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Part 1

Index 1

Execution Time	Without Index (ms)	With Index (ms)
Query 1	P: 0.127 | E: 1.189	P: 0.552 | E: 2.653
Query 2	P: 0.100 | E: 1.799	P: 0.314 | E: 3.365

a) Adding the index increased both the planning and execution timings for both queries.
b) Adding this index did not change the explain plan. A sequential scan was done for both queries 1 and 2, both with and without the index. The filter remained the same on both queries as well.
c) Yes, this is what was expected because the index created uses both the first and last name columns, whereas we're only using the first name column in our search. Meaning our index will be ignored because it's less efficient and the execution plan should remain the same.

Index 2

Execution Time	Without Index (ms)	With Index (ms)
Query 3	P: 0.319 | E: 2.037	P: 0.554 | E: 0.514

a) Adding the index increased the planning timing, but reduced the execution timing.
b) The index changed the execution plan. Instead of doing a sequential scan on employees, the execution plan does a bitmap index scan on the index we created, followed by a bitmap heap scan on employees.
c) Yes, this is what was expected, the planning time should increase because there are more instructions to be parsed and the execution time should decrease because the index is on a column that is used in a join and has lots of different values. The execution plan changed because it's faster to use the provided index than to sequentially scan.

Index 3

Execution Time	Without Index (ms)	With Index (ms)
Query 4	P: 1.180 | E: 23.184	P: 1.133 | E: 6.502

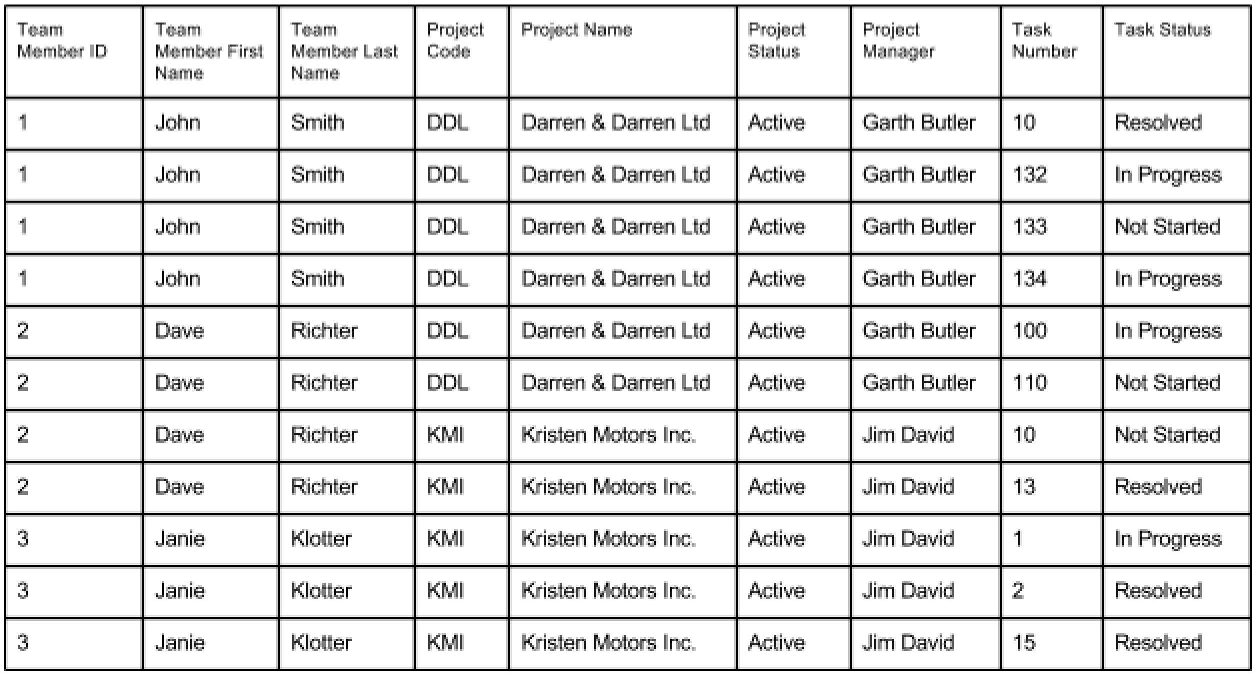
a) Adding the index doesn't appear to have changed the planning timing by a significant amount, however the execution timing was drastically reduced.
b) The index changed the plan. Within the subplan1 section of the execution plan, the plan changes from using a sequential scan on employee_jobs, with the filter (employee_id = e.id) to a index

scan of our created index with an index condition equal to the filter above. Within the join section of the main plan the plan switches from a sequential scan of employee_jobs, with the filter (job_id = j.id) to an index scan of our created index, with an index condition (job_id = j.id).

c) I did not expect the planning time to remain essentially the same, I thought it would increase slightly. I did expect the execution time to reduce quite a bit, because we're eliminating the need to go through the entire employee_jobs table when we're searching for matches of job IDs and employee IDs.

<u>Part 2</u>

1st Normal Form



Team Member ID	Team Member First Name	Team Member Last Name	Project Code	Project Name	Project Status	Project Manager	Task Number	Task Status
1	John	Smith	DDL	Darren & Darren Ltd	Active	Garth Butler	10	Resolved
1	John	Smith	DDL	Darren & Darren Ltd	Active	Garth Butler	132	In Progress
1	John	Smith	DDL	Darren & Darren Ltd	Active	Garth Butler	133	Not Started
1	John	Smith	DDL	Darren & Darren Ltd	Active	Garth Butler	134	In Progress
2	Dave	Richter	DDL	Darren & Darren Ltd	Active	Garth Butler	100	In Progress
2	Dave	Richter	DDL	Darren & Darren Ltd	Active	Garth Butler	110	Not Started
2	Dave	Richter	KMI	Kristen Motors Inc.	Active	Jim David	10	Not Started
2	Dave	Richter	KMI	Kristen Motors Inc.	Active	Jim David	13	Resolved
3	Janie	Klotter	KMI	Kristen Motors Inc.	Active	Jim David	1	In Progress
3	Janie	Klotter	KMI	Kristen Motors Inc.	Active	Jim David	2	Resolved
3	Janie	Klotter	KMI	Kristen Motors Inc.	Active	Jim David	15	Resolved

2nd Normal Form (Red = primary key)

Step 1

Team Member ID	Team Member First Name	Team Member Last Name	Project Code	Project Name	Project Status	Project Manager	Task Number	Task Status
1	John	Smith	DDL	Darren & Darren Ltd	Active	Garth Butler	10	Resolved
1	John	Smith	DDL	Darren & Darren Ltd	Active	Garth Butler	132	In Progress
1	John	Smith	DDL	Darren & Darren Ltd	Active	Garth Butler	133	Not Started
1	John	Smith	DDL	Darren & Darren Ltd	Active	Garth Butler	134	In Progress
2	Dave	Richter	DDL	Darren & Darren Ltd	Active	Garth Butler	100	In Progress
2	Dave	Richter	DDL	Darren & Darren Ltd	Active	Garth Butler	110	Not Started
2	Dave	Richter	KMI	Kristen Motors Inc.	Active	Jim David	10	Not Started
2	Dave	Richter	KMI	Kristen Motors Inc.	Active	Jim David	13	Resolved
3	Janie	Klotter	KMI	Kristen Motors Inc.	Active	Jim David	1	In Progress
3	Janie	Klotter	KMI	Kristen Motors Inc.	Active	Jim David	2	Resolved
3	Janie	Klotter	KMI	Kristen Motors Inc.	Active	Jim David	15	Resolved

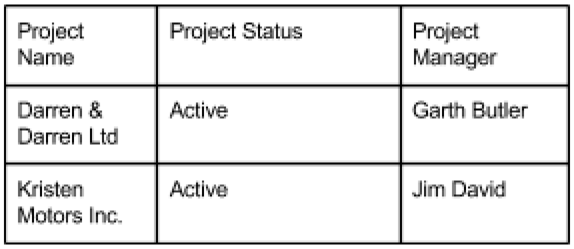
Step 2

Project Code	Project Name	Project Status	Project Manager
DDL	Darren & Darren Ltd	Active	Garth Butler
KMI	Kristen Motors Inc.	Active	Jim David

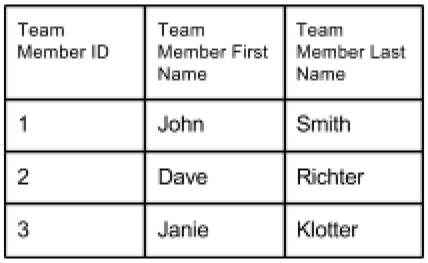
Project Code	Task Number	Task Status
DDL	10	Resolved
DDL	132	In Progress
DDL	133	Not Started
DDL	134	In Progress
DDL	100	In Progress
DDL	110	Not Started
KMI	10	Not Started
KMI	13	Resolved
KMI	1	In Progress
KMI	2	Resolved
KMI	15	Resolved

Team Member ID	Team Member First Name	Team Member Last Name
1	John	Smith
2	Dave	Richter
3	Janie	Klotter

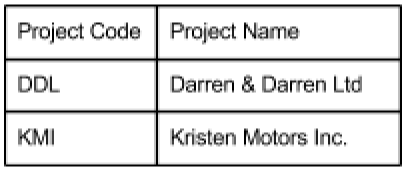
3rd Normal Form (After following steps from 2NF)



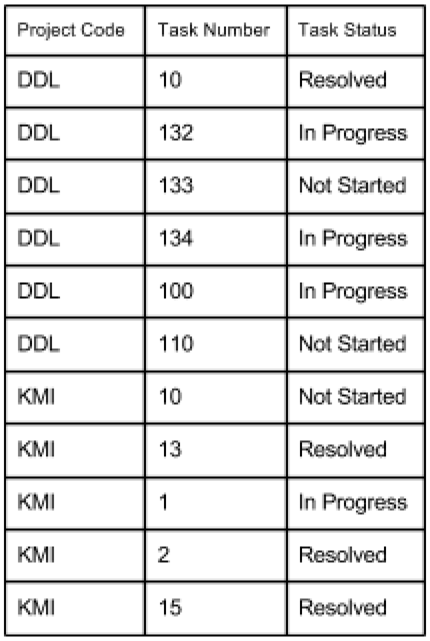
Project Name	Project Status	Project Manager
Darren & Darren Ltd	Active	Garth Butler
Kristen Motors Inc.	Active	Jim David



Team Member ID	Team Member First Name	Team Member Last Name
1	John	Smith
2	Dave	Richter
3	Janie	Klotter



Project Code	Project Name
DDL	Darren & Darren Ltd
KMI	Kristen Motors Inc.



Project Code	Task Number	Task Status
DDL	10	Resolved
DDL	132	In Progress
DDL	133	Not Started
DDL	134	In Progress
DDL	100	In Progress
DDL	110	Not Started
KMI	10	Not Started
KMI	13	Resolved
KMI	1	In Progress
KMI	2	Resolved
KMI	15	Resolved

Part 3

Question 1

a)

Account Number	Account Nickname	Account Balance
1	Chequing	350
2	Chequing	100

b)

Lost Update because Transaction B overwrites the data of Transaction A after Transaction A updates with it’s own update.

Dirty Read because Transaction B reads the uncommitted data of Transaction A after Transaction A updates.

Question 2

A *Non-repeatable Read* data inconsistency is caused because Transaction C reads all account information from the database. Then Transaction D inserts a new record and updates account 1's balance and finally Transaction C rereads the data all before committing.

x

Question 3

A *Dirty Read* data inconsistency is caused because Transaction F reads the accounts before Transaction E commits (in this case rolls back).