Design Techniques

Ch 2.6-2.12

1) What technique can we use for analysis?
2) What technique can we use for initial design?
3) What technique can we use to document a design?

Process

- 3 Software Process Phases

Analysis   →   Design   →   Implementation

Software design techniques...

Use cases   CRC Cards   UML Class Diagrams

Use Cases
an Analysis Technique

Use Case

Use Case
- An analysis technique for..

    describing requirements
- Lists steps to..
    complete an actor's ask
    - Actor:..

      a user or external system
- Ex: Word processor use cases for
    - install the program
    - load document
    - print

Use Case Example

Leave a Message

1) Caller dials main number of voice mail system

2) System speaks prompt: Enter mailbox number

3) User types extension number

4) System speaks:
   You have reached mailbox xxxx.
   Please leave a message now

5) Caller speaks message

6) Caller hangs up

7) System places message in mailbox

Variation #1

1.1. In step 3, user enters invalid extension number

1.2. Voice mail system speaks You have typed an invalid mailbox number.

1.3. Continue with step 2.

Variation #2

2.1. After step 4, caller hangs up instead of speaking message

2.3. Voice mail system discards empty message

Use Case Guidelines

- Task must be of.. value to a user
  - Ex: Not "see splash screen"

- Format
  - Can have a loose format to fit your needs.

- Content
  - Has a descriptive title/name.
  - Lists..
    not inter-class interaction.
  - Can have variations to describe alternative cases.
    - Ex: Error conditions.
  - Can have..
    - Ex: Program is running for "save document"

In-class exercise: Pledge Tracker Description

- Participants gather pledges from friends and neighbours for completing a charity walk-athon
  - Pledge lists donor's name and billing info.

- App reads pledge data from file (.csv) and:
  - Generates invoices for pledge (.pdf's)
  - Allow entry of payments received (saves to file)
  - Display summary of unpaid pledges (names, $)
  - Display summary of total pledge amounts:
    total $ pledged, $ paid, $ unpaid

In-class group exercise

- List use cases for the pledge tracker.
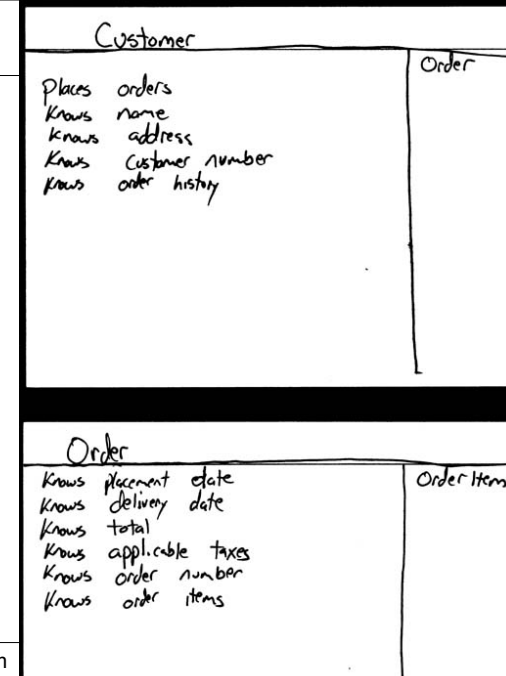
- Write out one use case.

CRC Cards
a Design Technique

CRC Cards

- CRC Cards:..

  Class Responsibility and Collaborator Card

- It's an index card listing:
  - Class Name
  - Class Responsibilities
    Ex: Manage messages
  - Class Collaborators
    .. classes it depends on
    Ex: Message class

Customer — Order
Places orders
Knows name
Knows address
Knows Customer number
Knows order history

Order — Order Item
Knows placement date
Knows delivery date
Knows total
Knows applicable taxes
Knows order number
Knows order items

CRC Cards

- Purpose
  - Support an.. informal design process

- Physical card support
  - Walk-through a use-case deciding..

    which classes do which tasks
  - Lay cards out on table and re-arrange them as needed.

- Small, so limit responsibility of the class
  - No "God" object (knows everything)
  - If too much on a card,..

CRC Process

1) For each discovered class, write its name on the top.
   - Look for.. nouns in the use-cases

2) Left side: Responsibilities
   - Not method names, but.. high level responsibilities
   - Message class example:

     Good: manage message content

     Bad: getContent(), getContentLength(), setContent()

3) Right side: Collaborators   (shows relationship b/w classes)
   - no particular order; which classes does this one use
   - does not line-up with responsibilities

4) Don't list all details; just enough to show.. it can do its job

CRC Example

Mailbox	
manage passcode	MessageQueue
manage greeting	
manage new and saved messages	

MailSystem	
manage mailboxes	Mailbox

CRC Use

- CRC Cards are good for
  - discussions and collaboration
  - eliciting design ideas and starting design
- But they are messy
  - Not good for recording design decisions.

    UML Diagrams do this!

CRC Example

- What classes would be in charity pledge tracker?

- Draw a CRC card for a class or two.

PLEDGE
manage payments
generate invoice
manage name
manage address

INVOICE

UML Class Diagrams
a Design Communication Technique

UML Class Diagram

- UML Class Diagram
  - A diagram showing.. classes and the relationships between them

DecoratorWindowTest
+main(args:String[]): void

<<interface>>
Window
+draw(): void
+getDescription(): String

SimpleWindow
+draw(): void
+getDescription(): String

WindowDecorator

HorizontalScrollBarDecorator
+draw(): void
+getDescription(): String
-drawHorizontalScrollBar(): void

VerticalScrollBarDecorator
+draw(): void
+getDescription(): String
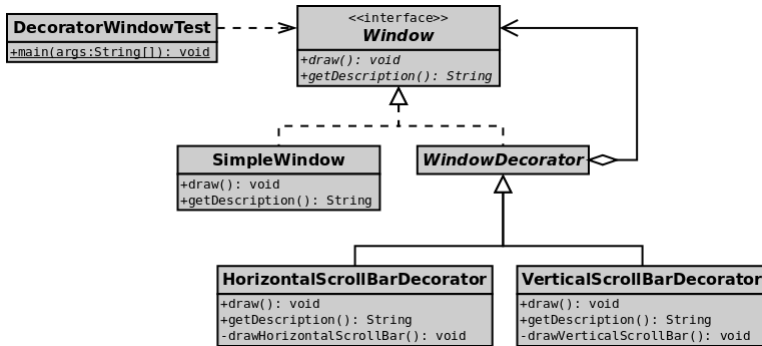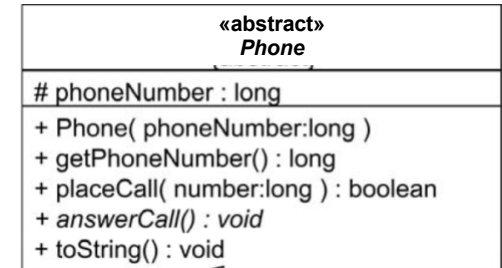-drawVerticalScrollBar(): void

Image from Wikipedia: UML2 Decorator Pattern

UML Class diagram implementation details

- 3 Sections
  - Class name
  - Attributes (fields)
  - Operations (methods)
- Types (Optional)
  - fieldName : type
  - methodName() : returnType
- Visibility: Can preceded attributes and methods
  - + for.. visibility   (don't need to show private methods)
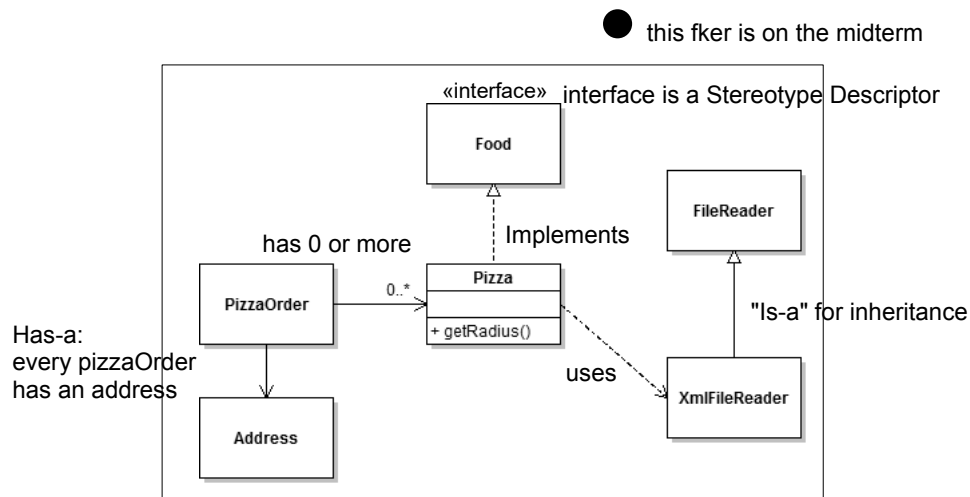 - # for.. protected
  - - for.. private

«abstract»
Phone

phoneNumber : long

+ Phone(phoneNumber:long)
+ getPhoneNumber() : long
+ placeCall(number:long) : boolean
+ *answerCall() : void*
+ toString() : void

Class Connections

● this fker is on the midterm

«interface» interface is a Stereotype Descriptor

Food

FileReader

has 0 or more

Implements

Pizza
+ getRadius()

PizzaOrder   0..*

"Is-a" for inheritance

Has-a:
every pizzaOrder
has an address

uses

XmlFileReader

Address
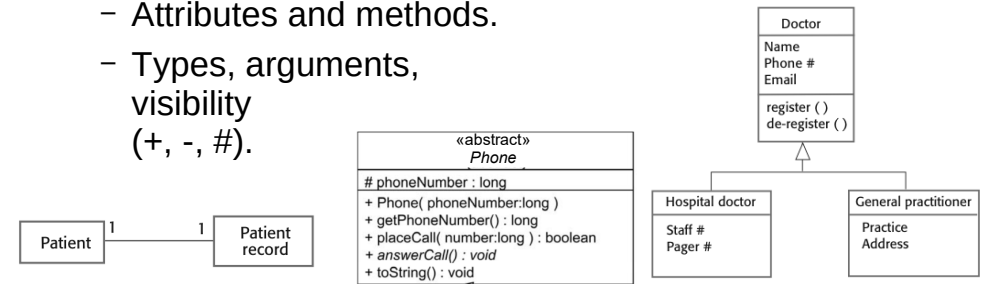

Level of Detail

- Choose required level of detail
  - What are you trying to show in your diagram?
  - Who is the.. intended audience: customer or devs?
- Some Options
  - Classes & relationships.
  - Attributes and methods.
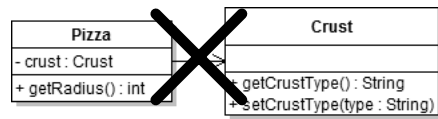 - Types, arguments, visibility (+, -, #).

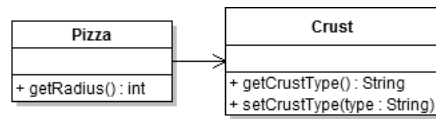Doctor
Name
Phone #
Email
register ( )
de-register ( )

«abstract»
Phone
phoneNumber : long
+ Phone(phoneNumber:long)
+ getPhoneNumber() : long
+ placeCall(number:long) : boolean
+ *answerCall() : void*
+ toString() : void

Patient 1 — 1 Patient record

Hospital doctor
Staff #
Pager #

General practitioner
Practice
Address

Class Diagram Notes

- If Pizza "has-a" Crust, don't.. list it as a field as well
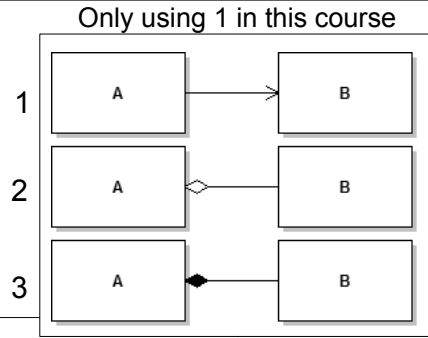

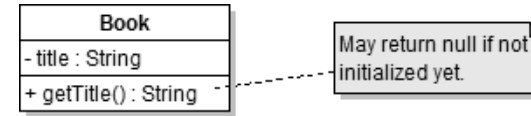✕ don't do this if Pizza "has-a" Crust

Only using 1 in this course

- A "has-a" B can be shown as any of the following:
  - 1 – Directed association (we'll use this; simplest)
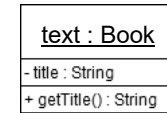 - 2 – Aggregation
  - 3 – Composition

More Notation

- Notes   add comments:

- Show objects:
  A class but with a ':' (and underlined)
  - .. <u>myCar : Car</u>

UML Class Diagram Example

- Draw a UML class diagram for the classes from the CRC cards for the pledge tracker.
  - Show just class names and relationships.

CHECK ONE NOTE FOR DIAGRAM

Summary

- Use Cases: Analysis
  - List tasks of value to the user.
  - Describe interaction steps between user and system.

- CRC: Early design process.
  - Index card listing class name, responsibilities, and collaborators.
  - High-level and informal description.

- UML Class Diagrams: Formalize design.
  - Draw classes and class relationships.