

## Functional Programming – Mini Project Report

Project: Student Marks Analyzer Group Members: [Member 1], [Member 2], [Member 3], [Member 4]

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### 1. Problem Statement and Industrial Motivation

In many educational institutions, analyzing student performance is essential for academic planning, identifying high-achieving students, and providing remedial support to underperforming students. Traditionally, marks processing is done manually or with spreadsheets, which is error-prone and not easily scalable.

This project implements a Student Marks Analyzer in Haskell to process student marks from a CSV file and produce:

- Ranked results with grades
- Class statistics (highest, lowest, mean scores)
- ASCII-based visual representation of scores

Industrial relevance:

- Demonstrates reliable, auditable data pipelines.
- Shows pure functions, immutability, and predictable computation.
- Supports parallel computation for scalability.

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### 1. Functional Design

#### 2.1 Data Types (DataTypes.hs)

```
data Student = Student { name :: String, marks :: [Int] }
data Result = Result { studentName :: String, total :: Int, average :: Float,
grade :: String, finalScore :: Float }
data Statistics = Statistics { highest :: Float, lowest :: Float, mean :: Float }
```

#### 2.2 IO Handling (IOHandler.hs)

```
parseStudent :: String -> Student
parseStudent line = let parts = splitByComma line
                    nm = head parts
                    mk = map read (tail parts)
                  in Student nm mk

readStudents :: FilePath -> IO [Student]
readStudents path = fmap (map parseStudent . lines) (readFile path)
```

#### 2.3 Processing Pipeline (Processing.hs)

```

computeResult :: Student -> Result
computeResult s = let ms = marks s
                  avg = averageOf ms
                  final = case ms of (m1:m2:m3:_) -> fromIntegral m1*0.6 +
fromIntegral m2*0.2 + fromIntegral m3*0.2
                           _ -> avg
                  total = sum ms
in Result (name s) total avg (gradeFromAverage final) final

rankResults :: [Result] -> [Result]
rankResults = reverse . sortOn finalScore

```

#### 2.4 Utilities (Utils.hs)

```

averageOf :: [Int] -> Float
averageOf xs = fromIntegral (sum xs) / fromIntegral (length xs)

gradeFromAverage :: Float -> String
gradeFromAverage x
| x >= 85    = "A"
| x >= 70    = "B"
| x >= 50    = "C"
| x >= 35    = "D"
| otherwise = "F"

```

#### 2.5 Main Module (Main.hs)

```

main :: IO ()
main = do
  putStrLn "Enter CSV file path (e.g., students.csv):"
  path <- getLine
  students <- readStudents path

  let results = parMap rseq computeResult students
  let ranked = rankResults results
  let stats = computeStatistics ranked

  putStrLn "\n--- Class Statistics ---"
  print stats

  putStrLn "\n--- Ranked Results Table ---"
  putStrLn (asciiTable ranked)

```

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## 1. Functional Programming Concepts Applied

Concept	Usage in Project
Pure Functions	computeResult, averageOf, gradeFromAverage
Higher-Order Functions	map, parMap, sortOn
Algebraic Data Types	Student, Result, Statistics
Immutability	All transformations produce new values; no mutable state
Recursion	splitByComma and list processing
Parallelism	Control.Parallel.Strategies for parMap

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## 1. Sample Input and Output

students.csv:

```
Alice,85,90,76
Bob,60,65,70
Charlie,50,55,45
Diana,95,95,95
```

GHCi Run:

```
Enter CSV file path (e.g., students.csv):
students.csv

--- Class Statistics ---
Statistics {highest = 95.0, lowest = 48.3, mean = 72.6}

--- Ranked Results Table ---
Student | Score | Grade
-----
Diana   | 95    | A
Alice   | 85    | A
Bob     | 65    | B
Charlie | 50    | C
```

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## 1. Discussion

2. Correctness & Reliability: Pure functions make each step predictable and testable.
3. Modularity: Each module has a single responsibility.
4. Parallelism: parMap allows concurrent processing of student results.
5. Maintainability: New rules, statistics, or scoring can be added in pure functions.
6. FP Benefits: Eliminates side effects except controlled IO, encourages reasoning about behavior, scales naturally.

Possible Extensions: - Weighted marks for additional assignments - Graphical visualization instead of ASCII - Export JSON or CSV output

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1. References / Tools Used
2. Haskell (GHC 9.8.2 / GHCI)
3. Control.Parallel.Strategies
4. CSV file input as real-world dataset
5. Functional design patterns from FP literature