8 week to practice: 17/2/2025-17/4/2025

# **1. Working with Java data types (10%)**

## **1.1 Operator, casting, unboxing-autoboxing**

### **1.1.1 Arithmetic Operators**

-Addition+, subtraction-, multiplication\*, division/, integer remainder %

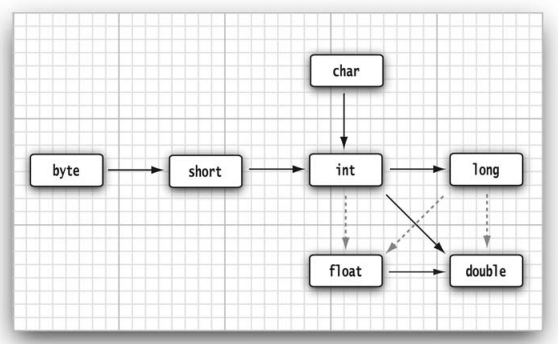
-**Note**: integer / 0 =exception, floating / 0 = NaN or infinite

### **1.1.2 Mathematical Functions and Constants**

-The Math class contains an assortment of mathematical functions.

-Almost methods in java.lang.Math return double, except: max, min, abs, round

### **1.1.3 Conversions between Numeric Types**

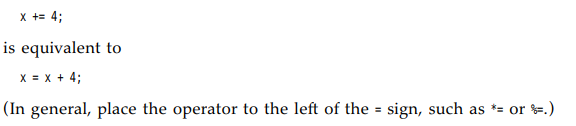


### **1.1.4 Casts**

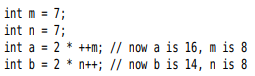
 

Note: boolean->number: 

### **1.1.5 Combining Assignment with Operators**



### **1.1.6 Increment and Decrement Operators**



### **1.1.7 Relational and boolean Operators**

- ==, !=, <, &&, ||..

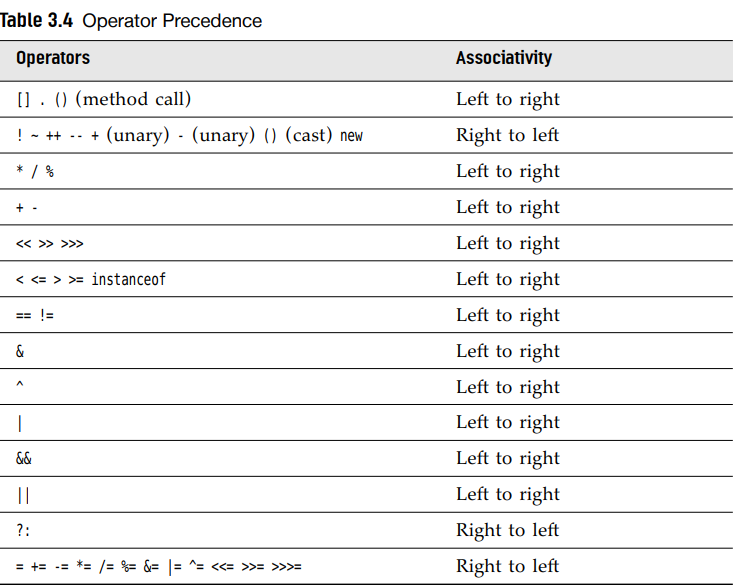
-The ternary ?: 

### **1.1.8 Bitwise Operators**

  
Note: ~ N = -(N+1)

-Shift operators: <<, >>

### **1.1.9 Parentheses and Operator Hierarchy**



## **1.2 String-StringBuilder**

### **1.2.1 String**

-Constructor: (), byte[], char[], String, StringBuilder

- Static methods: join, valueOf, format

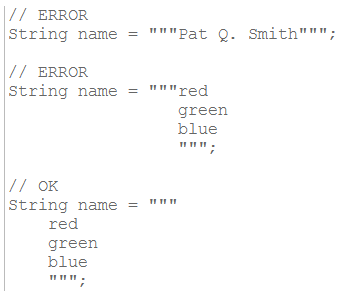
-Instatnce methods: charAt, concat, contains, startsWith, endsWith, equals, equalIgnoreCase, indexOf, indent, isBlank, isEmpty, lastIndexOf, length, repeat, replace, replaceAll, replaceFirst, split, strip, stripIndent, stripIndent, stripLeading, stripTrailing, subString, toLowerCase, toUpperCase, trim

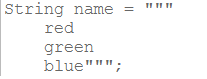
### **1.2.2 StringBuilder**

-Constructor: (), String

-Instance methods: append, capacity, charAt, delete, deleteCharAt, indexOf, lastIdexOf, insert, length(), replace, reverse, subString

### **1.2.3 Text block:**





-Trailing white space:Incidental white space + essential white space

## **1.3 Typer inference with var**

-var is not a keyword, can use var as variable name

-Var can use in:

+static/instance initialization block

+as a local variable

+iteration variable in enhanced for-loop

+as looping index in for-loop

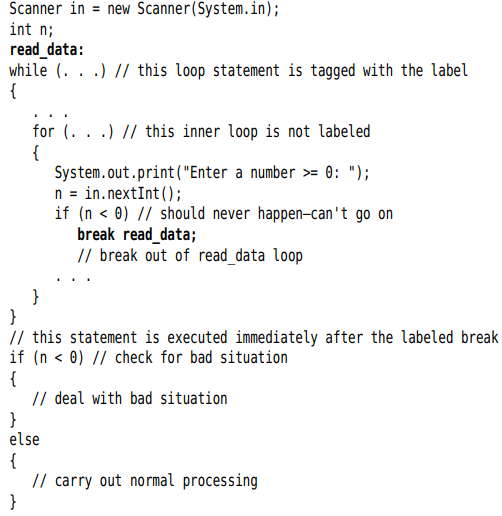
+as a return value from another method,

+as a return value in a method,

## **1.4 Controlling Program Flow (5%)**

-**break**: exit a switch and break out of a loop.

-label and break: break out of all nested loops



-**continue**: transfer control to the header of innermost enclosing loop

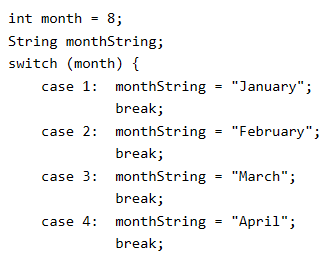
|  |  |
| --- | --- |
| |  | | --- | | -Note: labeled break or continue statement must always exist inside the loop where the label is declared | |

## **1.5 if/else, swith-case, loops**

### **1.5.1 Switch**

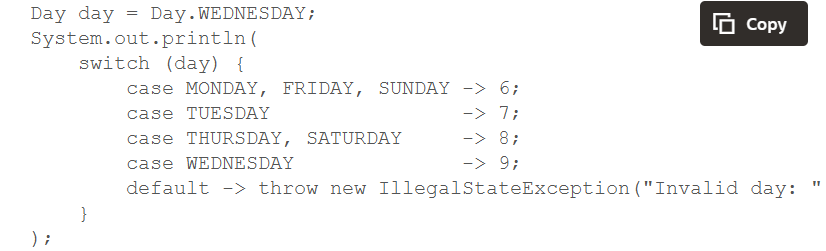
-works with: byte, short, char, int+ their wrap+ enumarted+String

-Switch statement

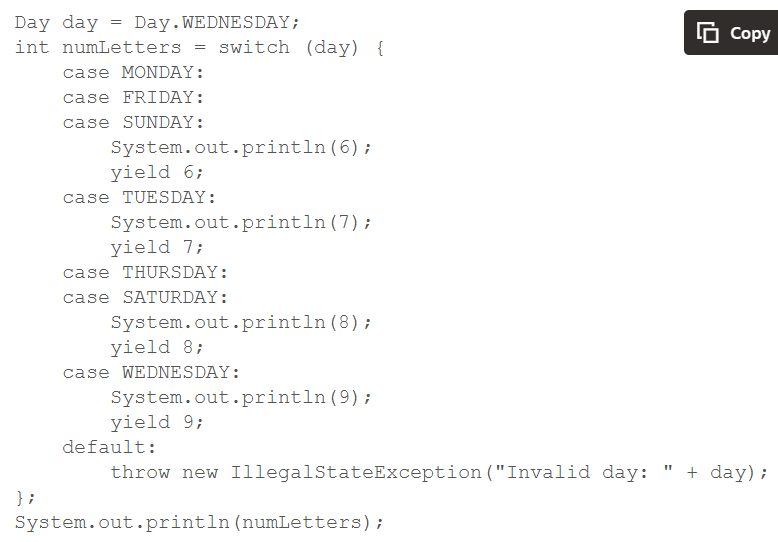


-Switch expression

+”case L->: Labels:



+”case L:” Statements and yield Statement



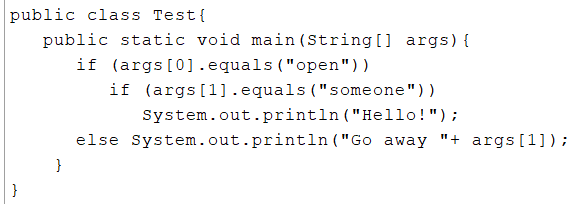
-Note:

+The default label is optional for switch statement and required for a switch expression only when the case labels are not exhaustive.

+Can’t mix switch expression+statement

### **1.5.2 If-else**

-An else clause belongs to the innermost if the first if() condition fails+there is no else associated to execute



# **2. Java Object-Oriented (30%)**

## **2.1 Class-objects declaration, initialization, life cycles**

-**Default field Initialization**:

If you don’t set a field explicitly in a constructor, it is automatically set to a **default value**: numbers to 0, boolean to false, object reference to null.

-**Constructor with no Arguments**:

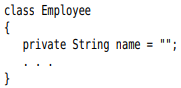
+Constructor with no arguments: creates an object whose state is set to an appropriate default.

+If a class with no constructors: a no-argument constructor is provided with all default values fields.

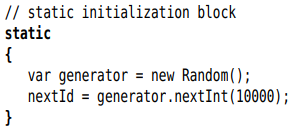
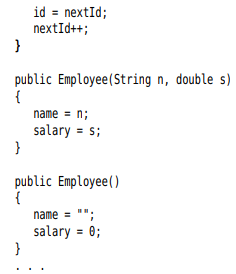
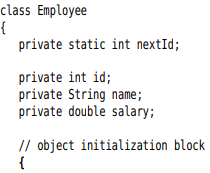
+If a class supplies at least 1 constructor but does not supply no-argument constructor => cannot construct object with no-arguments

-**Explicit Field Initialization**:

You can simply assign a value to any field in class definition. This assignment is carried out before the constructor executes.



-**Initialization Blocks**:



-**Constructor flow**

+First line calls a second constructor? Executes

+fields: default values + fields initializers and initialization block in the order in class declaration

+The body of constructor.

## **2.2 Fields, methods with instance, static, overloading**

-**Overloading**: several methods have the same name but different parameters and different return types.

|  |  |
| --- | --- |
| |  | | --- | | -An overriding method is not allowed to decrease accessibility | |

## **2.3 Nested class, inner class, local class, anonymous class**

### **2.3.1 Inner Class to access object state**

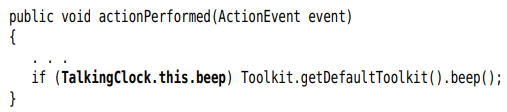
-**Can’t** have **static methods**, **can** have **final static fields**

-**Inner class method** gets to **access** both its own **data fields** and **those** of the **outer object** creating it.

### **2.3.2 Syntax rules for inner classes**

-**OuterClass.this** denotes the **outer class** reference

-**Method**:



-**Inner object constructor** more **explicitly**:







+Refer to **Inner class** when it occurs outside the scope of outer class: 

### **2.3.3 Local inner classes**

-You can define the class locally in a **single method**.

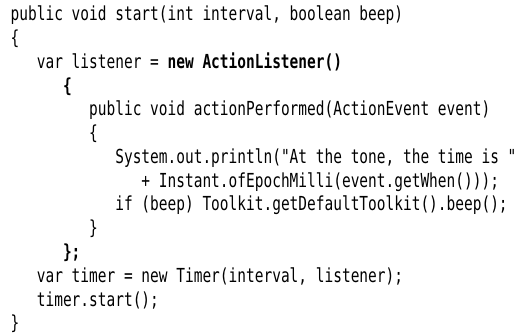
-Local classes are **not declared** with **access specifier**. Their **scope** is restricted to the **block** they’re **declared**

-**Local class** are completely **hidden** from the **outside**

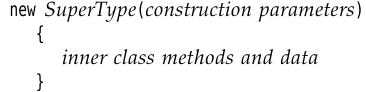
-**Local classes** can even **access** **local variables**. Those variable must be **effectively final***.*

### **2.3.4 Anonymous Inner Classes**

**Anonymous inner class**: class that don’t have name, used to make a single object of this class



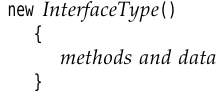
-General syntax:



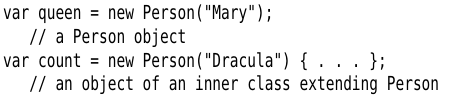
+SuperType can be an **interface, class**

-Anonymous inner class can’t have constructors. The construction parameters are given to superclass constructor.

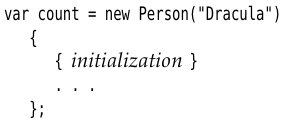
-When an inner class implements interface:



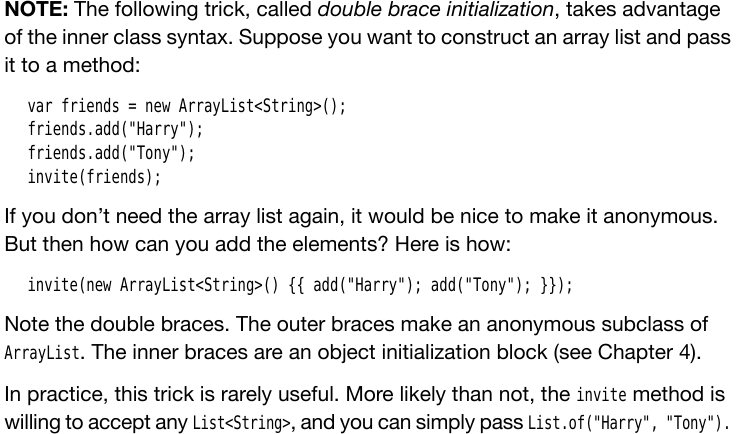
-Different:



-Note: You can provide object initialization block



-**Note**:

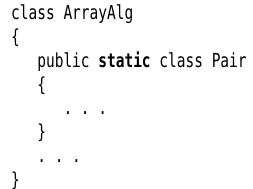


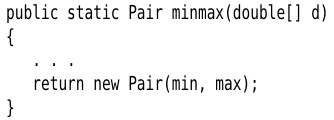
-**Anonymous class** can used in **static method.**

### **2.3.5 Static Inner Classes**

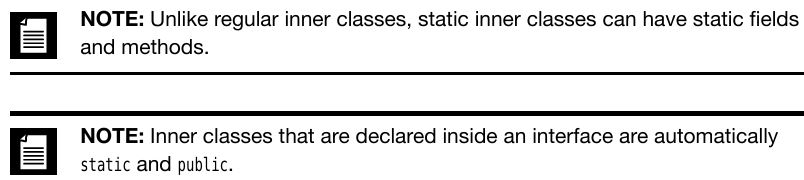
-**static inner class**: exactly like any other inner class, except that an object of a static inner class **doesn’t have** a **reference** to the **outer class object** that generated it.

-Use a static inner class when the inner class object is constructed inside a **static method**.





-Note

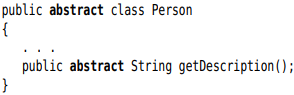


## **2.4 Encapsulation and immutability**

-**Encapsulation**(**information** **hiding**): combine data and behavior in one package and hide the implementation details from users of object. The bits of data in object are **instance fields**, procedures are **methods***.* An object is an instance of class and have values of instance fields: called **state**. The key to making **encapsulation** is to have methods never directly access instance in class other than their own.

## **2.5 Subclass, super class, abstract class**

-Moving up the inheritance hierarch, classes become more general and abstract. There are some attributes that make sense for every class. Using the **abstract**, you don’t need to implement the method:



-**Abstract methods** act as placeholders for method that are implemented in subclasses. It can has **instance fields** and **concrete methods**, or **no abstract method**.

-Abstract cannot be instantiated, you can create object variable but refer a nonabstract class. The variable always refers to an object of subclass.



-Abstract methods are an important concept in Java => inside interfaces.

## **2.6 Method call polymorphically**

-The fact that an object variable can refer to multiple actual types is **polymorphism***.* Automatically selecting the appropriate method at runtime is **dynamic binding**

**-Substituation principle**: you can use a subclass object whenever the program expects a superclass object

-Caution: Arrays of subclass can be converted to arrays of superclass. To make sure no corruption, all arrays remember the element type which they were created

-**Steps to check for valid override**First, check the method signature (i.e. method name and the parameter list). If the signature of the method in the subclass matches the signature of the method in the super class, then it could be a valid override, otherwise it is just an overloaded method. Note that signature does not include parameter names and parameter's generic type specification.  
Second, if it is a potential override, check the generic type specification of the parameters. If the overriding method does not use a generic type specification for the parameter type, then it is valid. The reverse is not valid i.e. the overriding method is allowed to erase the generic type specification but is not allowed to add a generic type specification if the overridden method does not have it. If both the methods have a generic type specification, then the specification must match exactly.  
For example, if the overridden method has Set<Integer>, then the overriding method can use Set or Set<Integer>. But if overridden method has Set, then the overriding method must also have Set for a valid override.  
  
Third, if it is a potential override, check the return type. Java allows "covariant" returns, which means, the return type of the overriding method must be the same or be a subtype of the return type mentioned in the overridden method. Check the two return types without the generic type specification. If return type of the overriding method is covariant with respect to the return type of the overriding method (for example, ArrayList is covariant with List), then perform the same check including the generic type specification (for example, ArrayList<CharSequence> is covariant with List<? extends CharSequence>).  
  
Don't get confused by the presence of <T> in the code. The same rules of overriding still apply. The T in <T> is called as the "type" parameter. It is used as a place holder for whatever type is actually used while invoking the method. For example, if you call the method <T> List<T> transform(List<T> list) with List<String>, T will be typed to String. Thus, it will return List<String>. If, in another place, you call the same method with Integer, T will be typed to Integer and therefore, the return type of the method for that invocation will be List<Integer>

**Type erasure of generic method parameters**Remember that unlike arrays, generic collections are not reified, which means that all generic information is removed from the compiled class. Thus, Set<CharSequence> and Set<String> are converted to just Set by the compiler while generating the class file. This implies that two methods whose parameter types differ only on the type specification are not really different methods.  
For example,  
void m(Set<CharSequence> cs), void m(Set<String> s), and void m(Set<SomeOtherClass> o) are not different method signatures at all. If you remove the type specification, they all resolve to the same signature i.e. void m(Set x).  
  
Hence, if you put them in the same class, the resulting class file will have two methods with the exact same signature. This is obviously a problem and so, the compiler rejects the code. If you put one of them in a superclass and another in a subclass, then from the compiler's perspective they constitute valid overloading, however, from the JVM's perspective it is an override and the JVM will not respect the compile time method binding done by the compiler based on the generic type specification. That is why Java does not allow this either.  
  
The exception to this rule is that the overriding method is allowed to erase the generic type specification. For example, if the overridden method has Set<Integer>, then the overriding method can use Set or Set<Integer>. But if overridden method has Set, then the overriding method must also have Set for a valid override.

**Rule of Covariant Returns**An overriding method (i.e. a sub class's method) is allowed to return a sub-type of the type returned by the overridden method (i.e. super class's method).  
  
So, first check whether the return type of the overriding method is a subtype. For example, if the overridden method returns List, the overriding method can return ArrayList but not Object.  
  
Next, you need to check the type specification of generic types. This is a bit complicated. To determine this, you must remember the following hierarchy of subtypes. Assuming that S is a sub type of T and <<< means "is a subtype of", here are the two hierarchies:  
  
**Hierarchy 1 : A<S> <<< A<? extends S> <<< A<? extends T>**Example: Since Integer is a subtype of Number, List<Integer> is a subtype of List<? extends Integer> and List<? extends Integer> is a subtype of List<? extends Number>.  
Thus, if an overridden method returns List<? extends Integer>, the overriding method can return List<Integer> but not List<Number> or List<? extends Number>.  
**Hierarchy 2 : A<T> <<< A<? super T> <<< A<? super S>**Example: List<Number> is a subtype of List<? super Number> and List<? super Number> is a subtype of List<? super Integer>  
Thus, if an overridden method returns List<? super Number>, the overriding method can return List<Number> but not List<Integer> or List<? super Integer>.  
It is important to understand that List<Integer> is not a subtype of List<Number> even though Integer is a subtype of Number.

## **2.7 Interface, private, static, default method**

2.7.1 Interface

-All **methods** in **interface** are **automatically** **public**, whether the keyword is specified or not.

-**Interface** is an **abstract class** with **no instance fields**. All fields in Interface are implicitly **public, static and final**, whether the keywords are specified or not.

-Interfaces are not classes. You can never use **new**

****

-But you can **declare**: . An interface variable must refer to implemented object: 

-A **reference** of interface type can be **cast** to any class that implements this interface.

-You can **extend any number of interfaces**.

-An overriding method must return either the **same type** or a **sub type** of the **return type** of overridden method.

-Classes can implement **multiple interfaces**.

+More than one method declaration may be implemented by a singer method declaration if they have the same name.

+If the methods throw exception, the overriding declaration must throw the subclass of the exceptions.

-Extend class and implements interface: only the superclass method matter, the interface is ignored



-**Multiple inheritance of state**: inherit instance fields.

-**Multiple inheritance of type**: implement interfaces and extend classes.

2.7.2 Static and private methods

-Static has a body. You can **redeclare** a static method as a **default** method in sub interface.

-private: has a body. You can use private static or instance methods.

2.7.3 Default methods

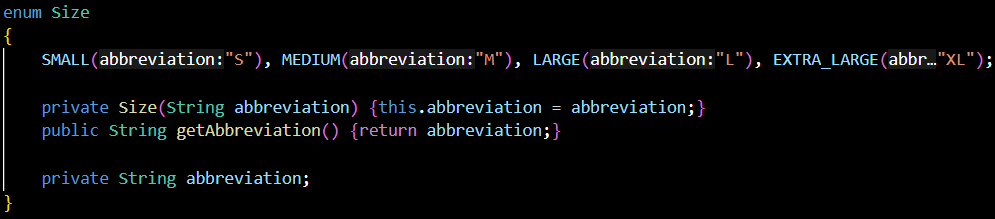
-Default methods supply a **default** implementation with default modifier. It can call other methods.

-It has a body.

-A subinterface can redeclare an inherited default method as **abstract** or provide a different implementation.

## **2.8 Enumeration**





-Enum type is a data type that enables for a variable to be a set of predefined **constants**.-> enum is **final +** Can’t override **clone()**. The enum **values** can be the **same** (MS1(“Ms.”), MS2(“Ms.”))

-enums implicitly extend **java.lang.Enum** -> **cant extend** anything else

-enum defines a class (enum type). The enum body can include methods and other fields. The compiler automatically adds special methods: static **values()** and **valueOf(), ordinal() name().**

-The **constants** are defined 1st, then fields + methods.

-The enum constructor must be **package** or **private** access.

**-Can’t access** **non-final static field** in **constructor**.

-Enums implement **Comparable** in the **natural order** which **they are defined**

# 3. Exception handling (5%)

3.1 try/catch/finally

3.2 Single-catch, multi-catch statements

3.3 Throw, throws

3.4 Try-with-resource

3.5 Custom exception

# 4. Working with Arrays and Collections (10%)

4.1 Array, List, Set, Map, Dequeue

4.2 Comparator, Comparable

4.3 Generic, wildcards

# 5 Working with Streams and Lambda expressions (15%)

5.1 Functional interfaces using lambda expressions

5.2 java.util.function package

5.3 Java Streams filtering, transforming, processing, reduction, grouping, partitioning

5.4 Sequential and parallel streams

# 6. Java Platform Module System (5%)

6.1 Modular vs non-modular application

6.2 Named module, unnamed modules, automatic modules

6.3 Expose, compile, run, deploy module

# 7. Concurrency (4%)

-Deadlock, livelock, starvation recognition

-Runnable, Thread

-Callable, ExecutorService

-java.util.concurrent locking api

# 8. Java I/O API (5%)

8.1 I/O Streams

8.2 NI/O API

8.3 Serialization and deserialization

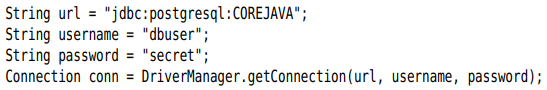
# 9. Securing Coding in Java SE Application (3%)

-Denial of service, code injection, data validation, data integrity

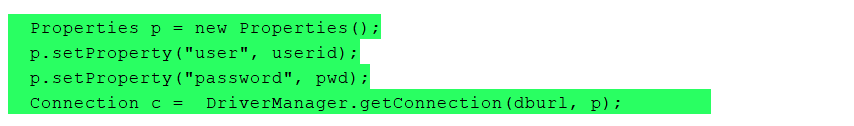
# 10. Database Applications with JDBC (2%)

## **10.1 Database connection, manipulation**

### **10.1.1 Connection**



-Use property:



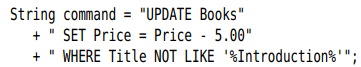
## **10.2 Working with JDBC Statement**

### **10.2.1 Executing SQL Statements**

-Execute a SQL statement, 1st create **Statement** object by **Connection** from **DriverManager.getConnection()**



-Place the statement into a string:



-**executeUpdate()** of Statement interface:



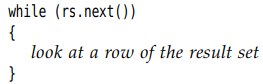
+**executeUpdate()** return a count of rows affected by SQL statement or zero.

+executeUpdate() can execute actions INSERT, UPDATE, DELETE, CREATE TABLE, DROP TABLE…

-**executeQuery()**: SELECT

+This method returns **ResultSet** object to walk through the result one row at a time:





+The order of rows is arbitrary. You can specify with **ORDER BY**

+Take the contents of the fields:



There are accessors for various type, such as getString() and getDouble(). Each accessor has 2 forms: string (name column) and numeric (number column) argument.

Each get method make type **conversions**. Example: getString() convert any type to string.

-**execute()**: catch-all statement to execute arbitrary SQL statements. It’s commonly used only for queries that a user supplies interactively.

### **10.2.2 Managing Connections, Statements, and Result Sets**

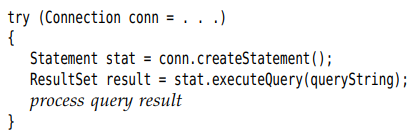
-Every Connection object can create one or more Statement objects. You can use the same Statement object for multiple unrelated commands and queries.

-A statement has at most one open result set. If you want multiple queries concurrently, use multiple Statement.

-There is a limit to the number of statements per connection. Use **getMaxStatements()** of **DatabaseMetaData** interface.

-**close()** when you done using ResultSet, Statement or Connection. **closeOnCompletion()** on Statement close automatically as soon as all its result sets have closed.

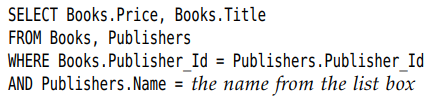
-Use **try-with-resource** with short-lived connection:



## **10.3 Query Execution**

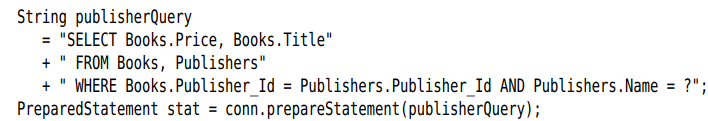
### **10.3.1 Prepared Statements**

-Prepared statements:



+We prepare a query with a host variable and use it many times, each time filling in a different string for the variable. -> improve performance

+Each host variable in a prepared query is indicated with a ?. If there is more than one variable, keep track of the positions of ? when setting the values



-You must bind the host variables to actual values with set(). There are different **set()** for various types

+ 1st argument is the position number of the host variable. 2nd argument is the value.

+If you reuse a prepared query that already executed, all host variables **stay bound** unless you change them with **set()** or **clearParameters()**.

-Once all variables have been bound to values, execute the prepared statement: 

-executeUpdate() return the count of changed rows.



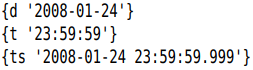
-**Note**:

+**setNull()** must use SQL type in java.sql.Types

### **10.3.3 SQL Escapes**

-“escape” syntax features are supported by databases but use database-specific syntax variations. JDBC driver translates the escape syntax to syntax of database.

-Date and time literals: Use d, t, ts for DATE, TIME or TIMESTAMP values:

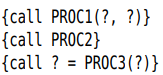


-Scalar function: function returns a single value.

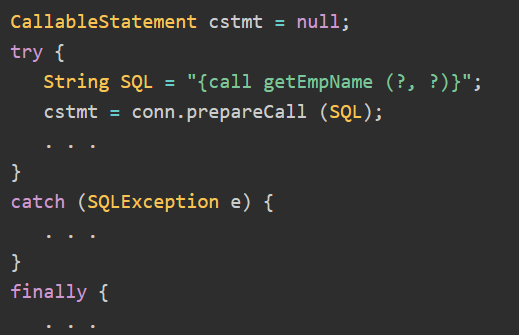
+Embed the standard function name and arguments:



-**Stored procedure**:



+Use **CallableStatement** interface:



Input: set…()

Output:



-Outer join

-\_ and % in LIKE:

+No standard way to use them literally.

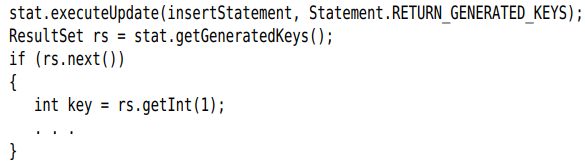
+Example: match all strings containing a \_



### **10.3.5 Retrieving Autogenerated Keys**

-Most databases support mechanisms for autonumbering rows in database. They differ among vendors. The automatic numbers are often used as primary key.

-Retrieving them:



## **10.4 Scrollable and Updatable Results Sets**

-In a **scrollable result**, you can move forward and backward through a result set and jump to any position.

-In an **updatable result set**, you can update entries so that the database is automatically updated.

### **10.4.1 Scrollable Result Sets**

-By default, result sets are not scrollable or updatable.

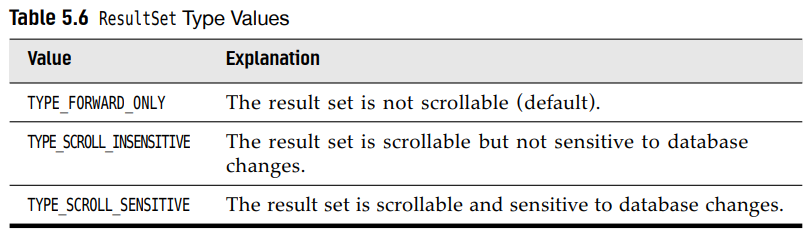
-Must obtain a different Statement object with:

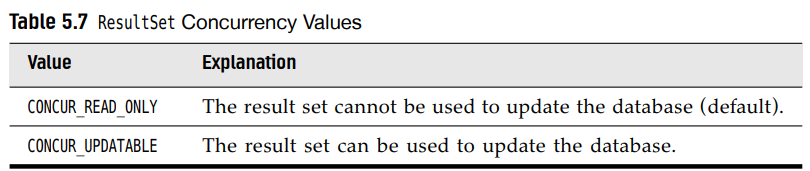


-For a prepared statement:



-**type** and **concurrency**:





-Example: scroll through a result set but don’t edit data:



+Return the result sets: 

are now scrollable. A scrollable result set has a **cursor** that indicates the current position.

+**getType()** and **getConcurrency()** of ResultSet interface to find out what mode a result set actually has.

-**Scrolling**:

+ return true or false

+ move the cursor by any number of rows

+ set the cursor to a row number

+ get the current row number

+first(), last(), beforeFirst(), afterLast()

+isFirst(), isLast(), isBeforeFirst(), isAfterLast()

### **10.4.2 Updatable Result Sets**

-Obtain updatable result sets:



-Note: Not all queries return updatable result sts

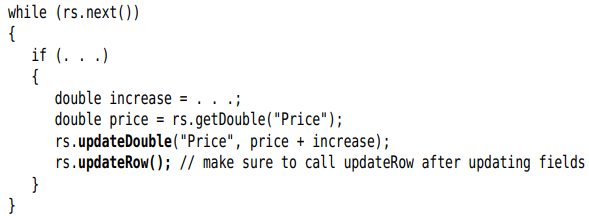
+The query is a join involves multiple tables not updatable

+The query involves only a single table or join multiple tables by their primary key: you should expect the result set to be updatable.

+getConcurrency() to find out.

-**Update**:



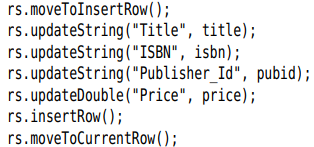


+There are **updateXXX** methods for all data types that correspond to SQL types: updateDouble(), updateString()

+**Note**: If you use updateXXX whose 1st parameter is the column number, be aware that this is the column number in the result set.

+updateXXX changes only the row values, not the database. Use updateRow(). You can also call cancelRowUpdates() cancel the updates to current row

-**Add** a new row to database:



+You can’t influence where the new data is added in the result set or database.

+If you don’t specify a column value in insert row, it’s set to SQL NULL. If the column has a NOT NULL constraint, an exception is thrown and the row is not inserted.

-Delete the row under the cursor: 

-To sum up, java programmers might find it more natural to manipulate the database contents through result sets than by constructing SQL statements.

## **10.5 Transactions**

-You can group a set of statements to form a **transaction**. It can be **committed** when all has gone well-or an error has occurred in one of them, it can be **rolled back** as if none of the statements had been issued.

-The major reason for grouping statements into transactions is **database integrity**.

### **10.5.1 Programming Transactions with JDBC**

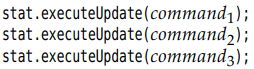
-By default, database connection is in **autocommit mode** –each SQL statement is committed to database as soon as it is executed. Once a statement is committed, you can’t roll it back.

-Turn off the default: 

-Create a statement object in normal way:



-executeUpdate() any number of times:



-If all statements have been executed without error:

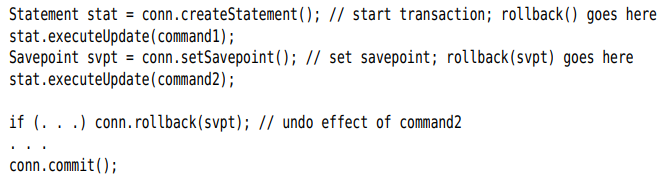


-If an error occurred: 

+All statements since the last commit are automatically reserved. You issue a rollback when the transaction was interrupted by a SQLException

### **10.5.2 Save Points**

-Create a save point marks a point to which you can later return without having to abandon entire transaction.



-If you no longer need a save point: 

### **10.5.3 Batch Updates**

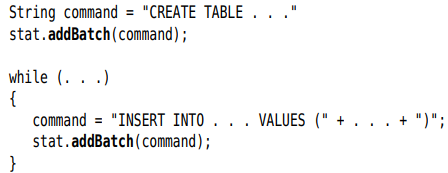
-In a batch updates, a sequence of statements is collected and submitted as a batch.

-**Note**: use **supportsBatchUpdates**() of **DatabaseMetaData** to find out if the databse supports this feature.

-Execute a batch:

+Create a Statement object: 

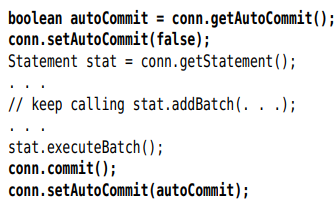
+**addBatch**() instead of executeUpdate():



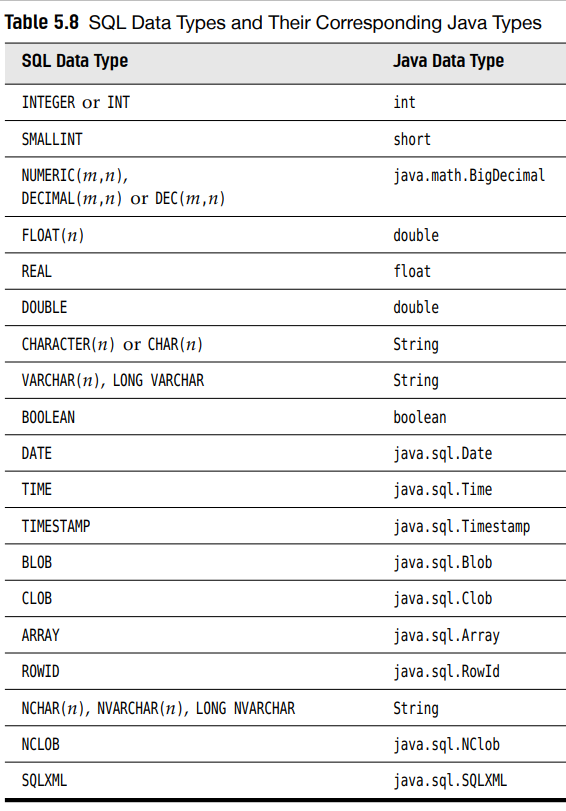
+Submit the entire batch: 

returns an array of row counts for all submitted statements.

-Treat the batch execution as a single transaction. If a batch fails in the middle, roll back to the state before the beginning of the batch.



### **10.5.4 Advanced SQL Types**



# 11. Localization (2%)

11.1 Locale

11.2 Resource bundle

11.3 Message format

11.4 Date format

11.5 Number format

# 12 Annotation (4%)

12.1 Built-in annotation

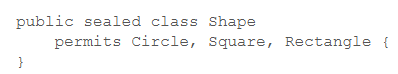
12.2 Annotation creation, applying

# 13.Record and Sealed Class

## **13.1 Sealed class**

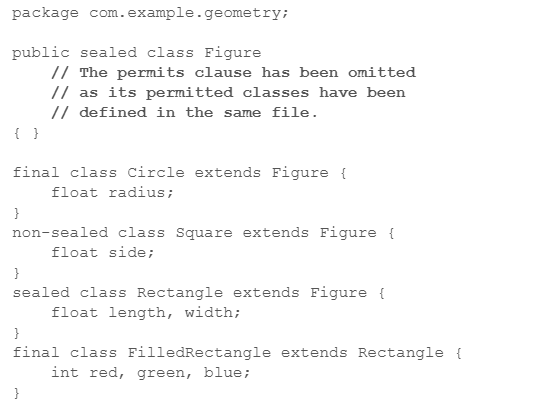
-Sealed classes and interfaces: restrict which other classes or interfaces may extend or implement them.

-Declare:



+The permitted subclasses are in the **same module** or in the **same package.**

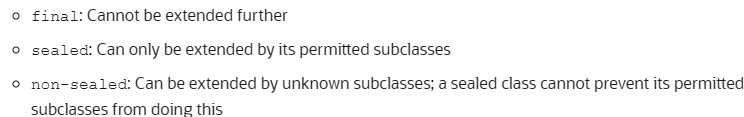
+You can define permitted subclasses in the **same file**, then you **can omit permits**:



-**Permitted subclasses**:

+Must **extend** the **sealed class**.

+Must be one of:



+Must be in the **same module** or **same package**.

-**Sealed interface**: specifies classes and interfaces that can extend and implement

-**Record** classes as **permitted subclasses** of a **sealed interface**: record is **final**

-**java.lang.Class methods**:

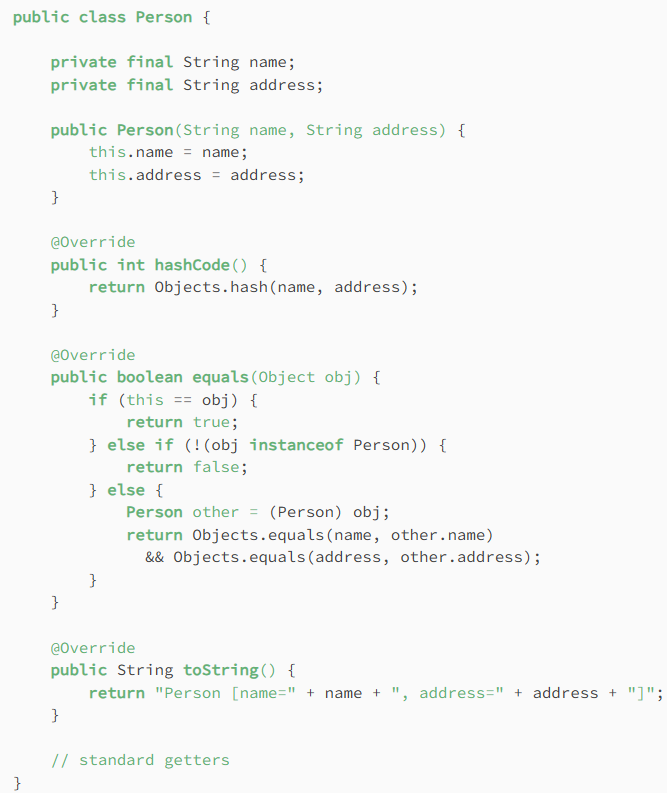
permittedSubClasses()

isSealed()

## **13.2 Record**

13.2.1 Purpose

-We write classes to hold data (database result, query result, information from a service), this data is **immutable**.

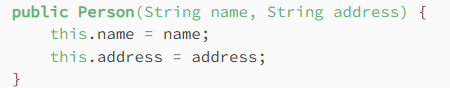


13.2.2 The basics

-JDK 14: Records are immutable data classes that requires only the type and name of fields. final equals(), final hashCode(), final toString(), private, final fields and constructor are generated by Java compiler.



-The equivalent constructor:



+Instantiate objects from record:



-The equivalent **getters** (Note: name of getter = name of instance fields, example: name()), equals (true if objects of same type and values match), hashCode (return same value for 2 objects if all field values match), toString(name of record+field names+field values)

-Record **can’t be extended** and **can’t have extend clause**.

-Record can implement Serializable interface

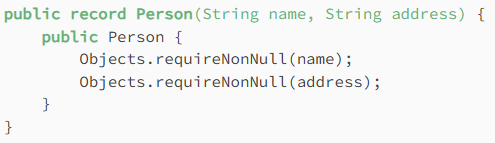
-Record may have at **most 1 varagrs** component.

* + 1. Constructors

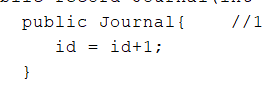
-**Canonical constructor**:

+We can **customize** constructor for **validation**: (**compact form**)

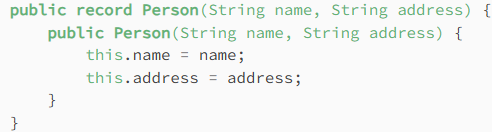
+Example: fields aren’t null



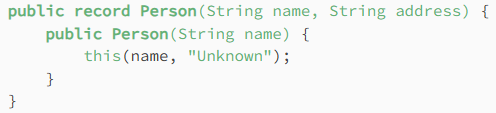
+Or:



+Creating a constructor with **same arguments** as the generated public constructor is valid, but each field is **manually initialized**: **regular form canonical constructor**

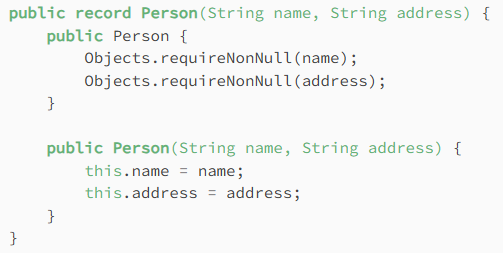


-**Non-canonical constructor**: Create **new constructors** with different arguments by supplying either a **canonical constructor** or **another constructor**:



-**Error** when declare **2 canonical constructors**:

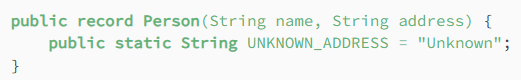
+Example: compact form + regular form

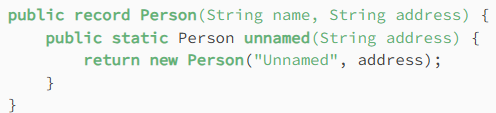


-Note: Compiler provides a canonical constructor for a record even when the programmer provides a non-canonical constructor and does not provide the canonical constructor

13.2.4 Static variables and methods

-We can use **static variables** and **static (and instance, not setter)** **methods** in record







# 14. Date and Time API

## **14.1 Time Line**

-**Instant** represents a point on the time line.

+An origin (**epoch**) is set at midnight of 1/1/1970 at the prime meridian passing through Greenwich Royal Observatory in London. Time is measured in 86400 seconds per day, to **nanosecond** precision. Instant values go back as far as a 1 billion years.

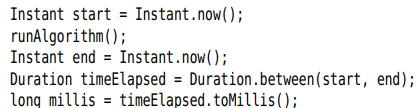
+**Instant.MAX** is 31/12/1000000000

+**Instant.now()** give the current instant.

+**Instant.truncatedTo(ChronoUnit):** make a copy

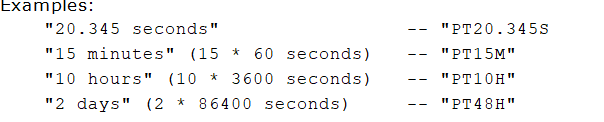
+You can compare 2 instants with **equals()** and **compareTo().**

+**Duration.between()** find out the difference between 2 instants. Example: measure the running time algorithm:

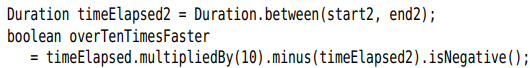


-Duration is the amount of time between 2 instants. You can get the length of Duration by **toNanos(), toMillis(), getSeconds(), toMinutes(), toHours(), toDays()**

**+toString() format**: PT…H…M…S



+Duration API has methods to carry out arithmetic.

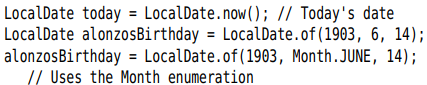




## **14.2 Local Date**

**TemporalAccessor** interface (get)-> **Temporal** interface (plus, minus, until, with) -> LocalDate,Time… + **TemporalAdjuster** interface

-**Construct** LocalDate with **now(**) or static **of()**:



-**Compute** the day of the year:



-**Period** express numbers of elapsed **years, months, days**. **toString() Period** format: P…D

+  or 

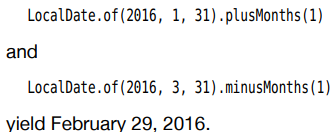
+**until()** yields the different between 2 local dates:



+Find the number of **days**:



-**Caution**: some methods in LocalDate could create non-existen dates:



-**getDayOfWeek()** yields the weekday as a value of **DayOfWeek** enumeration:

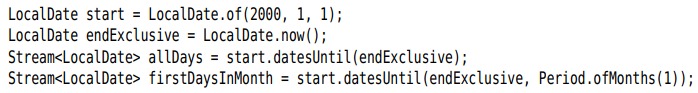


+DayOfWeek enumeration have **plus()** and **minus()**:



+**Note**: java.util.Calendar: Sunday has value 1.

-2 methods **datesUntil**() yield **streams** of LocalDate:



-There are also classes **MonthDay**, **YearMonth**, **Year** to describe **partial dates**.

## **14.3 Date Adjuster**

-**TemporalAdjusters** class provides a number of static methods for common adjustments. Pass the result of an adjustment method to **with(TemporalAdjuster)** or **TemporalAdjuster.adjustInto()**





## **14.4 Local Time**

-create an instance with **now()** or **of()**:



-**plus()** and **minus()** wrap around a **24-hour** day.



-**Note**: LocalTime doesn’t concern itself with AM/PM

-**LocalDateTime** class represent a date and time. This class is suitable for storing points in time in a fixed time zone (schedule of classes or events)

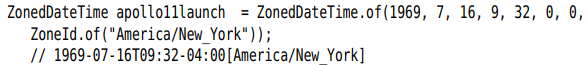
## **14.5 Zoned Time**

-Each time zone has an **ID** (America/New\_York, Europe/Berlin). **ZoneId.getAvailableZoneIds()** to find out all available time zones.

-**ZoneId.of(id)** yields a ZoneId object. You can use it to turn **LocalDateTime into ZonedDateTime** by **local.atZone(zoneId)**

**-**Construct a ZonedDateTime:



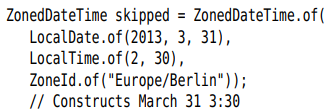


+**apollolaunch.toInstant()** to get the Instant.

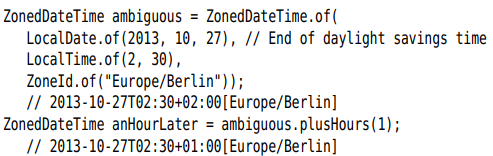
+ get **ZonedDateTime** from **Instant**, use **ZoneId**.

-Many methods of **ZonedDateTime** are the same as those of **LocalDateTime**

-**Daylight savings time**: clocks advance by an hour.

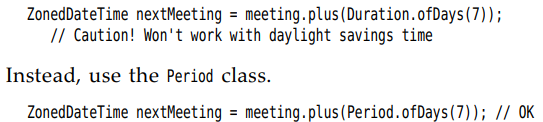


+When daylight time ends, clocks are set back by 1 hour, there are 2 instants with same local time.



The time has the same hours and minutes, but the zone offset has changed.

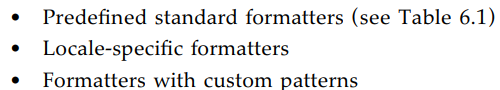
+Pay attention when adjusting a date across daylight savings time boundaries. Example: set a meeting for next week, don’t add 7 days:

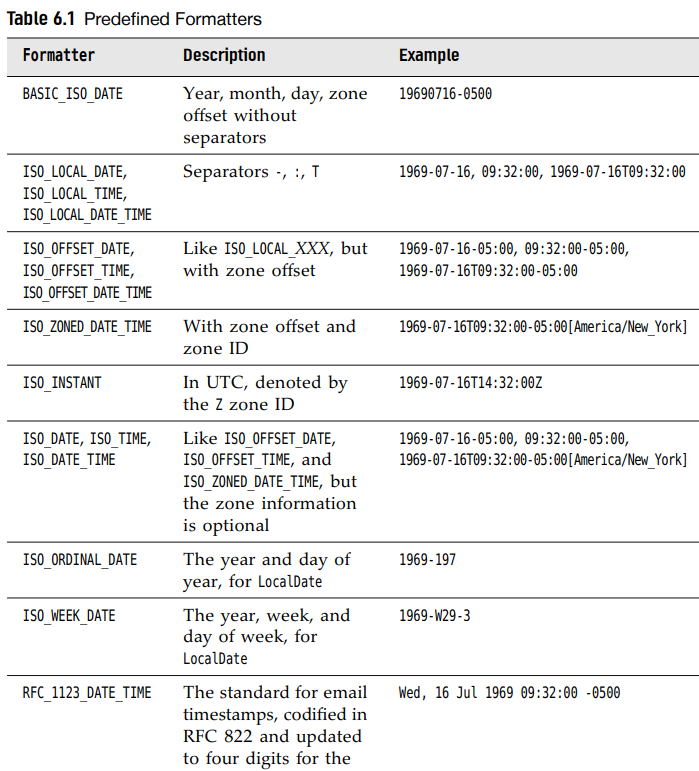
  
+between **ZonedLocalDate** in **DST** and not in DST: need to +1 hour to between time.

-**Caution**: **OffsetDateTime** represents times with an offset from UTCm without time zone rules.

## **14.6 Formatting and Parsing**

-**DateTimeFormatter** class provides 3 kinds of formatters to print date/time value:

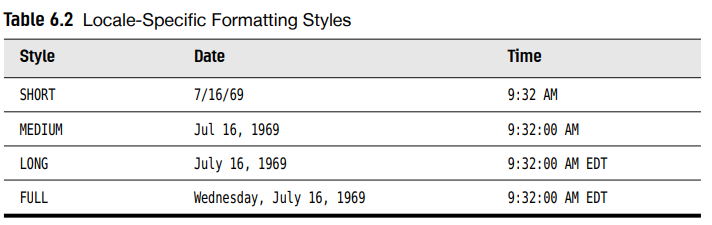




-Use one of the standard formatters:



-To present dates and times to human readers, use locale-specific formatter. There are 4 styles: SHORT, MEDIUM, LONG, FULL



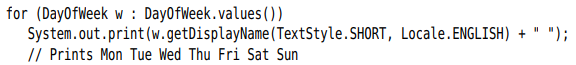
-Static ofLocalizedDate(), ofLocalizedTime(), ofLocalizedDateTime() create a formatter:



+These methods use default locale. Change **withLocale()**

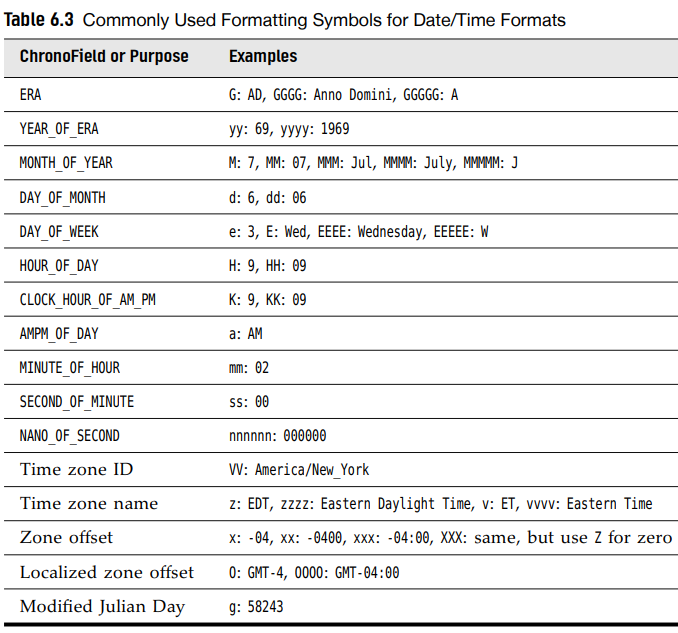


-**DayOfWeek** and **Month** enumerations have **getDisplayName()** for giving info in different locales and formats:

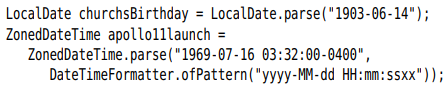


-**Note**: java.time.format.DateTimeFormatter class is intended as a replacement for java.util.DateFormat. Call formatter.toFormat()

-You can roll **your own date format** by specifying a **pattern**: 



-Parse a date/time value from a string: **parse()**



+1st call use standard ISO\_LOCAL\_DATE formatter. 2nd one use a custom formatter.