**Dijkstra in Practice**

Shortest Paths in Road Networks

Andrew V. Goldberg
Microsoft Research – Silicon Valley
https://research.microsoft.com/~goldberg/

**Dijkstra’s Algorithm**

scanned vertices shortest path found

**Bidirectional Version**

forward search / reverse search

**Bidirectional A*-search with Landmarks**

forward search / reverse search

**MST Applications**

On the History of the Minimum Spanning Tree Problem
R. L. Graham and Pavol Hell

Network Design
Logistics

Clustering / Taxonomy
Optimization problem over a graph: decide which
endangered species?

We have obtained satisfactory results by using
some examples of expressions recognized by the current system.

We presented a method for the structural analysis of on-line handwritten mathematical expressions based on a minimum spanning tree construction and symbol recognition. This allows immediate feedback and has undo-redo and visualization capabilities.

Our experiments showed that our method is robust to handle some
dominance. Our method handles non-standard layouts, like
ribover, hajic

Recognition of On-line Handwritten Mathematical Expressions Using a Minimum Spanning Tree Construction and Symbol Dominance

Ernesto Tapia and Raúl Rojas

Abstract

Given a mathematical expression to determine the optimal values of the
expression which describes the mathematical relationships among the symbols.

We apply some
technique to obtain a hierarchical structure of the

form a contiguous substring of the sentence.

The second step is to
determine using a classifier. The second step is to
apply some

More surprisingly, the representation is
extended naturally to non-projective pars-
guages with non-projective dependencies.

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Recognition of On-line Handwritten Mathematical Expressions

More surprisingly, the representation is
extended naturally to non-projective pars-
guages with non-projective dependencies.

Recognizing stacked arguments of sum-like operators, like the one used in (1). This
shows some examples of expressions recognized by the current system.

Ernesto Tapia and Raúl Rojas

Recognition of On-line Handwritten Mathematical Expressions Using a Minimum Spanning Tree Construction and Symbol Dominance

Extensions: Network Design

Given: undirected graph \( G = (V, E) \) with
edge costs \( c_e > 0 \) and terminals \( X \subseteq V \)

Find: subset \( T \subseteq E \) such that \( G' = (V, T) \) has
a path between each pair of terminals and the total cost is as small as possible

Small Extension of MST: Easier? Harder?

Minimum Steiner Tree Problem

Spatial Conservation Planning

• Which land should I buy to maximize the spread of
an endangered species?
• Optimization problem over a graph: decide which
nodes to add to the graph, given a fixed budget

Spatial Conservation Planning

Conservation Strategies

Formulate and solve network design problem as an integer program

Conservation Reservoir

Initial population

Our solution

Greedy baseline

Building outward from sources

Corridors
River Networks

- Web demo