

Database Development & Design

PHYSICAL MODEL

Outline

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- Attributes Constraints
- Physical Model Examples

Physical Model

A physical data model is usually derived from a logical data model for a particular relational database management system (RDBMS), thus taking into account all technology-specific details.

The aim of physical database design is to decide how the logical database design will be implemented. This involves:

- Defining Data types for fields.
- Defining constraints on these tables such unique, not null and domain definitions to check if data are out of the range.

Data Types

Main Data Types are:

- **Numeric** data types (Integer numbers, Double/Floating-point (real) numbers)
- **Character-string** data types (Fixed length, Varying length)
- **Bit-string** data types (strings of 1's and 0's)
- **Boolean** data type (Values of TRUE or FALSE or NULL)
- **DATE** data type (Ten positions, Components are YEAR, MONTH, and DAY in the form YYYY-MM-DD, Multiple mapping functions available in RDBMSs to change date formats)
- **Timestamp** data type (Includes the DATE and TIME fields, Plus a minimum of six positions for decimal fractions of seconds)

SQL Data Types – String

Data Type	Description
CHAR (size)	A FIXED length string (can contain letters, numbers, and special characters). The <i>size</i> parameter specifies the column length in characters - can be from 0 to 255. Default is 1
VARCHAR (size)	A VARIABLE length string (can contain letters, numbers, and special characters). The <i>size</i> parameter specifies the maximum column length in characters - can be from 0 to 65535
LONGTEXT	Holds a string with a maximum length of 4,294,967,295 characters
TEXT(size)	Holds a string with a maximum length of 65,535 bytes
BINARY(size)	Equal to CHAR() but stores binary byte strings. The <i>size</i> parameter specifies the column length in bytes. Default is 1

SQL Data Types – Numeric

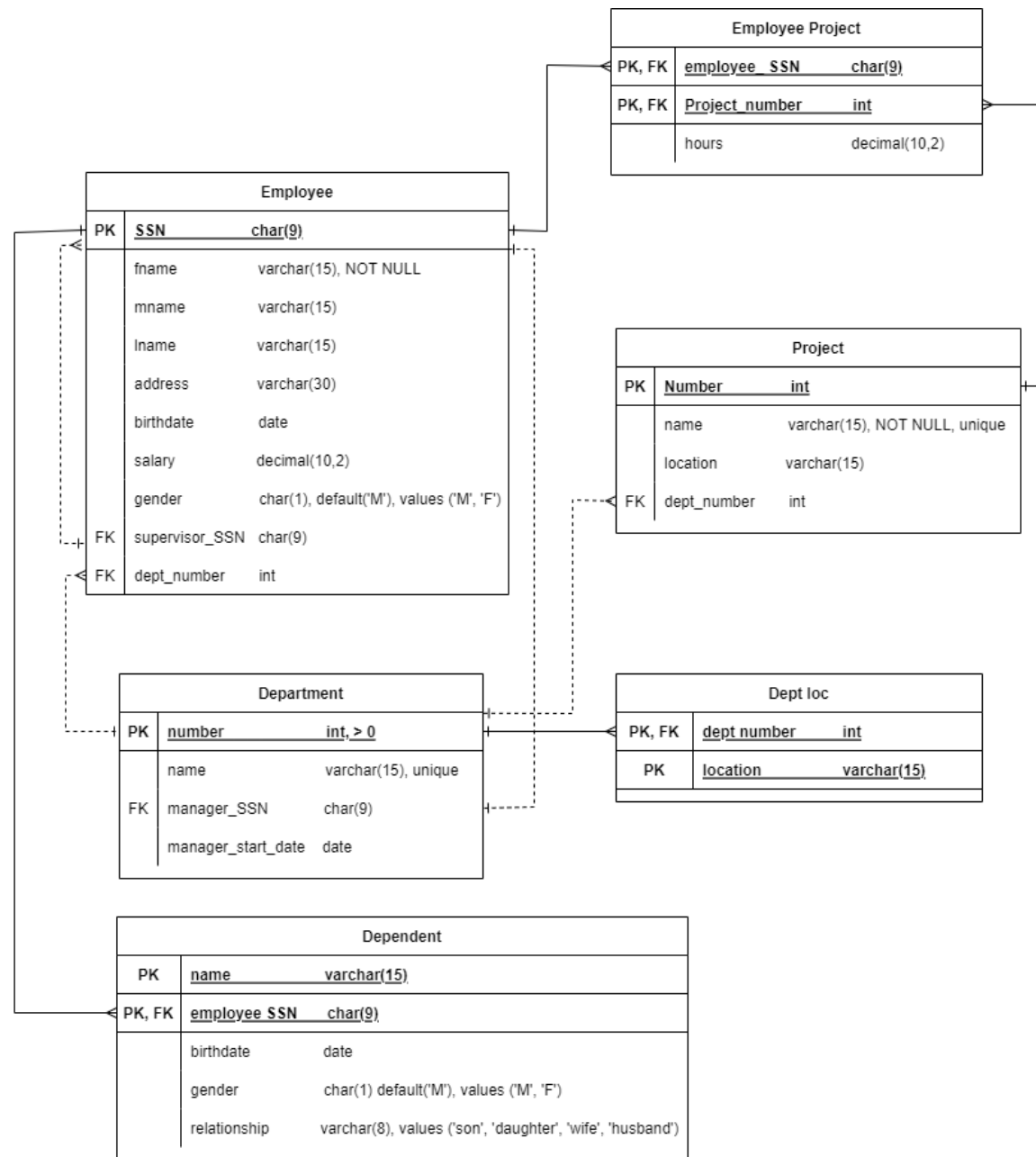
Data type	Description
BIT(<i>size</i>)	A bit-value type. The number of bits per value is specified in <i>size</i> . The <i>size</i> parameter can hold a value from 1 to 64. The default value for <i>size</i> is 1.
BOOL	Zero is considered as false, nonzero values are considered as true.
BOOLEAN	Equal to BOOL
INT(<i>size</i>)	A medium integer. Signed range is from -2147483648 to 2147483647. Unsigned range is from 0 to 4294967295. The <i>size</i> parameter specifies the maximum display width (which is 255)
FLOAT(<i>size</i>, <i>d</i>)	A floating point number. The total number of digits is specified in <i>size</i> . The number of digits after the decimal point is specified in the <i>d</i> parameter. This syntax is deprecated in MySQL 8.0.17, and it will be removed in future MySQL versions
DECIMAL(<i>size</i>, <i>d</i>)	An exact fixed-point number. The total number of digits is specified in <i>size</i> . The number of digits after the decimal point is specified in the <i>d</i> parameter. The maximum number for <i>size</i> is 65. The maximum number for <i>d</i> is 30. The default value for <i>size</i> is 10. The default value for <i>d</i> is 0.

SQL Data Types – Date/Date Time

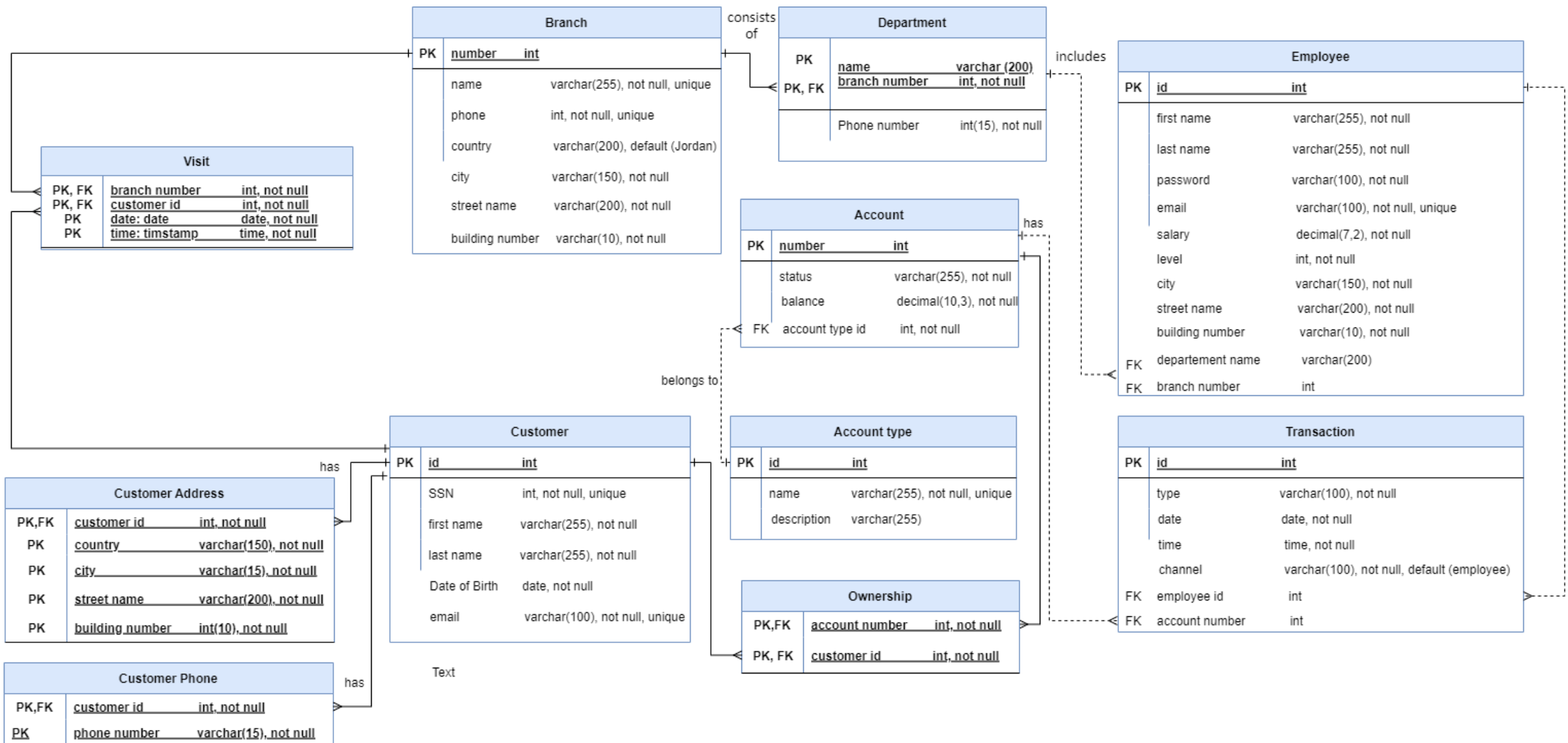
Data type	Description
DATE	A date. Format: YYYY-MM-DD. The supported range is from '1000-01-01' to '9999-12-31'
DATETIME(<i>fsp</i>)	A date and time combination. Format: YYYY-MM-DD hh:mm:ss. The supported range is from '1000-01-01 00:00:00' to '9999-12-31 23:59:59'. Adding DEFAULT and ON UPDATE in the column definition to get automatic initialization and updating to the current date and time
TIMESTAMP(<i>fsp</i>)	A timestamp. TIMESTAMP values are stored as the number of seconds since the Unix epoch ('1970-01-01 00:00:00' UTC). Format: YYYY-MM-DD hh:mm:ss. The supported range is from '1970-01-01 00:00:01' UTC to '2038-01-09 03:14:07' UTC. Automatic initialization and updating to the current date and time can be specified using DEFAULT CURRENT_TIMESTAMP and ON UPDATE CURRENT_TIMESTAMP in the column definition
TIME(<i>fsp</i>)	A time. Format: hh:mm:ss. The supported range is from '-838:59:59' to '838:59:59'
YEAR	A year in four-digit format. Values allowed in four-digit format: 1901 to 2155, and 0000. MySQL 8.0 does not support year in two-digit format.

Attributes Constraints

- Default value of an attribute
- NULL / NOT NULL of an attribute
- UNIQUE
- CHECK conditions of an attribute; for example, Dnumber value should be larger than 0.
- Domain constraint
- Other constraints for example, Dept_create_date attribute value should be less or equal to the Mgr_start_date attribute value for each record.



Physical Design Example



Physical Design Example - Bank System Scenario

References

- Elmasri, R., & Navathe, S. (2017). Fundamentals of database systems (Vol. 7). Pearson
- Eng. Lina's slides
- Dr. Raneem's slides
- [SQL Data Types for MySQL, SQL Server, and MS Access \(w3schools.com\)](#)