Online Appendix to: UNTANGLED: A Game Environment for Discovery of Creative Mapping Strategies

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36630	36610	36210	36010	36000	36010	36210	36610	36630
28630	28610	28210	28010	28000	28010	28210	28610	28630
21630	21610	21210	21010	21000	21010	21210	21610	21630
15630	15610	15210	15010	15000	15010	15210	15610	15630
10630	10610	10210	10010	P	10010	10210	10610	10630
630	610	210	10	0	10	210	610	630
10630	10610	10210	10010	10000	10010	10210	10610	10630
15630	15610	15210	15010	15000	15010	15210	15610	15630
21630	21610	21210	21010	21000	21010	21210	21610	21630

(a) Stripe and StripeDR cost factors.

36010	28010	21010	15010	10010	15010	21010	28010	36010
28010	21010	15010	10010	6010	10010	15010	21010	28010
21010	15010	10010	6010	3010	6010	10010	15010	21010
15010	10010	6010	10	0	10	6010	10010	15010
10010	6010	3010	0	N	0	3010	6010	10010
15010	10010	6010	10	0	10	6010	10010	15010
21010	15010	10010	6010	3010	6010	10010	15010	21010
28010	21010	15010	10010	6010	10010	15010	21010	28010
36010	28010	21010	15010	10010	15010	21010	28010	36010

(b) 8Way cost factors.

36010	28010	21010	15010	10010	15010	21010	28010	36010
28010	21010	15010	10010	6010	10010	15010	21010	28010
21010	15010	10010	6010	3010	6010	10010	15010	21010
15010	10010	6010	3010	0	3010	6010	10010	15010
10010	6010	3010	0	N	0	3010	6010	10010
15010	10010	6010	3010	0	3010	6010	10010	15010
21010	15010	10010	6010	3010	6010	10010	15010	21010
28010	21010	15010	10010	6010	10010	15010	21010	28010
36010	28010	21010	15010	10010	15010	21010	28010	36010

(c) 4Way cost factors.

36010	28010	21010	15010	6010	15010	21010	28010	36010
28010	21010	15010	10010	3010	10010	15010	21010	28010
21010	15010	10010	6010	10	6010	10010	15010	21010
15010	10010	6010	3010	0	3010	6010	10010	15010
6010	3010	10	0	N	0	10	3010	6010
15010	10010	6010	3010	0	3010	6010	10010	15010
21010	15010	10010	6010	10	6010	10010	15010	21010
28010	21010	15010	10010	3010	10010	15010	21010	28010
36010	28010	21010	15010	6010	15010	21010	28010	36010

(d) 4Way1Hop cost factors.

36110	28110	21110	15110	3110	15110	21110	28110	36110
28110	21110	15110	10110	110	10110	15110	21110	28110
21110	15110	10110	6110	10	6110	10110	15110	21110
15110	10110	6110	3110	0	3110	6110	10110	15110
3110	110	10	0	N	0	10	110	3110
15110	10110	6110	3110	0	3110	6110	10110	15110
21110	15110	10110	6110	10	6110	10110	15110	21110
28110	21110	15110	10110	110	10110	15110	21110	28110
36110	28110	21110	15110	3110	15110	21110	28110	36110

(e) 4Way2Hop cost factors.

Fig. 8. Cost factor tables for interconnect for all architectures.

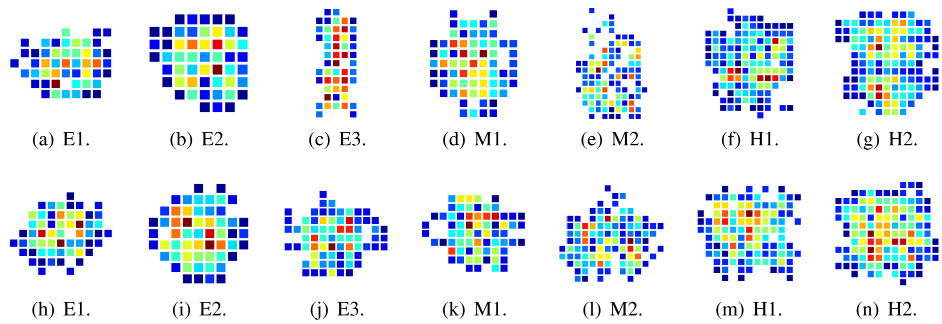


Fig. 9. Connectivity plots for the 4Way architecture. Warmer colors indicate higher-connectivity nodes are placed in these locations. (Top) Results from the top five human players on each graph; (bottom) results from the top five simulated annealing runs.

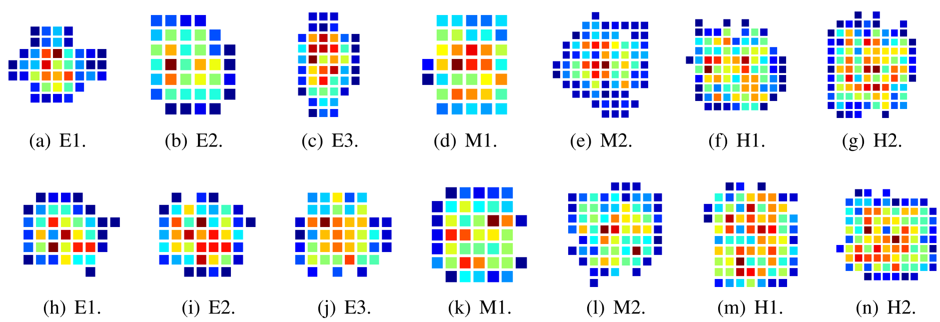


Fig. 10. Connectivity plots for the 4Way1Hop architecture. Warmer colors indicate higher-connectivity nodes are placed in these locations. (Top) Results from the top five human players on each graph; (bottom) results from the top five simulated annealing runs.

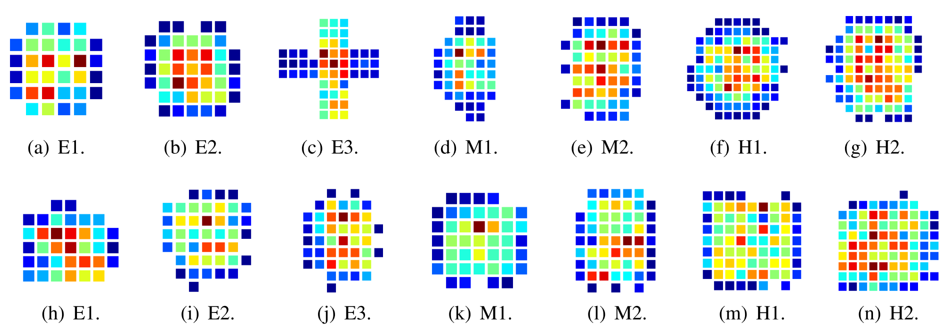
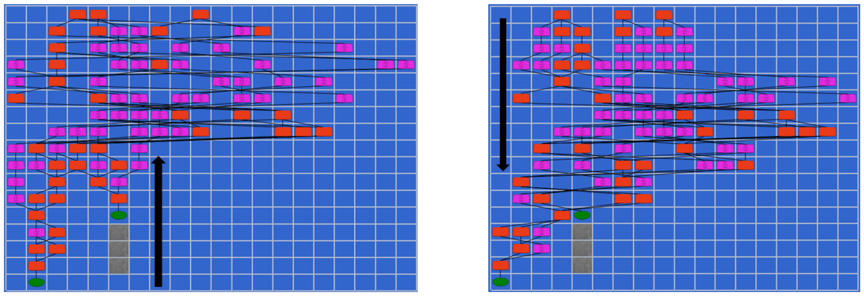
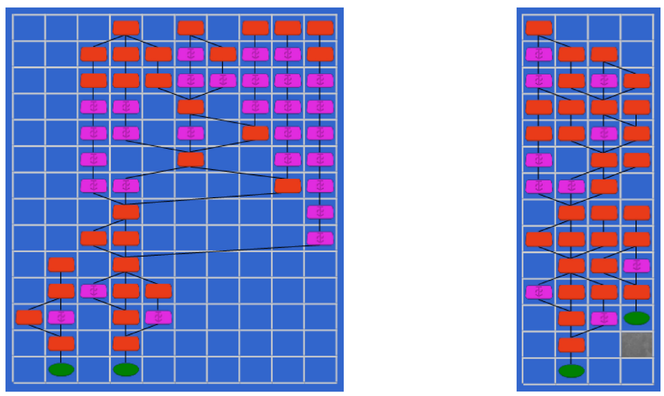


Fig. 11. Connectivity plots for the 4Way2Hop architecture. Warmer colors indicate higher-connectivity nodes are placed in these locations. (Top) Results from the top five human players on each graph; (bottom) results from the top five simulated annealing runs.



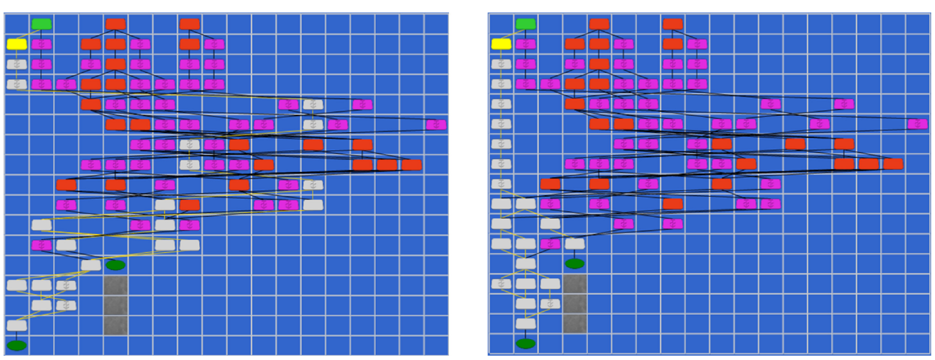
(a) Bottom-to-top. (b) Top-to-bottom.

Fig. 12. Solving Stripe,M2: bottom-to-top and top-to-bottom strategies.



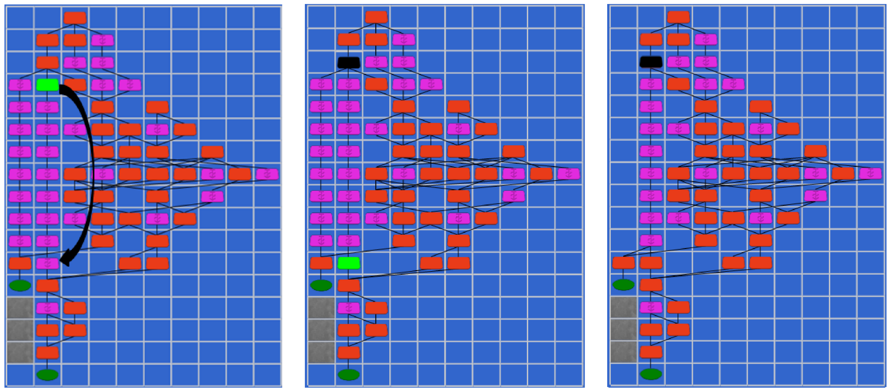
(a) In progress. (b) Final graph.

Fig. 13. Solving Stripe,M1: subchain identification. (a) This player has aligned various subchains to determine graph structure. (b) The final result, after much adjustment to compact the graph.



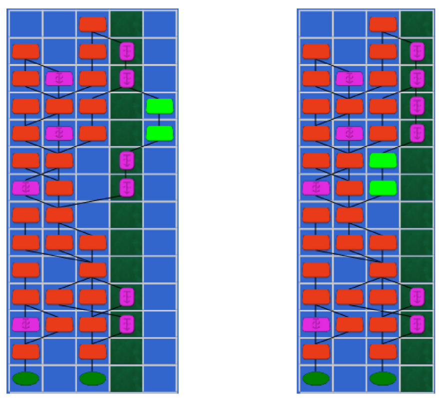
(a) Identifying the critical path. (b) Critical path alignment.

Fig. 14. Solving Stripe,M2: critical path alignment. (a) This player has identified a critical path in the graph. (b) After aligning nodes in this critical path in a compact manner.



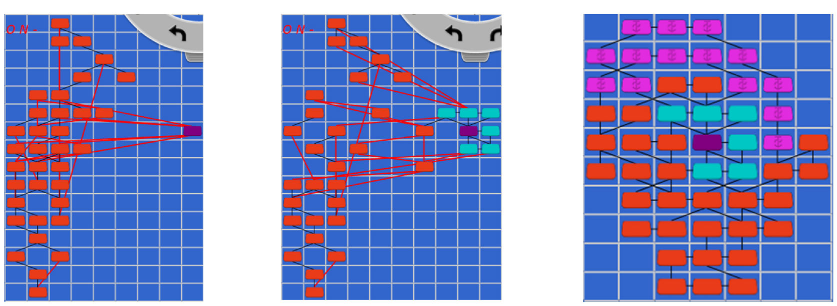
(a) An opportunity. (b) Two passgate chains. (c) After consolidation.

Fig. 15. Solving Stripe,M2: passgate consolidation. (a) The player identifies an opportunity to create a pair of matching passgate chains exiting a single parent. (b) Moving the green node down creates this opportunity. (c) After the merge, many passgates have been eliminated.



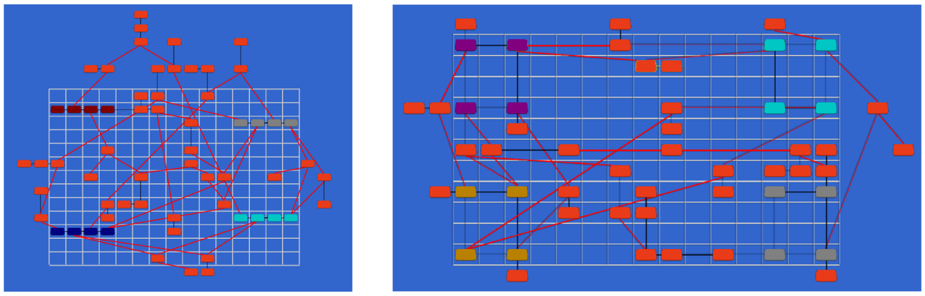
(a) Initial graph. (b) Final graph.

Fig. 16. Solving StripeDR,M1: passgate rearrangement. (a) The right-hand column of this graph contains two nodes that cannot be moved into the DR column. (b) Scheduling these nodes later in the computation reduces the overall width of the graph.



(a) (b) (c)

Fig. 17. Solving 8Way,M2: organic growth. (a) The player picks out a single node with high connectivity. (b) Building out from that central node. (c) The final solution.



(a) Example 1. (b) Example 2.

Fig. 18. Solving 4Way2Hop,H1: minimizing crossings. Two players are in the process of untangling the graph, understanding its structure, and minimizing crossings.

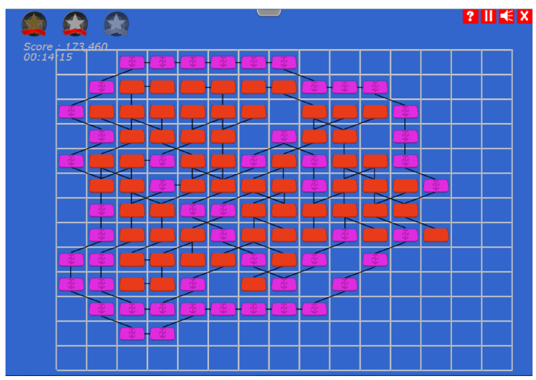
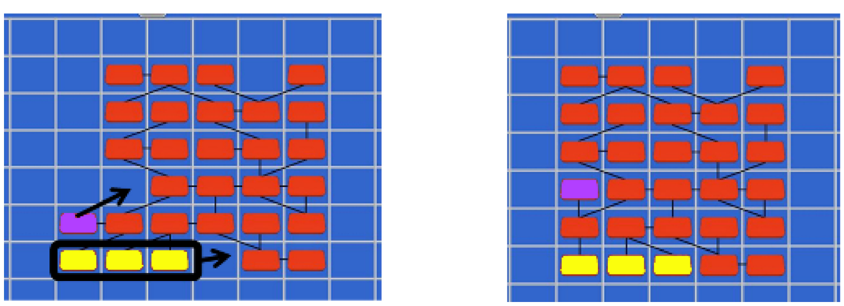


Fig. 19. Solving 8Way,H2: exterior routing. In this solution, the player has routed many long edges around the outside of the graph. This strategy was typically not successful in obtaining the highest score, although it was helpful in finding mappings without violations.



(a) Identifying opportunities. (b) The final graph.

Fig. 20. Solving 8Way,E2: pivoting. A player uses two coordinated moves to improve upon a graph generated by SA.

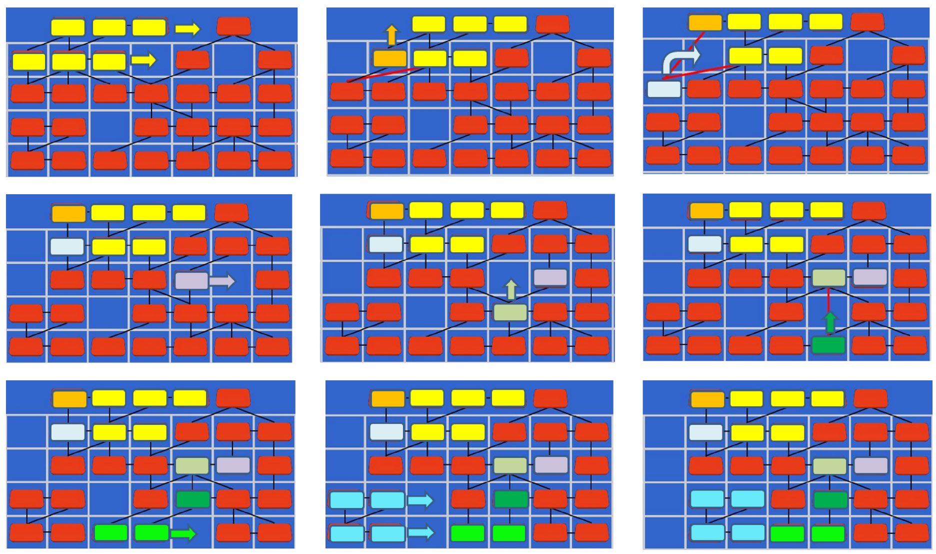


Fig. 21. Solving 8Way,M1: pivoting. A player uses a sequence of coordinated moves to improve upon a graph generated by SA.

(a) Identifying an opportunity.

(b) After rotation and placement.

Fig. 22. Solving 4Way,M1: cluster rotation. (a) This player has identified an opportunity to rotate an entire cluster of nodes in order to make it fit more compactly into the graph. The cluster has been moved from its initial placement in the bottom-left of the graph for clarity. (b) The final graph after rotating and replacing the node cluster.

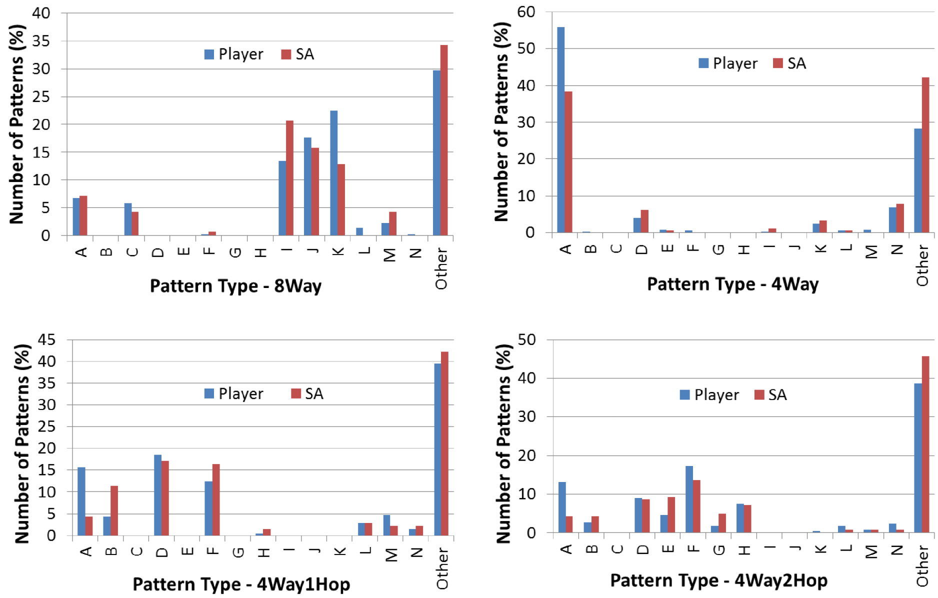


Fig. 23. Architecture-specific number of patterns (%) vs. pattern type.

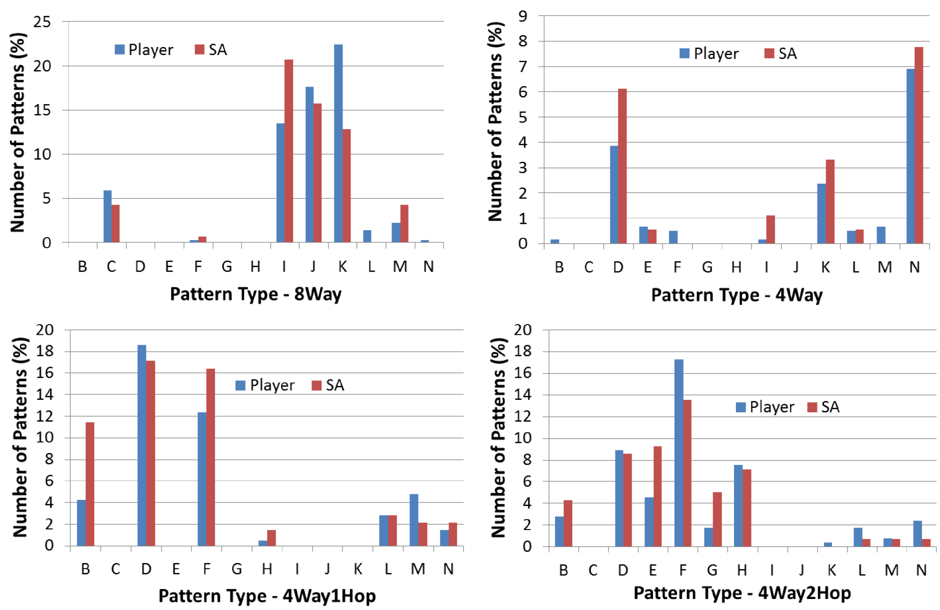


Fig. 24. Architecture-specific number of patterns (%) vs. pattern type (excluding pattern A and Others).