Floorplanning using Simulated Annealing

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Floorplanning

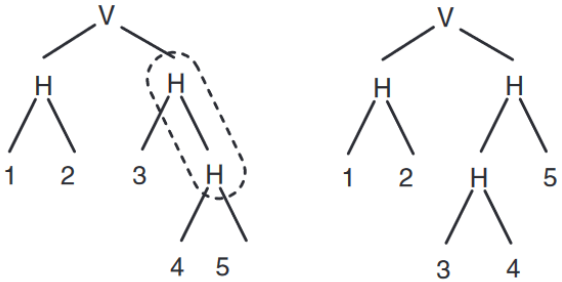
Modules

- hard
- rotatable

Costfunction

$$\alpha \frac{A}{A_{avg}} + (1 - \alpha) \frac{W}{W_{avg}}$$

Normalized Polish Expression [1]



- like Polish Expression, but no VV or HH allowed
  $\rightarrow$ no redundant solutions
- only 1 or 2 paths have to be updated ($> 2\times$ faster)

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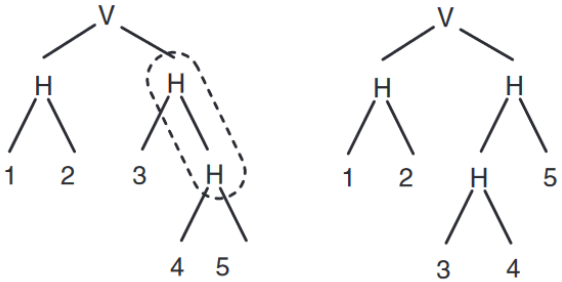

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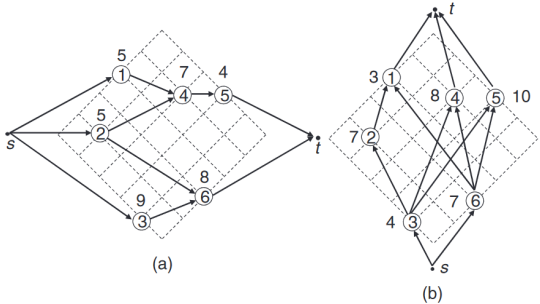
Sequence Pair [2]



Computing LCS efficiently

- $O(n \log n)$ algorithm requires balanced tree
- same paper also presents simple $O(n^2)$ algorithm ($> 6\times$ faster than standard DP)

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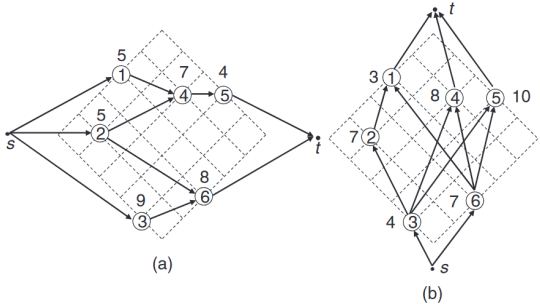

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Simulated Annealing

Estimate inital temperature

Let p be the initial probability of accepting a move.

$$p < \exp\left(\frac{-\Delta_{avg}}{T_{start}}\right) \Rightarrow T_{start} = \frac{-\Delta_{avg}}{\log p}$$

Set cool-rate for n iterations

$$\beta^n \, T_{start} = T_{end} \Rightarrow \beta = \left(\frac{T_{end}}{T_{start}}\right)^{1/n}$$

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Experiments

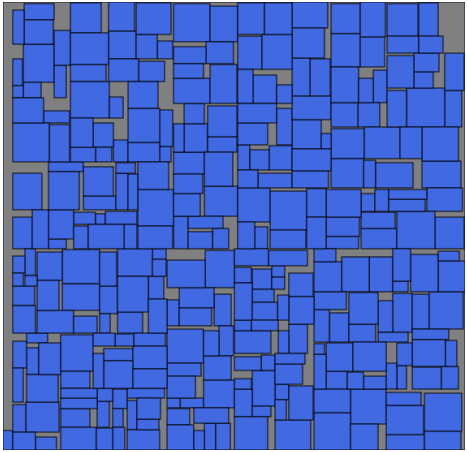
Setup

- rustc 1.73.0
- 300 modules, 1632 nets instance from GSRC-benchmark
- 5 repetitions
- 10^7 SA iterations, $p = 0.95$

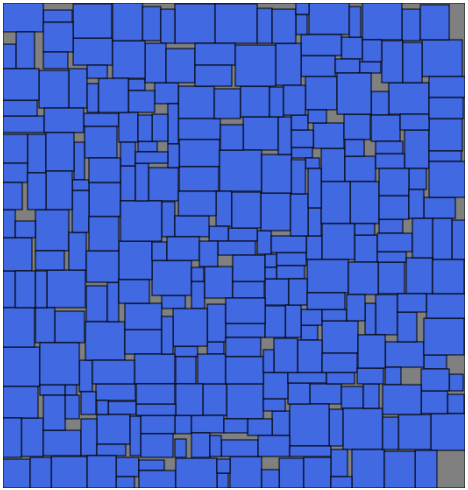
Runtime

- Normalized Polish Expression: 253.4s
- Sequence Pair 170.3s

Results



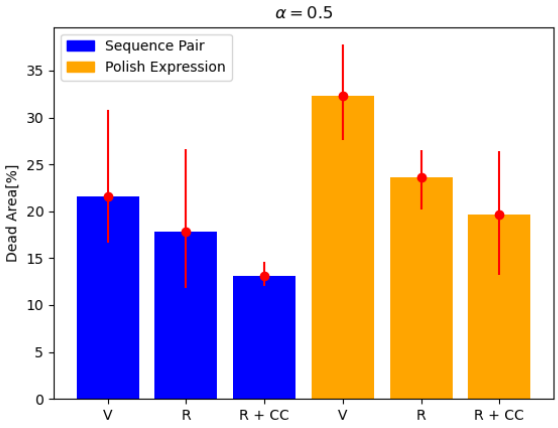
(a) Polish Expression, 7.94% dead area

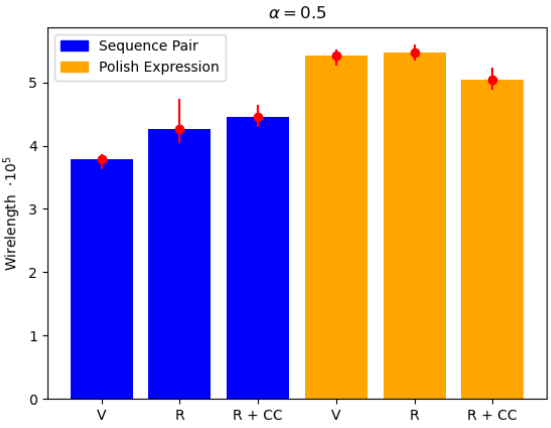


(b) Sequence Pair, 6.44% dead area

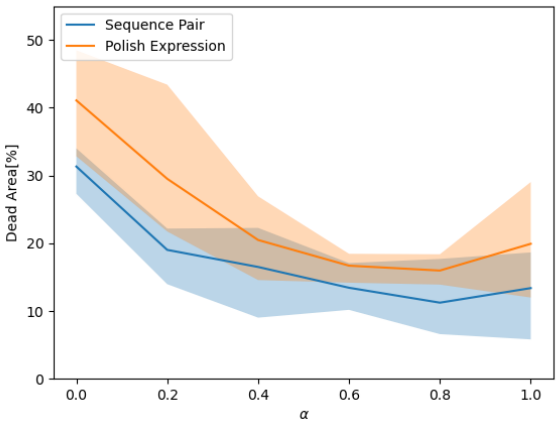
Experiments - Initial Solution

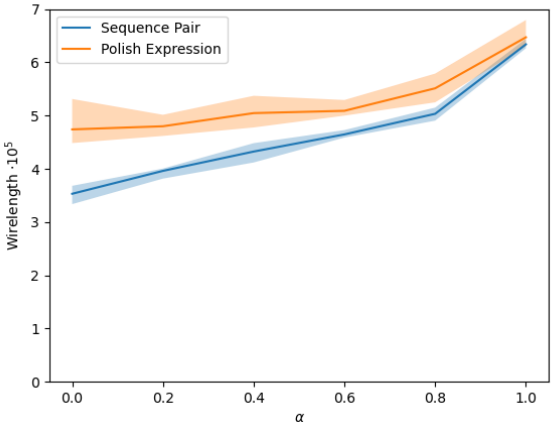
- V – vertical, R – recursive bisection, CC – cluster growing order





Experiments - Different α





References

[1] D.F. Wong and C.L. Liu. "A New Algorithm for Floorplan Design". In: *23rd ACM/IEEE Design Automation Conference*. 1986, pp. 101–107. DOI: 10.1109/DAC.1986.1586075.

[2] H. Murata et al. "Rectangle-packing-based module placement". In: *Proceedings of IEEE International Conference on Computer Aided Design (ICCAD)*. 1995, pp. 472–479. DOI: 10.1109/ICCAD.1995.480159.