

your name: _____ your person number: _____ - _____

Solution to Exam in
2D1359 & 2D1360 Objektorienterad modellering programmering
och analys
Tuesday, 23th October 2001, 14:00-19:00

No study aids allowed.

Points and grading:

Grade 3, 4, and 5 require 24, 28 and 32 out of 40 points

As some students noticed the total number of points is only 38 points, therefore grade 3,4, and 5 accordingly require 22, 26 and 30 out of 38 points.

Theoretical part:

Remark: Multiple choice questions have one and only one correct answer.

Question 1: (1) Abstract methods have

- a. No program code in the subclass
- b. Program code in the defining class
- c. Program code in the subclasses
- d. No program code in the defining class
- e. (b) and (c)
- f. (c) and (d)
- g. (a) and (b)

Correct answer: f

Question 2: (1) An association is

- a. A straight line in a class diagram
- b. Represented by a noun that describes the interaction
- c. A relationship between instances of classes
- d. A relationship between classes
- e. (a) and (d)
- f. (b) and (c)
- g. (b), (c) and (e)

Correct answer: c

Question 3: (1) Aggregation

- a. Means an object is built of other objects
- b. Means an object contains other objects
- c. Is always of multiplicity 1..*
- d. Is "is a kind of" relationship
- e. (b) and (c)
- f. (a) and (d)

Correct answer: b

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Question 4: (1) Which of the following statements are true for statechart diagrams

- a. An event is caused by a transition.
- b. An object has to be in exactly one state at a time.
- c. A state is a condition needed for a transition to occur.
- d. In a transition one or more attributes change their value.
- e. (a) and (c)
- f. (b) and (d)

Correct answer: f , but b also counts as a correct answer since changing state does not necessarily means that the object changes its attributes, but for example it could simply change the control flow.

Question 5: (1) Generalization is

- a. building objects from parts
- b. a “has a”-relationship
- c. a “kind-of” relationship
- d. realized by means of inheritance
- e. realized by means of composition
- f. (a) and (b)
- g. (c) and (d)
- h. (a) and (e)
- i. (a), (b) and (e)

Correct answer: g

Question 6: (1) Polymorphism

- a. requires abstract classes
- b. is realized by means of static binding
- c. is realized by means of dynamic binding
- d. enables subclasses to override the method of a superclass
- e. (a),(c) and (d)
- f. (a) and (c)
- g. (c) and (d)
- h. (b) and (d)

Correct answer: g

Question 7: (4) Which of the following phrases best describe the design patterns in the list. Match 10 out of 14 phrases with the 10 concepts below.

- a. Provide a placeholder for another object to control access to it.
- b. Convert the interface of a class into another interface clients expect.
- c. Supports low dependency and low impact of change.
- d. Lets clients treat individual and group of objects uniformly.
- e. Lets a class defer instantiation to subclasses.
- f. Provide an interface for creating families of related objects without specifying their concrete classes.
- g. Provides global access to a unique instance

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- h. When one object changes its state the state of dependant objects is synchronized.
- i. A class that has the information necessary to fulfill a responsibility.
- j. Assign responsibilities to an artificial class to support high cohesion and low coupling.
- k. An object responsible for receiving or handling system events.
- l. Define a family of algorithms and make them interchangeable.
- m. Provide a unified interface to a set of interfaces in a subsystem.
- n. An intermediate object that decouples other objects.

- 1. Observer
- 2. Factory Method
- 3. Expert
- 4. Controller
- 5. Low coupling
- 6. Composite
- 7. Singleton
- 8. Adapter
- 9. Abstract Factory
- 10. Strategy

Correct answer: 1-h, 2-e, 3-i, 4-k, 5-c, 6-d, 7-g, 8-b, 9-f, 10-l
a-Proxy, j-Pure Fabrication, m-Façade, n-Mediator

Question 8: (2) Describe in two sentences what is the difference between object oriented analysis and design.

Correct answer: OO analysis is finding and describing objects or concepts in the problem domain. OO analysis = what needs to be done. OO analysis=defining the problem/requirements

OO design is defining software objects and how they collaborate OO design = how is it done. OO design = conceiving a solution to the problem

Question 9: (2) What is (usually) the multiplicity (1..*, *.* , etc.) of the following associations?

- a. Brother is sibling of sister
- b. Child is a descendant of parent
- c. Person is married with person
- d. Twin is sibling of twin
- e. Student attends course
- f. Flight flies to airport
- g. Order contains items
- h. Customer purchases product

Answer: a: *.* , b: 1..*-2, c: 0,1-0,1 , d:1-1, e:*-*, f:*-1 or *-1..* , g:1-1..* , h:*-* or 0,1-*
In f flight refers to something like LH123 Frankfurt-Stockholm, which means there is only one concrete airport a flight goes to, but since the Swedish word flygg was ambiguous I also accept the interpretation of a *-1..* relationship.

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Question 10: (2) Describe in two sentences the roles of inception and elaboration within the unified process.

Answer: Inception is a feasibility study which envisions the product scope, approximate vision and business case. Elaboration generates a refined vision, iterative implementation of core architecture, resolution of high risks, identification of most requirements and scope. (see Larman pages 35 and 109).

Wrong answer Inception=Requirements, Elaboration = Design!

Question 11: (1) In the unified process requirements are described by

- a. Design model
- b. Domain model
- c. Use case model
- d. (a) and (b)
- e. (a) and (c)
- f. (b) and (c)

Correct answer: c

Question 12: (1) Extreme Programming advocates

- a. continuous integration
- b. a sequential, linear lifecycle
- c. refactoring
- d. (a) and (b)
- e. (a) and (c)
- f. (b) and (c)
- g. (a), (b) and (c)

Correct answer: e

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Practical Part:

Question 13: (8) A vending machine offers two different products A and B. Product A costs 4 SEK, product B 6 SEK. The customer inserts one coin at a time into the slot. The machine accepts coins in denominations of 1, 5 or 10 SEK. The machine displays the amount available for purchasing products. The machine has three buttons, button A to dispense product A, button B to dispense product B and button C to obtain change. At any time the customer can press button C to collect her change or amount paid, even if no purchase occurred previously. The customer can press buttons A and B at any time, but the machine only dispenses the corresponding product if the current amount paid is equal to or exceeds the product price. It is possible to make multiple purchases with one payment by using the remaining amount for another purchase (for example inserting a 10 SEK coin and purchasing product A twice and obtain 2 SEK change or for example inserting a 5 SEK coin, purchasing product A, inserting another 5 SEK coin and purchasing product B).

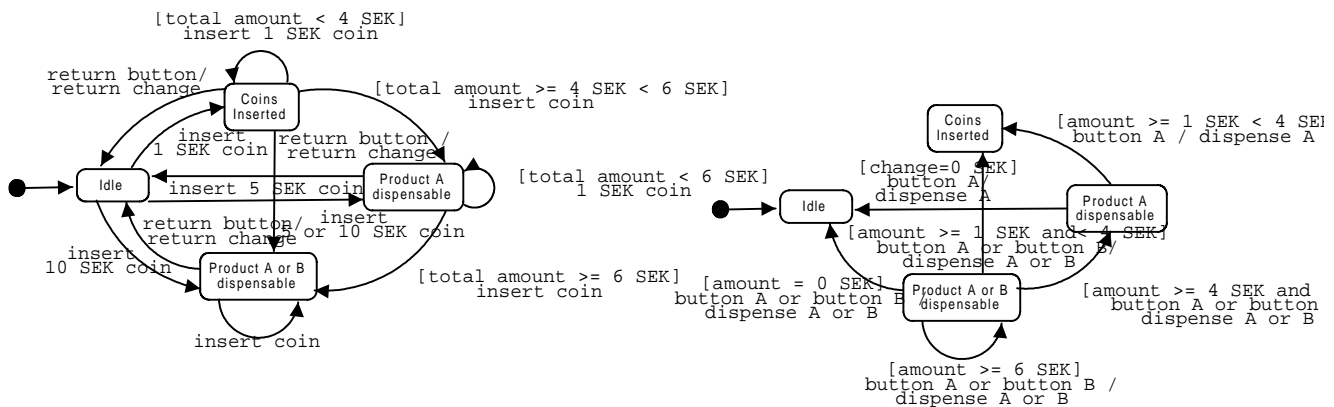
- a. Draw a state diagram for the vending machine.
- b. Draw a system sequence diagram for a scenario in which the customer inserts two 5 SEK coins, purchases product B and collects her change. Illustrate the information or product the vending machine shows or dispenses to the customer.

Draw the diagram on a separate sheet of paper with your name and person number. For the sake of clarity you can draw two copies of the state-chart diagram, that contain the same states but depict different types of events and transitions, for example for inserting coins, dispensing products and returning change.

Solution: States : idle (no money inserted), coins inserted (some money inserted but not enough to purchase any product, Product A dispensable (enough money to purchase product A but not B, Product A or B dispensable (enough money to purchase either A or B at least once)

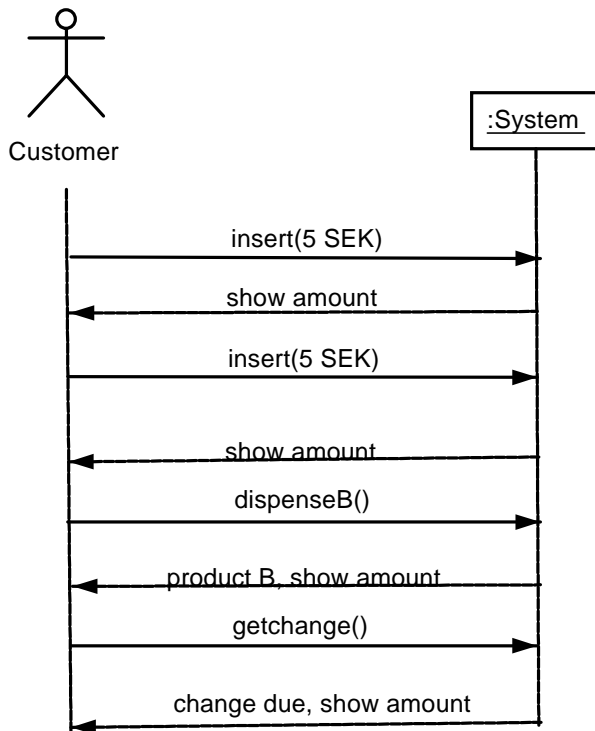
Events (external based on what the customer does) : button A, button B, return button, insert coin

Actions : (internal, responses of the machine) : dispense product A, dispense product B, return change

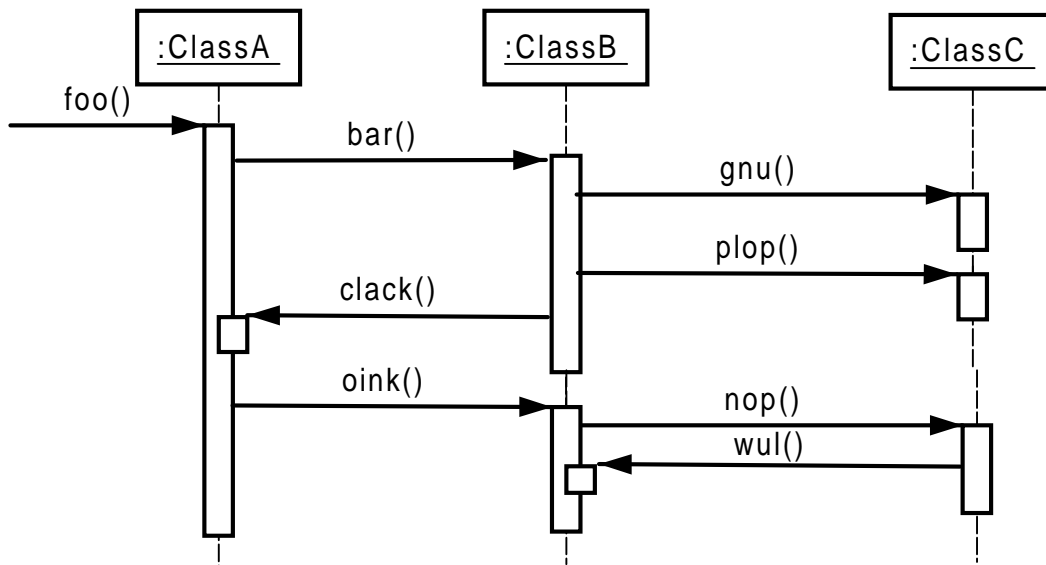


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solution b) System sequence diagram



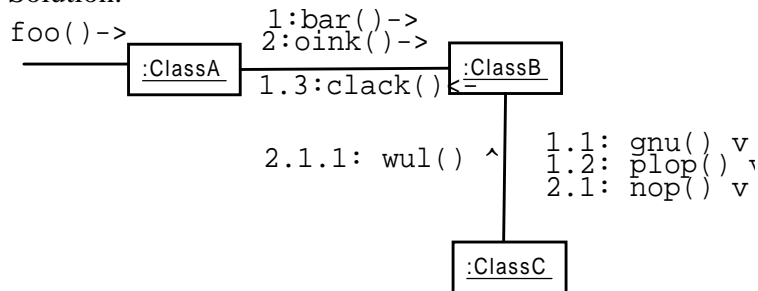
Question 14: (4) Draw the collaboration diagram that corresponds to the following sequence diagram



Draw the diagram on a separate sheet of paper with your name and person number.

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Solution:



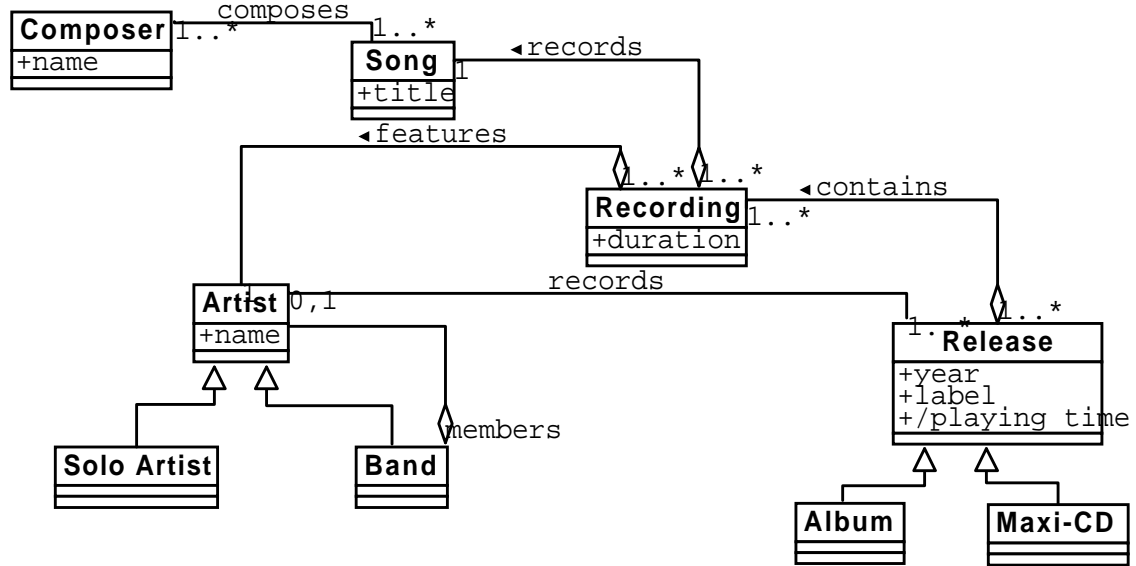
Important: Correct enumeration with nesting numbers (notice double nesting in wul()), only one link between classes (no arrow on link), arrows on messages, no number for initial message foo()

Question 15: (8) Draw a domain model as a UML class diagram, containing concepts, generalizations, named associations with multiplicity (composition and aggregation where applicable) and attributes for the following domain. The task is to design a software that helps you keep track of your collection of audio CDs. One distinguishes between two different types of releases, namely maxi-CDs and album CDs. Each release (album or maxi-CD) contains one or several recordings, a recording is a particular song performed by a particular artist, for example the album “Hot Rocks” by the Rolling Stones contains recordings of the songs “Time is on my side”, “Heart of Stone”, “Play with Fire” etc. Each recording has a playing time, for example “Time is on my side” has a playing time of 5:23. The same recording might occur on different releases, for example the original studio album and a “best-of” album. The same or a different artist might perform the same song in different recordings, for example the song “American Pie” by Don Mc Lean and Madonna or “Sympathy for the Devil” in a live and a studio version by the Rolling Stones. One distinguishes between solo artists (e.g. Madonna) and bands composed of artists, for example Paul McCartney, John Lennon, Ringo Starr and George Harrison are members of the Beatles. An artist can occur on different recordings in different roles, either as a solo artist or a band member, for example Sting as a solo artist or as a member of the band Police. A song has a title and is composed by one or several composers, for example the song “Hey Jude” is composed by Paul Mc Cartney and John Lennon. Each release has a title, release date, music label and a playing time that is calculated as the accumulated playing time of the recordings on the release. A release is usually associated with one particular solo artist or band, for example the album “Abbey Road” with the Beatles. Still, this is not always the case for example in case of movie sound tracks or events such as Woodstock, which feature a number of different artists on the same release.

Draw the diagram on a separate sheet of paper with your name and person number.

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Important: class diagram contains all domain concepts, associations named with a verb, correct multiplicity, correct and complete associations, correct attributes (year, label, title, duration), correct generalizations (CD or release generalization, specializations Album and Maxi-CD), distinction between concept song and recording, composite pattern for artist, solo artist band
Good-luck!!!