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” scores for opinions and statutes cited by a slip opinion.

(CT)  
[OP] 🡸 [SL] 🡺 [ST]

The ranking of statutes is determined by the citation count.

Ranking of Opinions Level 1:

For the following graph the ranking of opinions [OP0] cited by the slip opinion is determined by:

[ST1] 🡸 [OP0] 🡸 [SL] 🡺 [ST0]

Number of statutes [ST1] an opinion in [OP0] cites to that are in the set of statutes [ST0] cited by the slip opinion. Weighted by the citation count of the cited statute and the citation count of the statute cited by the slip opinion.

**Example data.**

Slip opinion. Cites to Opinion 1, Opinion 2, and Opinion 3. Cites to Statute 1, Statute 2, and Statute 3. Opinion 1 cites to Statute 2, and Statute 3. Opinion 2 cites to Statute 3 and Statute 4. Opinion 3 cites to Statute 4 and Statute 5. Each statute has a citation count equal to the number of the statute, so Statute 3 ranks highest with a count of 3. Opinion 4 has a citation count of 4. Opinion 5 has a citation count of 4. Opinion 6 to statute 3 has a citation count of 1 and opinion 6 to statute 2 has a citation count of 5.

[ST1-2(ct=2)] 🡸 [OP0-1] 🡸 [SL] 🡺 [ST0-1(ct=1)]  
[ST1-3(ct=3)] 🡸 [OP0-1] 🡸 [SL] 🡺 [ST0-2(ct=2)]  
[ST1-3(ct=3)] 🡸 [OP0-2] 🡸 [SL] 🡺 [ST0-3(ct=3)]  
[ST1-4(ct=4)] 🡸 [OP0-2] 🡸 [SL]   
[ST1-4(ct=4)] 🡸 [OP0-3] 🡸 [SL]   
[ST1-5(ct=5)] 🡸 [OP0-3] 🡸 [SL]   
[ST1-1(ct=1)] 🡸 [OP0-4] 🡸 [SL]  
[ST1-3(ct=3)] 🡸 [OP0-5] 🡸 [SL]  
[ST1-3(ct=4)] 🡸 [OP0-6] 🡸 [SL]  
[ST1-2(ct=5)] 🡸 [OP0-6] 🡸 [SL]

**Suggested Ranking Algorithm.**

Statute rank: Find the max citation count, add 1, divide by 4.0. Divide each statute citation count by the quartering factor and add 1 to rank each statute on a scale of 1-4. Statute-1 = 2, Statute-2 = 3, Statute-3 = 4.

Opinion Rank: First apply statute ranking to the statutes cited by the opinions cited by the slip opinion. Sum the rankings opinion to statute citation and ranking for the slip opinion statute citations. The apply the quartering algorithm to rank

Opinion 1 = (3 +3) + (4 + 4) = 10  
Opinion 2 = (3+ 3) = 8  
Opinion 3 = 0  
Opinion 4 = (4 + 2) = 6  
Opinion 5 = (4 + 4) = 8  
Opinion 6 = (3 + 3) + (4 + 3) = 13

**Concerns.**

Is summing more appropriate than products (multiplication) or some other function? What is the basis of graph theory for these kind of graph computations on this problem?