

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
 Department of Electrical Engineering and Computer Science
 6.001—Structure and Interpretation of Computer Programs
 Spring Semester, 1988

Problem set 11

Issued: May 3, 1988
 Due: Optional
 Reading: Text, Chapter 4, Sections 4.4 and 4.5.

The Query Language

The code for the query language is taken from the text, pp. 362 – 380. The code for the IBM Co. database is attached for your reference. Instructions relevant to the loading and editing of code (as required for the exercises) will be posted in lab.

Once you have installed the query system by means of the `load problem set` command, you should be able to start the system by evaluating

```
(query-driver-loop)
```

This starts the query system evaluator, which has its own driver loop for reading expressions from the terminal and evaluating them. You will notice that it provides you with its own prompt, `query->`. As with the normal Scheme `==>` prompt, you should end anything you type to the `query->` prompt with the `EXECUTE` key.

In order to make it easier to type complicated queries, we have added a command to the query language that will let you use the editor. If you type `(edit)` to the `query->` prompt, it will return you to the editor. You can use the editor to compose a query and *zap* one query down at a time. Use the `ZAP DEFINE` key to mark exactly one query to be executed; then use the `SCHEME` key to get back to the query language. Do not use the `EDIT` key on the terminal; that is like typing `ctrl-G` and then `(edit)`, which will get you out of the query language (back into Scheme) and then into the editor.

Work text exercises 4.28, 4.30, and 4.31. The first exercise requires you only to enter queries. For the second and third exercises, you will need to define rules. Test your rules on the IBM Co. database.

In the following exercises you are to write rules for the Query Language that can generate and test simple English sentences. Consider only sentences that consist of the word “the” followed by a *noun phrase* and a *verb phrase*.

- A noun phrase consists of either a noun, or an adjective followed by a noun phrase.
- A verb phrase consists of either a verb or a verb followed by an adverb.

First, install a set of assertions into the database to define the words in the vocabulary:

```
(noun dog) (noun cat) (noun professor) (noun student) (noun rat) (adjective red) (adjective slow)
(adjective dead) (verb ate) (verb ran) (verb slept) (verb drank) (adverb quickly) (adverb happily)
(adverb well)
```

Given these assertions, it is straightforward to write a pair of rules for inferring verb phrases. Complete the rules below by filling in the missing expressions.

```
(rule (verb-phrase (?x))
      exp1)
```

```
(rule (verb-phrase (?x ?y))
      exp2)
```

Test your rules by determining what verb phrases can be inferred from the database. Does it matter what order you enter these rules into the database? To check these rules on a Chipmunk, you will have to define a database for sentences analogous to the IBM database.

Now write rules for inferring noun phrases by filling in the missing expressions below:

```
(rule (noun-phrase (?x))
      exp3)
```

```
(rule (noun-phrase (?x . ?y))
      exp4)
```

Test your rules by determining what noun phrases can be inferred from the database. Does it matter what order you enter these rules into the database?

Finally, create a rule for inferring sentences from noun and verb phrases. Enter the rules for **append-to-form** (p. 347 of the text) into the database. **append-to-form** can be used to split a list of words into two parts. A sentence consists of the word “the” followed by a noun phrase followed by a verb phrase. Complete the following rule to infer sentences:

```
(rule (sentence (the . ?s))
      (and (append-to-form exp5)
            exp6
            exp7))
```

Verify that “The slow dog ran well” is an acceptable sentence. Under what reorderings of the **and** clauses is this sentence not accepted? Explain.

What sentences of the form “The red ...slept ...” satisfy the rules?

What sentences of the form “The ...rat ...slowly” satisfy the rules?

What query would you use to generate sentences?