# Chapter 8

# How to work with data types

# Objectives

## Applied

1. Code queries that convert data from one data type to another.

## Knowledge

1. Describe the data that can be stored in any of the character, numeric, date/time, and large object data types.
2. Describe ENUM and SET data types.

# MySQL data type categories

- Character
- Numeric
- Date and time
- Large Object (LOB)
- Spatial
- JSON

# The character types

| Type | Bytes |
|---|---|
| CHAR(M) | Mx4 |
| VARCHAR(M) | L+1 |

# How the character types work with utf8mb4

| Data type | Original value | Value stored | Bytes used |
|---|---|---|---|
| CHAR(2) | 'CA' | 'CA' | 8 |
| CHAR(10) | 'CA' | 'CA ' | 40 |
| VARCHAR(10) | 'CA' | 'CA' | 3 |
| VARCHAR(20) | 'California' | 'California' | 11 |
| VARCHAR(20) | 'New York' | 'New York' | 9 |
| VARCHAR(20) | "Murach's MySQL" | "Murach's MySQL" | 15 |

# Terms to know about character types

- Latin1 character set
- utf8mb3 character set
- utf8mb4 character set
- Unicode standard

# The integer types

| Type | Bytes |
|---|---|
| `BIGINT` | 8 |
| `INT` | 4 |
| `MEDIUMINT` | 3 |
| `SMALLINT` | 2 |
| `TINYINT` | 1 |

# How the UNSIGNED and ZEROFILL attributes work

| Data type | Original value | Value stored | Value displayed |
|---|---|---|---|
| INT | 99 | 99 | 99 |
| INT | -99 | -99 | -99 |
| INT UNSIGNED | 99 | 99 | 99 |
| INT UNSIGNED | -99 | None | None |
| INT ZEROFILL | 99 | 99 | 0000000099 |
| INT(4) ZEROFILL | 99 | 99 | 0099 |

## The fixed-point type

| Type | Bytes |
|---|---|
| DECIMAL(M, D) | Vary |

## The floating-point types

| Type | Bytes |
|---|---|
| DOUBLE | 8 |
| FLOAT | 4 |

## How the fixed-point and floating-point types work

| Data type | Original value | Value stored | Bytes used |
|---|---|---|---|
| DECIMAL(9,2) | 1.2 | 1.20 | 5 |
| DECIMAL(9,2) | 1234567.89 | 1234567.89 | 5 |
| DECIMAL(9,2) | -1234567.89 | -1234567.89 | 5 |
| DECIMAL(18,9) | 1234567.89 | 1234567.890000000 | 8 |
| DOUBLE | 1234567.89 | 1234567.89 | 8 |
| FLOAT | 1234567.89 | 1234570 | 4 |

# Terms to know about numeric data types

- Real number
- Precision
- Scale
- Exact numeric type
- Floating-point number
- Approximate numeric type

# The date and time types

| Type | Bytes |
|---|---|
| `DATE` | 3 |
| `TIME` | 3 |
| `DATETIME` | |
| `TIMESTAMP` | 4 |
| `YEAR[(4)]` | 1 |

# How MySQL interprets literal date/time values

| Literal value | Value stored in DATE column |
|---|---|
| '2018-08-15' | 2018-08-15 |
| '2018-8-15' | 2018-08-15 |
| '18-8-15' | 2018-08-15 |
| '20180815' | 2018-08-15 |
| 20180815 | 2018-08-15 |
| '2018.08.15' | 2018-08-15 |
| '18/8/15' | 2018-08-15 |
| '8/15/18' | None |
| '2018-02-31' | None |

# How MySQL interprets literal date/time values (continued)

| Literal value | Value stored in TIME column |
|---|---|
| '7:32' | 07:32:00 |
| '19:32:11' | 19:32:11 |
| '193211' | 19:32:11 |
| 193211 | 19:32:11 |
| '19:61:11' | None |

| Literal Value | Value stored in DATETIME or TIMESTAMP column |
|---|---|
| '2018-08-15 19:32:11' | 2018-08-15 19:32:11 |
| '2018-08-15' | 2018-08-15 00:00:00 |

# The ENUM and SET types

| Type | Bytes |
|---|---|
| `ENUM` | `1-2` |
| `SET` | `1-8` |

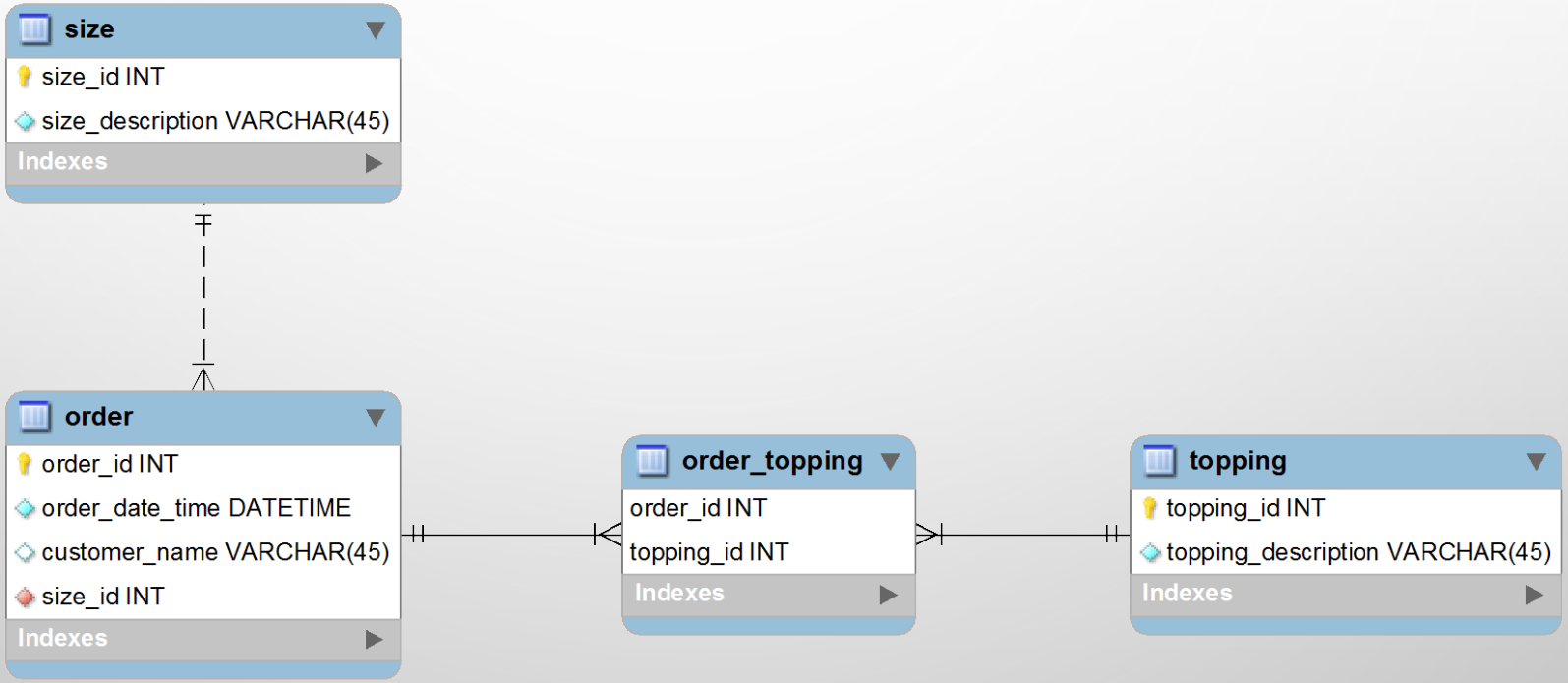
# How values are stored in ENUM columns

| Value | Stored in column ENUM ('Yes', 'No', 'Maybe') |
|---|---|
| `'Yes'` | `'Yes'` |
| `'No'` | `'No'` |
| `'Maybe'` | `'Maybe'` |
| `'Possibly'` | `''` |

# How values are stored in SET columns

| Value | Stored in column SET ('Pepperoni', 'Mushrooms', 'Olives') |
|---|---|
| `'Pepperoni'` | `'Pepperoni'` |
| `'Mushrooms'` | `'Mushrooms'` |
| `'Pepperoni, Bacon'` | `'Pepperoni'` |
| `'Olives, Pepperoni'` | `'Pepperoni, Olives'` |

# RELATIONAL ALTERNATIVES TO ENUM AND SET



## The large object types

| Type | Bytes |
|---|---|
| `LONGBLOB` | L+4 |
| `MEDIUMBLOB` | L+3 |
| `BLOB` | L+2 |
| `TINYBLOB` | L+1 |
| | |
| `LONGTEXT` | L+4 |
| `MEDIUMTEXT` | L+3 |
| `TEXT` | L+2 |
| `TINYTEXT` | L+1 |

## Terms to know about large objects

- BLOB (binary large object) types
- CLOB (character large object) types

# Implicitly convert a number to a string

```
SELECT invoice_total, CONCAT('$', invoice_total)
FROM invoices
```

| invoice_total | CONCAT('$', invoice_total) |
|---|---|
| 3813.33 | $3813.33 |
| 40.20 | $40.20 |
| 138.75 | $138.75 |

# Implicitly convert a string to a number

```
SELECT invoice_number, 989319/invoice_number
FROM invoices
```

| invoice_number | 989319/invoice_number |
|---|---|
| 989319-457 | 1 |
| 263253241 | 0.0037580505988908225 |
| 963253234 | 0.0010270601385803393 |

# Implicitly convert a date to a number

```
SELECT invoice_date, invoice_date + 1
FROM invoices
```

| invoice_date | invoice_date + 1 |
|---|---|
| 2018-08-02 | 20180803 |
| 2018-08-01 | 20180802 |
| 2018-07-31 | 20180732 |

## The syntax of the CAST function

```
CAST(expression AS cast_type)
```

## The syntax of the CONVERT function

```
CONVERT(expression, cast_type)
```

## Cast types you can use in these functions

```
CHAR[(N)]
DATE
DATETIME
TIME
SIGNED [INTEGER]
UNSIGNED [INTEGER]
DECIMAL[(M[,D])]
```

# A statement that uses the CAST function

```
SELECT invoice_id, invoice_date, invoice_total,
    CAST(invoice_date AS CHAR(10)) AS char_date,
    CAST(invoice_total AS SIGNED) AS integer_total
FROM invoices
```

| invoice_id | invoice_date | invoice_total | char_date | integer_total |
|---|---|---|---|---|
| 1 | 2018-04-08 | 3813.33 | 2018-04-08 | 3813 |
| 2 | 2018-04-10 | 40.20 | 2018-04-10 | 40 |
| 3 | 2018-04-13 | 138.75 | 2018-04-13 | 139 |

# A statement that uses the CONVERT function

```
SELECT invoice_id, invoice_date, invoice_total,
    CONVERT(invoice_date, CHAR(10)) AS char_date,
    CONVERT(invoice_total, SIGNED) AS integer_total
FROM invoices
```

| invoice_id | invoice_date | invoice_total | char_date | integer_total |
|---|---|---|---|---|
| 1 | 2018-04-08 | 3813.33 | 2018-04-08 | 3813 |
| 2 | 2018-04-10 | 40.20 | 2018-04-10 | 40 |
| 3 | 2018-04-13 | 138.75 | 2018-04-13 | 139 |

# The FORMAT and CHAR functions

```
FORMAT(number,decimal)
CHAR(value1[,value2]...)
```

# FORMAT function examples

| Function | Result |
|---|---|
| `FORMAT(1234567.8901,2)` | `1,234,567.89` |
| `FORMAT(1234.56,4)` | `1,234.5600` |
| `FORMAT(1234.56,0)` | `1,235` |

# CHAR function examples for common control characters

| Function | Control character |
|---|---|
| CHAR(9) | Tab |
| CHAR(10) | Line feed |
| CHAR(13) | Carriage return |

# A statement that uses the CHAR function

```
SELECT CONCAT(vendor_name, CHAR(13,10), vendor_address1,
    CHAR(13,10), vendor_city, ', ', vendor_state, ' ',
    vendor_zip_code)
FROM vendors
WHERE vendor_id = 1
```

```
US Postal Service
Attn:  Supt. Window Services
Madison, WI 53707
```