

HW1: Definition of an algorithm

Q1: What is a computational problem?

A1: A computational problem is a mathematical objective that can be achieved through a series of computing steps

Q2: Give the mathematical objective of the shortest path problem.

A2: Define a path from node x to node y as $P(x, y)$, and the set of all paths from node x to node y as $\wp(x, y)$. Find $P(x, y)$ such that $\sum_{e \in P(x, y)} e \leq \min_{P'(x, y) \in \wp(x, y)} \sum_{e' \in P'(x, y)} e'$.

Q3: Given a real-world application of the shortest path problem (other than the cheapest airfare).

A3: This is open.

Q4: What is an algorithm?

A4: Some definitions:

Wikipedia: An algorithm is “a self-contained step-by-step set of operations to be performed”.

Cormen, Leiserson, Rivest, and Stein: An algorithm is “any well-defined computational procedure that takes some input and produces some output.”

Knuth: An algorithm is “a finite, definite, effective procedure, with some input and some output.”

Q5: Which components are fundamental to describe an algorithm?

A5: Steps, Input, Output, Correctness, and Efficiency.

Q6: Will a correct algorithm always give optimal solution to the computational problem?

A6: No. An algorithm is correct if it works as intended and achieves what it claims. Many approximation algorithms, randomized algorithms, or local search algorithms do not always output the global optimal solutions; yet they are still correct.