

Density and Hubness

Libby Beer (libby.beer@gmail.com)

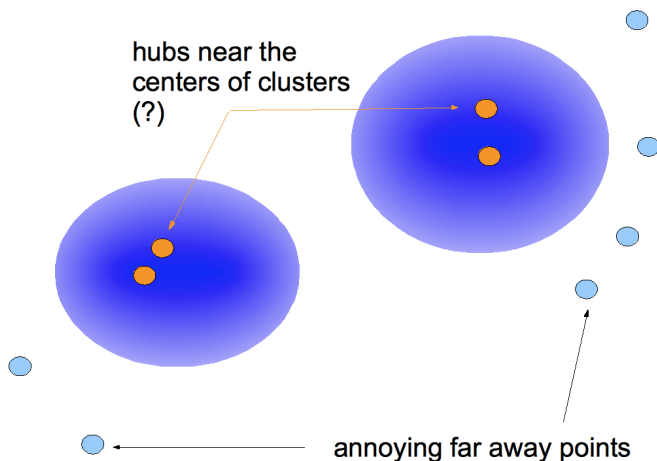
Jesse Metcalf-Burton (datasciencejess@gmail.com)

Marilyn Vazquez ()

July 20, 2017

Distances between points? Hubs?

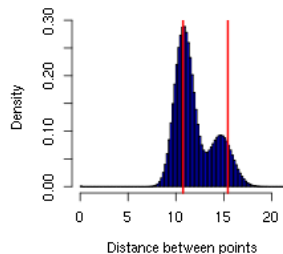
Can hubs help us cluster?



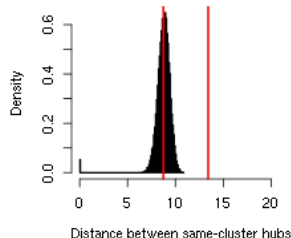
Distances with synthetic data

1-hubness//users/jesse//graphs/gaussians_1000_5000_60.mat.10.png

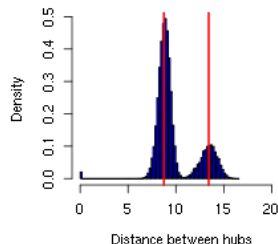
Distances between (all) points



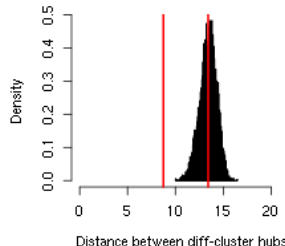
Intra-cluster distances



Distances between hubs



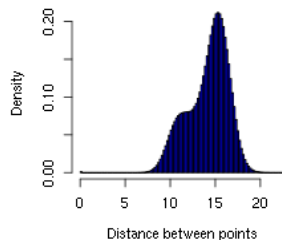
Inter-cluster distances



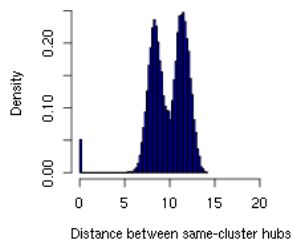
Distances with (other) synthetic data

jbness//users/jesse//graphs/synthetic_data_30_50_overlap30.mat.10.png

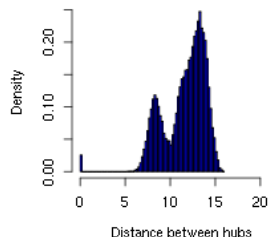
Distances between (all) points



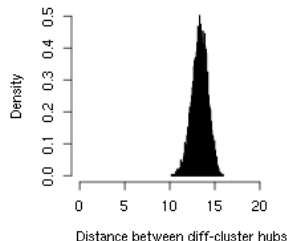
Intra-cluster distances



Distances between hubs



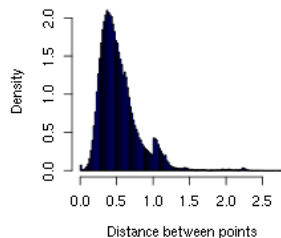
Inter-cluster distances



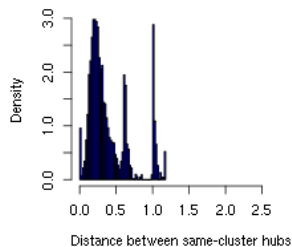
Distances with real data

:/wisdm-hubness//users/jesse//graphs/data_spam.mat.10.png

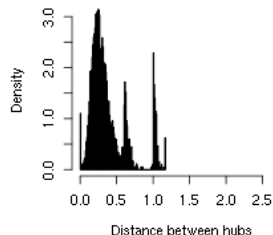
Distances between (all) points



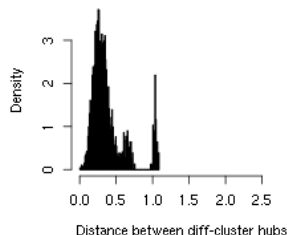
Intra-cluster distances



Distances between hubs

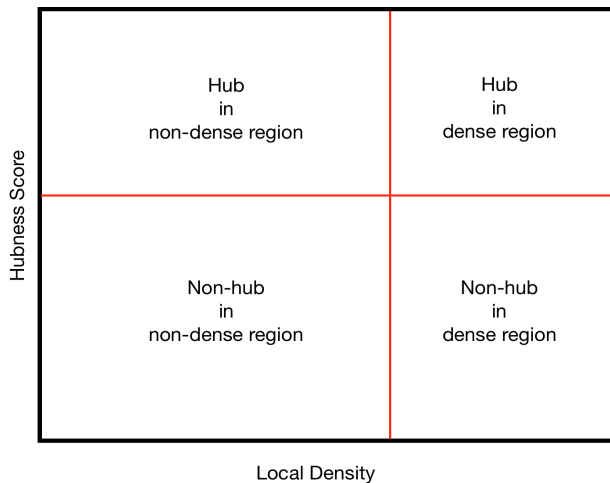


Inter-cluster distances



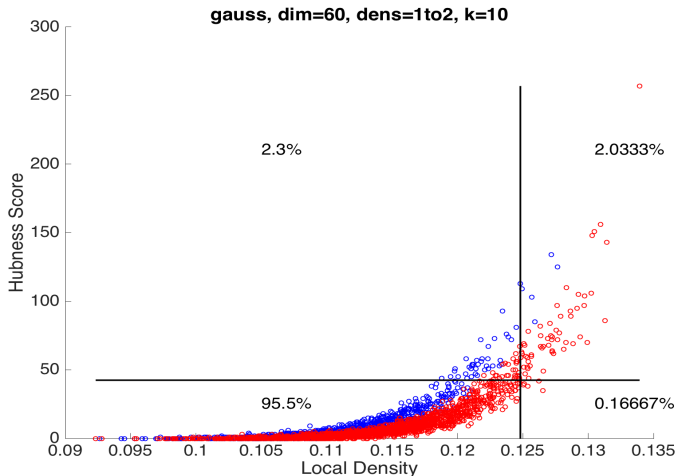
Do hubs appear in high density regions?

Intuition



Do hubs appear in high density regions?

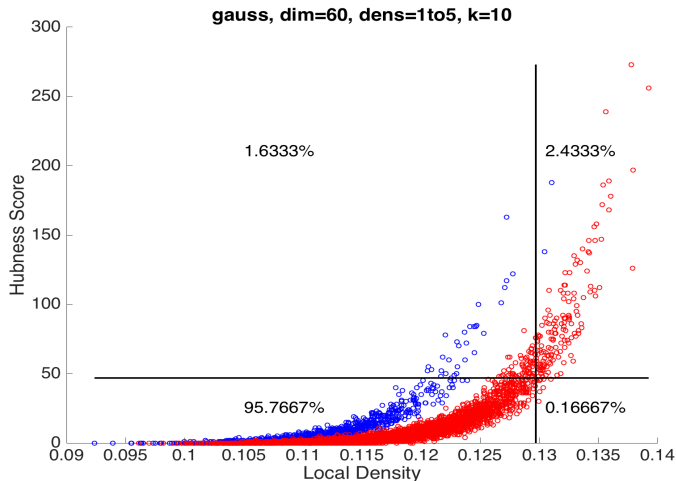
Answer: Sometimes!



Notice: (1) Proportion of hubs in the two density regions, (2) proportion of high density points that are hubs, and (3) more hubs in the denser cluster.

Do hubs appear in high density regions?

Answer: Sometimes!



Notice: (1) A LOT more hubs in the denser cluster and (2) the rise of two “wings” that correspond to the two different cluster.

From the experiments on the Gaussian data, we observe that:

- About 13 out of 36 experiments, there was a larger proportion of hubs in the low density region i.e. hubness scores and density are not exactly the same thing
- About 23 out of 36 experiments, there was a larger proportion of hubs in the high density region i.e. if a point is a hub, it is more likely to be in a high density region.
- All our experiments show that high density regions are mostly composed of hubs i.e. if a point is in a high density region, it is most likely a hub.

- More experiments of local density versus hubness scores for other density types e.g. uniform density
- Verify if patterns also show up in real data
- Data with more clusters to see if “wings” arise for each cluster