Ready for the Real World

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Lecture Goals

- Review material from Chapter 4 of the OO A&D textbook
  - Taking Your Software into the Real World
  - Alternative Designs / Design Trade-Offs
  - Use Case Analysis / More about Class Diagrams
  - Discuss the Chapter 4 Example: Todd & Gina's Dog Door, Take 3
  - Emphasize the OO concepts and techniques encountered in Chapter 4

Real World Context

- A key problem in software development is gaining an understanding of the context in which your software must operate
    - Chapter 4 starts out by identifying a problem with our bark recognizer software from the end of Chapter 3: It opens for ANY bark… even if the bark belongs to some other dog!
- In the perfect world, everyone uses your system just like you expect
    - As the book says “Everyone is relaxed and there are no multi-dog neighborhoods here!”
- In the real world, (unexpected) stuff happens and things go wrong
- Analysis is the tool that can help you understand your software’s real-world context, identify potential problems, and help you avoid them

The Role of Use Cases

- A well written use case can aid us in our goal of identifying real-world problems during the analysis phase
    - They are your means of communicating with your customers, your managers, and other developers about how your system will work in the real world
        - A customer may look at your scenarios and say “these are not very realistic”
        - Be open to comments like this, because you can then learn how to change your use cases to take into account the problems that will be encountered in the real world
- Once your use cases are updated, you can use them to glean the new requirements your system has to meet

Initial Changes

- Make use case more generic
  - We've been a bit "folksy" up to now, referring to "Todd and Gina" and "Fido" in our use case
  - We'll switch to using phrases like "owner" and "dog"
    - Except that in Boulder, we have to say "guardian" not "owner" ☺
- We'll update the use case to make sure that we specify that the bark recognizer opens the door ONLY for the "owner's dog"
  - We were playing fast and loose with requirements last time
    - looking at what we needed to do to introduce BarkRecognizer to our design, without thinking long and hard about what it really needed to do

New Use Case

What the Door Does

Main Path

1. The owner's dog barks to be let out.
2. **The bark recognizer "hears" a bark.**
3. **The bark recognizer detects the owner's dog and opens the door.**
4. The dog door opens.
5. The owner's dog goes outside.
6. The owner's dog does his business.
   - 6.1 The door shuts automatically
   - 6.2 Fido barks to be let back inside.
   - **6.3 The bark recognizer "hears" a bark (again).**
   - **6.4 The bark recognizer detects the owner's dog and opens the door**
   - 6.5 The dog door opens (again).
7. Fido goes back inside.

Alternate Paths

2.1 The owner hears her dog barking.

3.1 The owner presses the button on the remote control.

6.3.1 The owner hears her dog barking (again).

6.4.1 The owner presses the button on the remote control.

Discussion

- Note: I did things slightly differently from the book
  - I changed step 3 to say “The bark recognizer detects the owner’s dog and opens the door”
  - The book said “If it’s the owner’s dog barking, the bark recognizer sends a request to the door to open”
    - I didn’t like the use of “if” in this action step, instead I just decided that the bark we hear is always the owner’s dog.
    - I can add an additional path to this use case in which I can say something like: “The bark recognizer detects an unknown dog. Use case terminates.” Or I can create a separate use case that documents this behavior
- Note: my version of step 3 can be further improved by splitting it into two steps: one that does the detection and one that asks for the door to open

New Use Case

- If the bark recognizer is going to determine if a bark belongs to the owner's dog, we need to store a representation of that dog's bark

Storing a dog bark

1. The owner's dog barks "into" the door.
2. The door stores the owner's dog's bark.

- This may seem like its "not enough":
  - Pros: simple, primary actor should be dog in this use case
  - Cons: It feels a bit weird not to have a step that says something like "The owner issues a command to the door to prepare it to store the dog's bark"
    - But since that step sounds awkward, make it a precondition

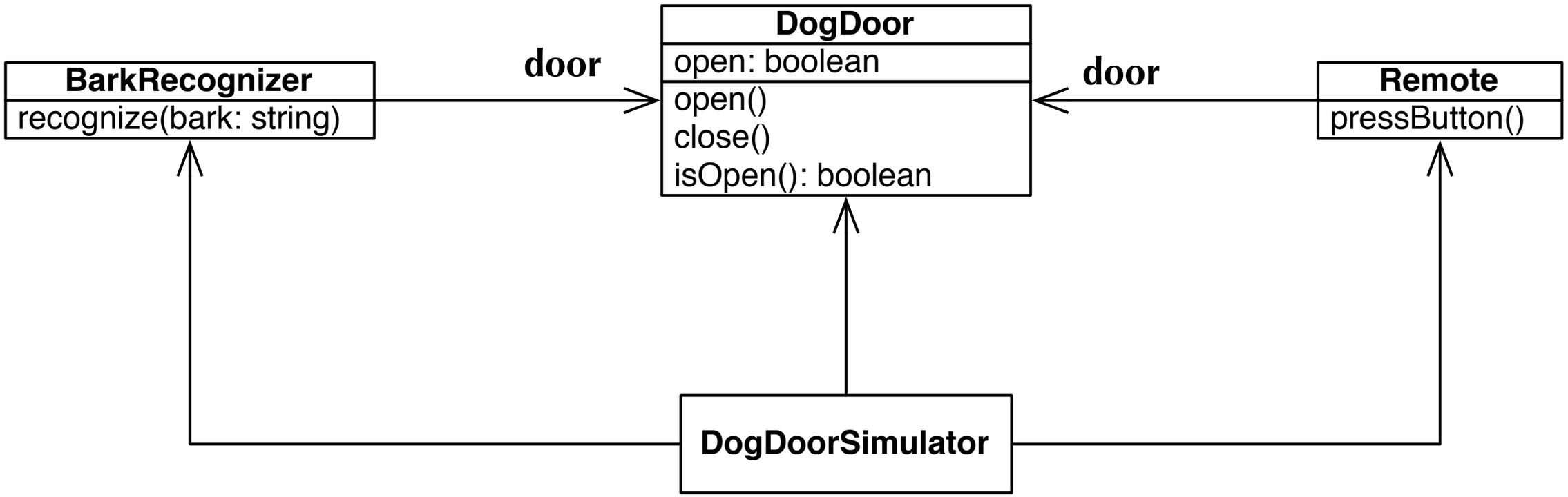
The Competition

- The book now holds a design competition between two programmers
  - Randy: simple is best right?
    - Bark sounds are just strings… I'll store the owner's dog's bark in the dog door and then just do a string comparison in bark recognizer
  - Sam: object lover extraordinaire
    - A "bark" is an important concept in our application domain. Lets make it a class and have it take care of "bark comparison"
- What do you think of these approaches?

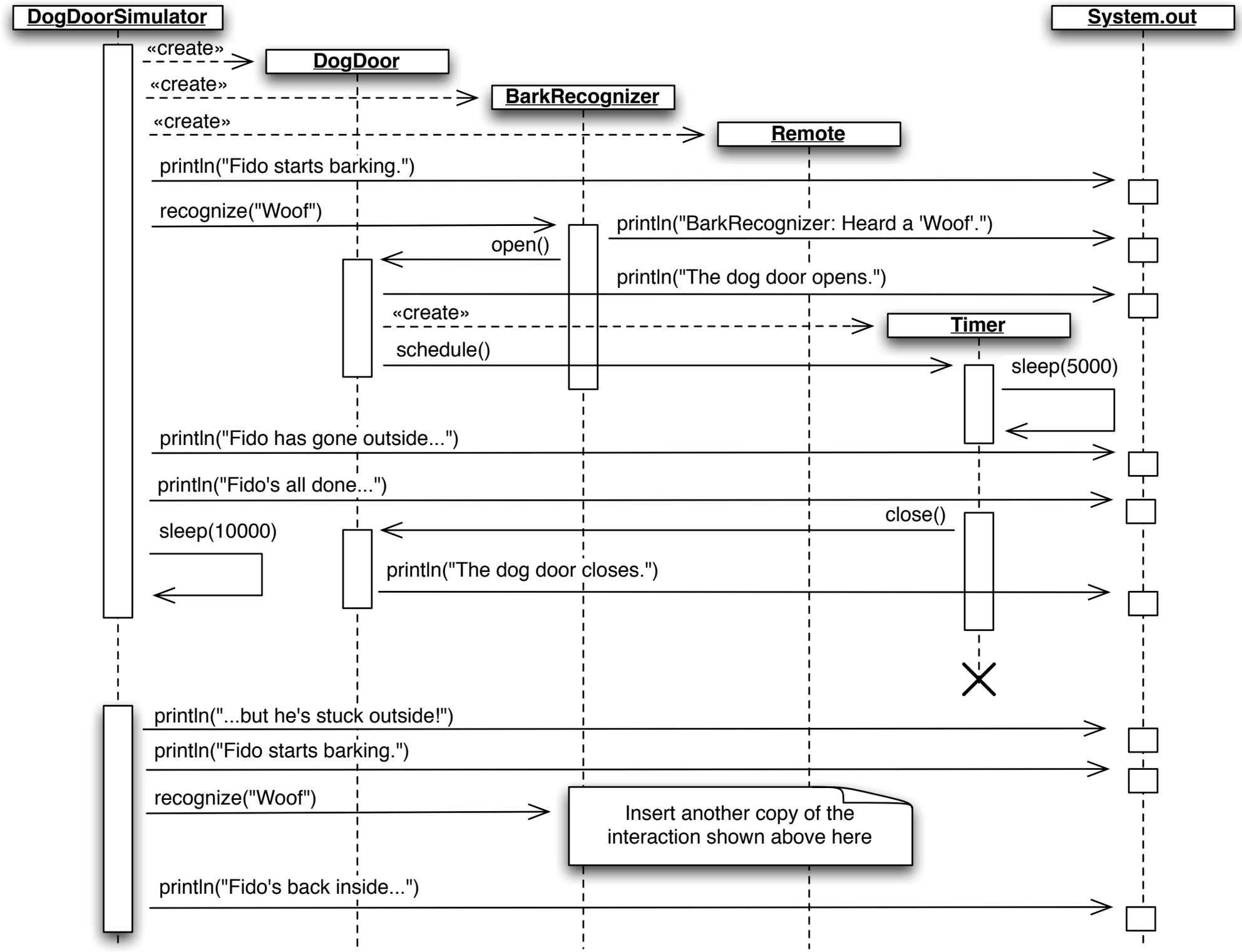
Discussion

- Randy's approach
  - Agile approach to software development
    - What is the simplest thing I can do today to meet my requirements?
    - Avoids "speculative complexity"
  - Fast: doesn't take long to modify the DogDoor class and update the BarkRecognizer to do the appropriate string comparison
- Sam's approach
  - Makes use of good OO design principles
    - Encapsulation and Delegation
      - A "bark" is something we need to track; it should be a class
      - Barks are strings now; But what if they turn into .wav files?
      - By delegating comparison to Bark, we hide those details from the rest of the system

Original Class Diagram



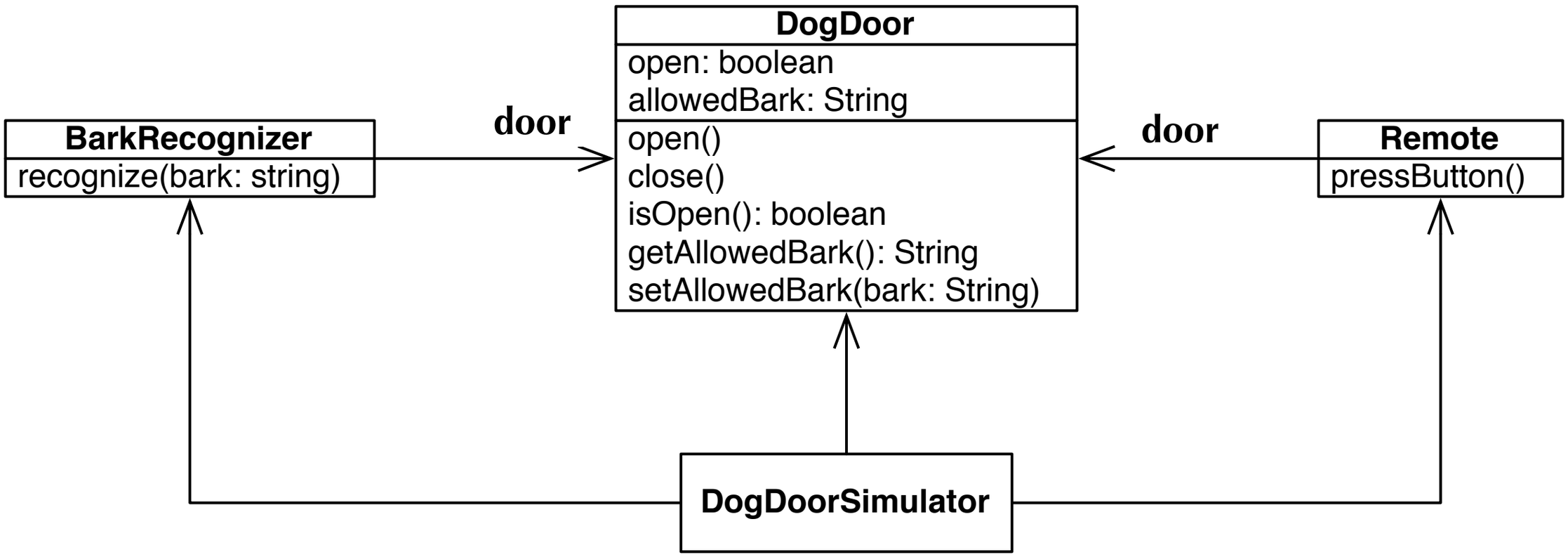
Behavior of Original System



Introduction to Sequence Diagrams

- Objects are shown across the top of the diagram
  - Objects at the top of the diagram existed when the scenario begins
    - All other objects are created during the execution of the scenario
- Each object has a vertical dashed line known as its lifeline
  - When an object is active, the lifeline has a rectangle placed above its lifeline
  - If an object dies during the scenario, its lifeline terminates with an “X”
- Messages between objects are shown with lines pointing at the object receiving the message
  - The line is labeled with the method being called and (optionally) its parameters
- All UML diagrams can be annotated with “notes”
- Sequence diagrams can be useful, but they are also labor intensive (!)

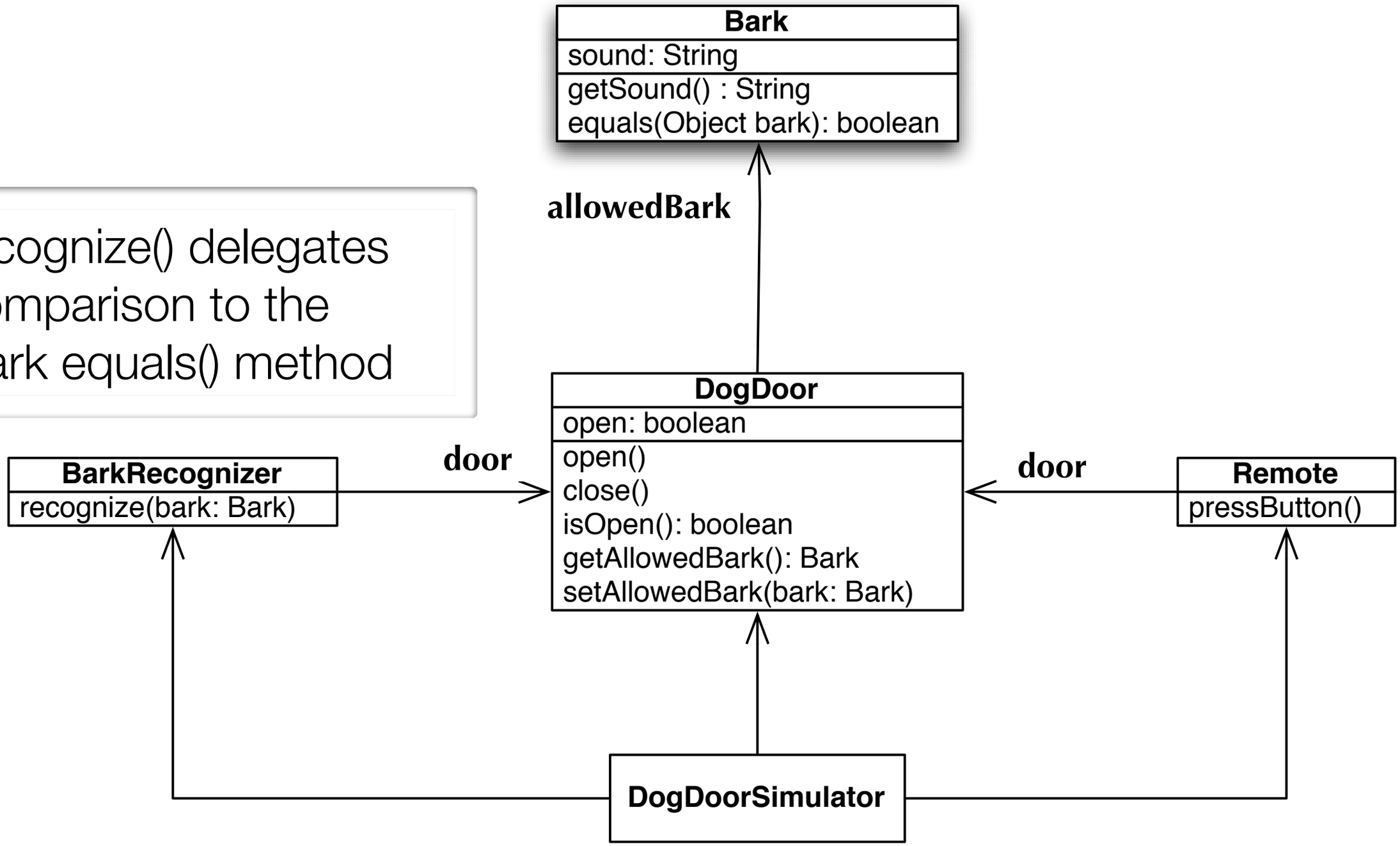
Randy's Class Diagram



BarkRecognizer's recognize() method has been updated to call getAllowedBark() and check to see if it matches the bark passed to it

Sam's Class Diagram

recognize() delegates comparison to the Bark equals() method



The Power of Delegation

- Sam's application is shielded from the details of how a "bark" is implemented
  - By using delegation to do the comparison of bark objects, his BarkRecognizer doesn't have to know that internally a bark is represented as a String
    - If we change the way a bark is represented, BarkRecognizer will be unaffected
    - Contrast with an alternative approach of BarkRecognizer calling the getSound() method of its two Bark objects and then doing a comparison itself; BarkRecognizer would then be tied to the implementation of the Bark class
- Delegation shields your objects from implementation changes to other objects in your software
  - The coupling between Bark and BarkRecognizer is looser having used delegation; there is still some coupling between them, but its not tight

The Results

- Sam's and Randy's solutions both work but both of them lost the competition!
  - They lost to a summer intern (and "junior" programmer), Maria
- Why?
  - She did a deeper analysis of the problem domain and identified a problem that both Sam and Randy ignored
    - The same dog can have different types of barks!
      - when its excited, sleepy, hungry, angry, scared, etc.
- Sam's and Randy's solutions would both fail in the real world
  - Maria was successful because she performed textual analysis on the use case
    - She realized that it was the "dog" that was the focus, not the "bark"

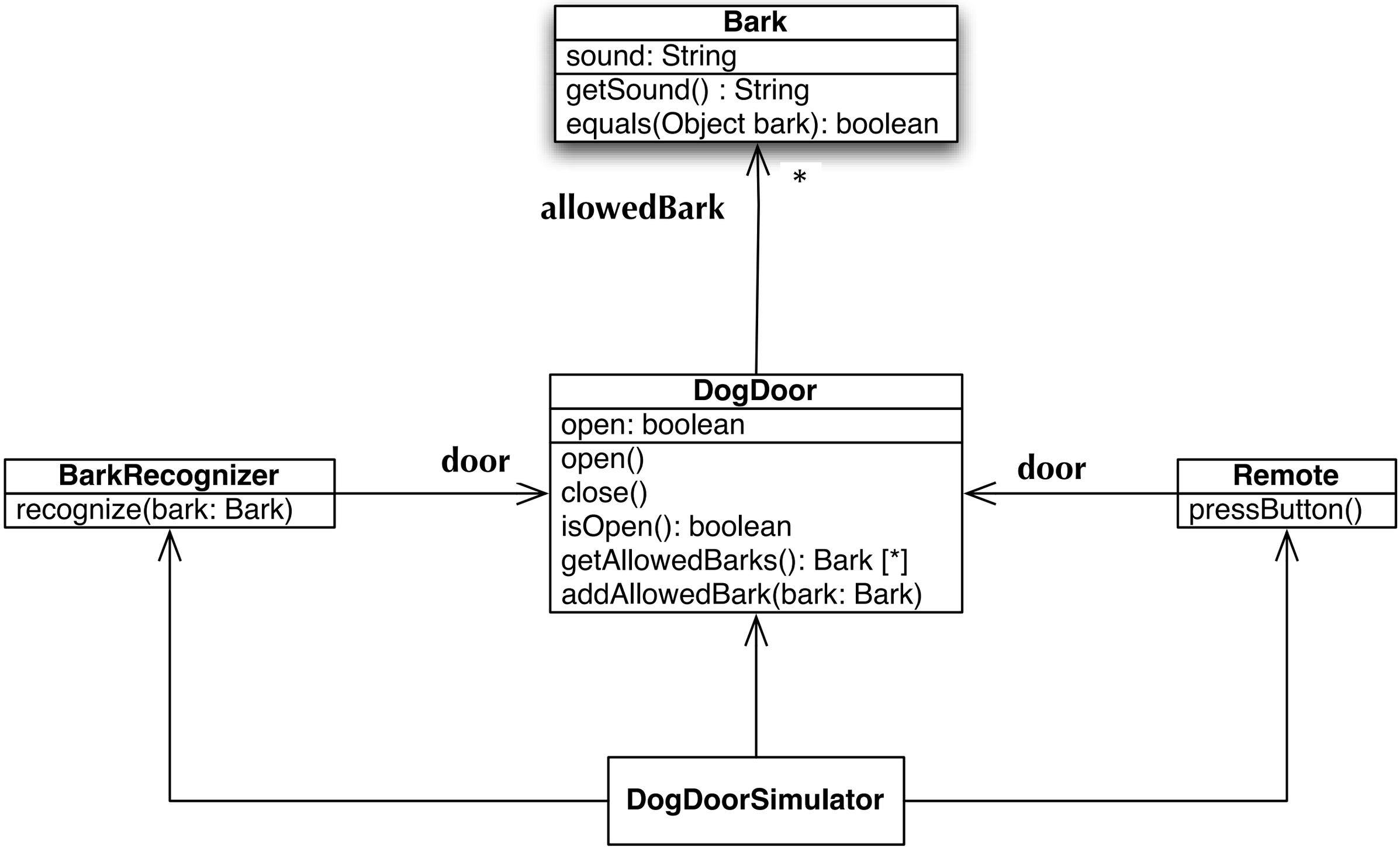
Textual Analysis

- Pay attention to the nouns in your use case
  - They may indicate a potential candidate for a class in your system
    - Some things don't need to be tracked
    - For example, we don't need a class for "Dog" in this system
  - They also provide hints on what your design should focus on
- Pay attention to the verbs in your use case as well
  - They may indicate potential candidates for methods in your system
  - They will also provide hints as to where a method should "live"
    - i.e. what class should be assigned the responsibility of handling the service provided by the method

Soft Science?

- The book discusses the potential problems with textual analysis
  - Wouldn't a slightly different wording of the use case lead to different results?
    - Yep
  - But, as they point out, only one or two wordings will accurately capture the real-world context that your system will find itself in
    - If you get your analysis wrong, you'll end up focused on the wrong thing, and even if your design is good, your system will fail
- A good use case clearly and accurately explains what a system does, in language that's easily understood and in which real world context is captured
- With a good use case, complete textual analysis is a quick and easy way to identify the potential classes and methods of your system

Maria's Class Diagram



New Notation

- In Maria's class diagrams in the book, you encountered a new notation
- For Attributes
    - allowedBarks: Bark [*]
- For Methods
    - getAllowedBarks(): Bark [*]
- (actually, its just a new type notation)
- It means that the type of allowedBarks and the return type of getAllowedBarks() is a collection of zero or more Bark objects
- You can indicate specific a specific multiplicity like this
    - allowedBarks: Bark [2..6] or allowedBarks: Bark [20]

Class Diagrams are Incomplete

- While class diagrams are useful, they do not provide a complete picture of a software system
  - They provide limited type information
    - Types are optional, and when a type specifies a multiplicity it does not indicate what collection class should be used
  - They don't tell you how to code a method
    - You'll need a use case or sequence diagram for that
  - They almost never talk about constructors
  - They do not provide information on how associations are instantiated
  - They don't provide explicit information on the purpose of a class
    - You only know the purpose of a class from its associated requirements and use cases

Demonstration

- Lets take a look at the final version of the software

Wrapping Up

- Systems fail if their developers failed to take into account the problems that they will encounter in the real world
  - Its tough to model the real world accurately but it can be done
    - if you are willing to expend the effort to create good use cases
    - A good use case precisely lays out what a system does, but does not indicate how the system accomplishes that task
- Textual analysis can provide you with information on the candidate classes and methods of your system
  - they also indicate where to focus when creating the design of your system
    - get the use case wrong, and you'll focus on the wrong thing

Coming Up Next

- Lecture 9: Nothing Stays the Same
    - Read Chapter 5 (part 1 and interlude) of the OO A&D book
- Lecture 10: Flexible Software
    - Read Chapter 5 (part 2) of the OO A&D book