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☐ FINAL EXAM
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An Analysis of A* Algorithm and Data Structure in Games

Introduction

Majority of the video games these days use more complex algorithms that use more resources in the process, not only that the majority of AAA games also consume a lot of storage space. Call of Duty®: Warzone is an example, a massive first-person shooter game that is a massive battle royale arena that caters 150 players that simultaneously battle to top the game rankings. The game has a massive 175 GB of hard drive space on PC, and nearly 92GB on consoles systems. Adding Modern Warfare onto the Warzone package increases the total size to about 250GB on PC and 150GB on consoles. This kind of massive game can cause more significant trouble when it comes to a user's total storage capacity. Thus, it requires continuous, optimized, and organized data handling so that the game runs smoothly and error free. In handling massive data like game files, algorithm and data structure is needed for organization, management, processing, retrieving data, storing data, and time complexity.

Background of the Study

A game is a form of play that uses ordered instruction or structure to in pursuit a certain objective or a goal. It is usually used for fun and entertainment through the years. There are different kinds of games that all ages can play depending on what they want to achieve to learn. Puzzles to learn logic, mathematical games to enhance basic math skills, reading games to increase reading ability, and even other video games to increase reaction speed, encourage teamwork, and many more.

Developing games these days uses more resources to achieve the most positive outcome. Some don't achieve this because of many problems that they face like hardware limitations, network connectivity, security concerns, and many more.

One of the major problems that the game developers face is time complexity of the algorithm, where the amount of time required in the algorithm execution is not achieved optimally. That's why learning algorithms and data structure is crucial because some algorithms have better time complexity when we apply them on some compatible data structures.

Evaluation of the Case

In the world of data processing data structure is the king, and data is the queen. Computers can't do anything without a program that tells them what to do. Thus, algorithm steps in it gives the computer step-by-step instructions to accomplish specific tasks and make decisions. It is used to find the best possible way to solve a problem, based on data storage, sorting and processing, and machine learning. In doing so, they improve its efficiency or time complexity and by using data structure data is stored more organized. It allows more algorithms to be written more efficiently and optimized use of resources.

Games nowadays are getting bigger in storage as the area that the players traverse gets bigger. One of the algorithms used to these kinds of games like role playing games and real time strategy games like Civilization and Age of Empires that uses pathfinding is A* Algorithms. A* algorithm is a path search algorithm, it is often used due to its completeness, optimality, and optimal efficiency. But its downside is it consumes more data storage. Even the games said above still suffer from bad pathfinding algorithms. A* algorithm also works in first person shooter games like Call of Duty, Counter Strike, and Valorant[3]. That uses few units moving around at the same time. An explanation might be that the exponential growth in the number of units moving around at the same time makes the game environment much more dynamic and it is hard to provide optimal paths for hundreds and thousands of units in real time using limited CPU and memory resources. Massive Multiplayer online games are another example of which involve real time pathfinding intensively, like Battle Realms and World of Warcraft and other similar games.

Solution

There are many approaches to tackle the large data that will be handled. There are many ways to lessen the impact in character or environment detail, in moving of the environment objects, and movement of characters in a map. There are many types of map representation that can be used in games, one widely used to be waypoint graph that also uses A* algorithm. Waypoint graph is a graph that uses waypoints, waypoints are set of point that has the coordinates of the physic space, but this solution is good only in 2D games and it requires a lot of waypoints to achieve an adequate movement in 3D games because of the complexity of the environment because the 3D environment has more points in the space compare in 2D. Thus, this is where the NavMesh Technique is best to be used. It uses polygons to layout and represent the map. As a result, the data that is being used is less because it can do pathfinding more quickly by using different kinds of polygon like convex polygon to traverse the map. The movement in it acts like a human compare in the Waypoint graph that can only be done in 2D space.

Conclusion

Games are developing fast and the data that is being used is getting bigger. Thus, there are many more problems that will need to be solved. That is where the algorithms and data structures will be utilized more. Using this kind of techniques, the data that is being processed in a video game will greatly reduce the storage that can be occupied and the data that is being needed to process it. In exchange the games are getting more indefinitely complex and because of this it will be needed to do more custom programming.

As the time passes there will be more techniques that will be created and used. That's why in game development, developers' study and use data structure and algorithms to transfer games from a concept to a playable reality, not just to enable the players to play games but to make the games experience that games will love.

References

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