Chapter 7

Results and Discussion

The present implementation of KBGIS is based on 83 rules and 490 objects.

Few of the plates that are output by the system, in response to some of the queries presented to it, are shown in the following pages. A narration of the query, the salient features of the corresponding production which processed the query are also presented for each plate. The background for all the output screens are white, due to problems with the colour printer As the latter is of low resolution (180 x 180 dpi), continuous areas in colour show awkward striations.

7.1. QUERY 1

7.1. A. Input Screen

![Figure 7.1. Screen for Selecting Option Parameters for Query 1]
Query Window

Qry1: Display the Transportation network of Thiruvananthapuram city with roads (priority 1), rivers, railway lines and place names (priority 1, priority 2)

Result Window

Roads-Priority 1
National Highway
Anayara Road
Kovalam Road
Airport Road
Veli Road
Attukal Road
Thiruvallom Rd

Click the item to isolate it on the Map
Qry1: Display the Transportation network of Thiruvananthapuram city with roads (priority 1), rivers, railway lines and place names (priority 1, priority 2)

Result Window

Roads-Priority 1
National Highway
Anayara Road
Kovalam Road
Airport Road
Veli Road
Attukal Road
Thiruvallom Rd

Legend:
- ROADS
- RIVERS & CANALS
- RAILWAY LINE
- COASTAL LINE

Locations:
- AKULAM
- PULAYANARKOTTA
- ANAYARA

Scale: 1:24,000
7.1. B. Plate 1

Query Objective: To display railway line, rivers, canals, and selected roads that pass through Thiruvananthapuram City, with important place names marked.

Query Options: Roads: Priority 1; Placenames: Priority 1 & 2

Production Name: find-roads-rivers-rail

Production:

\[ (p\ find-roads-rivers-rail\ (airdr1\ ^rriname\ name))\]

\[ (road\ ^rd-name\ <rdname>)\]
\[ ^st-xcord\ <st-xcord>\]
\[ ^st-ycord\ <st-ycord>\]
\[ ^end-xcord\ <e-xcord>\]
\[ ^end-ycord\ <e-ycord>\]
\[ ^rd-cord\ <rd-cord>\]
\[ ^rd-no\ <rdn>\]
\[ ^pr-no\ <1>\]

\[ (river\ ^rrname\ <rrname>)\]
\[ ^rr-cord\ <rr-cord>\]

\[ (rail\ ^rlname\ <rlname>)\]
\[ ^rl-cord\ <rl-cord>\]

\[ (place\ ^pname\ <pname>)\]
\[ ^x-cord\ <x-cord>\]
\[ ^y-cord\ <y-cord>\]
\[ ^priority\ <<1\ 2>>\]

\[ \rightarrow\ (call\ rdplotall\ <rdname>\ <rd-cord>\ <rdn>)\]
\[ (call\ rrplotall\ <rrname>\ <rr-cord>)\]
\[ (call\ riplottall\ <rlname>\ <rl-cord>)\]
\[ (call\ plotpointp\ <pname>\ <x-cord>\ <y-cord>)\]

Explanation:

Here, find-roads-rivers-rail is the name of the production. The element

\[ (airdr1\ ^rriname\ name)\]

is used as the control element, (also called context element) for selective activation of the rules in the context. This element has been declared by the literalize declaration of the OPS5 programme. Since OPS5 treats all data as symbolic or integer atoms, the individual strings in the control element must be converted to symbolic atoms before it is finally placed in the working memory. The program statements that perform these operations are shown in Appendix D.1

The attribute ^pr-no (on the tenth line of the definition) indicates the priority number of the roads. Since the priority is <1>, roads with “priority value” of 1 will
be selected. This will eliminate the clutter of the display by limiting the number of roads to be displayed. Priority 1 refers to the most important object, 4 refers to the least important. If all the roads are to be seen, priority value “All” is to be selected.

In the action part of the production, various procedures, external to OPS5 and written in Fortran, are invoked. Since the procedure calls are made from OPS5 environment, to a different, external, language environment, the arguments, *i.e.*, the strings enclosed within angle brackets, used in the procedure calls must be converted from the symbolic atoms to the appropriate data types before they can be processed. The routine that handles this conversion is shown in Appendix D.2.

The strings *rdplotall*, *rrplotall*, *riplotall*, and *plotpointp*, are all procedure names, and the strings enclosed within the angle-brackets are the arguments to the respective procedures.

Scale: 1:100,000
1:24,000 also shown upon zooming selected area
Response Time: 11 seconds
Display the important Tourist places in Thiruvananthapuram city with their locations and the roads that lead to them.

1. Kowdiar Palace
2. Boat club
3. Gandhi Bhavan
4. Attukal Temple
5. P.S Temple
6. Art Gallery
7. Beemapalli
7. 2. QUERY 2

7. 2. A. Input Screen

**Query Objective:** To display the important tourist places in Thiruvananthapuram City with their names and locations, and the major roads that lead to them.

**Production Name:** find-tourist-places-routes

**Production:**

```
<altpl "name name">(tourist-place "name "location <|ocation> "x-cord <x-cord1> "y-cord <y-cord1> "rd-adj <rdname> "tp-no <tpno>))
(place "pname <|olocation> "x-cord <x-cord2> "y-cord <y-cord2>)
(road "rd-name <rdname> "rd-cord <rd-cord> "st-xcord <st-xcord> "st-ycord <st-ycord> "rd-no <rd-no>
```

![Image of the input screen for selecting the optional query parameters for Query 2](image)

Figure 7.2. Screen for Selecting the Optional Query Parameters for Query 2

7. 2. B. Plate 2
In this query, find-tourist-places-routes is the identifier of the production that is to be used. The element

\[(altpl ^name name)\]

is the control-element or context-element used for activating the production. The symbol \(<altpl>\) is used as the element designator, which may be used to refer to that particular condition-element of the production at any stage in the program. The condition-element must be enclosed in braces when an element designator is associated with it. clgplotall and rdplotall are external procedure names.

The Display menu with the option Tourist Places appears first. The user has to select this option. Now the important tourist places are displayed with the roads that lead to them. The user also has the option to display more roads, railway lines, rivers etc. and place names on the map by selecting the other two options. If the Roads option is selected, then the Road Priority menu appears. If the Place Names option is selected then Place Names Priority menu appears.

In the resulting map, the tourist places are marked in green, with their names displayed in the result window. The user can scroll through the display using the scroll buttons on the scroll bar.

Response Time: 12 seconds
Find all the roads in Thiruvananthapuram city that are intersected by the river (KARAMANA)

Roads Intersected
1. National highway
2. Poojappura Road
3. Maradukadavu Rd
4. Kalladimukham Rd
5. Attukal road
6. Thiruvallom Rd
7. Kovalam Road
7.3. QUERY 3

7.3. A. Input Screen

![Figure 7.2. Screen for Selecting Option Parameters for Query 3](image)

7.3. B. Plate 3

Query Objective: To find and display all the roads that cross a particular river

Query Option: Karamana river

Production Name: find-all-roads-cross-river

Production:

\[
(p \text{ find-all-roads-cross-river})
\]

\[
(r \text{drcross})
\]

\[
(r \text{iver} \quad ^*r \text{name} \quad <\text{name}>)
\]

\[
(r \text{d-cross} \quad ^*r \text{d-cross} \quad \text{yes})
\]

\[
(r \text{cord} \quad ^*r \text{cord} <r \text{cord}>)
\]

\[
(r \text{oad} \quad ^*r \text{name} \quad <r \text{name}>)
\]

\[
(r \text{cross} \quad \text{yes})
\]

\[
(r \text{name} \quad <r \text{name}>)
\]

\[
(r \text{d-cord} \quad <r \text{d-cord}>)
\]

\[
(r \text{cord} \quad <r \text{cord}>)
\]

\[
(r \text{st-xcord} \quad <r \text{st-xcord}>)
\]

\[
(r \text{st-yord} \quad <r \text{st-ycord}>)
\]

\[
(r \text{d-no} \quad <r \text{d-no}>)
\]

\[
(p \text{name} \quad <p \text{name}>)
\]

\[
(p \text{x-cord} \quad <p \text{x-cord}>)
\]

\[
(p \text{y-cord} \quad <p \text{y-cord}>)
\]

\[
<->
\]

\[
(\text{call riverplot} \quad <\text{name}> \quad <r \text{cord}>)
\]

\[
(\text{call roadplot} \quad <r \text{name}> \quad <r \text{d-cord}>)
\]

\[
(\text{call plotpointp} \quad <r \text{d-no}> \quad <r \text{st-xcord}> \quad <r \text{st-ycord}>)
\]
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Explanation:

As in the explanation for the previous queries, the element

```
(rdrcross   ^rname    name)
```

is the control element used to activate the production.

In this query, the Display menu with the option Roads appears first. This is to be selected by the user. Now the Criteria menu appears with three options. Here the user can select any one of the three options. By selecting the first option the user is prompted to choose any one of the two options River/Railway line. By choosing the River option, the user is prompted for entering the name of the river. Once the name of the river is entered, the resulting map is displayed with all the roads that are intersected by the river (KARAMANA). The names of the roads that are intersected by the river are displayed in the result window.

Response Time: 9 seconds
7. 4. PLATE 4

Query Objective: To find and display all hotels with air-conditioned double rooms within 3 km of Central Railway Station and where non-vegetarian food is available.

Query Option:
- Hotels
- Air-conditioned
- Double rooms
- Non-vegetarian food
- Within 3 km of Central Railway Station

Production Name: find-hotels-aircon-near-central-rlystn

Production:

```
(p find-hotels-aircon-near-central-rlystn
  (alhtlloc ^name name1)
  (alhtloc (hotel ^name <name>
            ^location <location>
            ^x-cord1 <x-cord1>
            ^y-cord1 <y-cord1>
            ^htl-no <htlno>
            ^m-type non-veg
            ^t-type ac-double
            ^criteria (with-in <3>
                       <central-railway-station>))
  ->
  (call clgplotall <name> <x-cord1> <y-cord1> <htlno>))
```

Explanation:

For this production, find-hotels-aircon-near-central-rlystn is the name of the production, and (alhtlloc ^name name1) is the control element. The symbol <alhtloc> is the element designator. The condition-element is now enclosed in braces. The value for the attribute criteria is evaluated by the function within which takes two arguments, viz., the distance in km and the object identifier.

Response Time: 8 seconds
Find and display all the Colleges in Thiruvananthapuram city
(Adjacent to) National Highway 47

Names of Colleges
1. Sanskrit College
2. University Colg.
3. Fine Arts Colg.
4. Ayurveda College
5. N.S.S College
6. Law College
Query Window

Qry6 Display the distribution of Hospitals in Thiruvananthapuram city with their locations.

Result Window

Names of Hospitals
1. Nirmala Hospital
2. E.S.I Hospital
3. W & C Hospital
4. T.B Centre
5. G.G Hospital
6. General Hospital
7. S.U.I Hospital
7. 5. PLATE 5

Query Objective: To find and display all the colleges in Thiruvananthapuram City that are adjacent to National-Highway 47.

Query Option: Colleges
Adjacent (≤ 0.5 km)
National-Highway-47

Production Name: find-all-colleges-NH47

Production: See Appendix D.5

Explanation:

In the production, detailed in Appendix D.1 (alclg ^name name1) is the control element, while <edn> and <edgs> are element designators. NH 47 is displayed in cyan colour, to be distinct from other streets. In the knowledge base, the expression adjacent to means a distance less than or equal to 0.5 km. The output colleges are marked in green colour.

Response Time: 10 seconds

7. 6. PLATE 6

Query Objective: To find and display the distribution of hospitals in Thiruvananthapuram city.

Query Option: hospitals

Production Name: find-all-hospital

Production: See Appendix D.2

Response Time: 8 seconds
Query Window

Qry7 Find and display all schools located between (2 Km) and (6 Km) of the SECRETARIAT building.

Result Window

Names of Schools

1. Gvt. H.S Aryasala
2. St. Mary's H.S
3. N.S.S E.M.H.S
4. St. Rocha's H.S
5. Gvt. H.S Punthura
7. Med. College H.S
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7.7. PLATE 7

Query Objective: To find and display all schools between 2 km and 6 km of the Secretariat building.

Query Options: schools located between 2 km and 6 km of Secretariat building

Production Name: find-schools-around-secretariat

Production: See Appendix D.3

Response Time: 16 seconds

7.8. QUERY 8

7.8. A. Input Screen

![Query 8 Input](image)

**Figure 7.8.** Screen for Selecting the Optional Query Parameters for Query 8
Find three star hotels nearest to City Airport and located within (3 Km) of Central Railway station. Display the shortest route to it from the Airport.

Name of Hotel
HOTEL LUCIYA
7. 8. B. PLATE 8

Query Objective: To display the 3-star hotel nearest to City Airport and located within 3 km of Central Railway Station. Display the shortest route to it from the Airport.

Query Options:
3-star hotel nearest to City Airport within 3 km of Central Railway Station

Production Name: find-hotel-nearest-airport-and-route

Production:
(p find-hotel-nearest-airport-and-route

(htl
  ^name <name1>
  (public-utility
    ^name airport
    ^x-cord <x-cord1>
    ^y-cord <y-cord1>)
  (<hloc> (hotel
    ^name <htlname>
    ^location <location>
    ^x-cord <x-cord2>
    ^y-cord <y-cord2>
    ^criteria (closest <x-cord1> <y-cord1> within <3> <central-railway-station>))))

(place
  ^pname <location>
  ^x-cord <x-cord3>
  ^y-cord <y-cord3>)

- - ->

(call htlplot <name> <location>
  <x-cord2> <y-cord2>)
(call plotpoint <x-cord1> <y-cord1>)
(call plot-shortest-route <x-cord1> <y-cord1>
  <x-cord2> <y-cord2>))

Response Time: 18 seconds
Find and Display all the roads that intersect Railway line within the City.

1. Kadagampalli Rd.
2. Sankumukham Rd.
3. Anayara Road
4. Veli Road
5. National Highway
6. Chettikulam Rd.
7. Thirumala Road
Find and display the various objects located around Raj Bhavan within a window indicated by the user.

Objects Found
1. Art Gallery
2. Zoo
3. Napier Museum
4. Forest Museum
5. Kowdiar Palace
6. Tennis Club
7. Swimming Pool
7. 9. PLATE 9

Query Objective: Display all the roads that Intersect Railway line within the City.

Query Options: Roads
Intersect railway line

Production Name: find-all-roads-cross-rail.

Production:

(P find-all-roads-cross-rail
  (rail ^ril-cord <rl-cord> )
  (road ^rd-name <rdname>
    ^ril-cross yes
    ^crplcrl <crplc>
    ^rd-cord <rd-cord>
    ^st-xcord <st-xcord>
    ^st-ycord <st-ycord>
    ^rd-no <rd-no>)
  (place ^pname <crplc>
    ^x-cord <x-cord>
    ^y-cord <y-cord>))

<-->

(call railplot <rl-cord>)
(call roadplot <rdname> <rd-cord>)
(call plotpoint <rd-no> <st-xcord> <st-ycord>)

Response Time: 12 seconds

7.10. PLATE 10

Query Objective: Display all the objects located around 'Raj Bhavan' (the State Governor's House) within the window indicated by the user.

Query Options: All objects located around 'Raj Bhavan' within the window selected at run-time

Production Name: find-all-objects-in-window

Production: Not shown

Response time: 24 seconds; depends on the size and orientation of the window chosen
Display the distribution of crimes within a circular area 1.25 km in radius centered around Vallakadavu in Thiruvananthapuram city.
7. 11. PLATE 11

Query Objective: To display the distribution of crime within a circular area of diameter 2.5 km each centred around Vellayambalam and Vallakadavu.

Query Options:
- Crime Incidence
- Within a circle of radius 1.25 km centred around Vellayambalam and also Vallakadavu

Production Name: find-crimes

Production:
```
(p find-crimes
  (place ^pname  <pname1>
    ^x-cord  <x-cord1>
    ^y-cord  <y-cord1> )
  (crime ^location  <pname1>
    ^x-cord  (> (compute x-cord1 - 1.25)
      < (compute x-cord1 + 1.25)))
    ^y-cord  (> (compute y-cord1 - 1.25)
      < (compute y-cord1 + 1.25)))
  - - >
    (call clgplotall <pname1> <x-cord> <y-cord>))
```

Response Time: 11 seconds

Explanation:

The data pertaining to incidence of crime in the two localities, Vellayambalam and Vallakadavu, are not based on the police records, attempts made to obtain such data were not successful. The display shown are based on hypothetical data for two of the crime-prone areas of the city.
Query Window

Qry12 Find the shortest road distance from (East fort) to (Hotel South park)

Result Window

Shortest Road distance from East fort to Hotel South Park is 2.4 Km.
Query Objective: Find the shortest road distance from East Fort to Hotel South Park

Query Options: East Fort
Hotels South Park

Production Name: find-dist

Production

\[
\begin{align*}
(p \text{ find-dist} & \quad ^\text{name} \quad \text{name}) \\
& (\text{place} \quad ^\text{pname} \quad <\text{name1}>) \\
& \quad ^\text{x-cord} \quad <\text{x-cord1}> \\
& \quad ^\text{y-cord} \quad <\text{y-cord1}> \\
& \quad (\text{hotel} \quad ^\text{name} \quad <\text{name1}>) \\
& \quad ^\text{location} \quad <\text{loc1}> \\
& \quad ^\text{x-cord} \quad <\text{x-cord2}> \\
& \quad ^\text{y-cord} \quad <\text{y-cord2}> \\
& \quad (\text{road} \quad ^\text{rd-cord} \quad <\text{rd-cord}>) \\
& \quad ^\text{rd-name} \quad <\text{rd-name}> \\
& \quad ^\text{criteria} \quad \text{adjacent} <\text{name1}> \quad \text{adjacent} <\text{loc1}> \\
\end{align*}
\]

\[\rightarrow\]

\[
\begin{align*}
& (\text{call} \quad \text{find-shortest-dist} \quad <\text{x-cord1}> \quad <\text{y-cord1}> \\
& \quad <\text{x-cord2}> \quad <\text{y-cord2}> \\
& \quad <\text{rd-name}> \quad <\text{rd-cord}> \\
& (\text{call} \quad \text{roadplot} \quad <\text{rd-name}> \quad <\text{rd-cord}> \\
& (\text{call} \quad \text{plotpoint} \quad <\text{x-cord2} > \quad <\text{y-cord2}> \\
& (\text{call} \quad \text{plotpoint} \quad <\text{x-cord1} > \quad <\text{y-cord1}> \\
\end{align*}
\]

Response Time: 11 seconds
Find suitable locations for a High school (1 KM) away from coastal line and not more than (0.5 KM) off any road and within (3 KM) of any College and more than (4KM) away from any existing high schools.

- Exist. Colleges
- Exist. Schools
- New location
  For High school
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7. 13. PLATE 13

Query Objective: Find suitable locations for a High School 1 km away from coastal line and not more than 0.5 km off any road and within 3 km of any college and more than 4 km away from existing schools.

Query Options: High school
1 km away from coastal line
≤ 0.5 km from a road
≤ 3 km of a college
> 4 km away from existing schools

Production name: find-locations-hs

Production:

```
(p find-locations-hs
 (school
   (name <name1>)
   (type high-school)
   (location <location1>)
   (x-cord <x-cord1>)
   (y-cord <y-cord1>))

(road
   (rd-name <rdname>)
   (rd-cord <rd-cord>))

(boundary
   (bound-cord <bound-cord1>))

(make edn-research
   (type high-school)
   (x-cord <x-cord3>)
   (y-cord <y-cord3>)
   (criteria
     (away-from <bound-cord1> <1> <x-cord3> <y-cord3>
      with-in <3> <name2>
      away-from <name1> <4> <x-cord3> <y-cord3>
      with-in <0.5> <rd_cord> ))

  -->

  (call plotpoint <x-cord3> <y-cord3>))
```

Response Time: 26 seconds

7. 14. SUMMARY

THE OUTPUT some typical queries, in the form of screen print-outs are presented in this chapter. In certain cases, the input screen for the query is shown. A narration of the query, the options exercised by the user, the name of the production, and the code for the production, are followed by an explanation of the production and the related terms. In some other cases, the Input Screens are not shown.