A Study of Digital Ink to Inform the Scaling of a Classroom Interaction System

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The Problem

Classroom Presenter allows exercises to be conducted and submitted in-class, electronically to the instructor.
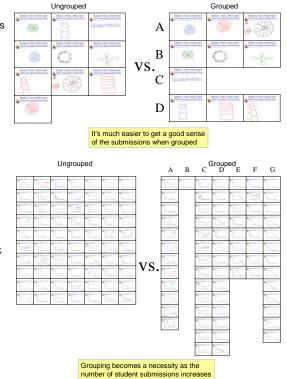
Instructor has several goals for responses or "student submissions":

- Get a sense for the distribution of responses
- Pick out creative or otherwise outlying responses
- Locate a specific type of response – to illustrate an important point

Scaling is a problem as class size increases.

Clustering is one solution, but to work the following must be true:

- Data must include natural clusters
- Instructors' goals must be achievable with clustering
- Clusters must be easily computable
- Clusters should not require excessive domain knowledge

Ungrouped vs. Grouped (A B C D)

It's much easier to get a good sense of the submissions when grouped

Ungrouped vs. Grouped (A B C D E F G)

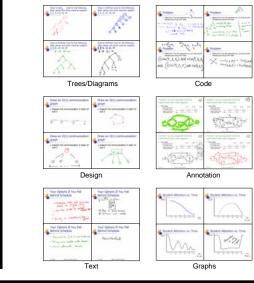Grouping becomes a necessity as the number of student submissions increases

The Student Submissions Data

We've collected a lot of real classroom data:

- 5 instructors
- 28 class sessions
- 87 different activities
- 1100 individual student submissions

Large variety of different types of activities:

Trees/Diagrams — Code — Design — Annotation — Text — Graphs

The Study and Results

Do Instructors View Grouping as Useful?

Surveyed instructors about what groups, if any, would have been useful for activities:

- In 33 of the 36 activities included: groups would have been useful
- For many activities the desired grouping was: "Correct", "Partially Correct", "Incorrect"
- For others, the desired grouping was based on a particular feature (i.e. shape)
- 3-5 groups usually desired

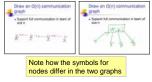| Activity Name	Average edit distance to instructor sort	Average edit distance across all sorts
EqAccess	1.4 (10%)	1.7 (12%)
FindCode	1.0 (10%)	1.4 (14%)
BehindWriteIn	2.8 (13%)	3.1 (15%)
ComGraph	3.4 (17%)	3.7 (19%)
HuffmanTree	4.5 (21%)	4.9 (23%)
FailReason	18.6 (42%)	18.5 (42%)

If the groupings agree then there is likely a "natural" grouping, otherwise no predominant grouping.

Answer: Yes, most of the time

Does the Data Form Groups?

Independently grouped the responses to several activities by hand.

Compared the resulting groupings to the instructors "ideal" grouping and to each other.

Answer: Depends highly on the activity

Can Groups be Formed Automatically?

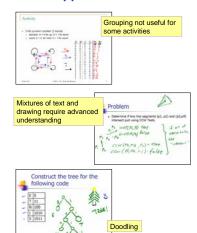First looked for simple algorithms that correctly clustered our data.

The flexibility of digital ink makes the medium expressive, but also difficult for automatic understanding.

Note how the symbols for nodes differ in the two graphs

Sometimes full understanding isn't necessary – just need to identify differences.

Answer: Intractable, but simple algorithms can work well

What are some Challenges of this Approach?

Grouping not useful for some activities

Mixtures of text and drawing require advanced understanding

Doodling

Classroom Presenter is free for educational and non-commercial use. It is available from: www.cs.washington.edu/education/dl/presenter/

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