

# 3<sup>rd</sup> Milestone Report for 15-400, Spring 2017

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## Major Changes :

There have been no major changes.

## Accomplishments So Far :

In our last meeting, we narrowed down to the following interesting questions. I have begun work on the third one.

1. The construction given by Balcan et al to show  $n^{\Omega\frac{1}{\alpha}}$  communities is slightly unsatisfactory in the sense that each community in this construction is a ‘blob’ of nodes, and the blobs are connected together randomly. It would be interesting to see if we can impose some kind of cluster maximality / well-connectedness restriction to remove this dependence on  $\frac{1}{\alpha}$ .
2. A well-connectedness criterion for clusters would probably imply some kind of ‘large spectral gap’-like property for our graphs / affinity systems. Spectral methods may be able to exploit this.
3. Balcan et al show that finding  $(\alpha, \beta)$ -clusters (without  $\rho$ -champions) is as hard as the hidden clique problem (which is believed to be hard). I am currently investigating if these reduction techniques extend to sparser clusters, where  $\alpha$  is sub-constant.

## Meeting The Milestone :

I have begun working on a concrete reduction problem now. Technically, my milestone was to start conjecturing algorithms for the sparse graph case, but the hardness problem seems more approachable to me right now. I would say I have met the milestone, just in the other direction as far as upper/lower bounds are concerned.

## Surprises :

No unpleasant surprises.

## Revisions To 15-400 Milestones :

No major revisions to milestones.

## Resources Needed :

I haven’t felt the need for any more non-trivial resources so far.