Information Technology Institute
Power BI Developer Track

Examination System

Supervisor:
Eng. **Sarah Salah**

Presented by:
Kareem Amr Mohammed Abdulaziz
Mohammed Ahmed Fathy Sherif
Mostafa Hussein Fathy Hussein
Mariam Ayman Hamed Mahmoud
Abdulrahman Hamdy Ahmed Makled

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ABSTRACT

For assessing and improving qualifications proficiency we need an essential tool to tell us whether these qualifications are put in their right places or not, to this reason, we introduce an examination system used to evaluate a student's knowledge and understanding of a particular subject or course.

The exam results can be used to identify areas that require improvement and to guide training and development efforts.

Moreover, the examination system is an essential component of the assessment process, which helps ensure quality education. As such, educational institutions need to design examination systems that are fair, reliable, and valid, to ensure that students receive accurate and meaningful feedback on their learning progress.

INTRODUCTION

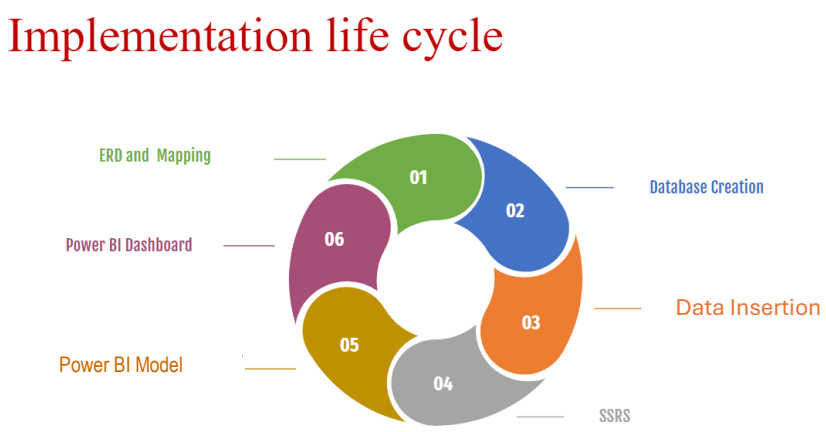
The pace of technological advancement is accelerating rapidly, and as technology continues to expand and improve, it has become essential for us to adapt and understand our needs in this evolving landscape. In this context, an examination system plays a crucial role in accurately assessing a student's current knowledge. It enables the identification of strengths and weaknesses, tracks progress and helps make data-driven decisions about training and development. By pinpointing areas for growth, it ensures that students can keep pace with the rapid advancements in technical skills across fields like data science and other courses.

Each branch consists of departments, which are further divided into tracks, each supervised by a designated instructor. Instructors are responsible for teaching courses within specific topics, and these courses are continually updated to reflect the latest technological trends. With the growing importance of data-driven decision-making, students are taught to work with tools like Python, OOP, SQL, data warehousing, and data mining, alongside tracks that cover areas such as Network Fundamentals, BI Tools, Cloud Computing, and more. These skills are becoming essential for students who aim to develop themselves through continuous learning with the guidance of professional instructors. The examination system incorporates various types of assessments, such as multiple choice and true/false questions, to evaluate student progress.

Students are divided into different intakes throughout the year, and they take exams at different times depending on their progress. By participating in these exams and receiving feedback in the form of grades and status, students can identify areas that need improvement and focus their learning efforts accordingly. This helps them stay current with the latest technologies and industry best practices. After receiving their exam feedback, students can assess whether they need to revisit course content or if they have successfully passed, allowing them to plan their learning journey effectively.

IMPLEMENTATION LIFE CYCLE

The implementation life cycle is an iterative process that ensures the system meets requirements, covering phases from entity-relationship diagrams to interactive dashboards.



ERD& Mapping: In this phase, we created detailed design specifications for the entity relationship diagram, and database schema.

Database creation: In this phase, we implemented the database schema, integrated all components into a functional system, and tested it to ensure it effectively manages exams and answers.

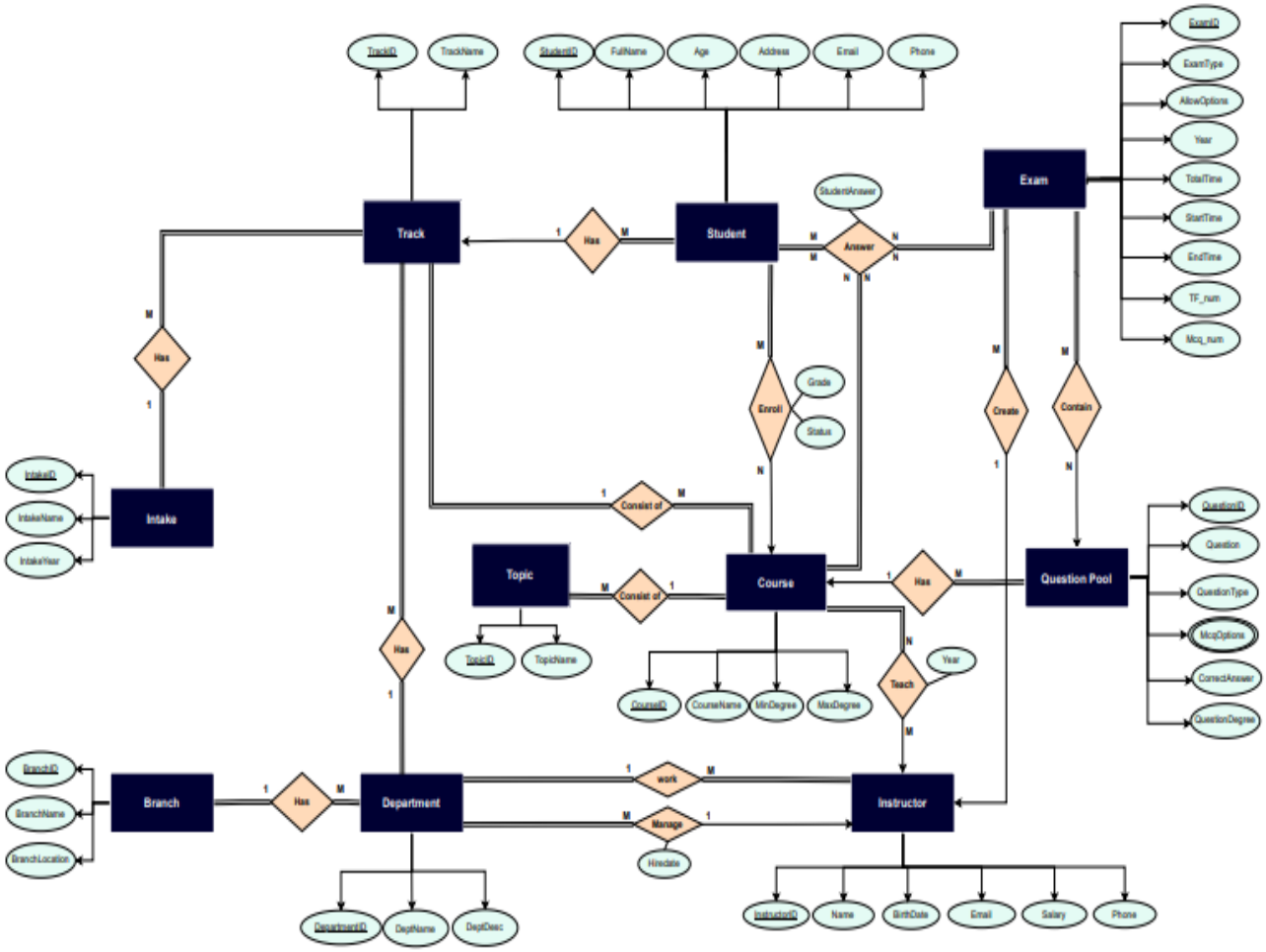
Data Insertion: In this phase, we carried out data insertion by importing data through CSV files and using Python scripts, ensuring the database was populated accurately and the system processed the data as expected.

SSRS: We utilized SQL Server Report Server to present data from stored procedures, generating targeted reports on various aspects such as courses, topics, and exams.

Power BI Dashboards: In Power BI, we designed a star schema for better performance, and we also designed dashboards to visualize data and provide insights on various metrics, including student performance, while also modifying the database into a star schema for a more efficient data warehouse model.

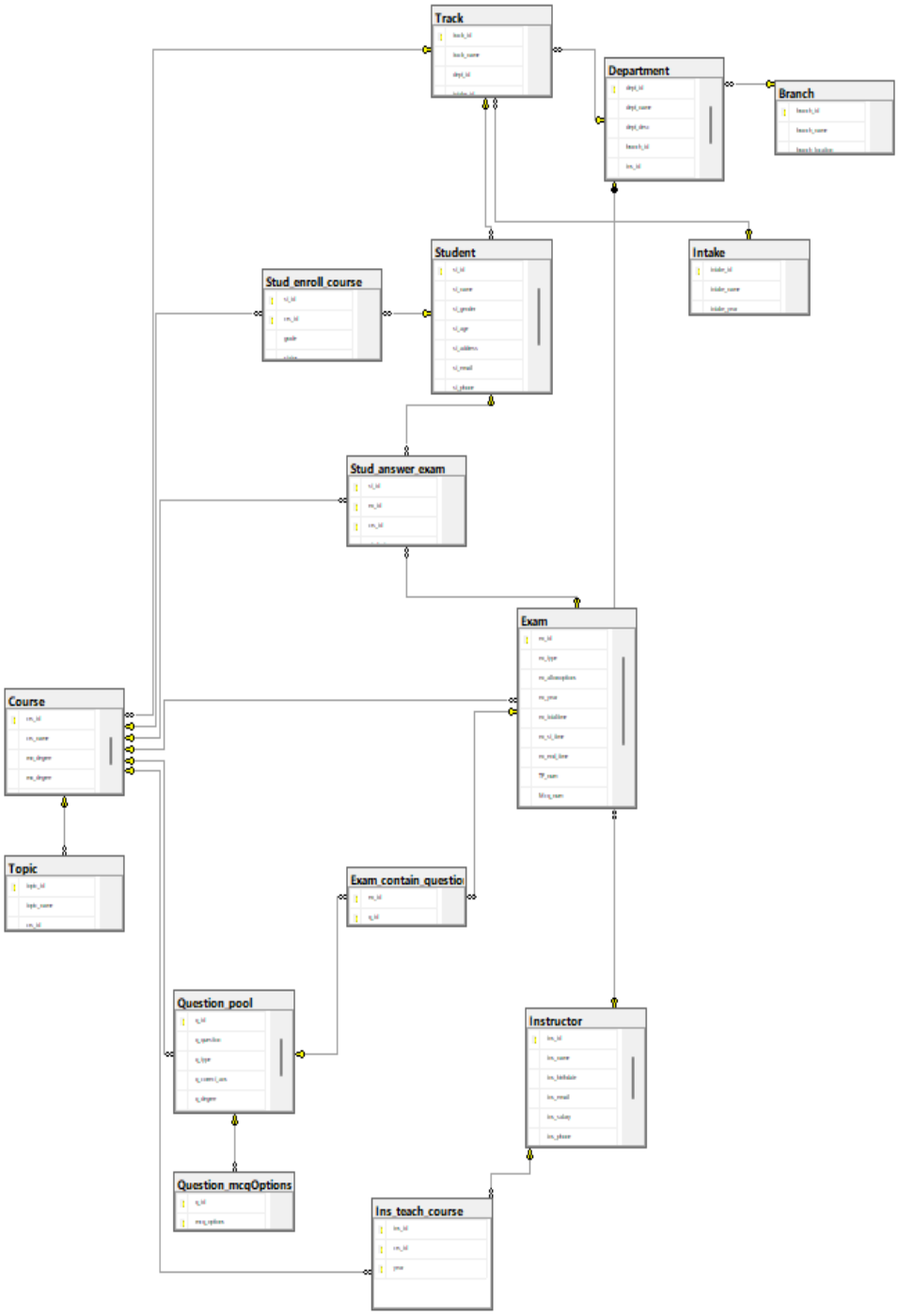
Entity Relationship Diagram (ERD)

The provided ERD represents a comprehensive examination management system for an educational institution. It includes key entities such as Student, Branch, Course, Track, Intake, Instructor, Exam, Question Pool, and Department. Students are organized by branches and tracks, which are further divided into different Intakes based on the academic year. Each Course belongs to a specific track, with Instructors responsible for teaching these courses. Exams are created by instructors using a Question Pool, and students take these exams, with their answers and performance being recorded. The system tracks grades, answers, and student progress. Instructors also manage the Departments, which oversee tracks and courses. The system allows for the efficient organization of educational structures and tracks all data related to student performance and course management.



DATABASE DIAGRAM

This SQL Server database diagram manages an examination system, organizing students, instructors, courses, and exams. It tracks enrolments, exam performance, and progress, ensuring efficient data management and evaluation.



STORED PROCEDURES IMPLEMENTATION

Stored procedures in the `Grad_Examination_System` database streamline data operations such as student enrolment, exam creation, and instructor assignments. They automate repetitive tasks, ensure data integrity, and enhance performance by encapsulating complex queries and business logic. This approach reduces manual intervention, ensuring efficient management of examination processes.

In the Grad_Examination_System, each table has four types of stored procedures to minimize manual intervention and streamline operations. Selection Stored Procedures.

Selection Stored Procedures: These procedures are designed to retrieve data from the respective tables.

```
create or alter procedure sp_selectstudents
as
begin try
    select * from student;
end try
begin catch
    print 'data is not valid';
end catch;
go

create or alter procedure sp_insertstudent
    @st_name varchar(max),
    @st_age int,
    @st_address varchar(max),
    @st_email varchar(max),
    @st_phone varchar(23),
    @track_id int
as
begin try
    insert into student (st_name, st_age, st_address, st_email, st_phone, track_i
    values (@st_name, @st_age, @st_address, @st_email, @st_phone, @track_id);
end try
begin catch
    print 'data is not valid';
end catch;
go
```

Update Stored Procedures: These procedures handle modifying existing records in the tables.

```
create or alter procedure UpdateInstructorCourse_sp
    @ins_id int,
    @crs_id int,
    @year int,
    @new_ins int,
    @new_crs int,
    @new_year int
as
begin try
    update Ins_teach_course
    set ins_id = coalesce(@new_ins, ins_id),
    crs_id = coalesce(@new_crs, crs_id),
    [year] = coalesce(@new_year, [year])
    where ins_id = @ins_id and crs_id = @crs_id and [year] = @year
end try
begin catch
print 'Data is Not Valid'
end catch
```

Insertion Stored Procedures: These automate adding new records, such as enrolling students or creating exams, ensuring data is correctly entered and reducing errors in the system.

```
Create or alter Proc insert_Branch @Branch_id int , @branch_name varchar(MAX) , @branch_location varchar(MAX)
as
begin try
insert into Branch values( @Branch_id , @branch_name  , @branch_location )
Select 'Insert is Successful'
End try
Begin Catch
Select 'Error Occurred During Insert'
Select ERROR_MESSAGE()
Select ERROR_LINE()
Select ERROR_NUMBER()
End Catch
```

Deletion Stored Procedures: These procedures handle removing records, such as deleting students, courses, or exams, ensuring that data is properly removed while maintaining referential integrity across the system.

```
Create or alter Proc Delete_Branch @Branch_id int
as
begin try
Delete From Branch where branch_id = @Branch_id
Select 'Delete is Successful'
End try
Begin Catch
Select 'Error Occurred During Delete'
Select ERROR_MESSAGE()
Select ERROR_LINE()
Select ERROR_NUMBER()
End Catch
```

Stored Procedure: ExamGeneration_sp

The ExamGeneration_sp stored procedure automates the process of generating exams. It inserts exam metadata into the Exam table, enrolls eligible students into the exam by adding their records into the Stud_answer_Exam table, and assigns True/False and MCQ questions from the Question_pool to the exam in the Exam_contain_question table. The procedure ensures that all questions are unique and randomly selected for each exam.

```
create or alter procedure ExamGeneration_sp
    @ex_id int,
    @ex_type varchar(20),
    @ex_allowoptions varchar(100),
    @ex_year int,
    @ex_totaltime int,
    @ex_st_time datetime,
    @ex_end_time datetime,
    @ex_TF_num int,
    @ex_Mcq_num int,
    @ins_id int,
    @crs_id int
as
    -- insert exam metadata in exam table
    exec InsertExam_sp @ex_id, @ex_type, @ex_allowoptions, @ex_year, @ex_totaltime, @ex_st_time, @ex_end_time, @ex_TF_num, @ex_Mcq_num, @ins_id, @crs_id

    begin try
    -- insert studets in student answer table
    insert into Stud_answer_Exam(st_id, ex_id, crs_id)
    select stc.st_id, @ex_id, stc.crs_id
    from Stud_enroll_course as stc, Exam as ex
    where ex.ex_id = @ex_id
    and stc.crs_id = ex.crs_id
    and stc.grade is null

    -- insert questions for exam in exam question table
    declare @tf_count int = 1
    declare @mcq_count int = 1

    -- insert T or F questions
    while @tf_count <= @ex_TF_num
    begin
    insert into Exam_contain_question (ex_id, q_id)
    select top 1 @ex_id, q.q_id
    from Question_pool as q
    where q.crs_id = @crs_id
    and q.q_type = 'T or F'
    and q_id not in (select q_id from Exam_contain_question where ex_id = @ex_id)
    order by newid()
    set @tf_count = @tf_count + 1
    end

    -- insert MCQ questions
    while @mcq_count <= @ex_Mcq_num
    begin
    insert into Exam_contain_question (ex_id, q_id)
    select top 1 @ex_id, q.q_id
    from Question_pool as q
    where q.crs_id = @crs_id
    and q.q_type = 'MCQ'
    and q.q_id not in (select q_id from Exam_contain_question where ex_id = @ex_id)
    order by newid()
    set @mcq_count = @mcq_count + 1
    end

    print 'Exam Generated Successfully'
    end try

    begin catch
        print 'Data is Not Valid'
    end catch

-- Exam (ex_id, ex_type, ex_allowoptions, ex_year, ex_totaltime, ex_st_time, ex_end_time, TF_num, Mcq_num, ins_id, crs_id)

-- test case
exec ExamGeneration_sp 1, 'Normal', 'answer all questions', 2024, 120, '09-01-2024 10:00:00', '09-01-2024 12:00:00', 3, 2, 1, 1
```

Stored Procedure: Display Exam

The procedure begins by taking a student ID and an exam ID as inputs. It first verifies if the student is recorded in the `Student_Answer_Exam` table for the specified exam. Additionally, it checks whether the current date falls within the start and end dates of the exam (both are datetime fields). If these conditions are satisfied, the procedure proceeds to display the exam questions. It continues to do so until the exam end time is reached, after which it prints a message indicating that the exam has ended and stops. If the conditions are not met, the procedure outputs a message stating "Not Valid To Enter The Exam!" and halts.

```
create or alter procedure display_exam @st_id int, @ex_id int
as
    begin
        declare @currentdate datetime = getdate()
        declare @start datetime = (select e.ex_st_time from Exam e where e.ex_id = @ex_id)
        declare @end datetime = (select e.ex_end_time from Exam e where e.ex_id = @ex_id)
        -- check validation
        if exists (
            select 1
            from Stud_answer_exam s
            where s.st_id = @st_id
            and s.ex_id = @ex_id
            and @currentDate between @start and @end)
            begin
                select q.q_id, q.q_question, q.q_type, ' - ' as mcq_options, q.q_degree
                from Question_Pool q, Exam_contain_question ex
                where q.q_id = ex.q_id
                and ex.ex_id = @ex_id
                and q.q_type = 'T or F'
                union
                select q.q_id, q.q_question, q.q_type
                , string_agg (qmcq.mcq_options, ' - ') within group (order by qmcq.mcq_options)
                , q.q_degree
                from Question_Pool q, Question_McqOptions qmcq, Exam_contain_question ex
                where q.q_id = ex.q_id
                and q.q_id = qmcq.q_id
                and ex.ex_id = @ex_id
                and q.q_type = 'MCQ'
                group by q.q_id, q.q_question, q.q_type, q.q_degree

                declare @c int = 1
                while getdate() < @end
                    begin
                        if @c = 1
                            begin
                                select 'Exam Ended' as 'Message'
                                set @c = 0
                            end
                    end
            end
        else
            print 'Not Valid To Enter The Exam!'
        return;
    end

-- test case
exec display_exam 1, 1
```

Stored Procedure: sp_StudentStatus

The sp_StudentStatus procedure takes a student ID and course ID, checks if the student has a grade in the Stud_enroll_course table, and sets a flag if found. If the grade meets or exceeds the minimum passing grade from the Course table, the student's status is updated to "pass." If not, it is set to "corrective." If no grade is found, it prints a message indicating no record exists for the student and course.

```
CREATE OR ALTER PROCEDURE sp_StudentStatus
    @st_id int,
    @crs_id int
AS
BEGIN


        DECLARE @grade int
        DECLARE @Flag Bit = 0
        SELECT @grade = grade
        FROM Stud_enroll_course
        WHERE st_id = @st_id AND crs_id = @crs_id and grade IS NOT NULL

        IF len(@grade) > 0
        Set @Flag = 1
        IF @Flag =1
        BEGIN
        IF @grade >= (select [mn_degree] from Course c where c.crs_id = @crs_id)
        BEGIN
            UPDATE Stud_enroll_course
            SET status = 'pass'
            WHERE st_id = @st_id AND crs_id = @crs_id AND grade = @grade
        end
        ELSE
        BEGIN
            UPDATE Stud_enroll_course
            SET status = 'corrective'
            WHERE st_id = @st_id AND crs_id = @crs_id
        END
        END

    ELSE
    BEGIN

        PRINT 'No record found for the given st_id and crs_id.'

    END
END
```

Stored Procedure: Correct_Questions

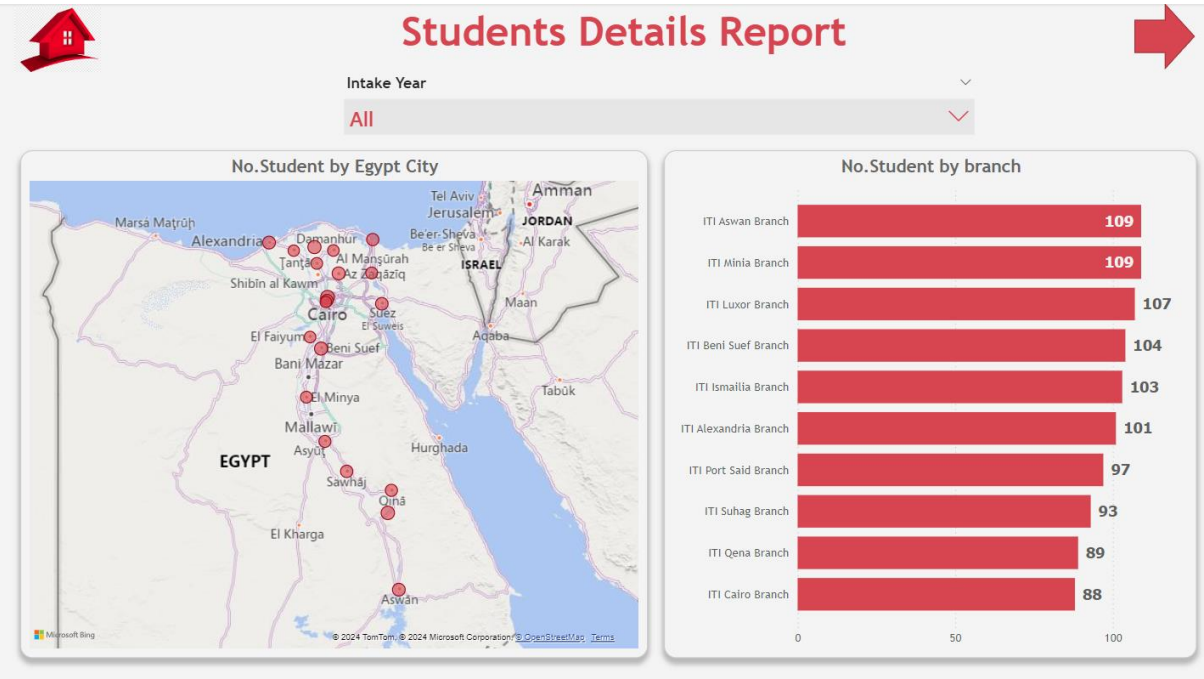
This stored procedure, `Correct_Questions`, evaluates a student's answers for a specific exam by comparing them with the correct answers stored in the `Question_pool` table. It calculates the student's grade by looping through each question, checking if the student's answer matches the correct answer, and adding the corresponding question's weight (degree) to the grade. Finally, it updates the student's grade in the `Stud_enroll_course` table and returns the calculated grade.

```
Create or Alter Proc Correct_Qestions (@Stu_id int ,@exm_id int , @crs_id int  )
AS

Declare @Correct_Answer Table (clo1 int identity(1,1) ,col2 nvarchar(max) )

Insert into @Correct_Answer(col2)
Select  a.q_correct_ans
From Question_pool a

Declare @Stu_Answer Table (clo1 int identity(1,1) ,col2 nvarchar(max) )

Insert into @Stu_Answer (col2)
Select value
From [dbo].[Stud_answer_exam] Cross Apply String_split( student_answer,',')
Where ex_id = 10

Declare @Dgree Table (clo1 int identity(1,1), col2 nvarchar(max) )

Insert into @Dgree (col2)
seLect a.[q_degree]
From [dbo].[Question_pool] a left join [dbo].[Exam_contain_question] b
On a.q_id = b.q_id
And b.ex_id = 10

Declare @Exam_num int

SELECT @Exam_num = TF_num + Mcq_num
From [dbo].[Exam]
Where ex_id = 10

Declare @loob int = 1
Declare @Grad int = 0

While  @loob <= @Exam_num
Begin
Declare @stu_value Nvarchar(Max)
Declare @correct_value Nvarchar(Max)
Select @stu_value = a.col2 , @correct_value = b.col2
From @Correct_Answer a inner join @Stu_Answer b
On a.clo1 = b.clo1
And A.clo1 = @loob

        If  @stu_value = @correct_value
            Begin
                Select @Grad = @Grad + col2
                From @Dgree
                Where clo1 = @loob

            End
set @loob = @loob + 1
End
Select @Grad

        Update [dbo].[Stud_enroll_course]
        Set grade= @Grad
        Where st_id = 1 And crs_id = 12

Go
```

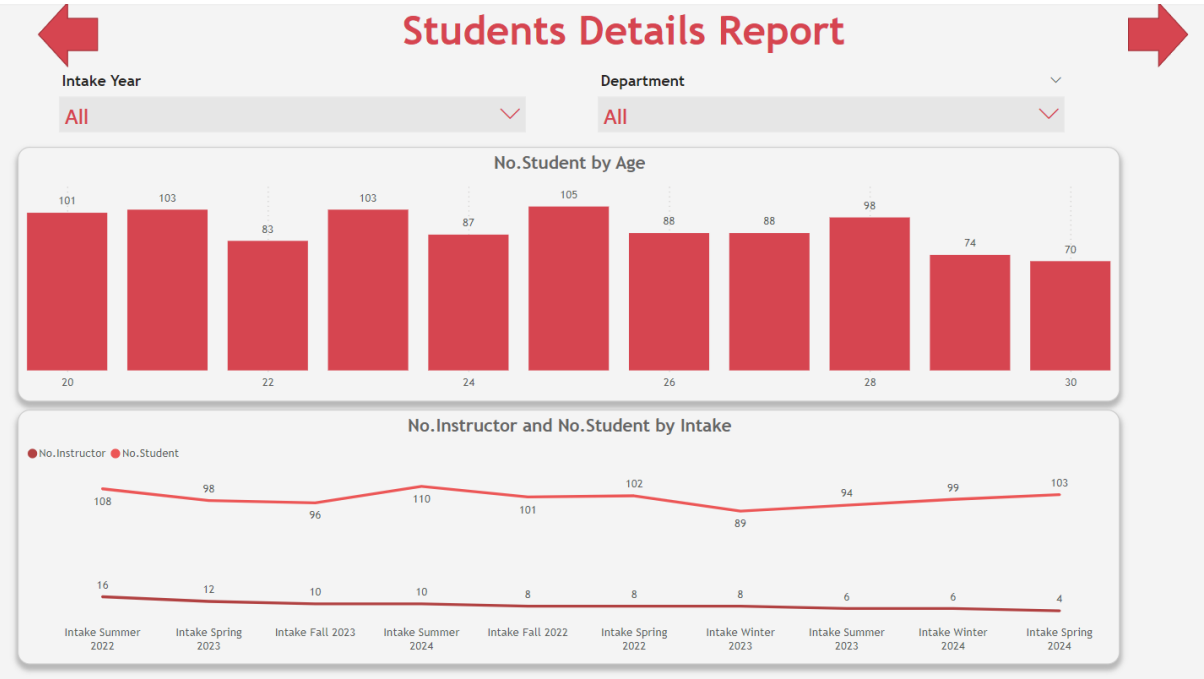
Power BI Dashboards

This dashboard offers an overview of key topics and acts as a central hub, guiding users to navigate through other related dashboards.

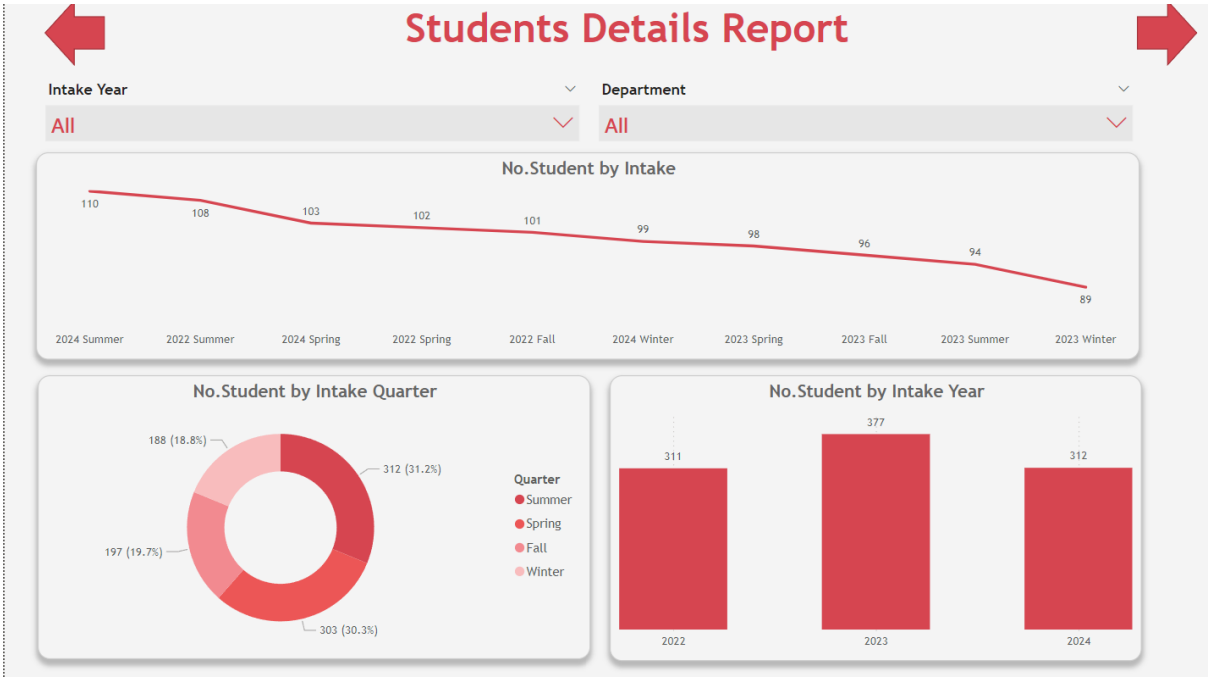
displays the student count for each branch, accompanied by an interactive map that highlights the location of each branch for easy reference.



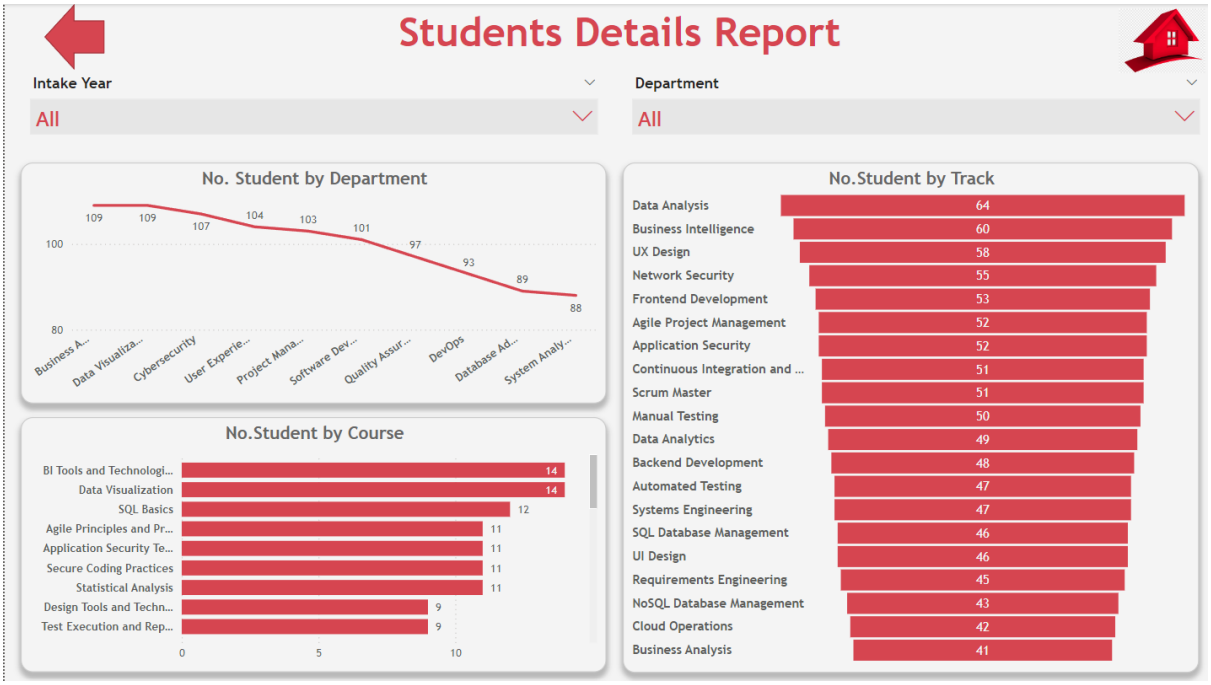
This dashboard shows student distribution by age and compares the number of students to instructors in each intake round.



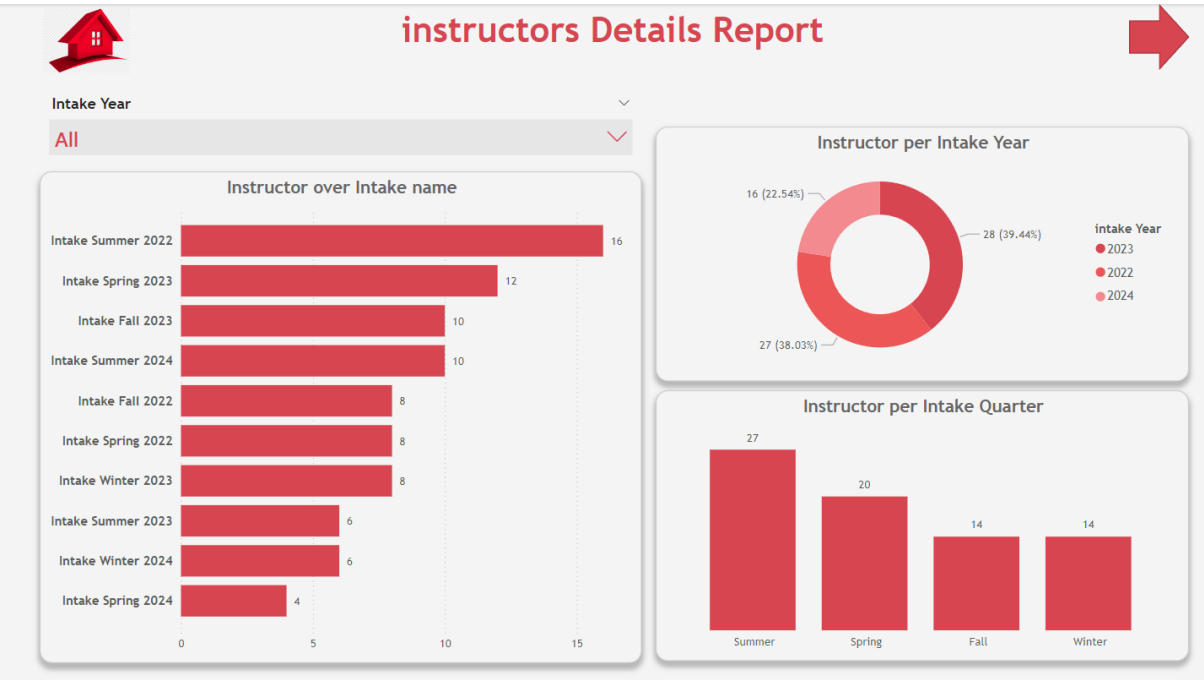
This dashboard displays the number of students in each intake round and provides a comparative analysis of student counts across all intake years.



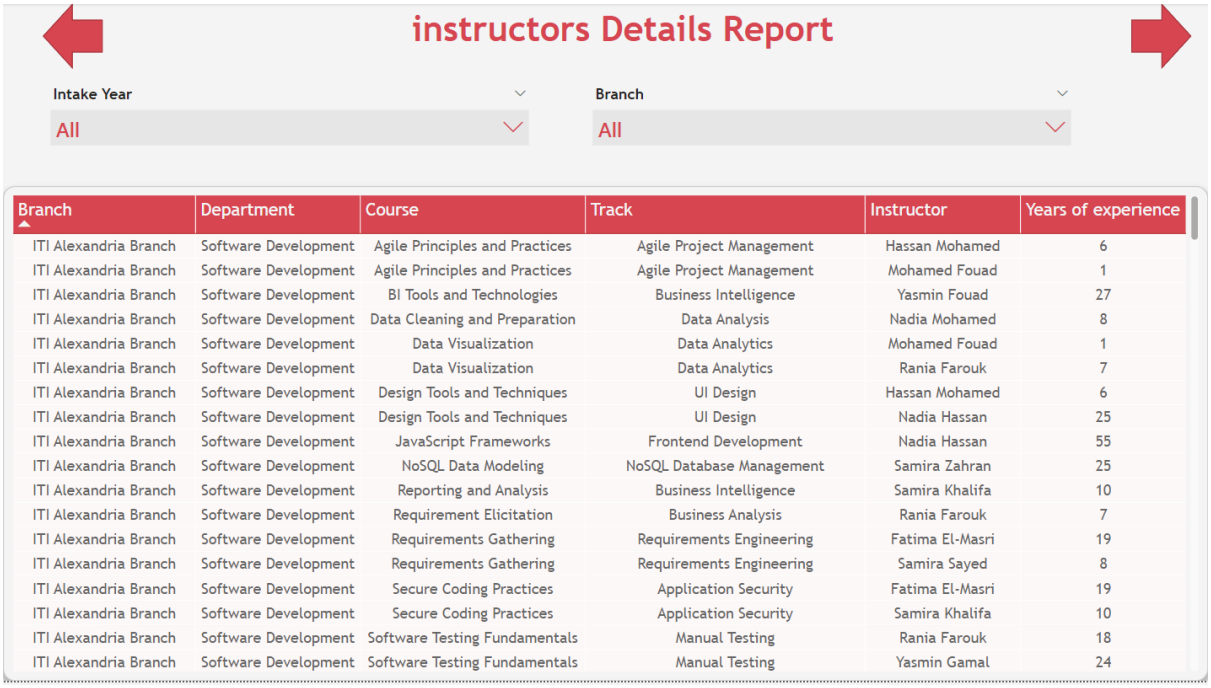
This dashboard presents the number of students in each department, along with breakdowns for each track and course, offering a detailed view of student distribution.



This dashboard displays the number of instructors in each intake round, along with their distribution across intake years and quarters.

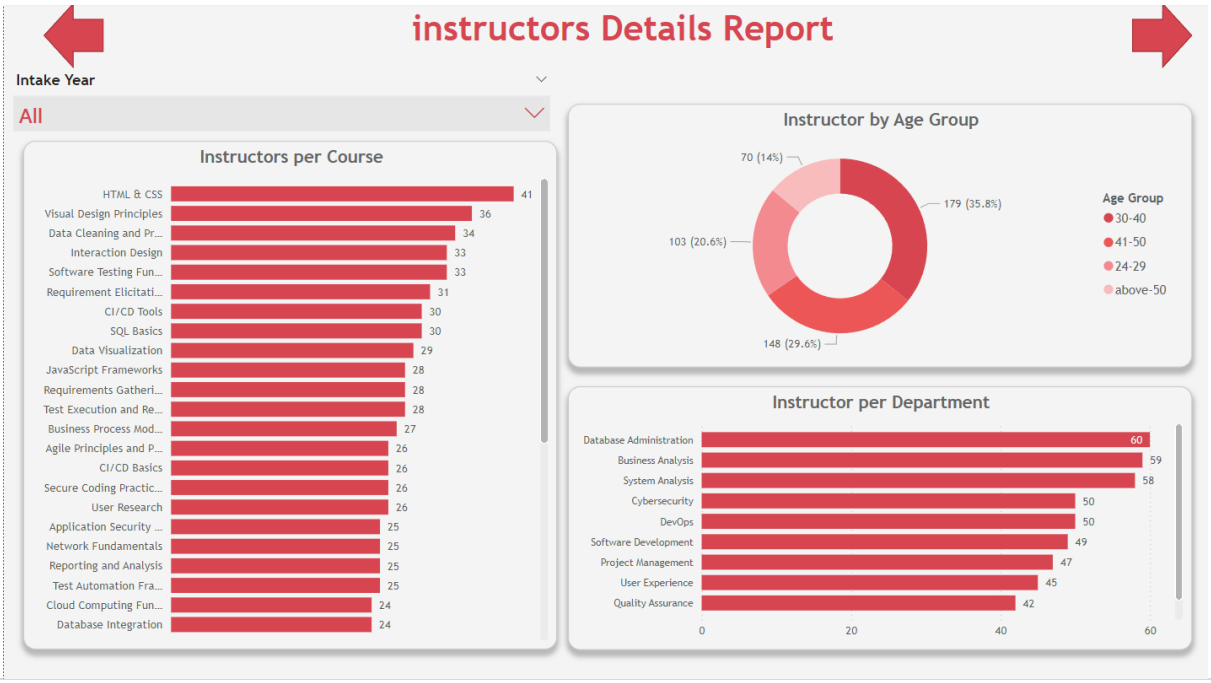


This dashboard presents detailed information for each instructor, including their branch, department, and the courses they are responsible for teaching, offering an overview of instructional assignments.

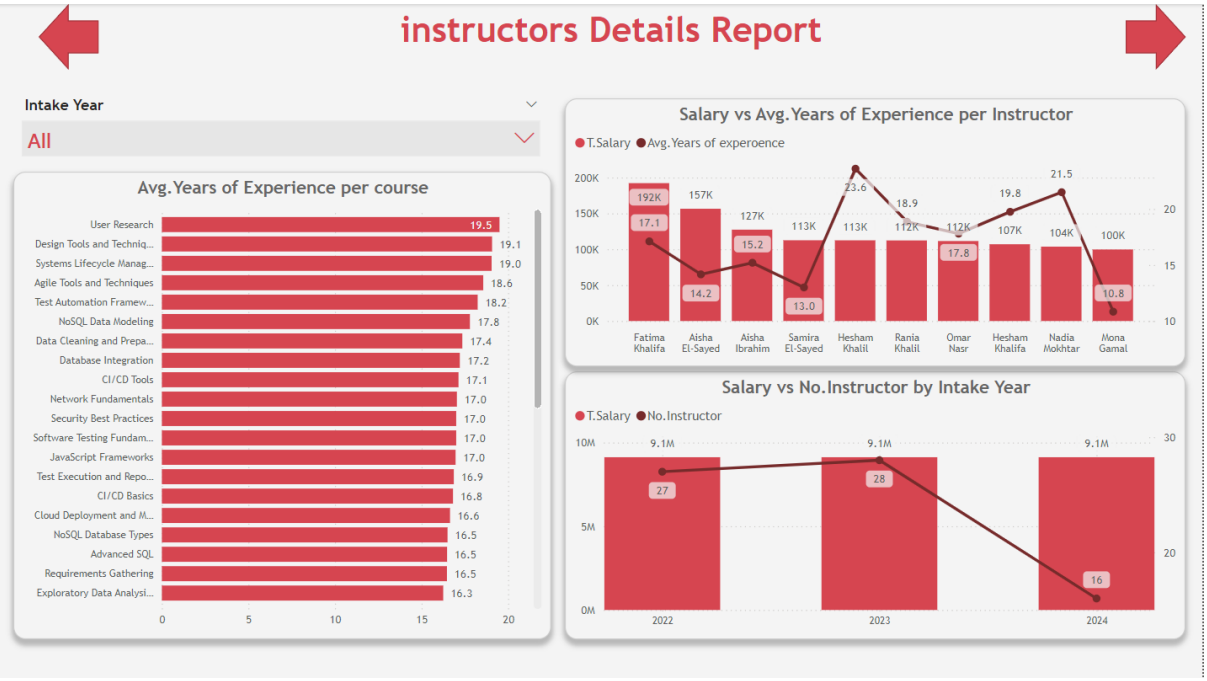


Branch	Department	Course	Track	Instructor	Years of experience
ITI Alexandria Branch	Software Development	Agile Principles and Practices	Agile Project Management	Hassan Mohamed	6
ITI Alexandria Branch	Software Development	Agile Principles and Practices	Agile Project Management	Mohamed Fouad	1
ITI Alexandria Branch	Software Development	BI Tools and Technologies	Business Intelligence	Yasmin Fouad	27
ITI Alexandria Branch	Software Development	Data Cleaning and Preparation	Data Analysis	Nadia Mohamed	8
ITI Alexandria Branch	Software Development	Data Visualization	Data Analytics	Mohamed Fouad	1
ITI Alexandria Branch	Software Development	Data Visualization	Data Analytics	Rania Farouk	7
ITI Alexandria Branch	Software Development	Design Tools and Techniques	UI Design	Hassan Mohamed	6
ITI Alexandria Branch	Software Development	Design Tools and Techniques	UI Design	Nadia Hassan	25
ITI Alexandria Branch	Software Development	JavaScript Frameworks	Frontend Development	Nadia Hassan	55
ITI Alexandria Branch	Software Development	NoSQL Data Modeling	NoSQL Database Management	Samira Zahran	25
ITI Alexandria Branch	Software Development	Reporting and Analysis	Business Intelligence	Samira Khalifa	10
ITI Alexandria Branch	Software Development	Requirement Elicitation	Business Analysis	Rania Farouk	7
ITI Alexandria Branch	Software Development	Requirements Gathering	Requirements Engineering	Fatima El-Masri	19
ITI Alexandria Branch	Software Development	Requirements Gathering	Requirements Engineering	Samira Sayed	8
ITI Alexandria Branch	Software Development	Secure Coding Practices	Application Security	Fatima El-Masri	19
ITI Alexandria Branch	Software Development	Secure Coding Practices	Application Security	Samira Khalifa	10
ITI Alexandria Branch	Software Development	Software Testing Fundamentals	Manual Testing	Rania Farouk	18
ITI Alexandria Branch	Software Development	Software Testing Fundamentals	Manual Testing	Yasmin Gamal	24

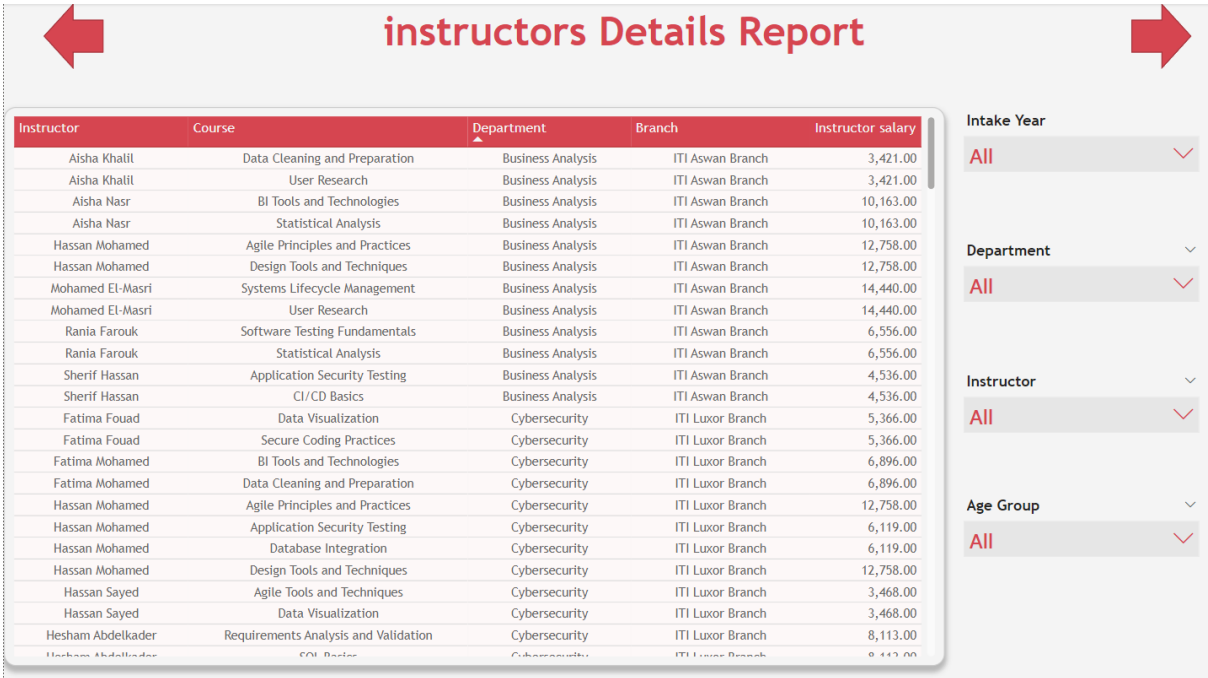
This dashboard illustrates the number of instructors by department and topic while also showcasing the distribution of instructors across various age groups.



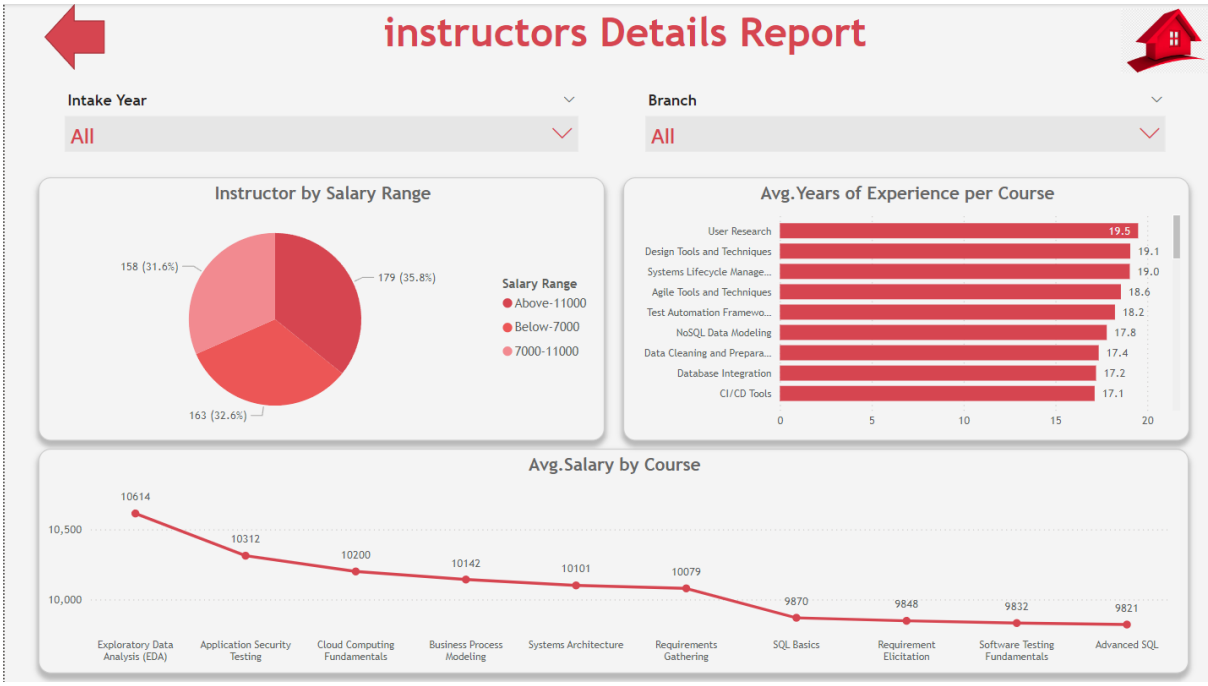
This dashboard displays the average salary for instructors by year and intake year, along with the average years of experience for instructors, providing insights into compensation trends and experience levels.



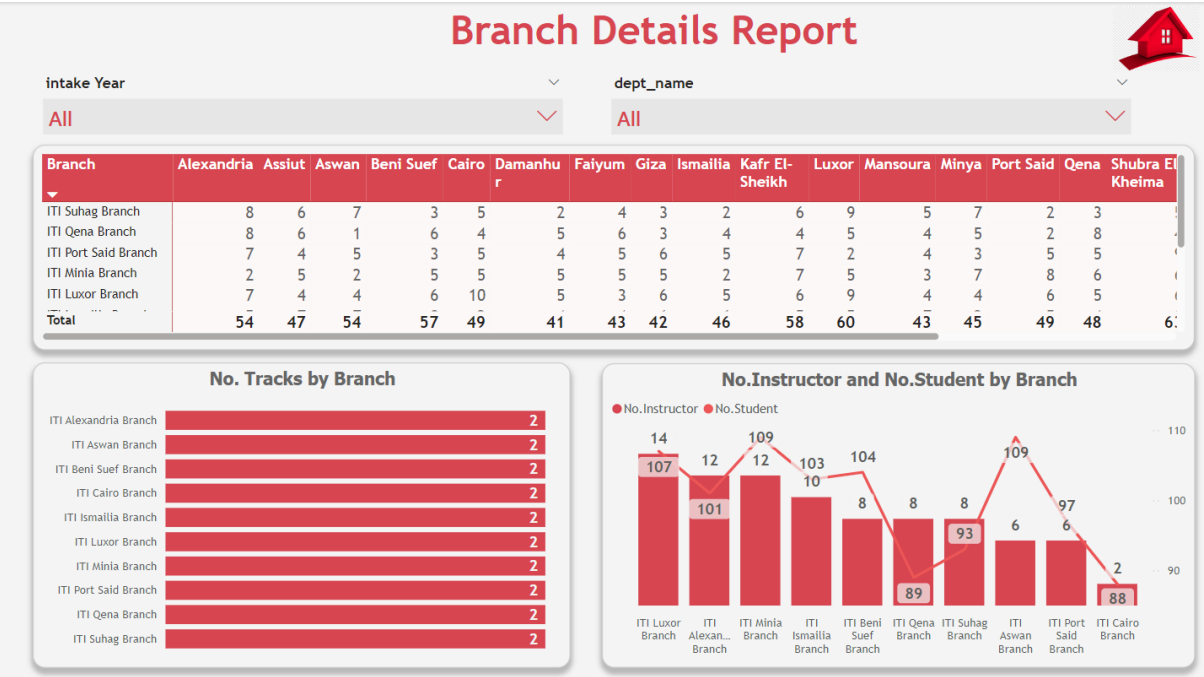
This dashboard presents instructors' personal information, including their salary and the courses they teach, offering a clear overview of faculty profiles.



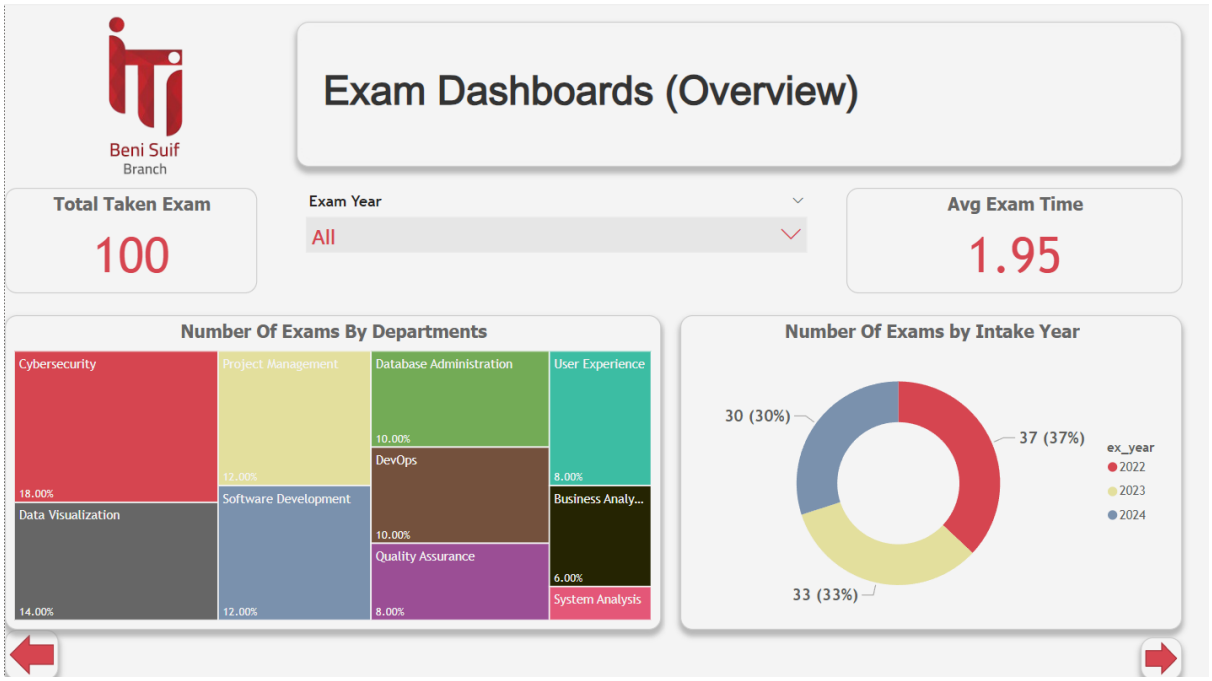
This dashboard displays the various salary ranges for instructors teaching each course, alongside the average years of experience for these instructors, providing insights into compensation and expertise.



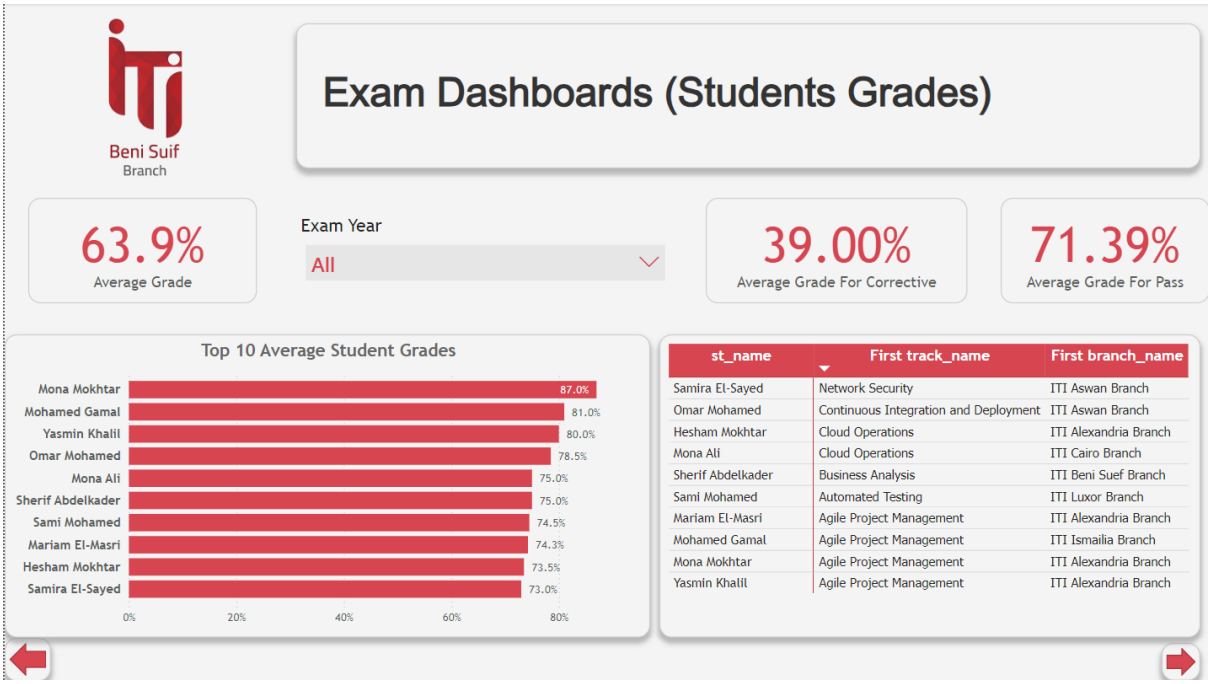
This dashboard presents detailed information for each branch, including the number of instructors and students, offering a comprehensive view of faculty and student distribution across branches.



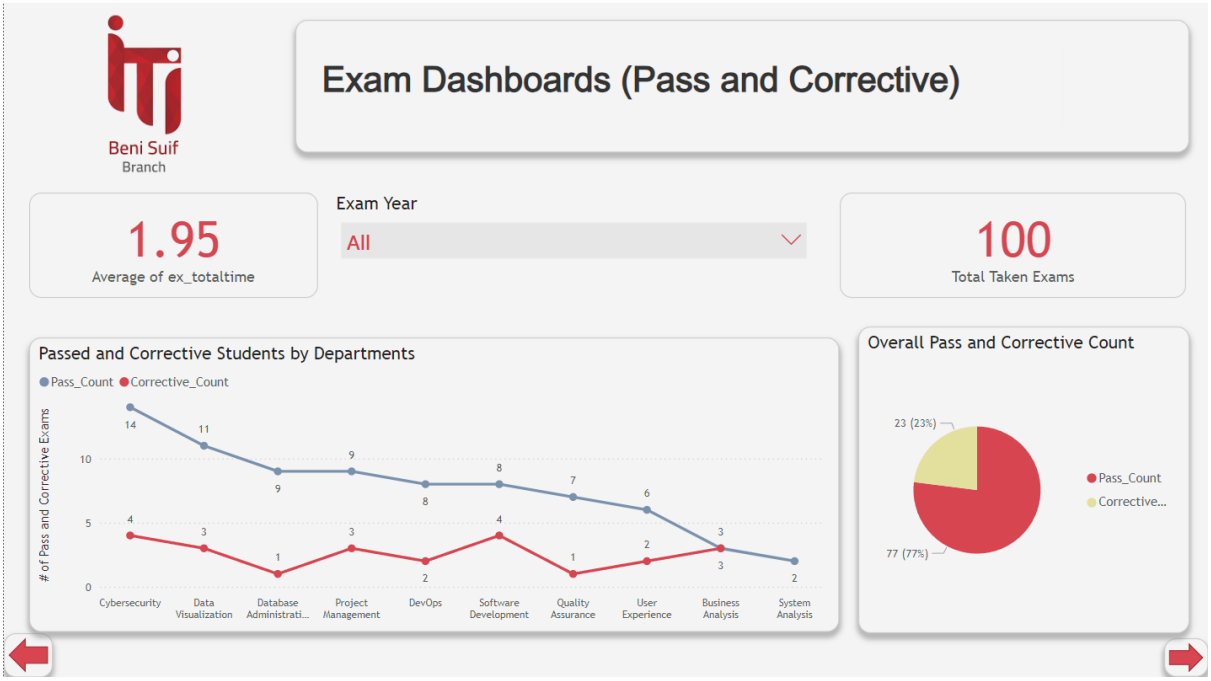
This dashboard provides an overview of exam statistics, including the average exam duration and the total number of exams for each department, offering valuable insights into departmental assessment activities.



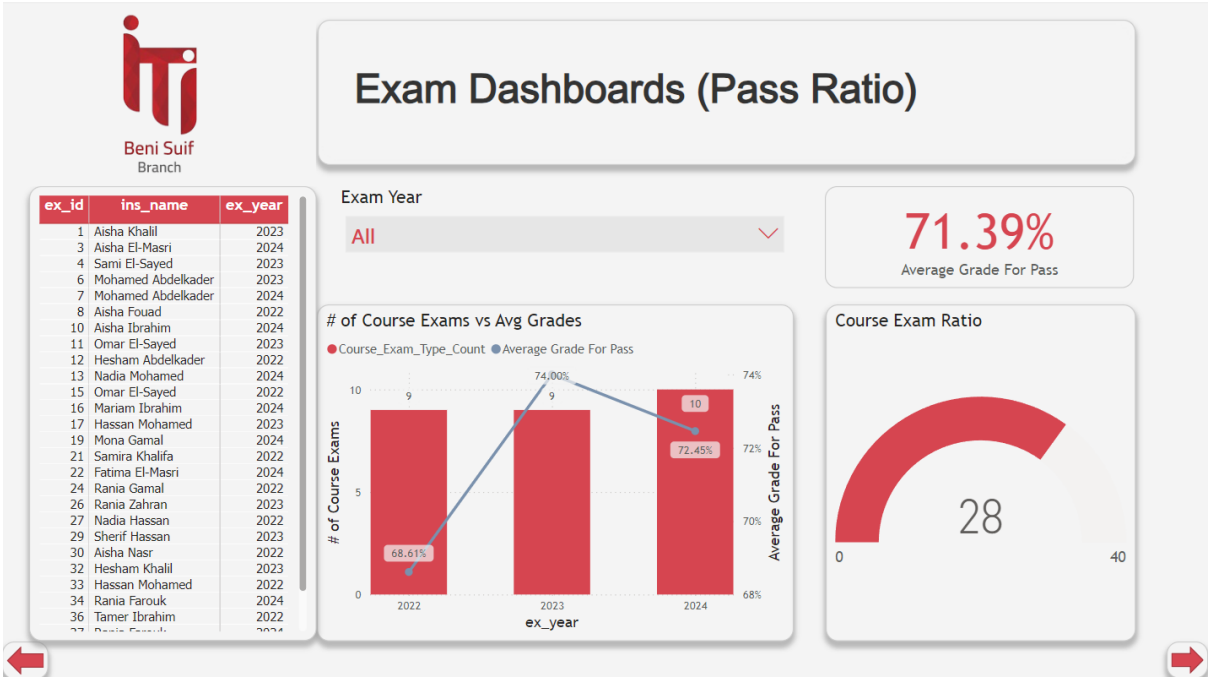
This dashboard displays the overall average exam grade, along with the average grades for corrective and passed students. It also highlights the top 10 students and the tracks they are enrolled in, providing a clear view of academic performance.



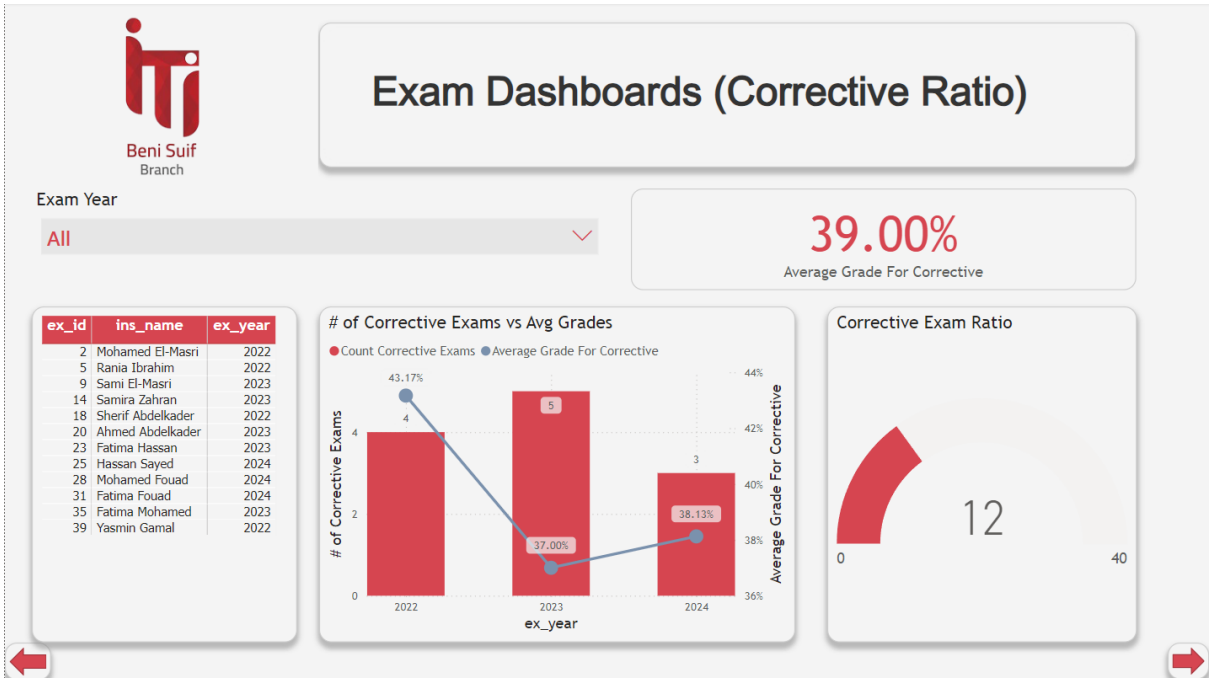
This dashboard displays the average exam duration and the total counts of passing and corrective exams across all departments, offering insights into overall assessment performance.



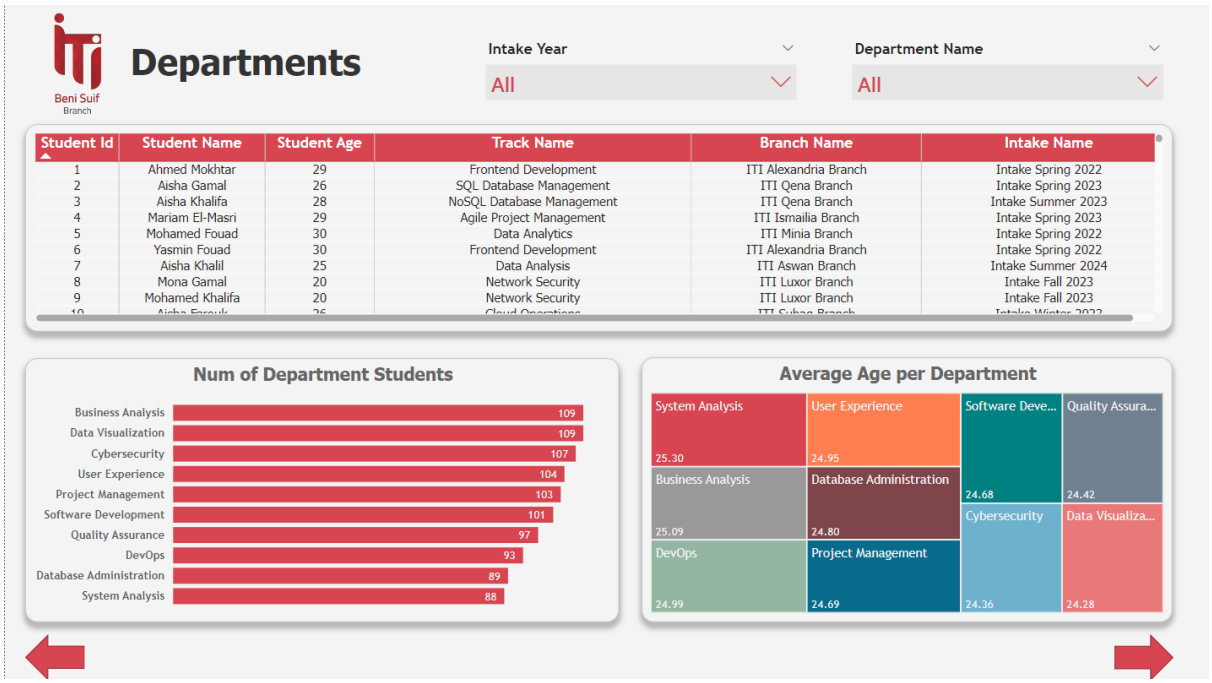
This dashboard highlights the instructors responsible for supervising exams, along with the pass ratio and average grade for each course, providing insights into instructional effectiveness and student performance.



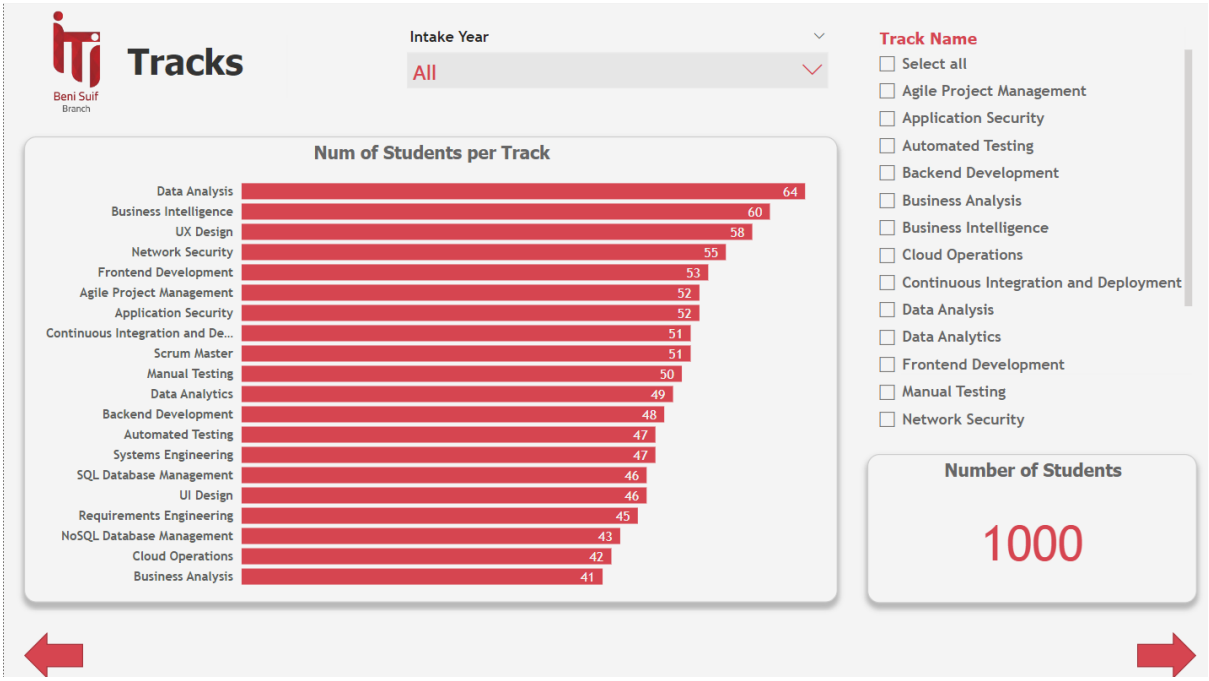
This dashboard highlights the instructors responsible for supervising exams, along with the corrective ratio and average grade for each course, providing insights into instructional effectiveness and areas needing improvement.



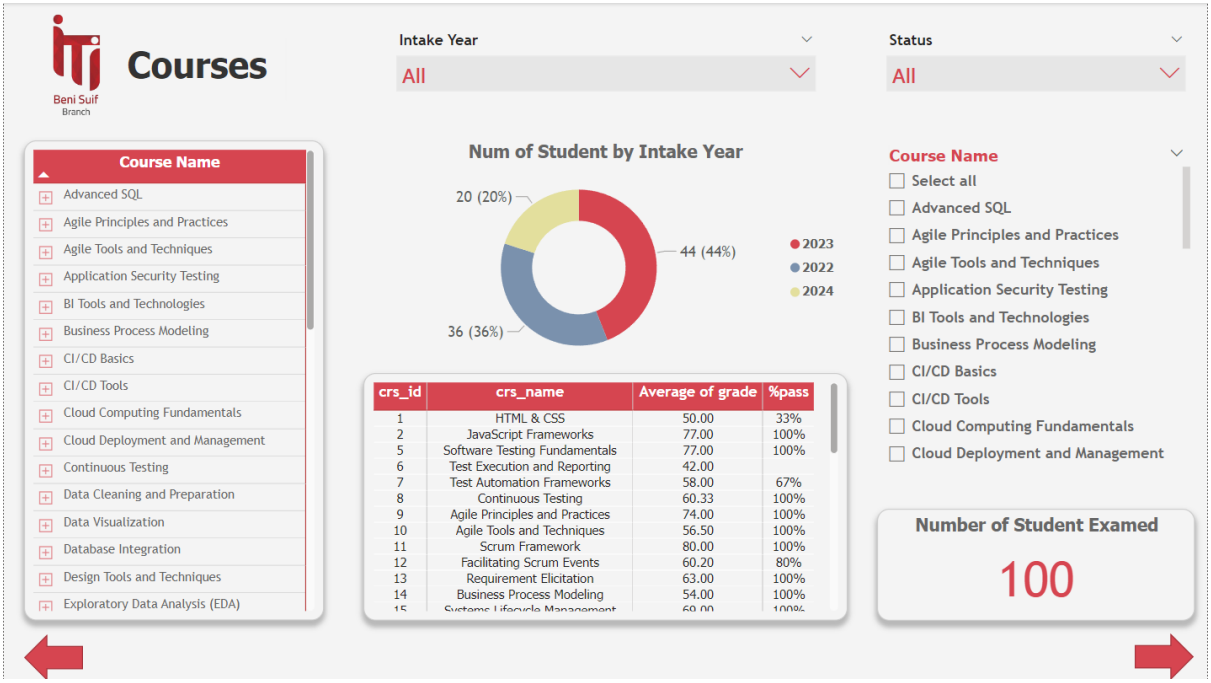
This dashboard presents departmental information, including the tracks offered, the number of students in each department, and their average age, providing a comprehensive view of student demographics across departments.



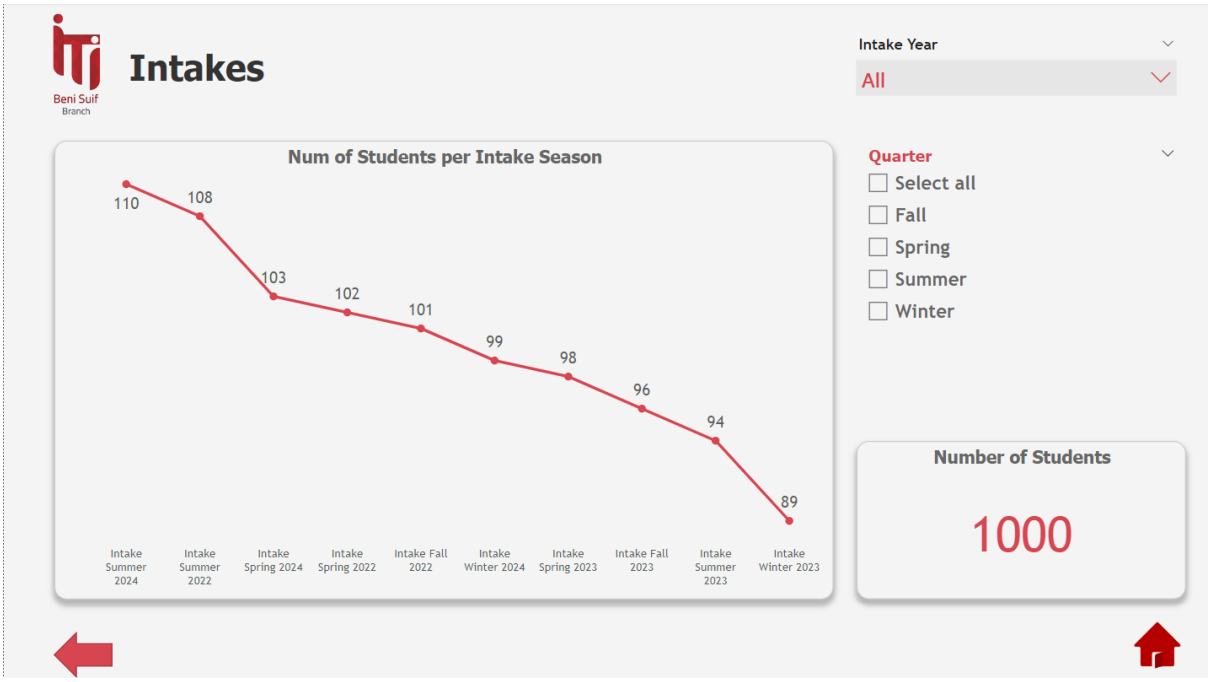
This dashboard displays the number of students in each track, along with the total student count, offering a clear overview of enrollment distribution.



This dashboard presents detailed information for each course, including the number of students enrolled by intake year, providing insights into course popularity and enrollment trends.



This dashboard displays the total number of students for each intake season, offering a clear view of enrollment trends across different periods.



REPORTS

Student’s Personal Information Report:

Retrieves all detailed and relevant student information, including personal details and any additional data, for students who are enrolled in the department corresponding to the specified department ID. This ensures a collection of student data specific to the given department.

Students information Report

Department id = 9

Student id	Name	Age	Address	Email	Phone Number	Track Name	Department name	Branch Name
8	Mona Gamal	20	Alexandria	thoward@outlook.com	20118747020	Network Security	Cybersecurity	ITI Luxor Branch
8	Mona Gamal	20	Alexandria	thoward@outlook.com	20118747020	Network Security	Cybersecurity	ITI Luxor Branch
9	Mohamed Khalifa	20	Kafr El-Sheikh	ggarcia@yahoo.com	20159764658	Network Security	Cybersecurity	ITI Luxor Branch
9	Mohamed Khalifa	20	Kafr El-Sheikh	ggarcia@yahoo.com	20159764658	Network Security	Cybersecurity	ITI Luxor Branch
11	Hesham Khalifa	23	Aswan	christian51@gmail.com	20129243968	Network Security	Cybersecurity	ITI Luxor Branch
11	Hesham Khalifa	23	Aswan	christian51@gmail.com	20129243968	Network Security	Cybersecurity	ITI Luxor Branch
15	Mohamed El-Sayed	24	Giza	umitchell@yahoo.com	20114669713	Network Security	Cybersecurity	ITI Luxor Branch
15	Mohamed El-Sayed	24	Giza	umitchell@yahoo.com	20114669713	Network Security	Cybersecurity	ITI Luxor Branch
24	Mona Fouad	20	Cairo	tracytaylor@gmail.com	20155281383	Application Security	Cybersecurity	ITI Luxor Branch
24	Mona Fouad	20	Cairo	tracytaylor@gmail.com	20155281383	Application Security	Cybersecurity	ITI Luxor Branch
28	Sami Mohamed	25	Alexandria	michaelwoodward@yahoo.com	20116874371	Network Security	Cybersecurity	ITI Luxor Branch
28	Sami Mohamed	25	Alexandria	michaelwoodward@yahoo.com	20116874371	Network Security	Cybersecurity	ITI Luxor Branch
32	Rania Hassan	21	Port Said	pbrown@yahoo.com	20155918963	Network Security	Cybersecurity	ITI Luxor Branch
32	Rania Hassan	21	Port Said	pbrown@yahoo.com	20155918963	Network Security	Cybersecurity	ITI Luxor Branch
45	Mona Ali	28	Cairo	therrera@outlook.com	20110618328	Network Security	Cybersecurity	ITI Luxor Branch

Students Grades Report:

Displays the student's grade for the selected course along with their status, showing whether they have passed or require corrective measures. This provides a clear view of the student's performance and progress in the course.

Students Grades Report

Student id = 7

Student Name	Course Name	Student Grade	Status
Aisha Khalil	HTML & CSS	33	Corrective
Aisha Khalil	JavaScript Frameworks	92	Pass

Instructor's Information Report:

Handles the retrieval of the instructor's full name who is responsible for teaching a specific course and the number of students in it by entering the corresponding instructor ID.

instructor information Report

instructor id 10

instructor Name	Course Name	Number of Students Per instructor Course
Fatima Zahran	Requirements Analysis and Validation	45
Fatima Zahran	Systems Architecture	47

Course's Topics Report:

Retrieves the complete list of topic names that are associated with and included in the selected course, providing an overview of the course content.

Report about All Topics in Course

Course Name = BI Tools and Technologies

Course id = 23

Topic Name
Data Warehousing Concepts
BI Tools Overview (Power BI, QlikView)
Data Modeling

Course Name = BI Tools and Technologies

Course id = 23

Question Student Answer Report:

Retrieves each question along with the corresponding answer letter selected by the student, providing a clear overview for review

Question Student Answer Report

Question	Answer
What is React?	d
Can React handle state management?	True
What is JSX?	b
Is React a framework or a library?	True
What does 'virtual DOM' refer to in React?	a
Can React be used for mobile development?	True
What is a component in React?	b
Is 'props' used to pass data to components in React?	True
What does 'state' manage in a React component?	c
Can React components be nested inside other components?	True

Student Exam:

Retrieves the multiple-choice questions along with all available answer choices, providing an overview of the question options.

Student Exam

- **What is data visualization?**

  a) The analysis of textual data
  b) The creation of data models
  c) The graphical representation of data
  d) The process of collecting and storing data

- **Is a bar chart a type of data visualization?**

  Ture [ ]
  False [ ]

- **What does 'interactive visualization' involve?**

  a) Allowing users to interact with the data
  b) Analyzing data trends automatically
  c) Exporting data to external files
  d) Generating static charts and graphs

Tools Used

Writing and running the SQL Scripts

Creating and designing the reports

Generating scripts and debugging the code

Creating and Designing Interactive dashboards

Designing the Entity-Relationship Diagram (ERD)

Organizing and assigning tasks among the team