OCW: Data structures and algorithms. Author: I. Segura-Bedmar.

Unit 6: Graphs.

Graphs are data structures where data can keep different relationships between them. Graphs are very versatile data structures that can be used in many of the real applications: representing users and their relationships in a social network, saving words and their relationships (synonymy, antonym, hyponym, etc.) in a dictionary lexicon, showing the metro stations and their connections, etc.

The lesson begins with some basic concepts: types of graphs, adjacent vertices, degree of a vertex, path, cycle, etc. Moreover, we study two different implementations of graphs: (i) based on the adjacency matrix, which consists of a square matrix where each element represents the weight between a certain started vertex (row matrix) of input and an ended vertex (column matrix), and (ii) based on the list of adjacency, where each vertex has a dynamic list associated that stores the vertices that are adjacent to it (with its weights if it is a weighted graph). For each implementation, the space and time complexity for the most frequent operations is discussed. This allows us to compare the two representations and discuss in which cases they are most appropriate.

Moreover, the lesson also study the main algorithms for graph traversal: breadth-first and depth-first. These algorithms allow us to visit all the vertices of a graph. These algorithms are very useful, for example, to calculate all possible paths between two metro stations, or to propose new relationships to users of a social network.

At the end of this lesson, we will study:

- Learn what a graph is and its main properties
- Implement the graph abstract data type using multiple internal representations.
- Understand the space and time complexity for each graph representation.
- Understand and implement algorithms to traverse a graph.
- Know how graphs can be used to solve a variety of problems.