Requirements specification for Asses student performance process

1. General description of business process

Assess student performance process

    a. General Description of the Business Process and Performance Metrics

This process makes sure that students' academic progress is consistently tracked and analyzed. It consists of such steps: the process begins with students completing homework, tests, or projects as part of their classes. Teachers then review and assess the submitted work. After grading student's work, the teachers enter the grade into the school's grading system, where students can see their grades and receive feedback. Students can be assessed multiple times throughout the academic year. Performance metrics may include grades and participation in additional activities.

The increase of the average grade of a student at a level not less than 3% annually compared to the previous year.

The increase of the amount of students participating in extracurricular activities not less than 0.5% annually compared to the previous year

    b. Typical Questions

What is the average grade per subject this semester?

How many students have at least a single grade of 5 or above in Mathematics?

What is the trend of the average grade over the last three years?

How does the average grade vary by teacher?

What is the percentage of students that have a weighted average of grades below or equal to 2.0 in mathematics?

How do extracurricular activities impact the average grade?

Which subjects have the highest and lowest percentage of students having weighted average grade being below 2.0?

How does attendance affect the average weighted grade of a student?

Which students have weighted average grade being below 2.0 from any subject?

Which teacher conducts classes that overall have the highest average grade on average in the last 5 years?

Which students have shown a decrease in the average weighted grade in the past 2 months?

Which students have the highest overall average weighted grade?

   c. Data

Information about student performance is stored in the Student Grading System (Relational Database). This includes student identifiers, subjects and assessment grades.

Extracurricular activity records are maintained in Excel file. This contains details on students' participation in for example: school clubs, sports, and arts programs.

2. Data sources structures
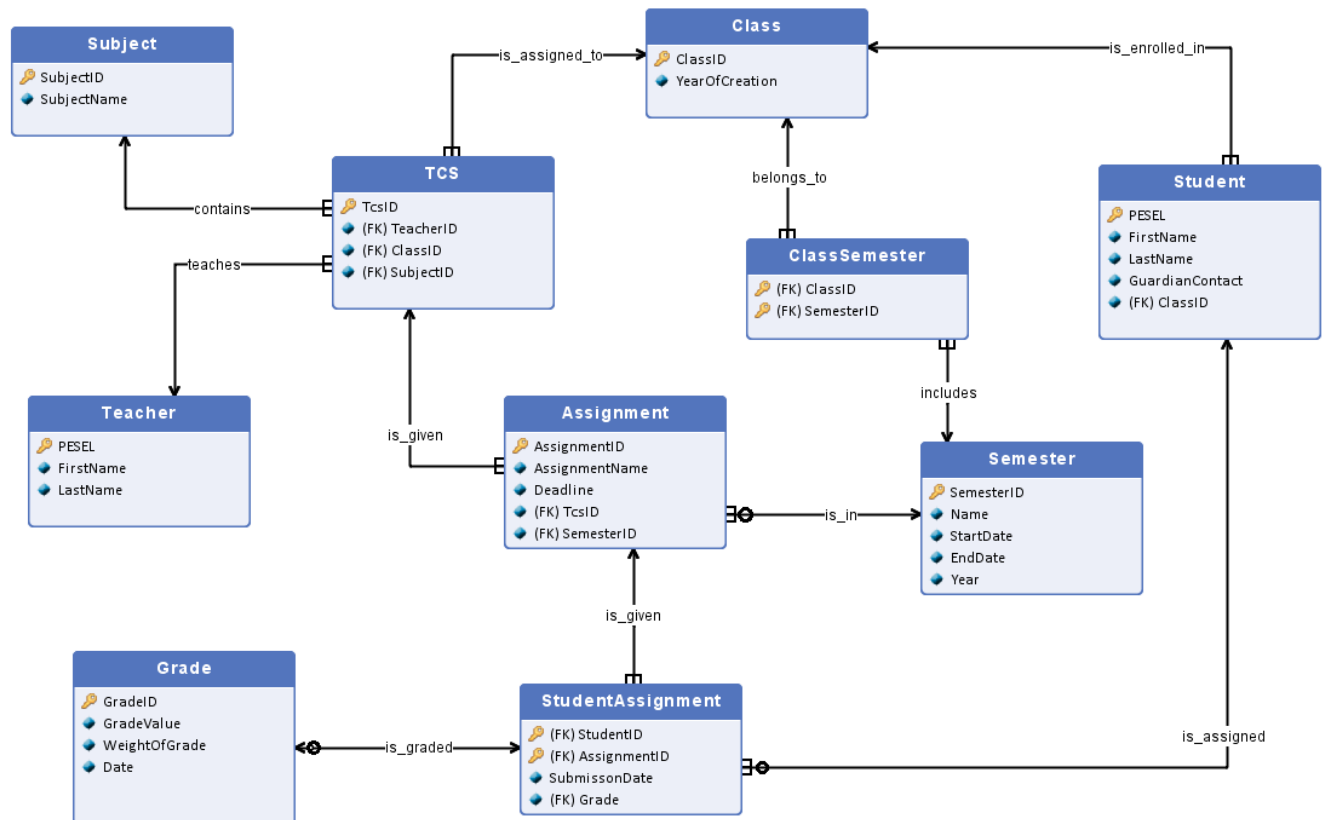
Student Grading System database

Table name	Attribute	Attribute Type	Description
Student	Student that is enrolled in the school – identified by PESEL		
	PESEL	String – 11 characters	Natural Primary Key
	FirstName	String – 30 characters	Student's first name
	LastName	String – 30 characters	Student's last name
	Guardian contact	String – 40 characters	Parent/guardian contact info (mail or phone no)
	(FK) ClassID	String – 2 characters	FK pointing at class. Implementation of one-to-many

			relationship between class and student (is part of)
Teacher	Teacher that teaches in the school identified by his PESEL		
	PESEL	String – 11 characters	Natural Primary Key
	FirstName	String – 30 characters	Teacher's first name
	LastName	String – 30 characters	Teacher's last name
TCS	Table representing many to many relationship among Teacher, Class and Subject		
	TcsID	Numeric	PK, auto incremented
	(FK) TeacherID	String – 11 characters	FK pointing at PESEL in Teacher table
	(FK) ClassID	String – 2 characters	FK pointing at ClassID in Class table
	(FK) SubjectID	Numeric	FK pointing at SubjectID in Subject table
Class	Table representing every class in school (1B, 3C, 7F)		
	ClassID	String – 2 characters	PK representing the class name (e.g. 2C, 4A)
	YearOfCreation	Integer	Represents the year in which the class was created
Assignment	Quiz, Homework, Exam anything that can be graded (but not always needs to be graded)		
	AssignmentID	Numeric	PK, auto incrementing starting from 1
	AssignmentName	String – 50 characters	Name of the assignment (e.g. Quiz – Chapter 3)
	Deadline	Datetime	Represents the deadline until which the assignment must be completed
	(FK) TcsID	Numeric	Foreign key referring to TCS table, indicating which

			teacher/class/subject the assignment is for
	(FK) SemesterID	Numeric	Foreign key referring to Semester table, indicating which semester was the assignment given in
Grade	Table representing every grade in the school		
	GradeID	Numeric	PK, Unique numeric identifier for a grade
	GradeValue	Decimal	Value of the grade received (on a scale from 1 to 6 with increments by 0,25)
	WeightOfGrade	Integer	Weight of a grade (scale from 0 to 6 with increments by 1)
	Date	Datetime	Date when the grade was entered to the system
Subject	List of subjects conducted in the school		
	SubjectID	Numeric	PK, auto generated starting from 1 with increment 1
	SubjectName	String – 50 characters	The name of a subject (e.g. Maths, Science, etc.)
StudentAssignment	Table representing many-to-many relationship between Assignment and Student		
	(FK) StudentID	String – 11 characters	Foreigh key referring to PESEL in Student table, part of composite PK
	(FK) AssignmentID	Numeric	Foreign key referring to AssignmentID in Assignment table, part of composite PK
	SubmissionDate	Datetime	Date when the assignment was submited
	(FK) GradeID	Numeric	Foreign key referring to the GradeID in Grade table

Semester	Describes information about the semester of an assignment/class		
	SemesterID	Numeric	PK, Unique numeric identifier for a semester, auto-incremented
	Name	String – 20 characters	Name of the semester (e.g., "Fall 2024", "Spring 2025")
	StartDate	Datetime	The date when the semester begins
	EndDate	Datetime	The date when the semester ends
	Year	Integer	Academic year of the semester (e.g., 2024)
ClassSemester	Table representing many-to-many relationship between class and semester		
	(FK) ClassID	Numeric	FK reffering to ClassID in Class table
	(FK) SemesterID	Numeric	FK referring to SemesterID in Semester table

Extracurricular activities Excel file

Sheet 1 (Information about the students taking part in additional activities outside of school)

Column A – PESEL (numeric)

Column B – Student First Name (text)

Column C – Student Last Name (text)

Column D – Student Date of Birth (text)

Column E – Class of the student (text)

Column F – Guardian contact info (text)

Sheet 2 (Detailed information about the extracurricular activities)

Column A – Student's PESEL (has to match the PESEL in Sheet 1)

Column B – Activity Type (text) - category of activity e.g. sports, arts, volunteering

Column C – Activity Name (text) - name of the activity

Column D – Frequency (text) - filled only for activities that are repeatable (e.g. meetings of some clubs), describes how often an activity takes place/has a meeting in a week

Column E – Start Date – date when the student started attending/taking part in the activity (Date in format year - month - day, e.g. 2019-11-14)

Column F – End Date – date when the student stopped attending/taking part in the activity (Date in format year - month - day, e.g. 2019-11-17)

Column G – Achievements/Remarks (text)

Column H – Location (text) - the location where the activity is/was taking place

3. Scenarios of analytical problems

Why was there an increase / decrease in average grades obtained by students this month?

1. Did holidays or other calendar events this month had an effect on on the weighted average of grades of students?
2. What are the subjects for which the average weighted grade improved the most in the last three months?
3. What is the percentage change in the average weighted grades of all students from biology in comparison to previous month?
4. Did the variance in student grades increase or decrease this month compared to the previous month?
5. Did students who joined and participated in extracurricular activities in the past month experience a positive change in the overall weighted average grade from all subjects?
6. Did the students with the highest number of assignments given in the past month experience a negative change in the average grade from all subjects past month?
7. Do students with higher average weighted grades also report higher levels of satisfaction

How do additional activities affect students' performance?

1. Is there a significant difference (significant difference is around half a grade) between the average weighted grades of students who participate in extracurricular activities compared to those who do not?
2. Has there been a student that participated in additional activities, which had weighted average grade being below 2.0 from any subject he participated in?
3. Which extracurricular activities are associated with the highest average weighted grades rankings among students?
4. How has the average weighted grade of students involved in extracurricular activities changed over the past five years?
5. Is there a statistically significant correlation between the number of extracurricular activities a student participates in and their average weighted grades?

4. Data needed for analytical problems

Analytical problem: Why was there an increase / decrease in average grades obtained by students this month?

1. Did holidays or other calendar events this month had an effect on the weighted average of grades of students?
   - **Grades of a student:** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade
   - **Data about holidays or special events:** Calendar with all such days marked. (It is an additional data source)

2. What are the subjects for which the average weighted grade improved the most in the last three months?
   - **Grades from a specific subject -** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade
   - **Dates of when the grades were published –** Student Grading System Database, table Grades, extracted from attribute date

3. What is the percentage change in the average weighted grades of all students from biology in comparison to previous month?
   - **Grades from biology subject -** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade

- **Dates of when the grades were published –** Student Grading System Database, table Grades, extracted from attribute date
- **Information about the subject –** Student Grading System Database, table Subject, column SubjectName

4. Did the variance in student grades increase or decrease this month compared to the previous month?
    - **Grades of students** – Retrieved from the Student Grading System Database, table Grades, column GradeValue.
    - **Dates of when the grades were published –** Student Grading System Database, table Grades, extracted from attribute date

5. Did students who joined and participated in extracurricular activities in the past month experience a positive change in the overall weighted average grade from all subjects?
    - **Grades of a student:** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade
    - **Student's PESEL, start and end date of an extracurricular activity:** Extracurricular activities excel file, Sheet 2, Columns A, E and F

6. Did the students with the highest number of assignments given in the past month experience a negative change in the average grade from all subjects past month?
    - **Grades of a student:** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade
    - **Assignments with a deadline in the past month:** Student Grading System Database, table Assignment, column Deadline

7. Do students with higher average weighted grades also report higher levels of satisfaction?
    - **Grades of a student:** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade
    - Since we cannot measure the satisfaction of students, we suggest introducing the survey system for students where they will be asked to answer some quick questions about their satisfaction level. Such survey should contain as minimum the following set of questions:
        - On a scale 1-5, how satisfied are you with the teaching quality in our school?

- On a scale 1-5, how difficult do you find your assignments? (1 – very easy, 5 – very difficult)
- Do you feel encouraged by your teachers to participate in classes? (Yes/No) If not, please provide teacher's name
- How often do you feel overwhelmed by your assignments? (Never / Sometimes / Often)

The survey would be conducted online via (e.g. via google forms). Its results could be automatically saved into the excel file. Structure of the file could be as follows:

- Column A – student's PESEL
- Column B – satisfaction of teaching quality on a scale 1-5
- Column C – student's opinion about difficulty of assignments
- Column D – YES/NO answer to the question: Do you feel encouraged by your teachers to participate in classes? If NO, then the column includes teacher's name as well
- Column E – Never/Sometimes/Often answer to the question: How often do you feel overwhelmed by your assignments?

Analytical problem: How do additional activities affect students' performance?

1. Is there a significant difference (significant difference is around half a grade) between the average weighted grades of students who participate in extracurricular activities compared to those who do not?
   - **Grade of a student** – Student Grading System Database, table Grades, column GradeValue and WeightOfGrade
   - **Does student take part in extracurricular activities –** extracurricular activities excel file; we check if the student's PESEL is present in Sheet 2 of the file

2. Has there been a student that participated in additional activities, which had weighted average grade being below 2.0 from any subject he participated in?
   - **Does student take part in extracurricular activities –** extracurricular activities excel file; we check if the student's PESEL is present in Sheet 2 of the file
   - **Grade of student -** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade

3. Which extracurricular activities are associated with the highest average weighted grades rankings among students?
   - **Grade of a student -** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade
   - **Name of extracurricular activities a student participates in** - Extracurricular activities Excel file, Sheet 2, Column C
   - **Does student take part in extracurricular activities –** extracurricular activities excel file; we check if the student's PESEL is present in Sheet 2 of the file

4. How has the average weighted grade of students involved in extracurricular activities changed over the past five years?
   - **Grade of a student -** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade
   - **Date of semester -** Student Grading System Database, table Semester, Columns startDate, endDate
   - **Does student take part in extracurricular activities –** extracurricular activities excel file; we check if the student's PESEL is present in Sheet 2 of the file

5. Is there a statistically significant correlation between the number of extracurricular activities a student participates in and their average weighted grades?
   - **Number of extracurricular activities a student participates in** - Extracurricular activities Excel file, Sheet 2, we count the number of occurrences of his PESEL in extracurricular activities
   - **Grade of a student -** Student Grading System Database, table Grades, columns GradeValue and WeightOfGrade