4. **Greedy Algorithms II**

- Edmonds branching algorithm demo

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**Edmonds branching algorithm demo**

**Phase 1: find cheapest edge entering each node**

![Diagram showing phase 1 of the Edmonds branching algorithm]

**Phase 1: replace costs with reduced costs**

![Diagram showing phase 1 of the Edmonds branching algorithm with costs replaced]

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**Edmonds branching algorithm demo**

**Input digraph** $G = (V, E)$

![Diagram of the input digraph]

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**Edmonds branching algorithm demo**

**Phase 1: find cheapest edge entering each node**

![Diagram showing phase 1 of the Edmonds branching algorithm]

**Phase 1: replace costs with reduced costs**

![Diagram showing phase 1 of the Edmonds branching algorithm with costs replaced]
Phase 1: find 0-cost directed cycle $C$ and contract

Phase 2: digraph $G'$

Phase 2: find cheapest edge entering each node

Phase 2: replace cost with reduced costs
Edmonds branching algorithm demo

Phase 2: find 0-cost directed cycle and contract

Phase 3: digraph $G''$

Phase 3: find cheapest edge entering each node

Phase 3: it's an arborescence!
Edmonds branching algorithm demo

**Phase 2': uncontract node and take all but one edge of cycle**

![Graph](image1)

**Phase 1': uncontract node and take all but one edge of cycle**

![Graph](image2)

**stop: no more nodes to uncontract**

![Graph](image3)

**min-cost arborescence**

![Graph](image4)