

CS3723 HOMEWORK #8, Due: 2pm, 4/17/08

Note: If you collaborated with your classmates or used their notes, please note which classmates you collaborated with. If you use an external source, besides the text book, lectures, notes provided by the instructor, and your own intellect, please cite that source. Use quote marks if you are quoting material word-for-word from any source (including the text book).

DATA ABSTRACTION (Chapter 9)

- What is the oldest abstraction mechanism provided by programming languages? And what does it encapsulate
 - List three features of data abstraction mechanism provided by languages.
- What is the difference between an interface and a specification?
 - In ML's `abstype` construct only the abstract type name and the names and types of the values/functions declared in the `abstype` are externally visible. What is the externally visible interface of:

```
exception Empty;
abstype queue = Q of int list
  with
    fun mk_Queue() = Q(nil)
    and is_empty(Q(l)) = l=nil
    and add(x,Q(l)) = Q(l@[x])
    and first (Q(nil)) = raise Empty
      | first(Q(x::l)) = x
    and rest (Q(nil)) = raise Empty
      | rest (Q(x::l)) = Q(l)
    and length (Q(nil)) = 0
      | length (Q(x::l)) = 1 + length (Q(l))
end;
```

OVERVIEW OF OBJECT-ORIENTATION (Chapter 10)

- List the four steps of Grady Booch's approach to object-oriented design.
 - List the four main language concepts for object-oriented programming.
- What is dynamic lookup (a.k.a., dynamic dispatch)?
 - How does dynamic lookup (e.g., a method invocation in Java) differ from an ordinary function call (e.g., in C)?
 - What is the key word for declaring a member function with dynamic lookup in C++?
- What do object-based abstraction and data abstraction both encapsulate (or as Mitchell says 'combine')?
 - What do both object-based and data abstraction 'involve distinguishing'?

6. ML's abstype feature allows one to create an abstraction that separates and hides (encapsulates) a single implementation behind its public interface.
 - (a) How is this different from the public interfaces provided in object-oriented language (e.g., created by classes and interfaces in Java)?
 - (b) Which two of the four object-oriented language concepts account for this difference between ML's abstype and object-oriented classes?
7.
 - (a) What is the basic principle associated with subtyping? Give its name, and define it.
 - (b) How does Mitchell define inheritance?
 - (c) What is the difference between subtyping and inheritance?
 - (d) What keyword is used for both inheritance and subtyping in Java?
 - (e) What is the keyword for the Java mechanism that provides only subtyping?
8. What is the difference between public, private, and protected members in Java? Define each one.
9. It is possible to mimic many aspects of objects in ML using records and closures. What is it about object-oriented programs cannot be mimicked using records and closures?
10.
 - (a) What is a design pattern?
 - (b) List two design patterns.
 - (c) How does the organization of a typical object-oriented program differ from an equivalent program with a conventional function-oriented organization?
 - (d) What design pattern allows a program to use subtyping and dynamic lookup to achieve an organization/effect similar to the type case used on p. 288 in your text book? (The answer to this question is not in the text book.)