

Best First Search in Artificial Intelligence

[ARTIFICIAL INTELLIGENCE](#)[BEGINNER](#)[CAREER](#)[GENERATIVE AI](#)

Artificial intelligence has become a part of our lives and aids in our regular activities. Whether we talk about computers, gadgets, or other equipment, AI-based algorithm models help ease our tasks and time management. One such specific algorithm within the field of AI is Best First Search. It behaves like a smart explorer that helps a computer program make the right decisions for the correct path at each step. The best first search in artificial intelligence eases our task and reduces efforts and time, leading to efficient decision-making and faster goal achievement.

In this article, you will learn about the best first search in AI. We will explain how the best first search algorithm works and why it is important in artificial intelligence. This method helps find the best paths by looking at the most promising options first, making it easier to solve problems in different areas.

Overview:

- Learn about Best First Search in AI, a heuristic-driven algorithm.
- Understand how Best First Search algorithm utilizes heuristic functions.
- Explore the role of Best First Search in AI applications.
- Discover the implementation details of Best First Search algorithm.
- Understand the limitations and challenges of Best First Search in AI.

Table of contents

- [What is the Best First Search?](#)
- [Key Concepts of BFS](#)
 - [Evaluation of Path](#)
 - [Use of Heuristic Function](#)
 - [Keeping Track](#)
 - [Iteration of Process](#)
- [What is a Heuristic Function?](#)
- [Algorithmic Details](#)
- [Comparison with A* Search](#)
- [Applications](#)
- [Implementation](#)
- [Challenges and Limitations](#)
- [Which Search Algorithm is Best in Artificial Intelligence?](#)
- [Conclusion](#)

What is the Best First Search?

Best first search (BFS) is a search algorithm that [functions](#) at a particular rule and uses a priority queue and heuristic search. It is ideal for computers to evaluate the appropriate and shortest path through a maze of possibilities. Suppose you get stuck in a big maze and do not know how and where to exit quickly. Here, the best first search in AI aids your system program in evaluating and choosing the right path at every succeeding step to reach the goal as quickly as possible.

For example, imagine playing a video game of Super Mario or Contra where you have to reach the goal and kill the enemy. The best first search aid computer system to control the Mario or Contra to check the quickest route or way to kill the enemy. It evaluates distinct paths and selects the closest one with no other threats to reach your goal and kill the enemy as fast as possible.

The best first search in artificial intelligence is an informed search that utilizes an evaluation function to opt for the promising node among the numerous available nodes before switching (transverse) to the next node. The best first search algorithm in AI utilizes two lists of monitoring the transversal while searching for graph space, i.e., Open and CLOSED. An open list monitors the immediate nodes available to transverse at the moment. In contrast, the CLOSED list monitors the nodes being transferred already.

Key Concepts of BFS

Here are some key features of the best first search in artificial intelligence:

Evaluation of Path

While using the best first search, your system always seeks possible nodes or paths that can be taken. Then, it picks the most promising or best node or path eligible to traverse the shortest distance node or path to reach the goal and exit the maze.

Use of Heuristic Function

The best first search uses a heuristic function in informed decisions. It helps find the right and quick path towards the goal, which is called a heuristic search. The user's current state in the maze is the input of this function, based on which it estimates how close the user is to the goal. Based on the analysis, it assists in reaching the goal in a reasonable time and with [minimum steps](#).

Keeping Track

The Best-First Search algorithm in AI assists the computer system in tracking the paths or nodes it has traversed or plans to traverse. It prevents the system from becoming entangled in loops of previously tested paths or nodes and helps avoid errors.

Iteration of Process

The computer program keeps repeating the process of the above three criteria until it reaches the goal and exits the maze. Therefore, the best first search in artificial intelligence consistently reevaluates the nodes or paths that are most promising based on the heuristic function.

What is a Heuristic Function?

The heuristic function refers to the function used in the informed search and evaluation of the best or promising path, route, or solution leading to the goal. It helps in estimating the right path in less time. However, the heuristic function does not always provide accurate or optimized results. Sometimes, it generates sub-optimized results. The heuristic function is $h(n)$. It calculates the cost of an optimal route or path between the states, and its value is always positive.

Algorithmic Details

There are two categories of search algorithms:

Uninformed Algorithm

It is also called a blind method or exhaustive method. The search is done without additional information based on the information already given in the problem statement. For instance, Depth First Search and Breadth First Search.

Informed Algorithm

The computer system performs the search based on the additional information provided, allowing it to describe the succeeding steps for evaluating the solution or path toward the goal. This popularly known method is the Heuristic method or Heuristic search. Informed methods outperform the blind method regarding cost-effectiveness, efficiency, and overall performance.

There are generally two variants of informed algorithm, i.e.,

- Greedy Best First Search:** As the name suggests, this algorithm is greedy and chooses the best path available. It uses a heuristic function and search, combined with depth and breadth-first search algorithms, and combines the two algorithms, selecting the most promising node while expanding the node present near the goal node.
- A* Best First Search:** This is the most widely used type of best-first search in AI. It is efficient due to the combined features of greedy best-first search and UCS. Compared to greedy search, A* uses a heuristic function to find the shortest path. It is quick and utilizes UCS with varied forms of heuristic function.

Comparison with A* Search

The differences between the best first search and A* searches are given in the table below.

Parameters	Best First Search	A* Search
Past knowledge	No prior knowledge.	Past knowledge involved
Completeness	Not complete	Complete
Optimal	May not optimal	Always optimal
Evaluation Function	$f(n)=h(n)$ Where $h(n)$ is heuristic function	$f(n)=h(n)+g(n)$ Where $h(n)$ is heuristic function and $g(n)$ is past knowledge acquired
Time Complexity	$O(bm^{m+1})$ where b is branching and m is search tree's maximum depth	$O(bm^{m+1})$ where b is branching and m is search tree's maximum depth
Space Complexity	Polynomial	$O(bm^{m+1})$ where b is branching and m is search tree's maximum depth
Nodes	When searching, all the fridges or border nodes are kept in memory	All nodes are present in memory while searching
Memory	Need less memory	Need more memory

Applications

Here are some of the most common use cases of the best first search algorithm:

Robotics

The best first search guides robots in a challenging situation and makes effective moves to navigate to their destination. Efficient planning is crucial in complex tasks so that robots can evaluate the right paths toward the goal and make informed decisions accordingly.

Game Playing

It helps game characters observe the threat, avoid obstacles, make the right strategic decisions, and evaluate the accurate path to reach the objectives within the time goal.

Navigation Apps

The best first search in AI is used in navigation apps like [Google Maps](#) to assist in the quickest routes. When we travel from one location to another, the algorithm considers factors like road conditions, traffic, U-turns, distance, and so on to navigate through the route with fewer obstacles and in less time.

Data Mining and Natural Language Processing

In [data mining](#), artificial intelligence employs the best first search to assess the most suitable features that align with the data, facilitating selection. This reduces computational complexity in machine learning and enhances data model performance.

Best-first search algorithms assess semantically similar phrases or terms to provide relevance. They are extensively used in [text summarization](#) and search engines, simplifying task complexity.

Scheduling and Planning

The best first search in artificial intelligence (AI) finds applications in scheduling work and activities, enabling resource optimization, and meeting deadlines. This functionality is integral to project management, logistics, and manufacturing.

Implementation

To implement it, computer programs write code in different computer languages, such as Python, C, Javascript, C++, and Java. The code provides instructions to the computer system to evaluate the routes, paths, or solutions and use heuristic functions.

Here is a brief overview of the steps for how the best first search in artificial intelligence can be implemented.

- **Step 1:** Choose an initiating node (suppose 'n') and place it in the OPEN list.
- **Step 2:** If the initiating node is empty, you must stop and return to failure.
- **Step 3:** Eliminate the node from the OPEN list and place it on the CLOSE list. Here, the node is the lowest $h(n)$ value, i.e., heuristic function.
- **Step 4:** Expand the node and create its successor.
- **Step 5:** Check each successor to see whether they lead to the goal.
- **Step 6:** If a successor node leads to the goal, you must return success and terminate the search process. Otherwise, you can continue with step 7.
- **Step 7:** The algorithm analyzes every successor for the evaluation function $f(n)$. Later, it examines whether the nodes are in the OPEN or CLOSED list. If it does not find a node in either list, it adds it to the OPEN list.
- **Step 8:** Return to step 2 and iterate.

Challenges and Limitations

The best first search in artificial intelligence has some benefits, but it also has some challenges and limitations.

1. The quality of the Heuristic must be good. If you compromise with quality, it may not provide effective estimates, and you may find errors in finding optimal solutions.
2. This algorithm is good for evaluating the right solution or path but does not guarantee the absolute best routes or solutions and opts for suboptimal routes.
3. The chances of getting stuck in a loop are higher.
4. The best first search in AI can be memory intensive in large data. It limits the ability to function effectively in resource-constrained situations.
5. It prioritizes choosing the right route based on its shorter length and not other factors like its quality. Therefore, evaluating an accurate route can be tricky.

Which Search Algorithm is Best in Artificial Intelligence?

There isn't a single "best" search algorithm in AI, as the optimal choice depends on the specific problem you're tackling. Here's a breakdown of two common types:

Uninformed Search Algorithms: These methods explore all possible paths without knowing the goal's location. For instance:

- Breadth-First Search (BFS) is efficient for finding the shortest path in specific scenarios, but it can waste time exploring irrelevant areas.
- Depth-first search (DFS) is sometimes faster than BFS, yet it risks getting trapped in infinite loops.

Informed Search Algorithms: These utilize additional information, often heuristics, to prioritize which paths to explore first. One widely used example is:

- A Search:* This algorithm balances BFS and greedy best-first search approaches. It efficiently finds optimal paths by estimating the cost of reaching the goal from any given node.

Each of these techniques involves an iterative deepening search, in which nodes are traversed from the current node towards an optimal path.

Conclusion

Experience the power of the Best First Search algorithm in Artificial Intelligence with our [BlackBelt+ Program](#). Learn how this algorithm serves as your professional guide in complex environments, aiding computer systems in optimizing paths and making informed decisions. Our program harnesses the potential of the Best First Search algorithm, utilizing heuristic functions to provide intelligent solutions based on prior knowledge. Join us to equip yourself with the skills to navigate complex problems and uncover multiple possibilities for superior solutions. Enroll in our BB+ Program today and elevate your AI expertise!

Hope you understand the best first search and their data structure, differentiating search space in algorithms. Also, with this pathfinding, the best first step is problem-solving and stating their start node for uniform cost search, i.e., true for different search techniques. These best search tutorials not only traverse the different codes like pseudocode, node b.

Frequently Asked Question

Q1. Which is the best AI search algorithm?

A. A* Search Algorithm is a well-known and powerful AI search algorithm. It utilizes the heuristic function $h(n)$ and past knowledge $g(n)$ to make informed decisions.

Q2. Can greedy search provide an optimal solution?

A. A greedy search does not consider all data and can lead to non-optimal results.

Q3. What is the difference between Dijkstra and Best-First Search?

A. Dijkstra's algorithm guarantees the shortest path to the goal. In contrast, the best first search does not guarantee the shortest route. It depends on the heuristic function used and the specific problem instance.

Q4. What is the recursive best first search in AI?

A. The recursive best first search belongs to the artificial intelligence algorithm that expands the frontier nodes in the best manner or order. Additionally, it prefers the specific node over others based on the problem-specific information.

Article Url - <https://www.analyticsvidhya.com/blog/2023/09/best-first-search-in-artificial-intelligence/>



[Analytics Vidhya](#)

Analytics Vidhya Content team