



# Fun with Algorithms:

**Implementing various  
practically useful  
algorithms**

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# Overview

## Introduction

Aside from the popular (BFS, DFS, sorting, hashing, binary search and tree traversal, divide and conquer, and basic data structures) there are some more algorithms important from a practical perspective. Not exactly the most important ones but very useful, practical and simple ones.

1. **Maze creation algorithms** - This is an application of algorithms like DFS, BFS, Dijkstra and A\* algorithms. The maze creation algorithm itself is not much useful, but it's a great playground for graph solving algorithms, which are extremely useful in the real world. A\* is also nice because all strategy games we play today use it to plan out the shortest walking route.
2. **Bloom filter** - It is probably one of the most useful algorithms to know that exist in the data structures world. It helps reducing lookup cost. It is important because lookups are usually very common and expensive, so a bloom filter checks if data access is even necessary beforehand.
3. **Huffman Coding** - The simplest form of efficient encoding. It is a lossless data compression algorithm. Also used in zip, gzip, etc.
4. **RLE Compression** - It is a very easy and simple technique of data compression.
5. **2D Ray Caster** - The simplest form of a 3D first person shooter one can build. This is how games like Wolfenstein 3D and Doom work. It's useful because it's extremely simple, and because ray casting is one of the core foundations of computer graphics.
6. **Deterministic & Heuristic game solvers** - It is an example of how AI works when playing games against the computer. The simplest one is the tic-tac-toe AI, but there are also algorithms that play chess and checkers, that use some heuristics to know the next best move.
7. **FFT (Fast Fourier Transform)** - Using FFT and similar algorithms such as DCT, wavelets, etc. is very useful to know for analyzing, compressing and modifying sound, images and video. Anything one can think of in signal processing - from changing pitches, auto-tuning, MP3

compression, JPEG compression, video compression, photoshopping, is done by transforming signals from the spatial domain to the frequency domain, and vice versa.

8. **Public-key cryptography** - Very powerful algorithms that solve the key issue of eavesdropping. Both RSA (public/private) and Diffie-Hellman (mutual key exchange) provide one with great understanding on how secure information travels in insecure channels today - secure web pages, certificates, SSH and end-to-end encryption are just a few examples.
9. **Control loop feedback algorithm (PID)** - The most basic algorithm for programming actual robots and IoT devices which controls a specific state by receiving feedback from sensors and applying commands to motors to adjust the state. Examples are thermostats, autonomous cars, computer guided missiles, etc.
10. **Convex hull Algorithms** - The problem of finding convex hulls finds its practical applications in pattern recognition, image processing, statistics, geographic information system, game theory, construction of phase diagrams, and static code analysis by abstract interpretation.

## Project Objective

- To implement some of the above-mentioned algorithms (probably 2 or 3 algorithms).
- To analyze the time and space complexity of the implemented algorithms.
- To improve/enhance the implemented algorithms for better efficiency and lesser time complexity (if possible).

# References

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