University of Toronto
Faculty of Arts and Science
Department of Computer Science

CSC340S - Information Systems Analysis and Design

Spring 1997   **John Mylopoulos**

Final Examination

> **All Aids Allowed**
> **Duration: 2 hours**
>
> **Make sure that your examination booklet has 18 pages**
> **(including this one).** Write your answers in the space provided.
>
> **This examination counts for 30% of your final mark.**

Name: _____
(Please underline your last name)

Student Number: _____

Question Marks

I. _____/20

II. _____/40

III. _____/40

Total _____/100

Part I (20 points) Multiple Choice Questions: 10 questions, 2 points each

Directions: In the following questions, circle exactly one answer which best completes the sentence. Although several statements seem correct, only one answer is most correct.

1.   Ethnomethodology
    a.   is a subfield of anthropology which studies how modern systems are built.

    b.   contains methods applicable to information gathering in systems analysis.
    c.   is an area of ethics which looks at the impact of information systems implementations on the work force.
    d.   is a methodology used in the social sciences which uses game playing to extract information from the population being studied.
    e.   is a field of research that tries to understand how people relate to their bodies.

2.   We normalize database schemata
    a.   in order to generate more efficient storage
    b.   in order to uncover hidden relationships between data.
    c.   in order not to lose valuable data.
    d.   in order to make updates more efficient.

    e.   for all of the above reasons (a through d.)

3.   Which of the following is a task for a systems analyst?
    a.   teaching training courses to new system users
    b.   regularly updating existing systems software with the new standard releases arriving from the vendor.
    c.   programming the main modules of the programs being developed.

    d.   writing job descriptions and work specifications for people to be hired with the new system.
    e.   seeking financial resources to pay for the proposed system.
    f.   all of the above (a through e).

4.   Which of the following might be an intangible benefit arising from the introduction of a new information system.
    a.   Employee productivity improvement resulting in twice as many orders processed per day.
    b.   Less shrinkage (theft) of inventory through the computerized control of the items kept in the storerooms.
    c.   An increase in the amount of money made on interest bearing investments because of the improvement in handling cash receipts.

    d.   Customer responsiveness and thus, more satisfied customers.
    e.   All of the above items (a through d) represent possible intangible benefits from the introduction of an information system.
    f.   None of the above items (a through d) represents a possible intangible benefit from the introduction of an information system.

5.   Which of the following items result in eliminating one or more of the phases of the Systems Development Lifecycle?
    a.   Using CASE tools

b.   Using Prototyping tools

c.   Purchasing a software application package
d.   Using object oriented technology
e.   all of the above (a through d).
f.   Only items a through c.

6.   End-User development

a.   is a systems development process in which the end-user is included in all design meetings and decision making.
b.   is systems development by the end-user through the use of various sophisticated software tools.
c.   refers to the training given to end-users in order to help them better understand the systems development process.
d.   refers to the training given to end-users in order to teach them the new system being developed.
e.   refers to the marketing strategies used to establish a customer base for new software products.

7.   A Structure Chart

a.   is a structural chart for showing the level and location of errors in software.
b.   is a chart for representing the data processes in an organization in object oriented form.
c.   is a chart for showing the possible states of a system and the various transitions possible between the states.

d.   is a chart that describes the detailed architecture of a system.
e.   is not explained by any of the above (a through d) descriptions.

8.   Which of the following items is **not** an appropriate behaviour for a good interviewer.
a.   showing good listening skills
b.   objectivity
c.   using a balance of open-ended and closed-ended questions
d.   restating responses of interviewee

e.   marketing - being able to sell the new system to its future users
f.   all of the above items (a through e) are behaviours or qualities needed by a good interviewer. Therefore "f" is the only correct answer.

9.   Cardinality in an Entity-Relationship diagram
a.   refers to the number of higher level entities that are used in the ER model.
b.   is used to show the average number of items that might typically be involved in a relationship, e.g., the average number of children a family might have or the average number of employees per department in a company.
c.   is used to show the ratio of one entity in relationship to another entity, i.e., the number of values that might occur for a related entity if the first entity is present.
d.   is used to show the order of the relationships between two entities, i.e., a many relationship always precedes a one relationship.

○ gives the count of the number of entities involved in a single relationship.

10. Which of the following items of information is unlikely to be found in a feasibility analysis?
   a. a cost / benefit analysis comparing alternative approaches.
   b. a list of the operational problems for the current system.
   c. a list of potential intangible benefits that may be gained by undertaking the project.
   d. an analysis of the potential risk involved in undertaking the project.

○ a projected schedule for undertaking the project.
   f. a set of recommendations on which alternative to consider.
   g. all of the above items (a through f) represent items likely to be found in a feasibility analysis.
   h. all of the above items except b and e represent items likely to be found in feasibility analysis.

Part II. Data Flow and Entity-Relationship Diagrams: In the **two** questions which follow, you will be given a description of an information system and the description of data to be handled by another information system. Your task will be to draw data flow diagrams for question 1 and ER diagrams for the data described in question 2. Be sure to read the questions carefully. Do your scratch work on the opposing page before drawing in your final answers. Data flow diagrams which are impossible to interpret because of all the scratching out and changes are not likely to have the most generous grading applied.

11. **(15 points)** Below you will find a description of an information system Draw the context level and the level 0 data flow diagrams for this system

Problem Description: *Queenston Prison System:*   A major penal centre has been built outside the town of Queenston for keeping prisoners convicted of only one offense or of white collar crimes. The prison facility has a constant flow of prisoners into and out of the prison   They are also moving prisoners within the prison based on their good behaviour. On a day to day basis, approximately 136 prisoner changes take place. The changes are processed in the prison control centre office by Miss Keepkey. Each day, the new prisoner processing division receives the new prisoners, conducts a physical examination, assigns the prisoners to living quarters and sends the information file on the new prisoners to Miss Keepkey's office. Miss Keepkey adds information on the new prisoner to a prisoner information database kept on her PC. She also updates her prisoner locator log which keeps records of where each prisoner resides. Finally, she files the actual folder away in an enormous storehouse of file cabinets which contains information on all prisoners who have ever stayed at Queenston. If a new prisoner is found to have been a previous occupant of Queenston, she consolidates both files.

As prisoners stay at Queenston, the officials review their behaviour record.   Good behaviour or closeness to release time warrant an upgrade in accommodations, usually to minimum security housing. Movement of prisoners to new quarters is done on a weekly basis. Orders are issued to move the prisoners and the move information is sent to Miss Keepkey.   She makes these changes in her prisoner locator log and her prisoner information database. She also pulls the prisoners long term file and notes good behaviour commendations.

A release review and parole board reviews prisoner records on a daily basis and generates a set of prisoners to be released either into the custody of a parole officer or without any restrictions. They notify the prisoner and send an update of the release to Miss Keepkey's office. She removes the prisoner from her prisoner information database and prisoner locator log and updates the long-term file of the prisoner to reflect the release.

Draw the Context Level Diagram for the Queenston Prisoner Locator System:

Scratch Page

Draw the Level 0 Data Flow Diagram for the Queenston Prisoner Locator System:

Final Answer
Draw the Level 0 Data Flow Diagram for the Queenston Prisoner Locator System:

12. **(25 points)**   Draw an entity-relationship diagram for the following information system.

The   Aeroporter Transport Services Company runs a limousine service that carries passengers to and from the Toronto airport to their homes or places of business. They maintain a database of customers on a PC in order to schedule pickups and also to keep their customers from having to repeat address information each time they call the limousine service. The database for the customers is accessed by customer telephone number. If a customer is picked up sometimes at their home and sometimes at their office, both home and office telephone numbers and addresses are stored in the database.   The customer may also schedule a pickup from the airport when his or her flight arrives or may call from the airport and reserve a limousine which will come in approximately five minutes.

When a request for a pickup comes in, the dispatcher checks for available drivers, calls one and assigns them to a customer. Typically cars are assigned to the driver each workday and often a driver will take a car home for an early morning pickup if needed.

The relevant customer and driver attributes kept in the database for managing the customer pickup and delivery is as follows:

Customer Name
Customer Home Telephone Number
Customer Home Address
Customer Home Region
Customer Work Telephone Number
Customer Work Address
Customer Work City Region
Date of Pickup

Time of Pickup
Driver assigned to Pickup
Special Pickup Information
Flight Number
Air Carrier
Arrival Time
Customer Drop-off City Region
Driver ID
Driver Name
Driver Address
Driver City Region
Driver Phone Number
Car ID
Car Make
Car License Number

12a. **(5 points)** Define a set of plausible functional dependencies among these attributes. You may use the notation

      A, B, C   -->   D, E, F

to indicate that each attribute on the righthand side of the arrow, i.e., D, E, F, functionally depends on attributes A, B, C.

Scratch Page

12b. **(20 points)** Draw a normalized ER diagram that captures the meaning of the data shown above. Specify carefully the cardinalities, attributes and keys of each entity and relatuinship on your diagram.

Final Answer

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Part III: (40 points) Medium-Sized Questions: There are **four** questions in this section, each worth 10 points.

13. **(10 points)** Suppose you have to redesign an interface used by clerical staff for data entry to a government database. The current interface is line-based. Your customer wants to redesign this interface to improve productivity and lower data entry error rates which are currently quite high.

Describe (a) the key questions you will want answered by the customer and current interface users to help you decide on a design; (b) key interface features and functions you'd consider in putting together a design.

8/10 marks for something like

(a)
- Current error types and error rates for data input through current interface;
- What do clerical staff think of the current interface? What do they like, don't like;
- How much is your customer willing to spend on hardware for a pixel-based monitor or the like;

(b)
- Error-checking procedures;
- Develop a graphics-based interface;

14. (**10 points**) The spreadsheet below shows the calculation of the discounted present value for a projected investment in an information system that is to be operational in 1997 and expected to be running for three years until 2000 before any overhaul would be needed. Is this a reasonable investment? Explain why it is or why it is not, and show your calculations.
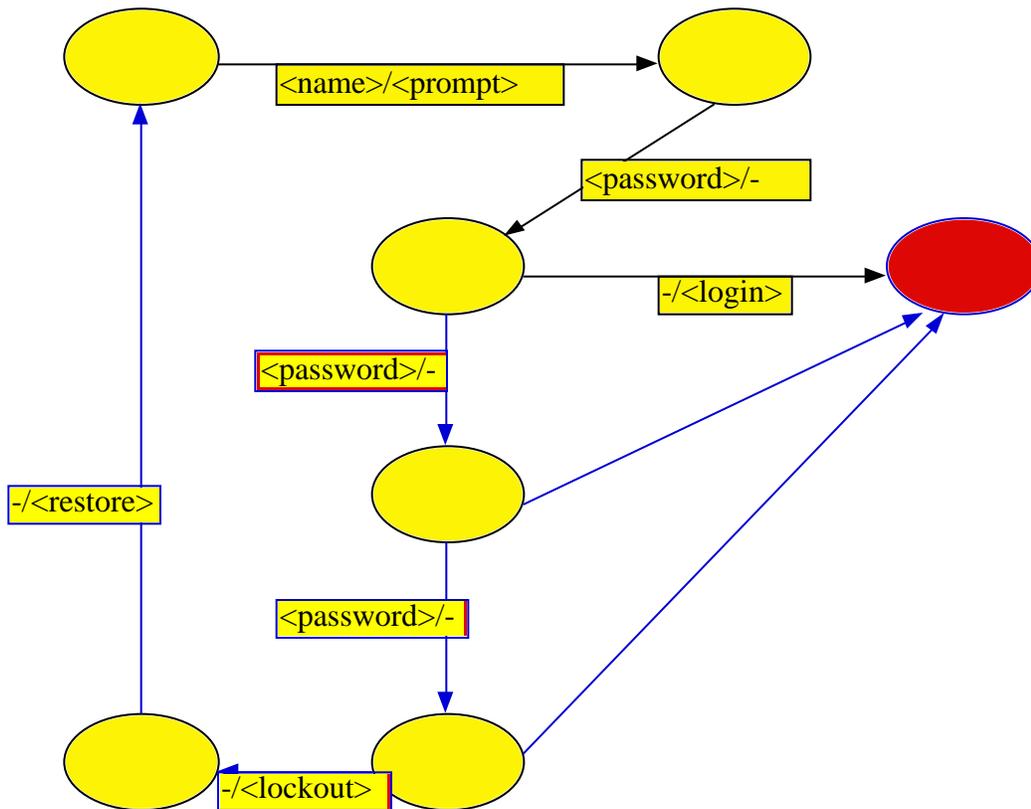
Year	1996	1997	1998	1999	2000
Initial Outlay	$50,000				
Annual Benefits		$20,000	$20,000	$20,000	$20,000
Discounting Factor		0.943	0.890	0.840	0.792
Discounted Present Value		$18,868	$17,800	$16,792	$15,842
Cumulative DPV		$18,868	$36,668	$53,460	$69,302

$$\frac{1}{1+X} = 0.943 \implies 1 = .943 + .943X \implies .057 = .943X \implies X = 6\%$$

The discount rate, X, is 6%. If $50K was invested at 6% for 4 years, the return would be $3,000 (1st year), $3,180, (2nd year), $3,370 (3rd year), $3,573 (4th year) for a total of $63,123 after 4 years.
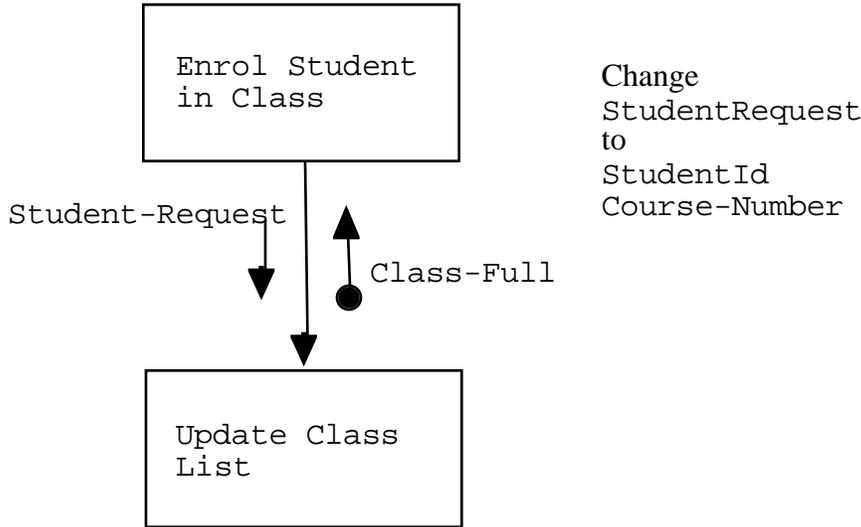
Therefore investment in the IS is reasonable.

15. **(10 points)** Draw a finite state machine which defines the dialogue structure of the interface of a login program. The login program takes in a user's login name and prompts her for a password, then checks that the user has authorization and logs the user. If there is a problem with the name or password, the user is given two more chances to input a valid name and password, otherwise the login program goes into a 10-minute time-out. It then returns to its original state.
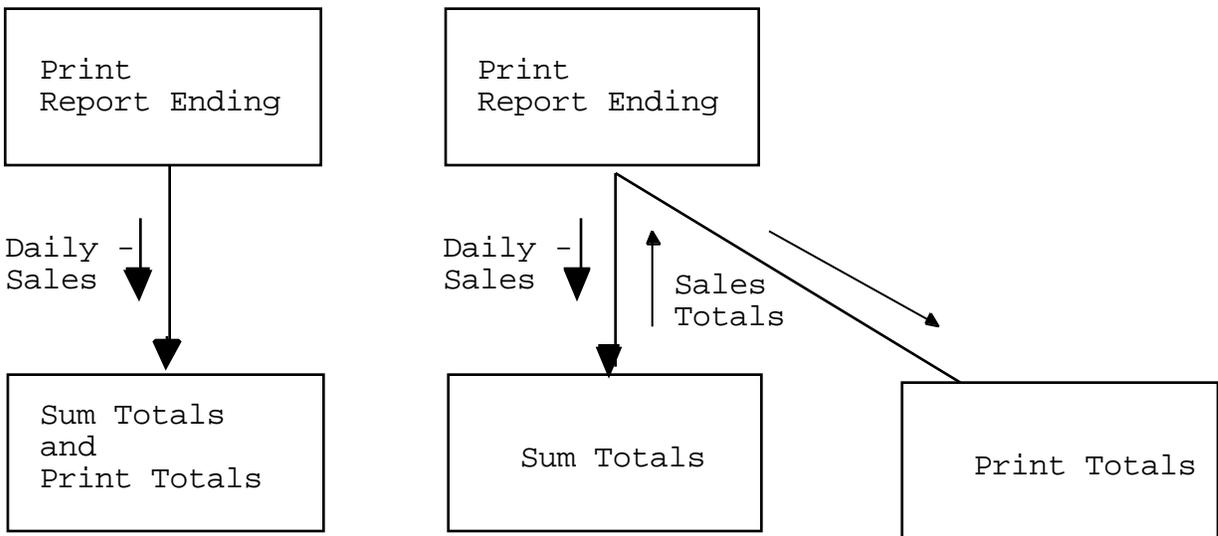
16. **(10 points)** The modules in the following structure charts are too closely coupled and possibly lack cohesiveness. Redraw these structure charts so that the modules are loosely coupled and highly cohesive.

16a. **(5 points)** The data record `Student-Request` contains the following data elements: `StudentId`, `Student-Name`, `Course-Number`, `Date`, `InstructorId` and `Instructor-Name`. The flag `Class-Full` indicates that the class is already full and enrollment can not proceed.

Change
StudentRequest
to
StudentId
Course-Number

16b. **(5 points)** `Daily-Sales` is a list of each daily sale record which includes an `ItemID`, `Item-Number` and `Total-Amount`. The report ending contains the following data elements: `Total-Sales`, `Total-Div-A`, `Total-Div-B`.

Scratch Page

Scratch Page