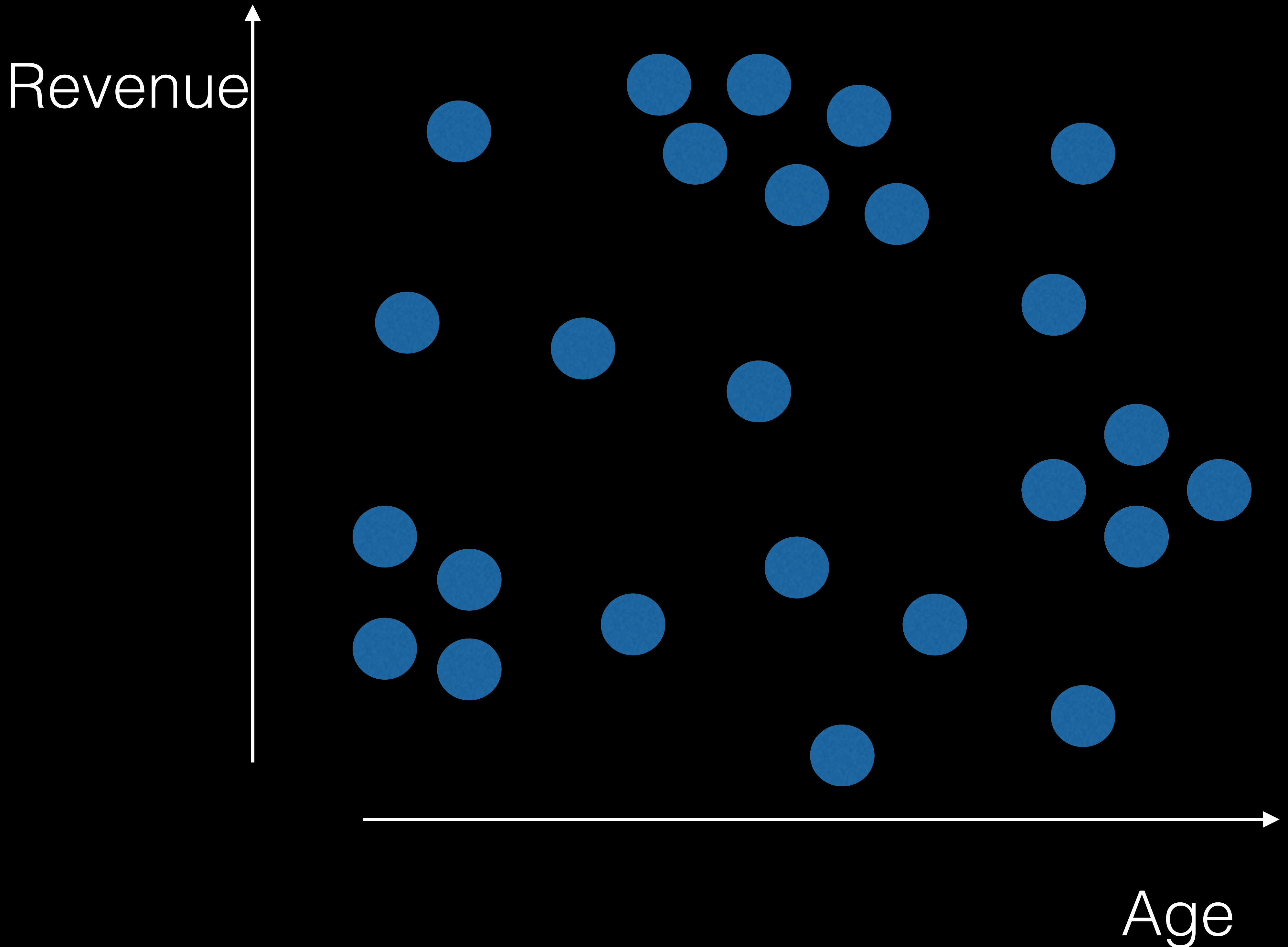
Mahout 102

Clustering

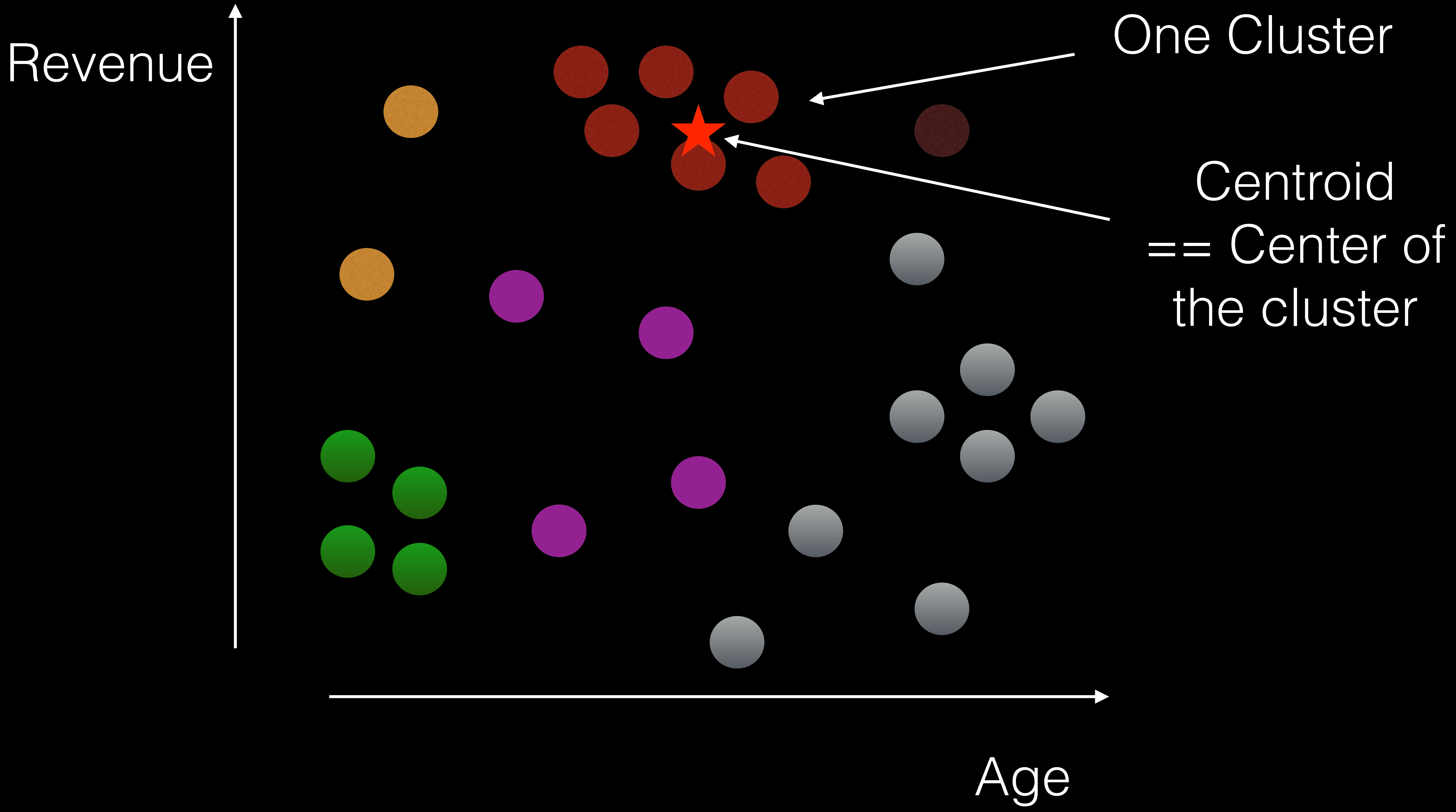
Goal for Today

- Quick Introduction To Clustering
- How does it work in Practice
- How does it work in Mahout
- Overview of Mahout Algorithms

Clustering



Clustering



clustering applications

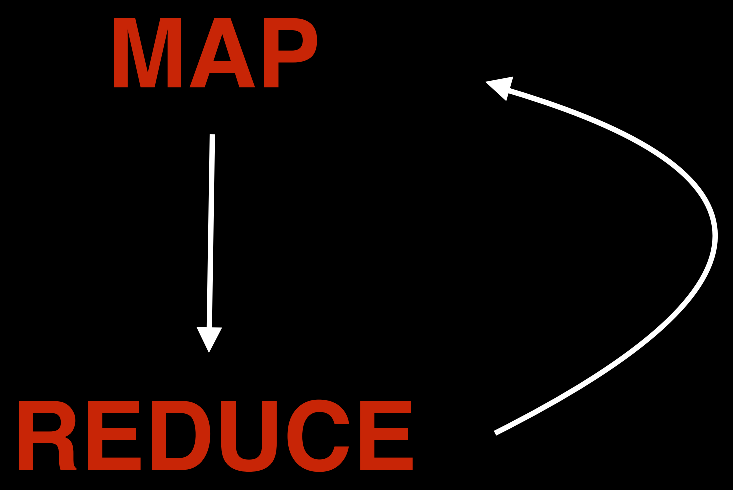
- Fraud: Detect Outliers
- CRM : Mine for customer segments
- Image Processing : Similar Images
- Search : Similar documents
- Search : Allocate Topics

K-Means

Guess an initial placement for centroids

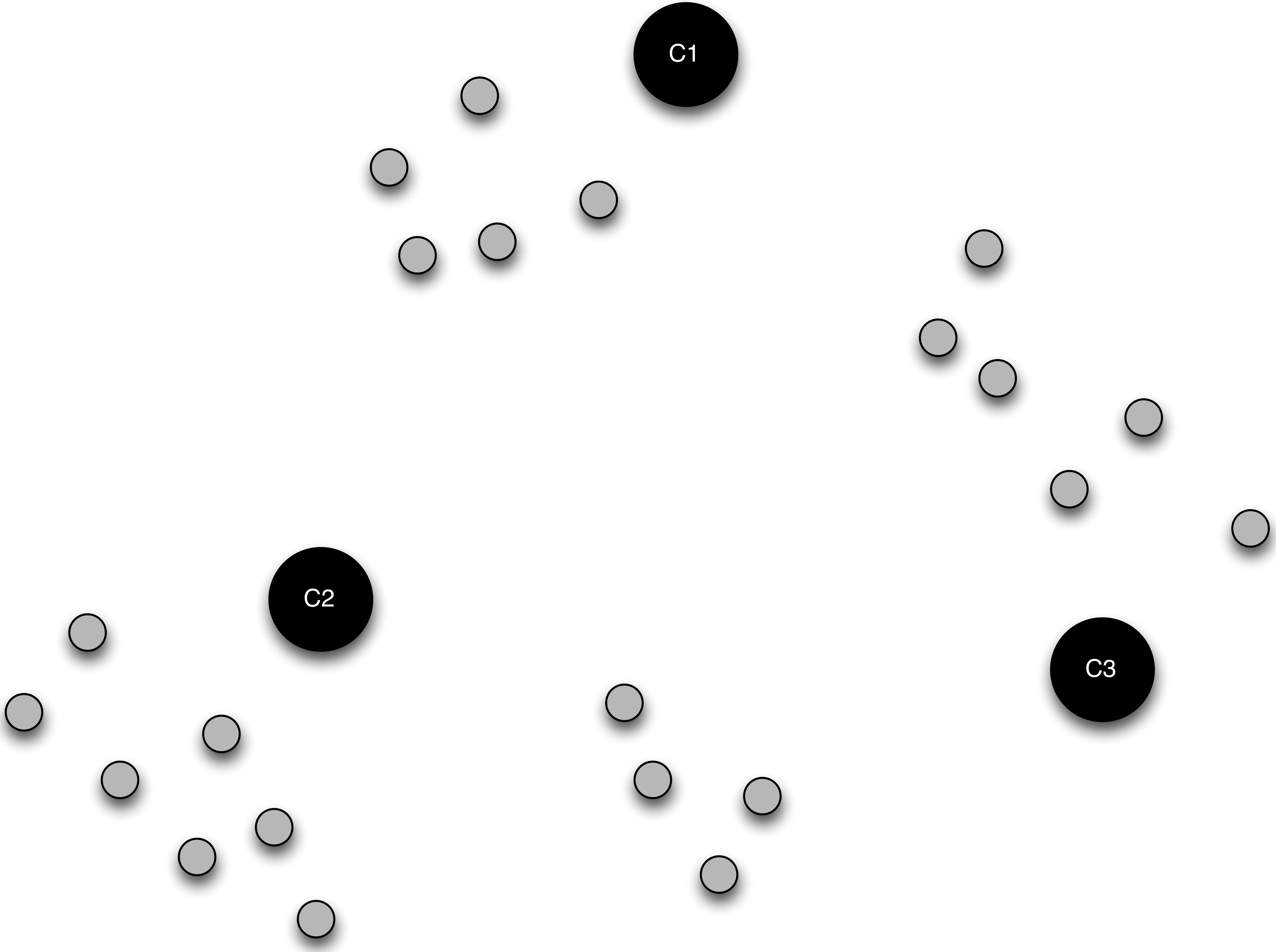
Assign each point to closest Center

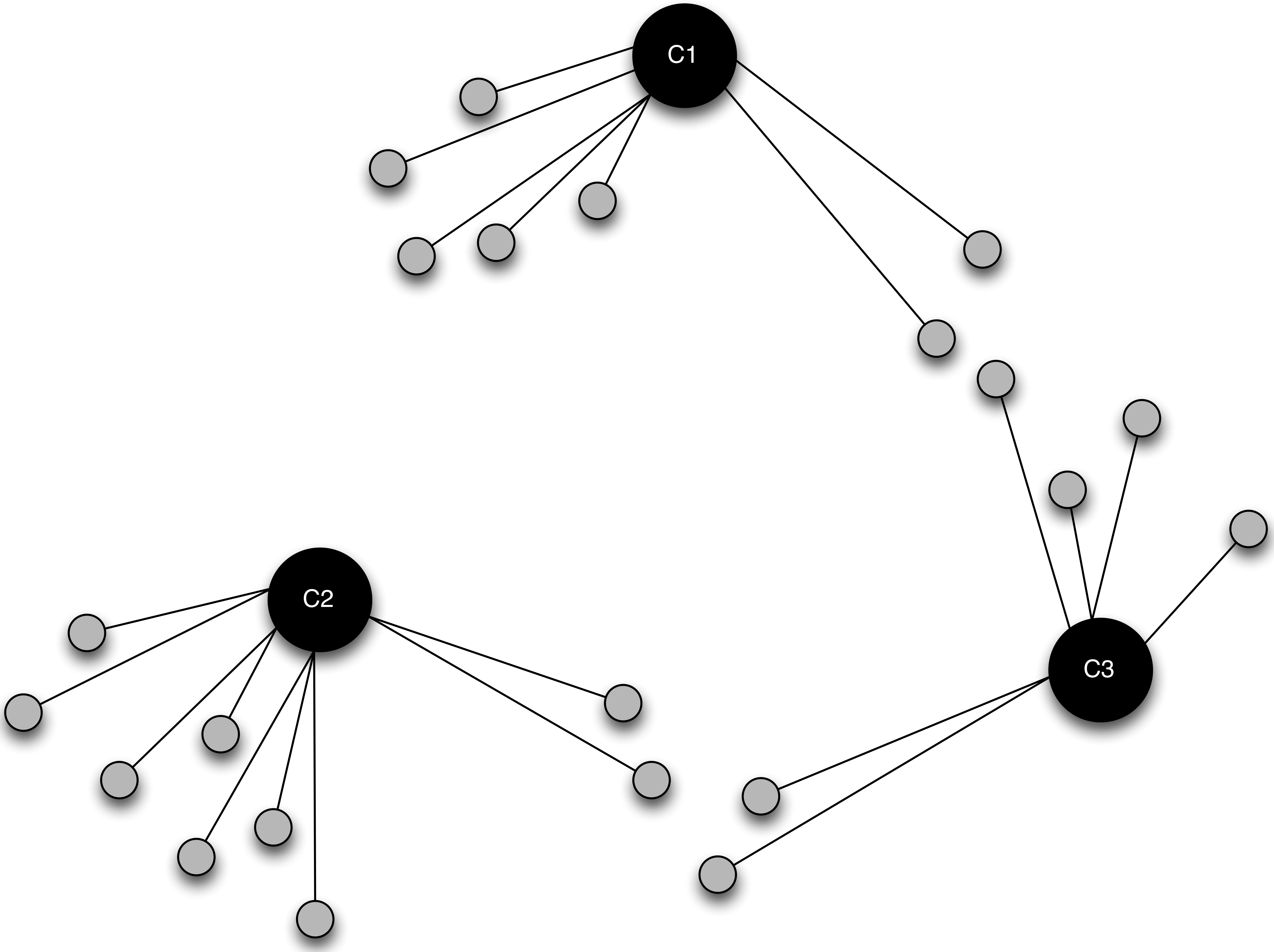
Reposition Center



MAP

REDUCE


C1
C2
C3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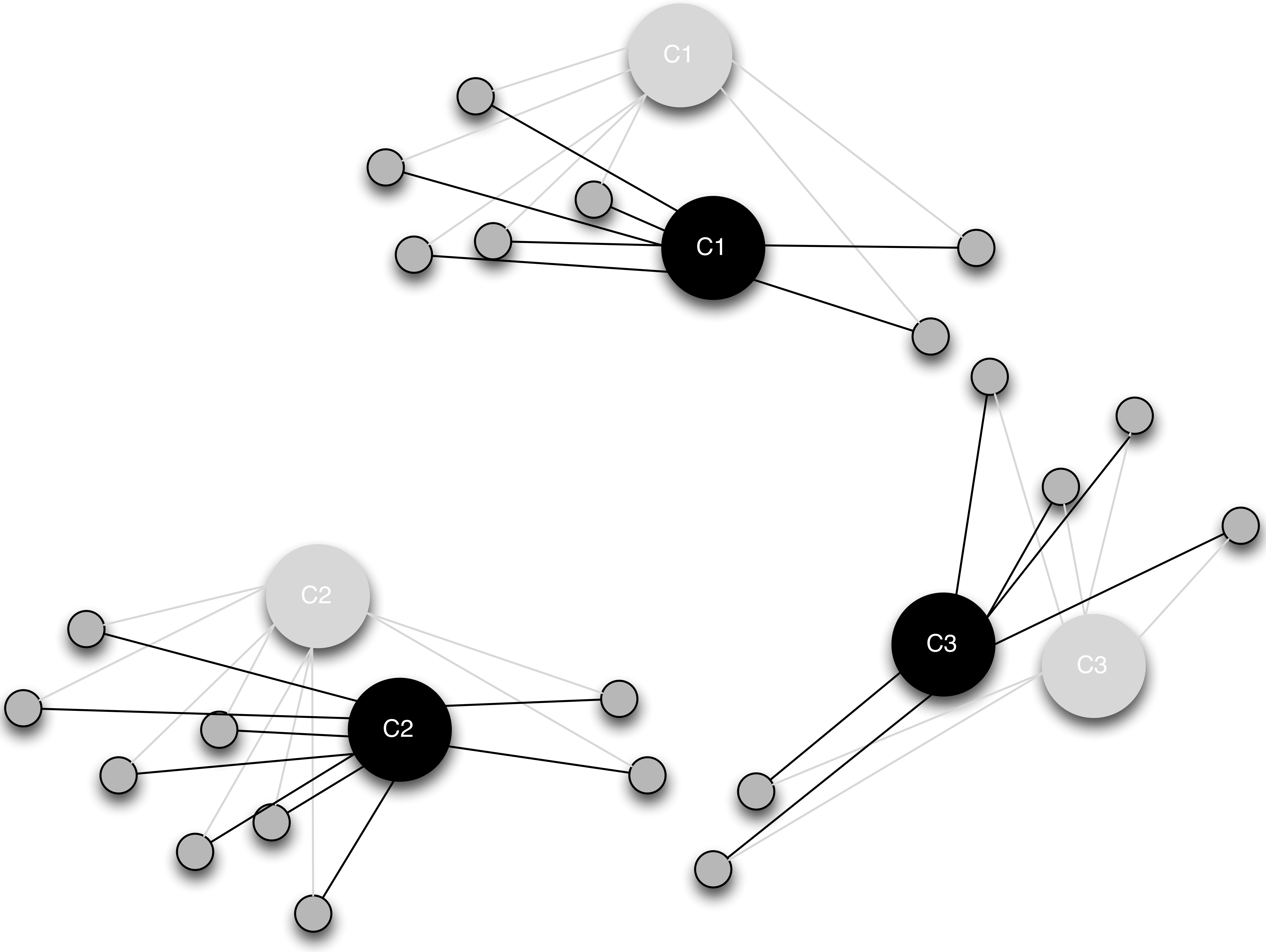
C1
C1
C2
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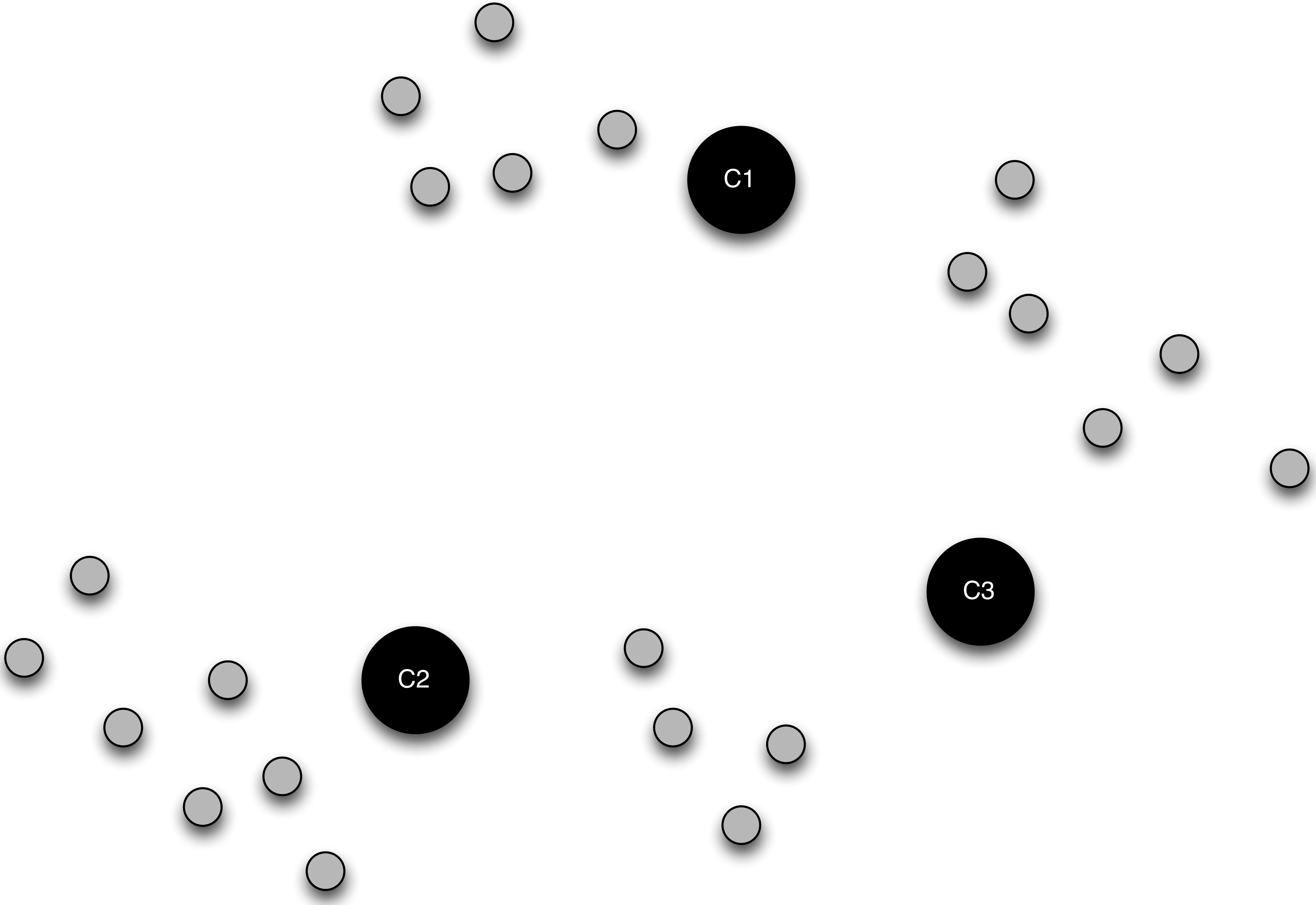
C3
C3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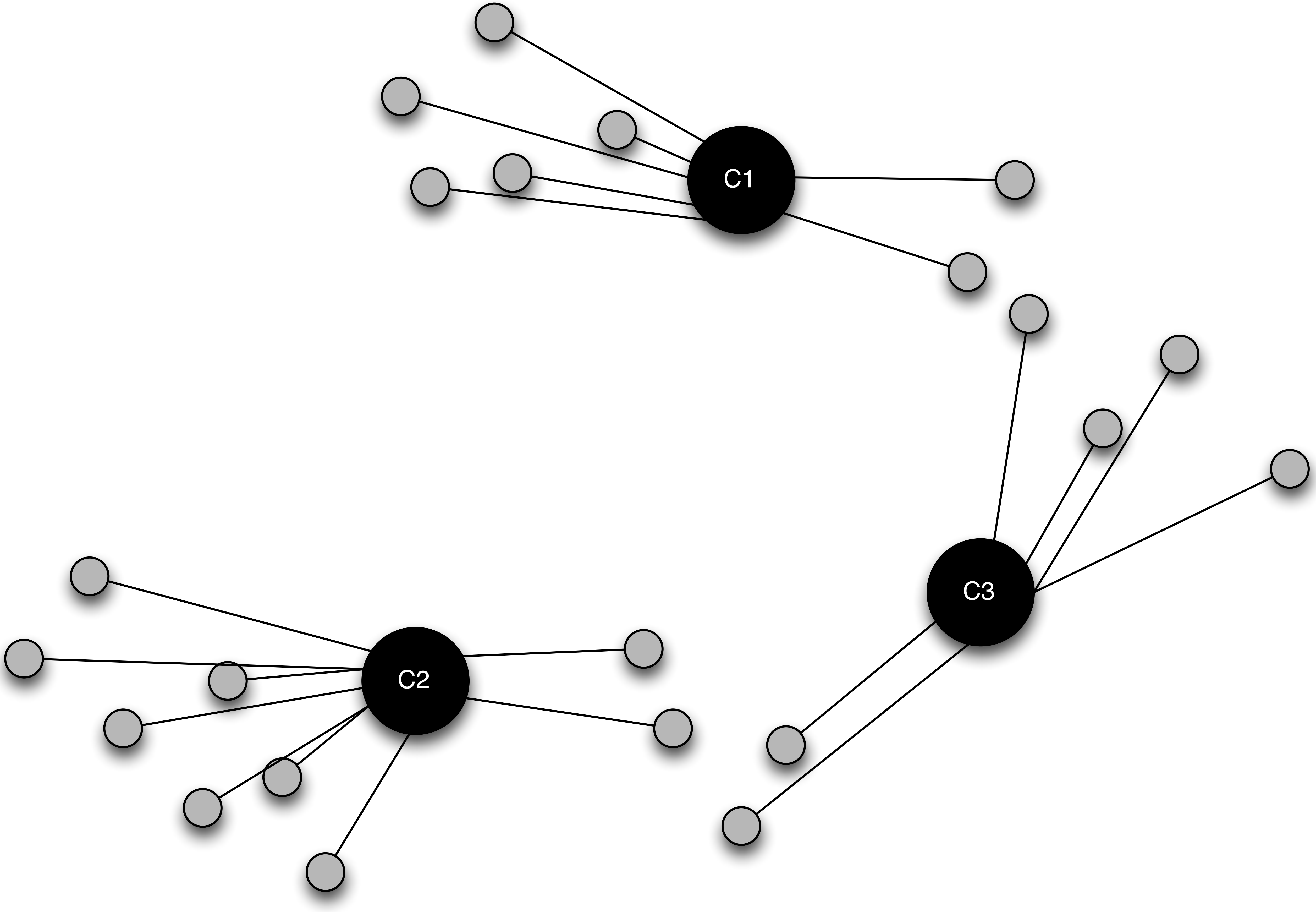
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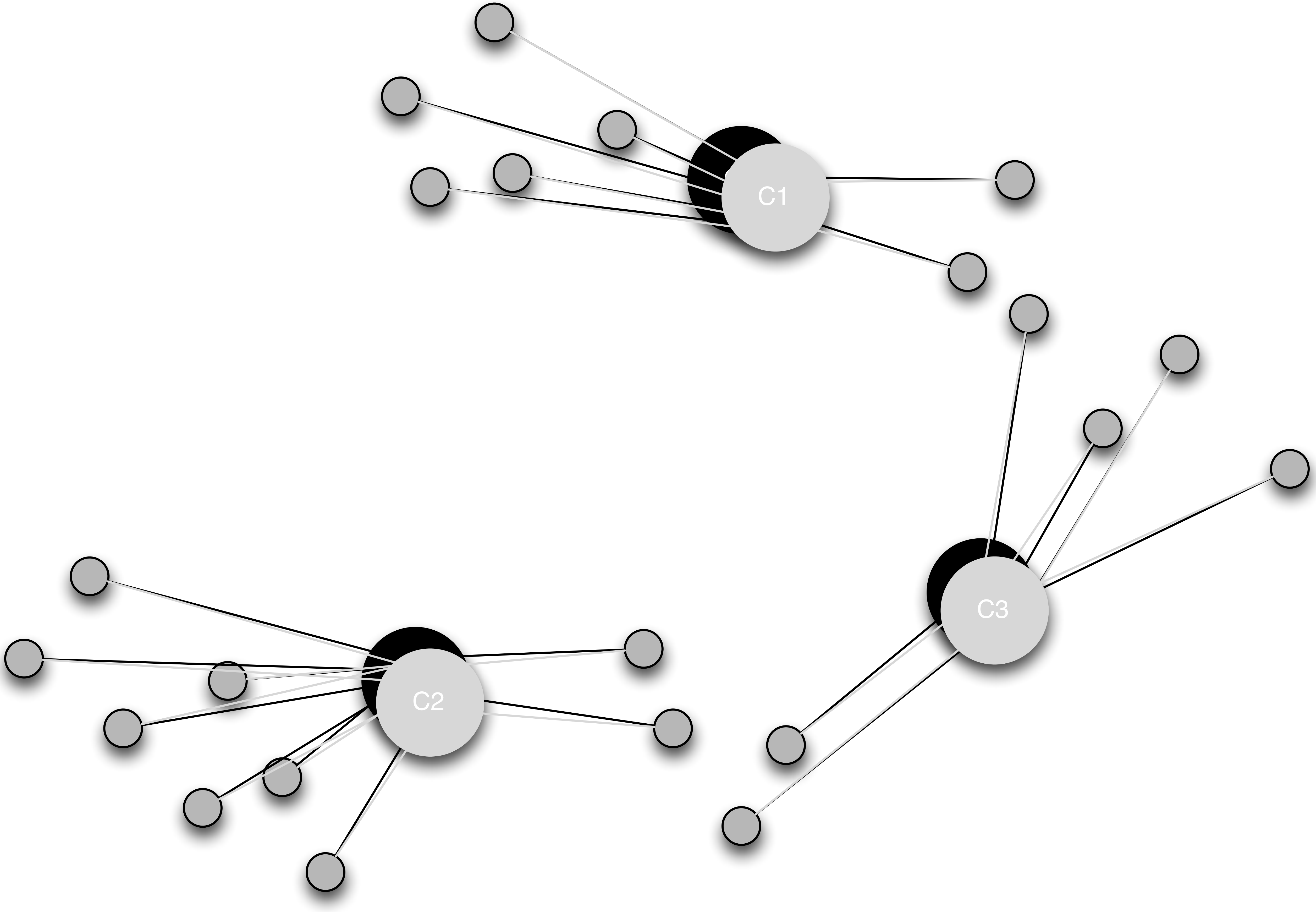
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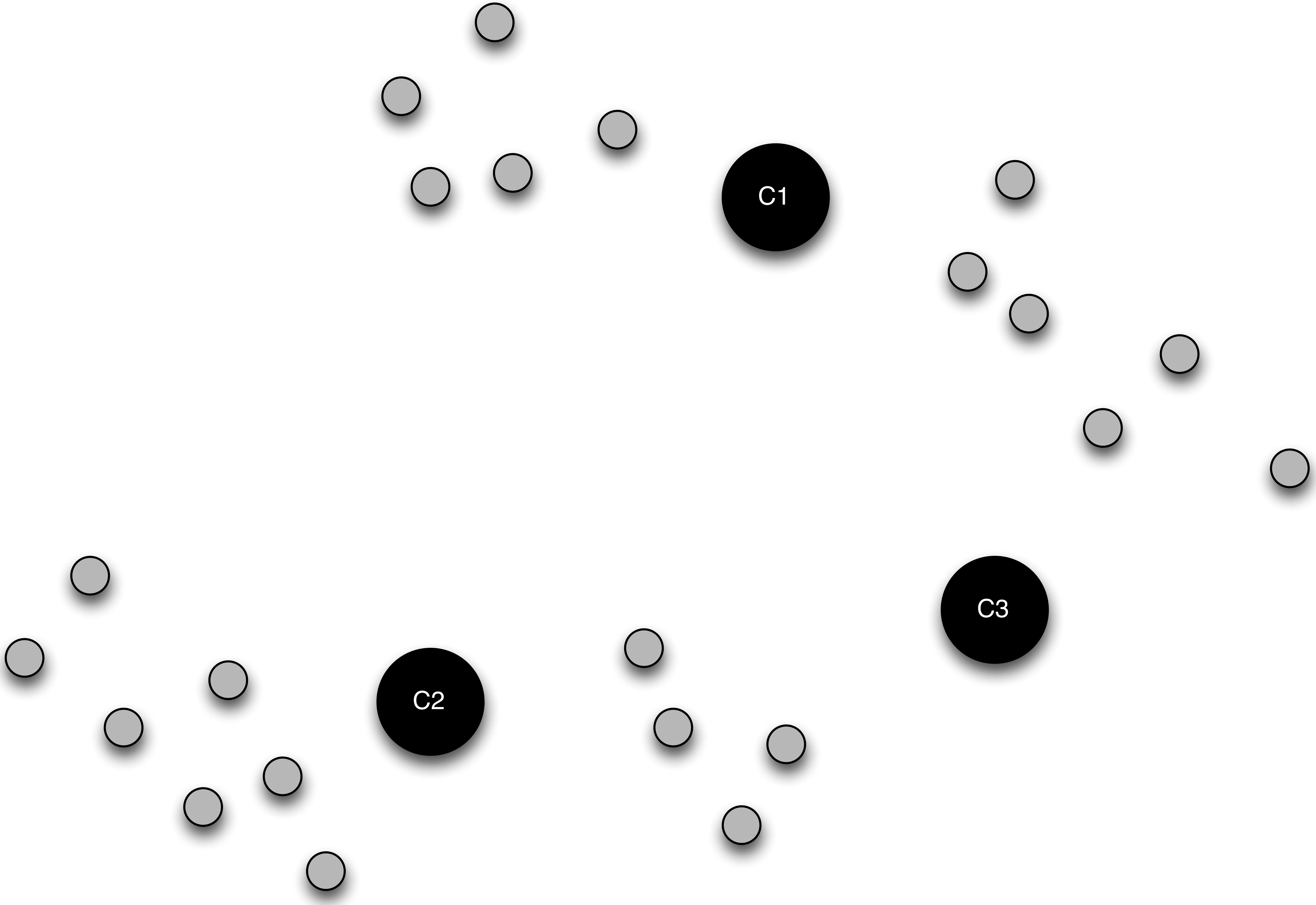
C1
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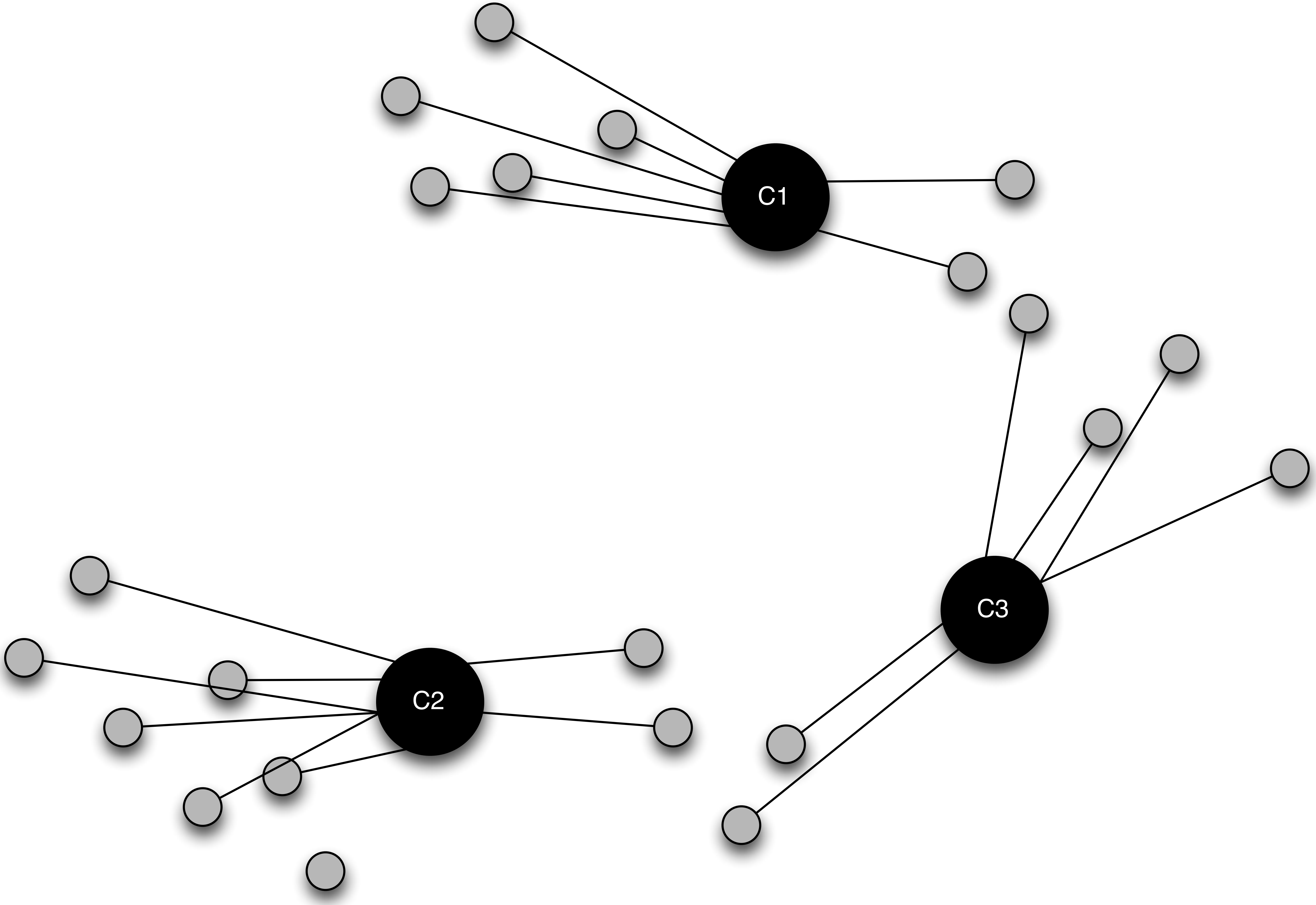
C1
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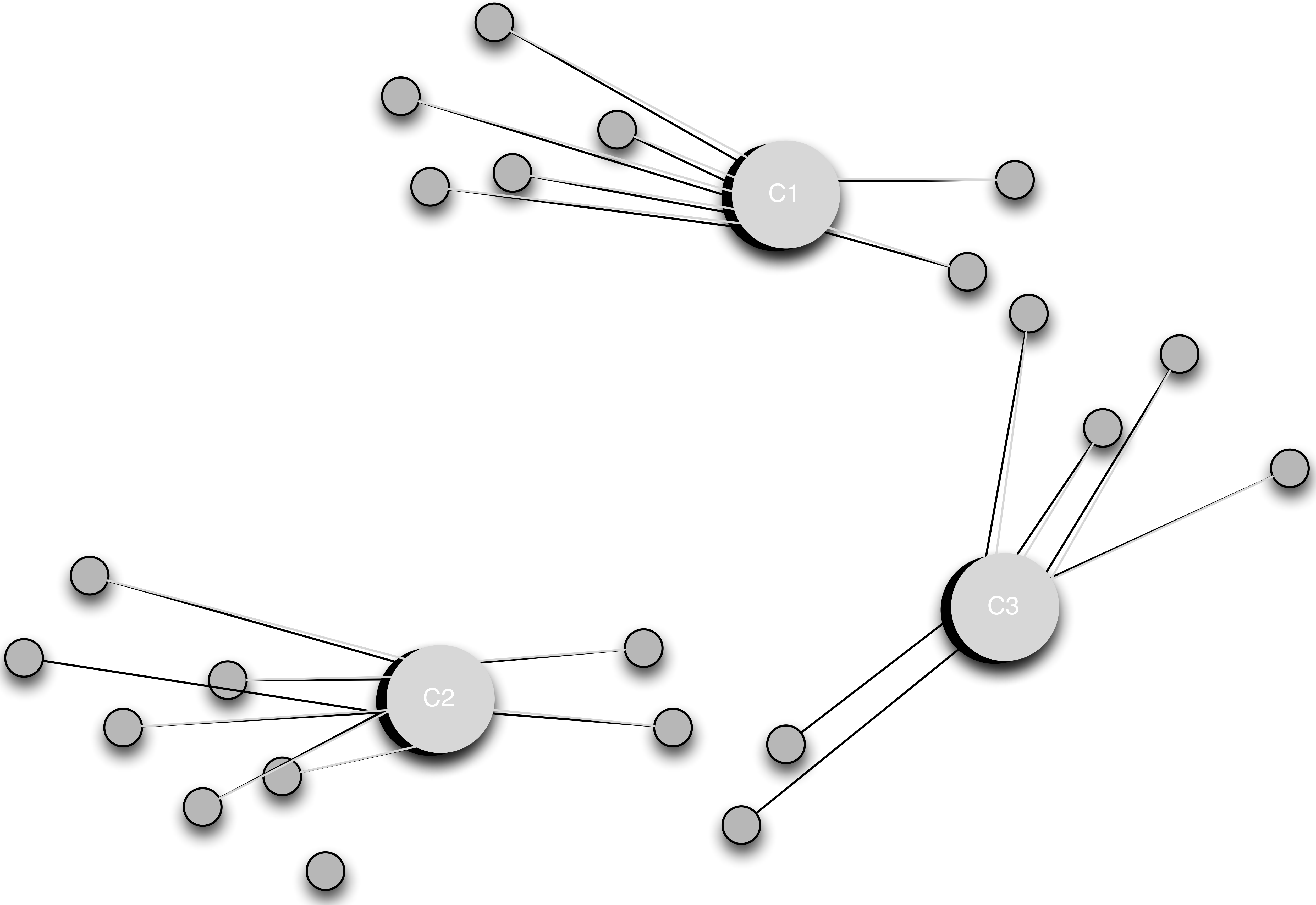

C1
C2
C3

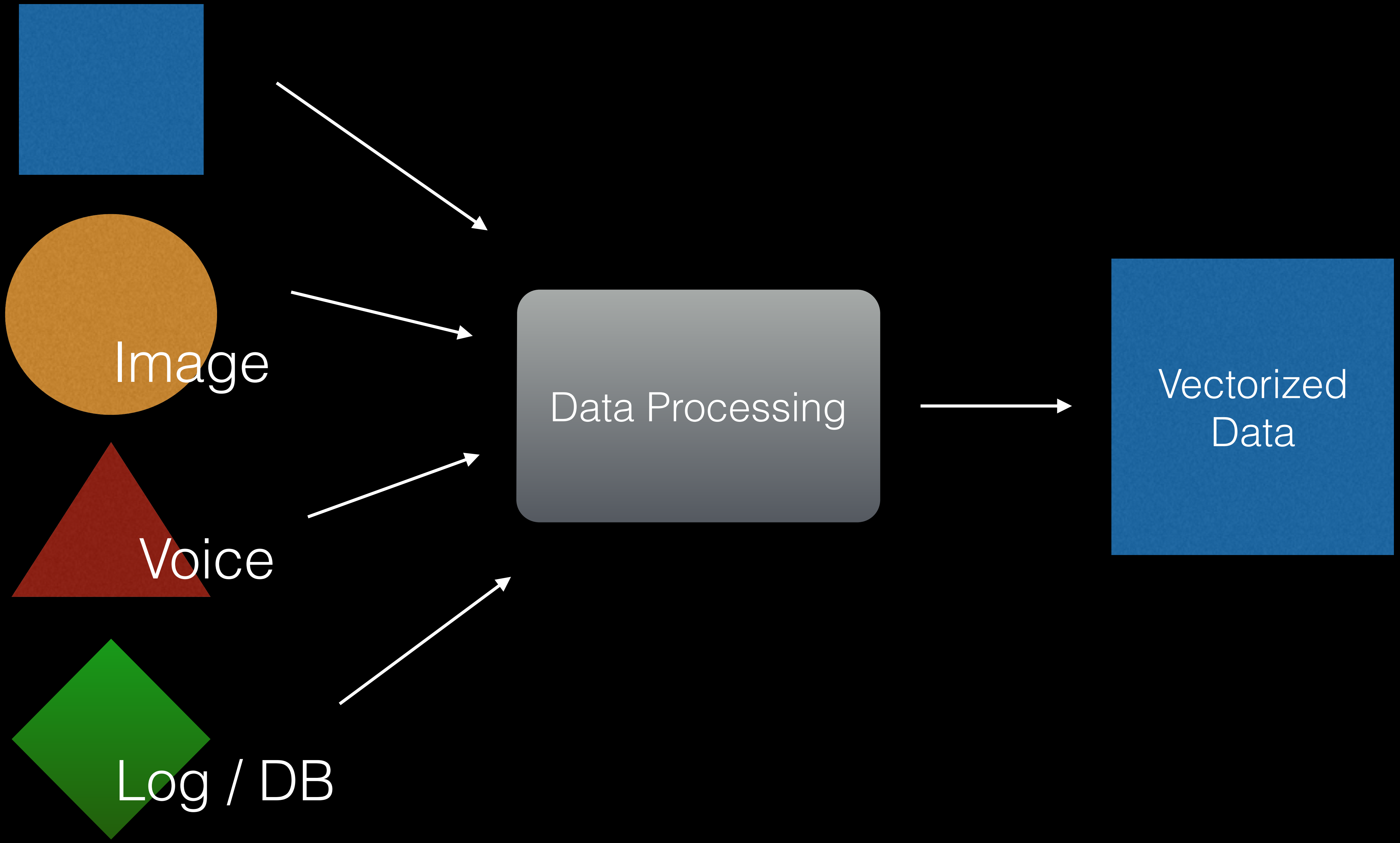
clustering challenges

- Curse of Dimensionality
- Choice of distance / number of parameters
- Performance
- Choice # of clusters

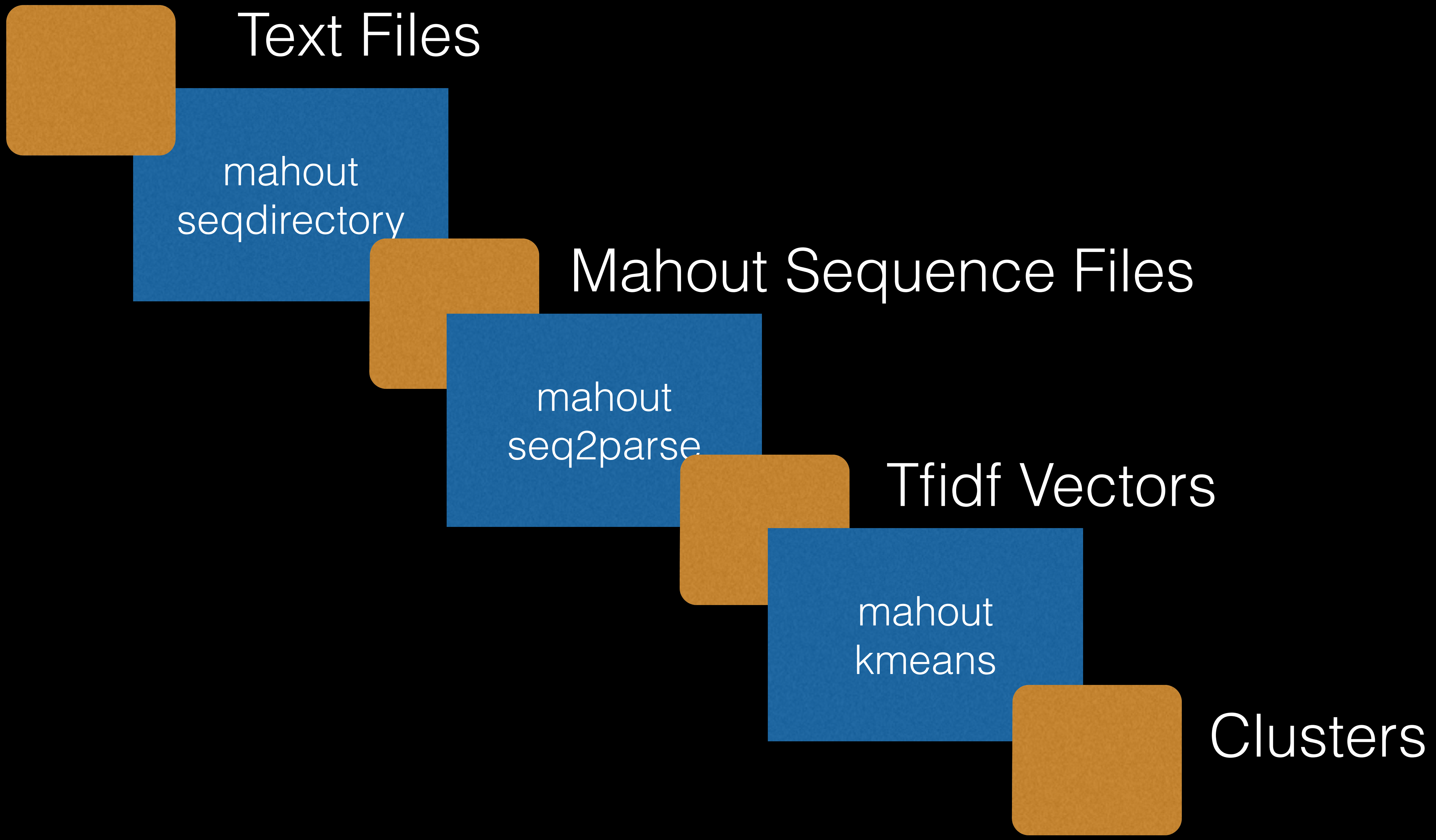
Mahout Clustering Challenges

- No Integrated Feature Engineering Stack: Get ready to write data processing in Java
- Hadoop SequenceFile required as an input
- Iterations as Map/Reduce read and write to disks: Relatively slow compared to in-memory processing

Data Processing



Mahout K-Means on Text Workflow



Text Files

mahout seqdirectory

Mahout Sequence Files

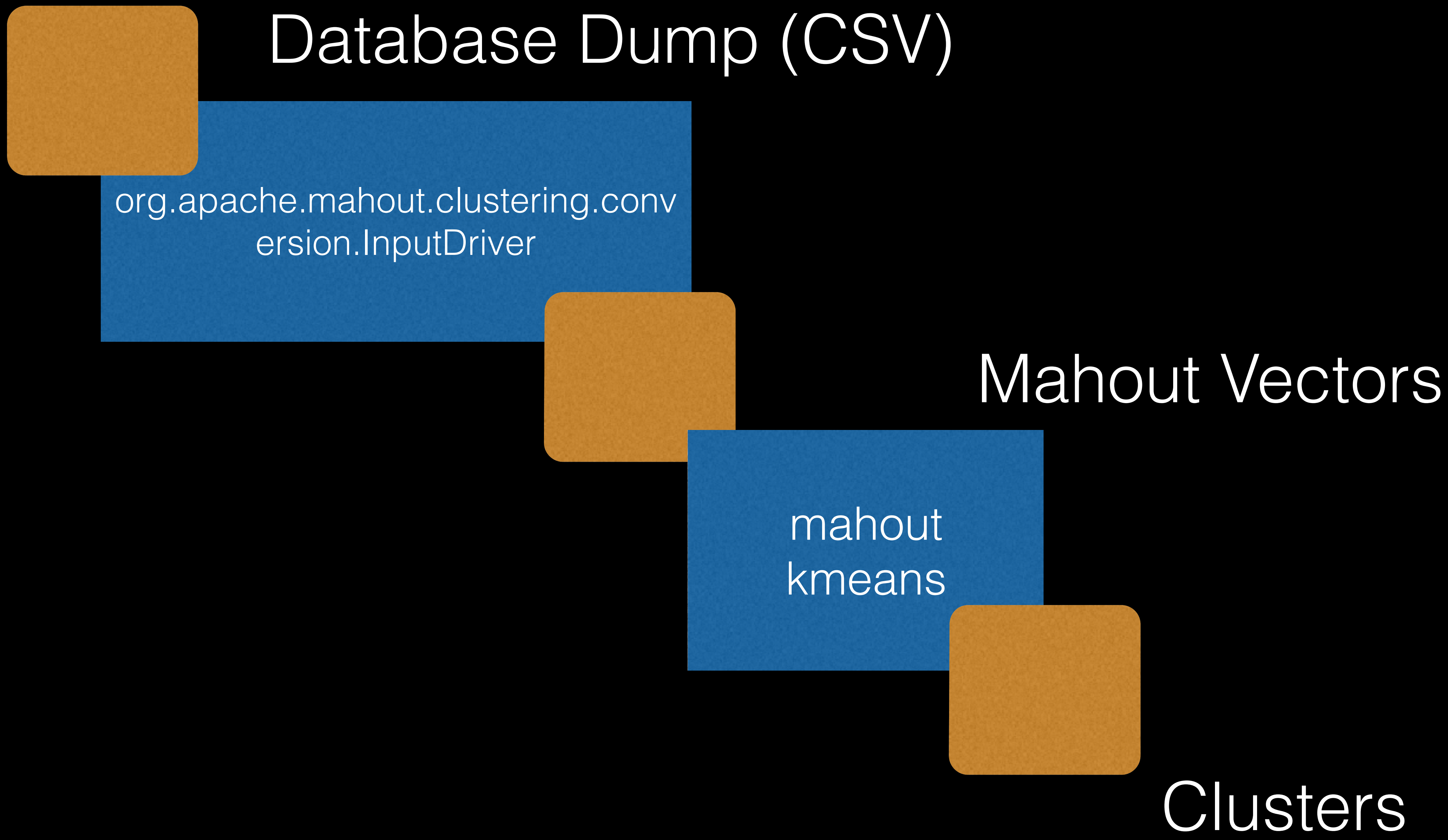
mahout seq2parse

Tfidf Vectors

mahout kmeans

Clusters

Mahout K-Means on Database Extract Worflow



Database Dump (CSV)

org.apache.mahout.clustering.conversion.InputDriver

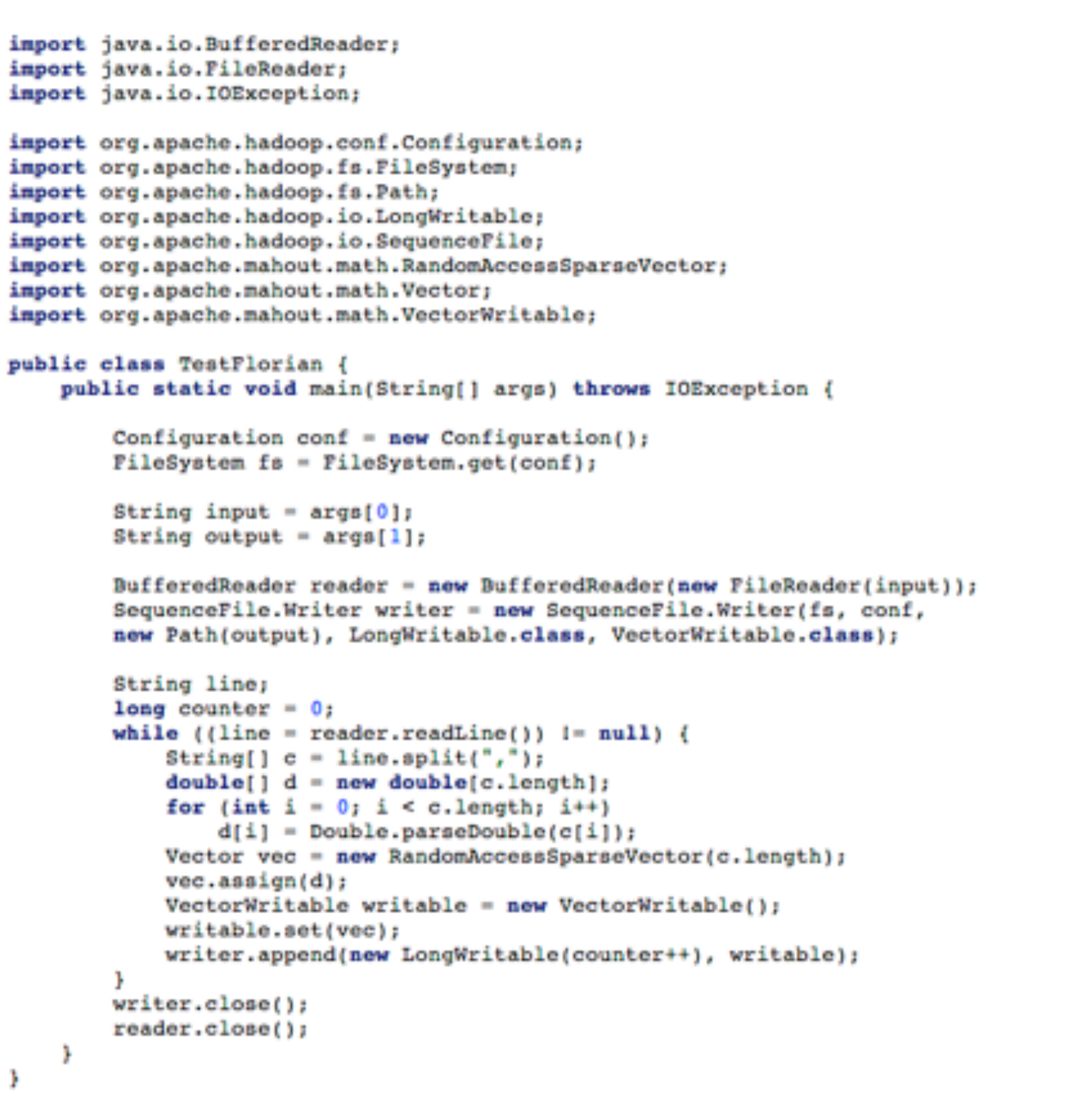
Mahout Vectors

mahout kmeans

Clusters

Convert a CSV File to Mahout Vector

- Real Code would have
  - Converting Categorical variables to dimensions
  - Variable Rescaling
  - Dropping IDs (name, forname …)



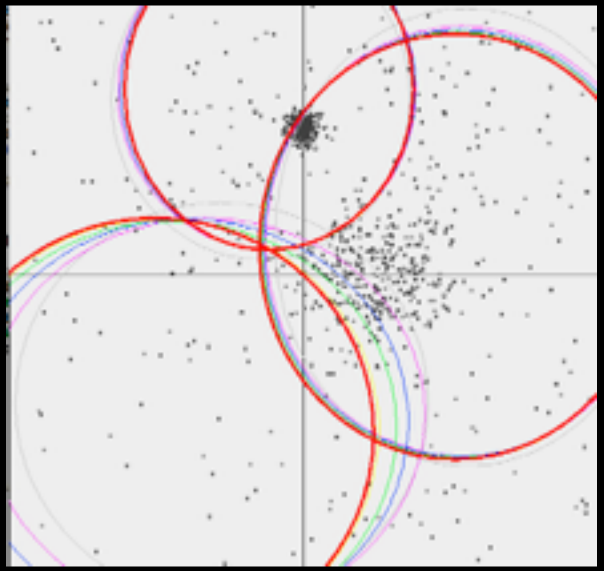
```java
import java.io.BufferedReader;
import java.io.FileReader;
import java.io.IOException;

import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.FileSystem;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.SequenceFile;
import org.apache.mahout.math.RandomAccessSparseVector;
import org.apache.mahout.math.Vector;
import org.apache.mahout.math.VectorWritable;

public class TestFlorian {
    public static void main(String[] args) throws IOException {

        Configuration conf = new Configuration();
        FileSystem fs = FileSystem.get(conf);

        String input = args[0];
        String output = args[1];

        BufferedReader reader = new BufferedReader(new FileReader(input));
        SequenceFile.Writer writer = new SequenceFile.Writer(fs, conf,
        new Path(output), LongWritable.class, VectorWritable.class);

        String line;
        long counter = 0;
        while ((line = reader.readLine()) != null) {
            String[] c = line.split(",");
            double[] d = new double[c.length];
            for (int i = 0; i < c.length; i++)
                d[i] = Double.parseDouble(c[i]);
            Vector vec = new RandomAccessSparseVector(c.length);
            vec.assign(d);
            VectorWritable writable = new VectorWritable();
            writable.set(vec);
            writer.append(new LongWritable(counter++), writable);
        }
        writer.close();
        reader.close();
    }
}
```

Mahout Algorithms

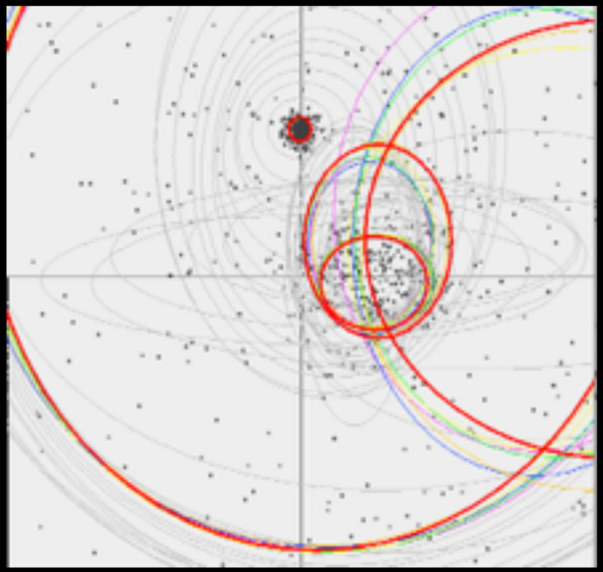
	Parameters	Implicit Assumption	Ouput
K-Means	K (number of clusters) Convergence	Circles	Point -> ClusterId
Fuzzy K-Means	K (number of clusters) Convergence	Circles	Point -> ClusterId * , Probability
Expectation Maximization	K (Number of clusterS) Convergence	Gaussian distribution	Point -> ClusterId*, Probability
Mean-Shift Clustering	Distance boundaries, Convergence	Gradient like distribution	Point -> Cluster ID
Top Down Clustering	Two Clustering Algorithns	Hierarchy	Point -> Large ClusterId, Small ClusterId
Dirichlet Process	Model Distribution	Points are a mixture of distribution	Point -> ClusterId, Probability
Spectral Clustering	-	-	Point -> ClusterId
MinHash Clustering	Number of hash / keys Hash Type	High Dimension	Point -> Hash*

Comparing Clustering

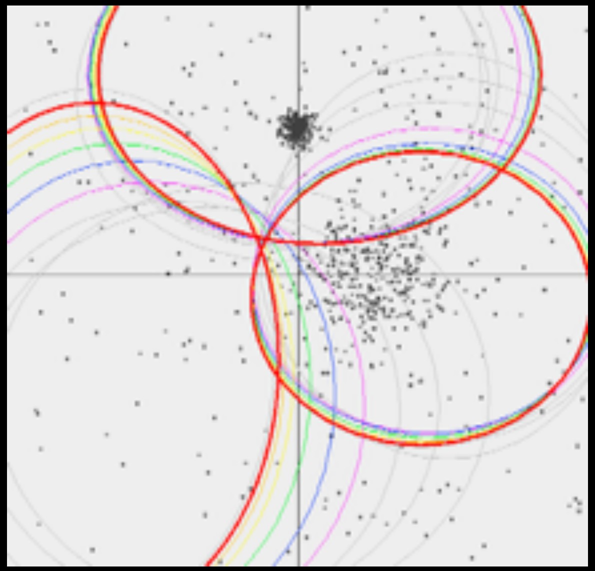
KMeans



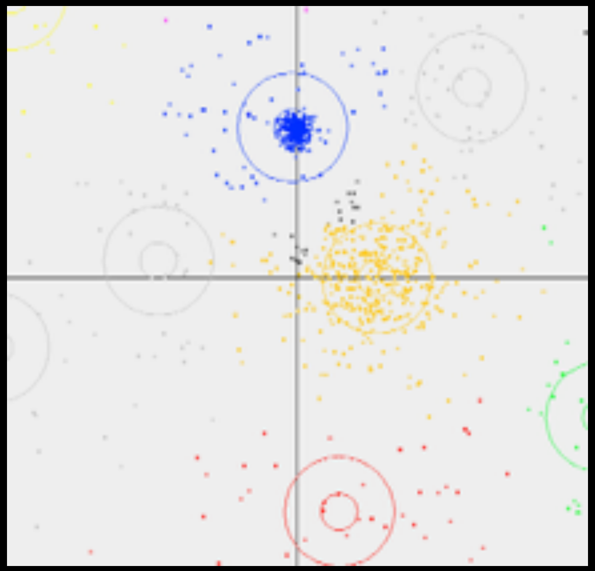
Dirichlet



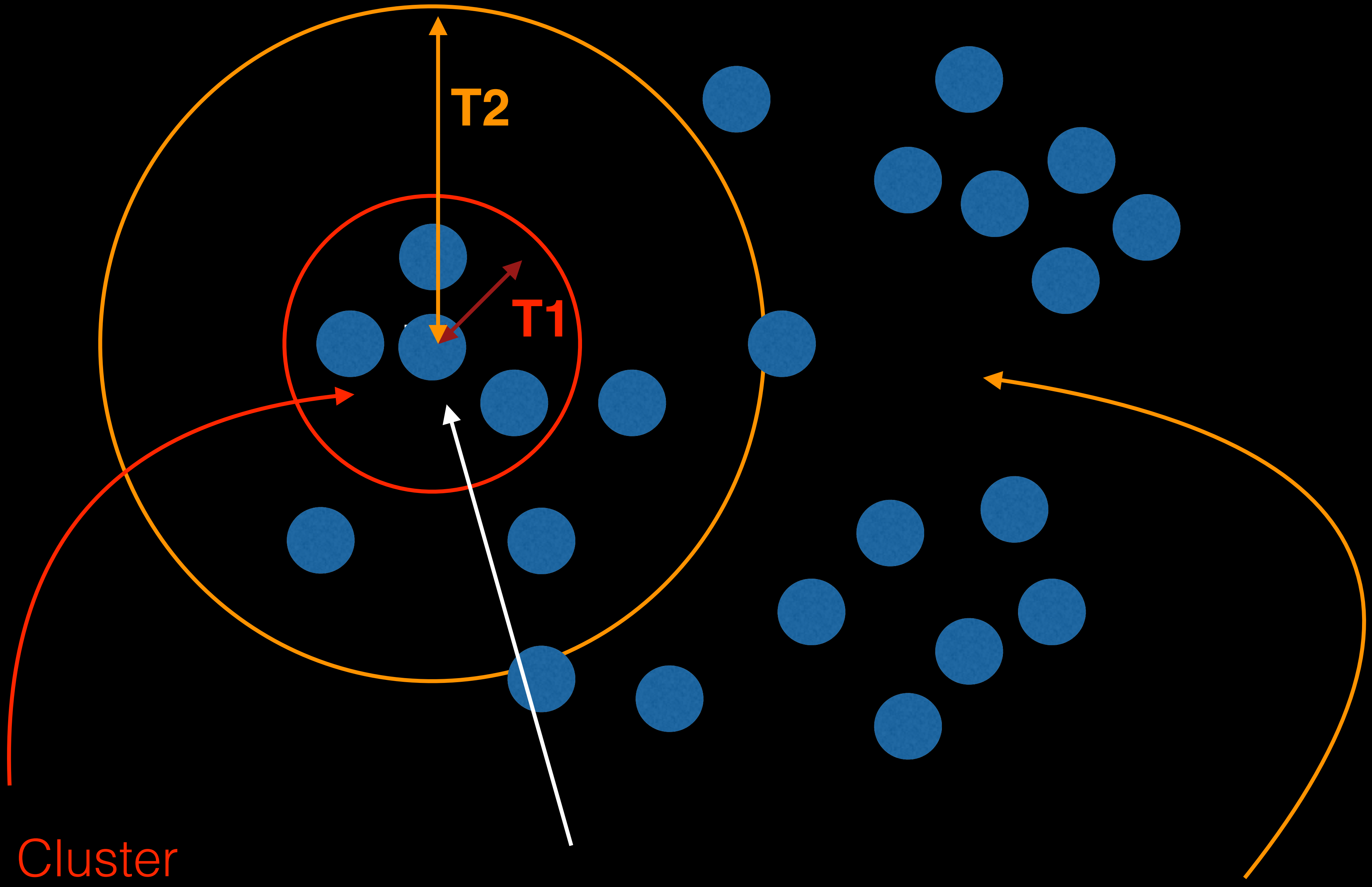
Fuzzy KMeans



MeanShift



Canopy Optimization



Surely in Cluster

Pick a random point

Surely not in cluster