

University of Toronto

**Faculty of Arts and Science
Department of Computer Science**

**Faculty of Arts and Science at Erindale
Department of Computer Science**

CSC340S - Information Systems Analysis and Design

Spring 2001

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April-May Examination

**No Aids Allowed
Duration: 2 hours**

Make sure that your examination booklet has 12 pages
(including this one). Write your answers in the space provided.

This examination counts for 35% of your final mark.

Name: _____
(Please underline your last name)

Student Number: _____

Question Marks

1. _____/15

2. _____/15

3. _____/15

4. _____/15

5. _____/15

6. _____/25

Total _____/100

Blockbuster Video managers want to improve the way they maintain information about their customers. In particular, they want to create an information system (“VideoSystem”) able to perform the following functions:

- Given the id of a customer, find his/her name, address and phone number;
- Given the id of a customer, determine if he/she has any outstanding videos (rented but not returned);
- Find out how many rental items are currently rented; this operation is performed very frequently!
- Return a rental item to the store; when a rental item is returned, it is inspected and its status is updated accordingly;
- Retrieve information about a particular rental item, given its id (barcode);
- Given a customer id and barcode, find the customer with the given id, find the rental item with the given barcode; if both exist (and the rental item is rentable) then rent the item to the customer;
- List all the rental items currently rented/owned by a specific customer;
- For a specific rental item, (if it is currently rented/owned) identify the customer who is renting it;

In general, the VideoSystem will need to keep track of a collection of customers and a collection of rental items, as well as relationships between them. Here are additional details on how Blockbuster Video conducts its business:

A customer can rent (possibly many) items.

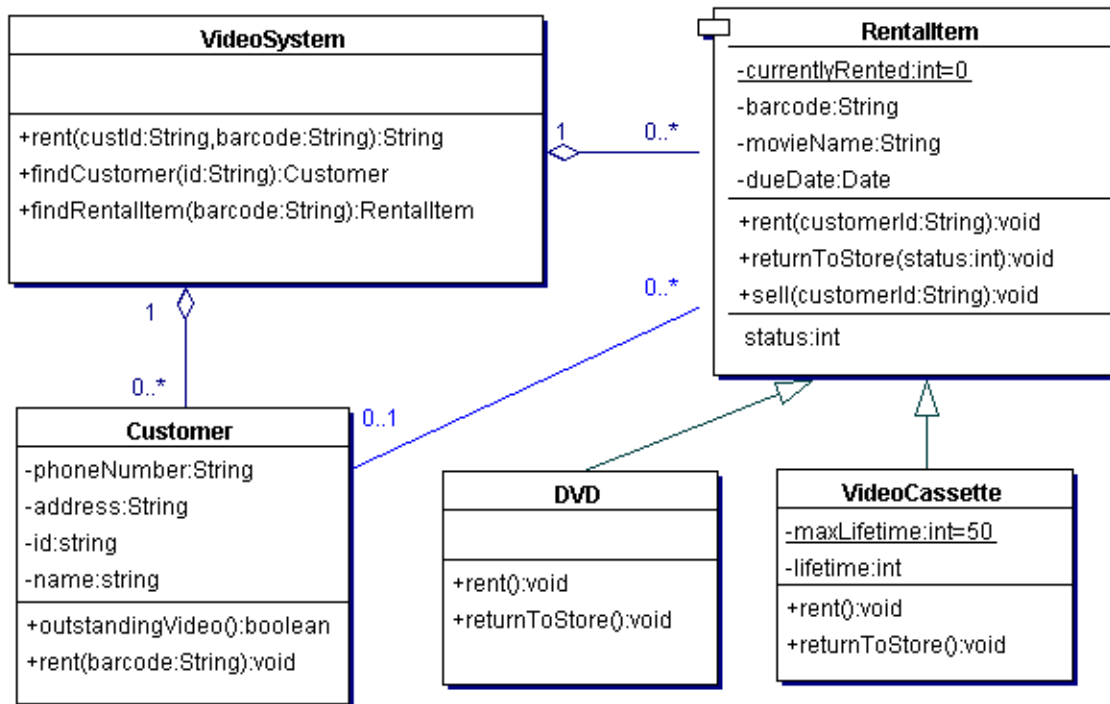
There are two types of rental items: DVDs and video cassettes (“videos”). Customers rent either of these two types of rental items. A rental item has a barcode and a movie name. The status of a rental item is either rented, available, expired (if it has been rented a maximum number of times), damaged or sold (if it was sold to a customer). If its rented, a rental items due date specifies the date that the item should be returned. Each video cassette has a lifespan (a maximum number of times that it can be rented). A newly created video cassette has a lifespan of 50 rentals. DVDs have unlimited lifespans. A non-damaged, available rental item can either be rented or sold to a customer. An expired rental item can only be sold. You can ask for the status of a rental item. All rental items can be rented (by a customer) and returned. When an item is returned, the clerk who handles the transaction labels it “OK” or “damaged” depending on its status. Because of the differences between DVDs and video cassettes, some of these operations (rent, return etc.) have DVD- or video cassette-specific components.

Customers can be retrieved by their id, rental items by their barcode.

Note: The above description is complex, may leave details out and supply unnecessary information. You will need to make some assumptions about the problem for the parts below. **MAKE SURE** you write your assumptions down!

1. [Class Diagrams; 15 marks]

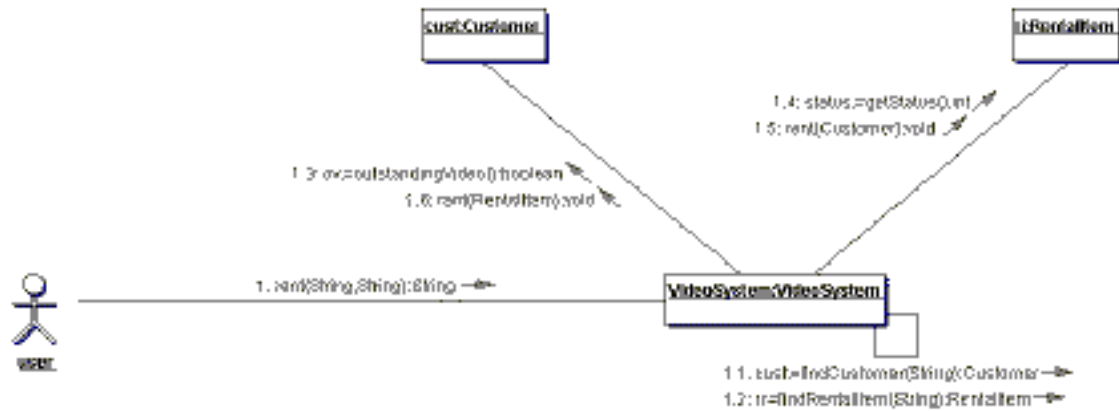
Draw a class diagram which represents the information handled by VideoSystem. Your class diagram should concisely and simply reflect the relationships described above. Make appropriate use of UML class diagram features: relationship (association, generalization, aggregation, multiplicity, etc.), visibility (public, private, static), attributes (including type), and operations (including signatures.)



Notes: Solutions which omit the VideoSystem class get full marks (they focus on the information handled by the system.)

2. [Collaboration Diagrams; 15 marks]

Draw a collaboration diagram for the rent method of the class of video cassettes. This method takes two arguments, the id of the customer, the barcode of the video to be rented. The method updates all the associated instances/classes accordingly (provided, the customer does not have any outstanding videos and the item is rentable), assuming that the customer and the item are both found. This operation returns a string indicating the success of the operation. Make sure to list your assumptions.

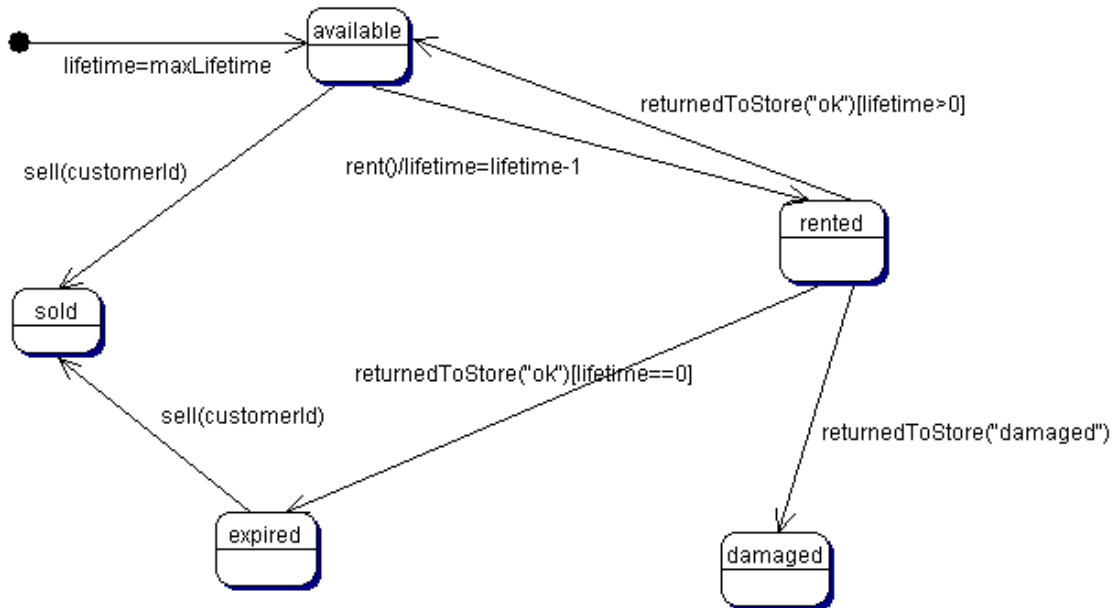


Notes:

- **Mark gently bad syntax, as long as a solution includes the basic logic of the method;**
- **Some solutions may specify on the transitions any conditions that apply (e.g., customer does not have outstanding videos)**

3. [State Diagrams; 15 marks]

Draw up a state diagram which describes the lifetime of a video cassette while it is owned by Blockbuster Video.



 4. [Human-Computer Interaction; 15 marks]


Here is a typical screen dump of an Explorer/Netscape-type browser interface. For each feature below, identify a group of one or more artifacts that exemplifies a good use of the feature. Explain why the group is a good example of the use of the feature. If no such group of artifacts exist, explain why.

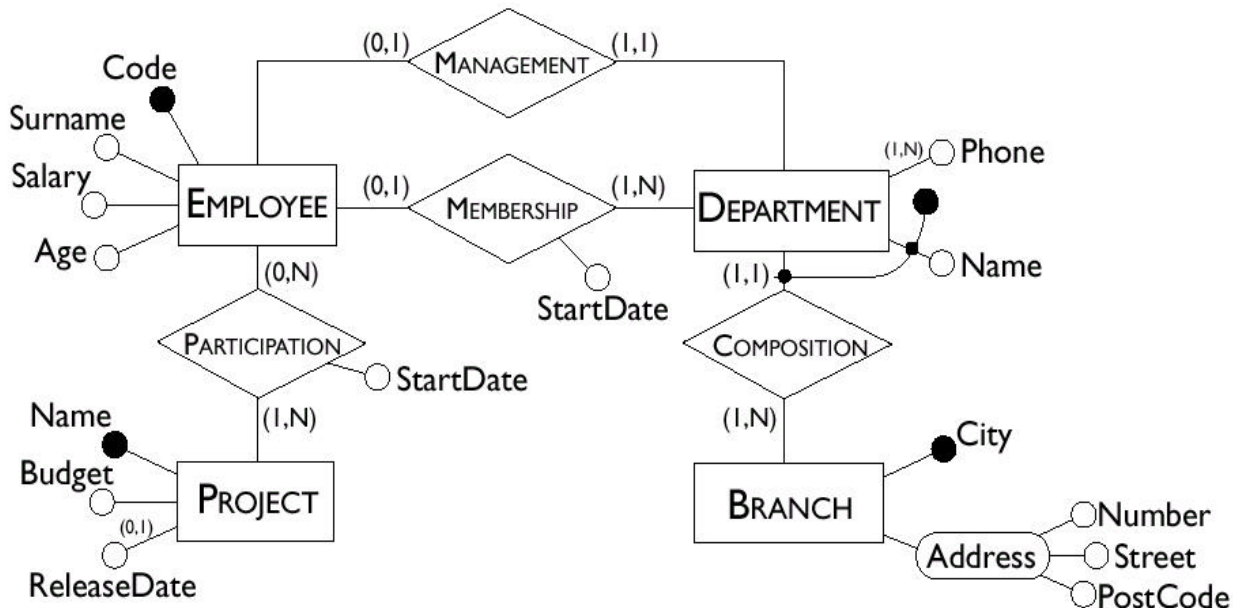
- Affordances: **Affordances: Slider on the right side. Arrows at the top and bottom suggest sliding the bar (even though they are buttons). The size/location of the bar suggests the allowable directions that this can be slid.**
- Mappings: **Search button, the icon with the magnifying glass. Magnifying glass used to look for things/expand things.**
- Feedback: **The scrolling logo on the top right to indicate that a search for a page is in progress. Tells the user that their last jump to a hyperlink is being processed.**
- Mental Model: **Following a sequence of links forms a chain. The UI allows navigation of this chain via the forward and back buttons.**
- Forcing Functions: **The forward/back buttons are enabled only if navigation of the chain in the specified direction is allowed.**
- Automatic Learning: **Links always consistently highlighted, visited links consistently highlighted. OR, interface uses the Netscape/Explorer layout and functions.**

5. [Database Design; 15 marks]

Write up the relational schema for the following ER diagram. Your schema should be in 1NF or better.

Notes:

- We are only interested in the final set of relations. We will not mark the steps used in generating the final set of relations.
- Make sure you identify all keys.
- Do not include any unnecessary tables in your relational schema.



Employee(**code**, surname, salary, age)

Branch(**city**, number, street, postalCode)

Department(**name**, **city**, managerEmployeeCode)

DepartmentPhone(**phoneNumber**, departmentName, departmentCity)

Project(**name**, budget, releaseDate)

Notes: Release date may be null; Composition and Management have been modelled!!

Membership(**employeeCode**, **departmentName**, **departmentCity**, startDate)

Notes: The alternative is to move this to Employee allowing null fields as it is described, an additional constraint needs to be added to the ER schema. This constraint allows an instance of Employee to participate at most once in the Membership relation

Participation(employeeCode, projectName, startDate)

Notes: Additional constraints need to be added to force each instance of Project to be represented in the Participation relation; There are ugly alternatives to the above (ie have a single instance of Employee in project (as well as the Participation relation)). Again, this is an ugly alternative.

6. [Short Questions; 25 marks total]

[Information Systems Analysis; 2 marks] Name two roles that a systems analyst needs to play during an information system development project. Explain each one briefly.

Two of:

Consultant -- often hired from outside, specifically for a project; this means that she brings a new perspective but will not be familiar with company culture/politics.

Supporting Expert -- knows well relevant hardware and software technologies, advises on alternative hardware/software configurations.

Change Agent -- will be expected to suggest alternative business processes which improve on current practices (business reengineer).

[Software Lifecycles; 2 marks] Name two examples of software processes. Explain each one briefly.

Lifecycles, such as waterfall or spiral, are software processes;

Alternatively, software processes for fixing a bug, generating a new release, testing a software system,...

[Implementation Phase; 2 marks] A software system implementation is not complete until the system has been thoroughly tested using stub, unit and system testing. Name two types of testing that need to be done after the software system has been implemented.

Two of

- **Alpha Testing** - testing system on friendly users, usually in-house
- **Beta Testing** - testing system on less than friendly users, usually an outside group who wants to use the system early
- **End-user testing** (or verification testing) - test the system in a simulated environment to see whether it meets user specifications and usability requirements; often done during alpha testing
- **Validation testing** -- run the system in a live environment, testing system performance, peak workload performance, human engineering test, methods and procedures test, backup and recovery test, audit testing, i.e., is system free of errors.

[Software Architectures; 4 marks] Consider the pipes-and-filters software architecture.

Describe what it is: *Components compute by performing local transformations on their inputs to produce their outputs and are termed **filters**. The connectors of components transmit the outputs of one component to the inputs of another and are termed **pipes**.*

Pros: *(Some of) Makes it easy to understand overall function of the system as a composition of filter functions; Encourages reuse of filters; Facilitates maintenance; Facilitates deadlock and throughput analysis*

Cons: *(Some of) Often leads to batch-type processing; Not good for interactive applications where you often want to do incremental computations, e.g., incremental display updates; Can't coordinate stream inputs; Data transmission critical for system performance*

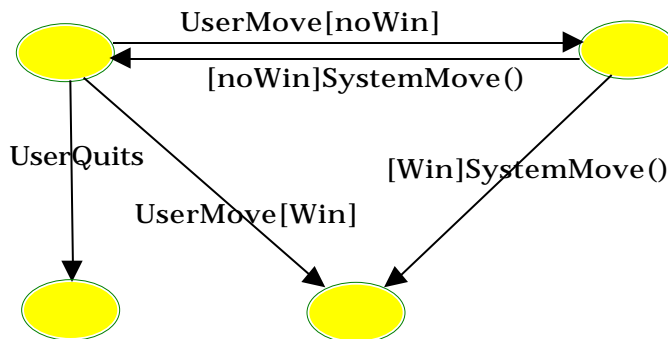
[Short Questions (continued); 25 marks total]

[Database Design; 5 marks] Consider a relation R(A,B,C,D,E) with primary key A, B and functional dependencies B->C and D->E. Place this relation in 3NF, or explain why it is already in 3NF.

Not in 2NF because C depends on part of the key (B->C)
 → R(A,B,D,E), R1(B,C)

Now it is in 2NF, but not in 3NF because a non-key depends on another non-key (D->E)
 → R(A,B,D), R1(B,C), R2(D,E)

[Interface Design; 5 marks] Consider the design of an interface for a 2-person game, such as chess or checkers. Draw a state diagram which describes the dialogue structure of the interface. Assume that the user always starts first, then the system and the user take turns making a move until the mover makes a winning move (e.g., a checkmate in chess), or the user decides to quit. Make sure to describe clearly events, conditions and actions associated with each transition of your diagram.



[Rules; 5 marks] A flight to London costs \$5,000 if the ticket is business class, and \$3,000 if it is economy. However, if you stay in London for more than one week, the economy fare only costs \$1,000. Draw a decision table which represents these conditions and outcomes. Make sure your table is minimal with respect to the number of rows and columns used.

Business?	Y	N	N	
>1week?	*	Y	N	
\$1,000		X		
\$3,000			X	
\$5,000	X			

[Scratch paper]

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