Microproject on the topic : 57,58.59.

-:Data system software : 2012:-

:Features :

- **R.D.B.M.S. –** RDBMS (Relational Database Management Systems) like Oracle, Microsoft SQL Server, IBM DB2, and MySQL were widely used for structured data management. Key trends included the rise of NoSQL databases, the adoption of in-memory databases like SAP HANA, and the integration with big data technologies. Cloud-based RDBMS services, such as Amazon RDS, were becoming more popular. RDBMS remained essential for enterprise applications due to their reliability, performance, security, and support for complex queries and analytics.
- **NOSQL database -** NoSQL databases like MongoDB, Cassandra, Redis, and Neo4j were gaining popularity for their ability to handle large-scale, unstructured data with flexible schemas and horizontal scalability. They were ideal for big data, real-time web applications, and content management. Despite their advantages, NoSQL databases faced challenges with consistency, maturity, and limited tooling compared to traditional RDBMS
- **Cloud database -** cloud databases were becoming more popular, offering scalable and easily managed solutions for data storage. Key players included Amazon RDS. These services provided automated backups high availability, and reduced administrative overhead.

:Application :

Applications	Information
	A popular RDBMS known for its high performance, scalability, and robust security features. It introduced advanced features like Automatic Storage Management (ASM), Real Application Testing, and Active Data Guard, enhancing data management, backup, and disaster recovery capabilities
	It is an operating system designed for servers. It offers improvements in virtualization, storage, networking, and automation. Key features include Hyper-V for virtualization, enhanced Active Directory, a new file system (ReFS), and improved storage solutions. It introduced the Modern UI and focuses on cloud integration.
	MySQL is an open-source relational database management system (RDBMS). It's widely used for web applications and data storage, known for its speed, reliability, and ease of use. MySQL supports SQL for database management and is often used in combination with PHP and Apache in the LAMP stack (Linux, Apache, MySQL, PHP/Python/Perl).

:Conclusion:

In 2012, the database landscape was diverse and dynamic, with robust options catering to a wide array of needs. Traditional RDBMS like Oracle 11g, Microsoft SQL Server, IBM DB2, and MySQL remained crucial for structured data management, offering high performance, scalability, and advanced features. NoSQL databases like MongoDB, Cassandra, Redis, and Neo4j gained traction for their ability to handle large-scale, unstructured data with flexibility and high availability. Cloud databases, such as Amazon RDS, Google Cloud SQL, and Microsoft Azure SQL Database, provided scalable, cost-effective, and easily managed solutions, reflecting the growing shift towards cloud-based infrastructure. Overall, the advancements in database technologies in 2012 were geared towards enhancing performance, scalability, flexibility, and ease of management to meet the evolving demands of businesses and applications.

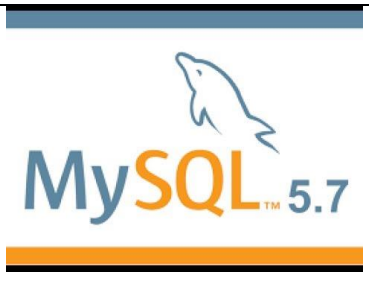
:Features:

- **Enhanced SQL features :** SQL databases introduced several key enhancements to boost performance, scalability, and flexibility. SQL Server 2012 added columnstore indexes for faster data warehousing, new T-SQL functions, and AlwaysOn Availability Groups for high availability. Oracle 12c introduced a multitenant architecture for easier management, the MATCH_RECOGNIZE clause for pattern matching, and adaptive query optimization.

- **NOSQL advancement :** NoSQL databases saw significant advancements aimed at improving performance, scalability, and integration with big data technologies. MongoDB enhanced its aggregation framework, added text search capabilities, and strengthened security features. Cassandra introduced a better query language (CQL3), improved secondary indexes, and enhanced Hadoop integration. Redis 2.8 brought improved clustering and replication features, boosting its real-time capabilities. HBase focused on better performance and scalability, along with improved integration with Hadoop and support for complex queries. Neo4j advanced its Cypher query language and enhanced graph processing performance

- **Big data integration :** big data integration saw significant advancements as organizations increasingly sought to harness large volumes of diverse data. Key technologies like Hadoop and Apache Spark gained widespread adoption for their ability to process and analyze massive datasets efficiently. Integration between traditional RDBMS and big data platforms improved.

:Application:

Applications	Information
	It introduced several key features, including a multitenant architecture that allows multiple pluggable databases within a single container database for easier management and consolidation. It also featured improved SQL pattern matching with the MATCH_RECOGNIZE clause.
	Microsoft SQL Server continued to be widely used, primarily featuring updates from SQL Server 2012. Key enhancements included columnstore indexes for faster data warehousing queries, AlwaysOn Availability Groups for high availability and disaster recovery, and improved T-SQL functions for better data handling and pagination.
	It brought significant improvements including enhanced performance and scalability, better JSON support, a new query optimizer, and improvements to replication and security.

:Conclusion:

The landscape of data system software was marked by significant innovations aimed at enhancing performance, scalability, and flexibility. RDBMS continued to evolve with features catering to enterprise needs, while NoSQL databases gained traction for their ability to handle unstructured data and provide high availability. The integration of big data technologies with traditional databases became more seamless, enabling businesses to leverage comprehensive analytics and gain deeper insights from their data. These advancements reflected a broader trend towards more powerful, scalable, and versatile data management solutions to meet the growing demands of modern applications and data-driven decision-making.

:Features:

- **Hybrid data base solutions :** Hybrid database solutions emerged as a prominent trend, combining the strengths of both traditional relational databases (RDBMS) and NoSQL databases. These solutions aimed to provide the scalability and flexibility of NoSQL systems, which are ideal for handling unstructured and semi-structured data, while retaining the reliability and robust transactional support of RDBMS. Hybrid databases allowed organizations to leverage the best of both worlds, supporting a variety of workloads and data types within a single, integrated environment

- **In memory computing :** In-memory computing emerged as a powerful technology trend, significantly enhancing the performance and speed of data processing by storing data directly in the main memory (RAM) of servers. This approach allowed for real-time analytics and accelerated transaction processing, addressing the limitations of traditional disk-based storage systems. By reducing data retrieval times and leveraging parallel processing, in-memory computing facilitated faster decision-making and improved the efficiency of applications in various sectors, including finance, telecommunications

- **Security :** Database security was a critical concern due to the increasing frequency and sophistication of cyber-attacks. Key issues included vulnerabilities in database management systems, the rise of SQL injection attacks, and insufficient encryption practices.

:Application:

Applications	Information
PostgreSQL	Introduced several significant features to enhance performance and usability. Key improvements included the addition of the UPSERT functionality (INSERT ON CONFLICT DO UPDATE), which allowed for more efficient handling of conflicts during data insertion. Other notable features were row-level security, which provided more granular access control, and enhanced JSONB capabilities for better handling of JSON data
mongoDB.	MongoDB 3.0 introduced significant improvements, including the WiredTiger storage engine, which enhanced performance and efficiency with better compression and concurrency control. This version also brought improved security features like role-based access control, better scalability, and more flexible data management capabilities.
redis	Redis 3.0, released in April 2015, introduced significant improvements and features to the in-memory data structure store. Notably, it included support for Redis Cluster, enabling automatic sharding for horizontal scalability across multiple nodes.

:Conclusion:

In 2015, data system software evolved significantly to address the increasing demands for scalability, performance, and security. Innovations in database technologies, such as the introduction of Redis 3.0 with Redis Cluster, exemplified efforts to enhance scalability and fault tolerance. Concurrently, the heightened awareness of security threats led to more robust measures in database management practices. The year marked a pivotal moment where advancements in data system software not only improved operational efficiency and real-time data processing but also underscored the critical importance of securing sensitive information against growing cyber threats.

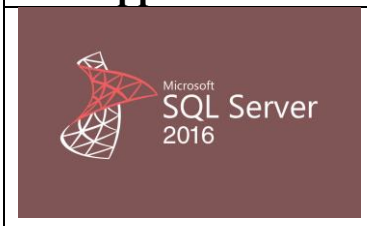
:Features:

- **Advanced analytics and machine learning** : advanced analytics and machine learning gained significant traction, transforming how organizations leveraged data. Machine learning algorithms, powered by increased computational capabilities and vast datasets, enabled more accurate predictive models and real-time analytics. The rise of deep learning, particularly neural networks, facilitated breakthroughs in image and speech recognition.

- **Improved security and compliance:** improved security and compliance in the tech industry focused on enhancing data protection and meeting regulatory standards. Companies adopted advanced encryption techniques, multi-factor authentication, and more sophisticated intrusion detection systems. Compliance efforts were driven by stricter regulations such as GDPR and HIPAA, leading to more rigorous data handling practices.

- **Semi – structured data** : semi-structured data gained significant attention due to the rise of big data and the need for more flexible data management solutions. Unlike structured data, which fits neatly into tables and rows, semi-structured data does not adhere to a strict schema, allowing for more variability and adaptability. Common formats for semi-structured data include JSON, XML, and NoSQL databases.

:Application:

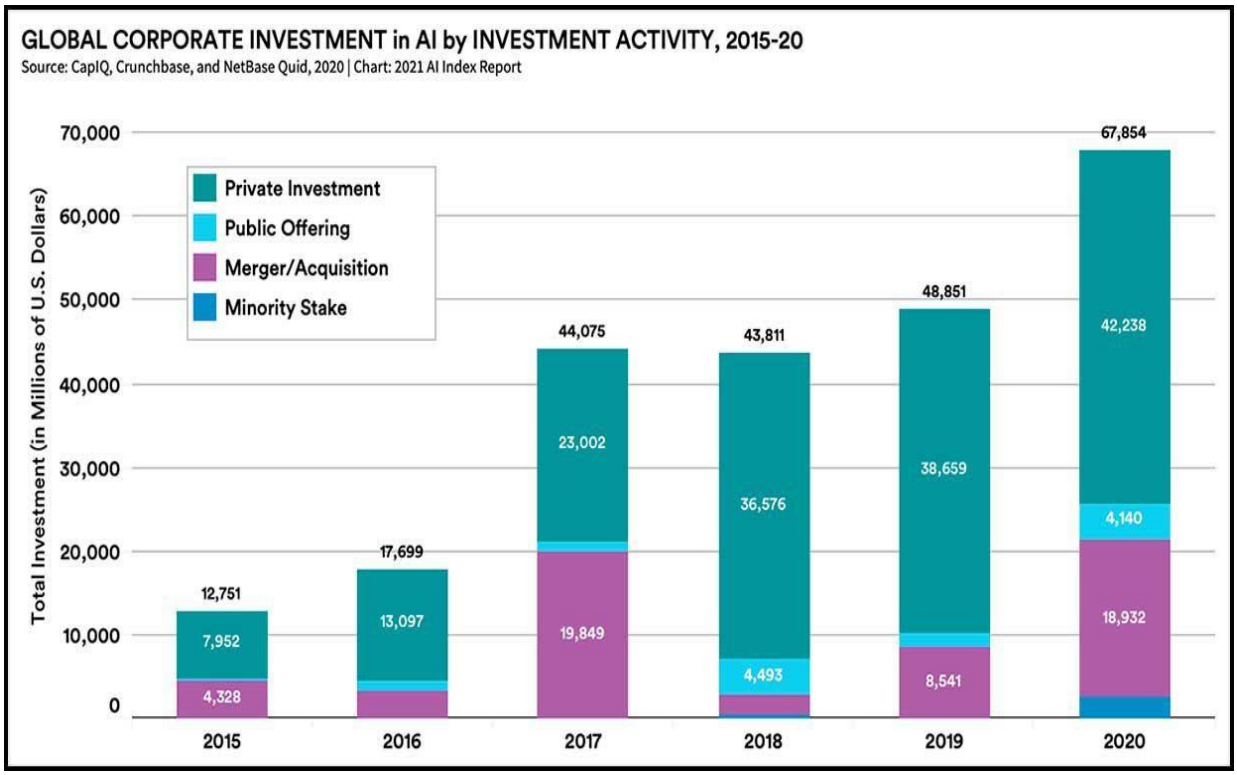
Applications	Information
	Microsoft SQL Server 2016, released in June 2016, introduced several advanced features and improvements focused on performance, security, and analytics. Key enhancements included real-time operational analytics, advanced data integration capabilities, and in-memory columnstore for high-speed analytics.
	Redis 3.2, released in May 2016, introduced several enhancements to the popular in-memory data structure store. Key features included improvements in Redis Cluster stability and performance, new commands such as BITFIELD for manipulating binary data, and enhancements to existing commands for better usability and efficiency. Additionally, Redis 3.2 brought better memory management, improved Lua scripting capabilities, and more robust support for HyperLogLog and Streams.

:Conlcusions:

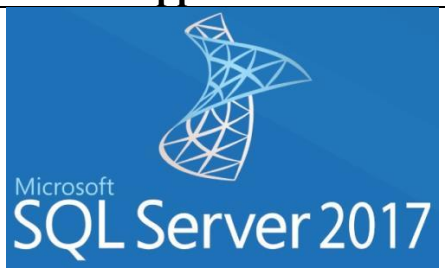
In 2016, data system software continued to evolve rapidly, driven by the need for advanced analytics and the integration of machine learning capabilities. The year saw significant improvements in data processing, storage, and real-time analysis, empowering organizations to extract deeper insights and make more informed decisions. Enhanced scalability, performance, and security measures became standard, addressing the growing complexity and volume of data. The widespread adoption of machine learning and AI technologies further revolutionized data systems, enabling more sophisticated predictive analytics and automation.

:Features:

- **Integration of the AI and machine learning :** The integration of AI in the field of databases began to gain significant traction, with a focus on enhancing data management and analytics. AI-driven techniques were employed to automate database tuning, improve query optimization, and enable predictive analytics. Machine learning algorithms helped in anomaly detection, data cleansing, and pattern recognition, making databases more efficient and reliable. Additionally, natural language processing (NLP) was increasingly used to facilitate more intuitive database queries, allowing users to interact with databases in more human-like ways. This integration marked a pivotal shift towards more intelligent, self-managing database systems.



:Application:

Application	Information
	Microsoft SQL Server 2017 is a relational database management system that supports a variety of data types and services, including structured, semi-structured, and spatial data. It introduced support for running SQL Server on Linux, containerization with Docker, and integrated machine learning capabilities with R and Python. The 2017 version also improved performance, security features, and introduced adaptive query processing to optimize query execution dynamically.
	MySQL 8.0 is a major release of the popular open-source relational database management system. It introduces several enhancements, including improved performance, better security features, and enhanced SQL capabilities. Key features include window functions, common table expressions (CTEs), JSON improvements, and support for Unicode 9.0.
	Cassandra 3.11 is a version of the Apache Cassandra database, a highly scalable, distributed NoSQL database designed for handling large amounts of data across many commodity servers. Released in August 2017, Cassandra 3.11 focused on performance improvements, including faster read and write operations, better compaction strategies, and enhanced caching.

:conclusion:

In 2017, database management systems (DBMS) saw significant advancements driven by the growing demand for handling large-scale, diverse data in real time. The year marked a shift towards more flexible, scalable solutions, with NoSQL databases like Apache Cassandra and MongoDB gaining prominence alongside traditional relational databases such as MySQL and PostgreSQL. Hybrid systems that combined SQL and NoSQL features also emerged, reflecting the need for versatile data management across different use cases. Additionally, cloud-based DBMS options became increasingly popular, offering organizations greater agility, scalability, and cost efficiency. Overall, 2017 was a pivotal year for DBMS innovation, emphasizing performance, scalability, and adaptability to meet the evolving needs of businesses.

:Features:

- **AI driven automation** : The advancements in AI-powered databases, which began in 2017, continued to gain momentum in 2018. Databases now began automating more complex and routine management tasks, such as automatic indexing, schema optimization, patch management, backups, and disaster recovery. Oracle made significant strides with its Autonomous Database, which was capable of self-tuning and self-patching, allowing enterprises to focus more on strategic business initiatives rather than database maintenance. AI algorithms monitored database performance, automatically identifying and resolving bottlenecks while ensuring optimal resource usage, effectively making database administration largely hands-off.

- **Blockchain for database security**: In 2018, blockchain technology emerged as a key player in the database ecosystem, particularly for enhancing security and data integrity. With blockchain's decentralized and immutable nature, databases could adopt blockchain principles to secure transactional data, making it tamper-evident and resistant to unauthorized modifications.

:Application:

Applications	Information
Oracle Autonomous Database ORACLE	Oracle's Autonomous Database represented a major leap forward in database technology. By fully embracing AI and machine learning, Oracle's Autonomous Database could automatically apply patches, tune performance, and recover from failures without human intervention. It featured machine learning algorithms that constantly monitored and optimized database workloads, ensuring peak performance at all times.
HYPERLEDGER FABRIC	Hyperledger Fabric, a blockchain-based solution by IBM, was integrated into its data management platforms to provide a secure, tamper-evident ledger for enterprise transactions. This technology enabled businesses to create immutable, auditable records of transactions, enhancing the trust and integrity of data management across distributed environments.

: Conclusions:

In 2018, the shift towards AI-driven automation in databases was firmly established, with more companies adopting autonomous databases that drastically reduced the complexity of database management. Blockchain integration brought a new layer of security to data management, making databases more secure and auditable, while the rise of edge computing catered to the growing demand for real-time data processing at the edge of the network. These trends reflected the industry's focus on building scalable, intelligent, and secure data management solutions for the future.

:Features:

- **Distributed SQL databases :** The adoption of distributed SQL databases gained traction as enterprises increasingly demanded databases capable of handling global, geographically distributed workloads with high consistency and low latency. Distributed SQL databases, such as CockroachDB and Google Spanner, combined the scalability of NoSQL with the consistency of SQL, providing an ideal solution for applications that required both strong consistency and global distribution.

- **Privacy and GDPR Compliance:** With the enforcement of privacy regulations like the General Data Protection Regulation (GDPR) in Europe and the California Consumer Privacy Act (CCPA) in the United States, data privacy and compliance became top priorities for organizations. Databases began incorporating features like data masking, encryption at rest, auditing, and granular access controls to ensure that sensitive data was adequately protected and that organizations could meet compliance requirements without compromising performance or usability.

:Application:

Applications	Information
CockroachDB	A distributed SQL database designed for cloud-native applications, CockroachDB provided high availability and scalability across multiple regions with strong consistency. Its distributed nature made it highly resilient to failures, and it was particularly well-suited for global applications with stringent performance and latency requirements.
Oracle Autonomous Database ORACLE	Oracle extended its autonomous database portfolio with Autonomous Data Warehouse, which provided automated setup, tuning, scaling, and security. This allowed businesses to easily set up and manage data warehouses without needing specialized database administrators, streamlining the process of extracting insights from large data volumes.

: Conclusions:

2020 underscored the importance of AI and autonomous capabilities in the database space, with more organizations turning to databases that could self-manage and self-optimize. The rise of distributed SQL databases offered a powerful solution for enterprises needing scalable and consistent database solutions across global regions. Privacy and compliance also became paramount, with databases introducing new features to ensure data security and regulatory adherence. As the digital landscape continued to evolve, databases adapted to meet the growing demands for automation, scalability, and security.

:Features:

- **Edge Databases** : As edge computing grew in popularity, edge databases began to emerge, designed to store and process data closer to the user, reducing latency for real-time applications. RedisEdge and SQLite were widely used for their ability to run lightweight, efficient databases at the edge, powering IoT devices and real-time analytics for applications like autonomous vehicles, industrial IoT, and remote monitoring.

- **AI driven optimization and Self-Tuning Databases:** In 2022, the push towards fully autonomous databases took another leap forward with advancements in AI-driven query optimization. Databases like Oracle Autonomous Database and Microsoft SQL Server integrated machine learning algorithms to dynamically adjust query execution plans based on real-time performance, optimizing resource usage and minimizing latency. This trend reduced the need for human intervention in database management, further automating complex tasks like performance tuning and resource allocation.

:Application:

Applications	Information
	The continued evolution of Oracle's fully autonomous database allowed businesses to automate resource management, performance tuning, and security patching. The integration of advanced machine learning for query optimization ensured that workloads could run faster and with fewer operational complexities, appealing to enterprises with large-scale data operations.
	Designed for IoT applications and edge computing, RedisEdge allowed data processing at the network's edge, providing ultra-low latency and high availability. It was particularly useful for real-time analytics in industries like healthcare, telecommunications, and smart cities.

: Conclusions:

2022 solidified the trend towards databases that operated closer to the user, either through edge computing or enhanced AI-driven operations. These innovations addressed the growing need for real-time data processing and minimal latency, particularly in industries relying on IoT and AI-driven applications. Compliance with local data laws also became a critical focus for global organizations, driving the development of region-specific and localized database solutions. Overall, 2022 was marked by a push towards greater automation, enhanced performance, and regulatory compliance in the database world.

:Features:

- **Generative AI Integration** : By 2023, the explosion of generative AI models transformed how databases interacted with large datasets. Models like OpenAI's GPT-4 and Google's BERT were increasingly embedded within databases to enable natural language querying, predictive modeling, and automated data classification. This integration made it easier for non-technical users to derive insights from data by asking questions in natural language, without needing to write SQL queries or understand complex database schema.

- **Quantum-Ready Databases:** Although still in its early stages, quantum computing started influencing the design of next-generation databases. Forward-thinking vendors like IBM and Google began exploring quantum-ready databases, capable of leveraging the massive computational power of quantum processors to solve complex problems such as optimization tasks and large-scale cryptography. These systems promised unprecedented speed and efficiency for applications requiring heavy computational workloads, though they remained largely experimental.

:Application:

Applications	Information
	Microsoft integrated OpenAI's GPT-4 model into its Azure SQL Database through the Azure OpenAI Service, enabling developers and businesses to perform natural language querying. This allowed users to interact with databases using conversational language, simplifying data analysis for non-technical staff.
	IBM initiated quantum-safe cryptography in its Db2 databases, preparing them for a future where quantum computing could break traditional encryption algorithms. While quantum-ready databases were still experimental, industries like financial services and defense began testing these systems to safeguard sensitive data against potential quantum threats. IBM's Db2 Quantum Safe edition employed post-quantum encryption algorithms, ensuring that long-term data remained secure in a post-quantum world.

: Conclusions:

2023 saw revolutionary changes in how databases were designed and operated, with a strong emphasis on AI integration, sustainability, and preparing for the quantum future. The integration of generative AI into databases lowered the technical barrier for users to interact with and derive insights from data, making data more accessible. Meanwhile, sustainability became a key focus for data centers, pushing database providers to develop energy-efficient solutions to reduce environmental impact. These trends indicated a future where databases would not only become more intelligent but also more conscious of their environmental footprint.

Designing the data base for the given survey :

Code :

```
CREATE TABLE Survey (
   Application_name VARCHAR2 (255),
   Date_of_issue DATE,
   Features VARCHAR2(1000),
   Year_of_application NUMBER
);
```

```
INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)
VALUES ('Oracle 11g RDBMS', TO_DATE('06-01-2012', 'MM-DD-YYYY'), 'Automatic Storage Management, Real Application Testing, Active Data Guard', 2012);
```

```
INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)
VALUES ('Operating System', TO_DATE('06-01-2012', 'MM-DD-YYYY'), 'Hyper-V, Modern UI, Enhanced Active Directory', 2012);
```

```
INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)
VALUES ('MySQL RDBMS', TO_DATE('06-01-2012', 'MM-DD-YYYY'), 'Open Source, Speed, Reliability', 2012);
```

```
INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)
VALUES ('Oracle 12c Multitenant', TO_DATE('06-01-2013', 'MM-DD-YYYY'), 'Multitenant Architecture, Pattern Matching', 2013);
```

```
INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)
VALUES ('SQL Server 2012', TO_DATE('06-01-2013', 'MM-DD-YYYY'), 'Columnstore Indexes, AlwaysOn Availability', 2013);
```

```
INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)
VALUES ('PostgreSQL 2015', TO_DATE('04-15-2015', 'MM-DD-YYYY'), 'UPSERT, Row-level Security, JSONB', 2015);
```

INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)

VALUES ('MongoDB 3.0', TO_DATE('03-01-2015', 'MM-DD-YYYY'), 'WiredTiger Engine, Role-based Access Control', 2015);

INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)

VALUES ('Redis 3.0', TO_DATE('04-15-2015', 'MM-DD-YYYY'), 'Redis Cluster, Horizontal Scalability', 2015);

INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)

VALUES ('SQL Server 2016', TO_DATE('06-01-2016', 'MM-DD-YYYY'), 'Real-time Operational Analytics', 2016);

INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)

VALUES ('Redis 3.2', TO_DATE('05-15-2016', 'MM-DD-YYYY'), 'Redis Cluster Stability, BITFIELD Command', 2016);

INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)

VALUES ('Db2 AI-Powered', TO_DATE('05-01-2017', 'MM-DD-YYYY'), 'Adaptive Query Optimization, Dynamic Workload Management', 2017);

INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)

VALUES ('Amazon Aurora', TO_DATE('06-01-2017', 'MM-DD-YYYY'), 'Predictive Analytics, Seamless AWS Integration', 2017);

INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)

VALUES ('Oracle Autonomous Database', TO_DATE('04-01-2018', 'MM-DD-YYYY'), 'Self-tuning, Self-patching', 2018);

INSERT INTO Survey (Application_name, Date_of_issue, Features, Year_of_application)

VALUES ('RedisEdge', TO_DATE('06-01-2022', 'MM-DD-YYYY'), 'Real-time Analytics, IoT Focus', 2022);

SELECT * FROM Survey;

Output:

APPLICATION_NAME	DATE_OF_ISSUE	FEATURES	YEAR_OF_APPLICATION
Oracle 11g RDBMS	06/01/2012	Automatic Storage Management, Real Application Testing, Active Data Guard	2012
Operating System	06/01/2012	Hyper-V, Modern UI, Enhanced Active Directory	2012
MySQL RDBMS	06/01/2012	Open Source, Speed, Reliability	2012
Oracle 12c Multitenant	06/01/2013	Multitenant Architecture, Pattern Matching	2013
SQL Server 2012	06/01/2013	Columnstore Indexes, AlwaysOn Availability	2013
PostgreSQL 2015	04/15/2015	UPSERT, Row-level Security, JSONB	2015
MongoDB 3.0	03/01/2015	WiredTiger Engine, Role-based Access Control	2015
Redis 3.0	04/15/2015	Redis Cluster, Horizontal Scalability	2015
SQL Server 2016	06/01/2016	Real-time Operational Analytics	2016
Redis 3.2	05/15/2016	Redis Cluster Stability, BITFIELD Command	2016
Db2 AI-Powered	05/01/2017	Adaptive Query Optimization, Dynamic Workload Management	2017
Amazon Aurora	06/01/2017	Predictive Analytics, Seamless AWS Integration	2017
Oracle Autonomous Database	04/01/2018	Self-tuning, Self-patching	2018
RedisEdge	06/01/2022	Real-time Analytics, IoT Focus	2022