DM865 — Heuristics and Approximation Algorithms

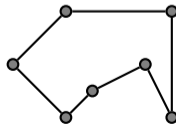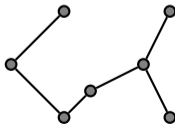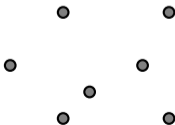|	
Teachers:	Marco Chiarandini & Lene Favrholdt
Credits:	10 ECTS
Prerequisites:	✔ Programming (DM502, DM503, DM550)
	✔ Algorithms and Datastructures (DM507)
	✓ Complexity and Computability (DM508, DM553)
	✓ Linear and Integer Programming (DM559, DM545, DM554, DM871)
Language:	English and/or Danish
Classes:	Intro: $2h \times 20$; training: $2h \times 15$
Material:	Slides + textbook + articles + starting code
Assessment:	Practical projects + oral exam

Double tree algorithm:

1. $T \leftarrow$ MST
2. Double all edges in T
3. $E_{tour} \leftarrow$ Euler tour
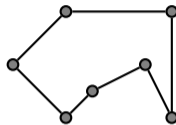4. Tour $\leftarrow$ vertices in order of appearance in E_{tour}

Approximation Algorithms
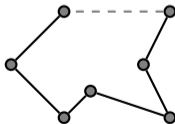
A 2-approximation algorithm for Metric TSP: Double-Tree
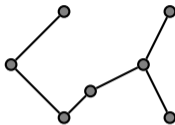
MST

$c(\text{MST}) \leq c(\text{OPT})$:

Tour

$c(\text{Tour}) \leq 2 \cdot c(MST)$
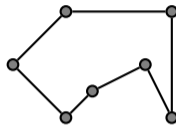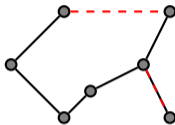
$\text{OPT} \rightarrow \text{ST}$

Double tree algorithm:
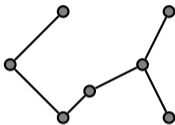
1. $T \leftarrow$ MST
2. Double all edges in T
3. $E_{tour} \leftarrow$ Euler tour
4. Tour $\leftarrow$ vertices in order of appearance in E_{tour}

Christofide's algorithm:
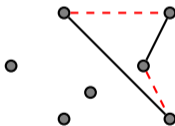
1. $T \leftarrow$ MST
2. Add minimum perfect matching of odd degree vertices in T
3. $E_{tour} \leftarrow$ Euler tour
4. Tour $\leftarrow$ vertices in order of appearance in E_{tour}

Approximation Algorithms

$$c(M) \leq \frac{1}{2}\text{OPT} :$$

$$c(M) \leq \frac{1}{2}c(\text{Tour}) \leq c(\text{Tour}) \leq c(\text{OPT})$$
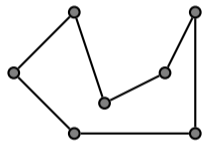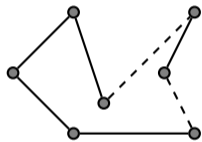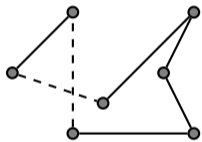
Approximation Algorithms

Lower bounds

Theorem

For $\alpha < \frac{185}{184}$, there is no α-approximation algorithm for Metric TSP.
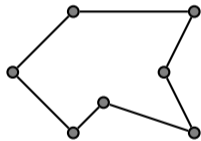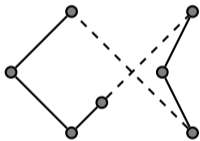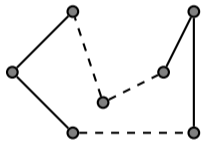
Theorem

There is no approximation algorithm for general TSP.

Local Search

Metaheuristics

Trying different changes / accepting worsening changes:

Contents

	Approx Algorithms	Local Search + Metaheuristics
Set Cover	✓	
Satisfiability	✓	✓
Traveling Salesman	✓	✓
Scheduling	✓	✓
Knapsack	✓	
Bin packing	✓	

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