Navigation Meshes and Real-Time Dynamic Planning for Computer Games

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This course will provide a comprehensive overview of navigation structures and algorithms for achieving real-time dynamic navigation for the next generation of computer games. Building on top of classical techniques in computational geometry and discrete search, we will introduce recent developments in real-time planning and discrete environment representations that enable the efficient and robust computation of paths with clearance constraints in large, complex, and dynamic environments. The addressed topics meet the growing needs of efficient navigation methods in today’s computer games. This course will target both Basic and Intermediate level attendees.

Topics Overview.

• **Part I: Geometric Path Planning.** We will revisit the classical Euclidean Shortest Path problem, the classical algorithms available for the problem, and the relevant methods and spatial structures from classical Computational Geometry. This introduction will motivate and justify the need for the more specialized methods that have been developed more recently for addressing the requirements of computer games.

• **Part II: Navigation Meshes.** In this section we will cover the recent navigation mesh structures that have been developed for computer games, classifying their approaches and formalizing their underlying geometric approaches and achieved properties. We will also cover how dynamic updates and robustness to degenerate input can be addressed in navigation meshes and will present several examples obtained by recent state of the art approaches.

• **Part III: Discrete Search Methods.** Starting from classical A*, we will introduce anytime and incremental variations of search algorithms that can efficiently compute paths in dynamically changing environments, while meeting strict time limits, and preserving optimality guarantees. We will describe extensions that incorporate different types of spatial constraints, and the use of GPU hardware to provide orders of magnitude speedup.

• **Part IV: Planning in Complex Domains.** This section will describe how the techniques described previously can be specifically applied to complex navigation problems, while generalizing to more complex domains, including behavior planning and multi-actor coordination.

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References


