Holistic AI × The Alan Turing Institute

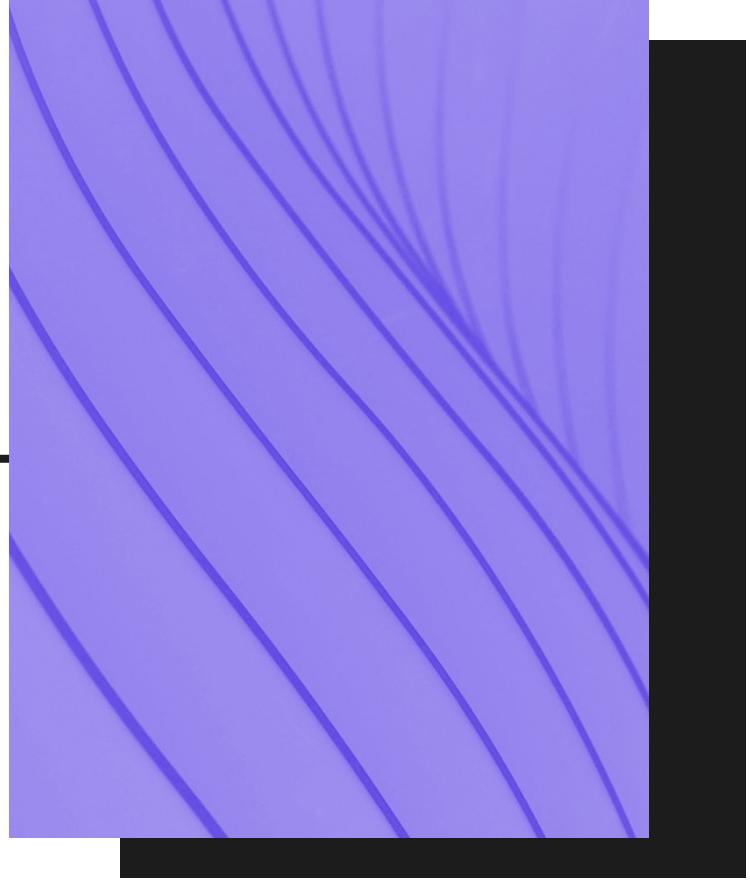
Bias in Clustering Systems Part II

Sachin Beepath
Assurance Officer, Holistic AI

Contents

Fairness in Clustering Tasks

1. Formalize group and individual fairness in clustering.
2. Demonstrate the different results for group and individual fairness.
3. Apply fairness notions to real world examples.



Motivating Example

A city would like to build 3 public parks but are unsure where to place them.

Motivating Example (Cont.)

- Assigns single park to serve large number of people in a dense region.
- Assigns two parks to a very sparse area of with a low population;

Motivating Example (Cont.)

- Assigns single park to serve large number of people in a dense region.
- Assigns two parks to a very sparse area of with a low population.

Group Fairness

Groups should be treated equally. No group should be adversely affected or given preferential treatment by decisions made by an algorithmic system.

- Balance
- Cluster Distribution KL Divergence
- Social Fairness
- Silhouette Difference

Individual Fairness

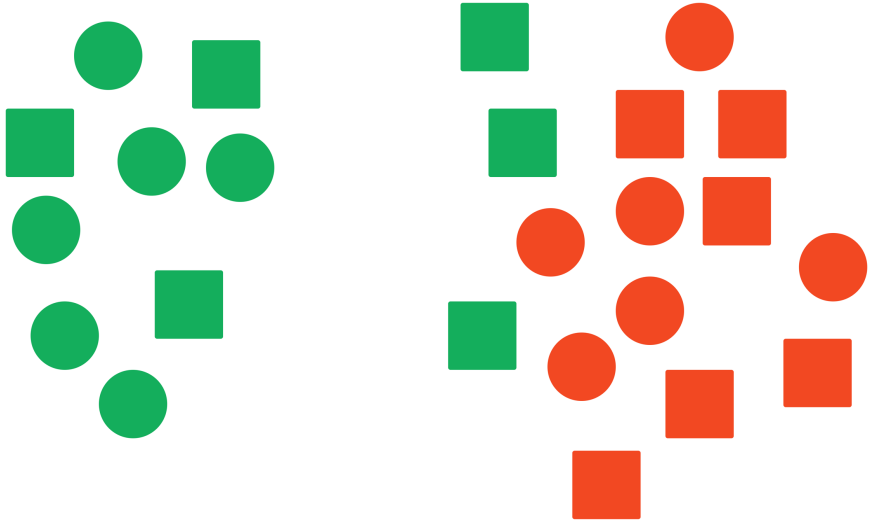
Similar individuals should receive similar treatment from an algorithmic system. Similar individuals should be clustered together.

- Proportionality: Clustering such that cluster centres are proportionally shared across individuals. Relevant for use cases that don’t involve protected attributes (park example).

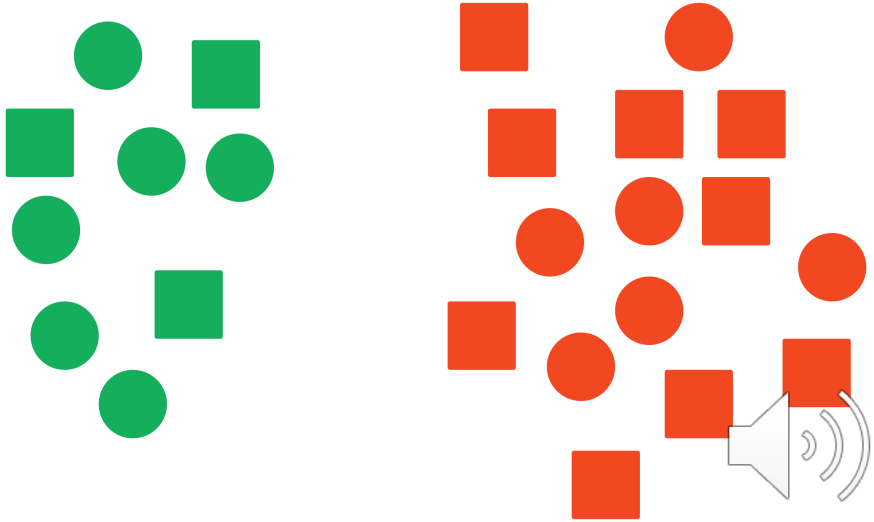
Group vs. Individual Fairness

Consider a clustering problem where there are two groups of objects, circles and squares:

Group Fairness

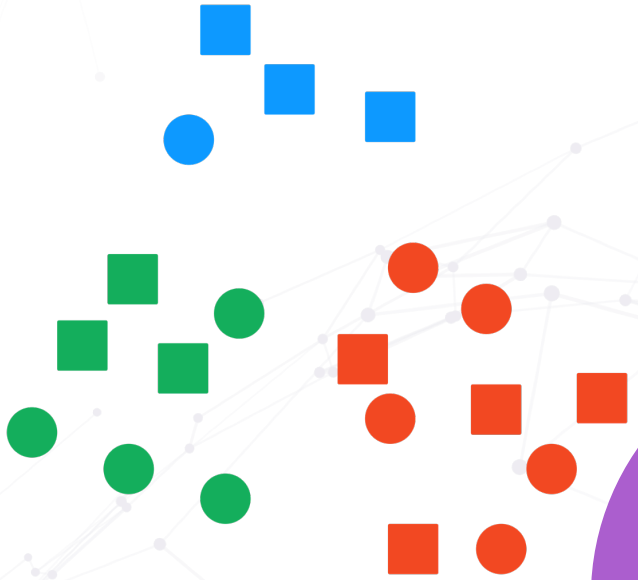


Individual Fairness

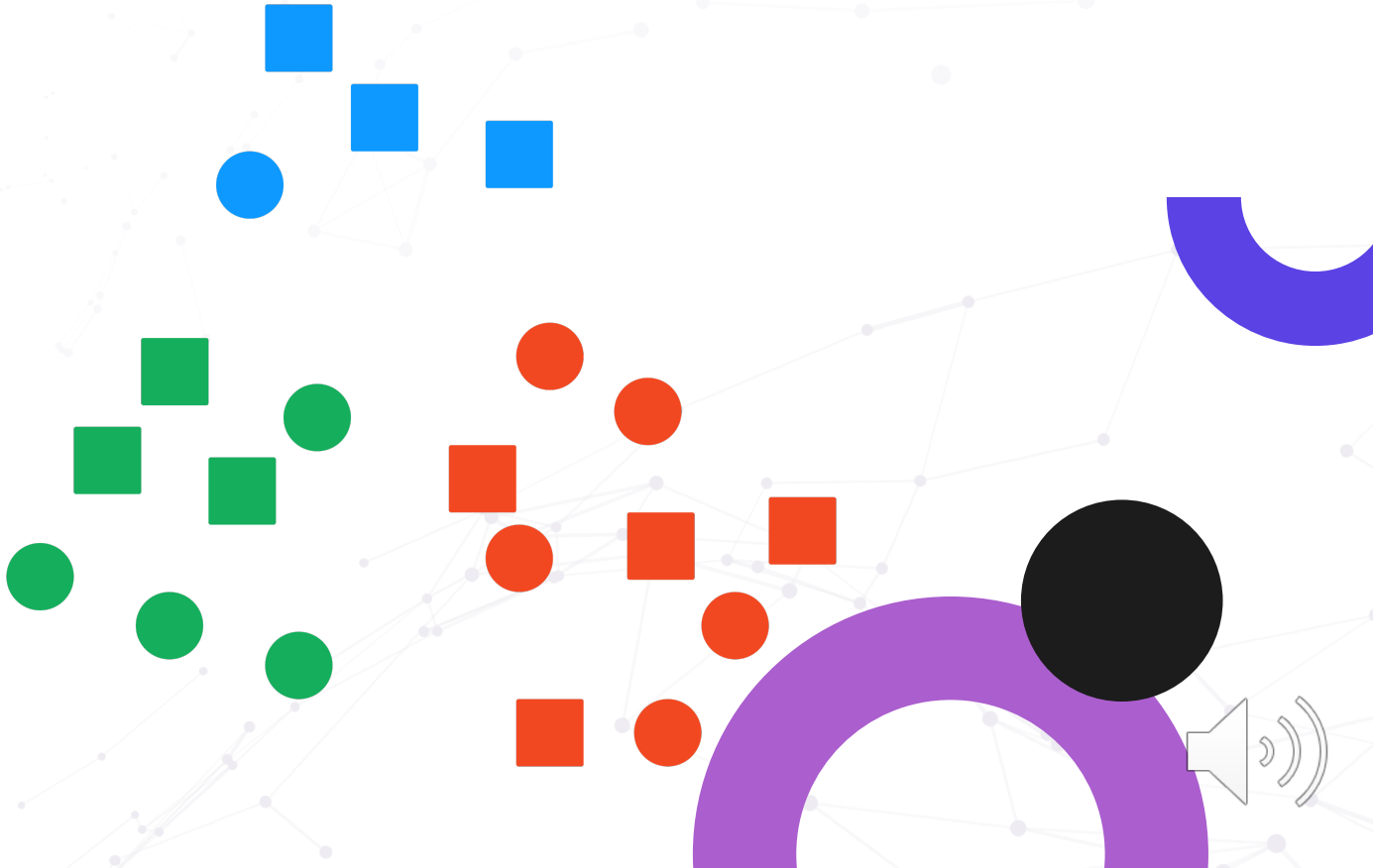


Part 2 Question 1

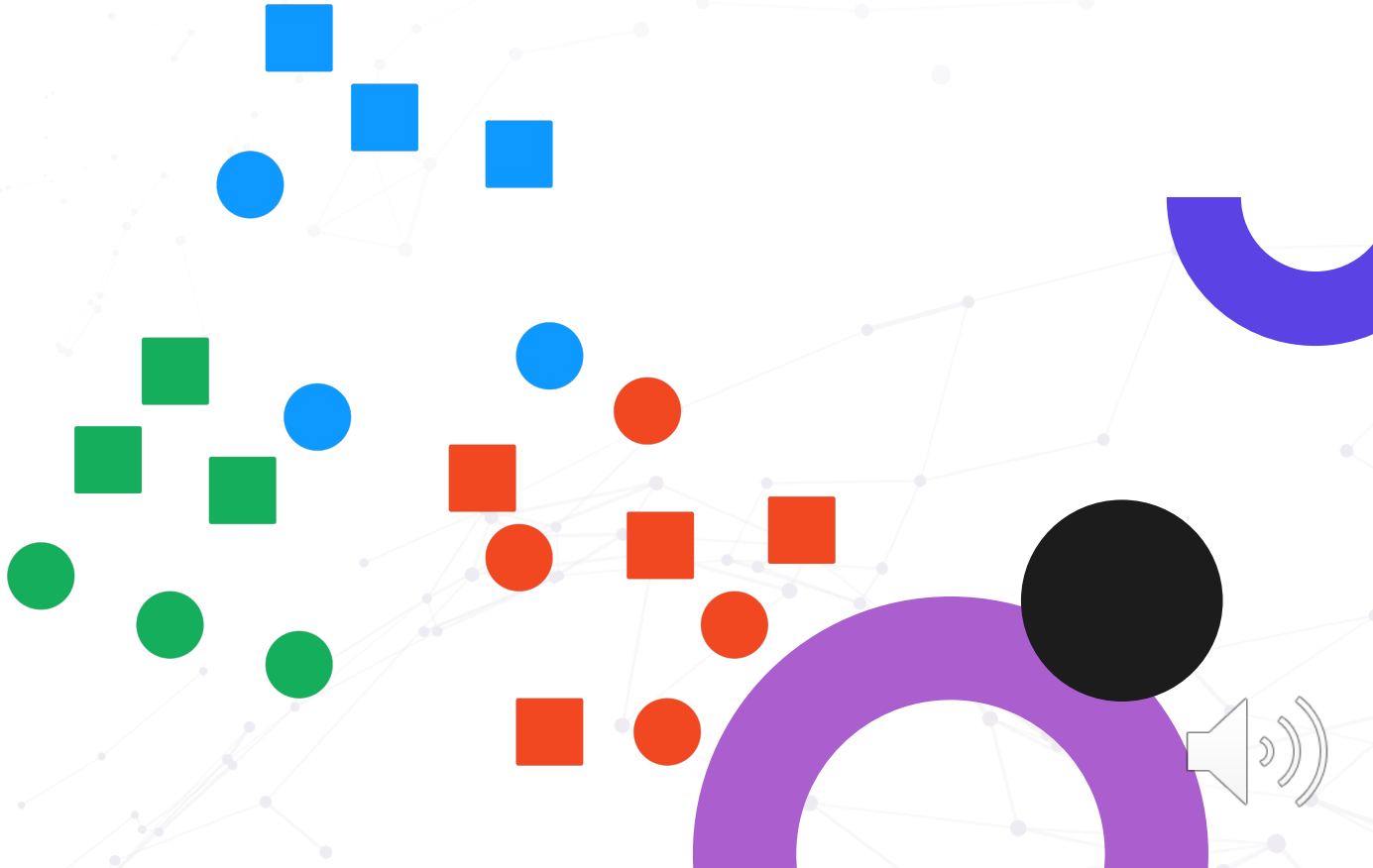
What changes need to be made to this system in order for it to be fair under the notion of group fairness?



Part 2 Question 1



Part 2 Question 1



Bank Loan Example

- Used to determine whether someone should get a loan based on how likely they are to default on it.
- More likely to reject women, POC, and married people due to bias.
- Clustering should consider group notion of fairness.
- Each cluster should have same proportion of protected groups.

Job Short Listing Example

- Apply clustering to group similar candidates together.
- Choose candidates to move on by what cluster they are assigned.
- Each cluster should have same proportion of protected groups.
- Assign top qualified members from marginalized group from rejected cluster to the accepted.

Prisoner Recidivism Example

- The tendency for a prisoner to reoffend can be interpreted as a probability.
- Soft Clustering to assign probability of reoffending.
- Can disproportionately assign higher probabilities to POC.
- Individuals with similar crime histories should be clustered similarly.

Conclusion

- Formalized group and individual fairness notions and metrics in clustering systems.
- Demonstrated how considering group fairness results in different outcomes than when considering individual fairness.
- Explored how to use various notions of fairness in real-world examples.

Contents