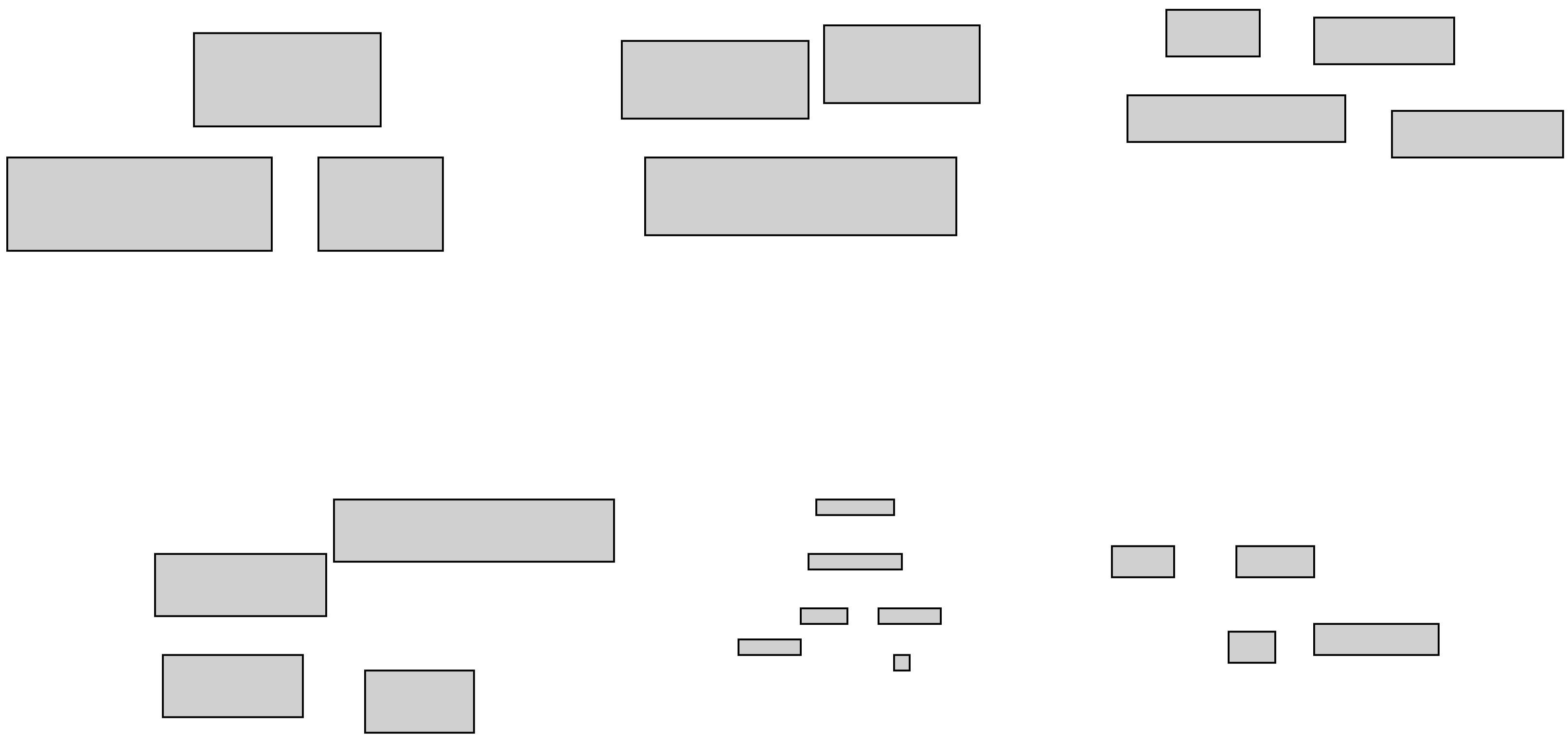
Problem Description

- Given: Set of Rectangles R
  - varying real lengths
  - widths drawn from integers in the range (typically) {1,2,3,4,5,6}
  - length/width ratios real values between 1 and 7
  - width w and penalty factors k_1 and k_2
    - *(*typically w = 9*)*

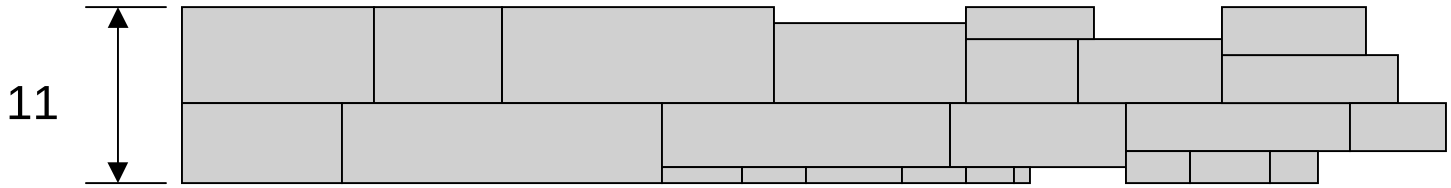
Task

- Arrange rectangles of *R* into a tiling of a rectangle of width at most *w*
  - in practical instances: 20-30 rectangles
  - *would prefer arrangement to be convex, arrangement must be connected*
- only translations of rectangles in R are allowed (no rotations)

Example



Possible Solution for $w = 11$



Optimization

- Linear combination of several criteria:
  - Minimize total length of arrangement
  - Minimize sum of adjacency costs
    - applies only to ***lateral*** adjacencies
  - Minimize sum of nonconvexity costs
    - applies only to ***long*** sides of rectangles

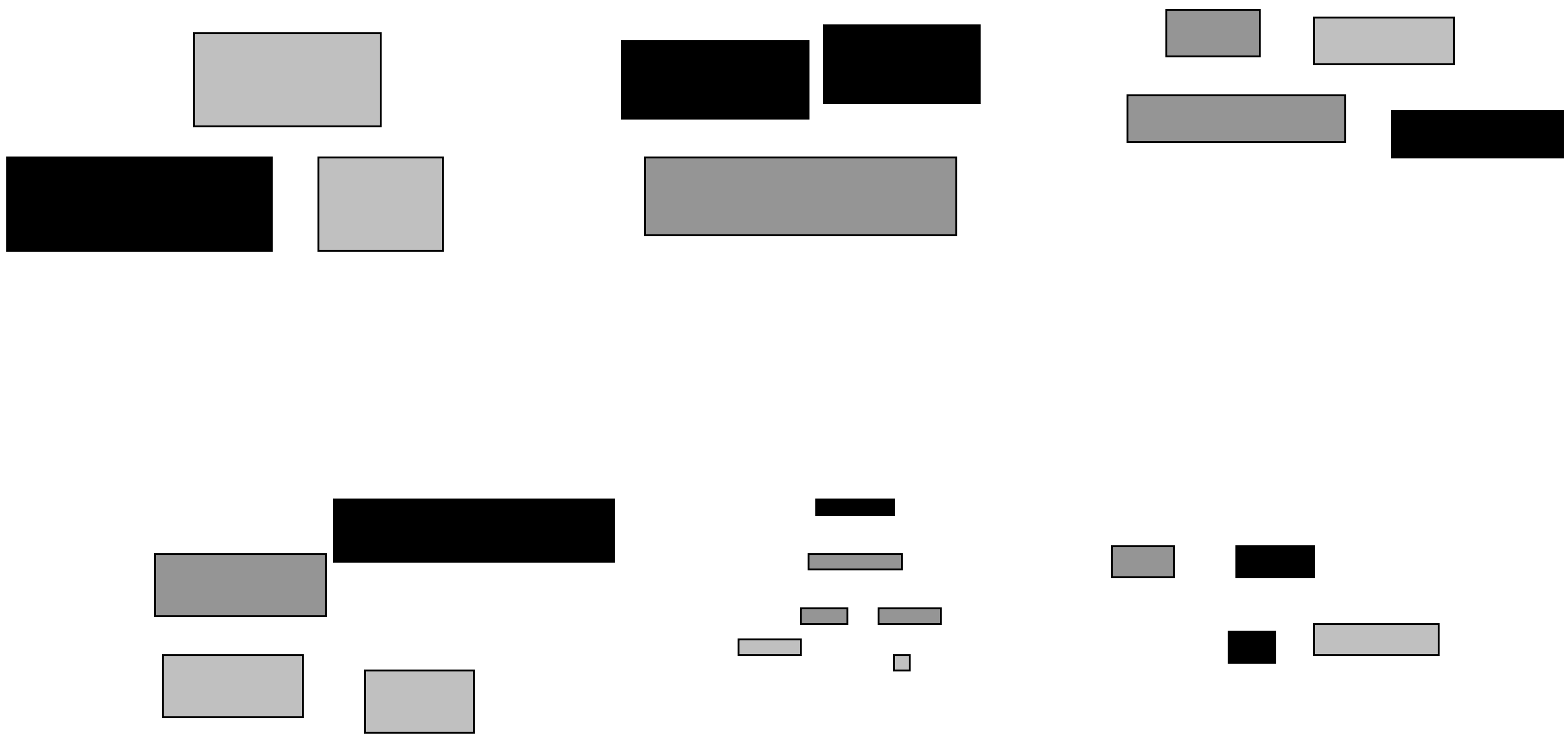
adjacency cost = k_1 * (length of common segment) * (difference in width)

nonconvexity cost = k_2 * (length of unshared segment) * (width of rectangle)

A More General Case

- *R* is partitioned into subsets such that, when arranged, rectangles within subsets must form a connected (not necessarily convex) region.
  - In practical instances, total of ~2000 rectangles total, subsets range in size from 4 to 40.

Example



A Possible Arrangement with Subset Connectedness Constraint

Approaches

- Certainly *NP*-hard
  - With $k_1=k_2=0$, and all rectangles having same width (= w/m), equivalent to multiprocessor scheduling
  - With $k_1=k_2=0$, $w=2$, and all rectangles having same width (=1), equivalent to *PARTITION*
  - combination of constraints
- Approximation algorithm needed
  - need reasonable heuristic.
  - how can we prove a bound such a heuristic?