Object Modeling Technique for Geographic Applications - OMT-G

OMT-G is a data model for the design of geographic database systems and applications. OMT-G starts with Unified Modeling Language (UML) class diagram primitives, introducing geographic primitives in order to enhance UML's semantic representation capabilities, thus reducing the distance between the designer's mental model of the reality and the usual representation tools. OMT-G provides primitives for modeling the geometric shape and location of geographic objects, supporting spatial and topological relationships, "whole-part" structures, networks, and multiple representations. Furthermore, the model allows the specification of alphanumeric attributes and methods associated to each class. The model's main strong points include its graphical expressivity and its compactness, since textual annotations are replaced by pictograms and symbols indicating explicit relationships, which are able to denote the dynamic nature of the interaction between spatial and non-spatial objects. From the model, it is also possible to derive spatial integrity constraints, specified along with the usual constraints found in conventional database design. Using these assets, the mapping between the conceptual schema and the physical implementation can be executed more soundly and preserving the semantics contained in the higher abstraction level.

OMT-G is based on three main concepts: *classes*, *relationships*, and *spatial integrity constraints*. Classes and relationships define the basic primitives that are used to create application static schemas. The spatial integrity constraints ensure the necessary conditions to keep the database always consistent. Two types of classes are proposed by the OMT-G model: *georeferenced* and *conventional*, as shown in Figure 1.

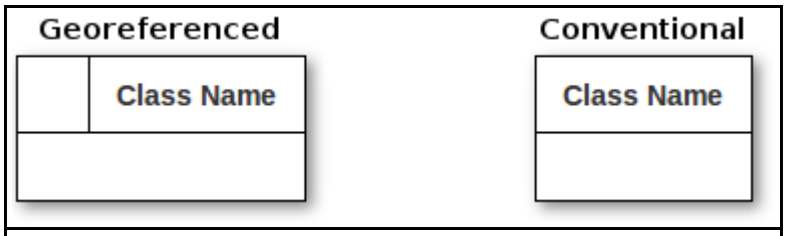


Figure 1 - OMT-G classes, simplified notation

Conventional classes behave as UML classes and have no geographical properties. Georeferenced classes include a geographical representation alternative, which specializes in two types of representations: discrete, associated with real world elements (*geo-objects*), or continuously distributed over the space (*geo-fields*). Geo-objects are represented with points, lines, polygons or network elements (nodes, unidirectional and bidirectional arcs). Geo-fields correspond to variables such as soil type, relief and temperature, often seen as a surface, and can be represented by isolines, tessellation, planar subdivision, sampling or triangular irregular network (TIN). Figures 2 and 3 show, respectively, examples of geo-object and geo-field classes.

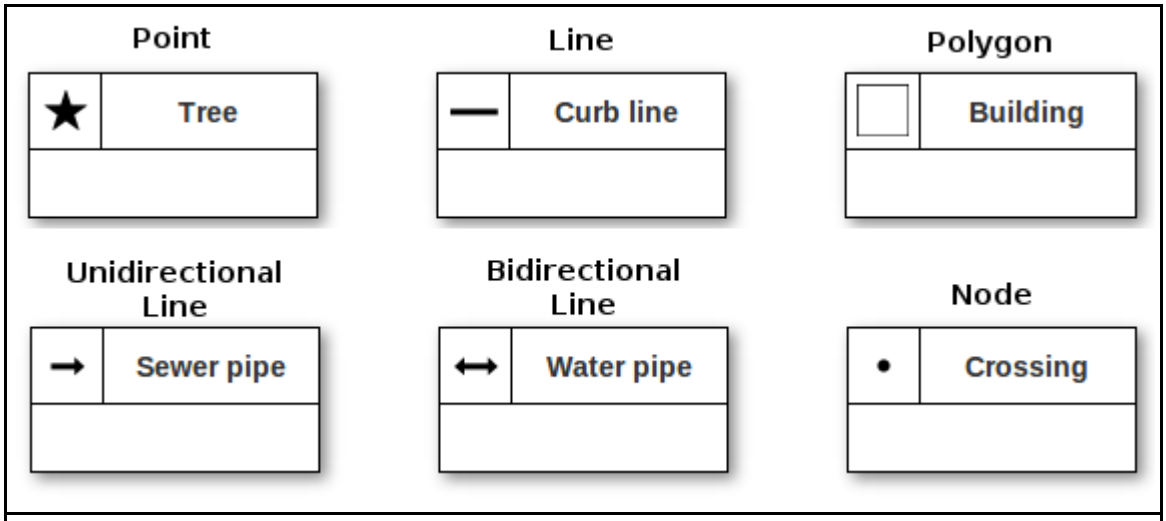


Figure 2 - OMT-G geo-object classes

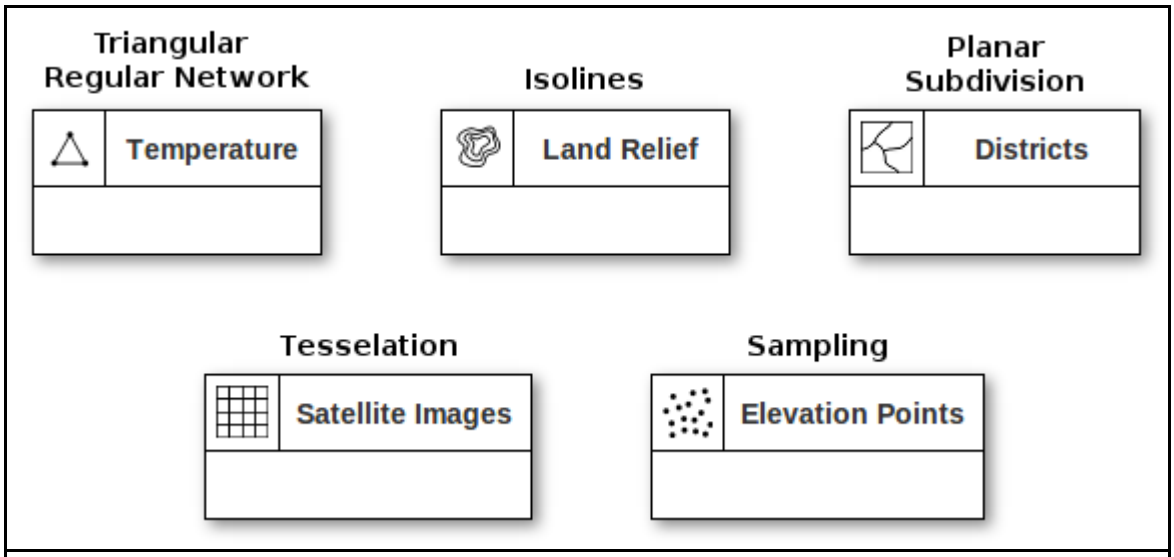
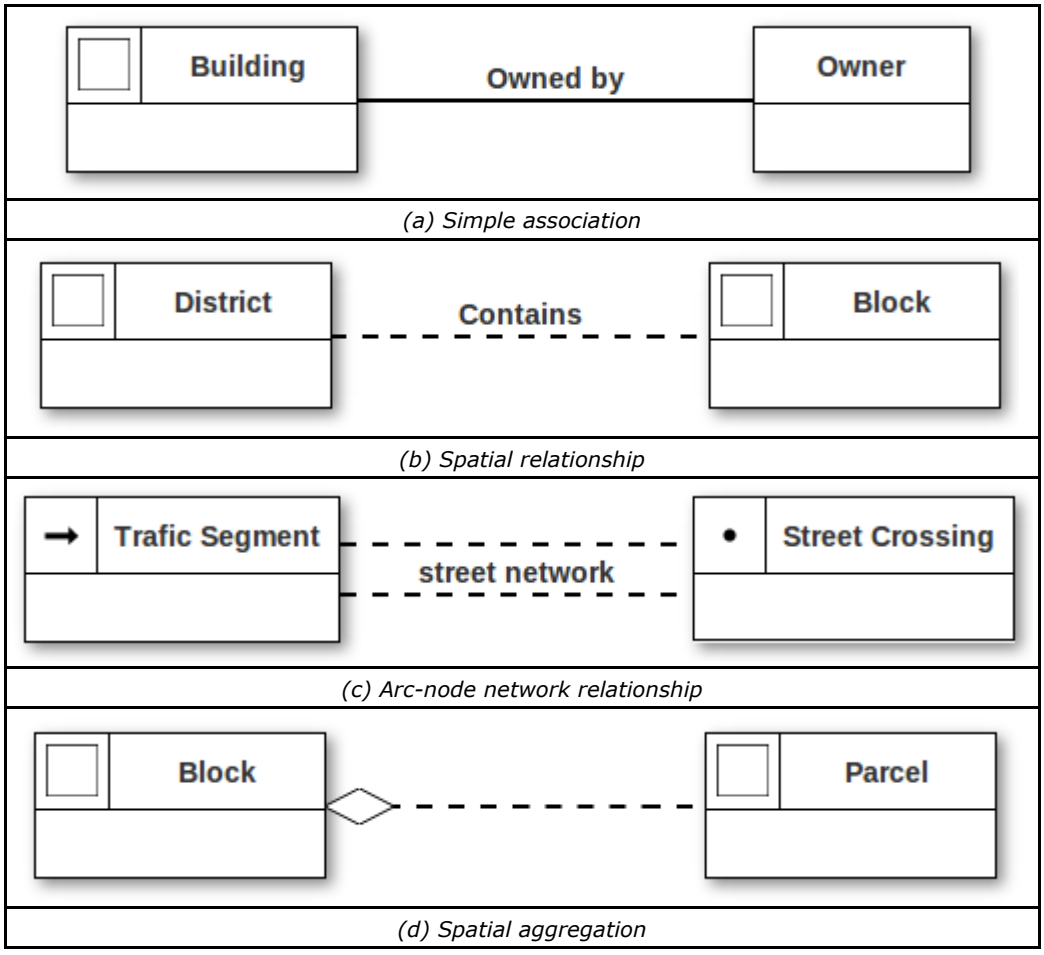
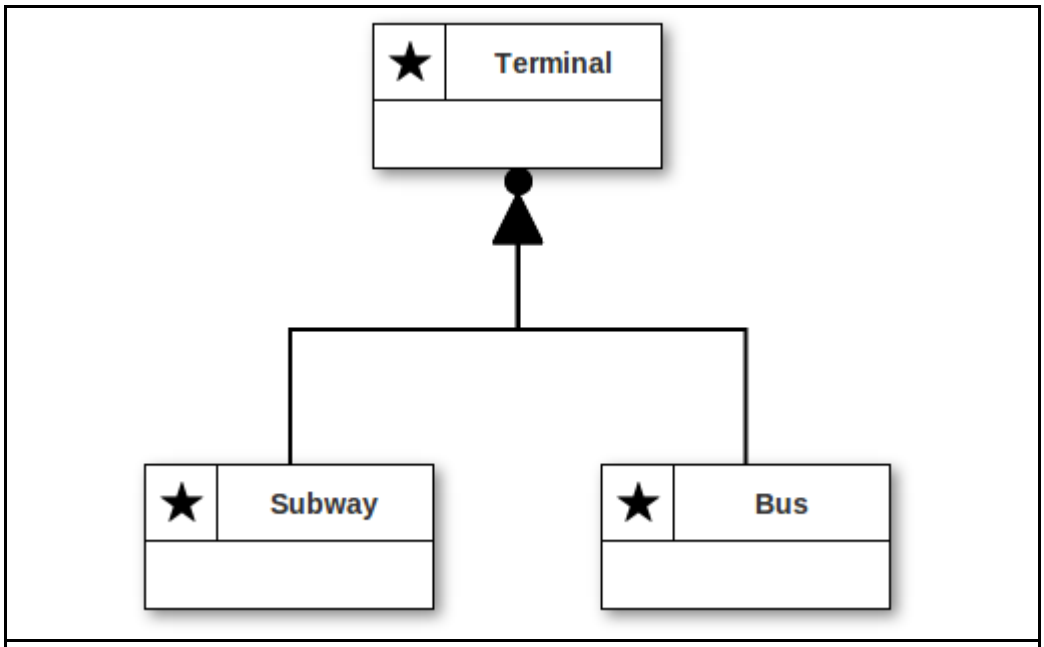


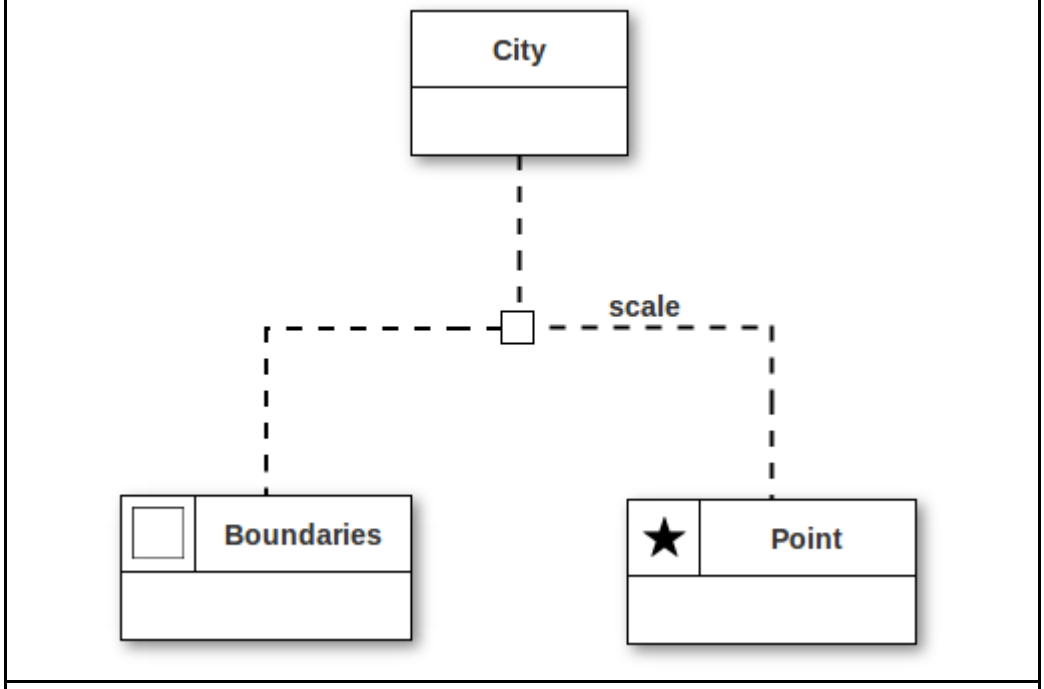
Figure 3 - OMT-G geo-field classes

Relationships can be *conventional*, i.e., simple associations, such as in UML relationships, or *georeferenced*. The latter include topological relations (e.g. touch, in, cross, overlap, and disjoint), arc-node network relations and spatial aggregations (i.e. "whole-part" aggregations). Generalizations and specializations can be total/partial or disjoint/overlapping and require that the participating classes have the same type of representation. The conceptual generalization allows modeling objects with multiple geographic representations, which may vary according to the scale or to the geometric shape. Figure 4 shows the OMT-G notations for relationships.





(e) Generalization / specialization



(f) Conceptual generalization

Figure 4 - OMT-G relationships

OMT-G é um modelo de dados dotado de recursos para o projeto de bancos de dados e aplicações geográficas. O OMT-G parte das primitivas definidas para o diagrama de classes da Unified Modeling Language (UML), introduzindo primitivas geográficas com o objetivo de aumentar a capacidade de representação semântica daquele modelo e, portanto reduzindo a distância entre o modelo mental do espaço a ser modelado e o modelo de representação usual. O modelo OMT-G provê primitivas para modelar a geometria e a topologia dos dados geográficos, oferecendo suporte a estruturas topológicas "todo-parte", estruturas de rede, múltiplas representações de objetos e relacionamentos espaciais. Além disso, o modelo permite a especificação de atributos alfanuméricos e métodos associados para cada classe. Os principais pontos do modelo são sua expressividade gráfica e sua capacidade de codificação, uma vez que anotações textuais são substituídas pelo desenho de relacionamentos explícitos, que denotam a dinâmica da interação entre os diversos objetos espaciais e não espaciais. A partir do modelo, são também definidas restrições de integridade espaciais, especificadas juntamente com as restrições de integridade que usualmente fazem parte do projeto de bancos de dados convencionais. Com isso, o mapeamento entre o projeto conceitual e a implementação física pode ser conduzido com mais segurança e com preservação da semântica expressa no nível de abstração mais alto.

Tools

OMT-G Designer [http://aqui.io/omtg]

OMT-G modeling tool based on StarUML [http://www.dcc.ufmg.br/~clodoveu/files/OMT-G/setup.exe] SourceForge page [http://sourceforge.net/projects/omt-gextensionf/files]

StarUML download link [http://staruml.sourceforge.net/en/download.php]

Microsoft Visio Stencils for OMT-G (English version) [http://www.dcc.ufmg.br/~clodoveu/files/OMT-G/OMT-G_english.zip]

Microsoft Visio Stencils for OMT-G (Portuguese version) [http://www.dcc.ufmg.br/~clodoveu/files/OMT-G/OMT-G_portugues.zip]

To install Visio stencils, simply unzip all files into the "My Shapes" folder.

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