

travelling salesman problem: shortest route via all customers
 load-balancing: divide workload optimally over servers
 knapsack: compute greatest value, subject to weight constraint

optimization problems

all valid solutions have a value

goal: compute optimal solution

most are NP-hard \rightarrow probably no polynomial time algorithm

alternatives: heuristic

or

approximation algorithm

not optimal
 but guarantees minimum quality

$ALG(I)$: value of solution computed by ALG on input I

$OPT(I)$: value of optimal solution for input I

for minimization problems:

ALG is a ρ -approximation algorithm, for some $\rho > 1$, if

$$ALG(I) \leq \rho \cdot OPT(I)$$

a 2-approximation gives at most twice the optimal solution's value

if there is at least one input such that $ALG(I) = \rho \cdot OPT(I)$,

then the approximation ratio ρ is tight

for maximization problems:

ALG is a ρ -approximation algorithm, for some $\rho < 1$, if

$$ALG(I) \geq \rho \cdot OPT(I)$$

a 0.5-approximation gives a solution with at least 50% of the optimal value