Fast 2D-Packing
An Introduction

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Well-Defined Problem

- Optimization problem
- Many forms of packing
- Rectangle, squares, circles, 2D, 3D...
Examples
More Examples
Many Areas of Application

• VLSI
• Lumber processing
• Glass cutting
• Sheet metal cutting
• Web page design
• Newspaper typesetting
Many Areas of Application

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- VLSI
Hard Problem

- 2D Orthogonal Packing of Rectangles
- No rotation of rectangles
- Shown to be NP Hard in 1979

⇒ HEURISTIC

- **Heuristic** (Greek: "Εὑρίσκω", "find" or "discover") refers to experience-based techniques for problem solving, learning, and discovery that give a solution which is not guaranteed to be optimal. Where the exhaustive search is impractical, heuristic methods are used to speed up the process of finding a satisfactory solution via mental shortcuts to ease the cognitive load of making a decision.

http://en.wikipedia.org/wiki/Heuristic
Most Heuristics
Most Heuristics
Most Heuristics
Most Heuristics
Most Heuristics
Time Consuming Heuristics

- Every new addition of a rectangle adds two new empty rectangles to data structure.
- Every new addition intersects with possibly several empty rectangles.
New Heuristic

Line
New Heuristic

Line
New Heuristic
New Heuristic

Segment
Rule

• You can only add a new rectangle (pack it) if it cuts segments fully.
Examples
Examples
Examples
Examples
New Heuristic
New Heuristic
New Heuristic
New Heuristic
New Heuristic
New Heuristic
Main Data-Structures

- Red-Black Trees: self-balancing search trees
- **Guaranteed** $O(\log n)$ insertion, deletion, & rearranging
- Not thread-safe!
Homework 2 Properties

- Rectangles sorted by area
- Greedy algorithm
- Top to bottom, left to right
- And one more...
Homework 2 Properties