

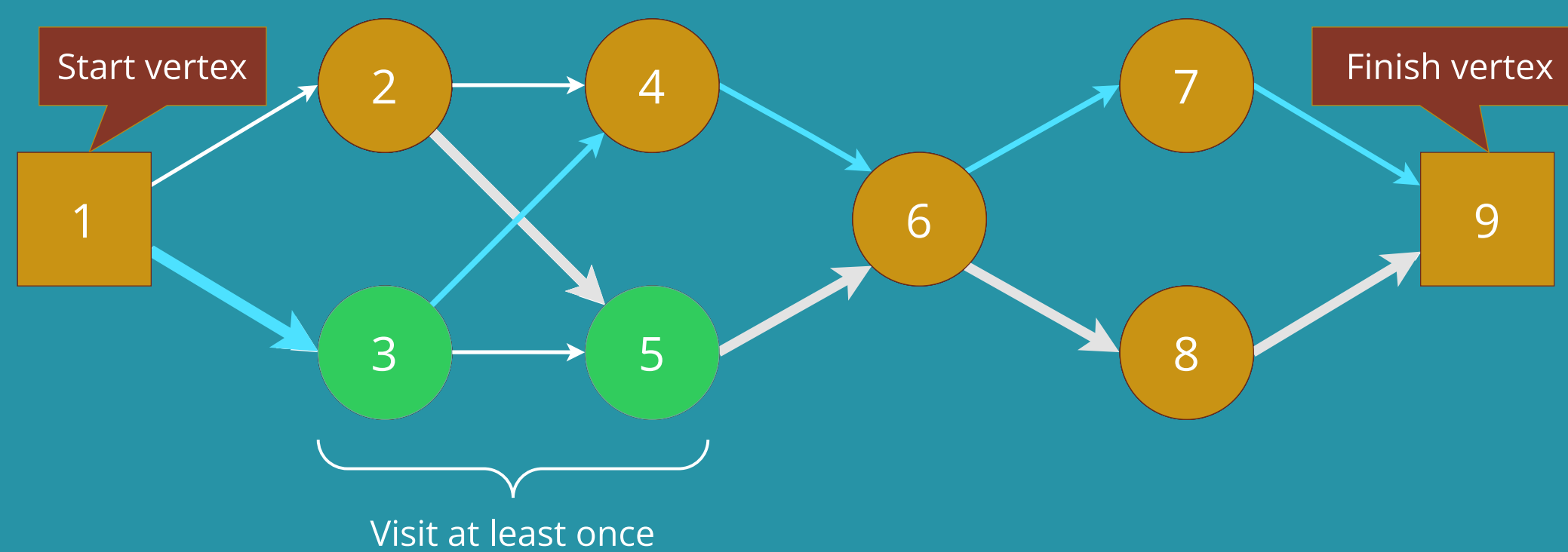


Paths, Proofs and Perfection: Human-Interpretable Proof System for Constrained Shortest Paths



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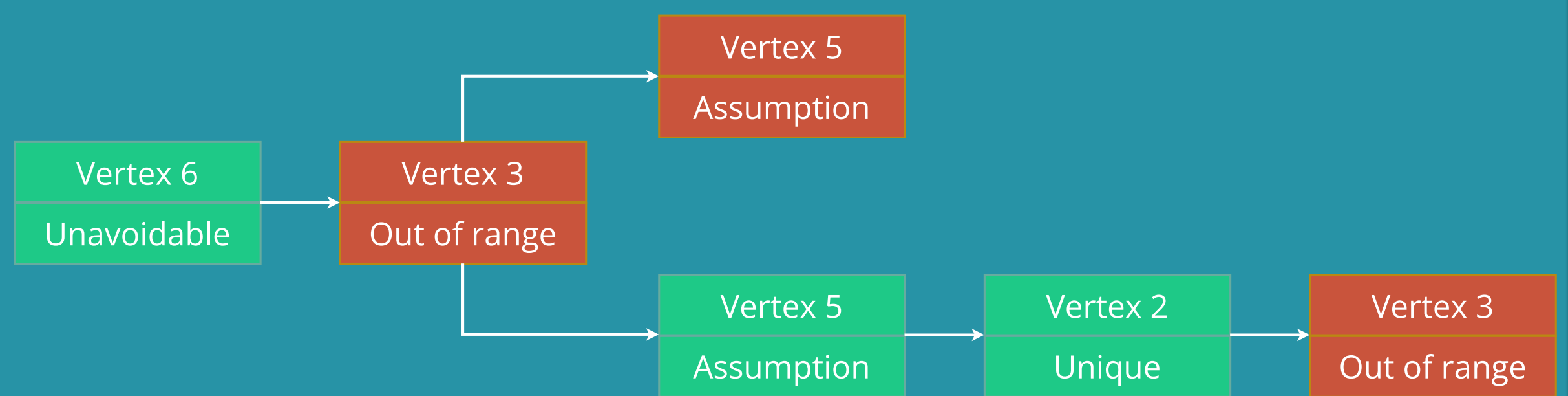
Motivation



- How to explain *why there is no shorter path* from 1 to 9?
- How should an explanation *look like*?

Our contributions: a proof system for graphs that is easy to understand

- *Domain-specific* proof system exploiting the graph-theoretic knowledge
- *Size-minimizing* proof search algorithm

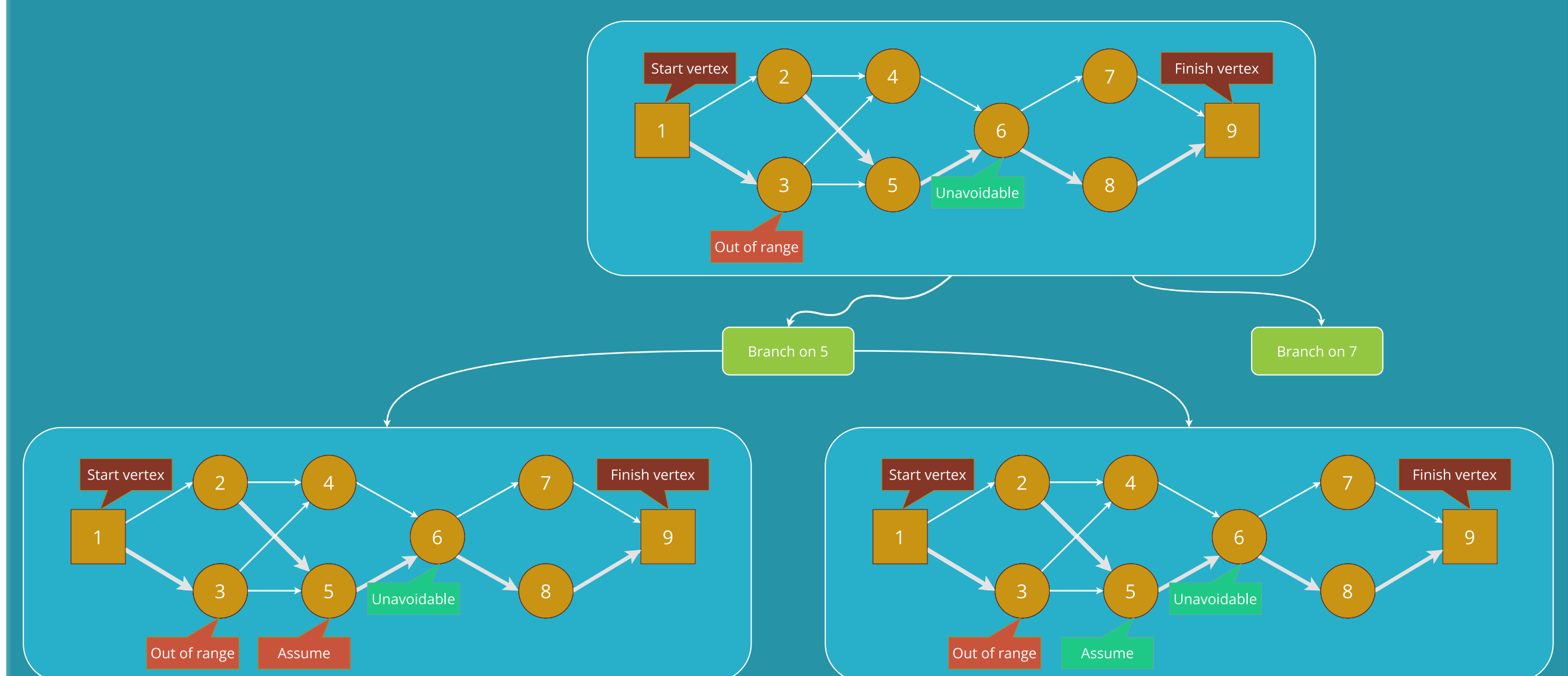


A domain-specific proof system

- *Tree-shaped proofs*
- *Reasoning tailored* to shortest path problems
- Proof steps include *out-of-range vertices, bridge edges* and other problem-centric concepts

Size-minimizing proof search

Best-first search over *trees of subgraphs*:



Experimental results

- *Baseline*: SCIP solver with cutting-plane proof logging
- "*Mandatory vertex set*" side constraints: *2x to 4x narrower* than the baseline
- *Resource (knapsack)* side constraints: on par or slightly worse