Lab3 Documentation

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`class graph.Graph`

Represents a directed graph.

`add_edge`(*edge: tuple*, *cost: int*)

Adds an edge to the graph. Preconditions: both of its vertices must exist, but the edge must not be present in the current graph.

:param cost:the cost of the added edge :param edge:tuple of 2 vertices, the added edge :return: nothing :raises Exception: if one of its vertices doesn't exist, if the edge already exists or if the cost is not integer

`add_vertex`(*vertex: str*)

Adds a vertex to the graph. Preconditions: the vertex must not exist in the current graph.

Parameters
`vertex` – given vertex

Returns

Raises
`Exception` – if the vertex already exists

`classmethod build_graph_from_given_vertices_and_edges`(*vertices*, *edges_with_costs*)

Builds a graph from a list of vertices and a list of edges with costs.

Parameters

- `vertices` – list of vertices
- `edges_with_costs` – list of tuples of 3 parameters - (first vertex, second vertex, cost)

Returns
created graph

Raises
`Exception` – if the list of received edges is invalid or if the vertices are not all strings

`classmethod build_random_graph`(*number_of_vertices: int*, *number_of_edges: int*)

Builds a random graph with a specified number of vertices and number of edges. Preconditions: the number of edges should be smaller than or equal to the square of the number of vertices.

Parameters
`number_of_vertices` – integer

:param number_of_edges:integer :return: created graph :raises Exception: if the number of edges is too large for a graph with distinct edges

`classmethod create_copy`(*graph*)

Creates a deepcopy of a graph

Parameters
`graph` –

Returns
created graph

`get_all_edges`()

Gets the list of all the edges in this graph.

Returns
list of tuple of 2 elements: a tuple for the edge (another tuple of 2 vertices) and an integer

`get_all_pairs_shortest_paths()`

Gets all the shortest paths, using the matrix multiplication algorithm. Enables the user to enter pairs of vertices and to obtain their shortest path

Raises
`Exception` – if the graph contains a negative cycle

`get_all_vertices()`

Gets the list of all the vertices in this graph.

Returns
list of vertices

`get_cost_of_edge`(*edge: tuple*)

Gets the cost of an edge.

Parameters
`edge` – tuple of vertices

Returns
integer - the cost of the given edge

Raises
`Exception` – if the edge does not exist

`get_in_degree_of_vertex`(*vertex: str*)

Gets the in-degree of a vertex. The in-degree is the number of vertices that directly reach
this vertex.

Parameters
`vertex` – given vertex

Returns
integer - the in degree

Raises
`Exception` – if the vertex does not exist

`get_inbound_neighbours`(*vertex*)

Gets the inbound neighbours of a vertex.

Parameters
`vertex` – given vertex

Returns
list of outbound neighbours

Raises
`Exception` – if the vertex does not exist

`get_isolated_vertices()`

Gets the list of all the isolated vertices

Returns
list of vertices

`get_number_of_minimum_paths_between_vertices`(*start_vertex*, *end_vertex*)

Bonus 1

`get_number_of_vertices`()

Gets the number of vertices in this graph.

Returns
integer

`get_number_of_walks_between_vertices_in_dag`(*start_vertex*, *end_vertex*)

Bonus 2

`get_out_degree_of_vertex`(*vertex*)

Gets the out-degree of a vertex. The out-degree is the number of vertices that are directly reachable from this vertex.

Parameters
`vertex` – given vertex

Returns
integer - the out degree

Raises
`Exception` – if the vertex does not exist

`get_outbound_neighbours`(*vertex*)

Gets the outbound neighbours of a vertex.

Parameters
`vertex` – given vertex

Returns
list of outbound neighbours

Raises
`Exception` – if the vertex does not exist

`is_edge`(*edge: tuple*)

Checks if an edge is part of this graph. Preconditions: the edge must be a tuple of 2 vertices.

Parameters
`edge` – tuple of 2 edges

Returns
boolean

Raises
`Exception` – if the edge is not a tuple of 2 vertices

`is_vertex`(*vertex: str*)

Checks if a vertex is part of this graph.

Parameters
`vertex` – given vertex

Returns
boolean

`remove_edge`(*edge: tuple*)

Removes an edge.

Parameters
`edge` – tuple of 2 vertices

Returns
nothing

Raises
`Exception` – if the edge doesn't exist

`remove_vertex`(*vertex: str*)

Removes a vertex.

Parameters
`vertex` – given vertex

Returns
nothing

Raises
`Exception` – if the vertex doesn't exist

`set_cost_of_edge`(*edge: tuple*, *cost: int*)

Sets the cost of an edge.

Parameters

- `edge` – tuple of vertices
- `cost` – integer

Returns
integer - the cost of the given edge

Raises
`Exception` – if the edge doesn't exist or if the cost is not an integer

`class graph_utils.GraphUtils`

Helper methods used for reading and writing graphs to files, in normal or modified format.

`static read_graph_modified_format`(*filename*)

Reads a graph in "modified format" from a given filename.

Preconditions: the file must exist, the filename must end with "modified.txt" and the graph should be in the valid format.

The "modified" format must obey the following rules: on the first line of the file, there are two numbers, separated by space: the number of vertices(n) and the number of edges(m). On the second line, there is the list of isolated vertices. On the following m lines, there are three numbers that describe each of the m edges: the starting vertex, the ending vertex and the cost of the edge.

Parameters
`filename` – string

Returns
Graph

Raises
`Exception` – if the graph is invalid, if the file doesn't exist, if the filename doesn't end with

"modified.txt" or if other file-related errors occurred

`static read_graph_normal_format`(*filename*)

Reads a graph in "normal format" from a given filename.

Preconditions: the file must exist, the graph must be in the valid format.

The “normal” format must obey the following rules: on the first line of the file, there are 2 integers, separated by space: the number of vertices (n) and the number of edges (m). On the next m lines, there are three numbers that describe each of the m edges: the starting vertex, the ending vertex and the cost of the edge.

Parameters
`filename` – string

Returns
Graph

Raises
`Exception` – if the graph is invalid, if the file doesn’t exist or if other file-related errors occured.

`static write_graph_modified_format`(*filename: str*, *graph*)

Writes a graph in “modified format” to a given file.

Parameters

- `filename` – string
- `graph` – Graph

Raises
`Exception` – if the filename doesn’t end with “modified.txt” or if other file-related errors occurred.

`static write_graph_normal_format`(*filename*, *graph*)

Writes a graph in “normal format” to a given file.

Parameters

- `filename` – string
- `graph` – Graph

Raises
`Exception` – if output-related errors occurred

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