PARSING HANDWRITTEN MATH FORMULAS

Lakshmi Ravi   Advisor: Dr. Richard Zanibbi

R·I·T

Computer Science @ RIT
B.Thomas Golisano College of Computing & Information Sciences

dprl

Goal

Identify **new features** for classifying spatial relationships and **improve the graph representation** of the input expression to increase the recognition rate
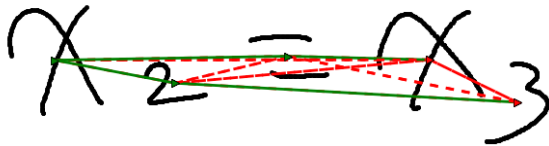
Graph Representation

➢ **Build** symbol Line of sight **graph**(LOS) **Eye** – Center of the symbol. **Connect** symbols visible from it's eye.

LOS graph and final layout tree(green)

➢ **Eliminate edges** with low confidence in LOS graph, based on visual, geometric and angular features.

Filtered graph and final layout tree(green)

System Overview

Build Symbol LOS Graph → Edge Elimination → Classify Layout → Extract Layout Tree
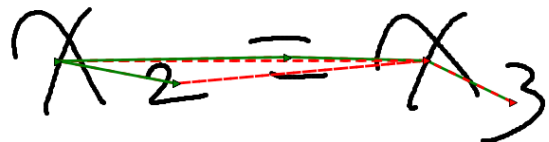
Features - Edge Elimination & Classification

Features are extracted between two symbols (parent and child).

❖ *Visual features* extracted by encapsulating the parent and child in concentric circles, divided into angular bins and find the density of parent, child and other symbol points in the bin

| Expression | Parent Features('=') | Child Features ('3') | Context ('x') |
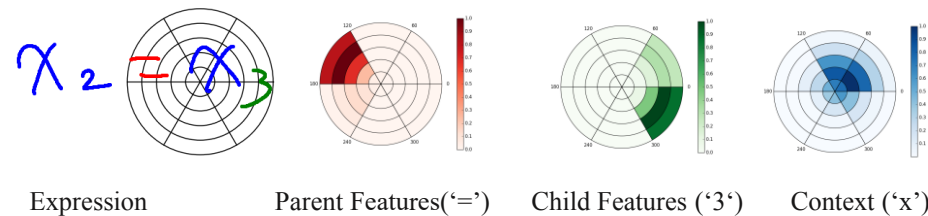
❖ *Geometric features* computes distance and offsets based on positioning of parent and child symbol's bounding boxes.

❖ *Angular features* finds the angular range blocked by the child symbol from the parent symbol's eye. The features are the lower bound and upper bound

Results

Dataset used: CROHME 2014

Scenario	Layout Recall	Formula Rate
Baseline [1]	92.4%	61.2%
Angular features	94%	62.4%
Edge Elimination	95%	63.7%

Conclusion

• Angular Features help in better layout classification.
• Elimination of edges improves the formula recognition rate.

References

1. L.Hu, R.Zanibbi, "MST Based Visual Parsing of Online Handwritten Mathematical Expressions", Intl Conf. Frontiers Handwriting, 2016
2. L.Hu, R.Zanibbi, "Line of Sight Graphs and Parzen Shape Context Features for Handwritten Math Formula", Intl Conf. Frontiers Handwriting, 2016