Arimaa

Arimaa, the Game of **¿Real Intelligence?**

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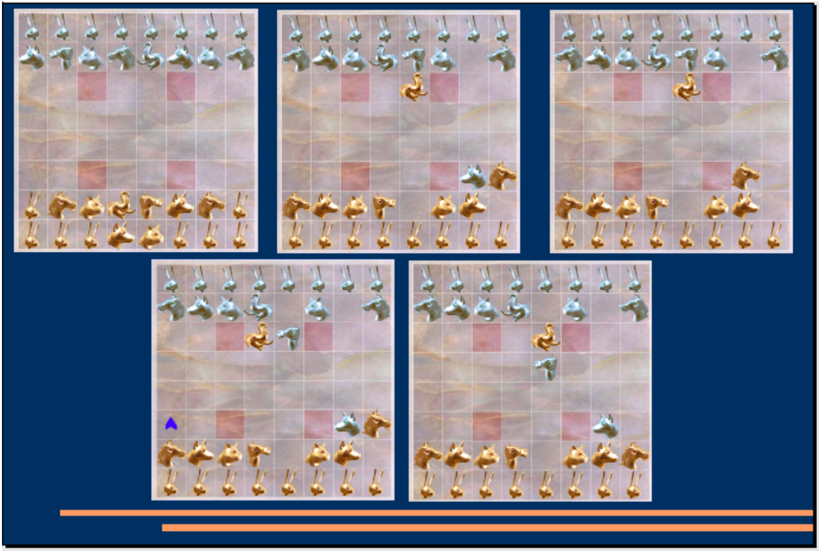
Arimaa: The Game of Real Intelligence

- Easy rules for humans to learn
- Computer ineptitude
    - Large branching factor
        - Multi-step moves
    - Variable opening position
    - Finals with many pieces left
    - Positional(arimaa) vs Materialistic(chess) evaluation

Rules

- Variable opening position
- 1 move $=$ 4 steps
- Push move
- Pull move
- Capture
- Immobilization
- Goal



The Challenge

- Program that can defeat the top human players
- Before 2020
- Reward of US$10.000

The Championship

- Computer championship(US$500 & US$200)
  - Floating triple elimination
  - 40 days playing before wcc
- Human championship(US$500 & US$200)
  - Floating double elimination
- Challenge match(US$10.000)
  - 3 3-game matches against top three humans

Developing a Bot
The Environment

- Simple interface
- gamestate file
- position file
- move file
- move output
- Bot kit (on-line and off-line)

Input files

- running/matchGamestatexxxxx
- running/matchMovexxxxxx
- running/matchPosxxxxxx

Output

- {Piece}{Pos}{Direction}
- `Ra1n Me2s de3s de4x Ef2e`

Matchoffline script

- `match test1 test2`
- test1 ./getMove getMove -d 4
- test2 ./getMove getMove -d 4

Developing a Bot
The Search

- Variations on minimax
  - Alphabeta
  - MTD(f) (zerowindow)
  - Killer heuristic
  - Nullmove Heuristic
  - Transposition tables
  - Search extensions
- Horizon effect

Alpha-Beta Search

```
evaluate (node, alpha, beta)
    if node is a leaf
        return the heuristic value of node
    if node is a minimizing node
        for each child of node
            beta = min (beta, evaluate (child, alpha, beta))
            if beta <= alpha
                return alpha
        return beta
    if node is a maximizing node
        for each child of node
            alpha = max (alpha, evaluate (child, alpha, beta))
            if beta <= alpha
                return beta
        return alpha
```

Developing a Bot
The Evaluation

- Feature extraction
  - Hand made
- Types
  - Linear Functions
  - Neural Networks(experimental)
- Tunning
  - Hand tuned
  - Genetic algorithms (experimental)

Developing a Bot
Possible Improvements

- Search via coevolutionary GA
- Train evaluation function via TD(Lambda)
- Automatic characteristic extraction
- Montecarlo Search

Bitboard handling and other technical stuff