

A Mathematical Modelling Approach to Design and Develop a Framework for Analysis of Students' Academic Performance System

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Abstract:

Due to Covid Pandemic, all are heading towards digitization of the process of manual work being conducted in organization. In this paper the current working of the student grading system is reviewed. The mechanical way to device the results is monitored and efforts required are assessed. In rural India, still at many colleges, the student's academic performance is assessed and derived on the basis of preparing results manually by the teachers which require large amount of time. There are certain limitations observed with current system. A Mathematical model based Framework is proposed for analysis of academic performance of the student, class and institution

Keywords: *Academic, Performance, Mathematical Model*

Introduction

Across Globe and also in India the impact of Covid 19 Pandemic has been significantly seen in huge use of digital medium for completing teaching learning activities. So also as per in Indian better schooling contraption, it's considerably visible that there's terrific growth in students enrolling in academic establishments. As in line with University Grants Commission (2008) [15] document titled "Higher Education in India- Issues associated with expansion, inclusiveness, high-satisfactory and finance", the variety of universities in India has expanded from 20 in 1950 to approximately 431 in 2008, faculties from 500 in 1950 to 20,677 in 2008 and enrolment of college students has expanded from mere 100,000 in 1950 to 11,612,000 in 2008. The Gross Enrolment Ratio (GER) i.e. that is a ratio of humans enrolled in better schooling establishments to overall populace of the humans in age organization of 18 to 23, rose from 0.7% in 1950 to approximately 11% in 2007. Still the truth stays that the GER in India is pretty low as compared to that of the evolved nations and international common having GERs 54.6 % and 23.2% respectively. Indian authorities targets to carry GER to 15 % via way of means of 2012-13. India's better schooling gadget is the 1/3 biggest within side the international subsequent to China and United States.

Many academic agencies have their very own gadget to manipulate college students profile and tests. Generally the pupil statistics is recorded in a document ee-e book that is received from the registration shape finished whilst they're registered for the primary time. The guide gadget can also additionally require longer time to look the pupil profile. There are possibilities of misplacement of document ee-e book. There is likewise scope of unauthorized get entry to of pupil document main to leakage of touchy statistics. In every academic agency, numerous tests are organized to assess pupil overall performance. In his 2004 Independence Day speech [13], Dr. A.P.J. Abdul Kalam, the then

President of India, stated that “there's a call for a more obvious and dependable gadget of exam, assessment and reporting”.

The fashionable strategies of tests in every agency are assignments, month-to-month check, and stop of time period checks. At the stop of every assignment, check and exam, the issue trainer facts pupil's marks and grades within the document book or in primary laptop software program which include Microsoft Excel for instructors with information and get entry to laptop. After that, the magnificence trainer wishes to decide pupil's function (ranking) in magnificence primarily based totally on their performances. However, it takes time to do those obligations due to the fact they want to formulate their very own calculation for sophistication function (ranking). The control of exam records of the huge variety of college students is a completely tiresome and a complicated task concerning extraordinary forms of records via way of means of extraordinary administrative line branches. The guide exam gadget results in errors, extra time consumption, inefficient and wastage of precious resources. Moreover ever growing paper primarily based totally document registers are hard to save securely because of area scarcity [5].

These obligations might be lots less difficult if all calculations for sophistication function (ranking) may be routinely finished whilst the trainer input assignments, check and checks marks. Generally end result is the universally regularly occurring standards for the dimension of the pupil's functionality in phrases of instructional overall performance within side the academic agency. It is used to degree a pupil's functionality in every issue supplied via way of means of the pupil. As the pupil end result poses significance to the pupil and his/her parents, there's want to keep away from not unusual place errors made for the duration of the end result processing, this could effortlessly be finished via way of means of an automatic end result processing gadget.

ICT, as a collection of latest computing and communicate artifacts, is a swiftly advancing generation. ICT [16, 17] has furnished method for quicker and higher communicate, green storage, retrieval and processing of records and alternate and usage of statistics to its users, be they individuals, groups, businesses, agencies or governments. ICT has the capacity to offer higher offerings to the citizens, interplay with enterprise companies and communicate and alternate of statistics among extraordinary groups of the authorities in a speedy, convenient, green and obvious manner. If top-rated capacity of ICT is utilized, it is able to virtually growth performance and effectiveness of the gadget. According to Sofield [14], academic establishments are spotting the significance of ICT in schooling and exam reforms. ICT has grown to be quintessential and a powerful device of increase in any society. The nature of generation is that the whole thing turns into nearly obvious as soon as its miles ingrained in ordinary life.

Review of Literature

To proffer method to the setback related to guide system of end result processing, an utility known as Student Academic Record Management System the usage of Microsoft Access to address the challenge of creating, storing, getting access to and retaining documents and database data is developed. According to [3], the selection of Microsoft Access became as it is easy and clean to code and to be had with bureaucracy and reviews. It is likewise handy in phrases of distribution with variations of Microsoft Office. MS Access model 2003 is selected for the implementation [4].

Some preceding works which have been completed on this area to cope with the trouble of manual end result processing [7-10]. In his work, [7] employs Microsoft Excel spread sheet application to

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construct an Intelligent Knowledge-Based System (IKBS), utilizing numerous programming centers furnished with the aid of using that utility (Excel). The vital difficulty right here is that the programming is tough coded into the cells, and cell referencing is used to reveal and track college students' performance. The system has been stated to be operating fine. However, it seems to be as an alternative restrictive, and requires significant understanding in programming. Similarly, withinside the work with the aid of using [10] Adobe Dreamweaver an Integrated Development Environment is used to create the Graphic User Interface and to jot down the codes. MYSQL Server, a Relational Database Management System, is used to create the database tables and records. Personal Home Page Pre-Processor (PHP) is used to speak with and control the database. This software, alaven though examined and observed to be running as expected, has but now no longer been positioned to apply widely.

Also when it was monitored to some of the colleges in rural area it was found that many of the instructors were very much stressed in preparing results in manual way. Imagine a trainer compiling simply 30 college students enough statistics that might assist in making beneficial outcomes and the strain the trainer ought to undergo. The trainer receives busy calculating (addition and division) every pupil's check and examination ratings. For each pupil, the trainer will upload what the pupil scored in first exam, second exam and examination to get the full for that issue, expect the issue is Mathematics; the trainer will repeat it for the remaining of subjects supplied to get of the overall assessments for every subject. To get the common assessment for this pupil, the trainer will ought to upload all of the overall ratings for every issue supplied after which divide via way of means of overall variety of topics supplied via way of means of the pupil [12]. The equal system is repeated for the closing 29 college students. After that, the trainer now orders the common ratings to rank the scholars 1st, 2nd, 3rd ... function with inside the magnificence, it does now no longer stop there. The trainer may also input the document into every pupil "Report Card" then create a large sheet referred to as Master Sheet for all of the college students' facts for further references. This is tense and time overriding, in order to manage this calculation and to make teachers less taxing, make their job enjoyable and to make them direct their attention on teaching is very easy with computerized system. There is duplication of work in the existing system because the same data is recorded in different branches of the examination. This leads to data replications as well as huge currency is spent by the university to purchase papers. In existing system, managing of students' record is very tedious. Retrieval of students' records through manual registers, maintaining of records and data reconciliation etc. are very time consuming.

On the alternative hand, Imagine one individual processing 3000-7000 college students end result from numerous classes with little toil of simply coming into college students' rankings as quickly as they're conducted, and results generated mechanically for printing irrespective of the scale of the students in a section/college. In every term, the system creates test and examination rankings sheet with college students names organized consequently with columns/rows created for every concern rankings coming into. This is given to the class instructor to fill in rankings after the test or examination is conducted. It can be taken again to the system for access and after that with only a click; the end result is prepared for printing.

Some of the constraints of the prevailing system [1]:

Repetition of Work: There is repetition of labor withinside the current system due to the fact the identical records is recorded in one of a kind branches of the exam. This results in records duplications in addition to large cash is spent with the aid of using the employer to buy papers. In current system, coping with of college students' file could be very tedious. Retrieval of college students' data thru guide registers, retaining of data and records reconciliation etc. are very time consuming.

Tempering of scholar Records: In guide exam system, there are probabilities of tempering with college students data. Sometimes faux results are organized and there may be no on line verification of the results. This results in unfair practices and it mars the credibility of an organization.

Some reviewed findings related to the prevailing system:

(a) **Inaccuracy:** The results produced with the aid of using the guide system might not be correct because of calculations which contain regular calculator and human reasoning.

(b) **Lack of safety of results:** The results processed are saved in documents. These documents are now and again attacked with the aid of using bugs together with termites or different pest

(c) **Late processing of results:** The brief time frame to be had for the processing of results, makes the lecturers contain in a length of very aleven though paintings, because of this maximum of the instances the results are produced overdue

(d) **Production of useless results:** As a end result of miscalculations withinside the guide results processing system the results produced are useless.

Sometimes the put off in assertion of results reason heavy losses to the scholars as commonly they can't be a part of in addition research or seem in aggressive checks due to the non-availability of exam bring about time [6]. Some extra troubles related to scholar instructional file control can also additionally consist of wrong path registration, overdue launch of college students' results, inaccuracy because of guide and tedious calculation and retrieval difficulties/inefficiency [3]. In maximum instances the records generated with the aid of using instructional establishments are normally created in non- delineated documents to be used with the aid of using one of a kind departments/devices withinside the establishments with the identical records acting on numerous of those documents. This method that an easy alternate of cope with might need to be processed in and probable 3 or 4 places, relying at the range of different documents on which those records appears. The improvement of database idea is the solution to those troubles wherein the quantity of redundant records is decreased and the opportunity that records contained on a document is probably erroneous due to the fact they had been by no means updated.

Review of Research and Development:

The Need for Automated Result Processing System

With automatic end result processing in an organization of learning, there can be masses of blessings to derive with the intention to afford the important conveniences for the scholars, Lecturers and managements withinside the academic establishments. The gain of computerize check taking, marking and end result ebook can't be overemphasis, [2] pick out the subsequent as gain of computerize check taking, Marking and resultsebook:

(i) **Automation Minimize Human Intervention:** There can be lesser human intervention (as tons as possible) in end result processing with the aid of using automating all of the involved activities.

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(ii) **Automation Facilitate Management:** The Computerized Statistical Analysis of Data will facilitate the control to look developments in end result at numerous levels. Management Information System (MIS) reviews will facilitate the Top Level Management to make strategic selection in want of the establishments and college students.

(iii) **Automation Minimizes Redundancy:** The use of Relational Database Management System for garage of college students' records will assist in minimizing the redundancy in database similarly to preserve consistency, integrity and safety of records.

In an academic community, statistics is fantastically important for proper college students' file and exam records. Student statistics, if now no longer well created and saved, will reason many mistakes in usage. Nearly, each segment of the instructional system calls for statistics processing [9].

Mathematical representation of the proposed system

System S=Students Academic Performance Analysis System

System S={C, T, Q, A, output} [C=Courses, T=Tests, P=Practicals, A=Assignments]

Courses $C = \{S', L, O, TCS, TCE, AC\}$

[L=Language, O=Optional, TCS=CompulsoryS, TCE=CompulsoryE, AC=CompulsoryAll]

$S' \in C$

Where, $S' = \{v, t, a\}$ [v=video, t=text, a=audio]

If System S consist of Course C

Output = $\{(S' \wedge L) \text{ AND } (S' \wedge O) \text{ AND } (S' \wedge AC) \text{ AND } ((S' \wedge TCS) \text{ OR } (S' \wedge TCE))\}$

$L \in C$ [L=languages]

Where $L = \{\text{'English'}\}$

If Course C consist of Language L

Output = $\{(S' \wedge \text{English})\}$

O=Optional $O \in C$

Where $O = \{\text{'Second', 'Fourth', 'Fifth', 'Sixth'}\}$.

Second = $\{\text{'Hindi', 'Marathi', 'French', 'Sanskrit', 'Information Technology', 'German'}\}$.

Fourth = $\{\text{'Organization Commerce', 'Mathematics'}\}$.

Fifth = $\{\text{'Electronics', 'Computer science'}\}$.

Sixth = $\{\text{'Mathematics', 'Sociology', 'Psychology', 'Economics'}\}$

If Course C consist of Optional O

Output = $\{(S' \wedge \text{Second} \wedge \text{Sixth}) \text{ OR } (S' \wedge \text{Second} \wedge \text{Fourth}) \text{ OR } (S' \wedge \text{Fifth})\}$

TCS=CompulsoryS $TCS \in C$

Where $TCS = \{\text{'Physics', 'Chemistry', 'Biology'}\}$

If Course C consist of CompulsoryS TCS

Output = $\{(S' \wedge \text{Physics} \wedge \text{Chemistry} \wedge \text{Biology}) \text{ OR } (S' \wedge \text{Physics} \wedge \text{Chemistry} \wedge \text{Mathematics})\}$

TCE=CompulsoryE $TCE \in C$

Where $TCE = \{\text{'Economics', 'Secretarial Practice', 'BookKeeping and Accounts'}\}$

If Course C consist of CompulsoryE TCE

Output = $\{(S' \wedge \text{Economics} \wedge \text{Secretarial Practice} \wedge \text{BookKeeping and Accounts})\}$

AC=CompulsoryAll $AC \in C$

Where $AC = \{\text{'Environmental Science', 'Physical Education'}\}$

If Course C consist of CompulsoryAll AC

Output = $\{(S' \wedge \text{Environmental Science} \wedge \text{Physical Education})\}$

$T \in C$ [T=test]

Where $T = \{t_1, t_2, \dots, t_n\}$.

$t_1 = \{t_{11}, t_{12}, \dots, t_{1n}\}$.

$t_2 = \{t_{21}, t_{22}, \dots, t_{2n}\}$.

$t_n = \{t_{n1}, t_{n2}, \dots, t_{nn}\}$.

If System S consist Test T

Output = $\{T\}$

If test = submit

Let, $F(M) = \sum_{i=1}^n t_i$ [M=marks]

If $F(M) \leq 35$ and ≥ 25 then

Calculate grace

R=pass with grace

Else

R=pass.

Else

R=Fail. [R=result]

Output = $\{R, M\}$

P=Practicals

$P \in S$

$P = \{p_1, p_2, \dots, p_n\}$

$p_1 = \{p_{11}, p_{12}, \dots, p_{1n}\}$

$p_2 = \{p_{21}, p_{22}, \dots, p_{2n}\}$

$p_n = \{p_{n1}, p_{n2}, \dots, p_{nn}\}$

If System S consist of Practicals P

Output = $\{P\}$

If P=submit

R=result

Output $\{R\}$

A=Assignments

$A \in S$

$A = \{a_1, a_2, \dots, a_n\}$

$a_1 = \{a_{11}, a_{12}, \dots, a_{1n}\}$

$a_2 = \{a_{21}, a_{22}, \dots, a_{2n}\}$

$a_n = \{a_{n1}, a_{n2}, \dots, a_{nn}\}$

If System S consist of Assignments A

Output = $\{A\}$

If A=submit

R=result

Output $\{R\}$

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Conclusion:

In this paper the various ways of the student grading system are reviewed and summarized the current working method of student progress in rural Indian Colleges. The mechanical way to device the results is monitored and efforts required are assessed. After viewing the limitations that were observed with current system, a Mathematical model based Framework is proposed for analysis of academic performance of the student, class and institution. It will help the teachers or trainers to generate the assessment of student's performance in very less amount of time.

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