Chocolate Game - Chomp

- First-Player Win
- quadratic board
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  - –
  - optimal strategy
    - take piece top right of the toxic piece
    - creates two independent fields
    - Tweedledum-Tweedledee-Principle
      - first player copies moves of second player
- rectangle board (of arbitrary size)
  - draws are not possible
    - must be a first or second player win
  - assuming A does not have a winning strategy
    - A can just take the top right piece
    - B makes a winning move
    - A could have just started with the move B just made
      - strategy stealing
    - contradiction
      - A must have a winning strategy for every possible game board size
      - First-Player Win
      - A's winning strategy exists but is unknown
        - for general board sizes

Tic Tak Toe

- [[2 Player Combinatorial Game]]
- no winner if played optimally
- [[Min-Max Decision Tree]]
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  - – * only 765 states when stopping after winning

Nine Men's Morris - Mühle

- http://ninemensmorris.ist.tugraz.at:8080/
- 3 phases
  - placing stones
  - moving stones
    - allowed along the lines

  - moving stones
    * jumping allowed
- 3 stones along a line
  - choose opponent's stone to remove
- draw if played optimally
- operations to combine equivalent game states
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Connect 4

- http://connect4.ist.tugraz.at:8080/
- First-Player Win
- states (7x6 board)
  - 0 to 42 fields which have a
    * yellow token
    * red token
    * no token
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  - 7 bit per column
    * $7 * 7 = 49$ bit require 6 byte + 1 bit
    * first 1 acts as separator
      ◆ marks the first token
      ◆ afterwards only the color is stored
    * last separator is not needed
      ◆ number of half moves = total number of tokens
      ◆ count tokens in first 6 columns
      ◆ tokens in last column = total number of tokens - tokens in first 6 columns
    * only store empty fields and colors without separator
      ◆ saves 1 bit ⇒ exactly 6 byte required
    *
- move generator
  - up to 7 successors
  - add a token to a non-full column
- identify final states
  - draw
    * 42 tokens placed and no win
  - lose
    * check if previous player has won

  - win
    - check 11 4-tuples which include just placed token
    - fields above just placed token not considered
- hybrid approach
  - store first 23 half moves in DB
  - compute remaining decision tree online
  - maximum remaining search depth $42 - 23 = 19$
    - with ~5 possible moves on average
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