Chapter 1 - The Role of Algorithms in Computing
Exercises & Problems

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Exercises

1.1 Algorithms

Exercise 1.1-1

A real-world example of sorting would be finding the cheapest, highest-rated, most reviewed, etc. item on an e-commerce site. A real-world example for computing a convex hull is robotic path planning. The robot would need to construct a path such that it envelopes any obstacles.

Exercise 1.1-2

Other than speed, one might use money saved or resources consumed as a measure of efficiency in a real-world setting.

Exercise 1.1-3

An array is a data structure. Its strengths are constant time lookup, its limitations are $O(n)$ deletion and insertion.

Exercise 1.1-4

The shortest path and the traveling-salesman problem (TSP) are similar in that they each want to find the most efficient path to take. They differ however in that even if we split up each leg of the journey in the traveling-salesman problem into shortest path between two points problems, those shortest paths may not be the most efficient path overall, since TSP has many nodes. The shortest path problem is just between two nodes.

Exercise 1.1-5

A real-world example of a problem in which only the best solution will do is sorting a huge data set quickly, such as to sift through medical data for a patient or help a wall-street broker with a sale/buy. A real-world example of a problem in which an approximately best solution will do is again an application of TSP for a freighting company trying to find the most efficient path of deliveries/pickups.

1.2 Algorithms as a Technology

Exercise 1.2-1

An example of such an application is an application that analyzes and visualizes data for businesses. Such an application requires very fast consumption and analysis of data as well as fast graphical algorithms to draw the data to the screen.

Exercise 1.2-2

Insertion sort beats merge sort for all values $n < 44$.

Exercise 1.2-3

The smallest number of n for this case to be true is $n = 15$.

Problems

Problem 1-1: Comparison of Running Times

In the table below, months are 31 days long and years are 365 days long.

	1 second	1 minute	1 hour	1 day	1 month	1 year	1 century
lgn	2^{10^6}	$2^{6\times10^7}$	$2^{3.6\times10^9}$	$2^{8.6\times10^{10}}$	$2^{2.7\times10^{12}}$	$2^{3.2\times10^{13}}$	$2^{3.2\times10^{15}}$
$\sqrt{n}$	10^{12}	3.6×10^{15}	1.3×10^{17}	7.5×10^{21}	7.2×10^{24}	9.9×10^{26}	9.9×10^{30}
n	10^6	6×10^7	3.6×10^9	8.6×10^{10}	2.7×10^{12}	3.2×10^{13}	3.2×10^{15}
$nlgn$	62746	2.80×10^6	1.33×10^8	2.75×10^9	7.43×10^{10}	7.97×10^{11}	6.86×10^{13}
n^2	1000	7745	60000	92952	1.6×10^6	1.77×10^6	1.77×10^8
n^3	100	391	711	2051	13924	14658	1.46×10^6
2^n	19	25	31	36	41	44	51
$n!$	9	11	12	13	15	16	17