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Analysis of Database of University Examination System: A Case Study

Balvir Singh[1*], A.J. Singh[2], Rajesh Chauhan[3]

[1]Research Scholar, Department of Computer Science H.P.U. Shimla
[2] Professor, Department of Computer Science H.P.U. Shimla
[3]System Administrator, Dept. UIIT, H.P.U. Shimla

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Abstract— The database of information system of any organization store crucial information. Organizations are considering this stored information as asset, because the information provided by the organization's information system play an important role in its functioning and also in the decision making processes. Depending on the availability of quality of information, administrative authorities of organization can take right decision for its stakeholders and for its better functioning. Keeping this in mind, present paper analysed the database of the University Examination System of Himachal Pradesh University. Data stored in the database of examination system is analysed and number of discrepancies are revealed in the data. There is lot of redundant and inconsistent data stored in the examination database. Upon analysing the data, it was found that there are number of fields in the database that store the redundant data, significant number fields are found empty besides, few constraints has been enforced on the majority of data. Poor database design is one of many factor that contributes to such problems. This paper also analyses the structure of relational table that lead to database of University Examination system and in the last highlight the findings of analysis.

Keywords— *Database, Data Quality, Information System, University Examination System,*

I. INTRODUCTION

Analysis of data is a process of inspecting, cleaning, transforming, and modeling data with the goal of discovering useful information, suggesting conclusions, and supporting decision-making. Data analysis is closely linked to data visualization and data dissemination. The term *data analysis* is sometimes used as a synonym for data modeling[1]. Data analysis is a process for obtaining raw data and converting it into information useful for decision-making by users[2]. This paper chose the database of University Examination System of Himachal Pradesh University as a case study for analysis. The automation of Himachal Pradesh University's Examination System started in late nineties to computerised the examination branch. The process started with enrolment/admission of student, examination and ends with preparing the result of candidate and by giving him/her a computerised result card. Such data of candidate has long term implication and hence needs archival. The result of undergraduate classes i.e. Bachelor of Arts, Bachelor of Science and Bachelor of Commerce and the result of some postgraduate classes i.e. Master of Arts, Master of Commerce have been processed automatically since academic session 2005-06. Examination process in Himachal Pradesh University is divided into two main process: Pre-Examination and Post-Examination Process. The Pre-Examination phase has following task: (1) Generating the profile of the Candidates. (2) Generating data for the conduct of examination at different centres. The Post-Examination phase deals with (1) Evaluation Process (Evaluation of answer sheet) (2) Compilation/Tabulation of the result (3) Declaration of result. The University Examination System as one of the most critical system in the University has changed its way of capturing, processing, storing and distributing information. Now a day more digital and online information is utilized in the University Examination System.

This paper analysed the data stored in the database of University Examination System of Himachal Pradesh University. First section of this paper, check this stored data for ambiguity, redundancy, inconsistency, and also to check whether the stored data, when entered the database followed the proper validation rule or not. In the second section that this paper analysed the structure of relational tables of examination database. The design parameters used in this structural analyses are defined in table1. The structural analysis of database of University Examination system against these parameters reveals many interesting things for database design and parameter-wise bar graphs are presented in this paper.

Corresponding *Author: Balvir Singh, thakur_balvir@yahoo.com*
Department of computer science, H.P. University Shimla, India.

II. RESEARCH METHODOLOGY

In the context of the Information Systems (IS), the "*Case Study research"* is significant and used in this reasearch paper. A case study is an empirical inquiry that "Investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident[3]. The case study research method is particularly well-suited to IS (Information System) research, since our objective is to study the information systems in organizations. Case study research can be positivist, interpretive, or critical,

depending upon the underlying philosophical assumptions of the researcher. Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. This paper analysed the database of University Examination System on the basis of common parameters listed in Table 1.

III. DATA ANALYSIS OF UNIVERSITY EXAMINATION SYSTEM:

The database of University Examination System which store the pre-examination and post-examination data of students enrolled in various streams in Himachal Pradesh University. This data is used by university authorities to generate Identity card/Hall ticket, generate sitting plan, exam centre wise statement, number of question papers to be print, prepare signature list etc. The quality of data stored in the database has great impact on the above listed task. Poor data quality may have adverse effects on decision making[4] After acquiring the database of University Examination System, this paper first analysed the data stored in the database and then analysed the structural design of database for undergraduate classes. Here this section highlights the discrepancies(bugs) found during data analysis along with the snapshot of database that highlighted the field containing problematic data. These snapshot are taken from database of University Examination system which store the pre-examination and post-examination data of students.

Bug#1

F	ROLL_NO	COLLEGE_DEPTT_NAME	SUB_1_PAPE	SUB_1_TOTA	SUB_1_TH_G	SUB_1_TOTA	SUB_1_MIN	SUB_1_MAX	SUB_1_PAPE
	11156787	Govt.College Bilaspur		39	-	39	35	100	
	11156791	Govt.College Bilaspur		36	-	36	35	100	
	306747	Govt.College Bilaspur		35	0	35	35	100	
	205027	Govt.College Bilaspur		17	-	17	35	100	
	205049	Govt.College Bilaspur		17	-	17	35	100	
	205096	Govt.College Bilaspur		14	-	14	28	80	
	205177	Govt.College Bilaspur		27	-	27	35	100	
	205141	Govt.College Bilaspur		14	-	14	35	100	
	205148	Govt.College Bilaspur		17	-	17	35	100	
	205180	Govt.College Bilaspur		19	-	19	28	80	
	205206	Govt.College Bilaspur		29	-	29	35	100	
	205212	Govt.College Bilaspur		19	-	19	35	100	
	205213	Govt.College Bilaspur		35	-	35	35	100	
	205223	Govt.College Bilaspur			-	ABS	35	100	
	205290	Govt.College Bilaspur		22	-	22	28	80	
	205326	Govt.College Bilaspur		10	-	10	28	80	
	205339	Govt.College Bilaspur		26	-	26	35	100	
	205426	Govt.College Bilaspur		37	-	37	35	100	
	205428	Govt.College Bilaspur		18	-	18	35	100	
	205430	Govt.College Bilaspur		37	-	37	35	100	
	205450	Govt.College Bilaspur		38	0	38	28	80	
	205466	Govt.College Bilaspur		20	-	20	35	100	

Fig. 1. Show Redundant data

In the above figure attribute Subject_minimum_passing_Marks (circled in red) for each subject is repeating again and again e.g. suppose if someone enters passing marks as 28 for subject whose passing marks are 35 for single student, then that student will get pass even though he failed in the subject. This implies that the database do not have any validation rules applied on the data.

Bug #2

There are number of empty fields in the existing database of university examination system. What does these empty fields signify is not clear, e.g. if organization hire new DBA, how can he figure out what does this blank information means and because of these empty field, a lot of memory is wasted.

EXAM_CENT	MARKS	AWARD_TYPE	EXAM_SESSION_MOI	EXAM_SESSION_YEA	PKT_NO	SUBJECT_NA	Add New Field
BL05	09	FRESH	March	2012	College-IA	Music	
BL05	15	FRESH	March	2012	College-IA	Pol Science	
BL05	17	FRESH	March	2012	College-IA	English	
		FRESH	March	2012	3AP-335		
	54	FRESH	March	2012	P3A-1018		
	56	FRESH	March	2012	P3A-1018		
KG10	11	FRESH	March	2012	College-IA	History	
KG10	7	FRESH	March	2012	College-IA	Physical Educa	
KG10	10	FRESH	March	2012	College-IA	English	
	35	FRESH	March	2012	3AP-279		
	26	FRESH	March	2012	3AP-282		
KG10	7	FRESH	March	2012	College-IA	Physical Educa	
KG10	11	FRESH	March	2012	College-IA	Pol Science	
KG10	8	FRESH	March	2012	College-IA	English	
	35	FRESH	March	2012	3AP-279		
KG10	5	FRESH	March	2012	College-IA	Physical Educa	
KG10	10	FRESH	March	2012	College-IA	Pol Science	
KG10	7	FRESH	March	2012	College-IA	English	
	32	FRESH	March	2012	3AP-279		

Fig. 2. Show empty field

Bug#3

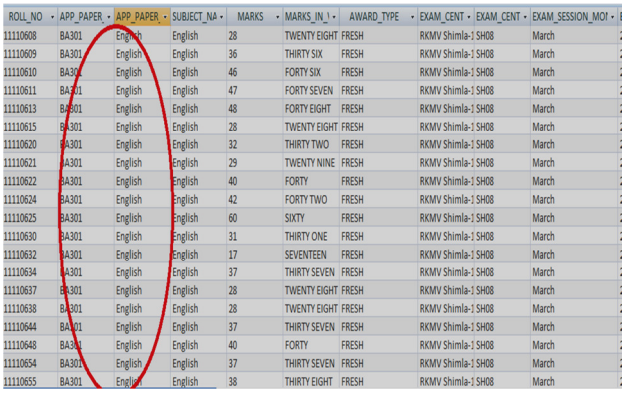
No checks has been applied to enter marks in words. Record 1 represents 24 as Twenty-four (notice '-') and Record 2 represents 28 as TWENTY EIGHT(circled in red). Suppose DBA wants to find all records with Twenty Eight, do the DBA search for Twenty-Eight or TwentyEight? It means no consistent format for representing data is used.

ROLL_NO	APP_PAPER	APP_PAPER	SUBJECT_NA	MARKS	MARKS_IN_T	AWARD_TYPE	EXAM_CENT	EXAM_CENT	EXAM_SESSION_MOI
403172	BA310			24	Twenty-four	FRESH	Govt.College N	SR01	March
651510	BA315	Pol Science	Pol Science	28	TWENTY EIGHT	FRESH	RKMV Shimla-1	SH08	March
70283	BA318	Sociology	Sociology	36	THIRTY SIX	FRESH	RKMV Shimla-1	SH08	March
101756	BA313	Mathematics-C	Mathematics	9	NINE	FRESH	RKMV Shimla-1	SH08	March
101780	BA313	Mathematics-C	Mathematics	10	TEN	FRESH	RKMV Shimla-1	SH08	March
11105705	BA318			59		FRESH	Govt.College B	BL01	March
11105713	BA318			57		FRESH	Govt.College B	BL01	March
11105718	BA318			40		FRESH	Govt.College B	BL01	March
11105726	BA318			42		FRESH	Govt.College B	BL01	March
11105731	BA318			51		FRESH	Govt.College B	BL01	March
11105734	BA318			35		FRESH	Govt.College B	BL01	March
11105739	BA318			28		FRESH	Govt.College B	BL01	March
11105743	BA318			56		FRESH	Govt.College B	BL01	March
11105753	BA318			59		FRESH	Govt.College B	BL01	March
11105776	BA318			58		FRESH	Govt.College B	BL01	March
11105780	BA318			38		FRESH	Govt.College B	BL01	March
11105781	BA318			47		FRESH	Govt.College B	BL01	March
11105783	BA318			49		FRESH	Govt.College B	BL01	March
11105791	BA318			51		FRESH	Govt.College B	BL01	March
11105809	BA318			48		FRESH	Govt.College B	BL01	March

Fig.3. Show Ambiguous data

Bug#4

There are number of records where same data is repeated again and again. e.g. data for paper code and appearing paper name appeared again & again for each student(circled in red). This duplication is of order O(N) where N is number of Students.

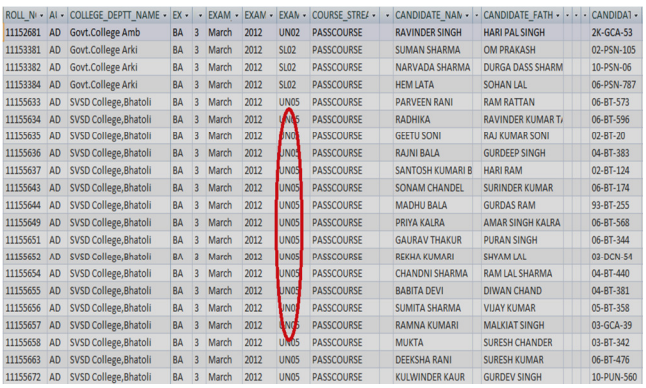


ROLL_NO	APP_PAPER	APP_PAPER	SUBJECT_NA	MARKS	MARKS_IN_I	AWARD_TYPE	EXAM_CENT	EXAM_CENT	EXAM_SESSION_MO
11110608	BA301	English	English	28	TWENTY EIGHT	FRESH	RKMV Shimla-1 SH08		March
11110609	BA301	English	English	36	THIRTY SIX	FRESH	RKMV Shimla-1 SH08		March
11110610	BA301	English	English	46	FORTY SIX	FRESH	RKMV Shimla-1 SH08		March
11110611	BA301	English	English	47	FORTY SEVEN	FRESH	RKMV Shimla-1 SH08		March
11110613	BA301	English	English	48	FORTY EIGHT	FRESH	RKMV Shimla-1 SH08		March
11110615	BA301	English	English	28	TWENTY EIGHT	FRESH	RKMV Shimla-1 SH08		March
11110620	BA301	English	English	32	THIRTY TWO	FRESH	RKMV Shimla-1 SH08		March
11110621	BA301	English	English	29	TWENTY NINE	FRESH	RKMV Shimla-1 SH08		March
11110622	BA301	English	English	40	FORTY	FRESH	RKMV Shimla-1 SH08		March
11110624	BA301	English	English	42	FORTY TWO	FRESH	RKMV Shimla-1 SH08		March
11110625	BA301	English	English	60	SIXTY	FRESH	RKMV Shimla-1 SH08		March
11110630	BA301	English	English	31	THIRTY ONE	FRESH	RKMV Shimla-1 SH08		March
11110632	BA301	English	English	17	SEVENTEEN	FRESH	RKMV Shimla-1 SH08		March
11110634	BA301	English	English	37	THIRTY SEVEN	FRESH	RKMV Shimla-1 SH08		March
11110637	BA301	English	English	28	TWENTY EIGHT	FRESH	RKMV Shimla-1 SH08		March
11110638	BA301	English	English	28	TWENTY EIGHT	FRESH	RKMV Shimla-1 SH08		March
11110644	BA301	English	English	37	THIRTY SEVEN	FRESH	RKMV Shimla-1 SH08		March
11110648	BA301	English	English	40	FORTY	FRESH	RKMV Shimla-1 SH08		March
11110654	BA301	English	English	37	THIRTY SEVEN	FRESH	RKMV Shimla-1 SH08		March
11110655	BA301	English	English	38	THIRTY EIGHT	FRESH	RKMV Shimla-1 SH08		March

Fig. 4. Show redundant data

Bug #5

There is duplication in Examination centre code(problem circled in red). Examination centre code is associated with each student where he has been appeared for exam. In the university, lakhs of students enrolled every year and appeared for exam in every session/semester, so there is lot of memory space wasted. Which again order of O(N)(where N is number of Students). There are number of problems associated with duplication of data. e.g. Insertion, Deletion and Update anomalies.

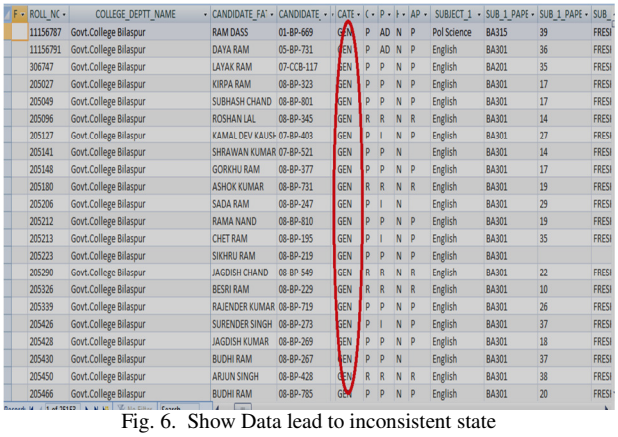


ROLL_N	AI	COLLEGE_DEPTT_NAME	EX		EXAM	EXAM	EXAM	COURSE_STRE	CANDIDATE_NAN	CANDIDATE_FATH				CANDIDAT
11152681	AD	Govt.College Amb	BA	3	March	2012	UN02	PASSCOURSE	RAVINDER SINGH	HARI PAL SINGH				2K-GCA-53
11153381	AD	Govt.College Arki	BA	3	March	2012	SL02	PASSCOURSE	SUMAN SHARMA	OM PRAKASH				02-PSN-105
11153382	AD	Govt.College Arki	BA	3	March	2012	SL02	PASSCOURSE	NARVADA SHARMA	DURGA DASS SHARM				10-PSN-06
11153384	AD	Govt.College Arki	BA	3	March	2012	SL02	PASSCOURSE	HEM LATA	SOHAN LAL				06-PSN-787
11155633	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	PARVEEN RANI	RAM RATTAN				06-BT-573
11155634	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	RADHIKA	RAVINDER KUMAR T				06-BT-596
11155635	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	GEETU SONI	RAJ KUMAR SONI				02-BT-20
11155636	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	RAJNI BALA	GURDEEP SINGH				04-BT-383
11155637	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	SANTOSH KUMARI B	HARI RAM				02-BT-124
11155643	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	SONAM CHANDEL	SURINDER KUMAR				06-BT-174
11155644	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	MADHU BALA	GURDAS RAM				93-BT-255
11155649	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	PRIYA KALRA	AMAR SINGH KALRA				06-BT-568
11155651	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	GAURAV THAKUR	PURAN SINGH				06-BT-344
11155652	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	REKHA KUMARI	SHYAM LAL				02-DCN-54
11155654	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	CHANDNI SHARMA	RAM LAL SHARMA				04-BT-440
11155655	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	BABITA DEVI	DIWAN CHAND				04-BT-381
11155656	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	SUMITA SHARMA	VIJAY KUMAR				05-BT-358
11155657	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	RAMNA KUMARI	MALKIAT SINGH				03-GCA-39
11155658	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	MUKTA	SURESH CHANDER				03-BT-342
11155663	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	DEEKSHA RANI	SURESH KUMAR				06-BT-476
11155672	AD	SVSD College,Bhatoli	BA	3	March	2012	UN05	PASSCOURSE	KULWINDER KAUR	GURDEV SINGH				10-PUN-560

Fig. 5. Show duplicate data

Bug #6

There is field in table named Category Name where no check for data validation has been added. For example GEN means general, OBC mean other backward class, SC/ST mean schedule cast/schedule tribe etc. But what if somebody mistakenly types it as Obn What would that mean OBC or GEN? or if someone mistakenly typed SU as ST this will lead to database in inconsistent state.

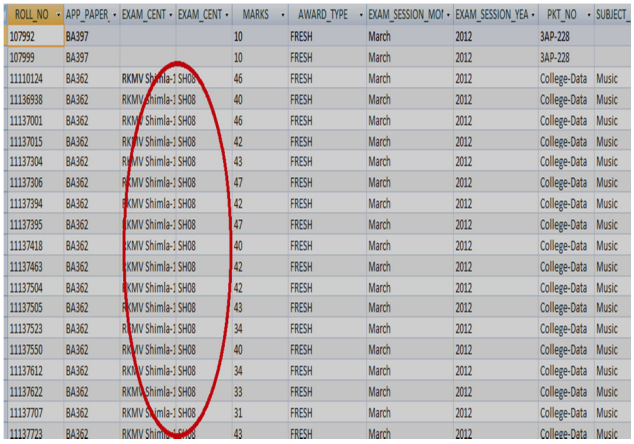


F	ROLL_NO	COLLEGE_DEPTT_NAME	CANDIDATE_FA	CANDIDATE_	CATE				AP	SUBJECT_1	SUB_1_PAPE	SUB_1_PAPE	SUB_
	11156787	Govt.College Bilaspur	RAM DASS	01-BP-669	GEN	P	AD	N	P	Pol Science	BA315	39	FRESI
	11156791	Govt.College Bilaspur	DAYA RAM	05-BP-731	GEN	P	AD	N	P	English	BA301	36	FRESI
	306747	Govt.College Bilaspur	LAYAK RAM	07-CCB-117	GEN	P	P	N	P	English	BA201	35	FRESI
	205027	Govt.College Bilaspur	KIRPA RAM	08-BP-323	GEN	P	P	N	P	English	BA301	17	FRESI
	205049	Govt.College Bilaspur	SUBHASH CHAND	08-BP-801	GEN	P	P	N	P	English	BA301	17	FRESI
	205096	Govt.College Bilaspur	ROSHAN LAL	08-BP-345	GEN	R	R	N	R	English	BA301	14	FRESI
	205127	Govt.College Bilaspur	KAMAL DEV KAUSH	07-BP-403	GEN	P	I	N	P	English	BA301	27	FRESI
	205141	Govt.College Bilaspur	SHRAWAN KUMAR	07-BP-521	GEN	P	P	N		English	BA301	14	FRESI
	205148	Govt.College Bilaspur	GORKHU RAM	08-BP-377	GEN	P	P	N	P	English	BA301	17	FRESI
	205180	Govt.College Bilaspur	ASHOK KUMAR	08-BP-731	GEN	R	R	N	R	English	BA301	19	FRESI
	205206	Govt.College Bilaspur	SADA RAM	08-BP-247	GEN	P	I	N		English	BA301	29	FRESI
	205212	Govt.College Bilaspur	RAMA NAND	08-BP-810	GEN	P	P	N	P	English	BA301	19	FRESI
	205213	Govt.College Bilaspur	CHET RAM	08-BP-195	GEN	P	I	N	P	English	BA301	35	FRESI
	205223	Govt.College Bilaspur	SIKHRU RAM	08-BP-219	GEN	P	P	N	P	English	BA301		
	205290	Govt.College Bilaspur	JAGDISH CHAND	08 BP 549	GEN	R	R	N	R	English	BA301	22	FRESI
	205326	Govt.College Bilaspur	BESRI RAM	08-BP-229	GEN	R	R	N	R	English	BA301	10	FRESI
	205339	Govt.College Bilaspur	RAJENDER KUMAR	08-BP-719	GEN	P	P	N	P	English	BA301	26	FRESI
	205426	Govt.College Bilaspur	SURENDER SINGH	08-BP-273	GEN	P	I	N	P	English	BA301	37	FRESI
	205428	Govt.College Bilaspur	JAGDISH KUMAR	08-BP-269	GEN	P	P	N	P	English	BA301	18	FRESI
	205430	Govt.College Bilaspur	BUDHI RAM	08-BP-267	GEN	P	P	N		English	BA301	37	FRESI
	205450	Govt.College Bilaspur	ARJUN SINGH	08-BP-428	GEN	R	R	N	R	English	BA301	38	FRESI
	205466	Govt.College Bilaspur	BUDHI RAM	08-BP-785	GEN	P	P	N	P	English	BA301	20	FRESI

Fig. 6. Show Data lead to inconsistent state

Bug #7

Image below depicts the fact that exam center and exam center code is getting repeated again and again(circled in red).This duplication is of O(N)(where N is number of students). And this duplication will increase as number of students increases because for each student, exam center name and exam code has to be entered by employee. Entering this data for the above said field again and again doesn't make any sense. Suppose by mistake data entry operator for RKMV college enter examination center code as SH-04. Which one will be correct SH08 or SH04. Not clear ?

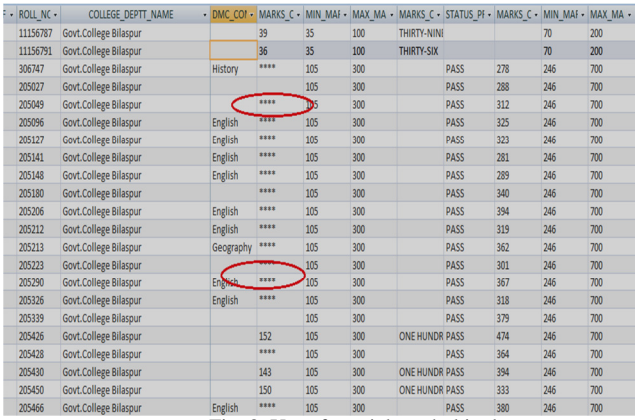


ROLL_NO	APP_PAPER	EXAM_CENT	EXAM_CENT	MARKS	AWARD_TYPE	EXAM_SESSION_MO	EXAM_SESSION_YEA	PKT_NO	SUBJECT_
107992	BA397			10	FRESH	March	2012	3AP-228	
107999	BA397			10	FRESH	March	2012	3AP-228	
11110124	BA362	RKMV Shimla-1 SH08		46	FRESH	March	2012	College-Data	Music
11136938	BA362	RKMV Shimla-1 SH08		40	FRESH	March	2012	College-Data	Music
11137001	BA362	RKMV Shimla-1 SH08		46	FRESH	March	2012	College-Data	Music
11137015	BA362	RKMV Shimla-1 SH08		42	FRESH	March	2012	College-Data	Music
11137304	BA362	RKMV Shimla-1 SH08		43	FRESH	March	2012	College-Data	Music
11137306	BA362	RKMV Shimla-1 SH08		47	FRESH	March	2012	College-Data	Music
11137394	BA362	RKMV Shimla-1 SH08		42	FRESH	March	2012	College-Data	Music
11137395	BA362	RKMV Shimla-1 SH08		47	FRESH	March	2012	College-Data	Music
11137418	BA362	RKMV Shimla-1 SH08		40	FRESH	March	2012	College-Data	Music
11137463	BA362	RKMV Shimla-1 SH08		42	FRESH	March	2012	College-Data	Music
11137504	BA362	RKMV Shimla-1 SH08		42	FRESH	March	2012	College-Data	Music
11137505	BA362	RKMV Shimla-1 SH08		43	FRESH	March	2012	College-Data	Music
11137523	BA362	RKMV Shimla-1 SH08		34	FRESH	March	2012	College-Data	Music
11137550	BA362	RKMV Shimla-1 SH08		40	FRESH	March	2012	College-Data	Music
11137612	BA362	RKMV Shimla-1 SH08		34	FRESH	March	2012	College-Data	Music
11137622	BA362	RKMV Shimla-1 SH08		33	FRESH	March	2012	College-Data	Music
11137707	BA362	RKMV Shimla-1 SH08		31	FRESH	March	2012	College-Data	Music
11137723	BA362	RKMV Shimla-1 SH08		43	FRESH	March	2012	College-Data	Music

Fig. 7. Duplicate data

Bug #8

From the figure given below, there are some fields in table which contain useful data where as some field contain ***. What does these *** means as per database is not cleared. These entry indicate that in marks section you can enter special characters and suppose if somebody gets 88 marks and while entering it in the database, he presses shift key for first digit that means data will be stored as *8. What would that mean? Again not clear.



ROLL_NC	COLLEGE_DEPTT_NAME	DMC_COI	MARKS_C	MIN_MAI	MAX_MA	MARKS_C	STATUS_PI	MARKS_C	MIN_MAI	MAX_MA
11156787	Govt.College Bilaspur		39	35	100	THIRTY-NINI			70	200
11156791	Govt.College Bilaspur		36	35	100	THIRTY-SIX			70	200
306747	Govt.College Bilaspur	History	****	105	300		PASS	278	246	700
205027	Govt.College Bilaspur			105	300		PASS	288	246	700
205049	Govt.College Bilaspur		****	105	300		PASS	312	246	700
205096	Govt.College Bilaspur	English	****	105	300		PASS	325	246	700
205127	Govt.College Bilaspur	English	****	105	300		PASS	323	246	700
205141	Govt.College Bilaspur	English	****	105	300		PASS	281	246	700
205148	Govt.College Bilaspur	English	****	105	300		PASS	289	246	700
205180	Govt.College Bilaspur		****	105	300		PASS	340	246	700
205206	Govt.College Bilaspur	English	****	105	300		PASS	394	246	700
205212	Govt.College Bilaspur	English	****	105	300		PASS	319	246	700
205213	Govt.College Bilaspur	Geography	****	105	300		PASS	362	246	700
205223	Govt.College Bilaspur		****	105	300		PASS	301	246	700
205290	Govt.College Bilaspur	English	****	105	300		PASS	367	246	700
205326	Govt.College Bilaspur	English	****	105	300		PASS	318	246	700
205339	Govt.College Bilaspur			105	300		PASS	379	246	700
205426	Govt.College Bilaspur		152	105	300	ONE HUNDR	PASS	474	246	700
205428	Govt.College Bilaspur		****	105	300		PASS	364	246	700
205430	Govt.College Bilaspur		143	105	300	ONE HUNDR	PASS	394	246	700
205450	Govt.College Bilaspur		150	105	300	ONE HUNDR	PASS	333	246	700
205466	Govt.College Bilaspur	English	****	105	300		PASS	380	246	700

Fig. 8. Use of special symbol in data

The discrepancies(bugs)found during the data analysis impelled us to find their root causes. Roots of all this problematic data stored in the database lies in the poor database design. Next section of this paper analysed the structure of each relational table of University Examination system. This structural analysis of relational tables is based on the various constraints e.g. primary key, foreign key, null, unique, check etc. imposed on each table and found that most of the data discrepancies shown in Fig. 1 to Fig. 8 are due to missing of these constraints in most of the table of University Examination database of Himachal Pradesh University.

IV. STRUCTURAL ANALYSIS OF UNIVERSITY EXAMINATION SYSTEM'S DATABASE:

In this section the structural analysis of tables of University Examination database is described and results of structure analysis are presented in visual form(bar charts). The parameters used in the structural analysis are listed in Table1. While designing the database for organization we must be cautious about redundancy, consistency and enforcement of various constraints. Principles and methodology for designing good database can be easily found in any standards text book of Database Management System(DBMS)[5][6], but due to time, budget and pressure from top management to get computerized the manual system, most of developer in government organization are not following the principles of good database design. Temporarily they computerized the application under hand but as size of database grows, these temporarily and not properly designed/planned solution not perform well in future, due to the exponentially increase in records in database. Keeping this in mind, the current research paper analyzed the structure of each relational table of database of University Examination System. The design parameter used in this analysis are listed in Table 1[7].

Database of University Examination System, consisting of thirty tables, of Himachal Pradesh University have been collected and analyzed for its structure. The successful implementation of Information System of any organization depends on the core designing principles of databases and for this reason, adherence to the well known parameters e.g. Data Redundancy, Primary key, Foreign key, Documentation, Stored procedures, Constraints, Transactions Handling and Master-data management are important and are necessary for building fairly good reliable and consistent database.

Table 1. Common Design Parameters

Parameter	Implication
Primary key	Consistency, reliability, long term sustainability, robustness, development time, data quality, Integrity.
Foreign key	Consistency, reliability, robustness, error rate, Integrity,entity relationship.
Data redundancy	Data quality, reliability, increases in the volume of undesirable data.
Documentation	Data administration (updating the conceptual schema, usefulness of tables), data migration, data merging.
Constraints	Data validation, semantic meaning to data, data duplication
Transactions	Data recovery, reliability, recovery, concurrency control
Master Data	GUI Development (by providing static data to GUI components for auto completion or validation purpose),Sharing, Interoperability.

The parameters and their implications on database design are described in Table 1. These parameters, though not comprehensive and can be found in any standard RDBMS text book as candidates of a good database design and if adhered to while designing database, these can increase the overall effectiveness of database[8]. The analyses of the relational databases of University Examination System against these parameters reveal many interesting things for database design and overall parameter-wise bar graph is presented for all discrepancies. Parameter wise description of structural analysis of database of University Examination System is described below.

A. Primary & Foreign Key

The primary key constraint uniquely identified the record in a relational table. The foreign keys are used to create relationships between tables. Natural relationships exist between tables of database of University Examination System. Defining foreign key helps in making the database consistent. The graph in Fig. 10 shows how Primary & Foreign keys are maintained in the database of University

Examination System. It depicts that some tables of databases are lacking in using Primary and none of the table in University Examination database use foreign keys. This whole scenario leads to integrity problem (Entity Integrity and Referential Integrity) in the database and hence the consistency is compromised which is implemented by foreign keys. Benefits that can be availed from referential integrity like improved data quality, faster development, fewer bugs and consistency across applications are not exploited[9]. And this lead to software full of bugs, slow performance and questioning the sustainability of applications.

B. Data Redundancies (Normalization)

The normalization of database is the process of organizing column and table of relational database to minimize the redundancy. Correctly normalized database not only reduces duplications but also helps in removing deletion, updation and insertion anomalies[10]. Generally the Boyce Code Normal form is fastest way of normalization database to minimize redundancies, however as per the given databases analysis, the database of University Examination System is full of redundancies, reason is, un-normalized database.

C. Documentation

Documentation of database helps in understanding the logic behind database design in many real life scenarios viz. for future modification of database, migrating the database, merger and acquisition of organizations, updating the conceptual schema or absence of original database designer during future scaling up of database. However as shown in fig. 10 the current analysis reveals that the databases have no documentation either in the database or in any other form. The database designer concerned with the application is the sole individual who knows the logic behind the database design and he/she also relies on his brain only. No format for documentation is followed in University Examination System of Himachal Pradesh University. Documentation helps the organization during the maintenance phase of its computerized system. The poor documentation also hints that designing a database for a government organization is 'single-man business' lacking any team work and software engineering approach.

D. Constraint Enforcement

To avoid wrong or invalid data from entering the database of University Examination System, enforcement of constraint in database design are necessary requirement. It is a good practice to validate data before entering it to the database, particularly when multiple applications/users access the databases.

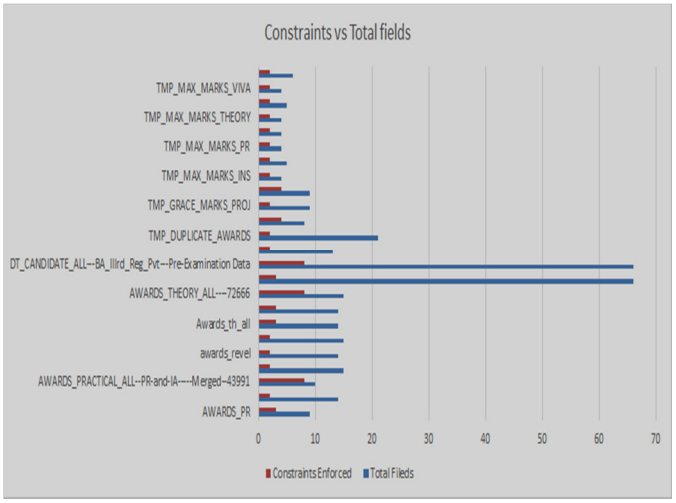


Fig. 9. Constraints Enforcement versus Total Fields

It's clear from the fig. 9 that in each relational table of University Examination System of Himachal Pradesh University, a very few constrains are enforced where as there are number of field in each table. Due to lack of checks in each table, the chances of entering wrong data at data entry level increases. Lack of constraint enforcement in database of University Examination System is also one of the reason for storing ambiguous/wrong data in database.

E. Transactional Inconsistencies

Transactions as a facility help in maintaining the consistency of databases in multi-user environment where many read and write requests concurrently execute on a single database. Transactions occurs during the processing of result of student must ensure the atomicity, consistency, durability and integrity of database. These properties also contributes towards concurrency and data recovery. This result of current analysis shows that University Examination System is reluctant in using transaction facility. Transactions are observed on the bases of use of logical structure (Stored procedure/stored queries/triggers etc) in the back end. To ensure consistency of data these logical structures are written within the block of "begin transaction and end transaction" for tables. After analysing the stored procedures used by University Examination System to process the result of students, the current analysis found no logical structure written within the block of "begin transaction and end transaction" for tables. Avoidance of transactions by the University Examination System means that they have no handy procedure to recover the previous data or state. This also implies that University Examination System's database may give

inconsistent and invalid results at anytime during the result processing cycle.

F. Master Data

Master data of any organization denotes the basic essential data which remains unchanged over a specific period of time. To identify the master data and its management in any organization is an important task because inconsistent or obsolete master data can lead to error-prone operations[11]. A system in development stage also needs master data in Graphic User Interface (GUI) components (combo boxes etc.) for auto completion and validation purpose. During the analysis of database of University Examination System we found that, only two table of master data are maintained e.g. one master table MT_PAPER_CODES store the paper/subject name and paper code whereas other master table MT_EXAM_CENTRE store the examination centres name and examination centres code. During the structural analysis we found that no master data has been maintained separately by University Examination system and the non-availability of master data limits sharing of data across different departments of University. Overall structural Analysis scenario of database of University Examination System is presented below:

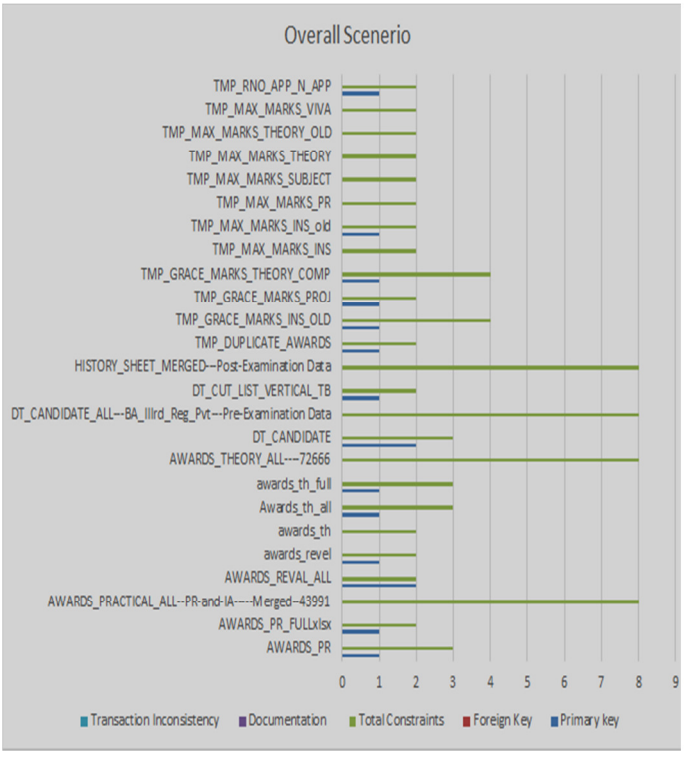


Fig. 10. Overall scenario

It's clear from Fig. 10 that there are very few constraints that has been imposed on the database of University Examination System. This paper analysed thirty tables for various keys and constraints. The key findings of current analysis are listed below. Out of 30 tables, only thirteen tables have primary key constraint associated with them. No table have a foreign key constraint. Almost every table has one or more constraint associated with it. Lacking foreign key constraint means that there is no dependency among tables. Which in turn leads to redundancy of data in the tables. During structural analysis of the database of University Examination System of Himachal Pradesh University, this paper has observed following anomalies:

- The data type of every field in each table type is varchar. Even primary key fields is set as Varchar which is not a good choice. and may lead to failures and errors while considering primary keys in the query.
- No foreign keys thus some tables have redundant data, which increases the updating anomalies and also increases the size of the database.
- Some primary keys are invalid and are not set properly. Various tables don't have primary key so it leads to redundancy inside the table.
- Almost every table have constraints but their values are not set properly, and most of the fields in tables have no constraints. Lack of constraint enforcement became the reason for storing wrong/ambiguous data in the database.
- To ensure consistency of data, logical structures should be written within the block of "begin transaction and end transaction" for tables. After analysing the stored procedures used by University Examination System to process the result of students, the current analysis found no logical structure written within the block of "begin transaction and end transaction" for tables
- Some tables are very large having large number of fields ranging from 51 –74 thus they are difficult to manage, update and also take more time to process query when data is required from such large table.

IV. CONCLUSION

The overall analysis result shows that the database of University Examination System of Himachal Pradesh University, not following the principles of good database design. The examination branch of Himachal Pradesh University processes student results at the cost of redundant and inconsistent data stored in data the database. Due to the

poor database design of University Examination System, the administrative authorities of Himachal Pradesh University unable to provide up-to-date information to its stakeholder. Due to this, most of the time, university fail to declare the result of student in stipulated time and many student every year deprived of taking admissions in neighbouring universities. In future the re-engineering of database of University Examination System is essential to overcome the discrepancies found during the analysis.

REFERENCES

[1] *Judd, Charles and, McCleland, Gary. "Data Analysis". Harcourt Brace Jovanovich. ISBN 0-15-516765-0. 1989*

[2] *O'Neil, Cathy and, Schutt, Rachel. "Doing Data Science". O'Reilly. ISBN 978-1-449-35865-5. 2*

[3] R. K. Yin . Case Study Research, Design and Methods, 3rd ed. Newbury Park, Sage Publications, 2002.

[4] Huang, Huan-Tsae, Lee, Y. W. and Wang, R. Y. Quality information and knowledge, Prentice Hall PTR. 1999

[5] H. Korth, & A. Silberschatz,., "Database System Concepts". 5th ed., McGraw-Hill, ISBN 007-124476-x. 2006

[6] *R. Elmasri. B. Navathe., "Fundamental of Database Systems", Fifth Edition, Published by Pearson Education, ISBN 978-81-317-1625-0. 2009*

[7] A. J. Singh, & R. Chauhan, "E-Government Databases: A Retrospective Study", Indian Journal of Computer Science and Engineering, Vol 1 No 2, 66-73, ISSN: 0976-5166. 2011

[8] L. Davidson, "Ten Common Database Design Mistakes", http://www.simple-talk.com/sql/database-administration/ten-common-database-design-mistakes.On-line, Accessed on : 22 *July, 2010*

[9] M. Blaha, "Referential Integrity is important for databases", Modelsoft Consulting Corp, www.odbms.org/experts.aspx. 2008 Accessed on: 15 July 2010.

[10] K. Tangwongson, P. Himabindu, M.Kaminsky, " Efficient Similarity Estimation for Systems Exploiting Data Redundancy". In Proc. IEEE INFOCOM, (San Diego, CA), Mar. 2010.

[11] Loser, C. Legner, and D. Gizanis, "Master Data Management for Collaborative ServiceProcesses", http://www.alexandria.unisg.ch/EXPORT/DL/Christine_Legner/28091.pdf, Accessed on 28 Jan., 2010.

AUTHORS PROFILE

Balvir Singh is an Assistant Professor in University Institute of Information Technology(UIIT), Himachal Pradesh University. He is M.Tech. and pursuig Ph.D from Himachal Pradesh University. His area of interest is data structure, data quality and database. He can be reached at thakur_balvir@yahoo.com

A. J. Singh has been teaching in the Department of Computer Science, Himachal Pradesh University, Shimla, India, since 1992. He is designated as professor. He has completed his Bachelor of Engineering in Computer Technology from NIT Bhopal (1991), M. Sc. in Distributed Information Systems from University of East London (1996), and Ph.D. from Himachal Pradesh University (2005). His areas of interest are e-governance, distributed information systems, ICT for development, and the impact of ICT on society. He can be reached at aj.hpucs@gmail.com

Rajesh Chauhan is System Administrator in UIIT and also teaching in UIIT. He is MCA from IGNOU and Ph.D from Himachal Pradesh University. His area of interest is database and e-governance. He can be reached at rajesh63673@gmail.com