



Principles of Computer Science I

Prof. Nadeem Abdul Hamid
CSC 120A - Fall 2004
Lecture Unit 14
Review



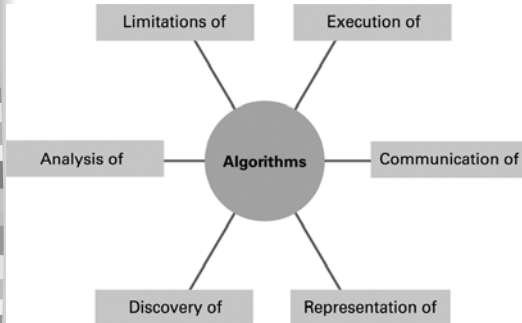
Final Exam

- December 6 - 10:30 AM
- Can use
 - Textbook
 - One (double-sided) page (8.5 x 11") of notes
- Can't use
 - Any other materials (lecture notes/lab work/etc)
 - Computer/calculator
- Thursday lab
 - Work on homework 9 problem
 - Ask questions, review for final
 - Course evaluations

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Algorithms and Computer Science



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Blind Men and the Elephant

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Designing Algorithms/Programs

- Break large tasks into smaller, easier, more concrete subtasks (functional decomposition)
- Build abstractions
 - simplifications/elimination of irrelevant details
- Abstractions should be well-encapsulated
- Encapsulation
 - How an abstract is implemented "behind-the-scenes" should not affect other pieces of the design that use the abstraction
 - Abstraction should provide a well-defined interface

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Object-Oriented Design Concepts

- View a task to be accomplished as a bunch of entities (objects/agents) interacting to solve the problem
- Programs are a collection of interacting objects that communicate with (call methods of/send messages to) each other
- Objects are a combination of data and associated operations that is supported upon that data

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Classes and Objects

- A class describes the data (fields) and operations (methods) of its objects
 - Every object belongs to some class
- An object contains data (instance variables/fields) representing state, and instance methods, which are the things it can do
 - Class may also contain its own data (class variables/static fields) and class methods, denoted by the keyword "static"
- Classes form an inheritance hierarchy (tree), with Object at the root
 - Every class, except Object, has exactly one immediate superclass, which may be denoted by the keyword "extends"
 - Subclasses inherit all the (non-private) fields and methods of superclasses (except the constructors)

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Constructors

- Class defines one or more constructors for initializing new objects of that class
 - If you don't provide a constructor, Java provides a default constructor with no arguments:
 - sets numeric/character fields to zero, booleans to false, object references to null
- Purpose of a constructor is to create an object in a valid state
- First thing a constructor does is call its superclass' constructor
 - If you don't explicitly do this, using "super(...)", then Java implicitly invokes (calls) the default constructor of the superclass
- Constructor for a class can call another constructor for the same class using "this(...)" as the first statement in the constructor
 - Avoids duplicated blocks of code in constructors

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Using Objects and Casting

- Declare object variables just like other variables
 - <classname> <objectvar>;
- But an object is not instantiated (allocated space and initialized) until you create one using the "new" keyword to call the appropriate constructor
- An object can be assigned to a variable of its own class or any of its superclasses
 - In the other direction, *i.e.* to assign an object to a variable of a subclass, you have to use an explicit cast
 - Casting an object to a more general type is called upcasting and is always legal
 - Casting an object to a more specific type is called downcasting and Java will check at run-time if it is legal
 - Casting does not affect what the object *is*, only what fields and methods are available on the object at the position the cast occurs

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Classes and Objects (cont.)

- The "instanceof" operator tests whether an object is an instance of a class
 - Returns true if the object is the class or any subclass thereof
 - Well-designed programs rarely use this
- A Java source code file may only contain one "public" class
 - Other non-public class definitions may be included in a single file
 - Name of the file must be the same as the name of the public class, but with a ".java" extension
- Classes should be as self-contained and independent as possible and reasonable
 - The interface (public fields and methods... made available to other code) should be kept small
- An object is responsible for keeping itself in a valid state at all times
 - Should limit access to its important data (fields)

Access

- Fields (instance/class variables) and methods are accessed by name
- Three dimensions to accessing name
 - Namespace
 - Scope
 - Access modifiers
- Java has six different namespaces:
 - Package names, type names, field names, method names, local variable names (including parameters), and labels
 - Identical names of different spaces do not conflict - *e.g.* a method may be named the same as a local variable - but it is best to avoid reusing names like this
- To refer to an instance feature (field/method) in a different object, use the syntax "otherObject.name"
- To refer to a class (static) feature in a different class, use the syntax "OtherClass.name"

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Scope

- Scope of an identifier (name) is the part of a class/file where it is "visible" or legal to use
 - Variable declared anywhere in a class can be seen everywhere in a class
 - Scope of method's parameters is the entire method
 - Scope of a variable declared in a block (indicated by braces, { }) extends from the declaration to the closing brace
 - Scope of a variable declared in the initialization part of a for loop is the entire body of the loop
- Class variables and methods (indicated by "static") can be used anywhere within the class
- Instance variables (fields) and methods can be used anywhere except in static methods
- Within an instance method, the keyword *this* refers to the object on which the method is currently executing
 - When a field and a local variable have the same name, the name refers to the local variable; use the prefix *this.* to refer to the field

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Access Privileges

- **public:** can be accessed from anywhere
- **protected:** can be accessed from any other class in the same package (folder) or from any subclass
- **package (default):** can be accessed from any other call in the same package
- **private:** cannot be accessed from outside the class
 - But private fields and methods can be accessed by other objects of the same class

Referring to Names

- Using fully qualified name:
 - `java.io.BufferedReader inFile = ...`
- Or import a specific class or all (using `*`) classes from a given package at the top of the file and then just use the name
 - `import java.io.*;`
 - ...
 - `BufferedReader inFile = ...`

Methods

- A method is a named, executable chunk of code
 - All executable statements must be in methods (one or two exceptions, which we won't mention here)
- Method has a signature: name and number and types of its parameters
- Method has a return type (not part of its signature)
 - If the return type is other than void, the method must return a value of the specified type in every possible case
- Method may define local variables (scope, etc.)
 - Concepts of static/public/private/etc. do not apply to local variables
 - Local variables have undefined values until they are initialized
- Every method must have a unique signature within a class
 - Methods in other classes (including sub/superclasses) may have the same signatures

Executing Methods

- Executing a method means to cause its statements to be performed upon a given object
 - Also referred to as "calling a method upon an object", "invoking a method on an object", "sending a message to an object"
- Method invocation consists of
 - A reference to the object (often by name) or class
 - A dot
 - The name of the method
 - Zero or more "arguments" enclosed in parentheses
- When a method call occurs, the values of the arguments are copied into the corresponding parameters of the method
- Upon completion, the result of a method call expression is its return value

Polymorphism

- "Having many forms"
- Polymorphism in Java
 - Ability to assign objects to superclass variables
 - Overriding methods
- Overloading methods
 - When a single class declares two or more methods with the same name but different signatures
 - When a method call is made, the method with the best matching signature is used ("invoked")

Overriding Methods

- A class declares a method with the same signature as an inherited method
 - Return type of an overridden method must be the same too
 - Overriding method may not throw more exceptions than those thrown by the overridden method
- When the method is invoked on an object (or class), the overriding method is the one used, even if the object is being reference through a variable of a superclass
- Can still invoke the superclass' version of the method (from inside the class) using "super.<name>(<parameters>)"
- Shadowing or hiding refers to this same phenomenon in the context of fields