



## Exercise 1 – Spatial concepts

### Aim

To get a better understanding of topological relationships and how these relationships are categorized.

### Preparations

Read carefully Worboys and Duckham (2004) section 4.4.2 and Lectures notes 1. Especially you should be familiar with the 4-intersection model.

### Task I - Theoretical part

Answer the following questions:

- 1) What is a *topological relationship*?
- 2) Give example of two spatial relationships that are topological.
- 3) Give example of two spatial relationships that are not topological.
- 4) Define the following topological relationships between the *cells* *A* and *B* by using the 4-intersection model. (A *cell* is a closed connected set in 2D.)
  - \* *A* disjoint *B*
  - \* *A* contains *B*

In the course literature the *4-intersection model* is described. This is, however, not the only model of categorizing topological relationships. Another model that is often used is the *9-intersection model* (DE-9IM). The 9-intersection model is similar to the *4-intersection model* (both are using intersection of *interior* and *boundaries*), but the 9-intersection model is more complicated.

Before answering the questions below you should read more about the 9-intersection model. More information is found in the document *Simple Feature Access Part 1: Common Architecture* under the heading *Relational operators* (6.1.14). The document can be downloaded from *Open Geospatial Organisation* (OGC) homepage (<http://www.opengeospatial.org/>) (see *Standards*->*Simple Feature Access 1*).

Answer the following questions:

- 5) What is the *exterior* of a polygon object?
- 6) For which combinations of *point*, *lineString* and *polygon* are the topological relationship *crosses* defined? Draw a figure that illustrates a *lineString* that crosses a *polygon*.

### Task II - Practical part

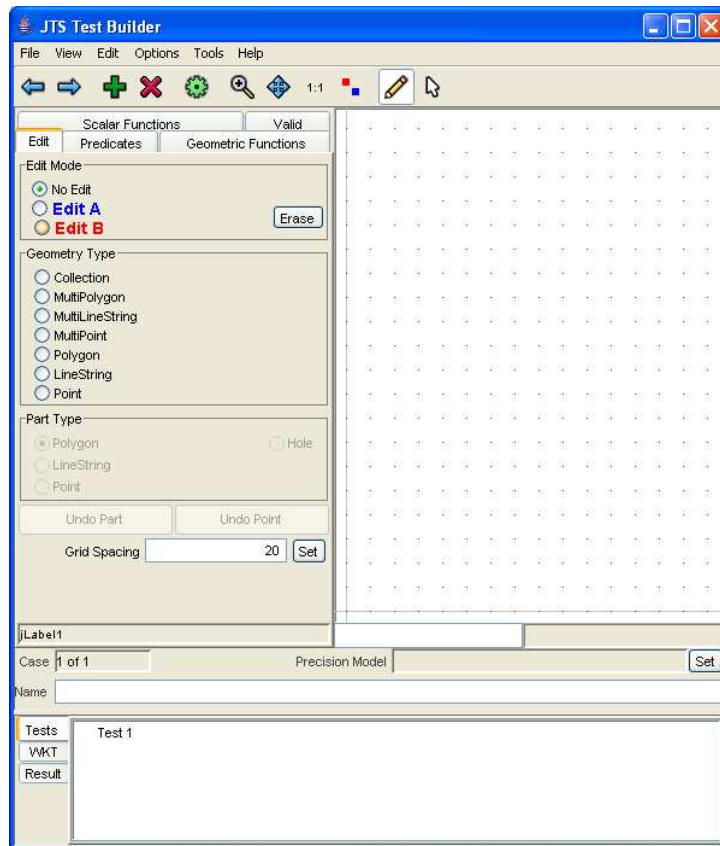
The topological relationships in the *9-intersection model* can be studied using a Java program called *JTS TestBuilder* (JTS = JTS Topology Suite). Information about this program can be obtained from the JUMP project website:

(<http://www.jump-project.org/project.php?PID=JTS&SID=OVER>).

JTS Test Builder is a java application and is installed on your computer as the program *TestBuilder.bat*.

Do the following:

- a) Go to *C:\jts17\bin* and run *TestBuilder.bat*. You will then get a menu as below.



- b) Study the manual (*JTS TestBuilder & TestRunner User Guide.pdf*) as found in the *C:\jts17\doc* library. Especially study the sections 3.4 and 3.5.

c) Go to *Edit* in the program *TestBuilder* and create two polygons (*A* and *B*) that *overlap*. Then select *Predicates* where you can test the topological relationship between *A* and *B* (by pressing *Run*). Try to interpret the values in the *Intersection matrix*. These values are defined as in the *9-intersection model*. Are the values in the *intersection matrix* as you would expect for the *overlap* relationship?

d) Repeat exercise c) with polygons with other topological relationships.

e) Try to use also *lines* and *points* in your testing of the topological relationships.

## Report:

To pass this exercise you have to submit a report with correct answers to the questions 1-6 above. You do not have to include the practical part in the report, but you must demonstrate how the program works for the exercise supervisor.