

Lights Out for Linear Algebra

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The game Lights Out, by Tiger Electronics, has inspired an impressive body of mathematical literature. The game works as follows: There is a 5 by 5 array of buttons, each of which can be either on or off. When a button is on, it lights up. When a button is pushed, its state changes, as do the states of its four neighbors, left, right, above, and below. The game starts with random collection of buttons that are lit. Your task is push buttons until you turn off all the lights.

In this presentation, we'll learn how to use linear algebra to solve Lights Out games, not just on a 5 by 5 board, but on any square board. We'll also see how to solve games played on a board "without boundary" (essentially on a torus, where the top and bottom rows are considered adjacent, and the left and right columns are considered adjacent), again of any size. Finally, we'll consider some new research about so-called easy games. A Lights Out game is easy if it can be solved by pushing precisely the buttons that are initially lit. We'll find that these games can be completely classified for all board sizes, with or without boundary.

