Recitation 6

Access Levels, UML

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1. Suppose classes A and B are in package ab, and classes C and D are in package cd. Furthermore, both C and B extend A, and D extends B. Assume all classes are declared to be public.

    1. Are protected members of A accessible in C? If yes, explain how. If not, explain why.

        ANSWER

        Protected members of A are *inherited* by C, but not accessible in C via instances of A.

    2. Are protected members of A accessible in D? If yes, how? If not, why?

        ANSWER

        Protected members of A are *inherited* by D via B (in other words, B inherits protected fields from A, and D from B), but as with C protected members in A are not visible in D via instance of A.

    3. Answer the same question as in 1. replacing A with B

        ANSWER

        Protected members of B are *NOT* inherited by C, nor are they accessible in C via instances of A, since C is in a different package than B, but does not extend B.

    4. Answer the same question as in 2. replacing A with B

        ANSWER

        D inherits protected members of B since it subclasses from B

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2. For each of the following pairs/groups of classes, show the most appropriate relationship between them using UML (include multiplicities for associations).

    Also show code outlines for the classes involved, including fields that pertain to the associations between them, if any (i.e. connections that are not super-sub or interface implementations). It doesn't matter exactly what data structure you use for fields that are collections--that is something that can be refined at implementation time, and does not change the UML. (Remember, the UML is language-independent, and different languages may offer different options of data structures.)

    1. Document-Keyword in a search engine

        ANSWER

        ```
              *  Contains >>  *
        Document ————————— Keyword
        ```

        This is a bidirectional relationship, i.e. a document can get at all the keywords in it, and a keyword can get at all the doocuments that contain it.

        ```
        public class Document {
          List<Keyword> keywords;  // keywords in this document, could be null
          ...
        }
        public class Keyword {
          List<Document> documents;  // documents that contain this keyword, could be null
          ...
        }
        ```

    2. Friend-Friend on Facebook

        ANSWER

        ```
             ____
            |    |
           *|    |
         Friend —
              *
        ```

        ```
        public class Friend {
          List<Friend> friends;   // could be null
          ...
        }
        ```

    3. Book-Chapter

        ANSWER

        ```
                 1..*
         Book <>——— Chapter   (Composition, diamond on Book should be shaded)
        ```

        Note: Multiplicity is not required on the Book side since by definition of a composition, a Chapter can only be in 1 book

```
public class Book {

  public class Chapter {
    ...
  }

  List chapters;   // must have at least one item, will be enforced
  ...                   // in any logic that accesses chapters
}
```

Note: Chapter is an inner class because a chapter is only defined in the context of a book, and is non-static because you can't create a Chapter instance without having a Book instance to contain it. In other words, there are no free-standing chapters. So, for instance, you might do something like this:

```
Book book = new Book();
Book.Chapter chapter = book.new Chapter();
```

4. Parking Lot-Car

ANSWER

```
              1      *
   ParkingLot <>——— Car (Aggregation that is NOT a composition, diamond not shaded)
```

Note: This is an aggregation since a parking lot contains cars. However, it is not a composition - if the parking lot goes away, the cars will continue to exist. In other words, the existence of a car does not depend on the lot in which it is parked.

```
public class ParkingLot {
  List<Car> cars;
  ...
}
public class Car {
  ParkingLot lot;   // single lot at which this car is parked, could be null
  ...
}
```

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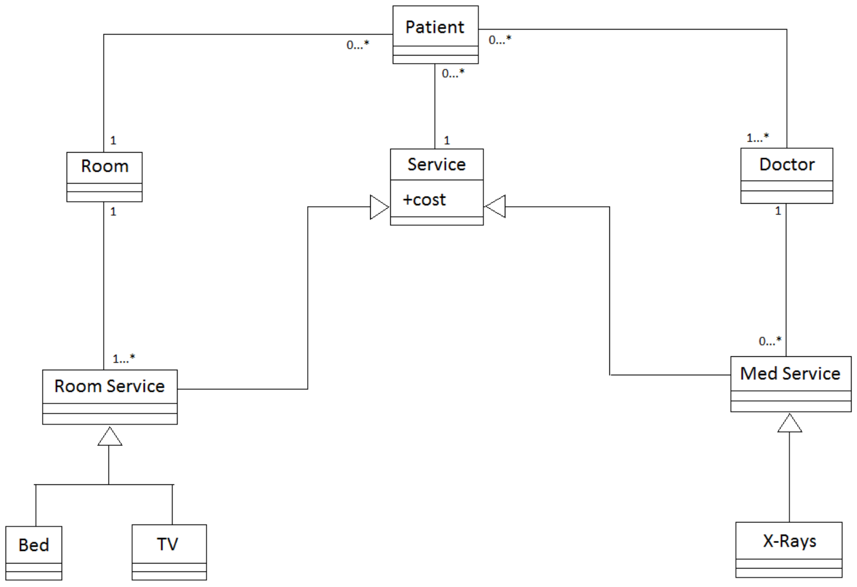
3. You are on a project that is developing software to manage a hospital. In particular, you are working on a sub-system that will model the patient care aspect including doctors, patients, hospital rooms, and services for which patients are billed. Services include medical services such as x-rays, as well as room services such as bed, TV, etc.

   Draw a UML class diagram of your model, with just the names of classes (fields and methods not required), and relationships between them. Make sure to show multiplicities on associations.

   SOLUTION

   (Some small changes may have been made in recitation, especially with multiplicities, so treat this as a starting solution...)


Patient
Room
Service
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Doctor
Room Service
Med Service
Bed
TV
X-Rays
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