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Rowlett, Peter

Developing strategic and mathematical thinking via game play: programming to investigate a risky strategy for Quarto.

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Summary: The Maths Arcade is an extracurricular club for undergraduate students to play and analyse strategy board games, aimed at building a mathematical community of staff and students as well as improving strategic and mathematical thinking. This educational initiative, used at several universities in the U.K., will be described. Quarto is an impartial game played at the Maths Arcade, in that there is one set of common pieces used by both players, and one where stalemates are a common outcome. While some students play without apparent direction until a winning opportunity appears, others adopt a more risky strategy of building the board towards a winning position, which could allow either player to win. Whether building towards a win is a sensible strategy, when the other player could equally well benefit, is a topic of debate at the Maths Arcade. Intending to suggest a possible student project, this article will describe a method to represent Quarto as an array of binary numbers, making the game suitable for programming in Python. Then, one strategy is programmed to play at random unless a winning move becomes available, while another is programmed to work towards a winning position. These are calibrated by playing against a completely random strategy and against themselves, then they are played against each other. The more risky strategy is found to win over the more naive player in around two thirds of one million games. Some limitations and possible areas of development are discussed.

Classification: M90 K50 M40 K90 P50
Keywords: risk; board games; mathematical thinking; game strategy; risk strategy; computer programming
http://www.math.umt.edu/tmme/vol12no1thru3/07_Rowlett.pdf