Discrete Math/Graph based ranking algorithm for slip opinions.

**Definitions:**

Cite to: A directed edge from a node to another node.

Cited by: A directed edge to a node from another node.

Slip opinion: [SL] = a node = an opinion, the same as other opinions that cites to statutes [ST] and opinions [OP] but is not cited by other opinions. Practically, it is newer than other opinions and so will never have been cited by other opinions.

Opinion: a member of a set of opinions [OP] that cites to statutes [ST] and opinions [OP] and is cited by other opinions [OP].

Opinions = [OP] = a set of opinion nodes that is cited by a set of opinion nodes [OP] and cites to a set of opinions nodes [OP] and sites to a set of statute nodes [ST].

Statute: a member of a set of statutes [ST] that is cited by opinions [OP].

Statutes = [ST] = a set of statutes [ST] that is cited by a set of opinion nodes [OP].

Citation Count: (CT) The number of times a node cites to another node. This is applicable only for opinion nodes to statute nodes. The number is an integer with a range of 1 to several hundreds.

Number of citations: (#) The number of opinions that cite to a specific opinion.

**Goal:**

To develop an “importance” ranking for opinions and statutes cited by a slip opinion.

**Goal of Ranking Algorithm.**

To rank each statute [ST0] in the set according to the citation count.

To rank each opinion [OP0] in the set according to how much in “agreement” the opinion [OP0] to statute [ST1] relationship is with the [SL] 🡺 [ST0] relationship.

**Data structure.**

[ST1](Ct1) 🡸 [OP0] 🡸 [SL] 🡺 (Ct0)[ST0]

* There is only one slip opinion [SL] for a slip opinion
* The slip opinion [SL] points to a set of statutes [ST0].
* There are citation counts (Ct0) between the slip opinion [SL] and each statute [ST0].
* The slip opinion [SL] points to a set of opinions [OP0]
* Each opinion [OP0] points to a set of statutes [ST1]
* There are citation counts (Ct1) between the opinion [OP0] and each statute [ST1] it points to.

**Graph Theory**

The Graph G(slip) = ([SL],[ST0]) is a directed, acyclic, disconnected multi-graph.

Example Data.

G(B286525)=(V,E).

V={SL,ST0-1,ST0-2}

SL=” B286525”

ST0-1 = “§§ 1523 - 1542.5-Penal”

ST0-2 = “§§ 23152 - 23229.1-Vehicle”

E={{SL,ST0-1},{SL,ST0-1},{SL,ST0-1},{SL,ST0-2}}

G(B286525) Adjacency Matix =

SL ST0-1 ST0-2

SL 0 3 1

SL0-1 0 0 0

SL0-2 0 0 0

G(B286525-OP0-1)=(V,E).

V={OP0-1,ST0-A,ST0-1,ST0-B}

OP0-1 = ” 49 Cal.4th 530”

ST0-A = “§§ 170 - 170.9-Civ. Procedure”  
ST0-1 = “§§ 1523 - 1542.5-Penal”

ST0-B = “§§§ 1100 - 1109-Evidence”

E={{OP0-1,ST1-A},{OP0-1,ST1-1},{OP0-1,ST1-1},{OP0-1,ST1-B},{OP0-1,ST1-B},{OP0-1,ST1-B}}

G(B286525-OP0-1) Adjacency Matix =

OP0-1 ST1-A ST1-1 ST1-B

OP0-1 0 1 2 3

ST1-A 0 0 0 0

ST1-1 0 0 0 0

ST1-B 0 0 0 0

G(B286525-OP0-2)=(V,E).

V={OP0-1, ST1-1}

OP0-1 = ” 95 Cal.App.4th 283”

ST1-1 = “§§ 1523 - 1542.5-Penal”

E={{OP0-1,ST1-A},{OP0-1,ST1-A}}

G(B286525-OP0-2) Adjacency Matix =

OP0-1 ST1-A

OP0-1 0 2

SL0-1 0 0

Which graph is more “similar” or should be ranked “higher” – G(B286525-OP0-1) or G(B286525-OP0-2)?

To determine this the distances between the adjacency matrices should be computed and compared. The adjacency degrees between of vertices should be normalized so that distance will be computed based on which graphs are more similar in terms of which statutes they point to rather than the differences in degrees. For example, an opinion graph could point to the same statutes as a slip opinion graph but with much higher degrees. This should be considered a close similarity, or small distance, instead of a large distance.

The adjacency matrices between graphs is computed with a simple distance formula:

The above equation only computes distance based on the first row of the adjacency matrix. Only the first row needs to be used in the computation because all the other rows will always contain 0 values.