

Physics of Cheating

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1. Introduction

Clustering phenomena are observed in various systems like in the snow flakes, in the material science or even in the socio-science. As we are all teaching assistant, we have been observing this phenomena in a series of homework in grading. In this research, analyze its intrinsic *structure* with characteristic phase transition by developing tools to quantify the properties.

2. Method

To quantify and analyze homework-network (HN), we propose items, or parameters, and assign a value to each HN to observe clustered state. By applying tools to each homework sets, we collect data and analyze.

Items: Logic flow, Common misconception, Habits, Figure, Due-date, Difficulty, Treating way of error, Understanding way of problem, score

Value:
$$\xi = \frac{1}{N} \sum_{i=1}^N \sum_{j \neq i}^N w_{ij} \mathbb{1}_{[v_i \sim v_j]}$$

N : Total number of nodes

w_{ij} : Weight

$\mathbb{1}_{[v_i \sim v_j]}$: 1 for connected nodes
0 otherwise

3. Key Result

We analyze raw data with previously developed measure, 'Value'. During the analysis, we noticed average score is not a good parameter so we introduce a better parameter, 'Difficulty'. With 'Difficulty', we present a one of non-trivial results. Fig. 1 shows 'Difficulty' gives more clear signal than 'Average'. Each extreme is correlated. Fig. 2 also gives consistent result with Fig. 1.

$$\text{Difficulty} := \frac{10 - \text{Average}}{10} + 10 \times \text{Fail.Ratio}$$

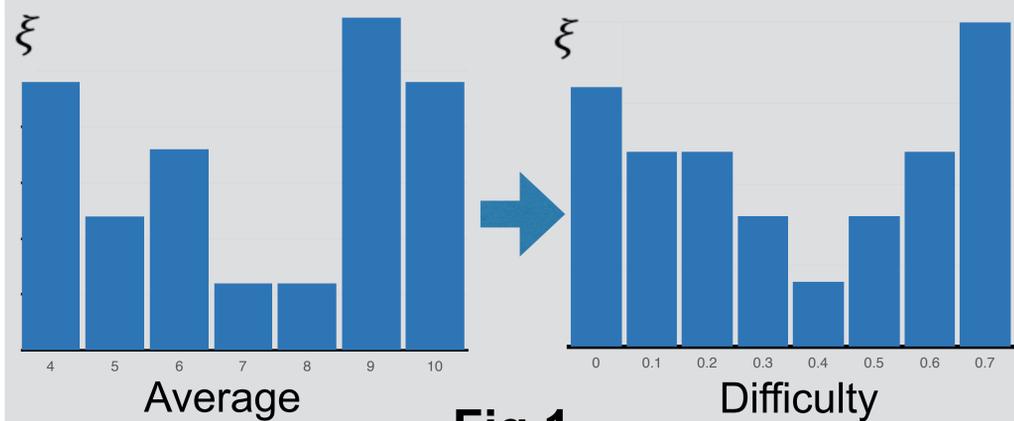


Fig.1

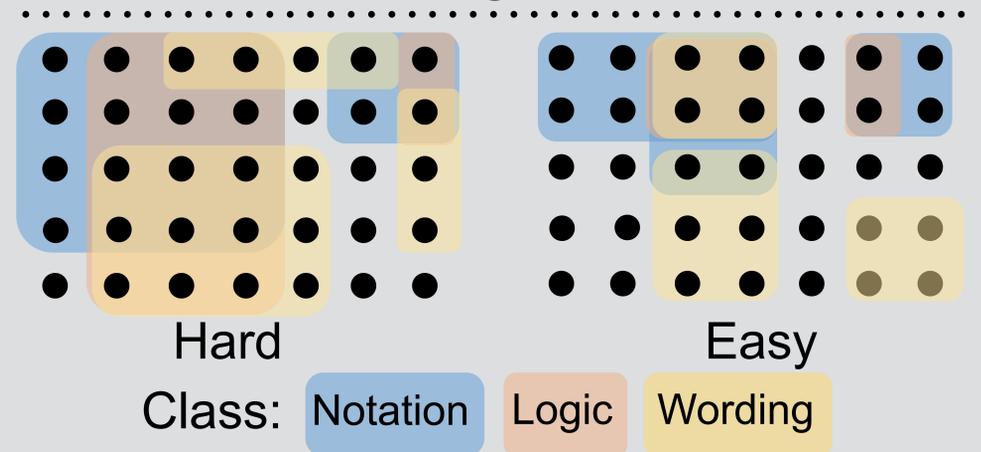


Fig.2

4. Conclusion

- I) As it is difficult, size of cluster grows.
- II) Very easy problems shows *large* cluster size.
 - A single measure may not be complete
- III) Very hard problem and easy problems also shows large cluster size but they can be distinguished by size of give-up group.
- IV) Hints or bias can enlarge cluster size.
 - Tips enhance intrinsic correlation.
- V) Due-date can affect the size of cluster.
 - Too far Due-date can make student too relaxed.
- VI) A single score is not very good measure.
- VII) With this graphs and in-class exam, one may track the source, hub, of HN
- VIII) We may find a map from this system spin-glass system.

5. Reference

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