UNIVERSITY OF WATERLOO
Computer Science CS 338 Midterm Examination
Winter 1995

INSTRUCTOR: G. E. Weddell TIME: 70 minutes

This is an open book examination. For example, class text, copies of overhead slides and printed notes may be used. Do all questions.

NOTE 1: For credit, material transcribed directly from the textbook or notes must be enclosed in clear quotation marks, and will receive less credit than material rephrased in your own words.

NOTE 2: Some of the questions in this examination are open ended; however, they can be answered to the level discussed in class by short organized answers. It is recommended that you spend part of your time organizing your answer, rather than writing down ideas in the order they occur to you. The conciseness and organization of your answers will be taken into consideration in the grading.

NOTE 3: There are 100 marks in total. As a guide to managing your time, the marks awarded for each question are indicated in parenthesis at the start of each question.

Question 1. (25 marks) Answer each of the following using no more than three sentences for each case.

(a) Define the notion of physical data independence.

(b) What other kind of data independence is supported by relational database technology? Explain why support for this other kind of data independence is important.

(c) Consider the assertion "SQL is a non-procedural query language." Does this assertion make sense? If so, is the assertion true or false? Explain.

(d) Define the notions of candidate key, primary key and foreign key as they relate to the relational model.

(e) Does every relation in a relational database have a candidate key? Justify your answer.

Question 2. (50 marks) Consider the following relational database schema for maintaining customer account information for a hypothetical banking enterprise.

```
CREATE TABLE Branch
   (  BNum              INTEGER NOT NULL,
      BName             VARCHAR(20) NOT NULL,
      City              VARCHAR(20) NOT NULL,
   PRIMARY KEY (BNum) );

CREATE TABLE Customer
   (  CNum              INTEGER NOT NULL,
      CName             VARCHAR(20) NOT NULL,
      City              VARCHAR(20),
   PRIMAY KEY (CNum) );

CREATE TABLE Account
   (  ANum              INTEGER NOT NULL,
      CNum              INTEGER NOT NULL,
      BNum              INTEGER NOT NULL,
      Balance           INTEGER NOT NULL,
   PRIMARY KEY (ANum),
   FOREIGN KEY (CNum) REFERENCES Customer,
   FOREIGN KEY (BNum) REFERENCES Branch );
```

Write SQL queries on this schema to answer each of the following.

(a) The number and name of each customer whose city is unknown.

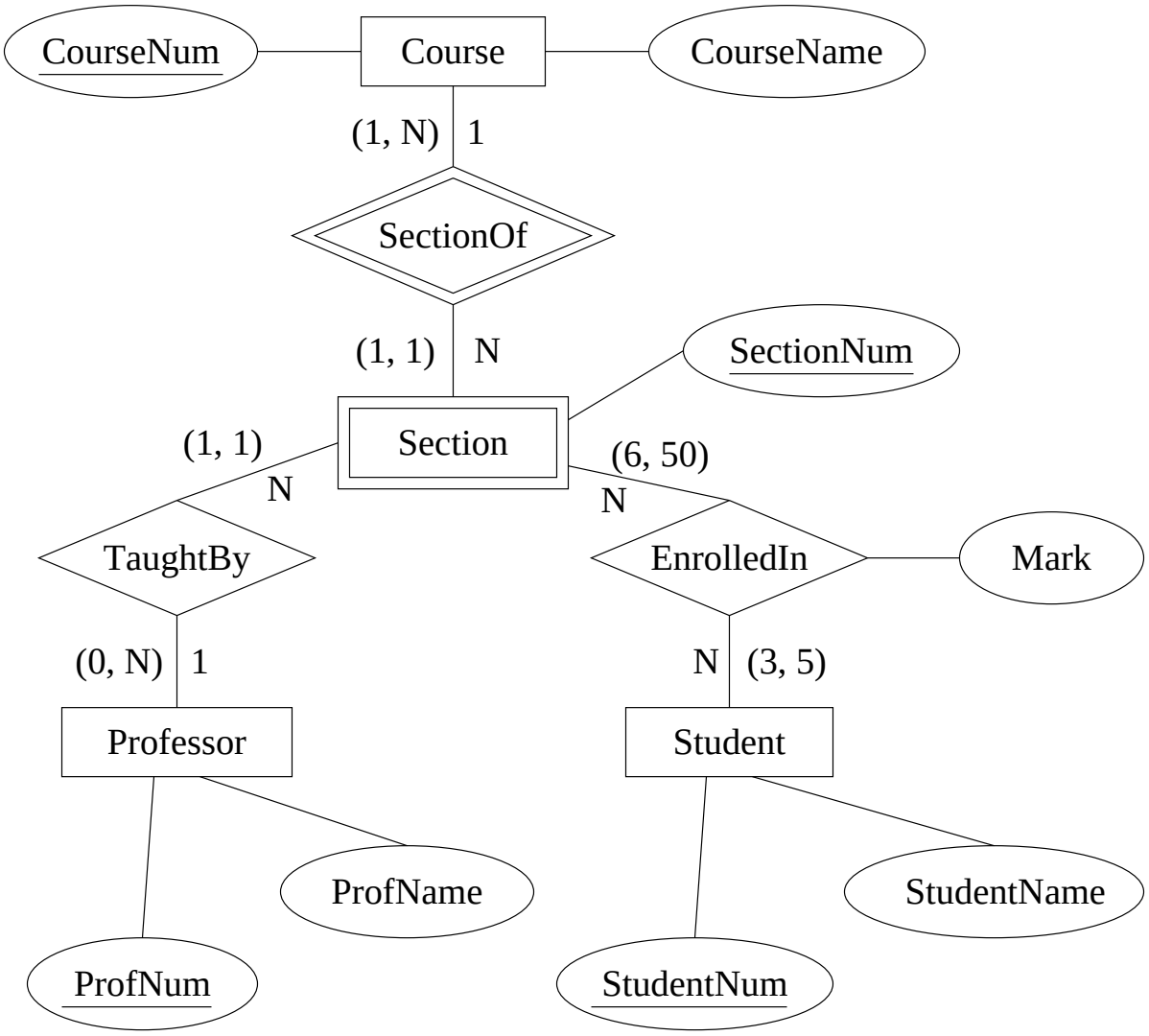
(b) The number and name of each branch with which the customer whose name is "T. Smith" has an account.

(c) All customer information of each customer with no account at any branch located in Waterloo.

(d) The total balance of all accounts for the customer whose name is "T. Smith".

(e) The number and name of branches with the fewest accounts.

Question 3. (25 marks) Consider the following E-R diagram defining a conceptual schema for a hypothetical university enrollment application.



Convert the E-R diagram to a relational schema consisting of a set of "CREATE TABLE" commands (such as those appearing in the previous question). Using a single sentence for each case, explain any constraints reflected in the E-R diagram that are *not* captured by your relational schema.