Data Structures II : Graph traversals

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Cocktail of the day: Margarita

Disclaimer: Keep alcohol out of the hands of minors.

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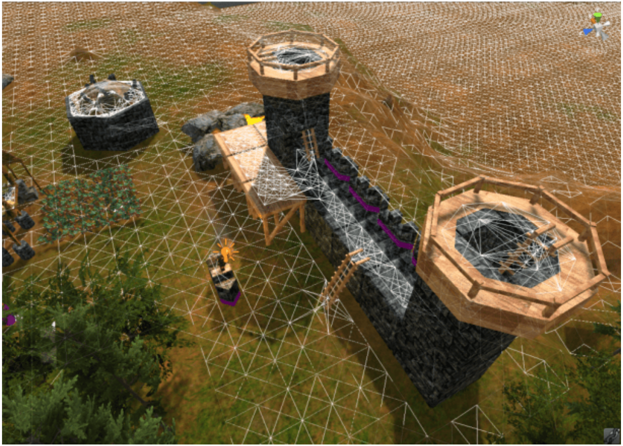
- 35 ml Tequila
- 20 ml Cointreau
- 15 ml lime juice

Videogames use graphs



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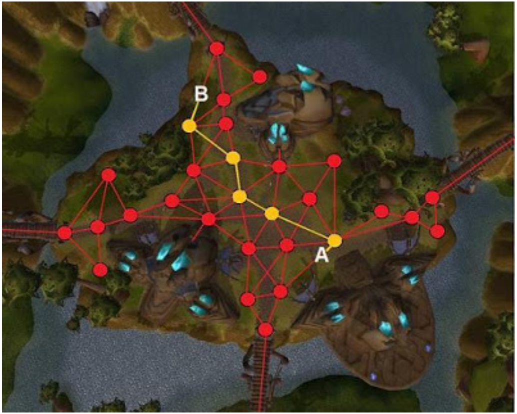

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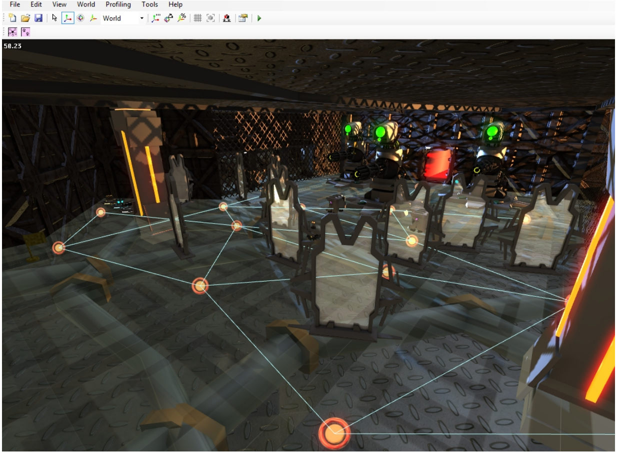
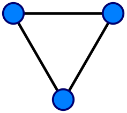


Directed graph

- An undirected graph (graph for short) G consists of a finite set of vertices V and a set of edges E.
- $G = (V, E)$
- It differs from a directed graph in that each edge in E is an unordered pair of vertices.
- If (v, w) is an undirected edge, then $(v, w) = (w, v)$.

Taken from [Aho77].



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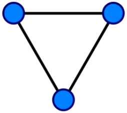
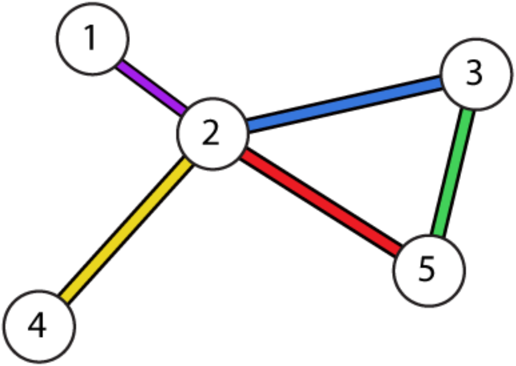


Taken from Wikipedia.

Example of an Undirected graph



Taken from http://www.alecjacobson.com/.

Deep-first search

- Depth-first search (DFS) is an algorithm for traversing or searching tree or graph data structures.
- One starts at the root (selecting some arbitrary node as the root in the case of a graph) and explores as far as possible along each branch before backtracking.

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DSF pseudo-code

```
procedure DFS(G,v):
    label v as discovered
    for all edges from v to w in G.adjacentEdges(v) do
        if vertex w is not labeled as discovered then
            recursively call DFS(G,w)
```

Taken from Wikipedia

Deep-first search simulator

https://www.cs.usfca.edu/~galles/visualization/DFS.html

Deep-first search complexity

Given a graph $G = (V, E)$, the complexity of DFS is

$$\Theta(V + E)$$

Breadth-first search (BSF)

- Another systematic way of visiting the vertices is called breadth-first search (BFS).
- The approach is called "breadth-first" because from each vertex v that we visit we search as broadly as possible by next visiting all the vertices adjacent to v.

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BSF pseudo-code

```
procedure BFS(Graph,source):
    create a queue Q
    enqueue source onto Q and mark source
    while Q is not empty:
        dequeue an item from Q into v
        for each edge e incident on v in Graph:
            let w be the other end of e
            if w is not marked:
               mark w and enqueue w onto Q
```

Taken from http://www.princeton.edu/~achaney/

Breadth-first search example

https://www.cs.usfca.edu/~galles/visualization/BFS.html

Breadth-first search complexity

Given a graph $G = (V, E)$, the complexity of BFS is also

$$\Theta(V + E)$$

Applications of DFS and BFS

One application is path finding!

`http://kevanahlquist.com/osm_pathfinding/`

Path finding is used in Google Maps and Videogames.

Quiz questions

- Deep-first search is translated into Spanish as “búsqueda en profundidad”. This algorithms traverses all the nodes until it finds a node that has no successors, when this happens it backtracks.
- Breadth-first search is translated into Spanish as “búsqueda en amplitud”. This algorithm traverses the nodes by levels, it means, first it traverses the successors of the node, then the successors of the successors of the node, and so on. To traverse the nodes this way, the algorithms uses a queue.

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References

- Please how to reference images, trademarks, videos and fragments of code.
- Avoid plagiarism

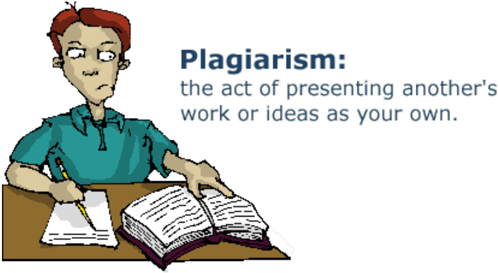

Figure: Figure about plagiarism, University of Malta [Uni09]

References

University of Malta.

Plagarism — The act of presenting another's work or ideas as your own, 2009.

[Online; accessed 29-November-2013].

Further reading

- Alfred Aho, Estructuras de Datos y Algoritmos. Capítulo 6: Grafos dirigidos.
- Alfred Aho, Estructuras de Datos y Algoritmos. Capítulo 7: Grafos no dirigidos. Páginas 314 - 321.