Influencing People

Q10.1 How is the closeness centrality of Dana in the graph on page **??** calculated?

First, we find the lengths of the shortest paths from Dana to everyone else:

- Dana to Anna: The shortest path is `(D, C, A)`, which consists of two links, `(D, C)` and `(C, A)`. Hence, the length is 2.
- Dana to Ben: We just add one more link to make `(D, C, A, B)`, which consists of three links, making the length 3.
- Dana to Cara: The shortest path is simply link `(D, C)`, which has a length of 1.
- Dana to Evan: The shortest path is again one link, `(D, E)`, with length 1.
- Dana to Frank: Again, the length of the single link `(D, F)` is 1.

Taking the average, we have

$$\text{Average D} = \frac{2+3+1+1+1}{5} = \frac{8}{5},$$

and then the reciprocal gives the closeness centrality:

$$\text{Closeness D} = \frac{5}{8} = 0.625.$$

The paths and lengths are summarized in Illustration 33.

Q10.2 How is the betweenness centrality of Dana calculated?

First, How high do we expect her betweenness centrality to be? Not very, because most shortest paths do not include her (see Illustration 34). In fact, there are only three pairs that have her on any shortest path. Which are these? Anna and Frank, Ben and Frank, and Cara and Frank. In each case, there are two shortest paths – one through Dana and one through Evan – so Dana is awarded 0.5 points for each, or $0.5 + 0.5 + 0.5 = 1.5$ total. All the rest of the pairs will not result in any points for her.

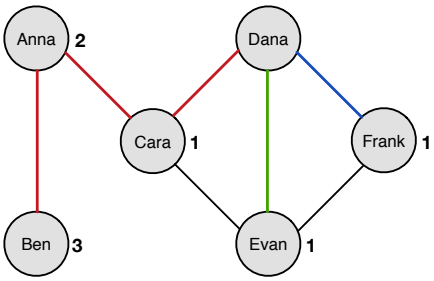

Illustration 33: Shortest paths and lengths for Dana.

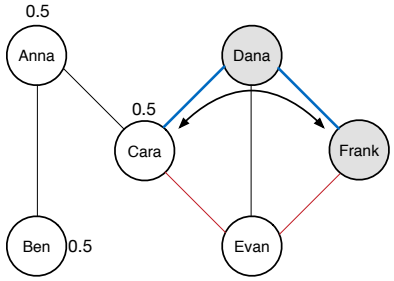

Illustration 34: Dana only lies on the shortest paths between pairs that traverse path `(C, D, F)`. The only paths that use these are those between Anna and Frank, Ben and Frank, and Cara and Frank, giving her half a point each.

Q10.3 What is the density of the cluster of Eve, Frank, George, and Hannah?

Eve has 60% of her neighbors inside, Frank 75%, and George and Hannah each have 100%. The density is the smallest of these, or 60%. Since this is larger than the flipping threshold of 50%, the cluster cannot be penetrated from the outside. This is why not all the nodes flipped in the contagion.