Large-Scale Search for The Witness Levels

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Level Design

• Significant work in games using AI for design
  • Browne, Isaksen, Jaffe, Nielson, A. Smith, G. Smith, Togelius, Zook (& many others)
Exhaustive Search

• Suppose we can generate all content:
  • No longer a question of *Content Generation*
  • A question of *Content Selection*

• How do we choose the best content?
Previous Work: Fling!

- Look for constraints that players learn
  - Select solutions that reward the players’ knowledge
Constraint: Each level has 1 solution
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**Result:**
Cannot take parallel moves
New Project: The Witness

• 2016 game by Jonathan Blow / Thekla, Inc
• Solve puzzles on deserted island
Can we create new, compelling levels for the game?
Design Strategy

Combine these puzzles...  ...with these.
Design Philosophy

• Select puzzles
Design Philosophy

• Select puzzles
• Understand puzzles
Design Philosophy

• Select puzzles
• Understand puzzles
• Subvert puzzles
Design Philosophy

• Select puzzles
• Understand puzzles
• Subvert puzzles
• Repeat
Design Philosophy

- Select puzzles
- Understand puzzles
- Subvert puzzles
- Repeat
First iteration

• Select puzzles
• Understand puzzles
  • Problems:
    • First solution solves all 3 puzzles
    • 2 puzzles taken alone have single solution
Subvert

• *Reminiscent of secret sharing algorithms*
  • Given any $n-1$ puzzles reveal as little information about the final solution
  • Single joint solution
• Find triples of puzzles where:
  • Every pair has many joint solutions
  • Taken together there is only one solution
Repeat

- Select new puzzles
- Understand
  - “Problems”
    - Simple heuristics lead to solutions
Subvert

• Add new constraints
• Break the heuristics that are learned
Thanks!

See full sequence:
http://movingai.com/witness.html