

Pre-Teaching Portfolio

Aparna Varde

Portfolio Narrative Statement

This portfolio includes my teaching goals and beliefs and the methods for putting them into action. This has been designed with specific reference to the course I intend to teach, namely DataBase Management Systems or DBMS. It also includes the actual details of the course, i.e. the syllabus and the course materials such as lecture notes, slides and others. A video recording of the introductory lecture to this class has been done, and critiqued with group members. The video critique is also included in this portfolio. In addition, some interesting anecdotes encountered in the world of teaching have been summarized. The portfolio is organized in five parts

Part I: Journal on Teaching Philosophy. This includes goals and beliefs, putting them into action, how the items in the portfolio reflect beliefs and goals, and personal growth plan for teaching.

Part II: Video Critique on the Introductory DBMS class. This includes a description of the contents of the videotape, reviewers comments and presenter's reaction to comments.

Part III: Syllabus for the DBMS course. This includes the general course information, course schedules, assignment policy and textbook selection.

Part IV: Course materials for the DBMS course. These include the slides, lecture notes, introductory quiz and teaching philosophy for the course.

Part V: Interesting Anecdotes in Teaching. These contain metaphors for learning and teaching, a memorable learning experience and grading practice examples.

Part VI: Statement of Interest. This summarizes my interest in teaching and how I intend to pursue it.

Part I: Journal on Teaching Philosophy

1. Goals for Students with reference to the DBMS class

Data Management is one of the areas of Computer Science that has applications in almost every field. The DBMS class (Data Base Management Systems) for college students

emphasizes the importance of the effective storage, retrieval and protection of information in any domain.

Raw data may be present but not easily available, and it is extremely important to have a system that manages and processes this data for efficient at-a-glance access. A student of Medicine may need this to store diagnostics and cures of diseases, a Law student may need to view case histories of clients and so forth.

The DBMS class teaches students to create and maintain their own database systems using software readily available in the industry such as Oracle or MS Access. It also provides knowledge on theoretical concepts like relational algebra and query processing.

Students are encouraged to work in teams in order to benefit from the knowledge in their individual disciplines and to promote co-operative learning in general. The class is more interactive, rather than the traditional lecture-style. In addition to bringing active participation from the students, this also helps the teacher gain knowledge by learning from the experiences of students.

Above all, students are requested to provide a statement of their long-term career objectives, so that the teacher has a better understanding of their needs and can mentor them along the way.

2. Putting Goals and Beliefs into Action

It is extremely important for students to understand the importance of Data Management. In order to get the feel for this, they will be made to go through a sample data collection exercise at the beginning of the course. They will gather information for a specific assignment in their respective domain, and store it without using Databases, also carrying out simple querying and retrieval operations. At this stage, they will record their experiences, and comment on the difficulties they encountered in the absence of effective tools and technology.

After a few initial lectures, they will be made to repeat the same task, this time with some introductory knowledge of Databases. On comparing the two approaches, they will be able to appreciate the benefits that a DBMS provides. This will also help them gauge their initial grasp of DBMS concepts.

Finally towards the end of the course, they will be required to design their own simple information retrieval system for a given application. This will give them thorough exposure to a multitude of DBMS tasks, such as database creation, maintenance, query processing etc. At this stage they would summarize their experiences with the knowledge gained. They would also be made to provide feedback to the course instructor about their view of the pros and cons of a DBMS from their perspective, and about how the course

enhanced their sphere of knowledge, and how the course can be improved even further. This would serve the purpose of the course instructor learning from the students about the application side of things and also about better structuring of courses.

The project-work for this course would all be done in teams, in order to bring out the collaborative skills in students and encourage them to learn from each other. There would be peer evaluation within teams to ensure that the students contribute effectively as members, but there would be no individual grades assigned so as to avoid unhealthy competition.

Lectures would be held in an interactive style to emphasize co-operative learning. Students would be asked to read up class material as well as extra information pertaining to their fields prior to the course, and contribute towards in-class discussions. Quizzes and debates would be organized from time-to-time to make the learning process more fun. Online tools such as discussion boards, drop boxes, e-mail, student-home-pages would be used to promote better interactions outside of class. Students would also be encouraged to use search engines, library facilities and the other resources available in the laboratories for their assignments to keep abreast with the latest technology. For students with PCs or laptops at home, facilities such as network cards, CD writers and more would be provided on campus, to enable easier access to school resources from home.

For students with disabilities, special terminals in the labs would be available, along with special software. Disabled students would also be asked to meet with the course instructor to set up the most suitable environment for their specific case.

At the end of the course, there would also be a final examination in theory to test the conceptual knowledge gained by students. This would be in addition to the theory homework assignments and mid-term.

Thus, the goals for learning and the general beliefs about effective teaching would be put into action, and student feedback would help improve this process even further. The goals and beliefs emphasized here are co-operative learning, application perspective, theoretical knowledge, diversity issues, systematic teaching-learning style and use of available technology.

3. Items in Teaching Portfolio and how they reflect Beliefs and Goals

The items that I would like to put in my teaching portfolio are:

1. Emphasis on co-operative learning
2. Teaching experience I have had in the past

3. The domain in which I intend to teach
4. Choosing a balance of different learning styles
5. Diversity issues

I would like to emphasize co-operative learning because it helps students learn from each other as well as from the teacher. It also helps the teacher gain more knowledge from the experiences of students. Rather than the traditional lecture style where students play more of a passive role in learning, this style encourages the students to get actively involved in class discussions, role plays, on-site events, labs, demos and more. Students grasp knowledge better this way.

Also teaching experience in the past such as being a TA (Teaching Assistant) really helps. Since the role of a TA is between that of a professor and a student, this helps understand the picture better. It is important to identify in what areas students need more help, and what is the best style to assist them in labs, home-works etc. This experience acquired early on in life can be very useful in actual teaching assignments.

Also knowledge of the teaching domain needs to be emphasized, in this case Databases. One of the most important aspects of being a good teacher is having thorough knowledge of one's field. This is obviously enhanced along the way as one progresses through actually teaching the course. But an initial grasp of the field and in-depth study in the field is extremely important for being a good teacher. Both breadth and depth of knowledge are important here. One needs to know about the different areas within and surrounding the field, in this case Computer Science in general, and aspects like Data Warehousing, Data Mining, Web Databases, Active Databases etc in particular.

It is also important to choose a balance of different learning styles. The aural learning style that focuses on auditory input, the visual style where students grasp what they see, the reading/writing style where students digest better by reading and writing what they learn, the kinesthetic style that involves all the senses, where students actually do things and acquire knowledge, and the multimodal style that uses a combination of all the above, are all equally important learning styles. Also some students are more focused research-oriented learners and some are more open, interested in diversifying. It is important to adopt a balanced learning style to address all kinds of students

In diverse learning environments like today, it is essential that we understand the needs of students from a variety of backgrounds, academically diverse and culturally varied too. The teacher student relationships in some countries like India and China for example are very different from the USA. Working across cultural boundaries presents a challenge. So does dealing with students having disabilities, since one's teaching styles should accommodate everyone. The same goes for male and female students, married and single students, students with children and so forth. It is also important for the teacher to be a friend and understand the personal problems of students and provide solutions wherever possible. Learning is a complete all-round experience. It is to be seen from different perspectives to encompass the whole sphere of knowledge.

4. Personal Growth Plan for Developing Teaching

Teaching is an art. It requires some natural talent, and the rest is developed by practice. The first step towards the growth plan for teaching is thorough knowledge of the subject. I intend to acquire this by in depth research in my field, namely Databases. This is the focus of my Ph.D. Dissertation. I seek every opportunity to make presentations based on my research, apply my skills in the real world, and attend related talks of the work of other researchers. I also intend to acquire general knowledge in the field of Computer Science by reading, taking courses and attending seminars and more.

Another important growth step is the development of a good teaching methodology. I intend to focus on co-operative learning principles here. Active involvement of the students in coursework is important. This includes in-class discussions, team-work projects, industrial visits etc. Also I would like to maintain a balance of learning styles as incorporated in the VARK philosophy.

Yet another factor is the diversity aspect. We encounter students from different parts of the world, with different academic backgrounds, some with special needs, and a fair balance of male and female students. I would take into account these factors in my growth plan. I would like to learn about various cultures and the teacher student relationships in different countries. This would help me understand my students better. I would also structure classes and assignments so as to accommodate students with disabilities, and students with diverse academic backgrounds. Also, in making groups and in class discussions, I would like to include a good mixture of male and female students.

I would also emphasize on the feedback of my students, peers and supervisors in improving my teaching and developing my growth plan. This could include suggestions on my speaking style, appearance in class, interactions with students, personal nature and more. Also there could be suggestions on taking refresher courses from time-to-time for the enhancement of knowledge. Also some students may need more individual attention and may communicate this as the course progresses. These and other factors would be incorporated in my growth plan.

Taking a sabbatical leave to pursue further related education and/or spend time in the corporate world, and taking summers off to do consulting in the industry are very important aspects of growth, especially with reference to my field of interest that has ever-growing needs. This would be incorporated in my growth plan as well.

In short, my growth plan is based on the five point indicators, namely knowledge, teaching skills, diversity, feedback and practical application. This would summarize the steps I intend to take towards a personal growth plan for developing teaching.

Part II: Video Critique

Class Topic

Introduction to Databases

Course

CS4444: DBMS

Presenter

Aparna Varde

Group Members

1. Kevin Keenaghan
2. Mary Thomas
3. Haitao Jiang

1. Contents

The topic of the class was Introduction to Databases. This was the initial class in the CS4444 course for undergraduate students. The course assumed no prior knowledge of Databases. The prerequisites for this course were introductory courses in Computer Science such as Data Structures and Programming Concepts. Knowledge of other areas of computers was an added plus but was not required. The class was assumed to consist

of people from diverse academic backgrounds, and a combination of students with no experience in the industry plus those with exposure to the corporate world.

The aim of this lecture was to provide the students the motivation to study databases and give them an overview of the preliminary concepts in databases. At the beginning of the class the students were asked to introduce themselves to get an idea of the level of each one's exposure to databases and to computer science in general. As an initial brainstorming exercise they were asked to share their thoughts about the management of data in their respective domains. Various data stores other than databases were presented to them, explaining the need for a more systematic way of information management. This was to make them understand the reason for attending this course.

The concepts introduced in this lecture were the definition of the terms database, DBMS (DataBase Management System) and database system, the overall system architecture, the types of DBMSs with a focus on relational DBMS or RDBMS, the terminology related to an RDBMS such as tables, tuples, attributes, keys and more, the roles in the database world with respect to job opportunities, the main advantages of using a DBMS and finally DBMS packages in the industry like Oracle, Sybase and MS Access.

The teaching style was interactive in terms of asking questions before introducing a concept, picking different students to answer questions, breaking down one question into simpler ones to stimulate an answer, repeating questions asked by students and answers given by them for the benefit of the whole class, tying in the questions and answers to the explanation of the actual concepts and giving real-world examples to make the students relate to their application. The two-way learning style gave the presenter more knowledge from the experiences of the students.

The slides had a good combination of text and pictures. They were clear and concise. At the end of the class, a summary was provided and finally homework was given to stimulate further interest. The homework assignment focused on students individually collecting, storing and retrieving data in their respective domain without the use of databases, and then discussing in groups the difficulties involved in this task. The groups were assigned through a course web page based on a mix of countries and academic backgrounds. The students were encouraged to use the discussion board for meetings. The purpose of this exercise was to understand the need for databases, to give the students an exposure to working in diverse teams, and to familiarize them with the learning tools available. Students with special needs were asked to contact the instructor during office hours. Finally they were all requested to continue learning about databases, with the hope that the initial class stimulated their interest.

2. Group Members Comments

All the group members applauded this lecture with the comment that it was excellent. Their joint reaction was "You make a very good teacher." They were happy with the clarity of thought, the interactive presentation style, the good use of pictures and concise

text, the real-world examples and also the idea of summarizing concepts at the end and assigning stimulating homework. They were also happy with the assignments of teams with students from diverse backgrounds and with the emphasis on learning tools.

For a new student who did not know much about databases, they said, the class provided a well-designed introduction with the motivation to get deeper into the field. They liked the fact that the presenter initially gave them a brainstorming exercise to understand the essence of the whole course and finally assigned homework on the same lines after the students had an overview session on databases. They also appreciated the fact that the presenter kept them awake by directing questions to different students, and breaking down questions into simpler ones to make it easier for them to think of the answer. They felt that the idea of picking examples from the real world was great, since that made them relate better to what they were studying. They also appreciated the application perspective in terms of the job prospects in the database world, and an introduction to the actual DBMS packages in the industry.

On the improvement side, they suggested that some animation be introduced rather than repeated navigation between the slides when the presenter explained concepts with a specific example. They also felt that the presenter's style of speaking, though loud and clear, could be made even better by not softening / speaking faster towards the end of sentences. This becomes more obvious in a recording than in a live class. They also felt that the whole talk could have been shorter. The length aspect however applied to almost everyone's talk, the reason being that teaching in an interactive style goes a lot slower than research presentations. In the latter, one can safely assume 15 slides for 15 minutes, but in teaching 15 slides take easily about 25 or even 30 minutes.

They could not find too many points for a negative critique, commenting that the presenter seemed to have experience in the teaching side. The video rubric consisted of all As from all group members. One particular comment was that when you are really deep into a field doing research, it becomes relatively difficult to come up with an introductory lecture and make people from diverse backgrounds understand the very basic concepts, but nevertheless the presenter did an excellent job.

3. Presenter's Reaction

The initial reaction of the presenter to the comments of the group members was pleasant surprise. The group members' comments were better than expected. One tends to get critical of one's own style especially after watching a videotape of the class. The greatest hurdle was that of making an introductory class really interesting, after being so involved with research group talks, but that was crossed successfully.

Personally, the presenter felt that the scope for improvement was exactly in the areas pointed out by the group members. The idea of navigating between screens while explaining an example, though good for enforcement of ideas can be a little distracting at times. One solution could be animation, but considering the debate in the teaching world about animation being a source of distraction too, other solutions are repeating the same slide in the slide show as each new concept gets explained, or redrawing the picture on every slide along with an explanation.

Regarding the maintaining of a constant pace and volume while speaking, this was noticed by the presenter even before the group pointed it out, since this becomes really obvious on watching a video. This style could be an obstacle especially to students with disabilities. The solution is to practice reading and speaking and keep recoding on audio and video to get better breath control. Also regular exercise helps better control of breath and helps one improve one's speaking style.

The third suggestion about the talk being longer than expected is something that applied universally, and the best way to improve is it to use the 1:2 ratio described in the group comments. Have one slide for every two minutes, taking into account the time that will be involved in interactive class discussions, since teaching takes relatively longer than making research presentations.

On the whole, the presenter was happy with the response from the group members and would use the feedback they gave to improve the teaching style even further. The all As from all members in video rubrics really came as a pleasant surprise. The presenter is highly motivated to pursue a career in teaching.

Part III: Syllabus for the DBMS course

1. Content of Syllabus

CS 4444: DataBase Management Systems (DBMS)

C-Term, Fall 2002

Practically every field today deals with the processing of data. This data needs to be effectively stored and extracted. A DataBase Management System (DBMS) has thus become a crucial part of computer systems. This DBMS course focuses on the knowledge of the internal aspects of database systems. We will learn about the main techniques involved the management of data such as collection, storage, protection, indexing, query processing, optimization and the theory behind these. Practical application of the concepts will be provided through intensive projects using software like Oracle, Sybase, MS Access and other commercially available tools. On completing this course, students will be able to design their own database applications useful in academics and industry. The prerequisites for this course are Introduction to Computer Systems (CS1001) and Data Structures (CS2002). Knowledge of Software Engineering is recommended. This course sets the stage for the Graduate Level DBMS Course CS555. This class will be taught in the co-operative learning style with heavy focus on team- work, teacher-student interaction, lab-work and active student involvement. .

Course Homepage and Mailing List

Page: <http://www.cs.wpi.edu/~cs4444>, List: cs4444@wpi.edu

Class meetings

In D-term, on Monday, Tuesday and Thursday
11:00am - 11:50am in FL320.

Teaching Staff

Professor: Aparna Varde, FL-319, x5857, aparna@wpi.edu
Office Hours: Wednesday: 10:00 a.m.-12 noon and Friday: 1:00 p.m.-3:00 p.m.

TA: John Smith, FL-A20, jsmith@wpi.edu
Office Hours: Monday 2-3 p.m., Wednesday 3-4 p.m., Friday 1-2 p.m.

A. Instructional Objectives

This course gives an overview of database management systems. It is intended to be an introductory course in databases. No prior knowledge of data models, query languages or application packages is assumed. Familiarity with software such as Oracle, Sybase and MS Access is a plus, but is not necessary. We will emphasize on how the knowledge of

database systems is useful in your respective domain. We will learn the theoretical concepts behind how data models evolved, study the relational data model in detail, and apply this knowledge to create and maintain a simple database system. The principles of logical and physical storage management, query processing and optimization, indexing structures, transaction processing, security issues and concurrency control will be covered in later lectures

B. Course Schedule

DATE	TOPICS	READINGS from Text Book	DUE
8/31	Introduction	1, 2.1	
9/1	Basic Concepts, Data Modeling	2.1, 2.2, 2.3	
9/5	Entities and Relationships (ER)	2.2 - 2.5	
9/7	Design Principles	2.4 - 2.7	
9/8	Relational Model	3.1, 3.2	HW #1
9/11	Conversion from ER to Relational	3.2 - 3.4	
9/12	Functional Dependencies	3.5, 3.6	Pr #1
9/14	Functional Dependencies	3.5, 3.6	
9/15	Normalization	3.6, 3.7	HW #2
9/18	Normalization	3.7, 3.8	
9/19	Relational Algebra	4.1	Pr#2
9/21	Relational Algebra	4.5 - 4.7	
9/22	Introduction to SQL	5.1, 5.2	HW #3
9/25	SQL Basics, Query Processing	5.2 - 5.4	
9/26	Mid-term EXAM	covers material through 9/21	
9/28	Aggregation, Schemas	5.4 - 5.8	Pr #3
9/29	Schemas, Views, Nulls	5.6 - 5.9	
10/2	Keys and Constraints in SQL	6.1 - 6.6	HW #4
10/3	Embedded SQL	7.1	
10/5	Transactions in SQL	7.2	Pr #4
10/6	Embedded SQL with Java: JDBC	Notes	
10/9	Intro to XML and DBs	Notes	

10/10	Intro to Object Relational features	8.5, 8.6	HW #5
10/12	Group Project Presentation		
10/13	Advanced Topics Discussion 1	Notes (Not included in Final Exam)	
10/16	Advanced Topics Discussion 2	Notes (Not included in Final Exam)	Pr #5
10/17	Advanced Topics Discussion 3	Notes (Not included in Final Exam)	HW #6
10/19	Final Exam	Cumulative	

Note: HW is homework and Pr is project.

C. Assignments:

- **Group Application Project (30% of grade)**

This is a team project in which students will work in groups of 4 assigned by the instructor to ensure diversity. The goal is to develop an application that uses database management systems for example an online bookstore. The deliverables for the course project are an initial survey, the actual software, complete and exhaustive test cases, a technical report and peer evaluation. All members of the group will be assigned the same grade subject to peer evaluation and the discretion of the instructor in special cases.

- **Homework (20% of grade)**

Homeworks are assigned at the beginning of each class. They are based on the students' knowledge of academic concepts studied in class.

- **Mid-term Exam (20% of grade)**

This is an in-class closed book exam to test the application of concepts studied until the middle of the term.

- **Final Exam (20% of grade)**

This is an in-class closed book exam to test the application of concepts studied until the end of the term.

- **Quizzes and Class Discussions (10% of grade)**

On the spot Quizzes will be conducted from time-to-time without any prior notice. This is to ensure that the students keep abreast with the materials, and also to make classes more interactive. In class participation in regular lectures is also strongly encouraged.

- **Assignments Policy**

All assignments must be turned in at the beginning of class on the due date. Late assignments will not be accepted since homework solutions will be discussed in class. Exceptions to lateness policy are at the discretion of the instructor based on genuine cases. If there are extensions to due dates they will be sent to the class mailing list. Students are encouraged to use the discussion board and have group meetings outside of class for homeworks and projects. However, homework assignments must be turned in individually.

- **Honor-Code Policy**

The requirement is that the work you do is your own. Any source of reference must be cited. Group discussions through the discussion board and meetings outside of class are encouraged, but each student must turn in individual homework assignments. Any duplication of another students work constitutes a **violation of the honor code** and will

If you have any questions about what this policy means, please discuss the matter with the instructor now.

- **Students with Special Needs**

Students with special provisions needed such as those meeting the ADA (American Disabilities Act) may contact the instructor during office hours. Students with any problems of a personal or academic nature may also feel free to approach the instructor. Provisions will be made based on the policy of the school.

D. Textbook and Recommended Reading

The required textbook for this course is: “*A First Course in Database Systems*”, J. Widom and J. D. Ullman, Prentice-Hall, 1997.

Other recommended reading:

1. *Fundamentals of Database Systems, 3rd Edition*, R. ElMasri, and S. Navathe, Benjamin Cummings, 1999.
2. *Principles of Data and Knowledge Base Systems, Volume 1*, J.D. Ullman, Computer Science Press, 1989.
3. *Database System Concepts, 2nd Edition* H.F. Korth, and A. Silberschatz, McGraw-Hill, 1991.
4. *Database Management Systems*, Raghu Ramakrishnan and Johannes Gerhke, McGraw-Hill, 1st Edition, 2nd printing, 1997.
5. *Understanding the New SQL: A Complete Guide*, J. Melton and A. R. Simon, Morgan-Kaufmann, 1993.
6. *A Guide to the SQL Standard (third edition)* C. J. Date and H. Darwen, Addison-Wesley, 1994.

2. Teaching Philosophy and Objectives for the DBMS course

Teaching is more of an interactive than a one-way process. Co-operative Learning emphasizes concepts such as team-work, teacher-student interaction, combination of theory with practice and active student involvement in the course. Principles of co-operative learning form the essence of the teaching policy outlined in the syllabus.

Students learn better when they actually implement what they learn. Hence the emphasis on the application project. This is also important for them to understand the practical significance of the course in their respective domain.

The grading policy has been designed to ensure fairness. Though group work is encouraged, individual accountability is important to ensure that each student has grasped the concepts of the course. Therefore homework assignments, a midterm and a final exam have been included in the course.

Peer evaluation has been included in the group project. This serves two purposes. First, the students get to play the role of the instructor and learn to comment on each others work. Second, this ensures that each student contributes effectively to the team project. All members of the group are assigned the same grade for the team-project to prevent unhealthy competition within the group.

Group discussion through discussion boards and class meetings is strongly encouraged for classes and assignments. This is so that students exchange ideas with each other as they learn new concepts. However assignments are to be turned in individually to ensure the individual grasp of knowledge.

Quizzes and in class discussions add to the interactive nature of the course. They also ensure that the student is attentive and is well-prepared for each class.

The Honor Code policy has been emphasized so that the students understand the meaning and importance of academic honesty. This is just as useful as the knowledge gained through the course.

Provisions for students with disabilities and other problems have been made in keeping with the policy of the school. This is to promote fairness to all. In short, the syllabus has been designed to incorporate good teaching principles and promote a healthy learning environment.

3. Selection of Textbook

The textbook selected for this course is.

- “*A First Course in Database Systems*”, J. Widom and J. D. Ullman, Prentice-Hall, 1997.

Reasons for selection

- a) This book provides an excellent overview of database concepts intended for an undergraduate class. It is better in comparison with other books reviewed in terms of clarity of concepts, introductory knowledge and examples provided.
- b) It is a fairly recent publication encompassing knowledge from the advances in database technology.
- c) It ties in well with the other books recommended for this course as cross-reference. Basic concepts studied here can be applied to using the SQL reference, and advanced techniques in books such as the one by Ramakrishnan.

Other books recommended for this course are:

- *Fundamentals of Database Systems, 3rd Edition*, R. ElMasri, and S. Navathe, Benjamin Cummings, 1999.
- *Principles of Data and Knowledge Base Systems, Volume 1*, J.D. Ullman, Computer Science Press, 1989.
- *Database System Concepts, 2nd Edition* H.F. Korth, and A. Silberschatz, McGraw-Hill, 1991.

For cross references in CS4444, and

- *Database Management Systems*, Raghu Ramakrishnan and Johannes Gerhke, McGraw-Hill, 1st Edition, 2nd printing, 1997.

For advanced reading, as this is a textbook for the graduate DBMS course CS555, and

- *Understanding the New SQL: A Complete Guide*, J. Melton and A. R. Simon, Morgan-Kaufmann, 1993.
- *A Guide to the SQL Standard (third edition)* C. J. Date and H. Darwen, Addison-Wesley, 1994.

For SQL reference manuals handy during implementation.

The books have been carefully selected so as to provide the student a good introductory knowledge of the DBMS course, background reading and implementation reference, and also to set the ground for further study in databases.

Part IV: Course Materials for the DBMS course

1. Lecture Slides

The lecture slides for this course are available in the following powerpoint presentation:

Introduction_to_Databases[1].ppt

This is being submitted as an attachment with this narrative

2. Lecture Notes

**CS4444: DBMS
Fall 2003 (C-Term)
Instructor: Aparna Varde**

Class 1: Introduction to Databases

The effective management of data is extremely important in almost every field today. A few examples of data that people from different professions deal with on a day-to-day are summarized below:

- Doctors have to deal with diagnostics of patients, and categorize data based on individuals, chronology, illnesses and so forth.
- Lawyers have histories of their clients organized on case-to-case basis.

- Managers need to store records of their employees with information like personal data, work related data and more.
- Teachers must have easy access to profiles of students with details like courses taken, grades received, goals and objectives, personal information and others.
- Students also need to organize data like course information etc.

Likewise almost every domain we can think of has immense amounts of data to manage. Data has traditionally been stored in a variety of formats. These include

- Documents e.g. written in MS Word and stored online.
- Flat files that could even be handwritten and kept in file cabinets
- Raw data that may be scattered all over the place, i.e. it exists but you don't know where, could be written on scrap pieces of paper lying around.
- More organized data e.g. in tabular form like statistical information.
- Other formats like pictures, e.g. photographs, maps etc.
- Not stored anywhere physically i.e. simply cluttered in the human memory.

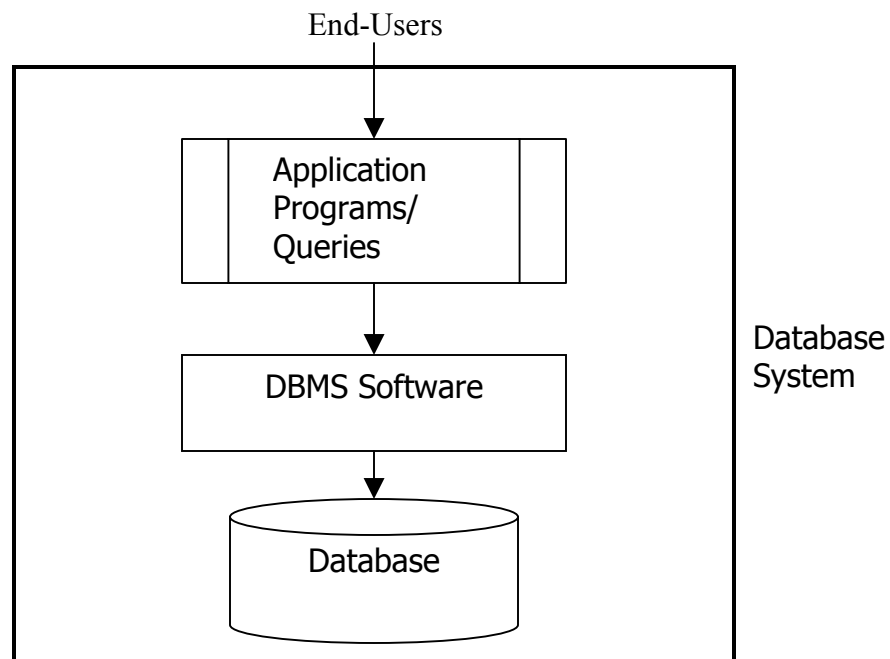
We need a more organized way of storing and retrieving the data. This is essentially what a database does. It helps store all the data in one place in a sophisticated manner, enabling fast access, easy updates, protection features and mechanisms for recovery from failures.

The terms database, DBMS (DataBase Management System) and Database System are often used synonymously. However, there are subtle differences between the three, as the following definitions point out.

- **Database** : This is a collection of data that is organized so that its contents can easily be accessed, managed, and updated.
- **DBMS (DataBase Management System)**: This is a collection of programs that enables users to create and maintain a database
- **Database System**: This refers to the Database along with the DBMS and the programs/queries that enable the application to function as a whole.

Figure 1: Database System Environment

The relationship is made clearer in Figure 1.



There are different types of DBMS. The most common is the relational DBMS or RDBMS. This organizes data in the form of tables representing real world entities with rows and columns corresponding to the instances and properties of the entity respectively. Recent developments include the object-oriented DBMS or OODBMS (in line with object-oriented programming languages) that represents entities as classes and their instances as objects, and the object-relational DBMS or ORDBMS that combines the best features of both. More discussion on the OO and OR models of a DBMS is beyond the scope of this course. These models will be studied in the Advanced Databases class. For this course, we focus on the RDBMS.

The concept of an RDBMS is best explained with an example. Consider a library management system. This has books, journals, magazines, video-tapes, CDs etc. The users of the system could be students, faculty and staff if we refer to a school library. Each real world entity, for example a book can be mapped into a table in a database. We will study more on this in the class on entity-relationship modeling. For now, we can focus on the following two entities, namely book and author, as shown in Figure 2.

Figure 2: Sample RDBMS tables

Book

<u>ISBN</u>	Title	Author	Price
AA333	Network	J.White	420.00
TH111	Metals	K.Dalton	150.00

Author

<u>SSN</u>	Name	Address	Phone
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With reference to the above example, the following terms are explained.

- Table: This is a database representation of an entity in real world, e.g. book table.
- Schema: This refers to the structure of the database, not its content, i.e. the layout of the tables without their entries.
- Tuple: This is an instance of an entity, and forms a row in the table, e.g. each book in the book table.

- Attribute: This is a property of an entity, and forms a column in the database, e.g. author, title.
- Primary Key: This refers to one or more attribute(s) that uniquely identify a tuple, e.g. ISBN number in the book table.
- Foreign Key: This refers to attribute(s) connecting two or more tables, e.g. the author field in the book table is a foreign key for the author table, or in other words the name field in the author table serves as a foreign key referencing the author field in the book table.
- View: This is a subset derived from database e.g. view of authors and titles only.
- Meta-Data: This is data about the data e.g. in a library, the books form the data, and the catalog forms the meta-data.

There are various roles in the database world, based on the tasks involved in database management. These refer to the actual jobs one would apply for, if pursuing a career in databases.

- DataBase Administrator (DBA): This is a very important position, since it involves controlling the database system as a whole. The DBA is responsible for recovery from failures, security and protection issues, dealing with inadvertent situations like system crashes and more. Since this requires the person to be on-site whenever a problem occurs, most DBAs work round the clock, typically carrying pagers or cellphones so they are reachable almost anywhere.
- DataBase Designer: This position involves the actual development of the database management system. It requires a thorough knowledge and understanding of database concepts from a theoretical and application standpoint. Creating, updating and maintaining a database are issues here.
- System Analyst/Application Developer: This position fits into the application programs module in Figure 1. The analyst and/or programmer needs to understand the overall functionality of the DBMS without getting into the details of its creation, maintenance etc. Instead he/she needs to focus on how the databases can be used to perform the intended function of the overall system, and then implement the system accordingly.
- End-User: These are the people who actually use the system, i.e. the client company that wants the product or the customers to whom one would sell the product etc.

The use of databases makes life easy for almost everyone. We have seen its applications in various domains. It is also clear that a programmer would benefit from using databases to store data related to the system being developed, rather than create simple data structures to store data relevant to the program. On a more precise level, the following are the advantages of database management systems.

- Control redundancy: With reference to the example in Figure 2, we create two tables instead of one to store the book and author information. That is because, if one author has written say 5 books, then we would not want to store personal

details of the same author 5 times. We would rather store author information separately and reference it as needed. Thus databases help minimize redundancy. The disadvantage of redundancy in addition to wasted storage space, is the consistency issue. If we keep multiple copies of the same information, we need to make sure that one update gets reflected in all the copies. Thus, databases are a big boon in controlling redundancy.

- Restrict unauthorized access: We need to protect our systems from intruders. We also need to provide security within the group in multi-user environments. Storing data in a DBMS helps to achieve this.
- Provide persistent storage for data: If a programmer creates a data structure such as an array to store data generated during the program, then this data structure does not exist after program execution. This is referred to as transient storage. If another program wishes to access the same data, it needs to be regenerated. However, a database provides persistent storage implying that the database and its contents persist or continue to exist after program execution, and can be reused by other programs.
- Represent relationships among data: When data is stored using a certain model, in our case the relational model for databases, it becomes easier to understand and represent the relationships between entities in the system. For example in Figure 2, we know how book is related to author and we model that using a foreign key. This can be pictorially represented in the form of E-R or Entity-Relationship diagrams that will be studied in detail later.
- Enforce integrity constraints: Constraints are conditions that ensure the correctness of the data and the relationships between them. For example, if a particular field is a primary key for a table, then that field cannot be null, since it serves to uniquely identify a tuple. Similarly a foreign key must be non-null, and if the instance of the parent entity is deleted, then appropriate action must be taken on the child entity, i.e. in Figure 2, if all books written by an author cease to exist, then the author information should get deleted. A DBMS allows us to enforce these constraints, thus ensuring the integrity of the data.
- Provide backup and recovery: The DBMS has mechanisms to provide for recovery from failures like erroneous transactions, system crashes etc. Examples of these are commit and rollback operations, which will be studied in detail later in this course.
- Allow Concurrency Control: In a multi-user environment, it could happen that two users try to update the value of the same field at the same time. A DBMS has features like locking and transaction control, making sure that at a time only one update by one user goes through. This again is a topic that will be covered in more detail in this course.

Some of the popular DBMS packages that exist today are Oracle, Sybase, MS Access etc. Oracle provides relational and object-relational features, Sybase provides web database features like Websql in addition to regular relational features, and MS Access is good for PC and desktop applications. SQL is the most popular language for querying relational databases.

In short, we have covered the need for databases, the differences between the terms database, DBMS and database system, the types of DBMS, the terminology associated with RDBMS, the roles in the database world, the advantages of a DBMS and the popular DBMS packages. We will be dealing with more details of these, and further topics such as E-R modeling, relational algebra, query processing, transaction management, indexing, normalization and others in later chapters.

Home-work 1 (to be turned in hard copy at the beginning of class 2)

- Part 1 (to be done individually)
 - Collect and store data for a sample application in your domain without using databases. Run simple retrieval tasks on your data.
- Part 2 (teams of four)
 - Discuss the difficulties involved in the above task. Record difficulties of each member in your team including yourself.

Lab 1 (to be turned in electronically in the week following class 2)

- Get an account on Oracle from the CCC
- Then do the following
 - Login to wpi.wpi.edu
 - At prompt, say “source coraenv”
 - Then enter, “sqlplus”
 - System will prompt you for Oracle username and password. Enter that.
- Refer to Chapter 1 of the Oracle handbook.
 - Create the simple database with 3 tables as explained in the example there.
 - Populate the table with sample entries from the manual
 - Turn in an electronic screen dump of created, populated tables in the database.

3. Quiz for the class

Instructions

This quiz is being offered at the beginning of Class 2. Please attempt this individually.
Time allotted: 20 minutes

1. Categorize the following as Database, DBMS, Database System or neither.
 - a.) Sybase
 - b.) Airline Reservation System
 - c.) DB2
 - d.) Organization of student records in a university in normalized tables
 - e.) SQL
 - f.) Online storage of patient case histories with software that helps doctors analyze.

2. Refer to the example given in class regarding book and author. As discussed in class the primary keys for book and author are ISBN and SSN respectively.
 - a) Identify a foreign key and explain its advantage
 - b) Explain what would happen if we tried to insert another record in the book table with the ISBN number "TH111".
 - c) Does it matter if the SSN field in the author table is left blank and the other fields are populated. (i.e. would the system accept this or point an error)?
 - d) If instead, the phone field in the author table is left blank and all other fields are populated, what would the system do? (i.e. difference between c and d if any).

- 3) If you had a commitment at home every evening that only allows you to work fixed hours every day (say 9 am to 5 pm), then which of these jobs would be least suitable for you and why?
 - a) Database Designer
 - b) Database Administrator
 - c) System Analyst

4. Teaching Philosophy for the class

The teaching philosophy in this course in DataBase Management Systems (DBMS) emphasizes co-operative learning. The class-style involves group discussion, active student involvement in answering questions, interactions with each other within and outside class and more.

The use of slides aids the learning process since students grasp better when they see and hear at the same time. They are forced to stay awake and listen when the instructor prompts for questions and picks different students to answer. They also have the opportunity to relate their respective domain of knowledge to the course being taught. Moreover, they understand the significance of the course and what job prospects this field of study, namely Data Management has for them. This introductory class on databases drills many concepts into their minds that will be useful later.

The idea of an in-class assignment somewhere mid-way between the class, is to give students an opportunity to interact with each other and produce results in a simple team-work assignment. This also helps them assess how much knowledge they have gained from the class up to that point.

The first homework assignment gives them a hands-on experience of how difficult it is to manage data without databases. This is essential, so that they can grasp the significance of the course. Moreover, this also gives them the experience of team-work outside class.

The teams are assigned in such a way as to ensure a mix of countries, academic backgrounds, gender etc. Special provisions are made in the course for students with disabilities. The teaching style accommodates all kinds of students.

The first lab gives the students an exposure to the very basics of Oracle and SQL statements. This is important to be able to work on database application development later in the course. This also gives them an experience of using handbooks and manuals as reference for a particular task.

The quiz administered at the beginning of class two tests the ability of the students to retain the knowledge they have grasped during class one. This is kept short and simple with the objective of encouraging students to pay attention in class, and to be prepared for the next class.

The overall learning style in this class and in the course as a whole is designed with the VARK principles in mind. The learning styles of different students are taken into account. This helps maintain a balance and caters to the needs of all the students.

In short, it is hoped that this course provides students a good theoretical and practical knowledge of DBMS i.e. database management systems.

Part V: Interesting Anecdotes In Teaching

1. Metaphors for Teaching and Learning

Metaphor 1: A student's mind is like a computer. the teacher writes the software to make it work.

Explanation: The teacher here actually provides the knowledge(software) that makes the student(computer) do the learning(functioning). Without the software, the student may have the capacity to produce results, just like a computer has all the parts needed. But the software actually makes the computer function effectively, analogous to a student being made to utilize his/her potential effectively to contribute to the learning process as a whole.

Metaphor 2: Students are like cells in biology. the teacher provides the framework to make the cells effectively function as organs, and the organs in turn to form the human body.

Explanation: This is for co-operative learning. the student himself is just a single entity like a cell. the teacher makes the students co-operate, thereby sharing knowledge and working together to behave like organs. organs can be analogous to classrooms. the teacher then provides promotes more team work to make the organs (classes) effectively function as a bigger whole unit, i.e. the human body, analogous to the university or academic institution as a whole. this metaphor emphasizes the essence of students and teachers in the success of an institution and of the learning process in general.

Metaphor 3: Learning is like the producing of the movie in which the director acts as a teacher and the actor/actress acts as a student.

Explanation: Given a good script, to make a blockbuster, we need the excellent director and actress/actor, and the most important of all, we need the cooperation of them. The director should have an overall view for the whole movie and give directions to the actress/actor, and the actress/actor should try her/his best to perform the role. They must exchange their thought thoroughly and deeply to gain the best effort for the movie. This metaphor focuses on the cooperation of the teacher and the student. To get the knowledge, both the student and the teacher should have a clear idea about what they

need to do, the process of teaching and learning will be in such a harmony that the efficiency will reach the peak.

Metaphor 4: Learning is like purchasing a car in which the dealer acts as a teacher and the customer acts as a student.

Explanation: When the customer enters the car-market to purchase a car, maybe she/he has no idea which kind of car she/he will purchase, maybe she/he already got something in her/his mind, both case she/he need the dealer to give her/him some advice on the car, then she/he can make a decision. The dealer should have plenty of knowledge about the car, according to different request from the customer, sh/hee will give corresponding explanation to her/him. This metaphor focuses on the responsibility of the student and the teacher. The teacher should give the guide according to the different level of the student. The student should have the desire to learn more knowledge from the teacher and use the knowledge into her/his real life. by this way, the learning process will be finished efficiently.

2. A Memorable Learning Experience

The most rewarding learning experience I have ever had is “car-driving lessons”. I know this is a different kind of learning, not the usual classroom one, but I would still like to mention it, since it is my most unforgettable experience. I hardly drove back in Bombay, and on coming here did not drive for the first two years, being an MS student.

When I got my first job, I started taking driving lessons, and the instructor Mark happens to be one of the most patient persons I have ever met. We started on a friendly note, me telling Mark everything about my fear of the roads, especially freeways, and about my really bad sense of direction, and he explaining to me how things would be even harder for me, since I have been brought up in a country where the traffic is on the opposite side of the road, compared to the United States. Mark first insisted that I thoroughly read the Massachusetts driver’s manual again, even though I had already cleared the written test and obtained a learner’s permit.

The learning style was that I had to read a specific chapter and then practice the concepts introduced there in the next driving lesson. For example, I would read about the rules involved in entering and exiting freeways, and then he would take me on a freeway the next day, helping to drill those concepts into my head. He realized that my biggest weakness was lack of concentration, and suggested some deep meditation exercises that I was supposed to regularly practice at home. This really helped me improve my focus.

Another good part of the learning process was that we spread out the lessons, three times a week, over a period of one month, rather than doing a crash course. This gave an overall better learning curve. If I ever found a particular skill too hard to acquire, then he gave me more lessons on that one, encouraging me to keep pursuing and never give up.

That motivation really helped. Parallel parking was one such skill. In order to improve my sense of direction, Mark chose different routes for practice, going through a route the first time, explicitly pointing out where we took a turn etc, and then making me go through it a second time, without his guidance. I fumbled up initially, but gradually learned to pay more attention, and towards the last lesson, was able to do a better job.

Also, one thing I really appreciate about this experience, was that when it was time for me to take the actual road test on my first scheduled date, Mark suggested that I cancel the appointment. He said that even if I cleared by a stroke of good luck, I was still not confident enough to drive alone. “I have seen situations where if I had not intervened, you would have gotten into serious accidents”, he said. He suggested that I increase my tutoring sessions by another couple of weeks, and focus only on practicing, since I had almost reached the end of my learning curve in acquiring the knowledge. During these two weeks, Mark made me drive without his instructions, interrupting only if I made a mistake. He said, “Take each of these practice classes as if it is your final road test.” So I did, and it really mustered my confidence.

When I finally rescheduled the road test, and appeared for it, the person offering the test was quite pleased with my driving. I did not make any mistakes, and cleared at the first attempt, much to the surprise of all my friends. When I conveyed the good news home in India, my family was overjoyed. This may seem a small achievement to most of you, but for me it was crossing a big milestone of my life. The fact that I can now drive a car and be mobile without being dependent on anyone was a very thrilling feeling. I have been driving for the past three years in the USA now, and even long-distance driving seems fun. Thanks to the great learning experience.

3. Best and Worst Assessment Methods

1. Best Practice: One of the best examples I have encountered in assessment methods was in my undergraduate class in software engineering. The professor asked us to develop a small sample of code every week, both without and with documentation. We had to work in teams of two. The coding was done individually, and then we had to evaluate each others' work. The purpose was to find bugs in another person's code. We rotated teams in the class for each assignment. We tried out both the documented and undocumented code. The bugs were to be found by a simple walkthrough first, and then by actual execution. We used test cases developed by the other person, plus designed our own. Then we assigned points to our team member. We also gave suggestions for fixing bugs. Self evaluation was done as a second round, and we gave ourselves points. Then the third round was evaluation by the instructor. Since this was done after peer-evaluation and bug-fixing and self-evaluation, this had the dual advantage of students having better performance and making the teachers grading job easier. It also taught us an important lesson in software engineering that it is always harder to find faults with your own code, which is why development and testing teams are usually separate from each other in the

industry. This is one of the best assessment methods I have experienced.

2. Worst Practice: One of the worst grading practices I have experienced is the ranking system back in my high school days. The students were ranked as 1,2,3 and so forth and the ranks went down as far as 30, this being the actual class size. This made the top-ranker feel great and the rank 30 student feel rather dejected. I feel assigning grades, where even all students can get As if they deserve, is a much better system than ranking. Ranking leads to unhealthy competition among students, and there are times when they refuse to help each other before examinations, for fear of sharing the knowledge they have that would give them a higher rank. I think that this is one of the worst practices, hampering co-operative learning.

Part VI: Statement of Interest

Having obtained a Baccalaureate in Computer Engineering and a Masters in Computer Science, I am now pursuing a Ph.D. in Computer Science with a focus in Databases. Upon the completion of my Doctorate, I intend to pursue a career in academia as a Faculty member. My primary interest is graduate teaching and research, although I also wish to get involved in undergraduate teaching in order to enhance the breadth of my knowledge and experience.

During my Masters and Ph.D. at Worcester Polytechnic Institute (WPI), I worked as a Teaching Assistant (TA). My responsibilities included conducting labs and help sessions, grading, proctoring exams and the like. This involved closely working with both professors and students. I would like to work as an undergraduate Instructor during the final year of my Ph.D., if I get the opportunity.

Graduate and undergraduate teaching both require depth and breadth of knowledge. My Ph.D. is helping me acquire the depth in the field of databases. My research so far has focused on Data Warehouses, with specific emphasis on View Maintenance, I have three international publications in the Data Warehousing area. My other research interests include Data Mining and Web Databases. Regarding the breadth of knowledge, my Bachelors and Masters along with approximately 4 years of work experience in the Software industry, have helped me acquire that. I think it is an asset to have exposure to the real world, in order to be an effective teacher.

Besides the knowledge, I possess very good communication skills, and have earned the reputation of having the talent for teaching from my students, colleagues and supervisors. I also have an easy-going nature and am able to mix easily with students. Having grown up in India, studied in the USA, and traveled to other countries, I have the exposure to a variety of cultures and the educational system in different countries. I would also be able to cater to students with special needs. Having taken the seminar in college teaching (IDG501) at WPI, I have a formal perspective of teaching methodologies.

I would like to start with teaching an undergraduate course in Databases. A DBMS course would be a good example. I could then move on to teaching Advanced Databases to graduate students. These are my preferences. However, I would also be comfortable teaching any of the core graduate courses in Computer Science for a start. These are Software Engineering, Operating Systems, Analysis of Algorithms and Foundations of Computer Science. Yet another alternative would be teaching the fundamental course in undergraduate school such as Introduction to Programming, Engineering Mathematics and similar courses.

As time progresses, I would like to get more involved with research, in terms of supervising students with their undergraduate qualifying projects and with graduate Masters theses. It would take me quite some time and experience, before I can actually become an advisor for Ph.D students, although I would like to do that eventually. I would like to spend my summers working in the industry to gain more experience. My ultimate goal is to reach the level of Full Professor or higher. Teaching is my passion and when one pursues ones passion, a career becomes a life in itself.