Interconversions and Testing

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Summary

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Interconversions with Other Representations

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- **Strings – Formatting and Parsing**

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- Strings – Formatting and Parsing
- Other JDK Date/Time Classes

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- Database Persistence

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String Interconversion

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Date/Time classes expose methods:

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- `toString()`
- `parse(CharSequence)`

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- `format(TemporalAccessor)`
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- `parse(CharSequence)`

– these delegate to `DateTimeFormatter` methods:

```
• format(TemporalAccessor)
• parse(CharSequence)
• parse(CharSequence,
          TemporalQuery<T>)
```

Obtaining `DateTimeFormatter` Instances

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Predefined Instances

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Factory Methods

Using predefined date and time styles

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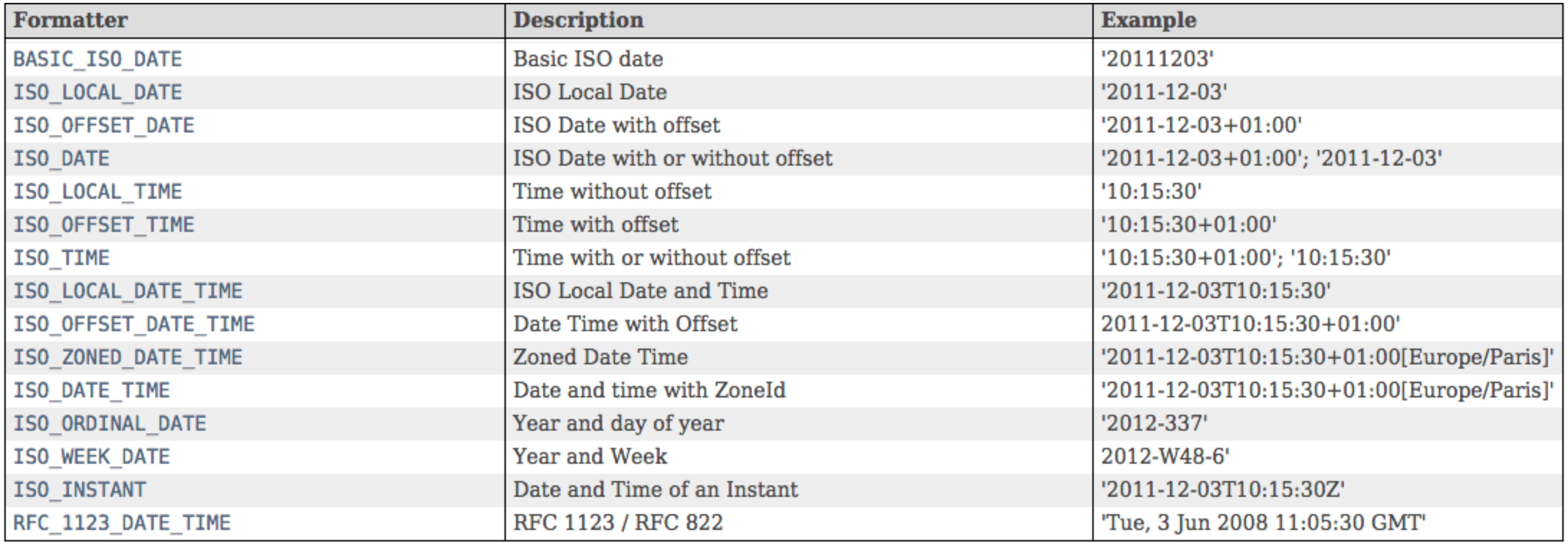
Most flexible way of creating

Predefined `DateTimeFormatters`



Formatter	Description	Example
`BASIC_ISO_DATE`	Basic ISO date	'20111203'
`ISO_LOCAL_DATE`	ISO Local Date	'2011-12-03'
`ISO_OFFSET_DATE`	ISO Date with offset	'2011-12-03+01:00'
`ISO_DATE`	ISO Date with or without offset	'2011-12-03+01:00'; '2011-12-03'
`ISO_LOCAL_TIME`	Time without offset	'10:15:30'
`ISO_OFFSET_TIME`	Time with offset	'10:15:30+01:00'
`ISO_TIME`	Time with or without offset	'10:15:30+01:00'; '10:15:30'
`ISO_LOCAL_DATE_TIME`	ISO Local Date and Time	'2011-12-03T10:15:30'
`ISO_OFFSET_DATE_TIME`	Date Time with Offset	2011-12-03T10:15:30+01:00'
`ISO_ZONED_DATE_TIME`	Zoned Date Time	'2011-12-03T10:15:30+01:00[Europe/Paris]'
`ISO_DATE_TIME`	Date and time with ZoneId	'2011-12-03T10:15:30+01:00[Europe/Paris]'
`ISO_ORDINAL_DATE`	Year and day of year	'2012-337'
`ISO_WEEK_DATE`	Year and Week	2012-W48-6'
`ISO_INSTANT`	Date and Time of an Instant	'2011-12-03T10:15:30Z'
`RFC_1123_DATE_TIME`	RFC 1123 / RFC 822	'Tue, 3 Jun 2008 11:05:30 GMT'

Predefined DateTimeFormatters

Formatter	Description	Example
BASIC_ISO_DATE	Basic ISO date	'20111203'
ISO_LOCAL_DATE LocalDate	ISO Local Date	'2011-12-03'
ISO_OFFSET_DATE	ISO Date with offset	'2011-12-03+01:00'
ISO_DATE	ISO Date with or without offset	'2011-12-03+01:00'; '2011-12-03'
ISO_LOCAL_TIME LocalTime	Time without offset	'10:15:30'
ISO_OFFSET_TIME OffsetTime	Time with offset	'10:15:30+01:00'
ISO_TIME	Time with or without offset	'10:15:30+01:00'; '10:15:30'
ISO_LOCAL_DATE_TIME LocalDateTime	ISO Local Date and Time	'2011-12-03T10:15:30'
ISO_OFFSET_DATE_TIME OffsetDateTime	Date Time with Offset	2011-12-03T10:15:30+01:00'
ISO_ZONED_DATE_TIME ZonedDateTime	Zoned Date Time	'2011-12-03T10:15:30+01:00[Europe/Paris]'
ISO_DATE_TIME	Date and time with ZoneId	'2011-12-03T10:15:30+01:00[Europe/Paris]'
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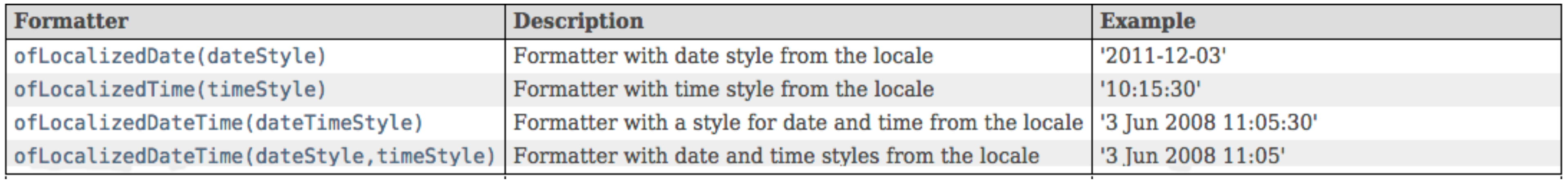
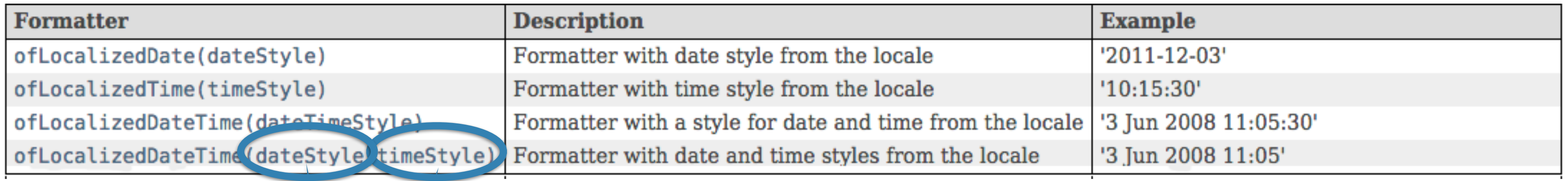


Formatter	Description	Example
`ofLocalizedDate(dateStyle)`	Formatter with date style from the locale	'2011-12-03'
`ofLocalizedTime(timeStyle)`	Formatter with time style from the locale	'10:15:30'
`ofLocalizedDateTime(dateTimeStyle)`	Formatter with a style for date and time from the locale	'3 Jun 2008 11:05:30'
`ofLocalizedDateTime(dateStyle,timeStyle)`	Formatter with date and time styles from the locale	'3 Jun 2008 11:05'

`DateTimeFormatter` Factory Methods



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`ofLocalizedDate(dateStyle)`	Formatter with date style from the locale	'2011-12-03'
`ofLocalizedTime(timeStyle)`	Formatter with time style from the locale	'10:15:30'
`ofLocalizedDateTime(dateTimeStyle)`	Formatter with a style for date and time from the locale	'3 Jun 2008 11:05:30'
`ofLocalizedDateTime(dateStyle,timeStyle)`	Formatter with date and time styles from the locale	'3 Jun 2008 11:05'

Arguments of type :
`java.time.format.FormatStyle`

The enum `FormatStyle`

The enum FormatStyle

FormatStyle members:

- FULL
- LONG
- MEDIUM
- SHORT

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Year, output in a field at least four characters wide

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Literal "-"

Formatter Patterns

Patterns define string formats

- e.g. the pattern for ISO_LOCAL_DATE is "yyyy'-'MM'-'dd"

Year, output in a field at least four characters wide

Month, output in a field exactly two characters wide

Formatter Patterns

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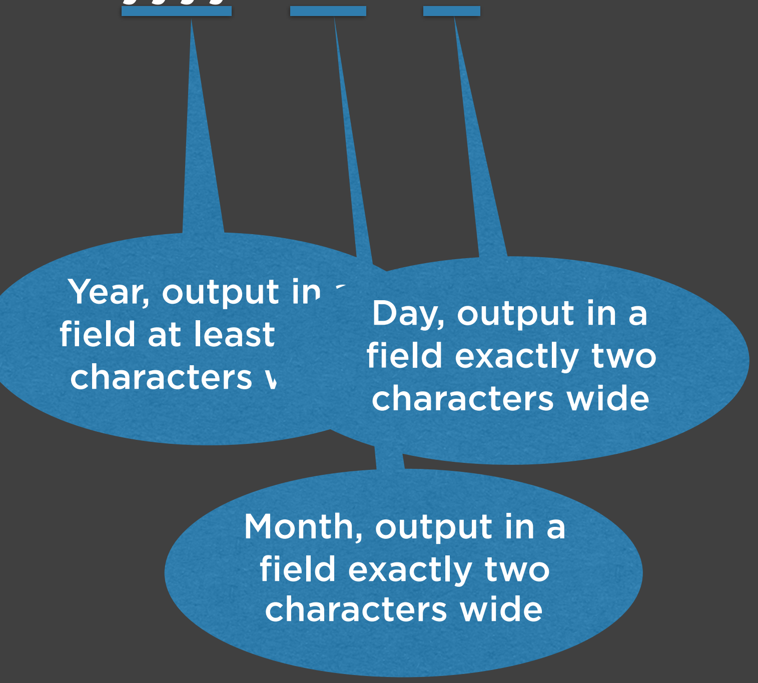
Year, output in
field at least
characters
Day, output in a field exactly two characters wide
Month, output in a field exactly two characters wide

Formatter Patterns

Patterns define string formats

- e.g. the pattern for ISO_LOCAL_DATE is "yyyy'-'MM'-'dd"

A few other pattern symbols:

Symbol	Meaning
K	hour of am/pm
a	am/pm of day
E	day of week
Z	zone offset
[	optional section start
]	optional section end

Formatter Properties

Formatter Properties

Properties of
`java.time.format.DateTimeFormatter`

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- Zone
  - Used when a zone is required but not supplied by the parse string or date-time value

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- `Zone`
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  - Used for localization
- `ResolverStyle`
  - `STRICT`, `LENIENT`, or `SMART`

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DateTimeFormatter Builder

DateTimeFormatter Builder

- Implementation of the Builder Pattern
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- Can append existing `DateTimeFormatters`

`DateTimeFormatter Builder`

- Implementation of the Builder Pattern
  - Simplifies the construction of complex objects
- Can set properties:
  - zone
  - locale
  - resolver style
- Can append existing `DateTimeFormatters`
- Once building is complete, calling `toFormatter()` creates a `DateTimeFormatter`

DateTimeFormatterBuilder

`DateTimeFormatterBuilder`

e.g. to parse `LocalDate`s in this format:

"2018 Aug 23"

DateTimeFormatterBuilder

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we could use a formatter:

```
   DateTimeFormatter.ofPattern("yyyy' 'MMM' 'dd")
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To create the equivalent `DateTimeFormatterBuilder` we would write

DateTimeFormatterBuilder

e.g. to parse `LocalDate`**s in this format:**

"2018 Aug 23"

we could use a formatter:

```
DateTimeFormatter.ofPattern("yyyy' 'MMM' 'dd")
```

To create the equivalent `DateTimeFormatterBuilder` **we would write**

```
DateTimeFormatterBuilder dtfBuilder = new DateTimeFormatterBuilder()
        .appendValue(YEAR, 4)
        .appendLiteral(" ")
        .appendText(MONTH_OF_YEAR, SHORT)
        .appendLiteral(" ")
        .appendValue(DAY_OF_MONTH, 2);

DateTimeFormatter formatter = dtfBuilder.toFormatter();
```

DateTimeFormatterBuilder

e.g. to parse `LocalDate`**s in this format:**

"2018 Aug 23"

we could use a formatter:

```
DateTimeFormatter.ofPattern("yyyy' 'MMM' 'dd")
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To create the equivalent `DateTimeFormatterBuilder` **we would write**

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            .appendText(MONTH_OF_YEAR, SHORT)
            .appendLiteral(" ")
            .appendValue(DAY_OF_MONTH, 2);

    DateTimeFormatter formatter = dtfBuilder.toFormatter();
```

Other TextStyle options:
NARROW, FULL

TemporalAmount classes

The Class Period

The Class Period

`toString()` - ISO-8601 format

TemporalAmount classes

The Class Period

`toString()`	- ISO-8601 format
`parse(Period)`	- relaxed ISO-8601

TemporalAmount classes

The Class Period

toString()	- ISO-8601 format
parse(Period)	- relaxed ISO-8601

For more flexible formatting, can use accessors

- getYears()
- getMonths()
- getDays()

`TemporalAmount` classes

The Class Duration

The Class Duration

`toString()`	- fixed format
`parse(String)`	- fixed format

The Class `Duration`

`toString()`	- fixed format
`parse(String)`	- fixed format

In Java 8, the only accessors are

- `getSeconds()`
- `getNano()`

`TemporalAmount` classes

TemporalAmount classes

The Class Duration

`toString()`	– fixed format
`parse(String)`	– fixed format

In Java 8, the only accessors are

- `getSeconds()`
- `getNano()`

Java 9 provides new methods:

- `toNanosPart()`
- `toMillisPart()`
- `toSecondsPart()`
- `toMinutesPart()`
- `toHoursPart()`
- `toDaysPart()`

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Legacy Date/Time Classes

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java.util.Date	Instant	toInstant()	from(Instant)

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Legacy Type	java.time Equivalent	Conversion Methods	
java.util.Date	Instant	toInstant()	from(Instant)

java.util.GregorianCalendar	ZonedDateTime	toInstant()
		toZonedDateTime()
			from(ZonedDateTime)

Legacy Date/Time Classes

Legacy Type	`java.time` Equivalent	Conversion Methods	
`java.util.Date`	`Instant`	`toInstant()`	`from(Instant)`
`java.util.GregorianCalendar`	`ZonedDateTime`	`toInstant()` `toZonedDateTime()`	`from(ZonedDateTime)`
`java.util.TimeZone`	`ZoneId`	`toZoneId()`	`getTimeZone(ZoneId)`

Legacy Date/Time Classes

Legacy Type	`java.time` **Equivalent**	**Conversion Methods**	
`java.util.Date`	`Instant`	`toInstant()`	`from(Instant)`
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`java.util.TimeZone`	`ZoneId`	`toZoneId()`	`getTimeZone(ZoneId)`
`java.sql.Date`	`LocalDate`	`toLocalDate()`	`valueOf(LocalDate)`

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java.util.GregorianCalendar	ZonedDateTime	toInstant()
		toZonedDateTime()
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java.util.TimeZone	ZoneId	toZoneId()	getTimeZone(ZoneId)
java.sql.Date	LocalDate	toLocalDate()	valueOf(LocalDate)
java.sql.Time	LocalTime	toLocalTime()	valueOf(LocalTime)

Legacy Date/Time Classes

Legacy Type	`java.time` **Equivalent**	**Conversion Methods**	
`java.util.Date`	`Instant`	`toInstant()`	`from(Instant)`
`java.util.GregorianCalendar`	`ZonedDateTime`	`toInstant()` `toZonedDateTime()`	`from(ZonedDateTime)`
`java.util.TimeZone`	`ZoneId`	`toZoneId()`	`getTimeZone(ZoneId)`
`java.sql.Date`	`LocalDate`	`toLocalDate()`	`valueOf(LocalDate)`
`java.sql.Time`	`LocalTime`	`toLocalTime()`	`valueOf(LocalTime)`
`java.sql.Timestamp`	`Instant`	`toInstant()` `toLocalDateTime()`	`from(Instant)`

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`java.util.Date`	`Instant`	`toInstant()`	`from(Instant)`
`java.util.GregorianCalendar`	`ZonedDateTime`	`toInstant()` `toZonedDateTime()`	`from(ZonedDateTime)`
`java.util.TimeZone`	`ZoneId`	`toZoneId()`	`getTimeZone(ZoneId)`
`java.sql.Date`	`LocalDate`	`toLocalDate()`	`valueOf(LocalDate)`
`java.sql.Time`	`LocalTime`	`toLocalTime()`	`valueOf(LocalTime)`
`java.sql.Timestamp`	`Instant`	`toInstant()` `toLocalDateTime()`	`from(Instant)`
`java.nio.file.attribute.FileTime`	`Instant`	`toInstant()`	`from(Instant)`

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Persistence Without JPA Support

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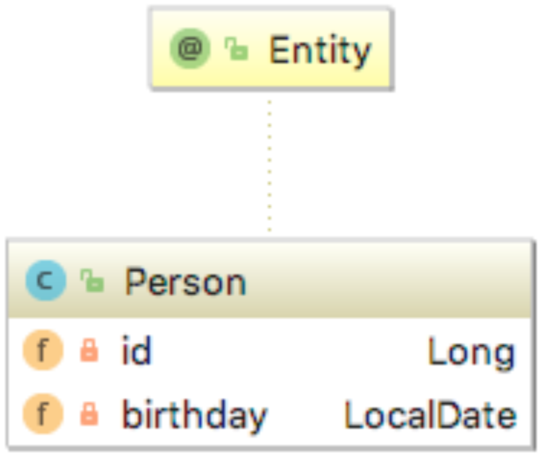

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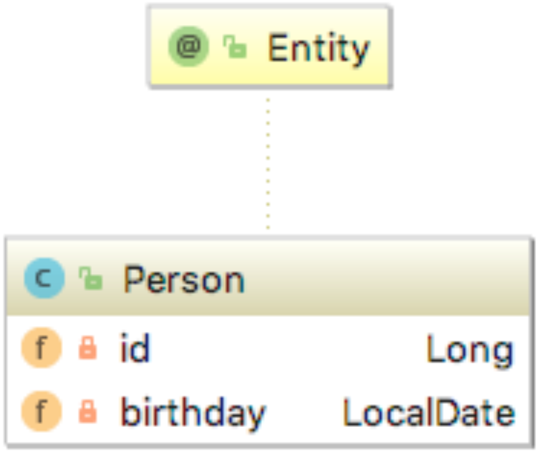

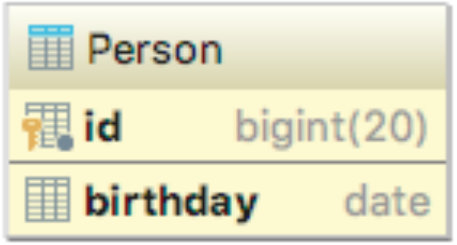

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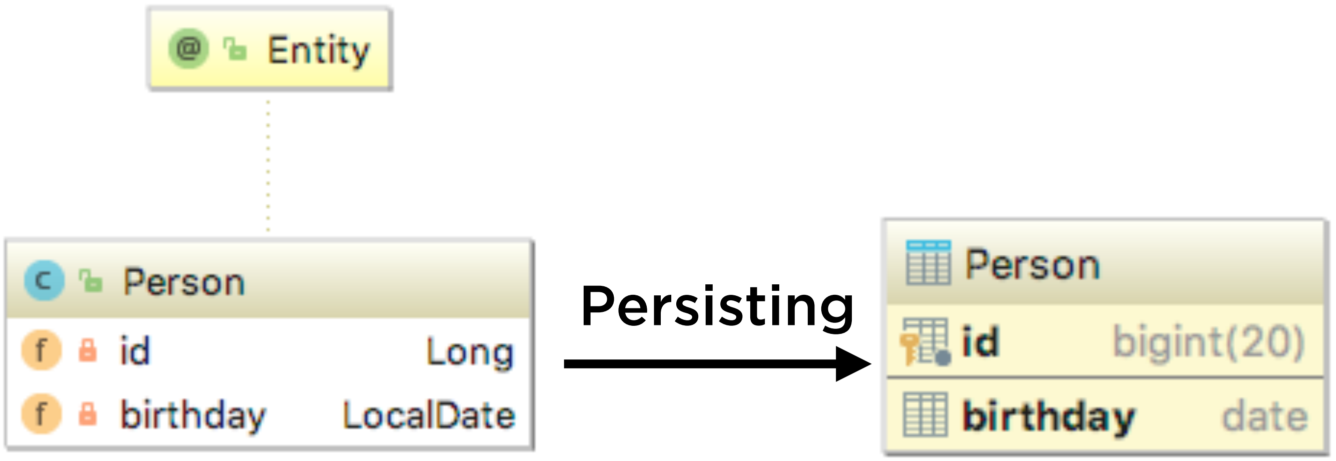

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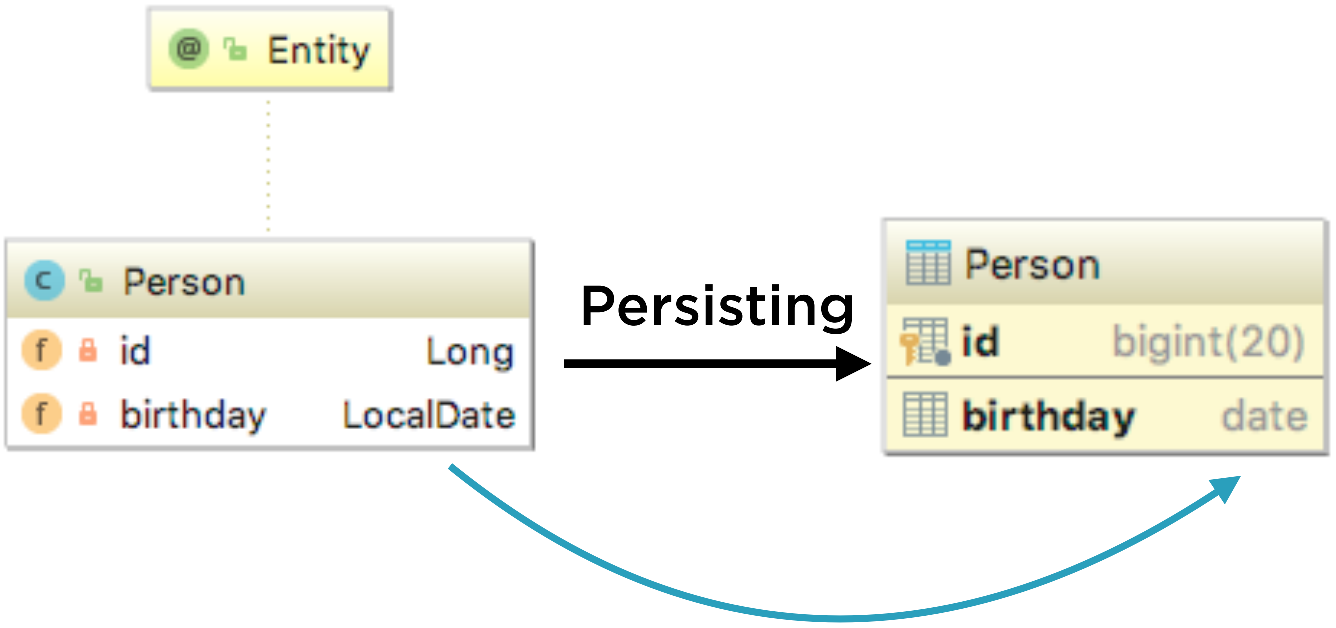

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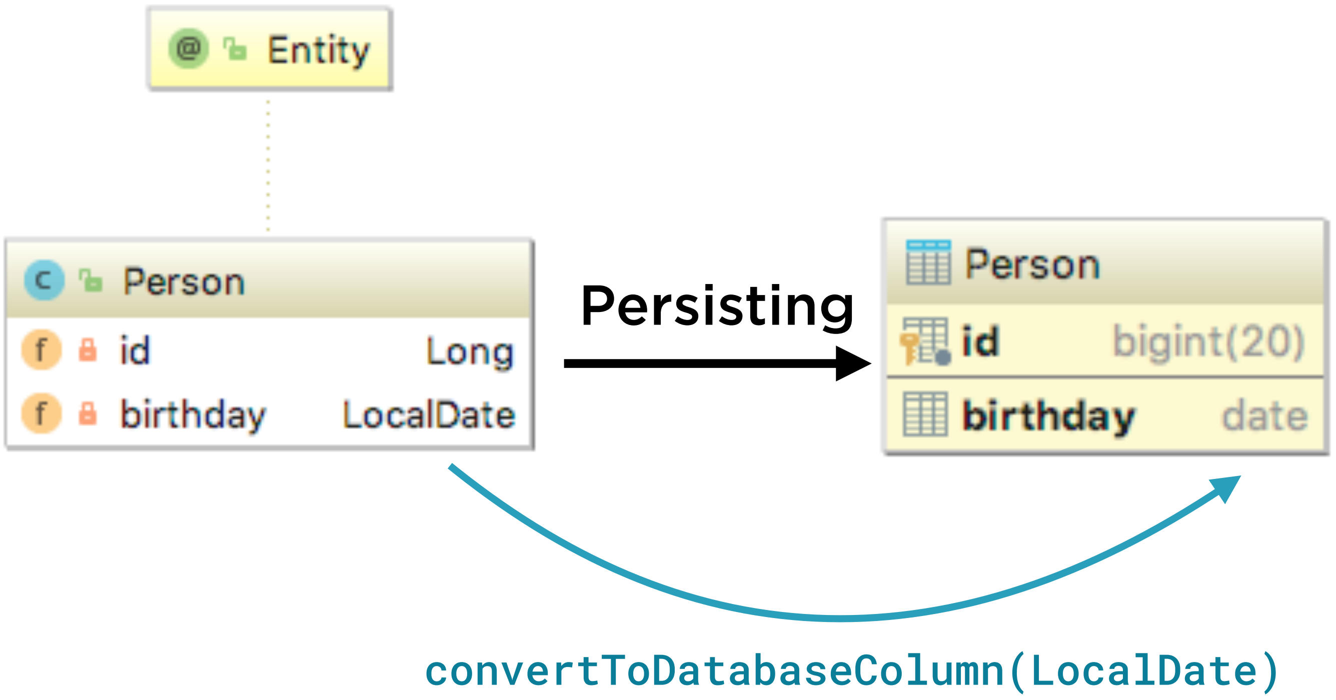

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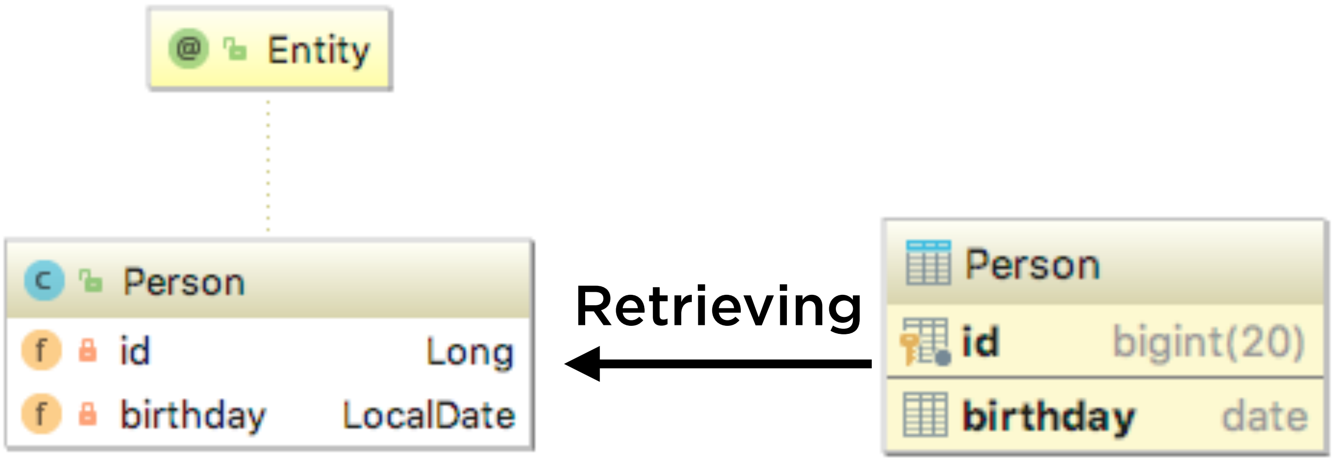

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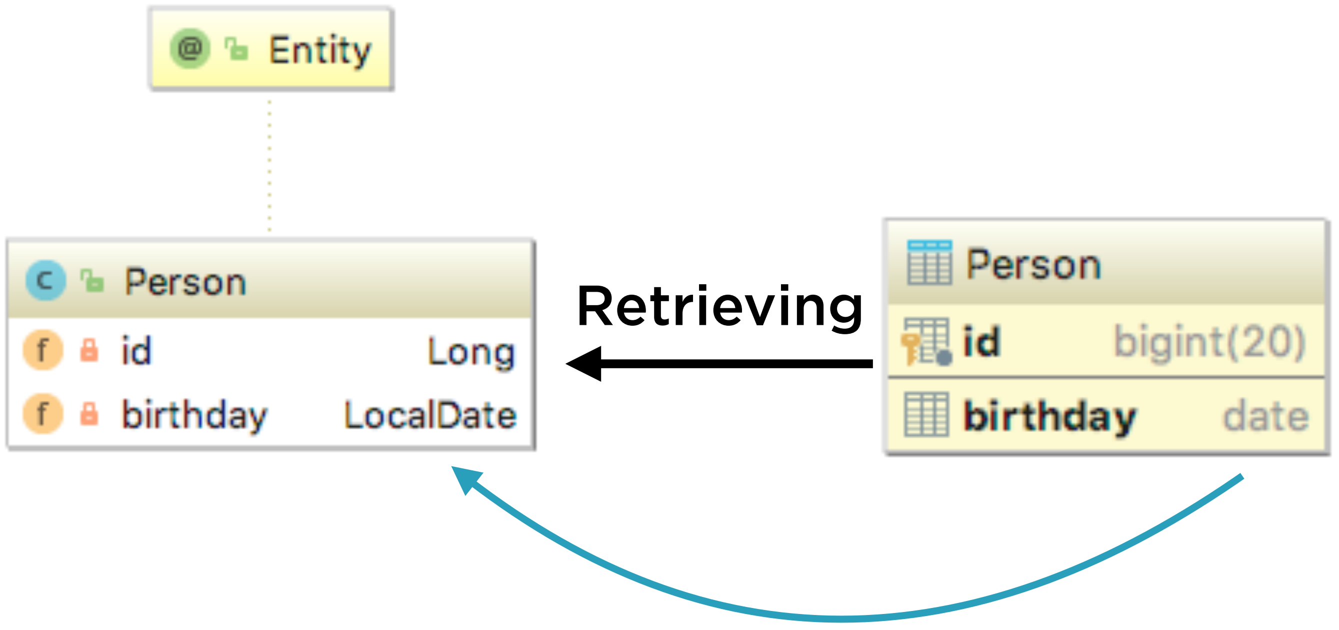

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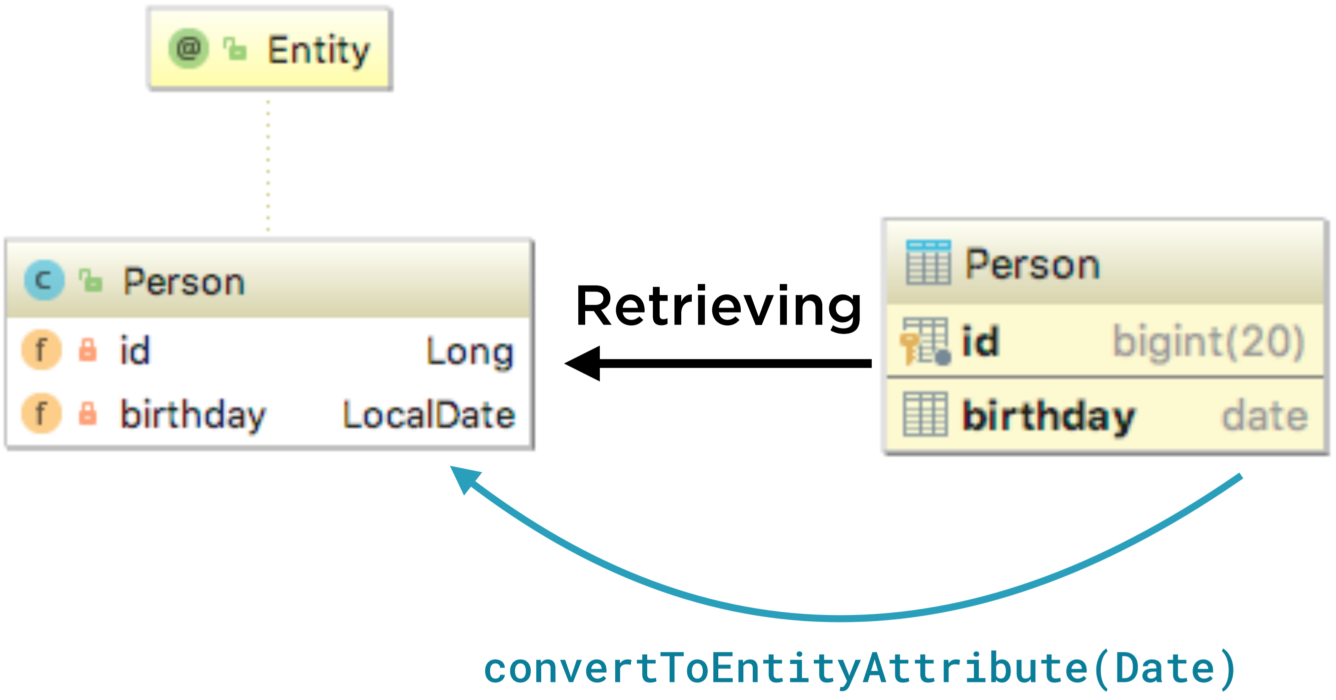

```
interface AttributeConverter<X,Y> {
   Y convertToDatabaseColumn(X)
   X convertToEntityAttribute(Y)
}
```

```
public class LocalDateAttributeConverter implements AttributeConverter<LocalDate, Date> {
```

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public class LocalDateAttributeConverter implements AttributeConverter<LocalDate, Date> {

    @Override
    public Date convertToDatabaseColumn(LocalDate localDate) {
       return (localDate == null ? null : Date.valueOf(localDate));
    }
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    @Override
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```java
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public class LocalDateAttributeConverter implements AttributeConverter<LocalDate, Date> {

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    }
}
```

Three conversion libraries:

- **https://github.com/perceptron8/datetime-jpa**
- **https://github.com/marschall/threeten-jpa**
- **https://bitbucket.org/montanajava/jpaattributeconverters**

With JPA Support

JPA 2.2

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Supported by

- DataNucleus
- EclipseLink (v2.7+)
- Hibernate (v5.3+)

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JAVA TYPE	JDBC TYPE
java.time.LocalDate	DATE
java.time.LocalTime	TIME
java.time.LocalDateTime	TIMESTAMP
java.time.OffsetTime	TIME_WITH_TIMEZONE
java.time.OffsetDateTime	TIMESTAMP_WITH_TIMEZONE

With JPA Support

JPA 2.2

Supported by
- **DataNucleus**
- **EclipseLink (v2.7+)**
- **Hibernate (v5.3+)**

Hibernate also supports persistence of Duration, Instant, and ZonedDateTime

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java.time.LocalDate	DATE
java.time.LocalTime	TIME
java.time.LocalDateTime	TIMESTAMP
java.time.OffsetTime	TIME_WITH_TIMEZONE
java.time.OffsetDateTime	TIMESTAMP_WITH_TIMEZONE
java.time.Duration	BIGINT
java.time.Instant	TIMESTAMP
java.time.ZonedDateTime	TIMESTAMP

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Methods of the Class `Clock`

Methods of the Class `Clock`

Factory Methods

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Factory Methods

```
systemDefaultZone()
systemUTC()
system(ZoneId)
```

Methods of the Class `Clock`

Factory Methods

```
systemDefaultZone()
systemUTC()
system(ZoneId)
tickSeconds(ZoneId)
tickMinutes(ZoneId)
```

Methods of the Class `Clock`

Factory Methods

```
systemDefaultZone()
systemUTC()
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tickMinutes(ZoneId)
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systemDefaultZone()
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Accessors

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instant()
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Accessors

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instant()
millis()
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systemUTC()
system(ZoneId)
tickSeconds(ZoneId)
tickMinutes(ZoneId)
fixed(Instant, ZoneId)
```

Accessors

```
instant()
millis()
getZone()
```

```
private Calendar cal;
private ZonedDateTime start;
@Before
public void setup() {
   cal = new Calendar();
   start = ZonedDateTime.now()
}
@Test
public void testNoWorkPeriods() {
    cal.addEvent(Event.of(start, start.plusHours(1),""));
    NavigableSet<WorkPeriod> combined = cal.overwritePeriodsByEvents(ZoneId.systemDefault());
    assertTrue(combined.isEmpty());
}
```

Testing without a `Clock`

```
private Calendar cal;
private ZonedDateTime start;
@Before
public void setup() {
   cal = new Calendar();
   start = ZonedDateTime.now()
}
@Test
public void testNoWorkPeriods() {
    cal.addEvent(Event.of(start, start.plusHours(1),""));
    NavigableSet<WorkPeriod> combined = cal.overwritePeriodsByEvents(ZoneId.systemDefault());
    assertTrue(combined.isEmpty());
}
```

Testing without a `Clock`

```java
private Clock clock;
private Calendar cal;
private ZonedDateTime start;
@Before
public void setup() {
   cal = new Calendar();
   clock = Clock.fixed(Instant.EPOCH, ZoneOffset.UTC);
   start = ZonedDateTime.now(clock);
}
@Test
public void testNoWorkPeriods() {
    cal.addEvent(Event.of(start, start.plusHours(1),""));
    NavigableSet<WorkPeriod> combined = cal.overwritePeriodsByEvents(clock.getZone());
    assertTrue(combined.isEmpty());
}
```

Testing with a Clock

Using a Mocking Framework to Simulate Changed Time in a Method

```
@Test
public void myTest() {
    testObject.methodThatAcceptsAnInstant(clock.instant());

    testObject.methodThatAcceptsAnInstant(clock.instant());
}
```

Using a Mocking Framework to Simulate Changed Time in a Method

```
private Instant currentTime;





@Test
public void myTest() {
    testObject.methodThatAcceptsAnInstant(clock.instant());
    currentTime = currentTime.plus(1, ChronoUnit.DAYS);     // simulate passage of time
    testObject.methodThatAcceptsAnInstant(clock.instant());
}
```

Using a Mocking Framework to Simulate Changed Time in a Method

```
private Instant currentTime;
private Clock clock = Mockito.mock(Clock.class);
@Before
public void setup() {
   currentTime = Instant.EPOCH;     // or other initialisation
   when(clock.instant()).thenAnswer(invocation -> currentTime);
}
@Test
public void myTest() {
    testObject.methodThatAcceptsAnInstant(clock.instant());
    currentTime = currentTime.plus(1, ChronoUnit.DAYS);     // simulate passage of time
    testObject.methodThatAcceptsAnInstant(clock.instant());
}
```

Using a Mocking Framework to Simulate Changed Time in a Method

Interconversions and Testing

Interconversions with Other Representations

- Strings – Formatting and Parsing
- Other JDK Date/Time Classes
- Database Persistence

Unit Testing

Demo: Testing the Methods of the Task Scheduler

Summary

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