

# Database Management Systems

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**IIT Guwahati**

Tue, 05<sup>th</sup> Jan 2021

# Greetings

2021

- Wishing you all a very happy new year
- With a positive hope that you all will be here on campus in this year
- That you will be leading regular academic activities with no constraints

# Outline

## Theory

- About CS245
- Text books
- Pre-requisites
- Evaluation model
- Grading policy
- Re-evaluation policy

# Outline

## Databases Lab

- About CS246
- Pre-requisites
- Lab organization
- Lab material
- Lab teaching assistants (TAs)
- Evaluation model
- Grading policy

# About CS245

## Syllabus

### Using DBMS as a black box

- ER Model
- Relational model and algebras
- SQL
- Normalization

# About CS245

## Syllabus

### Internals of relational DBMS

- File organizations
- Indexing (tree, hash, and bitmap)
- Implementation of relational operators

# About CS245

## Syllabus

### Transaction management

- ACID properties
- Concurrency control
- Crash recovery

# About CS245

## Syllabus

### Non-relational DBMS

- When time permits
- Consistency and availability trade-offs
- NoSQL databases (key-value, document, and graph)

# CS245: Books

## Text Books

- R. Ramakrishnan and J. Gehrke **Database Management Systems**, McGraw Hill, 2014
- H. Garcia-Molina, J. Ullman, J. Widom, **Database System: The Complete Book**, 2nd Edition, Pearson, 2013

# CS245: Pre-requisites

## Course Pre-requisites

Have credited [CS203](#) Algorithms and Data Structures

# About Instructors

## Two Instructors

- Dr. V. Vijaya Saradhi ([saradhi@iitg.ac.in](mailto:saradhi@iitg.ac.in))
  - CS245: Will take the first 21 lectures; starting from 05 Jan 2021
  - CS245: Covers SQL, ER model, relational algebra
  - CS245: Will conduct two exams
  - CS246: Will conduct five lab sessions; starting from 11 Jan 2021

# About Instructors

## Two Instructors

- Dr. Rashmi Dutta Baruah ([r.dutta@iitg.ac.in](mailto:r.dutta@iitg.ac.in))
  - CS245: Will take subsequent 21 lectures; starting from 23 Feb 2021
  - CS245: Covers systems aspects of databases
  - CS245: Will conduct two exams
  - CS246: Starting from 01 Mar 2021

# CS245: Evaluation Model

S. No.	Description	Weightage (%)	Exam Date
1	First exam	25	28-Jan-2021
2	Second exam	25	18-Feb-2021
3	Third exam	25	To be announced
4	Fourth exam	25	To be announced

# CS245: Grading and Re-evaluation Policy

- Relative grading is followed
- Check your answers and compare with the published answers
- Approach the TA in case of ambiguity
- Resolve it **within a week** publishing of marks

# About CS246 Database Management Systems Lab

## Syllabus

- Using a relational DBMS Writing SQL queries, accessing a DBMS from external applications, writing systems programs
- Each lab carries equal weightage

# About CS246 Database Management Systems Lab

## Material/Text Books

- Same as that of CS245

# CS246: Labs Organization

## Organization

- Every lab will have an assignment
- You will be given necessary information to perform the assignment
- Individual efforts is what is expected out of the given assignments.

# CS246: Labs Organization

## Evaluation and Grading

- The solution will be evaluated by the TAs
- Marks will be awarded as per your implemented solution
- Re-evaluation request must be made before the next lab assignment
- Relative grading is followed

# Databases

## Introduction

- Integral part of our day-to-day life
- Some times we have not paid close attention while interacting with the database systems
- Examples

# Example - 01

## List of courses

Academic Running Course List By Department Wise																
S.No.	Department	Period	Course Code	Course Name	L	T	P	C	Course Start Date	Course End Date	Grades Submission End Date	Coordinator Name	Instructor name	Class Timings	Exam Date	Eligibility
1	Civil Engineering	JAN - MAY 2021	CE205	Structural Analysis I	3.00	3.00	0.00	0.00	05 Jan, 2021	21 Apr, 2021	28 Apr, 2021	Prof. Arjun Datta	Prof. Arjun Datta		21 Apr, 2021 (8:00 AM - 12:00 PM)	Eligible for:- B Tech Civil Engineering; B Tech Civil Engineering;
2	Civil Engineering	JAN - MAY 2021	CE212	Civil Engineering Materials Laboratory	0.00	0.00	0.00	0.00	05 Jan, 2021	21 Apr, 2021	28 Apr, 2021	Dr. Indra Siva Ranjan Gandhi	Dr. Indra Siva Ranjan Gandhi		Eligible for:- B Tech Civil Engineering; B Tech Civil Engineering;	

## Example - 02

### List of open electives

**List of Open electives for Winter Semester(Jan - May 2021) of Academic year 2020-2021**

Sl.no	Course Code	Course Name	Class Slot
1	CE559	Watershed Management & Remote Sensing Application	F
2	ME671	Biomaterials: Design and Applications	F
3	ME674	Soft Computing in Engineering	F
4	CS577	C-Based VLSI Design: Synthesis, Optimization and Verification	F
5	DD606	Product Detailing	F
6	BT633	Human Biology and Diseases	F
7	BT622	Biofuels	F
8	BT640	Neural Imaging And Signal Systems	F
9	CL618	Natural Gas Engineering	F
10	CL625	Fundamentals of Micro-nano Fluidics and Micro-Fabrication	F
11	CL639	Biofluid Mechanics	F
12	CL643	Computer Aided Applied Optimization	F
13	EE626	Pattern Recognition and Machine Learning	F
14	PH446	Fundamentals of Astrophysics	F
15	PH465	Optoelectronics	F

# Example - 03

## HSS elective allotment

**Indian Institute of Technology Guwahati**

**Academic Affairs**

### HSS Elective Allocation for January May 2021 Semester

Sl. No	Roll No	Name	Course No	Course Name
1	170101001	Aayush Patni	HS 424	Economics of Uncertainty and Information
2	170101002	Abhishek Jaiswal	HS 415	History of Contemporary India
3	170101003	Aditya Vardhan Gara	HS 415	History of Contemporary India
4	170101004	Ajinkya Shivashankar	HS 420	Writing Systems of the World
5	170101005	Aman Mishra	HS 401	Management of Organizational Behaviour
6	170101006	Aman Raj	HS 429	Indian Business History
7	170101007	Aniket Rajput	HS 401	Management of Organizational Behaviour
8	170101008	Annanya Pratap Singh Chauhan	HS 429	Indian Business History
9	170101009	Anubhav Tyagi	HS 424	Economics of Uncertainty and Information
10	170101011	Aranya Aryaman	HS 415	History of Contemporary India
11	170101012	Arpit Gupta	HS 429	Indian Business History
12	170101013	Aryan Agrawal	HS 429	Indian Business History
13	170101014	AVIRAL GUPTA	HS 424	Economics of Uncertainty and Information
14	170101015	Avneet Singh Channa	HS 415	History of Contemporary India
15	170101016	B Shri Raam Reddy	HS 424	Economics of Uncertainty and Information
16	170101017	Rohith Chodavarapu	HS 424	Economics of Uncertainty and Information
17	170101018	Bhavani datt	HS 421	Sociological Perspectives on Modernity

# Example - 04

## List of Foreign Students

Citizenship of India (OCI)  
 Self- Financed Candidates  
 Information for incoming exchange  
 students  
 Information Regarding Internship  
 Before Arriving at ITG  
 After Arriving at ITG

Guwahati. He/she will also bear travel cost from his/her home country to India(Guwahati)

Student should attach either a bank statement showing that they have enough finances in their own bank account or a letter from their parents or sponsors certifying that they will support all the expenses incurred by the student as mentioned above in (1)

DOAER will forward the list of selected students to DOAA, (with the departmental approval/selection report) along with (1) and (2) received from the student for processing and obtaining the Director's approval. [More...](#)

### List of current international students

#### Category

2019  
 2018  
 2017  
 2016  
 2015

SL. NO.	NAME	COUNTRY	PROGRAM	DEPT.
1	Dr. Md. Arifur Rahman Khan	Bangladesh	Post Doc	BSBE
2	Marina Orrite Serrano	Spain	B.Tech. (Exchange)	EEE
3	Dr. Sayed Mehdi Dehdashti	Iran	Post Doc	BSBE
4	Yusuke Ono	Japan	B.Tech. (Internship)	Mechanical Engineering
5	Takahiro Hiramatsu	Japan	B.Tech. (Internship)	Mechanical Engineering
6	Ms. Adejoke Naomi Kolawali	Nigeria	Research Intern	BSBE
7	Mr. Albion W. L. Gonzalez	Spain	B.Tech. (Exchange)	Mechanical Engineering
8	Mr. Florian Drouet	France	M.Tech.	Civil Engineering
9	Mrs. Kawkab Kanjo	Syria	M.Tech.	Biosciences and Bioengineering
10	Mr. Ali Jraisheh	Syria	M.Tech.	Mechanical Engineering
11	Ms. Nafiseh Manteghi	Iran	M.Tech.	Biosciences and Bioengineering

# Example - 05a

## List of Hostels (static)

The screenshot shows a university website's homepage with a navigation bar at the top. The navigation bar includes links for Home, Rules, Scholarship, SAC, Boards, SA Courses, Hostels, Forms, Quick Links, and Team. A dropdown menu for 'Hostels' is open, listing the names of various hostels: Borak, Brahmaputra, Dibang, Dihing, Dhemaji, Karimganj, Lohit, Manas, Married Scholars', Sivasagar, Subansiri, and Umiam. Below the navigation bar, there is a promotional banner for an 'Online Anonymous Counselling Portal'. The banner features three questions: 'Are you feeling Low?', 'Are you confronted with situations that you are not sure how to deal with?', and 'Or you find it difficult to discuss in a face to face situation?'. It also includes a call to action 'Visit our Online Anonymous Counselling Portal' and images of a smartphone and a computer monitor. At the bottom of the page, there are links for Students' Achievements, All Achievements, Recent Announcements, and Past Announcements. A news card at the bottom left is titled 'IT-Guwahati students build car that can go 0-60 km/hour in 6 seconds' and includes a small image of a car. Another news card at the bottom right is titled 'Tobacco Free Guidelines Circular - 15/2020' and includes a small image of a document.

Hostels

- Borak
- Brahmaputra
- Dibang
- Dihing
- Dhemaji
- Karimganj
- Lohit
- Manas
- Married Scholars'
- Sivasagar
- Subansiri
- Umiam

Students' Achievements      All Achievements      Recent Announcements      Past Announcements

IT-Guwahati students build car that can go 0-60 km/hour in 6 seconds

Tobacco Free Guidelines  
Circular - 15/2020

# Example - 05b

## List of Items (dynamic)

The screenshot shows the Amazon.in homepage with a sidebar menu on the left and a main content area on the right.

**Left Sidebar (Hello, Sign in):**

- Fire TV Stick
- Kindle E-Readers & eBooks
- Audible Audiobooks
- Amazon Prime Video
- Amazon Prime Music

**Shop By Department:**

- Mobiles, Computers
- TV, Appliances, Electronics
- Men's Fashion
- Women's Fashion
- See All: ▾

**Programs & Features:**

- Gift Cards & Mobile Recharges
- Flight Tickets

**Main Content Area:**

- Amazon Fashion:** SUPER SALE 1ST - 3RD JAN UP TO 70% OFF
- Home essentials | Amazon Brands & more:** Bedsheets, curtains & more; Cloth organizers, boxes & baskets
- EOSS | Style for Mens | Up to 70% off:** Clothing; Footwear
- Sign in for your best experience:** Sign In securely
- Laptops from Top Brands:** A grid of laptop images.

# Observations

In the presented examples

- Examples 1 to 4 are in tabular form
- Each table has **fixed** number of columns
- Each table has **varying** number of rows
- Columns within a table hold values
- Example 5a/5b on the other hand not merely resembles data in the table format

# Databases

## Application Specific

- Structured
- Un-structured

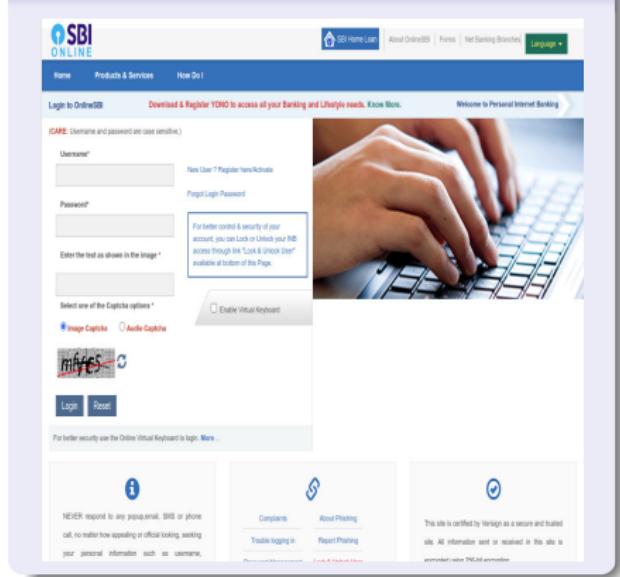
# Databases

## What Differentiates These?

- How elements are stored?
- How queries are formulated?
- How elements are retrieved?
- How elements are updated?
- How multiple user engagement is handled?
- How volume of the queries is handled?
- How quality is achieved?

# Structured - Example 01

## Banks

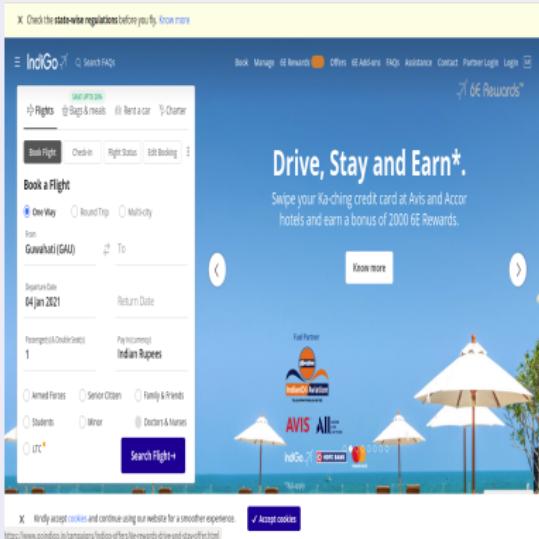


## Queries

- What is my savings bank balance?
- Deposite 10000 rupees
- Withdraw 5000 rupees
- Provide me the last months bank statement

# Structured - Example 02

## Airlines



## Queries

- List flights between Guwahati & Vizag on 15-Jan-2021
- Book a ticket of 5 passengers on flight 6E-512
- Pay money
- Modify the date of travel from 15-Jan-2021 to 16-Jan-2021 on the same flight with same set of passengers

# Structured - Example 03

## Railways

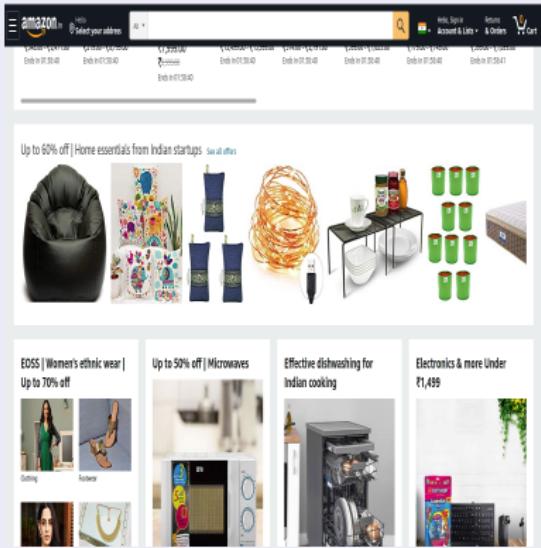


## Queries

- List trains between Guwahati & Vizag on 15-Jan-2021
- Book a ticket of 5 passengers on train 12345 & 12842
- Pay money
- Modify the date of travel from 15-Jan-2021 to 16-Jan-2021 on the same train with same set of passengers

# Structured - Example 04

## E-commerce

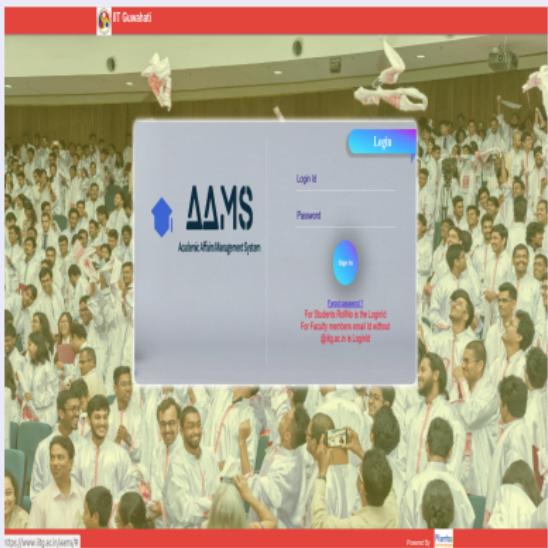


## Queries

- List books on database management systems
- Buy the book by Raghu Ramakrishnan
- Pay money
- Modify the shipping address

# Structured - Example 05

## University



## Queries

- Show my transcript
- Show the list of courses this semester
- Add the elective CS544
- Drop the added elective
- Register

# Structured - Example 06

## Competitive Exams

The screenshot shows the homepage of the Joint Seat Allocation Authority (JSSAA) for the Academic Year 2020-21. The page title is "Joint Seat Allocation Authority 2020" and it specifies "IITs, NITs, IEST, IIITs and Other-GFTIs for the Academic Year 2020-21". The logo of the Ministry of Education is visible. The main content area includes sections for "Important Information", "Introduction", "Qualifying Examination", "Admitting Institutes", "Information Regarding Related Related to JSSAA", "Opening and Closing Rank", and "Admission & Partial Fee Payment (JNTU System)". A sidebar on the left lists "Important Instructions to Candidates", "Eligibility for JNTU System", "Public Notice: Change of Willingness (Order 18, 2020)", "Instructions to Candidates", "State of Eligibility Document", "Print Labeled Choices", "Counseling Schedule (Updated on Nov 16, 2020)", "User Roles", "View Participating Institute Profile", and "Important Instructions to Candidate for Admission". A footer at the bottom contains a link to the "Helpdesk" and a "Logout" button.

## Queries

- Show my list of choices
- Select IIT Roorkee, 4 years B Tech in CSE
- Delete IIT Ropar, 4 years B Tech in Chemical Engineering
- Add NIT Warangal, 4 years B Tech in ECE
- Confirm my choices
- Float my choices
- Pay the fee

# Structured - Example 07

## Passport

Sunday, January 03, 2021 | 10:00:10 PM | Skip to main content | Screen Reader Access | Sitemap | Home | A- A+ 🔍

Passport Seva  
Consular, Passport & Visa Division  
Ministry of External Affairs, Government of India

New User Registration  
Existing User Login  
Check Appointment Availability  
Track Application Status

National Call Centre  
1800-258-1800

Passport Office Page  
Passport Office

Mission/Post Page  
Country

Login for Official Users  
Official Users

Notices and Updates

Before You Apply

Information Corner | Forms and Affidavits | Document Advisor | Feedback and Grievances

Getting Started | Tactual Appointment Opening Time  
FAQs | Appointment Availability Status  
Passport Act and Rules | Fee Calculator  
Quick Guides | Know your Police Station  
Instructions Booklet | Locate Passport Seva Kendras  
All India Network of Passport Services | Locate Common Service Centers  
Public Advisory | Caution for Public

Steps to Apply | Value Added Services

## Queries

- Show the available free slots
- Book the slot on 12-Jan-2021
- Submit relevant documents
- Pay the fee

# Structured - Example 08

## Land Registration

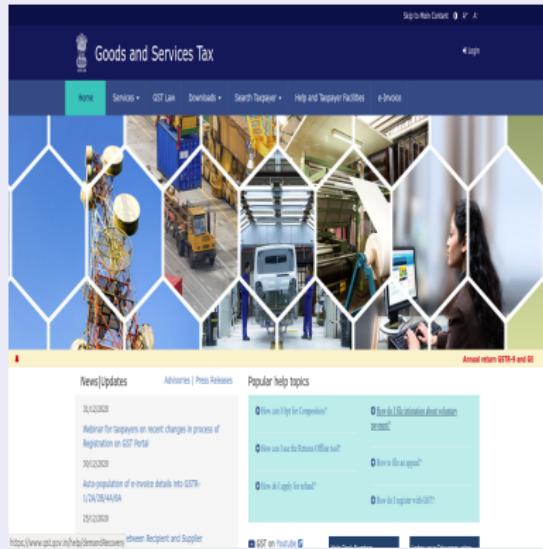


## Queries

- Show my land records
- Book the available slot with the Registrar
- Pay stamp duty
- Register biometric data
- Submit relevant documents
- Register my land

# Structured - Example 09

## GST



## Queries

- Show how much tax to be paid this month
- Pay the tax amount
- Claim tax concessions
- Show the tax paid history for last three months

# Structured - Example 10

## Income Tax

The screenshot shows the official website for Income Tax e-filing. The top navigation bar includes links for About Us, Feedback, Accessibility Options, Contact Us, e-News, and Help. A search bar is also present. The main banner features a purple background with the text "NO MORE FEE. GET YOUR PAN INSTANTLY" and "APPLICATION FREE". Below the banner, there are links for "APPLY NOW", "e-Verify your Return using Aadhaar", "Required User? Login Here", and "Forgot Password? Reset". On the left side, there are "Quick Links" for filing forms like DTRV9, Instant PAN through Aadhaar, Tax Calculator, Link Aadhaar, e-Pay Tax, Verify Return, View Form 26AS(Tax Credit), Outstanding Demand, ITR Status, Know Your TAN, Verify Your PAN Details, Tax Calendar, Check Refund Dispatch Status, and Verification of applicability u/s 194N. There are also links for "News & Updates" (including news from 9/10/2020, 8/10/2020, and 30/9/2020) and "How to?" (including links for Scan the Supporting Documents, e-Verify Return, Reset Password, Update PAN/Aadhar Details, and Report Account Mismatch). At the bottom, there is a section titled "More" with "Statistics" and a summary of user activity: Individual Registered Users (85565), Registered and Aadhaar Linked (1204324), Not Registered but Aadhaar Linked (1612335), and e-Verified ITRs (Q3-21) (409454).

## Queries

- Get the form number ITR-1
- Fill this years tax returns information
- Save the entered data
- Pay the remaining tax amount
- File the tax returns

# What is the underlying structure?

## Queries

- Data is stored in a tabular format
- Stored data is from the system defined data types
- Operations are centered around tables
- Tables are manipulated; rows of tables are manipulated
- Multi-user, volume, scale, integrity etc.

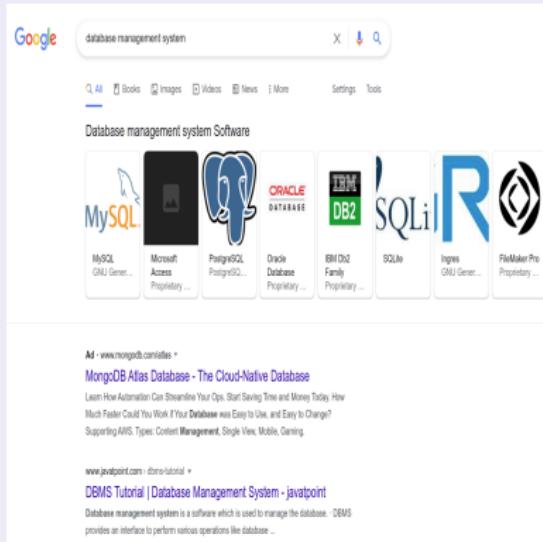
# Databases

## Un-structured

- Text
- Documents
- Images
- Audio
- Videos
- Source code
- Software binaries
- Graphs
- Maps
- Biometric databases
- :

# Unstructured - Example 01

## Text

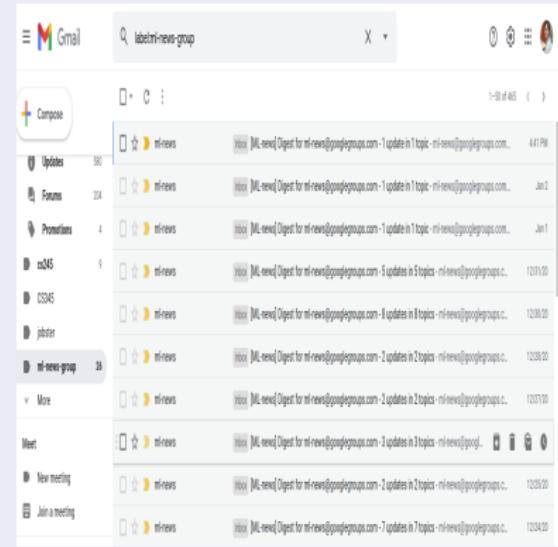


## Queries

- Query expressed in natural language
- Retrieved data is text, pdf, ppt, etc
- Data: Only querying allowed
- Understanding user intent is important

# Unstructured - Example 02

## Text



## Queries

- Retrieve emails from specified cs245 course
- Retrieve emails containing text "database management"
- Compose email to course instructor
- Delete emails

# Unstructured - Example 03

## Documents

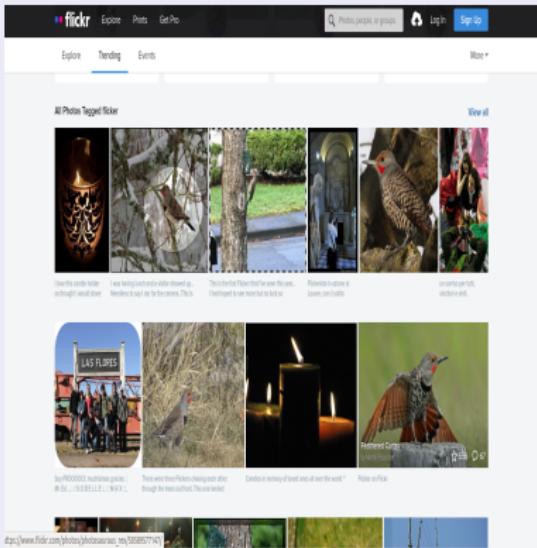
The screenshot shows the homepage of the Neural Networks journal. At the top, it displays the journal's name "Neural Networks" with a subtitle "Supports open access". Below this, there are navigation links for "Articles & Issues", "About", "Publish", "Submit your article", and "Guide for authors". A search bar is also present. The main content area is titled "Volume 135" (Issue 3, March 2018). It features several article abstracts with titles like "A comprehensive study of class incremental learning algorithms for visual tasks", "Insights on the role of external globus pallidus in controlling olfactory neurons", and "Exploration of image statistics with sparse coding in the case of stereo vision". Each abstract includes a "Download PDF" link and an "Article preview" link.

## Queries

- List all the articles published in March 2018
- List all the articles containing "SQL"
- Show the article titled "A Relational Model of Data For Large Shared Data Banks"
- List all the articles published by the author E. F. Codd

# Unstructured - Example 04

## Images

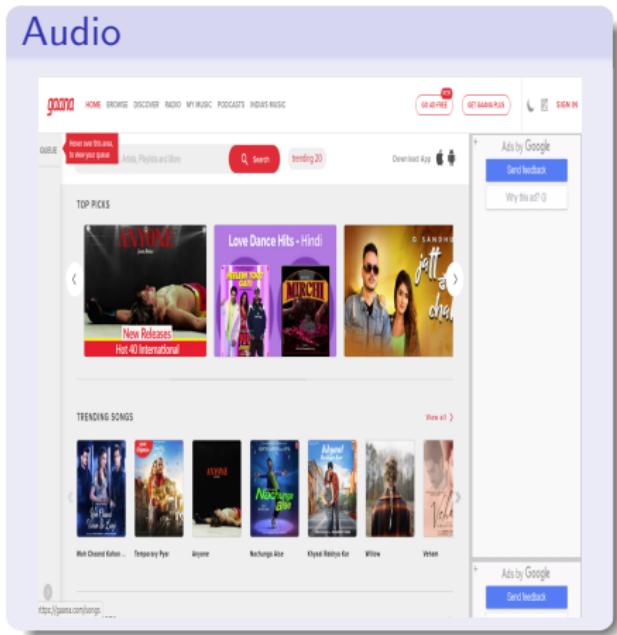


## Queries

- Show the images with IIT Guwahati
- Show the images containing serpentine lake
- Show the images in the year 2020
- Show the images from the author

# Unstructured - Example 05

## Audio

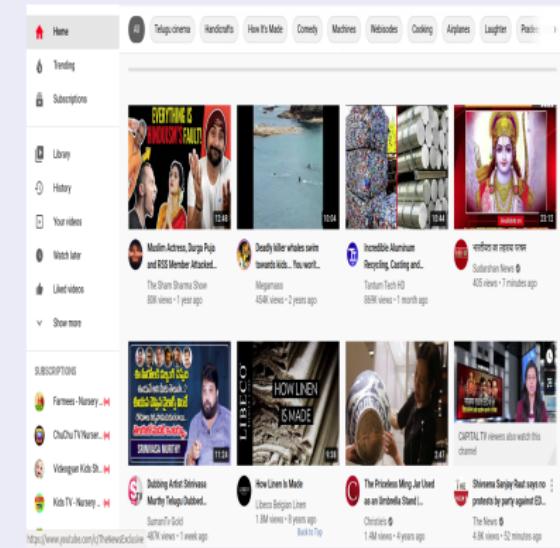


## Queries

- List all songs by Shri. S. P. Balasubrahmaniam
- List all songs by Smt. Lata Mangeshkar
- List all the songs in the movie Gadar
- Play the song "Main Nikla"

# Unstructured - Example 06

## Video



## Queries

- Search videos by a natural language query (IIT Guwahati)
- Show the videos by a particular author
- Play a selected video
- Show the live show TV debate

# Unstructured - Example 07

## Source Code

The screenshot shows a GitHub repository page for the 'vim/vim' project. The main navigation bar includes links for 'Why GitHub?', 'Team', 'Enterprise', 'Explore', 'Marketplace', and 'Pricing'. On the right, there are buttons for 'Sign in' and 'Sign up'. Below the navigation, there are filters for 'Code', 'Issues', 'Pull requests', 'Actions', 'Projects', 'Wiki', 'Security', and 'Insights'. The 'Code' tab is selected. The main content area displays a list of commits. Each commit includes the author's name, a brief description, and the date it was pushed. The commits are as follows:

- patch 8.2.2398: soft test fails when locale is Canadian English (pushed 36 minutes ago)
- patch 8.2.1442: updated references to the Mac Cursor GLA (pushed yesterday)
- patch 8.2.2395: Build with Ruby and clang may fail (pushed 5 months ago)
- patch 8.2.1721: MS-Windows installer doesn't work (pushed 6 days ago)
- patch 8.2.1720: patch 8.2.1721: MS-Windows installer doesn't work (pushed 3 months ago)
- patch 7.3.4065 (pushed 5 years ago)
- patch 8.2.2390: fuzzy matching doesn't give access to the source (pushed 22 hours ago)
- patch 8.2.2398: soft test fails when locale is Canadian English (pushed 36 minutes ago)
- patch 8.1.1409: causing the distribution doesn't work as documented (pushed 13 months ago)
- patch 8.2.2395: CI on strict Linux not, several download delays not (pushed 18 days ago)
- patch 8.2.2395: GitHub actions CI isn't used for all available platforms (pushed 17 days ago)
- patch 8.1.1292: test42 is even as binary by git diff (pushed 15 months ago)
- warning (pushed 8 months ago)

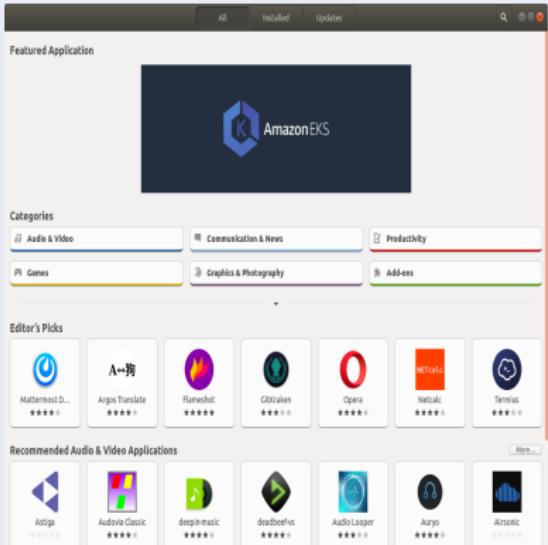
At the bottom of the commit list, there are sections for 'Releases', 'Sponsor this project', and 'Packages'.

## Queries

- List the changes made to `edit.c` on Wednesday, 30-Dec-2020
- Un-do changes made on Wednesday, 30-Jan-Dec-2020
- List who all modified the file `insert.c` between 01-Jan-2021 and 05-Jan-2021
- Insert a new file `menu.c`

# Unstructured - Example 08

## Binaries

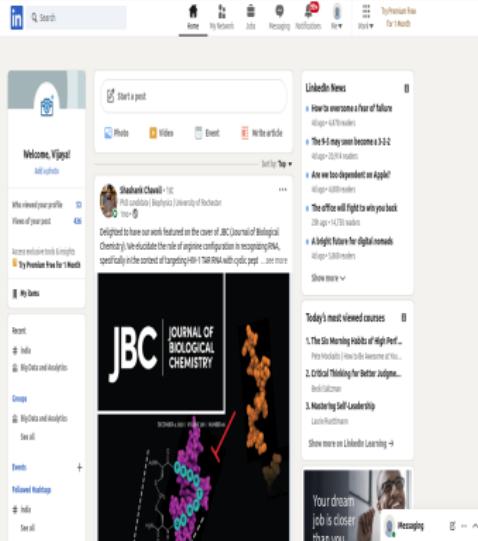


## Queries

- Update vim
- Install firefox new version
- Delete all the previous installed versions of firefox
- Update all libraries

# Unstructured - Example 09

## Graphs

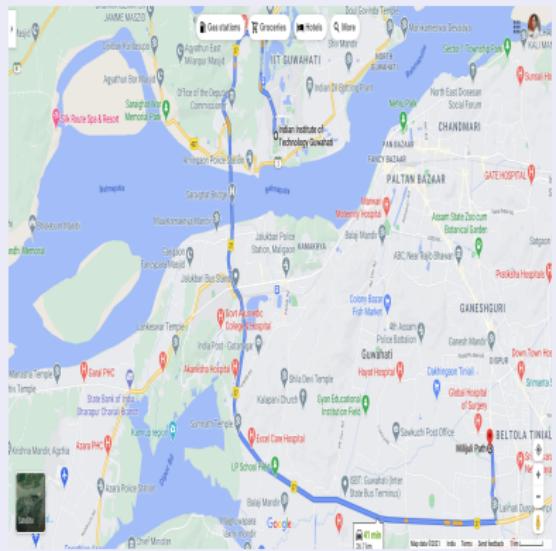


## Queries

- List all my school friends
- List all my colleagues at previous company
- Make a new connection with the HR of that company
- Post a job requirement which reach to all my known contacts and their contacts only.

# Unstructured - Example 10

## Maps



## Queries

- Show the map at my location at specified resolution
- Show all the ATMs only
- Show all the hotels near by my area
- Show the route between place A to place B.
- Show all the alternate routes between A and B

# Unstructured - Example 11

## Biometric databases



## Queries

- Verify the person with the given finger print!
- Verify the person with given AADHAR number
- Verify the person with face

# DBMS

## What it contains?

- A DBMS is a **collection of programs** that enables users to **create and maintain** a database
- DBMS is a **general-purpose software system**
- It facilitates the process of
  - Defining
  - Constructing
  - Manipulating and
  - Sharing database among various users and applications

# Defining

## Elements

Defining a database involves specifying

- the **data types**
- **data structures**
- **constraints** on the data to be stored in the database
- Database descriptive information is also stored by the DBMS
- The description is in the form of database catalog which is the **meta-data**

# Constructing, Manipulating and Sharing

## Elements

- Constructing the database is the process of storing the data on some **storage medium** that is controlled by the DBMS
- **Manipulating** a database includes functions such as
  - Querying the database to retrieve specific data
  - Updating the database to reflect changes in the mini-world
  - Generating reports from data
- **Sharing** a database allows multiple **users** and **programs** to access the database **simultaneously**

# An Example

## University Database

- Storing information about students, courses, & grades
- Database structure and a few samples of data for such a database

# An Example

Student

name	student_number	class	major
Smith	17	1	CS
Brown	8	2	CS

Course

name	number	credit_hours	department
Intro to CS	CS1310	4	CS
Data structures	CS3320	4	CS
Discrete Maths	MA2410	3	MATH
Databases	CS3380	3	CS

# An Example

Section

sid	number	semester	year	instructor
85	MA2410	Fall	2007	King
92	CS1310	Fall	2007	Anderson
102	CS3320	Spring	2008	Knuth
112	MA2410	Fall	2008	Chang
119	CS1310	Fall	2008	Anderson
135	CS3380	Fall	2008	stoneson

# An Example

Grade\_Report

stdent_number	sid	grade
17	112	B
17	119	C
8	85	A
8	92	A
8	102	B
8	135	A

Prerequisite

course_number	prerequisite
CS3380	CS3320
CS3380	MATH2410
CS3320	CS1310

# An Example

## University Database

- The database is organized in five files
- Each of which stores **data records of same type**
- STUDENT file stores records of all the students
- COURSE file stores records of all the courses
- ...

# An Example

## Define

- To *define* this database, structure of records of each file must be specified
- Specify different *types of data elements* to be stored for each record
- STUDENT record includes: Name, Student\_number, Class and Major
- A similar description should be done for all the files
- Descriptions specify domain example: grade must be from the set {'A', 'B', 'C', 'D', 'F', 'I'}

# An Example

## Construct

- To *construct* this database, we store data to represent each student, course, section, grade report, and prerequisite
- Each of these must be in different **files**
- Records in various files may be **related**
- Example: Record **Smit** in Student file is **related to** two records in Grade\_Report file
- Similarly, each record in **Prerequisite** file relates to two course records
  - One representing course
  - Other representing prerequisite
- Such relations are prevalent in **relational databases**

# An Example

## Manipulate - Querying

- Involve querying and updating
- Example: Retrieve the transcript of 'Smith'
- List names of students who took database course in fall 2008 and their grades in that section
- List the pre-requisites of database course

## Manipulate - Updating

- Change the class of 'Smith' to sophomore
- Create a new section for database course for this semester
- Enter a grade of 'A' for 'Smith' in the database section of last semester