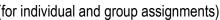
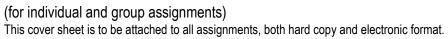


### Faculty of Business and Enterprise

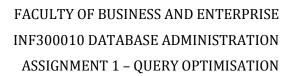
## **Assignment Cover Sheet for Undergraduate Courses**







STL	JDENT(S) DETAILS	6							
		Student 1	Student 2	Student 3	Student 4	Student 5			
Stud	lent ID Number(s)	700513X							
Fam	ily Name(s)	Bunawan							
Give	n name (s)	Jonas							
SUE	BJECT DETAILS								
Subj	ect Code	INF30010	Subject Title	Database Administration	n				
Lect Nam	urer's/Supervisor's	Irene Moser		Tute/Lab day & time Lab 1 (1) Tuesday,		uesday, 11:30 – 12:30			
	SIGNMENT DETAIL	_S							
	or Topic Addressed	Assignment1 – Query (	Optimisation						
Due	Date	Monday, 21st September	er 2015	Date Received	Friday, 18 Sept	tember 2015 7:33:05 PM			
DEC	CLARATION								
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2.	To the best of my/our	belief, no part of this assi	gnment has been	copied from any other studer	nt's work or from a	any other source except			
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3.	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;					s been authorised by the			
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	referencing have been	checked and corrected.							
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## **Database Administration**

## **Query Optimisation**

INF30010\_A02\_T003

#### **Author:**

Jonas Bunawan – BICT (Business Systems) – 700513X

Date: 18/9/2015

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### **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.



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### 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	Index Case	All rows plan	Cost	First rows(1) plan	Cost
For Results					
PLANA4K/P	PK Indexes only	PLANA4K	26	PLANA4KFR	5
LANA4KFR					
PLANA4K/P	Wine(CID)	PLANA4K	26	PLANB4KFR	5
LANB4KFR					
PLANA4K/P	Wine(grade)	PLANA4K	26	PLANC4KFR	5
LANC4KFR					
PLANA4K/P	Wine(VID)	PLANA4K	26	PLANA4KFR	5
LANA4KFR					
PLANA4K/P	Wine(CID), Wine(grade)	PLANA4K	26	PLAND4KFR	5
LAND4KFR					
PLANA4K/P	Wine(grade), Wine(CID)	PLANA4K	26	PLANE4KFR	5
LANE4KFR					
PLANA4K/P	Wine(CID), Wine(VID)	PLANA4K	26	PLANF4KFR	5
LANF4KFR					
PLANA4K/P	Wine(VID), Wine(CID)	PLANA4K	26	PLANA4KFR	5
LANA4KFR					
PLANA4K/P	Wine(grade), Wine(VID)	PLANA4K	26	PLANG4KFR	5
LANG4KFR					
PLANA4K/	Wine(VID), Wine(grade)	PLANA4K	26	PLANA4KFR	5
PLANA4KFR					
PLANA4K/P	Wine(CID), Wine(grade),	PLANA4K	26	PLANH4KFR	5
LANH4KFR	Wine(VID)				

PLANA4K/P	Wine(CID), Wine(VID),	PLANA4K	26	PLANI4KFR	5
LANI4KFR	Wine(grade)				
PLANA4K/P	Wine(grade), Wine(VID),	PLANA4K	26	PLANJ4KFR	5
LANJ4KFR	Wine(CID)				
PLANA4K/P	Wine(grade), Wine(CID),	PLANA4K	26	PLANK4KFR	5
LANK4KFR	Wine(VID)				
PLANA4K/P	Wine(VID), Wine(CID),	PLANA4K	26	PLANA4KFR	5
LANA4KFR	Wine(grade)				
PLANA4K/P	Wine(VID), Wine(grade),	PLANA4K	26	PLANA4KFR	5
LANA4KFR	Wine(CID)				

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



## 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 STATEME	ENT	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 UNIQUI	E SCAN	SYS_C00188704   1     0 (0)  00:00:01
* 6   TABLE ACCESS	S BY INDEΣ	X 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 I   00:00:01	BY INDEX 1	ROWID   VINEYARD   1   48   1 (0)
Predicate Information (ide	ntified by o	peration id):
5 - access("CLASS"."CI		
6 - filter("GRADE"='A')	)	
7 - access("WINE"."CII	D"='SHIRAZ	Z')
8 - access("WINE"."VII	D"="VINEY	ARD"."VID")
1.1.2.2.3 PLANC4KFR Plan hash value: 31117389	954	
Id   Operation	Name	Rows   Bytes   Cost (%CPU)  Time





0   SELECT STATEMENT
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



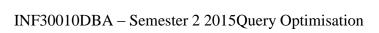
1   NESTED LOOPS
2   NESTED LOOPS
3   NESTED LOOPS     2   226   3 (0)  00:00:01
4   TABLE ACCESS BY INDEX ROWID  CLASS   1   46   1 (0)  00:00:01
* 5   INDEX UNIQUE SCAN   SYS_C00188704   1     0 (0)  00:00:01
6   TABLE ACCESS BY INDEX ROWID  WINE   2   134   3 (0)  00:00:01
* 7   INDEX RANGE SCAN   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
1   NESTED LOOPS
2   NESTED LOOPS
3   NESTED LOOPS



4	TABLE ACCESS BY INDEX	X 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	X 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   00:00:	01	ROWID   VINEYARD   1   48   1 (0)
	ate Information (identified by o	
	ccess("CLASS"."CID"='SHIRA	
7 - a	ccess("GRADE"='A' AND "W	INE"."CID"='SHIRAZ')
8 - a	ccess("WINE"."VID"="VINE	YARD"."VID")
	2.6 PLANF4KFR ash value: 1014991871	
Id   0	Operation   Name	Rows   Bytes   Cost (%CPU)  Time
0 8	SELECT STATEMENT	1   161   5 (0)  00:00:01
1  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	X 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
0   SELECT STATEMENT
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)  
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
0   SELECT STATEMENT
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	t (%CPU)  Ti	me
0   SELECT STATEMEN	NT		1   161	5 (0)  00:0	0:01
1   NESTED LOOPS				1	
2   NESTED LOOPS		1	161   5	(0)  00:00:01	Ι
3   NESTED LOOPS		1	113   4	(0)  00:00:01	ι
4  TABLE ACCESS E	3Y INDEX RO	OWID  CL	ASS	1   46	1 (0)  00:00:01
* 5   INDEX UNIQUE	SCAN   S	SYS_C001	88704   1	0	(0)  00:00:01
6  TABLE ACCESS F	BY INDEX RO	OWID  WI	NE	1   67	3 (0)  00:00:01
* 7   INDEX RANGE S	SCAN   V	WGVCIDX	K   1	1 (0	)  00:00:01
* 8   INDEX UNIQUE S	CAN   S	SYS_C001	88721   1	0	(0)  00:00:01
9   TABLE ACCESS BY 00:00:01	Y INDEX RO	WID   VII	NEYARD	1  48	1 (0)
Predicate Information (iden	• •	ation id):			
5 - access("CLASS"."CID		-			
7 - access("GRADE"='A'	AND "WINE	"."CID"='S	SHIRAZ')		
filter("WINE"."CID"=	SHIRAZ')				
8 - access("WINE"."VID'	'="VINEYAR	.D"."VID")	)		



#### 1.1.2.2.11PLANK4KFR

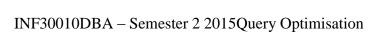
Plan hash value: 1200239092

\_\_\_\_\_\_ | Name | Rows | Bytes | Cost (%CPU)| Time | | Id | Operation | 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  $|*\ 5\ | \quad INDEX\ UNIQUE\ SCAN \qquad |\ SYS\_C00188704\ | \quad 1\ | \quad | \quad 0 \quad (0)|\ 00:00:01\ |$ | 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

1.2.1 Results			[ a ·		
File Name	Index Case	All rows plan	Cost	First rows(1) plan	Cost
For Results					
PLANA2K/PL	PK Indexes only	PLANA2K	71	PLANA2KFR	6
ANA2KFR					
PLANA2K/PL ANB2KFR	Wine(CID)	PLANA2K	71	PLANB2KFR	6
PLANA2K/PL ANC2KFR	Wine(grade)	PLANA2K	71	PLANC2KFR	6
PLANA2K/PL ANA2KFR	Wine(VID)	PLANA2K	71	PLANA2KFR	6
PLANB2K/PL AND2KFR	Wine(CID), Wine(grade)	PLANB2K	62	PLAND2KFR	6
PLANC2K/PL ANE2KFR	Wine(grade), Wine(CID)	PLANC2K	62	PLANE2KFR	6
PLANA2K/PL ANF2KFR	Wine(CID), Wine(VID)	PLANA2K	71	PLANF2KFR	6
PLANA2K/PL ANA2KFR	Wine(VID), Wine(CID)	PLANA2K	71	PLANA2KFR	6
PLANA2K/PL ANG2KFR	Wine(grade), Wine(VID)	PLANA2K	71	PLANG2KFR	6
PLANA2K/PL ANA2KFR	Wine(VID), Wine(grade)	PLANA2K	71	PLANA2KFR	6
PLAND2K/PL ANH2KFR	Wine(CID), Wine(grade), Wine(VID)	PLAND2K	38	PLANH2KFR	5
PLANE2K/PL ANI2KFR	Wine(CID), Wine(VID), Wine(grade)	PLANE2K	38	PLANI2KFR	5
PLANF2K/PLA NJ2KFR	Wine(grade), Wine(VID), Wine(CID)	PLANF2K	39	PLANJ2KFR	5
PLANG2K/	Wine(grade), Wine(CID),	PLANG2K	38	PLANK2KFR	5



PLANK2KFR	Wine(VID)				
PLANA2K/PL ANA2KFR	Wine(VID), Wine(CID), Wine(grade)	PLANA2K	71	PLANA2KFR	6
PLANA2K/PL ANA2KFR	Wine(VID), Wine(grade), Wine(CID)	PLANA2K	71	PLANA2KFR	6

Table 2.2.3.1: Results Table For Block Size 2048

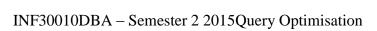
#### 1.2.2 Query Plans

### 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')



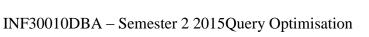


### 1.2.2.1.2 PLANB2K

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)  00:00:0
* 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')



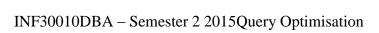
1.2.2.1.7 PLANG2K Plan hash value: 19234192	56	
Id   Operation	Name	Rows   Bytes   Cost (%CPU)  Time
0   SELECT STATEME	NT	25   4025   38 (3)  00:00:01
* 1   HASH JOIN		25   4025   38 (3)  00:00:01
2   NESTED LOOPS		25   2825   27 (0)  00:00:01
3   TABLE ACCESS E	BY INDEX	ROWID  CLASS2   1   46   1 (0)  00:00:01
* 4  INDEX UNIQUE	SCAN	SYS_C00188736   1     0 (0)  00:00:01
5   TABLE ACCESS E 00:00:01	BY INDEX	ROWID  WINE2   25   1675   26 (0)
* 6   INDEX RANGE S	SCAN	WGCVIDX   25     1 (0)  00:00:01
7   TABLE ACCESS F	ULL	VINEYARD2   160   7680   10 (0)  00:00:01
Predicate Information (ider	-	
1 - access("WINE2"."VII		
4 - access("CLASS2"."C	ID"='SHIR	RAZ')
6 - access("GRADE"='A'	AND "WI	INE2"."CID"='SHIRAZ')
1.2.2.2 First_Rows(1)		
1.2.2.2.1 PLANA2KFR Plan hash value: 20480027	36	
Id   Operation	Name	Rows   Bytes   Cost (%CPU)  Time



0 SELECT STA	ГЕМЕNТ		1  16	1   6 (0)  00:00:0	01
1   NESTED LOC	OPS				
2   NESTED LO	OPS	1	1   161	6 (0)  00:00:01	
3   NESTED LC	OOPS	1	1   113	5 (0)  00:00:01	
4   TABLE AC	CESS BY INDEX	X ROWID	CLASS2	1  46  1	(0)
* 5   INDEX UN	NIQUE SCAN	SYS_C	C00188736	1   0 (0)	00:00:01
* 6  TABLE AC	CESS FULL	WINE2	2   1	67   4 (0)  00:	:00:01
* 7   INDEX UN	IQUE SCAN	SYS_C	C00188753	1    0 (0)	00:00:01
8   TABLE ACC 00:00:01	ESS BY INDEX	ROWID	VINEYAR	ED2   1   48	1 (0)
Predicate Informatio	n (identified by c	pperation io	l):		•
5 - access("CLASS	S2"."CID"='SHIR	RAZ')			
6 - filter("WINE2'	'."CID"='SHIRAZ	Z' AND "C	GRADE"='A	<u>.'</u> )	
7 - access("WINE	2"."VID"="VINE	YARD2".	"VID")		
1.2.2.2.2 PLANB2F Plan hash value: 738					
Id   Operation	Name	Row	vs   Bytes	Cost (%CPU)  Time	1
0   SELECT STA	ГЕМЕПТ		1  16	1   6 (0)  00:00:0	01
1   NESTED LOC	OPS	1			
2   NESTED LO	OPS	1	1   161	6 (0)  00:00:01	
3   NESTED LO	OOPS	1	1   113	5 (0)  00:00:01	



4   T   00:00:01		K ROWID  CLASS2   1   46   1 (0)
* 5	INDEX UNIQUE SCAN	SYS_C00188736   1     0 (0)  00:00:01
* 6   T		X ROWID  WINE2   1   67   5 (0)
* 7	INDEX RANGE SCAN	WCIDX   4     1 (0)  00:00:01
* 8   I	NDEX UNIQUE SCAN	SYS_C00188753   1     0 (0)  00:00:01
9 TA		ROWID   VINEYARD2   1   48   1 (0)
Predicate	Information (identified by o	pperation id):
5 - acce	ess("CLASS2"."CID"='SHIR	 (AZ')
6 - filte	r("GRADE"='A')	
7 - acce	ess("WINE2"."CID"='SHIRA	AZ')
8 - acce	ess("WINE2"."VID"="VINE	YARD2"."VID")
	PLANC2KFR value: 333276067	
Id   Ope	eration   Name	Rows   Bytes   Cost (%CPU)  Time
0   SEL	ECT STATEMENT	1   161   6 (0)  00:00:01
1   NE	STED LOOPS	
2   NE	ESTED LOOPS	1   161   6 (0)  00:00:01
3   NI	ESTED LOOPS	1   113   5 (0)  00:00:01
4   T		K ROWID  CLASS2   1   46   1 (0)
* 5	INDEX UNIQUE SCAN	SYS_C00188736   1     0 (0)  00:00:01





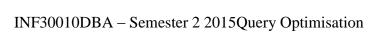
* 6   TABLE ACCESS BY INDEX ROWID  WINE2   1   67   7 (0)  00:00:01
* 7   INDEX RANGE SCAN   WGIDX   15   1 (0)  00:00:01
* 8   INDEX UNIQUE SCAN   SYS_C00188753   1     0 (0)  00:00:01
9   TABLE ACCESS BY INDEX ROWID   VINEYARD2   1   48   1 (0)   00:00:01
Predicate Information (identified by operation 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
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)  
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 | -----| 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 |  $|*\ 8\ |\ \ INDEX\ UNIQUE\ SCAN \qquad |\ SYS\_C00188753\ |\ \ 1\ |\ \ |\ \ 0\ \ (0)|\ 00:00:01\ |$ 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')



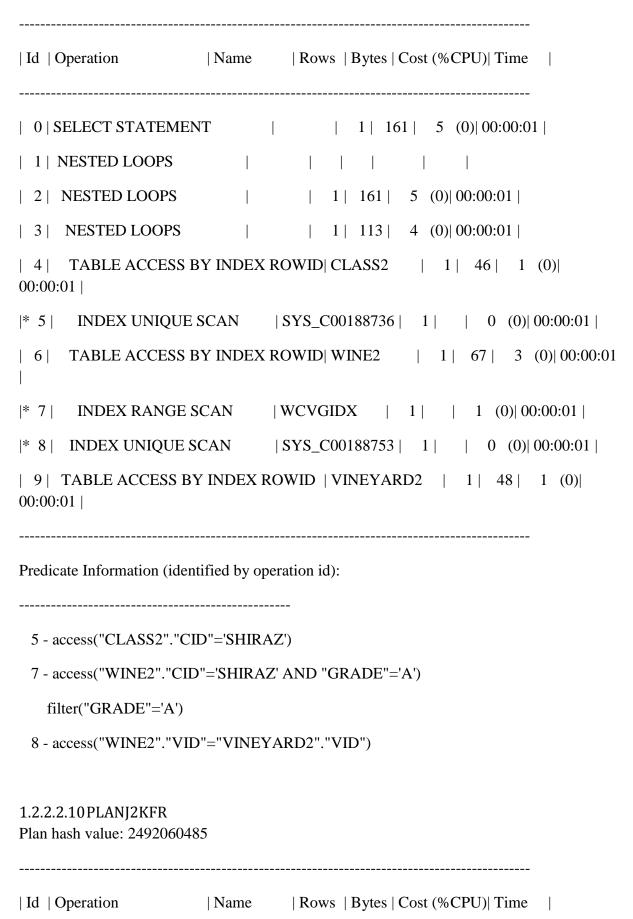
### 8 - access("WINE2"."VID"="VINEYARD2"."VID")

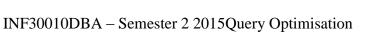
# 1.2.2.2.8 PLANH2KFR Plan hash value: 963497978 | Id | Operation | Name | Rows | Bytes | Cost (%CPU) | Time | | 1 | NESTED LOOPS | | | | | | 2 | NESTED LOOPS | | 1 | 161 | 5 (0) | 00:00:01 | | 3 | NESTED LOOPS | | 1 | 113 | 4 (0)|00:00:01 | | 4 | TABLE ACCESS BY INDEX ROWID | CLASS2 | 1 | 46 | 1 (0) | 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









0   SELECT STATEMENT
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)  00:00:0
* 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
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")
1.2.2.2.11PLANK2KFR Plan hash value: 3838535368
Id   Operation   Name   Rows   Bytes   Cost (%CPU)  Time
0   SELECT STATEMENT

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



```
| 1 | NESTED LOOPS
                         | 2 | NESTED LOOPS
                        1 | 161 | 5 (0) | 00:00:01 |
                                   1 | 113 | 4 (0)| 00:00:01 |
| 3 | NESTED LOOPS
                                TABLE ACCESS BY INDEX ROWID CLASS2 | 1 | 46 | 1 (0)
| 4|
00:00:01 |
|* 5 | INDEX UNIQUE SCAN | SYS_C00188736 | 1 | | 0 (0)| 00:00:01 |
     TABLE ACCESS BY INDEX ROWID| WINE2 | 1 | 67 | 3 (0)| 00:00:01
| 6|
      INDEX RANGE SCAN | WGCVIDX | 1 | 1 (0)| 00:00:01 |
|* 7|
|* 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')
```

### 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	Index Case	Cost
For Results		
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: 30087	5179
_	Name   Rows   Bytes   Cost (%CPU)  Time
	MENT   52   8372   26 (4)  00:00:01
* 1   HASH JOIN	52   8372   26 (4)  00:00:01
* 2   TABLE ACCE	SS FULL   WINE   52   3484   19 (0)  00:00:01
3   NESTED LOOP	S   160   15040   6 (0)  00:00:01
4  TABLE ACCE	SS BY INDEX ROWID  CLASS   1   46   1 (0)  00:00:
* 5   INDEX UNIQ	UE SCAN   SYS_C00188704   1   0 (0)  00:00:01
6  TABLE ACCE	SS FULL   VINEYARD   160   7680   5 (0)   00:00:01
	identified by operation id):
·	 VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CII D"='SHIRAZ' AND "GRADE"='A')
5 - access("CLASS".	
<b>2.1.2.2PLANB4K</b> Plan hash value: 38279	54562
Id   Operation	Name   Rows   Bytes   Cost (%CPU)  Time
0   SELECT STATE	MENT   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
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')
<b>2.1.2.4PLAND4K</b> 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')

<b>2.1.2.5PLANE4K</b> 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')
<b>2.1.2.6PLANF4K</b> 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')
<b>2.1.2.7PLANG4K</b> 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')
<b>2.1.2.8PLANH4K</b> 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')

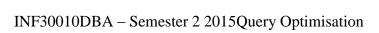
6 - access("CLASS"."CID"='SHIRAZ')

#### 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

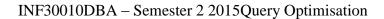
Plan hash value: 28096		
Id   Operation	Name	Rows   Bytes   Cost (%CPU)  Time
		52   8372   235 (1)  00:00:03
* 1   HASH JOIN	1	52   8372   235 (1)  00:00:03
* 2   TABLE ACCES   00:00:03	SS BY INDEX	ROWID   WINE   52   3484   228 (0)
* 3   INDEX FULL	SCAN	WVGIDX   375     6 (0)  00:00:01
4  NESTED LOOF	PS	160   15040   6 (0)  00:00:01
5   TABLE ACCES	SS BY INDEX	ROWID  CLASS   1   46   1 (0)  00:00:01
* 6  INDEX UNIQ	UE SCAN	SYS_C00188704   1     0 (0)  00:00:01
7  TABLE ACCE	SS FULL	VINEYARD   160   7680   5 (0)  00:00:01
Predicate Information (		peration id):
1 - access("WINE"."	VID"="VINEY.	ARD"."VID" AND "WINE"."CID"="CLASS"."CID")
2 - filter("WINE"."C	ID"='SHIRAZ')	
3 - access("GRADE"	='A')	
filter("GRADE"='	A')	
6 - access("CLASS".	"CID"='SHIRA	Z')
<b>2.1.2.11PLANK4K</b> Plan hash value: 23140	75526	
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')
<b>2.1.2.13PLANM4K</b> 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')

_	_	_	_	_					
7	1	7	1	1	D	IΛ	ΝI	N4	v
Z.	1.	. <b>Z</b> .	•	4	r	ı.A	/ V	/V 4	$\mathbf{n}$

Plan hash value: 266478		
Id   Operation	Name	Rows   Bytes   Cost (%CPU)  Time
		52   8372   60 (2)  00:00:01
* 1   HASH JOIN		52   8372   60 (2)  00:00:01
2   TABLE ACCESS 00:00:01	S BY INDEX I	ROWID   WINE   52   3484   53 (0)
* 3   INDEX RANGI	E SCAN	WGCVIDX   52     1 (0)  00:00:01
4  NESTED LOOPS	5	160   15040   6 (0)  00:00:01
5   TABLE ACCES	S BY INDEX	ROWID  CLASS   1   46   1 (0)  00:00:01
* 6  INDEX UNIQU	JE SCAN	SYS_C00188704   1     0 (0)  00:00:01
7  TABLE ACCES	S FULL	VINEYARD   160   7680   5 (0)   00:00:01
Predicate Information (i		peration id):
1 - access("WINE"."V	ID"="VINEY	ARD"."VID" AND "WINE"."CID"="CLASS"."CID")
3 - access("GRADE"=	'A' AND "WI	NE"."CID"='SHIRAZ')
6 - access("CLASS"."	CID"='SHIRA	Z')
0.4.0.4		

#### 2.1.2.15PLANO4K

Plan hash value: 2765962227

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Id   Operation	Name	Rows   Bytes   Cost (%CPU)  Time
		52   8372   67 (2)  00:00:01
* 1   HASH JOIN		52   8372   67 (2)  00:00:01
2   TABLE ACCESS BY 00:00:01	Y INDEX R	OWID   WINE   52   3484   60 (0)
* 3   INDEX FULL SCA	N   V	WVCGIDX   52     8 (0)  00:00:01
4  NESTED LOOPS		160   15040   6 (0)  00:00:01
5   TABLE ACCESS B	Y INDEX F	ROWID  CLASS   1   46   1 (0)  00:00:01
* 6   INDEX UNIQUE S	SCAN	SYS_C00188704   1     0 (0)  00:00:01
7  TABLE ACCESS FU	ULL	VINEYARD   160   7680   5 (0)  00:00:01
3 - access("WINE"."CID"  filter("WINE"."CID"='S	='SHIRAZ' SHIRAZ' A	ND "GRADE"='A')
<b>2.1.2.16PLANP4K</b> Plan hash value: 330961121		
Id   Operation	Name	Rows   Bytes   Cost (%CPU)  Time
0   SELECT STATEMEN	VT	52   8372   67 (2)  00:00:01
* 1   HASH JOIN	1	52   8372   67 (2)  00:00:01
2   TABLE ACCESS BY 00:00:01	Y INDEX R	OWID   WINE   52   3484   60 (0)



* 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
Predic	cate Information (identified by operation id):
1 - a	access("WINE"."VID"="VINEYARD"."VID" AND "WINE"."CID"="CLASS"."CID")
3 - 8	access("GRADE"='A' AND "WINE"."CID"='SHIRAZ')
fi	lter("WINE"."CID"='SHIRAZ' AND "GRADE"='A')
6 - 8	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	1
Cost = 1	
Cost – I	
5 INDEVIMIQUE COAN CVC COOL99704	0
5 INDEX UNIQUE SCAN SYS_C00188704	U
Cost = 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	49
Cost = 50	
3 INDEX RANGE SCAN WCIDX Cost = 1	1
4 NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS	1
Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188704	0
Cost = 0	
7 TABLE ACCESS FULL VINEYARD Cost = 5	5
2.2 P. 1. 0.C.1.1.1 F.11 CO. DI DI ANDARE	1

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	48
Cost = 49	



3 INDEX RANGE SCAN WGIDX Cost = 1	1
4NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS  Cost = 1	1
6INDEX 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	645
Cost = 651	
3 INDEX FULL SCAN WVIDX Cost = 6	6
4 NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS	1
Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188704	0
Cost = 0	
7TABLE ACCESS FULL VINEYARD Cost = 5	5
2.4. Desults & Calculation Table of Overy Plan DI ANDAK E	D1 1

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



	Cost of step
	or 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 WCGIDX Cost = 1	1
4NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS	1
Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188704	0
Cost = 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
OUEDV DI AN	
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
4NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS  Cost = 1	1
6INDEX 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
	r
QUERY_PLAN	
0_ SELECT STATEMENT Cost = 108	0
1 HASH JOIN Cost = 108	1
2 NESTED LOOPS	0
3 TABLE ACCESS BY INDEX ROWID CLASS	1
Cost = 1	
Cost = 1	
4INDEX UNIQUE SCAN SYS_C00188704	0
Cost = 0	
	100
5 TABLE ACCESS BY INDEX ROWID WINE	100
Cost = 101	
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
OUEDV DI AN	
QUERY_PLAN	
0_ SELECT STATEMENT Cost = 114	0
0_SELLET STATEMENT Cost = 114	
	1
1 HASH JOIN Cost = 114	1
2 TABLE ACCESS BY INDEX ROWID WINE	100
C 4 107	
Cost = 107	
3 INDEX FULL SCAN WVCIDX Cost = 7	7
4NESTED LOOPS Cost = 6	0
11\LS1LD LOOIS Cost = 0	
5 MARIE ACCEGG BY BIREY BOWIE OF ACC	1
5 TABLE ACCESS BY INDEX ROWID CLASS	1
Cost = 1	
6 INDEX UNIQUE SCAN SYS_C00188704	0
0 INDEA UNIQUE SCAN 515_C00188/04	U
Cost = 0	
7 TABLE ACCESS FULL VINEYARD Cost = 5	5
/ TABLE ACCESS FOLL VINETARD COSt = 5	
	1

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



2NESTED LOOPS Cost = 225	0
3 TABLE ACCESS BY INDEX ROWID CLASS	1
Cost = 1	
4INDEX UNIQUE SCAN SYS_C00188704	0
Cost = 0	
5 TABLE ACCESS BY INDEX ROWID WINE	222
Cost = 224	
6INDEX 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	222
Cost = 228	
3 INDEX FULL SCAN WVGIDX Cost = 6	6
4 NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS  Cost = 1	1
6INDEX 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
	32 333 F
QUERY_PLAN	
0_ SELECT STATEMENT Cost = 60	0
1 HASH JOIN Cost = 60	1
2 TABLE ACCESS BY INDEX ROWID WINE	52
	32
Cost = 53	
3 INDEX RANGE SCAN WCGVIDX Cost = 1	1
4 NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS	1
Cost = 1	
6 INDEX UNIQUE SCAN SYS_C00188704	0
Cost = 0	
Cost – o	
7 TADLE ACCECCEULL VINEYADD Corr. 5	5
7 TABLE ACCESS FULL VINEYARD Cost = 5	3

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
2NESTED LOOPS Cost = 54	0
3 TABLE ACCESS BY INDEX ROWID CLASS  Cost = 1	1
4INDEX UNIQUE SCAN SYS_C00188704 Cost = 0	0
5 TABLE ACCESS BY INDEX ROWID WINE  Cost = 53	52
6INDEX 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

	I a .
	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	1
Cost = 1	
Cost – 1	
4 INDEX UNIQUE SCAN SYS_C00188704	0
·	
Cost = 0	
5 TABLE ACCESS BY INDEX ROWID WINE	52
Cost = 54	
- J 1	



6INDEX 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	52
Cost = 53	
3 INDEX RANGE SCAN WGCVIDX Cost = 1	1
4 NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS  Cost = 1	1
6INDEX UNIQUE SCAN SYS_C00188704	0
Cost = 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	52
Cost = 60	
3 INDEX FULL SCAN WVCGIDX Cost = 8	8
4 NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS	1
Cost = 1	
6 INDEX UNIQUE SCAN SYS_C00188704	0
Cost = 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	52
Cost = 60	
3 INDEX FULL SCAN WVGCIDX Cost = 8	8
4NESTED LOOPS Cost = 6	0
5 TABLE ACCESS BY INDEX ROWID CLASS	1
Cost = 1	



6INDEX UNIQUE SCAN SYS_C00188704	0
Cost = 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	Index Case	Cost
For Results		
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

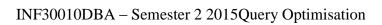
### 2.2.2 Query Plans

#### 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)  00:00:0
* 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')
<b>2.2.2.2PLANB2K</b> 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')	
<b>2.2.2.3PLANC2K</b> 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   348- 00:00:02	4   142 (0)
* 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')
<b>2.2.2.4PLAND2K</b> 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):





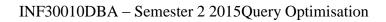
- 1 access("WINE2"."VID"="VINEYARD2"."VID" AND "WINE2"."CID"="CLASS2"."CID")
  - 2 filter("WINE2"."CID"='SHIRAZ' AND "GRADE"='A')
  - 6 access("CLASS2"."CID"='SHIRAZ')

#### 2.2.2.5PLANE2K

Plan hash value: 4165277677	
-----------------------------	--

| Name | Rows | Bytes | Cost (%CPU)| Time | | Id | Operation | 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:
* 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')
<b>2.2.2.7PLANG2K</b> 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')
<b>2.2.2.8PLANH2K</b> 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

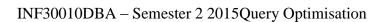


5   TABLE ACCESS BY INDEX ROWID  CLASS2   1   46   1 (0)  00:00:01
* 6   INDEX UNIQUE SCAN   SYS_C00188736   1     0 (0)  00:00:01
7   TABLE ACCESS FULL   VINEYARD2   160   7680   10 (0)  00:00:01
Predicate Information (identified by operation id):
1 - access("WINE2"."VID"="VINEYARD2"."VID" AND "WINE2"."CID"="CLASS2"."CID")
2 - filter("GRADE"='A')
3 - access("WINE2"."CID"='SHIRAZ')
filter("WINE2"."CID"='SHIRAZ')
6 - access("CLASS2"."CID"='SHIRAZ')
<b>2.2.2.9PLANI2K</b> 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 |  $|*\ 3\ |\ \ INDEX\ FULL\ SCAN \qquad |\ WVGIDX2 \qquad |\ 375\ | \qquad |\ 6\ (0)|\ 00:00:01\ |$ | 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")

Assignment 1 – Query Optimisation





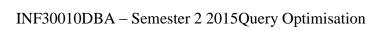
- 2 filter("WINE2"."CID"='SHIRAZ')
  3 access("GRADE"='A')
  filter("GRADE"='A')
- 6 access("CLASS2"."CID"='SHIRAZ')

#### 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')





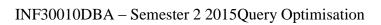
### 2.2.2.12PLANL2K

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')
<b>2.2.2.13PLANM2K</b> 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')
<b>2.2.2.14PLANN2K</b> 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')
Plan hash value: 587734858
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



## INF30010DBA – Semester 2 2015Query Optimisation

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')
<b>2.2.2.16PLANP2K</b> 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

ants & carculation	
	Cost
	of step
QUERY_PLAN	
0_ SELECT STATEMENT Cost = 71	0
0_SELECT STATEMENT COSt = 71	
1 HASH JOIN Cost = 71	1
2 TABLE ACCESS FULL WINE2 Cost = 59	59
3 NESTED LOOPS	0
4 TABLE ACCESS BY INDEX ROWID	1
CLASS2 Cost = 1	
5 INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 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
2TABLE 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
6INDEX 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
	Cost
	of step
OUEDV DI AN	
QUERY_PLAN	
0_ SELECT STATEMENT Cost = 154	0
0_SELECT STATEMENT Cost = 134	U
1 HASH JOIN Cost = 154	1
2TABLE ACCESS BY INDEX ROWID WINE2	141
Z INDEL ACCESS BI INDEX ROWID WINEZ	1
Cost = 142	
3 INDEX RANGE SCAN WGIDX2 Cost = 1	1
5 INDEA RANGE SCAN WOIDAZ COST = 1	
4 NESTED LOOPS Cost = 11	0
5 TABLE ACCESS BY INDEX ROWID	1
CLASS2 Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188736	0
•	
Cost = 0	



7 TABLE ACCESS FULL VINEYARD2 Cost =	10
10	ı
	i

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	752
Cost = 758	
3INDEX FULL SCAN WVIDX2 Cost = 6	6
4NESTED LOOPS Cost = 11	0
5 TABLE ACCESS BY INDEX ROWID	1
CLASS2 Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 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
	10
2 TABLE ACCESS BY INDEX ROWID WINE2	49
Cost = 50	
3 INDEX RANGE SCAN WCGIDX2 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	0
Cost = 0	
7TABLE 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
OUTDAY DI ANI	
QUERY_PLAN	
0_ SELECT STATEMENT Cost = 62	0
1 HASH JOIN Cost = 62	1
2 TABLE ACCESS BY INDEX ROWID WINE2	49
Cost = 50	
3 INDEX RANGE SCAN WGCIDX2 Cost = 1	1
4NESTED LOOPS Cost = 11	0
5 TABLE ACCESS BY INDEX ROWID	1



CLASS2 Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 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
OUEDV DI AN	
QUERY_PLAN	
0_ SELECT STATEMENT Cost = 113	0
1 HASH JOIN Cost = 113	1
2 NECTED LOODS Co. 102	0
2NESTED LOOPS Cost = 102	U
3 TABLE ACCESS BY INDEX ROWID	1
CLASS2 Cost = 1	
4INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 0	
5 TABLE ACCESS BY INDEX ROWID WINE2	100
Cost = 101	
6INDEX 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
3INDEX FULL SCAN WVCIDX2 Cost = 7	7
4NESTED 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
2NESTED LOOPS Cost = 248	0
3 TABLE ACCESS BY INDEX ROWID	1



CLASS2 Cost = 1	
4 INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 0	
5 TABLE ACCESS BY INDEX ROWID WINE2	245
Cost = 247	
6INDEX 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
4NESTED 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	52
Cost = 53	
3 INDEX RANGE SCAN WCGVIDX2 Cost = 1	1
4NESTED LOOPS Cost = 11	0
5 TABLE ACCESS BY INDEX ROWID	1
CLASS2 Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 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	1
CLASS2 Cost = 1	
4INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 0	
5 TABLE ACCESS BY INDEX ROWID WINE2	52
Cost = 53	
6INDEX 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
2NESTED LOOPS Cost = 55	0
3 TABLE ACCESS BY INDEX ROWID CLASS2 Cost = 1	1
4INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 0	
5 TABLE ACCESS BY INDEX ROWID WINE2  Cost = 54	52
6INDEX 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	52
Cost = 53	
3 INDEX RANGE SCAN WGCVIDX2 Cost = 1	1
4 NESTED LOOPS Cost = 11	0
5 TABLE ACCESS BY INDEX ROWID	1
CLASS2 Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 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	52
Cost = 60	
3 INDEX FULL SCAN WVCGIDX2 Cost = 8	8
4 NESTED LOOPS Cost = 11	0
5 TABLE ACCESS BY INDEX ROWID	1
CLASS2 Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 0	
7 TABLE ACCESS FULL VINEYARD2 Cost =	10
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
3INDEX FULL SCAN WVGCIDX2 Cost = 8	8
4NESTED LOOPS Cost = 11	0



5 TABLE ACCESS BY INDEX ROWID	1
CLASS2 Cost = 1	
6INDEX UNIQUE SCAN SYS_C00188736	0
Cost = 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';
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
	ExtendedQueryA	N/A	11
ExtendedQuery	ExtendedQueryB	WINEV, WINEVIDX	70
	ExtendedQueryC	WINEC, WINECIDX	8
	Query1A	N/A	19
Query1	Query1B	WINEV, WINEVIDX	68
	Query1C	WINEC, WINECIDX	2
Query2	Query2A	N/A	3
2401,2	Query2A	WINEV, WINEVIDX	3
	Query2B	WINEC, WINECIDX	22

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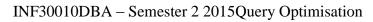
	Query3A	N/A	5
Query3	Query3B	WINEV, WINEVIDX	68
	Query3A	WINEC,WINECIDX	5

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")





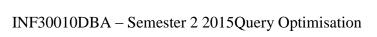
Note
- dynamic sampling used for this statement (level=2)
3.2.2 ExtendedQueryB Plan hash value: 492726288
Id   Operation   Name   Rows   Bytes   Cost (%CPU)  Time
0   SELECT STATEMENT   1   217   70 (0)  00:00:01
1   NESTED LOOPS     1   217   70 (0)  00:00:01
2   NESTED LOOPS     1   165   69 (0) 00:00:01
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)
<b>3.2.4 Query1A</b> 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):
```

Assignment 1 – Query Optimisation



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```
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 |
______
|* 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 |
-----
|* 1 | TABLE ACCESS FULL | CLASS | 6 | 342 | 22 (0) | 00:00:01 |
Predicate Information (identified by operation id):
```



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1 - filter("COLOUR"='RED')
Note
- dynamic sampling used for this statement (level=2)
<b>3.2.9 Query3A</b> Plan hash value: 916984494
Id   Operation   Name   Rows   Bytes   Cost (%CPU)  Time
0   SELECT STATEMENT
* 1   TABLE ACCESS FULL  VINEYARD   18   5436   5 (0)  00:00:01
Predicate Information (identified by operation id):
1 - filter("PID"='PEN')
<b>3.2.10 Query3B</b> Plan hash value: 916984494
Id   Operation   Name   Rows   Bytes   Cost (%CPU)  Time
0   SELECT STATEMENT
Predicate Information (identified by operation id):

Assignment 1 – Query Optimisation



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.