# Social_Graph

1.0

Generated by Doxygen 1.8.14

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# 1 Namespace Index

## 1.1 Namespace List

Here is a list of all namespaces with brief descriptions:



# 2 Hierarchical Index

## 2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

object



# 3 Class Index

## 3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

# 4 File Index

## 4.1 File List

Here is a list of all files with brief descriptions:



# 5 Namespace Documentation

## 5.1 DiGraph Namespace Reference

A very simple directed graph class.

### Classes

- class DiGraph
  *Class implementing a directed graph structure using a dictionary for holding vertices and a set for holding edges.*
- class Edge
  *An edge holds the vertex it points to and its cost (or weight).*

### Functions

- def cmp (x, y)
  *Replacement for built-in function cmp that was removed in Python 3.*
- def main (argv=None)
  *Main method.*

### 5.1.1 Detailed Description

A very simple directed graph class.

**Author**

Paulo Roma.

**Since**

12/09/2018

**See also**

https://www.python-course.eu/graphs_python.php

#### 5.1.2 Function Documentation

##### 5.1.2.1 cmp()

```
def DiGraph.cmp (
              x,
              y )
```

Replacement for built-in function cmp that was removed in Python 3.

Compare the two objects x and y and return an integer according to the outcome.

**Parameters**

| | |
|---|---|
| *x* | first object. |
| *y* | second object. |

**Returns**

a negative value if x $<$ y, zero if x == y and strictly positive if x $>$ y.

Referenced by DiGraph.Edge.cmpCost().

##### 5.1.2.2 main()

```
def DiGraph.main (
              argv = None )
```

Main method.

Creates a simple graph.

### 5.2 SocialGraph Namespace Reference

Manages a social network of friendships.

**Classes**

- class SocialGraph

  *Create a graph to model a social network of friendships.*

**Functions**

- def main (args=None)

  *Create an empty graph aGraph.*

#### 5.2.1 Detailed Description

Manages a social network of friendships.

**Author**

Paulo Roma.

**Since**

13/09/2018

#### 5.2.2 Function Documentation

##### 5.2.2.1 main()

```
def SocialGraph.main (
              args = None )
```

Create an empty graph aGraph.

Parse each line, print the entire line on the console, and call the corresponding method.

The command is case sensitive. Assume that the file format is correct.

add arg1 arg2 arg3

- call aGraph.addEdge(arg1, arg2, int(arg3))

showFriends arg1

- call aGraph.adjacentTo(arg1)

remove arg1

- call aGraph.remove(arg1)

recommendFriends arg1 arg2 arg3

- call the recommendFriends(arg1, arg2, int(arg3)), where:
  - arg1 is the name of the person to recommend new friends for.
  - arg2 is either "dist" or "weightedDist" indicating the method to select people to recommend as new friends.
  - int(arg3) is the maximum number of new friends to recommend.

**Parameters**

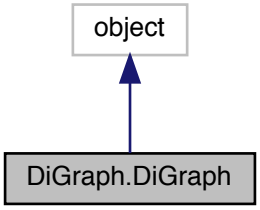
| | |
|---|---|
| *args* | args[1] Input filename with all the commands and arguments. |

# 6 Class Documentation

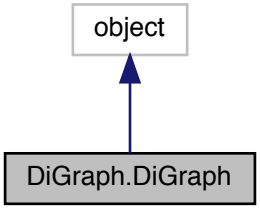
## 6.1 DiGraph.DiGraph Class Reference

Class implementing a directed graph structure using a dictionary for holding vertices and a set for holding edges.

Inheritance diagram for DiGraph.DiGraph:




Collaboration diagram for DiGraph.DiGraph:




**Public Member Functions**

- def __init__ (self)

  *Create an empty graph.*
- def getInfinity (self)

  *Returns the largest edge cost.*
- def addEdge (self, src, dst, c=1)

*Add a directed edge from the source node to the destination node.*

- def addVertex (self, vertex)

  *Add a vertex to the graph with an empty set of edges associated with it.*
- def numVertices (self)

  *Returns the number of vertices in this graph.*
- def vertices (self)

  *Returns all vertices in this graph.*
- def adjacentTo (self, vertex)

  *Gets all vertices adjacent to a given vertex.*
- def hasVertex (self, vertex)

  *Checks whether a given vertex is in the graph.*
- def numEdges (self)

  *Returns the number of edges in this graph.*
- def getEdge (self, src, dst)

  *Gets the edge from src to dst, if such an edge exists.*
- def hasEdge (self, src, dst)

  *Check whether an edge from src to dst exists.*
- def removeVertex (self, vertex)

  *Remove this vertex from the graph if possible and calculate the number of edges in the graph accordingly.*
- def incomingEdges (self, vertex)

  *Return a set of nodes with edges coming to this given vertex.*
- def __repr__ (self)

  *Return a representation of the graph as a string.*
- def Dijkstra (self, source)

  *Compute Dijkstra single source shortest path from the source node.*
- def Dijkstra2 (self, source, dest)

  *Compute Dijkstra shortest path from the source to the destination node.*

#### Public Attributes

- graph

  *A dictionary that stores an entry of a node, as the key, and a set of outgoing edges (destination node, weight) from the node, as its value.*

#### Private Member Functions

- def __generate_edges (self)

  *A method generating the edges of the graph.*

#### Private Attributes

- __numEdges

  *Total number of edges in the graph.*
- __infinity

  *The largest edge distance.*
- __pathToNode

  *Holds the path from a source node to a given node.*
- __dist

  *Accumulated distance from source to a node.*

#### 6.1.1 Detailed Description

Class implementing a directed graph structure using a dictionary for holding vertices and a set for holding edges.

#### 6.1.2 Constructor & Destructor Documentation

##### 6.1.2.1 __init__()

```
def DiGraph.DiGraph.__init__ (
              self )
```

Create an empty graph.

#### 6.1.3 Member Function Documentation

##### 6.1.3.1 __generate_edges()

```
def DiGraph.DiGraph.__generate_edges (
              self )  [private]
```

A method generating the edges of the graph.

Edges are represented as tuples with one (a loop back to the vertex) or two vertices.

References DiGraph.DiGraph.graph.

Referenced by DiGraph.DiGraph.__repr__().

##### 6.1.3.2 __repr__()

```
def DiGraph.DiGraph.__repr__ (
              self )
```

Return a representation of the graph as a string.

References DiGraph.DiGraph.__generate_edges(), and DiGraph.DiGraph.graph.

##### 6.1.3.3 addEdge()

```
def DiGraph.DiGraph.addEdge (
              self,
              src,
              dst,
              c = 1 )
```

Add a directed edge from the source node to the destination node.

If there is already existing edge from src to dst, replace the existing weight with the new weight.

**Parameters**

| | |
|---|---|
| *src* | Source node. |
| *dst* | Destination node. |
| *c* | Weight of the edge. |

**Returns**

- False if src or dst is None,
- or c <= 0,
- or src == dst,
- True if a new edge from src to dst is added with the weight.

References DiGraph.DiGraph.__numEdges, DiGraph.DiGraph.addVertex(), DiGraph.DiGraph.getEdge(), DiGraph.DiGraph.graph, and DiGraph.DiGraph.hasVertex().

#### 6.1.3.4 addVertex()

```
def DiGraph.DiGraph.addVertex (
              self,
              vertex )
```

Add a vertex to the graph with an empty set of edges associated with it.

**Parameters**

| | |
|---|---|
| *vertex* | Vertex to be added. |

**Returns**

- False if vertex is None or vertex is already in the graph.
- True otherwise.

References DiGraph.DiGraph.graph, and DiGraph.DiGraph.hasVertex().

Referenced by DiGraph.DiGraph.addEdge().

#### 6.1.3.5 adjacentTo()

```
def DiGraph.DiGraph.adjacentTo (
              self,
              vertex )
```

Gets all vertices adjacent to a given vertex.

**Parameters**

| | |
|---|---|
| *vertex* | |

**Returns**

A set of vertices in which there is an edge from the given vertex to each of these vertices.

```
- An empty set is returned if there is no adjacent node,
- or the vertex is not in the graph,
- or vertex is None.
```

References DiGraph.DiGraph.graph, and DiGraph.DiGraph.hasVertex().

Referenced by DiGraph.DiGraph.Dijkstra().

#### 6.1.3.6 Dijkstra()

```
def DiGraph.DiGraph.Dijkstra (
              self,
              source )
```

Compute Dijkstra single source shortest path from the source node.

**Parameters**

| | |
|---|---|
| *source* | Source node. |

**Returns**

- Empty dictionary if the source is None,
- or it is not a vertex in the graph,
- or it does not have any outgoing edges.
- Otherwise, return a dictionary of entries, each having a vertex and smallest cost going from the source node to it.

**See also**

```
Dijkstra's algorithm
https://docs.python.org/2/library/heapq.html
https://www.pythoncentral.io/priority-queue-beginners-guide/
```

References DiGraph.DiGraph.__dist, DiGraph.DiGraph.__pathToNode, DiGraph.DiGraph.adjacentTo(), DiGraph.↩
DiGraph.getEdge(), DiGraph.DiGraph.getInfinity(), DiGraph.DiGraph.hasVertex(), and DiGraph.DiGraph.vertices().

Referenced by DiGraph.DiGraph.Dijkstra2().

#### 6.1.3.7 Dijkstra2()

```
def DiGraph.DiGraph.Dijkstra2 (
              self,
              source,
              dest )
```

Compute Dijkstra shortest path from the source to the destination node.

**Parameters**

| | |
|---|---|
| *source* | Source node |
| *dest* | Destination node |

**Returns**

- Empty list if the source or dest are None,
- or they are not a vertex in the graph,
- or source does not have any outgoing edges.
- Otherwise, return a list of edges for reaching dest from source with the smallest cost.

**See also**

`Dijkstra's algorithm`

References DiGraph.DiGraph.__pathToNode, DiGraph.DiGraph.Dijkstra(), and DiGraph.DiGraph.hasVertex().

#### 6.1.3.8 getEdge()

```
def DiGraph.DiGraph.getEdge (
              self,
              src,
              dst )
```

Gets the edge from src to dst, if such an edge exists.

**Parameters**

| | |
|---|---|
| *src* | source vertex. |
| *dst* | target vertex. |

**Returns**

- an edge if there exists an edge from src to dst regardless of the weight.
- None otherwise (including when either src or dst is None or src or dst is not in the graph).

References DiGraph.DiGraph.graph, and DiGraph.DiGraph.hasVertex().

Referenced by DiGraph.DiGraph.addEdge(), DiGraph.DiGraph.Dijkstra(), DiGraph.DiGraph.hasEdge(), and Di↩ Graph.DiGraph.removeVertex().

#### 6.1.3.9 getInfinity()

```
def DiGraph.DiGraph.getInfinity (
              self )
```

Returns the largest edge cost.

References DiGraph.DiGraph.__infinity.

Referenced by DiGraph.DiGraph.Dijkstra().

#### 6.1.3.10 hasEdge()

```
def DiGraph.DiGraph.hasEdge (
              self,
              src,
              dst )
```

Check whether an edge from src to dst exists.

**Parameters**

| | |
|---|---|
| *src* | source vertex. |
| *dst* | target vertex. |

**Returns**

- True if there exists an edge from src to dst regardless of the weight, and
- False otherwise (including when either src or dst is None or src or dst is not in the graph).

References DiGraph.DiGraph.getEdge().

Referenced by DiGraph.DiGraph.incomingEdges().

#### 6.1.3.11 hasVertex()

```
def DiGraph.DiGraph.hasVertex (
              self,
              vertex )
```

Checks whether a given vertex is in the graph.

**Parameters**

| | |
|---|---|
| *vertex* | given vertex. |

**Returns**

- True if the given vertex is in the graph.
- False otherwise, including the case of a None vertex.

References DiGraph.DiGraph.graph.

Referenced by DiGraph.DiGraph.addEdge(), DiGraph.DiGraph.addVertex(), DiGraph.DiGraph.adjacentTo(), DiGraph.DiGraph.Dijkstra(), DiGraph.DiGraph.Dijkstra2(), DiGraph.DiGraph.getEdge(), DiGraph.DiGraph.incomingEdges(), and DiGraph.DiGraph.removeVertex().

#### 6.1.3.12 incomingEdges()

```
def DiGraph.DiGraph.incomingEdges (
              self,
              vertex )
```

Return a set of nodes with edges coming to this given vertex.

**Parameters**

| | |
|---|---|
| *vertex* | given vertex. |

**Returns**

- empty set if the vertex is None or the vertex is not in this graph.
- Otherwise, return a non-empty set consists of nodes with edges coming to this vertex.

References DiGraph.DiGraph.hasEdge(), DiGraph.DiGraph.hasVertex(), and DiGraph.DiGraph.vertices().

Referenced by DiGraph.DiGraph.removeVertex().

#### 6.1.3.13 numEdges()

```
def DiGraph.DiGraph.numEdges (
              self )
```

Returns the number of edges in this graph.

**Returns**

Total number of edges in this graph

References DiGraph.DiGraph.__numEdges.

#### 6.1.3.14 numVertices()

```
def DiGraph.DiGraph.numVertices (
              self )
```

Returns the number of vertices in this graph.

**Returns**

Number of vertices (nodes) in the graph.

References DiGraph.DiGraph.graph.

#### 6.1.3.15 removeVertex()

```
def DiGraph.DiGraph.removeVertex (
              self,
              vertex )
```

Remove this vertex from the graph if possible and calculate the number of edges in the graph accordingly.

For instance, if the vertex has 4 outgoing edges and 2 incoming edges, the total number of edges after the removal of this vertex is subtracted by 6.

**Parameters**

| | |
|---|---|
| *vertex* | Vertex to be removed. |

**Returns**

- False if the vertex is None, or there is no such vertex in the graph.
- True if removal is successful.

References DiGraph.DiGraph.__numEdges, DiGraph.DiGraph.getEdge(), DiGraph.DiGraph.graph, DiGraph.DiGraph.hasVertex(), and DiGraph.DiGraph.incomingEdges().

#### 6.1.3.16 vertices()

```
def DiGraph.DiGraph.vertices (
              self )
```

Returns all vertices in this graph.

**Returns**

A set of vertices in this graph. When there are no vertices in the graph, return an empty set.

References DiGraph.DiGraph.graph.

Referenced by DiGraph.DiGraph.Dijkstra(), and DiGraph.DiGraph.incomingEdges().

### 6.1.4 Member Data Documentation

#### 6.1.4.1 __dist

```
DiGraph.DiGraph.__dist  [private]
```

Accumulated distance from source to a node.

Referenced by DiGraph.DiGraph.Dijkstra().

#### 6.1.4.2 __infinity

```
DiGraph.DiGraph.__infinity  [private]
```

The largest edge distance.

self.__infinity = sys.maxint

Referenced by DiGraph.DiGraph.getInfinity().

#### 6.1.4.3 __numEdges

`DiGraph.DiGraph.__numEdges [private]`

Total number of edges in the graph.

Referenced by DiGraph.DiGraph.addEdge(), DiGraph.DiGraph.numEdges(), and DiGraph.DiGraph.removeVertex().

#### 6.1.4.4 __pathToNode

`DiGraph.DiGraph.__pathToNode [private]`

Holds the path from a source node to a given node.

Referenced by DiGraph.DiGraph.Dijkstra(), and DiGraph.DiGraph.Dijkstra2().

#### 6.1.4.5 graph

`DiGraph.DiGraph.graph`

A dictionary that stores an entry of a node, as the key, and a set of outgoing edges (destination node, weight) from the node, as its value.

Referenced by DiGraph.DiGraph.__generate_edges(), DiGraph.DiGraph.__repr__(), DiGraph.DiGraph.addEdge(), DiGraph.DiGraph.addVertex(), DiGraph.DiGraph.adjacentTo(), DiGraph.DiGraph.getEdge(), DiGraph.DiGraph.hasVertex(), DiGraph.DiGraph.numVertices(), DiGraph.DiGraph.removeVertex(), and DiGraph.DiGraph.vertices().

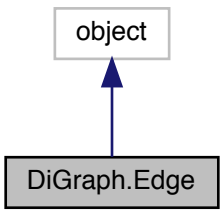
The documentation for this class was generated from the following file:

- DiGraph.py

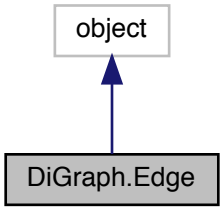
## 6.2 DiGraph.Edge Class Reference

An edge holds the vertex it points to and its cost (or weight).

Inheritance diagram for DiGraph.Edge:



Collaboration diagram for DiGraph.Edge:




#### Public Member Functions

- def __init__ (self, n, c)

  *Constructor from a node and its cost.*
- def getVertex (self)

  *Get the target vertex.*
- def getCost (self)

  *Get this edge cost.*
- def setCost (self, c)

  *Set the cost of this edge.*
- def cmpCost (self, other)

  *Compare two edges based on the cost only, not on the vertex.*
- def __repr__ (self)

  *An unambiguous representaion of this edge.*
- def __hash__ (self)

  *An Edge object must be hashable.*
- def __eq__ (self, obj)

  *Operator ==.*
- def __contains__ (self, obj)

  *Operator in.*

#### Private Attributes

- __node

  *Node/vertex the edge points to.*
- __cost

  *Edge cost.*

### 6.2.1 Detailed Description

An edge holds the vertex it points to and its cost (or weight).

### 6.2.2 Constructor & Destructor Documentation

#### 6.2.2.1 __init__()

```
def DiGraph.Edge.__init__ (
              self,
              n,
              c )
```

Constructor from a node and its cost.

**Parameters**

| | |
|---|---|
| *n* | node/vertex. |
| *c* | weight or cost associated with the edge. |

### 6.2.3 Member Function Documentation

#### 6.2.3.1 __contains__()

```
def DiGraph.Edge.__contains__ (
              self,
              obj )
```

Operator in.

Only compare the nodes but not the cost of the nodes.

#### 6.2.3.2 __eq__()

```
def DiGraph.Edge.__eq__ (
              self,
              obj )
```

Operator ==.

Only compare the nodes but not the cost of the nodes.

**Parameters**

| | |
|---|---|
| *obj* | the edge for comparing this edge to. |

**Returns**

(self.__node == obj.__node)

References DiGraph.Edge.__node.

#### 6.2.3.3 __hash__()

```
def DiGraph.Edge.__hash__ (
              self )
```

An Edge object must be hashable.

**Returns**

hash((self.__node, self.__cost))

References DiGraph.Edge.__cost, and DiGraph.Edge.__node.

#### 6.2.3.4 __repr__()

```
def DiGraph.Edge.__repr__ (
              self )
```

An unambiguous representaion of this edge.

**Returns**

a string representation of this edge.

References DiGraph.Edge.__cost, and DiGraph.Edge.__node.

#### 6.2.3.5 cmpCost()

```
def DiGraph.Edge.cmpCost (
              self,
              other )
```

Compare two edges based on the cost only, not on the vertex.

**Parameters**

| | |
|---|---|
| *other* | the edge for comparing this edge to. |

**Returns**

-cmp(self.getCost(), other.getCost())

References DiGraph.cmp(), and DiGraph.Edge.getCost().

#### 6.2.3.6 getCost()

```
def DiGraph.Edge.getCost (
              self )
```

Get this edge cost.

**Returns**

the cost of this edge.

References DiGraph.Edge.__cost.

Referenced by DiGraph.Edge.cmpCost().

#### 6.2.3.7 getVertex()

```
def DiGraph.Edge.getVertex (
              self )
```

Get the target vertex.

**Returns**

the node this edge points to.

References DiGraph.Edge.__node.

#### 6.2.3.8 setCost()

```
def DiGraph.Edge.setCost (
              self,
              c )
```

Set the cost of this edge.

**Parameters**

| | |
|---|---|
| *c* | given cost. |

References DiGraph.Edge.__cost.

### 6.2.4 Member Data Documentation

#### 6.2.4.1 __cost

`DiGraph.Edge.__cost [private]`

Edge cost.

Referenced by DiGraph.Edge.__hash__(), DiGraph.Edge.__repr__(), DiGraph.Edge.getCost(), and DiGraph.↩ Edge.setCost().

#### 6.2.4.2 __node

`DiGraph.Edge.__node [private]`

Node/vertex the edge points to.

Referenced by DiGraph.Edge.__eq__(), DiGraph.Edge.__hash__(), DiGraph.Edge.__repr__(), and DiGraph.↩ Edge.getVertex().

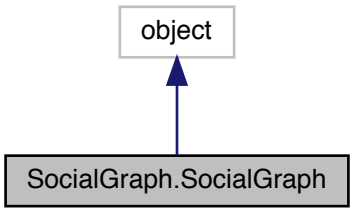
The documentation for this class was generated from the following file:

- DiGraph.py

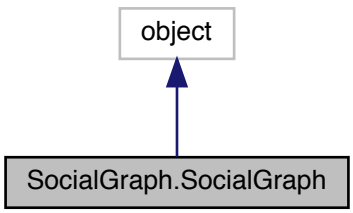
## 6.3 SocialGraph.SocialGraph Class Reference

Create a graph to model a social network of friendships.

Inheritance diagram for SocialGraph.SocialGraph:




Collaboration diagram for SocialGraph.SocialGraph:



#### Public Member Functions

- def __init__ (self, file)

  *Constructor from a file of commands.*
- def readGraphFile (self, file)

  *Create a graph from a file.*
- def recommendFriends (self, personOfInterest, option, topK)

  *Recommend topK (e.g., 5) best friend candidates who are not already a friend of personOfInterest.*

#### Public Attributes

- dg

  *Graph of friendship.*

### 6.3.1 Detailed Description

Create a graph to model a social network of friendships.

See the homework description.

### 6.3.2 Constructor & Destructor Documentation

#### 6.3.2.1 __init__()

```
def SocialGraph.SocialGraph.__init__ (
              self,
              file )
```

Constructor from a file of commands.

### 6.3.3 Member Function Documentation

#### 6.3.3.1 readGraphFile()

```
def SocialGraph.SocialGraph.readGraphFile (
              self,
              file )
```

Create a graph from a file.

References SocialGraph.SocialGraph.dg, and SocialGraph.SocialGraph.recommendFriends().

#### 6.3.3.2 recommendFriends()

```
def SocialGraph.SocialGraph.recommendFriends (
              self,
              personOfInterest,
              option,
              topK )
```

Recommend topK (e.g., 5) best friend candidates who are not already a friend of personOfInterest.

- If dist option is used, find the shortest path from personOfInterest to all the other nodes in the graph using Dijkstra's single source shortest path algorithm and friendship distances. The smaller the distance means the closer the relationship.
- If weightedDist option is used, after computing the shortest path like in the dist option to all the other nodes in the graph, multiply each distance with the total number of edges in the graph less the number of incoming edges to that node.

For instance, suppose the graph has a total of 10 edges.

Suppose the shortest distance from personOfInterest to node A is 5 and there are 4 incoming edges to A, the weighted distance is 5#(10-4)=30.

- The lower the weighted distance, the better the candidate.

This method considers both distance and popularity. The person with a lot of incoming edges means that the person is likely more well-liked by other people and should be recommended.

- Sort the distance/weighted distance in increasing order.
- If there are less than topK candidates, return only those candidates.
- If there are more than topK candidates, return only the topK candidates, when there are no other candidates with the same distance/weighted distance as the last candidate in the topK list.
- If there are other candidates with the same distance/weighted distance as the last candidate in the topK list, return all the candidates with the same distance. In this case, more than topK candidates are included in the list.

**Parameters**

| | |
|---|---|
| *personOfInterest* | Name of the person to recommend new friend candidates for. |
| *option* | Either dist or weightedDist, which indicates whether to use the friendship distance or the weighted friendship distance. |
| *topK* | Desirable maximum number of candidate friends to recommend. |

**Returns**

List of candidate friends.

References SocialGraph.SocialGraph.dg.

Referenced by SocialGraph.SocialGraph.readGraphFile().

#### 6.3.4 Member Data Documentation

##### 6.3.4.1 dg

`SocialGraph.SocialGraph.dg`

Graph of friendship.

Referenced by SocialGraph.SocialGraph.readGraphFile(), and SocialGraph.SocialGraph.recommendFriends().

The documentation for this class was generated from the following file:

- SocialGraph.py

# 7 File Documentation

## 7.1 DiGraph.py File Reference

### Classes

- class DiGraph.Edge
  *An edge holds the vertex it points to and its cost (or weight).*
- class DiGraph.DiGraph
  *Class implementing a directed graph structure using a dictionary for holding vertices and a set for holding edges.*

### Namespaces

- DiGraph
  *A very simple directed graph class.*

### Functions

- def DiGraph.cmp (x, y)
  *Replacement for built-in function cmp that was removed in Python 3.*
- def DiGraph.main (argv=None)
  *Main method.*

## 7.2 SocialGraph.py File Reference

### Classes

- class SocialGraph.SocialGraph
  *Create a graph to model a social network of friendships.*

### Namespaces

- SocialGraph
  *Manages a social network of friendships.*

### Functions

- def SocialGraph.main (args=None)
  *Create an empty graph aGraph.*

# Index