

**Group 12**

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The optimization process started with adding primary keys to the tables with single attribute primary keys, followed by creating the indices and the Materialized views.

**Indices** - To optimize the queries, we created two indices:

1. **CourseRegistrations**(StudentRegistrationId)

StudentRegistrationId is required for most queries and materialized views. Table 1 shows that it has a high impact on the running time of query 1. As Query 1 is executed 100 times we decided to keep this optimization despite the memory costs.

2. **CourseOffers**(CourseId)

Just as the index on CourseRegistrations this index has a high impact on the running time of Query 1.

**Materialized views** - To increase the optimization, we created 3 materialized views:

1. **GPAPERStudentRegistrationId** (StudentRegistrationId, GPA, totECTS, StudentId, DegreeId, BirthyearStudent, Gender)

We created this view since 4 queries (2, 3, 6 and 7) required the GPA from students.

2. **MaxGrade** (CourseOfferId, maxGrade)

This Materialized view is created especially for query 6 since the max grades of students are required for this query.

3. **noFailsAlumni** (StudentRegistrationId)

This Materialized view is created especially for query 2, the running time is 51 seconds, but because of this view the running time of query 2 is almost negligible.

The running times of the queries are given in table 1. The running times of the optimization, with the amount of space they require is given in table 2.

<b>Table 1</b>	No optimization	Indices	Materialized views	Final time on the server
Query 1	12.68	0.9	0.9	25
Query 2	//	//	66	3
Query 3	//	//	18.9	17
Query 4	4.5	4.5	5.2	6
Query 5	94	94	94	143
Query 6	//	//	14.7	12
Query 7	//	//	21.4	14
Query 8	97	98	98	26

<b>Table 2</b> Description optimization	Initialization time	Memory required	Useful for Queries
Index on Students (Student Id)	12.68	1713 MB	All Queries
Index on CourseOffers (Course Id)	0.267	8792KB	
GPAPERStudentRegistrationId	98	325KB	Queries 2, 3, 6 and 7
MaxGrade	92	13MB	Query 6
noFailsAlumni	51	240KB	Query 2