Towards Practical Ambiguity Sets

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Alice and Eve

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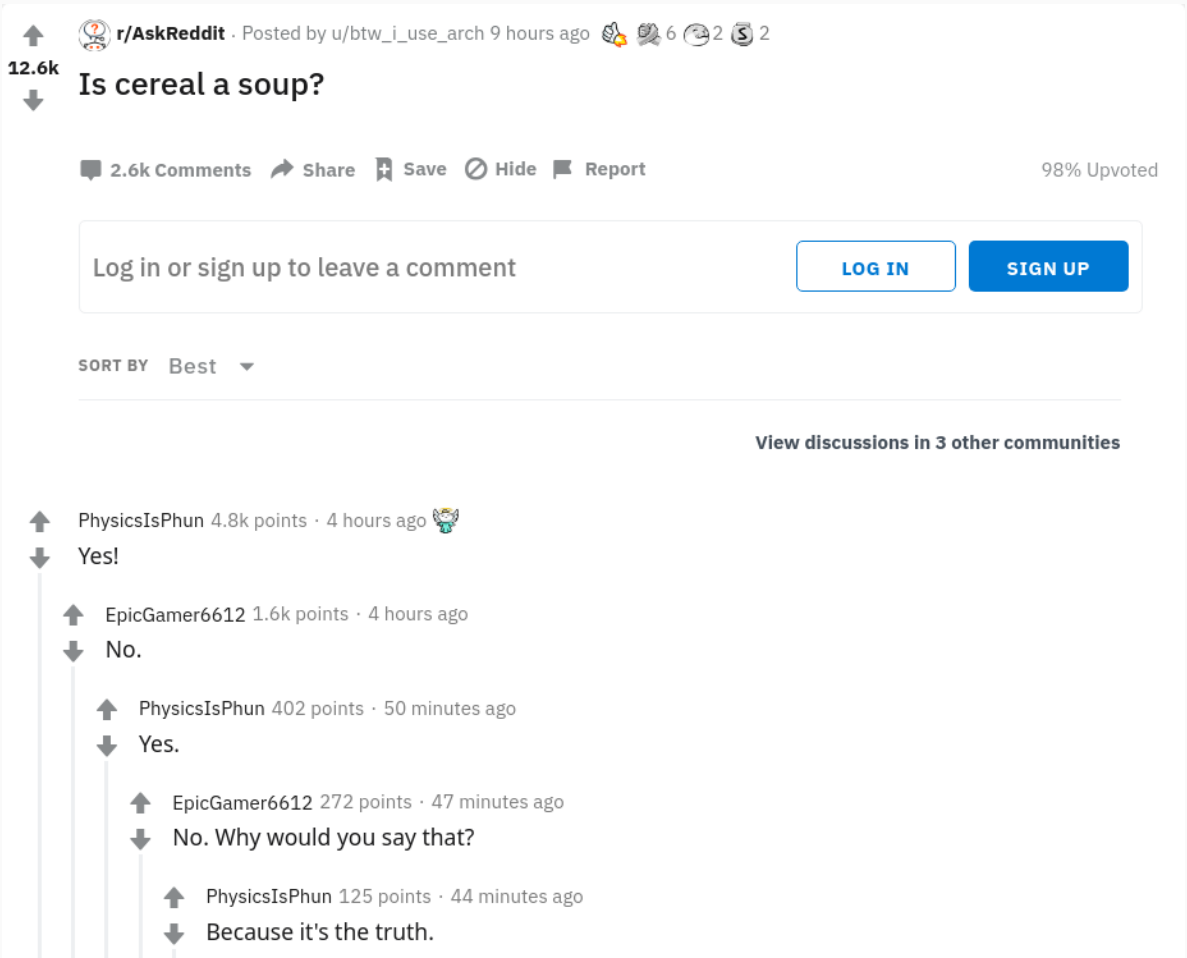
However, remember Eve uses Reddit too...

Alice and Eve



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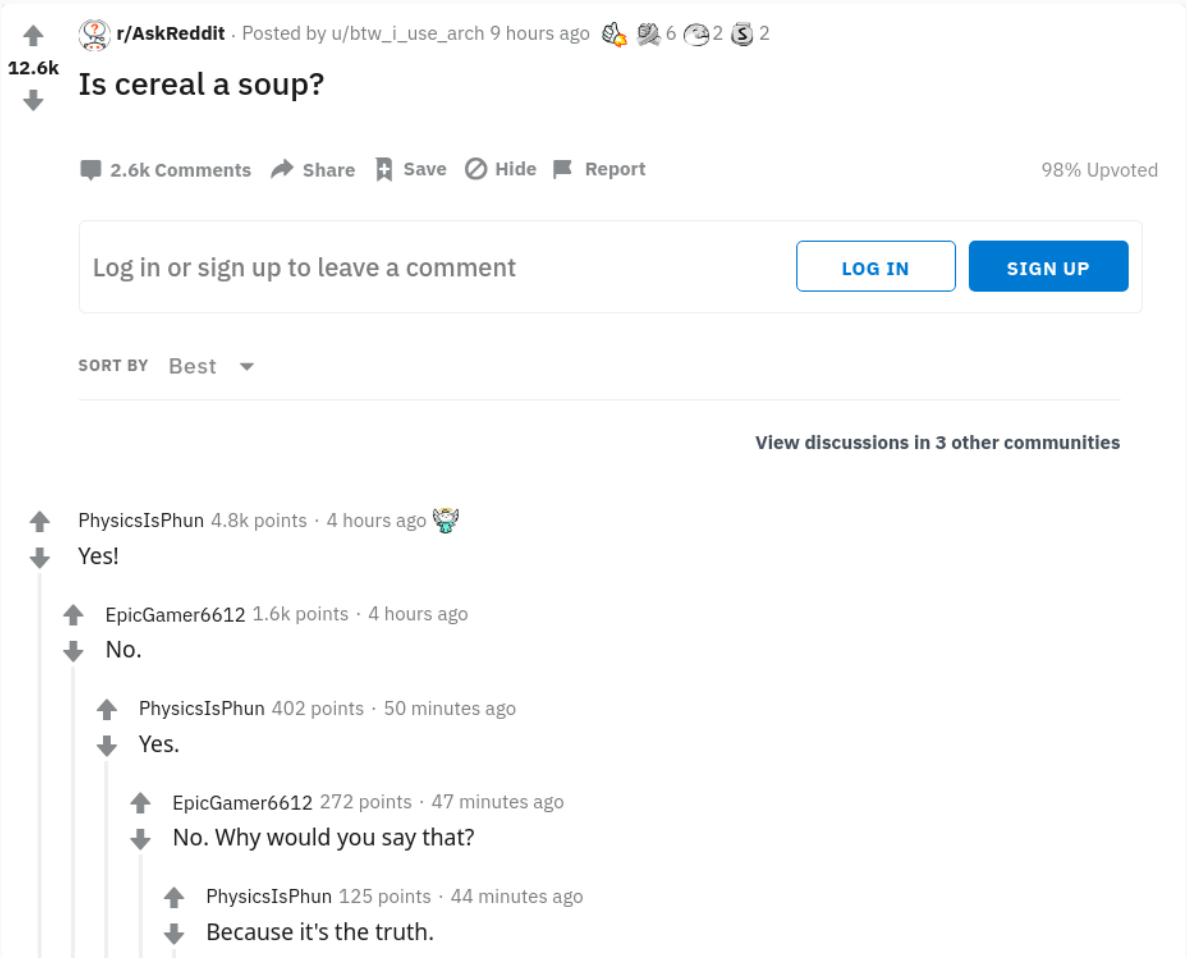
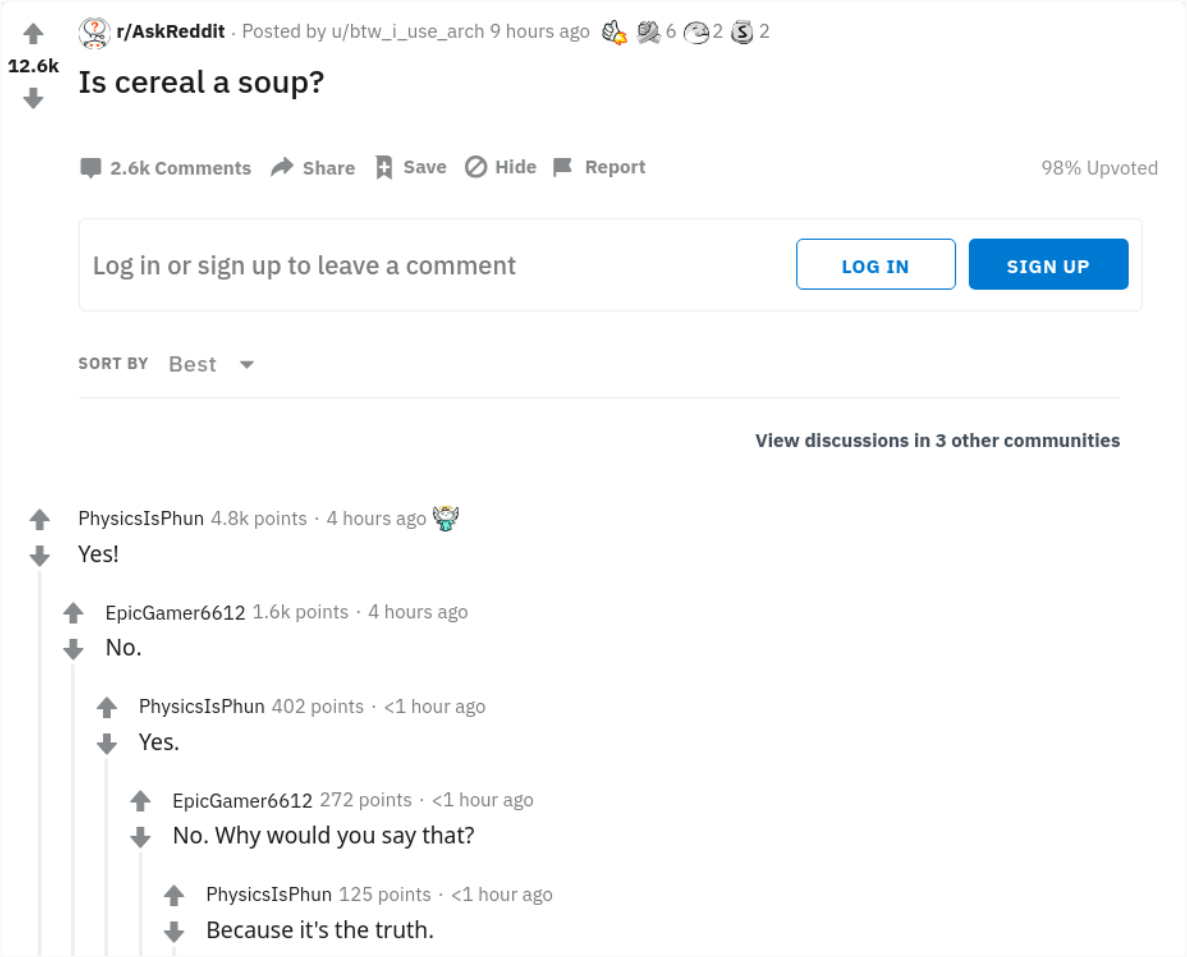


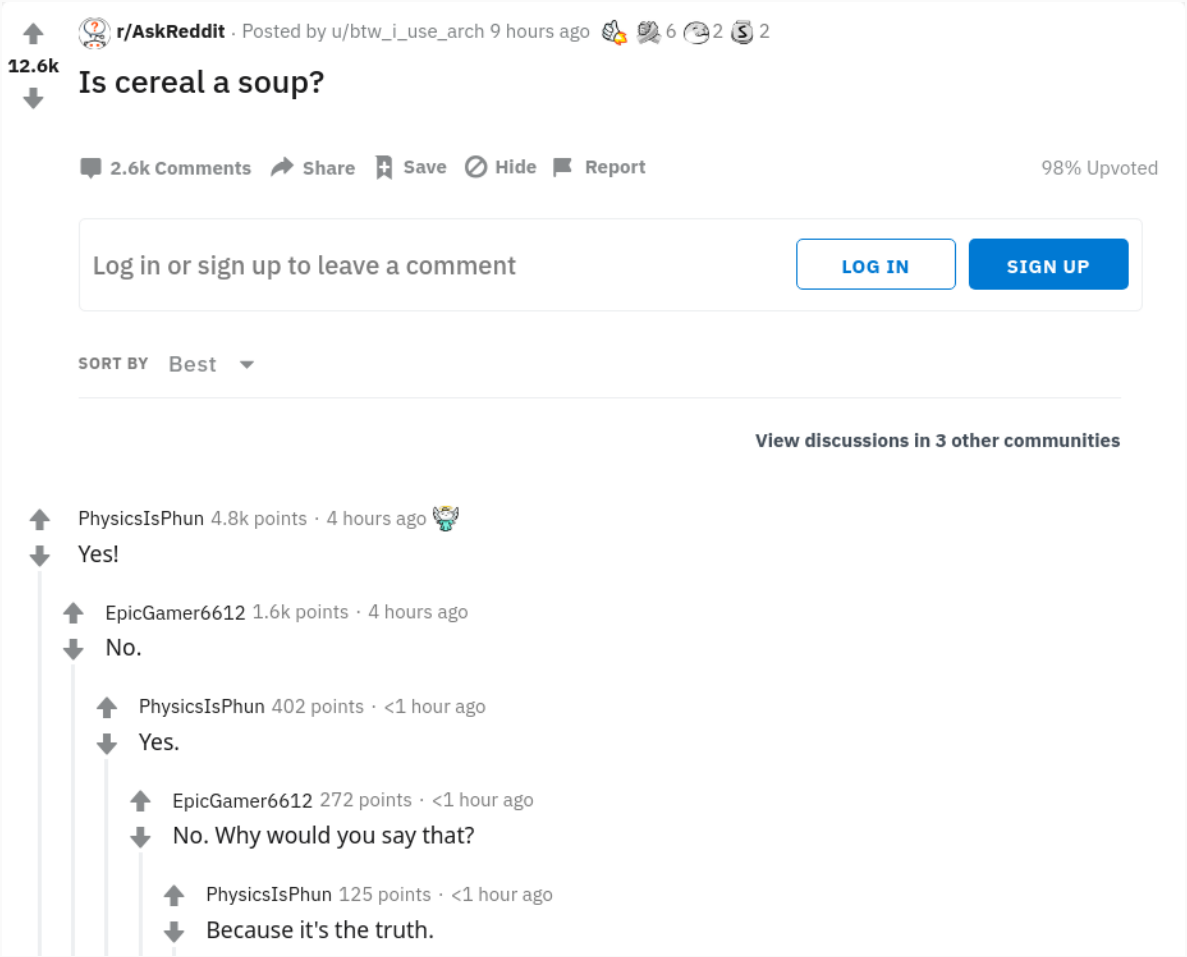
Alice's traffic
251 min ago
47 min ago

Alice and Eve



Alice's traffic
240 min ago
0 min ago

Alice and Eve



Alice's traffic
240 min ago
0 min ago
0 min ago

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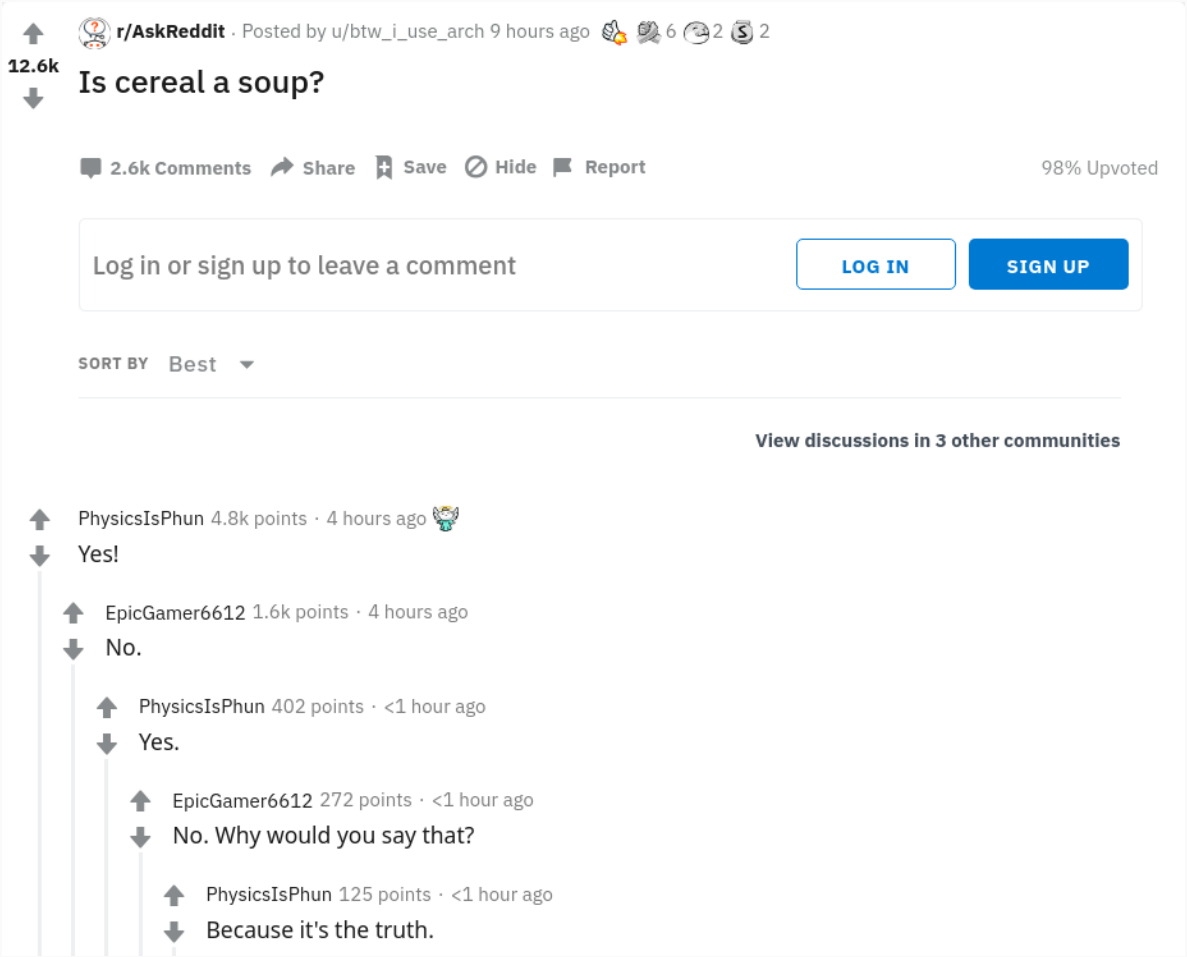

Alice's traffic
240 min ago
0 min ago
0 min ago

Alice's fake messages are called **dummy messages**.

Alice, Bob, and Eve

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- Alice can give up on looking like Bob and just post enough dummies to look like PhysicsIsPhun.

We would say EpicGamer6612 (Alice) and PhysicsIsPhun are in an ambiguity set , since Eve can't determine which of the two Alice is.

More Realistic Examples

\Eve" could be. . .

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- Internet providers

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Basically any adversary who can see the users' activity, but not the contents of incoming or outgoing tra c (hidden with encryption).

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- How do we group people to look the same in a good way (and what does \good" entail)?
- How do we pick the budget for a group of people?
- Is such a system practical in real life?

Our Project

Ambiguity Sets

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We make a compromise between performance and privacy:

- Users are placed into ambiguity sets of size at least k, for some integer k.
- Each user in the set looks identical to every other user in the set from the adversary's point of view.
- We try to create sets to find a balance between performance and privacy.

Alice and Carl

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The Perfect Ambiguity Sets

Minimizes unnecessary tra c

The Perfect Ambiguity Sets

Minimizes unnecessary tra c

Maintains good privacy

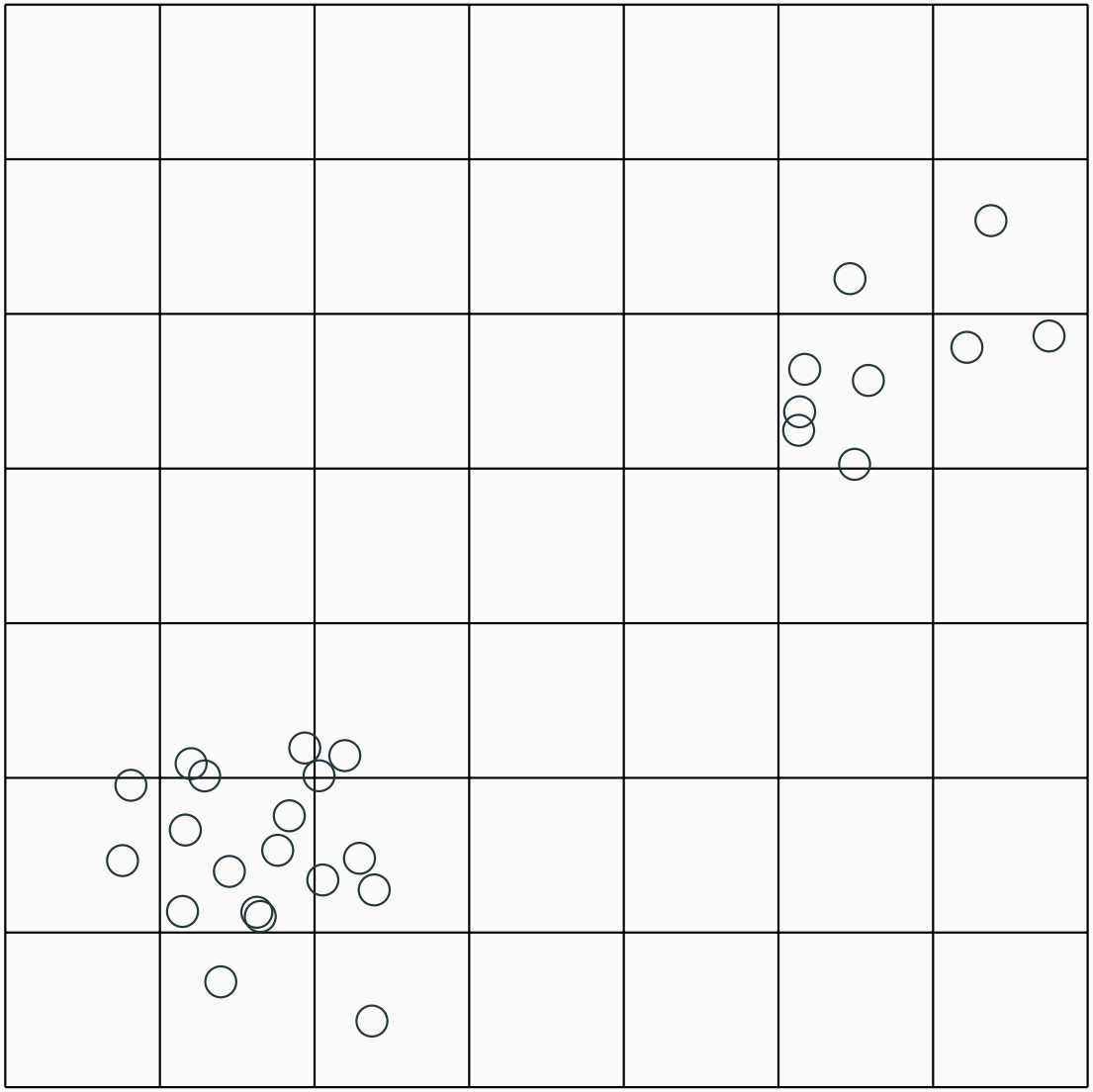
The Perfect Ambiguity Sets

- Minimizes unnecessary tra c
- Maintains good privacy

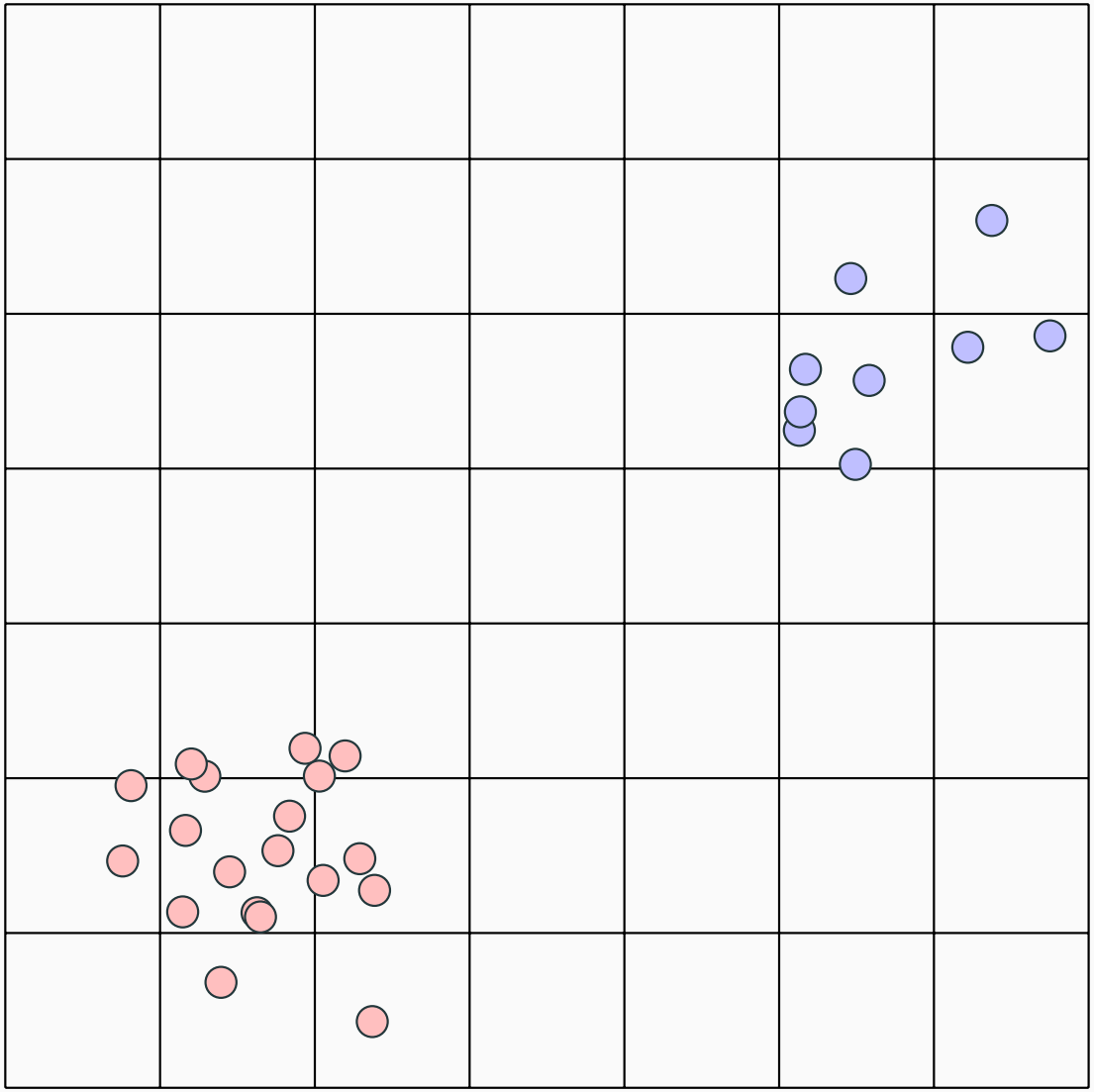
Achieving both of these at the same time is hard.

Creating Ambiguity Sets

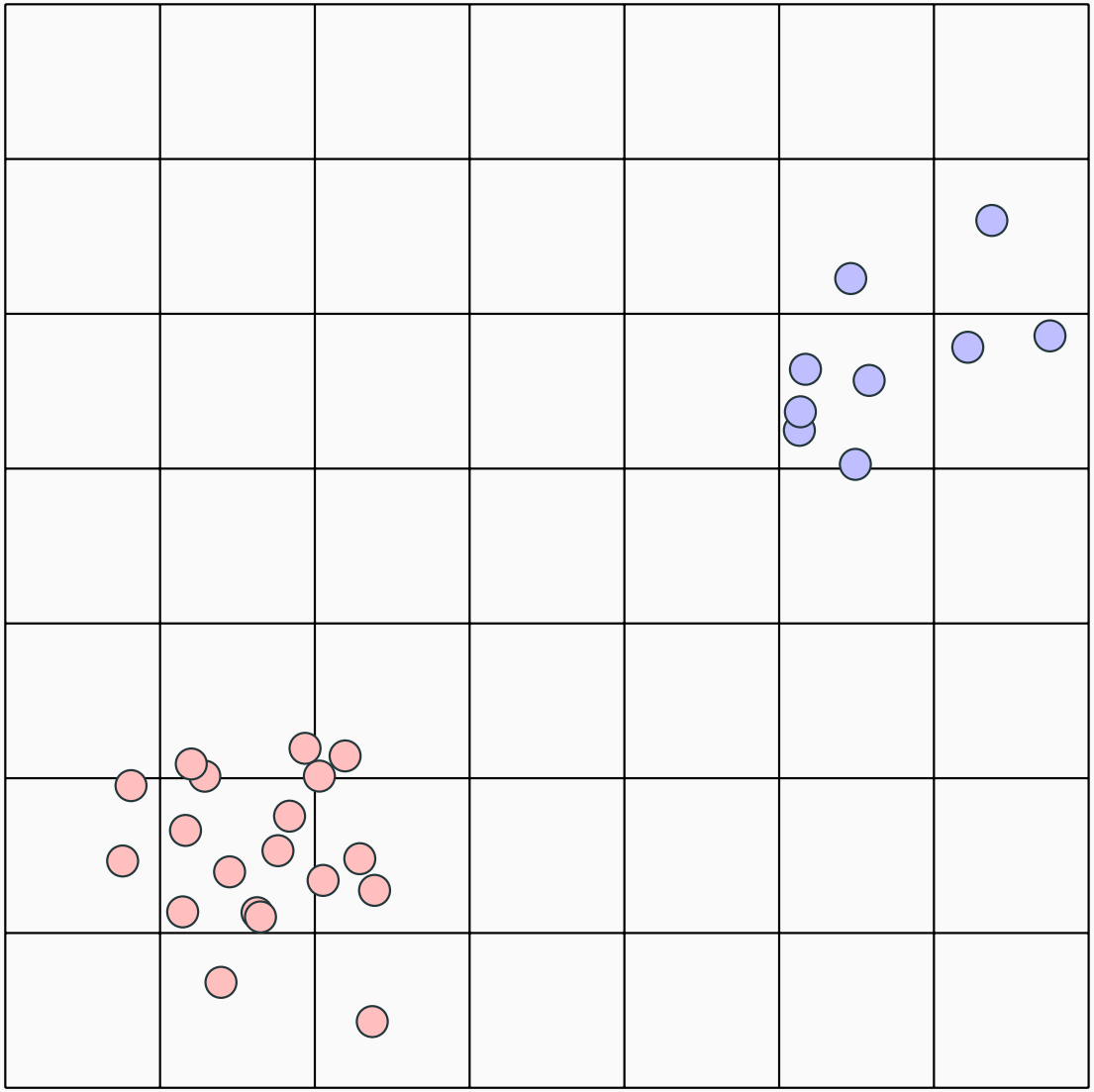
K-Means



K-Means



K-Means



K-means attempts to minimize the inertia of each cluster.

Inertia as an Indicator of Performance

Each dot here represents 1 clustering setup (with a di erent random seed)

Cluster Sizes

(On a dataset of 100 users)

Picking a Budget

The Budget

Once the ambiguity sets are created, we de ne a budget (how much tra c people should send) based on the mean activity over users in the set.

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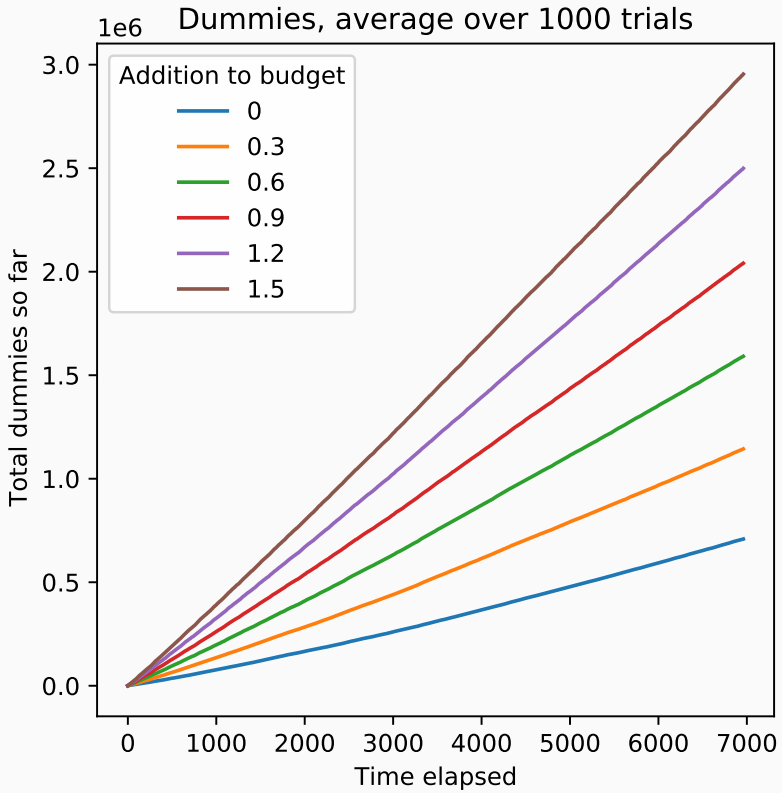
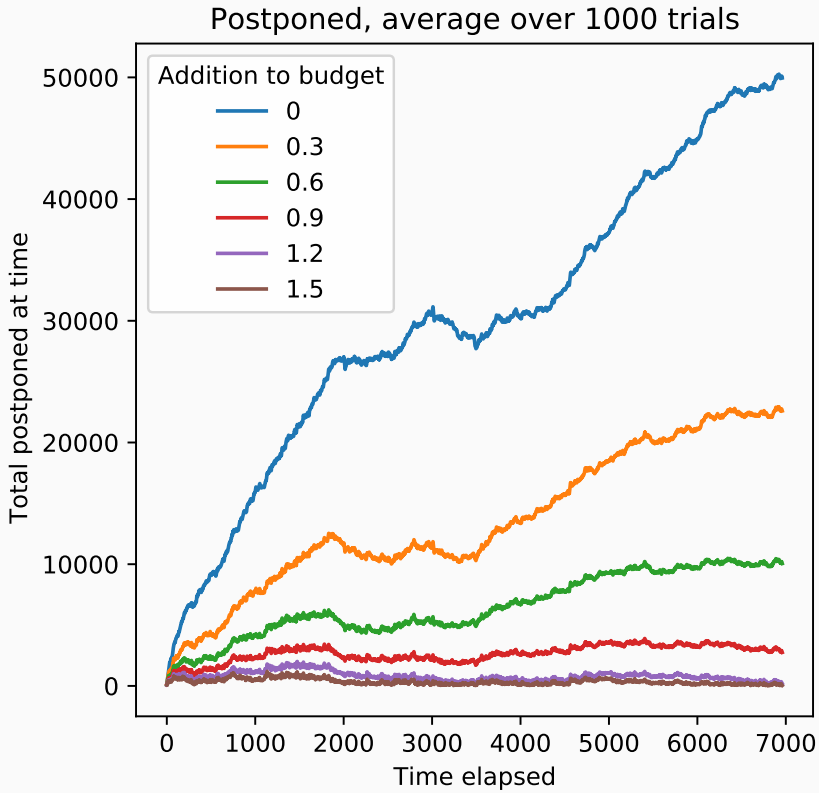
> If a user sends under the budget, they send dummy messages until the budget is reached.
>
> If a user sends over the budget, their messages are postponed to a later round.

In general, we care more about reducing postponed messages over reducing dummy messages.

The Solution

$$\text{budget} = \text{mean} \quad (1 + \text{addition to budget})$$





Future Research

Testing this on bigger datasets

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Looking more closely at the people who make up the sets here

Acknowledgements

Kyle Hogan

Dr. Gerovitch & Prof. Devadas

PRIMES Program & MIT

Thanks for listening!