Ch29

Declarative Programming

CHAPTER ASSIGNMENT · 15 MARKS

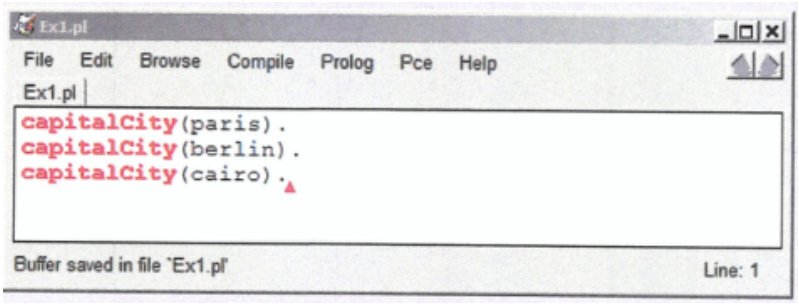
Name _____ Class _____ No. _____ Date _____

Answer every question in the space given. Show your working. You may use the chapter page to help you.

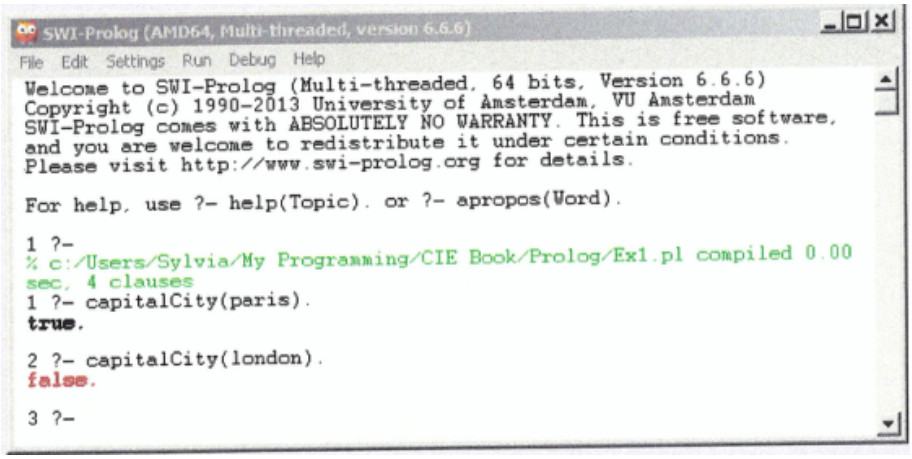
Questions from *Computer Science for Cambridge International AS & A Level Coursebook*, 2nd edition, Sylvia Langfield and Dave Duddell (Cambridge University Press), for classroom use.

Tasks and questions from the chapter

29.01 Launch the editor (File, New ...) from the SWI-Prolog environment. Enter the three clauses, as shown in Figure 29.02. Then save the file (File, Save buffer) as Ex1.



29.02 Run your own queries. You first need to consult the knowledge base (File, Consult ...) from within the Prolog environment. Note that SWI-Prolog uses the prompt `?-` (see Figure 29.03).



If your query does not get a response, check that you have:

- consulted your knowledge base (green text in Figure 29.03)
- used lower-case letters appropriately
- used a full stop at the end of your query.

Q29.01 What answer do you expect to get from Prolog to the following query?

```
sibling(dave, X).
```

29.03 Write a knowledge base for your own family. You can include more predicates, for example:

Predicate	Meaning
male(fred).	Fred is male
female(alia).	Alia is female

Write a rule for father.

Test your program.

29.04 Add the ancestor rules to the Family knowledge base and check that the following query gives the correct results:

```
ancestor(A, jack).
```

29.05 Enter the code from Worked Example 29.05 into the Prolog editor. Save it and consult it. Then pose the following query:

```
factorial(5, Answer).
```

Do you get the correct answer?

29.06 Test the recursively defined rule `writelist/1` to output the elements of a list.

```
writeList([]).
writeList([H|T]):-write(H), nl, writeList(T).
```

RP **Reflection Point:** Can you explain the difference between a fact and a rule?

Exam-style questions

1 A logic programming language is used to represent, as a set of facts and rules, details of cities of the world. The set of facts and rules are shown below in clauses labelled 1 to 17.

```
01  capital(vienna).
02  capital(london).
03  capital(santiago).
04  capital(caracas).
05  capital(tokyo).
06  cityIn(vienna, austria).
07  cityIn(santiago, chile).
08  cityIn(salzburg, austria).
09  cityIn(maracaibo, venezuela).
10  continent(austria, europe).
11  continent(chile, southAmerica).
12  continent(uk, europe).
13  continent(argentina, southAmerica).
14  iVisited(vienna).
15  iVisited(tokyo).
16  capitalOf(City, Country)
      IF capital(City) AND cityIn(City, Country).
17  europeanCity(City)
      IF cityIn(City, Country) AND continent(Country, europe).
```

These clauses have the following meanings:

Clause	Meaning
01	Vienna is a capital.
06	Vienna is in Austria.
10	Austria is in the continent of Europe.
14	I visited the city of Vienna.
16	City is the capital of Country if City is a capital and it is in Country.
17	City is a city in Europe if City is in Country and Country is in Europe.

(a) Write down the extra clauses needed to express the following facts:

(i) London is in the UK. [1]

(ii) I visited the city of Strasbourg. [1]

(b) The clause `cityIn(City, austria)` would return the result: `vienna, salzburg`.
Write down the result returned by the clause: `continent(Country, southAmerica).` [2]

(c) Complete the rule to list countries that I have visited [3]

`countriesIVisited(Country) IF ...`

2 In a particular country, to become a qualified driver you must:

• have a licence: there is a minimum age at which a person can be issued with a licence and it is different for cars and trucks

• pass a theory test: it is the same test for cars and trucks

• pass a driving test for a specific vehicle (car or truck).

A declarative programming language is to be used to represent the knowledge base shown below:

```
01  minimumAge(car, 18).
02  minimumAge(truck, 21).
03  age(fred, 19).
04  age(jack, 22).
05  age(mike, 17).
06  age(jhon, 20).
07  age(emma, 22).
08  age(sheena, 19).
09  hasLicence(fred).
10  hasLicence(jack).
11  hasLicence(mike).
12  hasLicence(jhon).
13  hasLicence(emma).
14  hasLicence(sheena).
15  allowedToDrive(X, V)
      IF hasLicence(X) AND minimumAge(V, L)
        AND age(X, A)
        AND A >= L.
16  passedTheoryTest(jack).
17  passedTheoryTest(emma).
18  passedTheoryTest(jhon).
19  passedTheoryTest(fred).
20  passedDrivingTest(jhon, car).
21  passedDrivingTest(fred, car).
22  passedDrivingTest(jack, car).
23  passedDrivingTest(jack, truck).
24  passedDrivingTest(sheena, car).
25  qualifiedDriver(X, V)
      IF allowedToDrive(X, V)
        AND passedTheoryTest(X)
        AND passedDrivingTest(X, V).
```

These clauses have the following meanings:

Clause	Meaning
01	The minimum age for a car licence is 18.
03	Fred is aged 19.
09	Fred has a licence.
15	Person X is able to drive vehicle V if person X has a licence and the age A of person X is greater than or equal to the minimum age L to drive vehicle V.

(a) Give **one** example of a fact in this knowledge base. [1]

(i)

(ii) Give **one** example of a rule in this knowledge base. [1]

(b) State the output produced from these clauses:

(i) `passedDrivingTest(Who, truck).` [1]

(ii) `allowedToDrive(mike, car).` [1]

(iii) `NOT(hasLicence(sheena)).` [1]

(c) Write a clause to output:

(i) all qualified car drivers [2]

(ii) all drivers who have passed the theory test but not a driving test. [3]

(d) To produce the output from a clause, the inference engine uses a process called backtracking.

Consider the clause: `AllowedToDrive(mike, car).`

Identify the order in which clauses are used to produce the output. For each clause, describe the result that it returns. [5]

End of assignment · Check your answers against the chapter at gurujazzy.com/subjects/computer-science/as-a-level/declarative-programming/