Previous Work

- Generative outperforms direct on regular problems
- No tests across a continuum of problem regularity
fromNode \* toNode

\((x_1, y_1) (x_2, y_2)\)

... for all \((x_1, y_1) (x_2, y_2)\) pairs

HyperNEAT

Stanley et al. 2007
Fixed Topology (FT) NEAT

\[ x_1 \ x_1 \rightarrow x_2 \ y_2 \ \text{weight} \]

\[ \begin{array}{cccc}
0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 \\
0 & 0 & 0 & 2 \\
0 & 0 & 1 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 2 & 0 \\
0 & 0 & 2 & 0 \\
\end{array} \]

etc...

direct encoding

Clune et al. IEEE TEC. 2011
Outline

• Background

• Experiments
  • Part I: regularity
    - generative exploits problem regularity to outperform direct
    - produces regular behaviors and brains
    - bias towards regularity can be harmful
    - on problems with irregularity
    - combining generative and direct offers path forward

• Conclusion
Target Weights Problem

- match target ANN
- intuitive, scalable regularity, no epistasis

![Diagram showing different levels of regularity with same values and random values indicated]
The Generative Encoding Exploits Regularity

Clune et al. PPSN. 2008
Clune et al. IEEE TEC. 2011
Bit Mirroring Problem

intuitive, scalable regularity, has epistasis

Solution

Type 1

Type 2

within-column regularity

within-row regularity

constraints: column and row, row, none

Clune et al. PPSN. 2008
Clune et al. IEEE TEC. 2011
Bit Mirroring Problem

- HyperNEAT can exploit intermediate regularity ($p < .05$)
- Outperforms direct encoding ($p < .05$)

Clune et al. PPSN. 2008
Clune et al. IEEE TEC. 2011