 00:00:01 |

|   3 |    NESTED LOOPS              |              |     1 |   165 |    10   (0)| 00:00:01 |

|   4 |     TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    50 |     1   (0)| 00:00:01 
|

|*  5 |      INDEX UNIQUE SCAN        | SYS_C00197393 |     1 |       |     1   (0)| 00:00:01 |

|*  6 |     TABLE ACCESS FULL         | WINE          |     1 |   115 |     9   (0)| 00:00:01 |

|*  7 |    INDEX UNIQUE SCAN          | SYS_C00197404 |     1 |       |     0   (0)| 00:00:01 |

|   8 |   TABLE ACCESS BY INDEX ROWID  | VINEYARD      |     1 |    52 |     1   (0)| 
00:00:01 |

-------------------------------------------------------------------------------------------
```

Predicate Information (identified by operation id):

```
---------------------------------------------------

   5 - access("CLASS"."CID"='SHIRAZ')

   6 - filter("PCTALC"=12.6 AND "WINE"."CID"='SHIRAZ' AND "GRADE"='A')

   7 - access("WINE"."VID"="VINEYARD"."VID")
```

```
Note

-----

   - dynamic sampling used for this statement (level=2)
```

3.2.2 ExtendedQueryB

```
Plan hash value: 492726288

-----------------------------------------------------------------------------------------

| Id  | Operation                    | Name          | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |               |     1 |   217 |    70   (0)| 00:00:01 |

|   1 |  NESTED LOOPS                |               |     1 |   217 |    70   (0)| 00:00:01 |

|   2 |   NESTED LOOPS               |               |     1 |   165 |    69   (0)| 00:00:01 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS         |     1 |    50 |     1   (0)| 00:00:01 |

|*  4 |     INDEX UNIQUE SCAN        | SYS_C00197425 |     1 |       |     1   (0)| 00:00:01 |

|*  5 |    TABLE ACCESS FULL         | WINE          |     1 |   115 |    68   (0)| 00:00:01 |

|*  6 |   TABLE ACCESS CLUSTER       | VINEYARD      |     1 |    52 |     1   (0)| 00:00:01 |

-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   4 - access("CLASS"."CID"='SHIRAZ')

   5 - filter("PCTALC"=12.6 AND "WINE"."CID"='SHIRAZ' AND "GRADE"='A')

   6 - filter("WINE"."VID"="VINEYARD"."VID")


Note

-----

   - dynamic sampling used for this statement (level=2)
```

3.2.3 ExtendedQueryC

```
Plan hash value: 697310335

-------------------------------------------------------------------------------------------

| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |

-------------------------------------------------------------------------------------------

|   0 | SELECT STATEMENT             |              |    35 |  7595 |     8  (13)| 00:00:01 |

|*  1 |  HASH JOIN                   |              |    35 |  7595 |     8  (13)| 00:00:01 |

|   2 |   NESTED LOOPS               |              |    35 |  5775 |     2   (0)| 00:00:01 |

|   3 |    TABLE ACCESS BY INDEX ROWID| CLASS        |     1 |    50 |     1   (0)| 00:00:01 |

|*  4 |     INDEX UNIQUE SCAN        | SYS_C00197343 |     1 |       |     1   (0)| 00:00:01 |

|*  5 |    TABLE ACCESS CLUSTER      | WINE         |    35 |  4025 |     1   (0)| 00:00:01 |

|   6 |   TABLE ACCESS FULL          | VINEYARD     |   160 |  8320 |     5   (0)| 00:00:01 |

-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - access("WINE"."VID"="VINEYARD"."VID")

   4 - access("CLASS"."CID"='SHIRAZ')

   5 - filter("PCTALC"=12.7 AND "WINE"."CID"='SHIRAZ' AND "GRADE"='A')

Note

-----

   - dynamic sampling used for this statement (level=2)
```

3.2.4 Query1A

```
Plan hash value: 1463773509

--------------------------------------------------------------------------

| Id  | Operation         | Name | Rows  | Bytes | Cost (%CPU)| Time     |

--------------------------------------------------------------------------

|   0 | SELECT STATEMENT  |      |    25 |  1400 |    19   (0)| 00:00:01 |
|*  1 |  TABLE ACCESS FULL| WINE |    25 |  1400 |    19   (0)| 00:00:01 |
--------------------------------------------------------------------------
Predicate Information (identified by operation id):
---------------------------------------------------
   1 - filter("WINE"."CID"='SHIRAZ' AND "GRADE"='A')
```

3.2.5 Query1B

```
Plan hash value: 1463773509
--------------------------------------------------------------------------
| Id  | Operation         | Name | Rows  | Bytes | Cost (%CPU)| Time     |
--------------------------------------------------------------------------
|   0 | SELECT STATEMENT  |      |    25 |  1400 |    68   (0)| 00:00:01 |
|*  1 |  TABLE ACCESS FULL| WINE |    25 |  1400 |    68   (0)| 00:00:01 |
--------------------------------------------------------------------------
Predicate Information (identified by operation id):
---------------------------------------------------
   1 - filter("WINE"."CID"='SHIRAZ' AND "GRADE"='A')
```

3.2.6 Query1C

```
Plan hash value: 1445314747
---------------------------------------------------------------------------------
| Id  | Operation            | Name     | Rows  | Bytes | Cost (%CPU)| Time     |
---------------------------------------------------------------------------------
|   0 | SELECT STATEMENT     |          |    35 |  3220 |     2   (0)| 00:00:01 |
|*  1 |  TABLE ACCESS CLUSTER| WINE     |    35 |  3220 |     2   (0)| 00:00:01 |
|*  2 |   INDEX UNIQUE SCAN  | WINECIDX |     1 |       |     1   (0)| 00:00:01 |
---------------------------------------------------------------------------------
Predicate Information (identified by operation id):
```

```
---------------------------------------------------

   1 - filter("GRADE"='A')

   2 - access("WINE"."CID"='SHIRAZ')

Note

-----

   - dynamic sampling used for this statement (level=2)
```

3.2.7 Query2A

```
Plan hash value: 14845877

---------------------------------------------------------------------------

| Id  | Operation         | Name  | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------

|   0 | SELECT STATEMENT  |       |     5 |   255 |     3   (0)| 00:00:01 |

|*  1 |  TABLE ACCESS FULL| CLASS |     5 |   255 |     3   (0)| 00:00:01 |

---------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - filter("COLOUR"='RED')
```

3.2.8 Query2B

```
Plan hash value: 14845877

---------------------------------------------------------------------------

| Id  | Operation         | Name  | Rows  | Bytes | Cost (%CPU)| Time     |

---------------------------------------------------------------------------

|   0 | SELECT STATEMENT  |       |     6 |   342 |    22   (0)| 00:00:01 |

|*  1 |  TABLE ACCESS FULL| CLASS |     6 |   342 |    22   (0)| 00:00:01 |

---------------------------------------------------------------------------

Predicate Information (identified by operation id):
```

```
---------------------------------------------------

   1 - filter("COLOUR"='RED')

Note

-----

   - dynamic sampling used for this statement (level=2)
```

3.2.9 Query3A

```
Plan hash value: 916984494

-----------------------------------------------------------------------------

| Id  | Operation         | Name     | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------

|   0 | SELECT STATEMENT  |          |    18 |  5436 |     5   (0)| 00:00:01 |

|*  1 |  TABLE ACCESS FULL| VINEYARD |    18 |  5436 |     5   (0)| 00:00:01 |

-----------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------

   1 - filter("PID"='PEN')
```

3.2.10 Query3B

```
Plan hash value: 916984494

 -----------------------------------------------------------------------------

| Id  | Operation         | Name     | Rows  | Bytes | Cost (%CPU)| Time     |

-----------------------------------------------------------------------------

|   0 | SELECT STATEMENT  |          |    18 |  5436 |    68   (0)| 00:00:01 |

|*  1 |  TABLE ACCESS FULL| VINEYARD |    18 |  5436 |    68   (0)| 00:00:01 |

-----------------------------------------------------------------------------

Predicate Information (identified by operation id):

---------------------------------------------------
```

```
  1 - filter("PID"='PEN')
```

3.3 Conclusion

A cluster does not have positive effects in a query that is only intended to access a single table itself where the cluster refers to as it will force the query to run through the whole table to find the expected data. Furthermore, it will obviously not affect table that does not have any relation to the cluster (as for example: cluster on VINEYARD Table and WINE Table, which in this case is WINEV will not be used to access CLASS Table).

I was assuming that 2 clusters could be useful for the given query so that the query would run faster. I was wrong since cluster, WINEV, that is related VINEYARD Table, which has more blocks, made the query even slower (more I/O cost) because it forced the query to access table fully. On the other hand, WINEC cluster made the query run faster since it has less blocks in the table.

4. Overall Conclusion – Indexing & Clustering

By this point, we all know that Index and Cluster can be useful to speed up database access. However, they would also bring negative impacts to certain condition. Based on the conducted practice for this assignment, it can be told that index(es) and cluster(s) should be created carefully considering their creation will not only bring good impact, but also some disadvantages based on how they are used (as how they have been highlighted on each section conclusion). Practice will make a better understanding on how to use index(es) and cluster(s) properly. For a DBA Beginner, trial & error fixing practice will hopefully lead to a further understanding in administer database.

Although a dba is systematically provided some useful information in optimizing a database and decently designing a database, a manual practice can be a good learning prior to the actual system optimization. For example, it is good to formerly know how to calculate cost of query so that index(es) & cluster(s) can be created properly and useful for later stage of using the database, although we can find the cost out by running some existing query, i.e: **explain for**, and then get the results from explain for table.