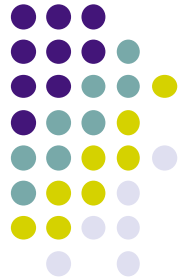
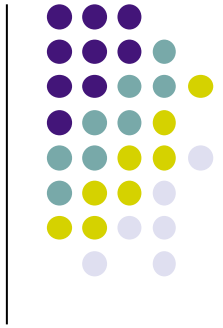
Java, multiple inheritance, and exceptions



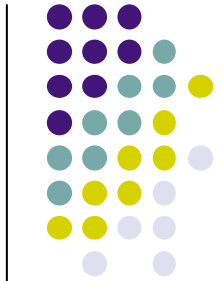
- This lesson completes the discussion of data abstraction and object-oriented programming with presentations of Java, multiple inheritance, and exceptions
- Java is a popular object-oriented language that has much support for practical programmers
- Multiple inheritance is when a class inherits from more than one class
- Exceptions are an important concept in imperative languages for handling error conditions (both program errors and environment errors)

Introduction to Java



- Java is the most-used language in the world today
  - Supported by libraries, tools, a high-quality implementation (the JVM) and a large developer community
  - But Java is >20 years old: there are many competitors, of which C++, Scala, and Erlang exemplify other parts of the language space
    - C++: closer to the processor architecture; older than Java
    - Scala: a more modern functional/object language built on the JVM
    - Erlang: a multi-agent language for highly available applications
- It is important to understand the execution of Java
  - Examples of Java semantics with the abstract machine
  - Java's support for object-oriented programming
  - Limitations of Java

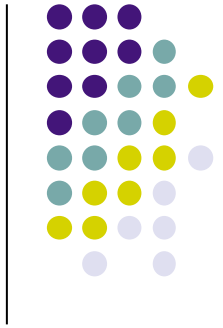
Two philosophies: Java versus C++



- Both Java and C++ implement an imperative paradigm supplemented with concurrency
  - (We will discuss concurrency in the next lesson)
  - Structured programming: a program is a set of nested blocks where each block has an entry and exit; there is no “goto” instruction in Java (but there is in C++)
  - Imperative control: if, switch, while, for, break, return, etc.

- Basic difference in design philosophy
  - C++ allows access to internal representation of data structures; memory management is manual
  - Java hides the internal representation; memory management is automatic (“garbage collection”)

Example program in Java

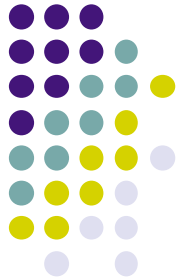


```
class Fibonacci {
   public static void main(String [] args) {
      int lo=1;
      int hi=1;
      System.out.println(lo);
      while (hi<50) {
         System.out.println(hi);
         hi=lo+hi;
         lo=hi-lo;
      }
   }
}
```

- All programs have a method `main` annotated `public static void`, executed when the program starts
- A Java variable (argument or local variable) is a cell
- Local variables must be initialized before use
- Integers are not objects but ADTs

- The method `println` is overloaded – there exist many methods with that name and the implementation chooses the right method according to the argument type (this is also called static polymorphism)

public static void main(…)



- All methods can be given modifiers

- The `main` method has the following modifiers:
  - `public`: visible in the whole program (no restrictions)
  - `static`: there is one per class (not one per object)
  - `void`: the method returns no result
    (so it is a procedure, not a function)
- The `main` method has one argument
  - `String[]`: the argument's type, an array that contains String objects