Hyper-Heuristics and Sudoku

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Introduction
Aims

- Aim of the project: to code a programme that will find a valid solution to a Sudoku grid of order $n$ as quickly as possible.
Background

"Sudoku" is an abbreviation of the Japanese phrase "Suuji wa dokushin ni kogiru"

Contrary to the Japanese name, the 1st modern Sudoku was published in the US in 1979 by Howard Garns; a retired architect and puzzlemaker.
Sudoku

Figure: Standard Sudoku Puzzle

A typical Sudoku puzzle, as displayed above, is "order 3"
Background

Figure: Order 4
Backtracking Algorithm

- Systematic Method
- Steps through grid
- Pros and Cons

Backtracking Algorithm Performance

Order of Sudoku

In (time taken/s)
Hyper-Heuristics

- What is a Heuristic?
- Which are used?
- Hyper-Heuristic?
- Cost function

(a) Sudoku Box

(b) Completed Sudoku

Figure: Order 3
Methods

Decisions

Figure: Decision Process
Results
Results

- Start with empty grid
- Random Selection, Only Improve

**Figure:** Simple Random Selection, Only Improve
Results

- Simulated Annealing:

\[ p = \begin{cases} 
1, & \text{if } ProposedCost < CurrentCost \\
e^{\delta/t}, & \text{if } ProposedCost \geq CurrentCost 
\end{cases} \]

\[ \delta = CurrentCost - ProposedCost \]

Figure: Simple Random Selection, Simulated Annealing
Results

- Beyond Simple Random?

*Figure*: Simple Random Selection, Simulated Annealing
Results

Figure: Comparison
Concluding Remarks
Summary

- Backtracking
- Hyper-Heuristic
Further Work

Improvements?

- Programme algorithm to learn
- Sequences
- Logic

- Solve partially filled grids
- Record-to-record?
References
References


Thank you!

Questions?