Towards an Evolved Lower Bound for the Most Circular Partition of a Square

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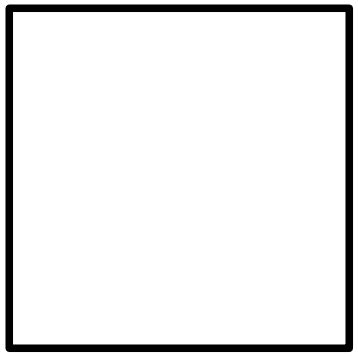
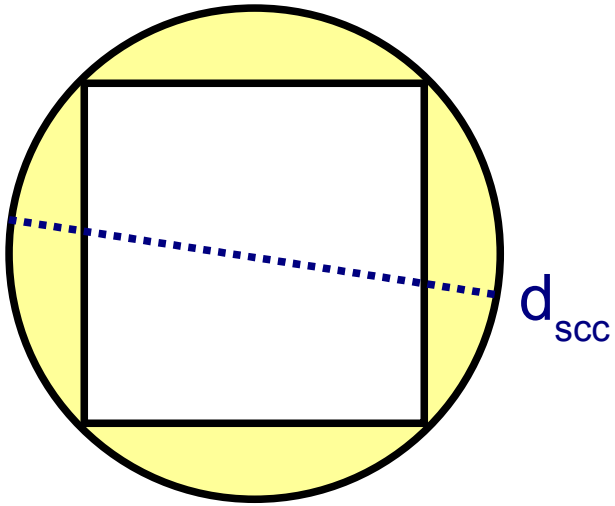
artificial intelligence research koblenz

Circular Polygons



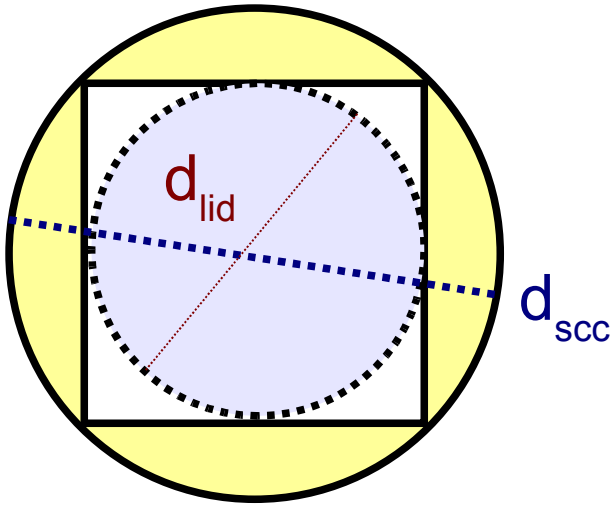
Circular Polygons



Aspect ratio γ

$$= \frac{\text{diameter(smallest circumscribing circle)}}{}$$

Circular Polygons

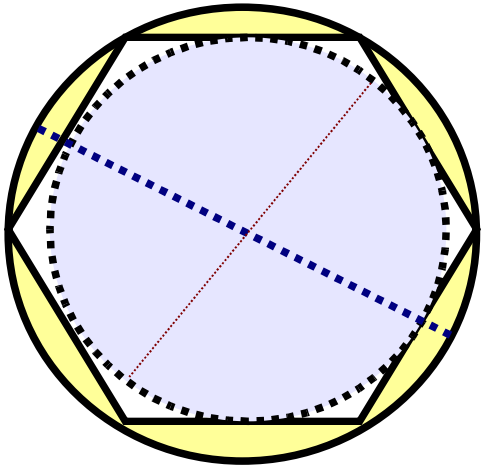


Square: $\gamma = 1.414$

Aspect ratio γ

$$= \frac{\text{diameter(smallest circumscribing circle)}}{\text{diameter(larges inscribed circle)}}$$

Circular Polygons



Square: γ = 1.414

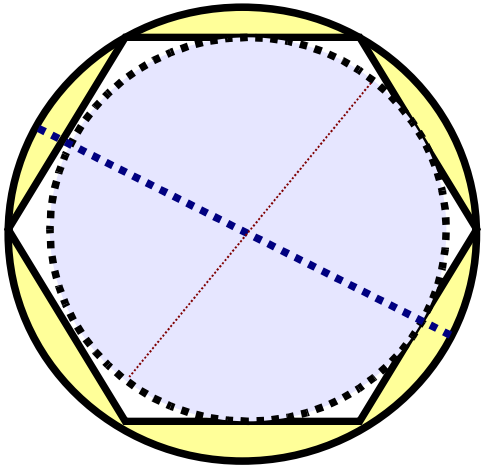
Pentagon: γ = 1.236

Hexagon: γ = 1.155

Aspect ratio γ

$$= \frac{\text{diameter(smallest circumscribing circle)}}{\text{diameter(larges inscribed circle)}}$$

Circular Polygons



Square: γ = 1.414

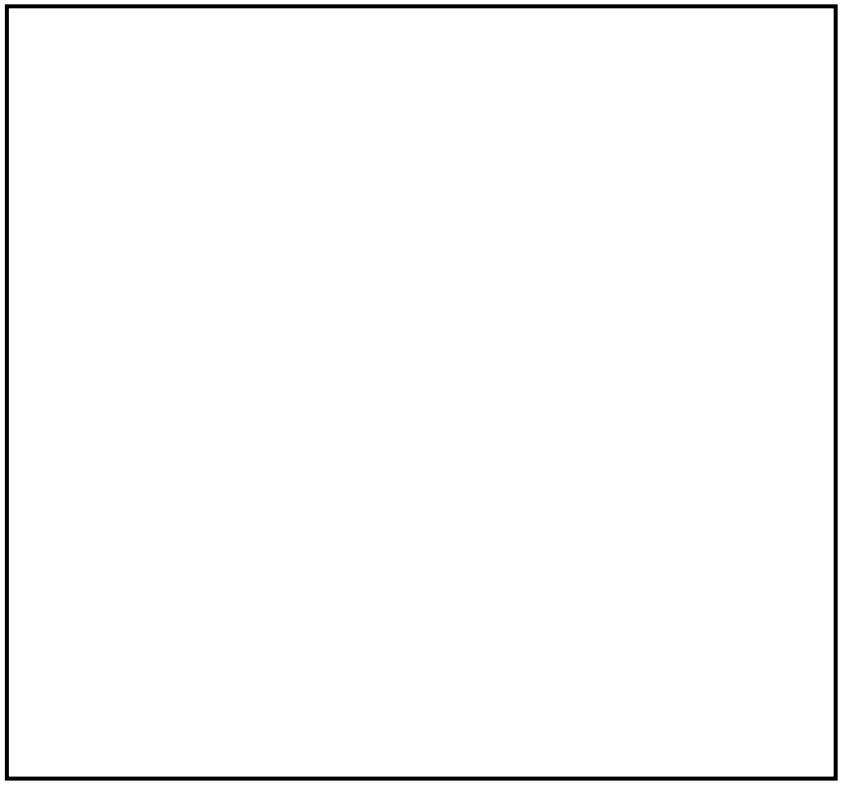
Pentagon: γ = 1.236

Hexagon: γ = 1.155

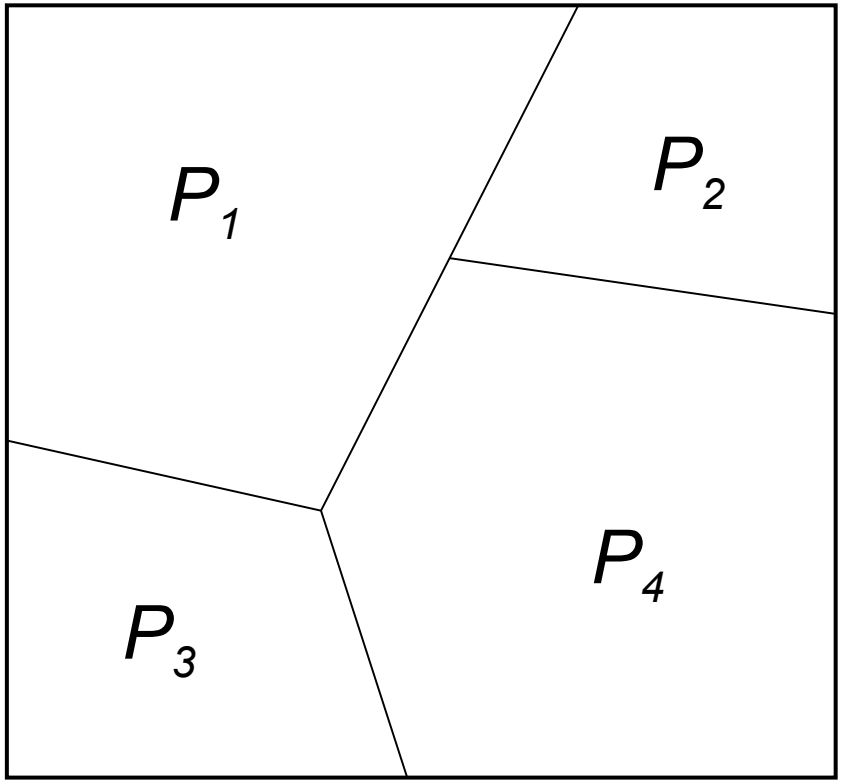
Aspect ratio γ

Near 1.0 → circular

Circular Partitions

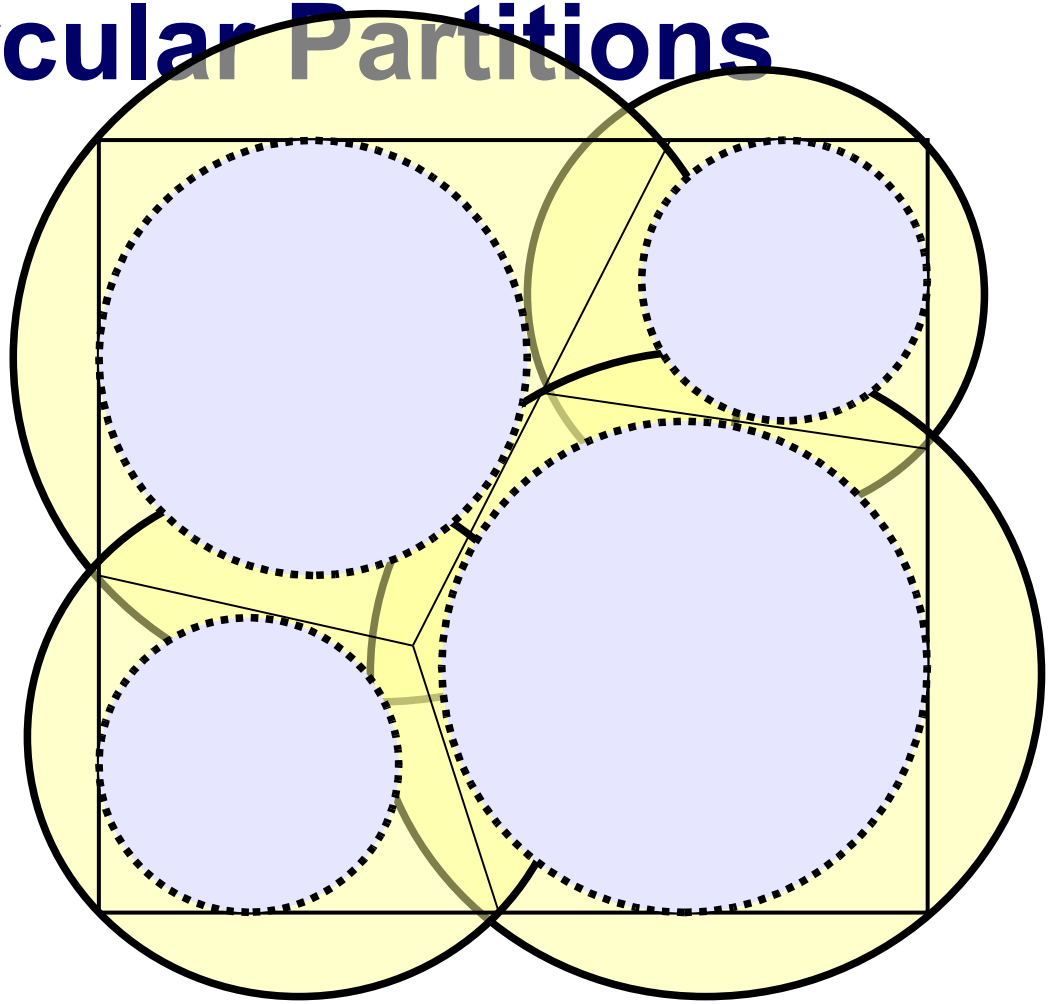


Circular Partitions



Partition of a polygon P in $P_1, \ldots, P_n$

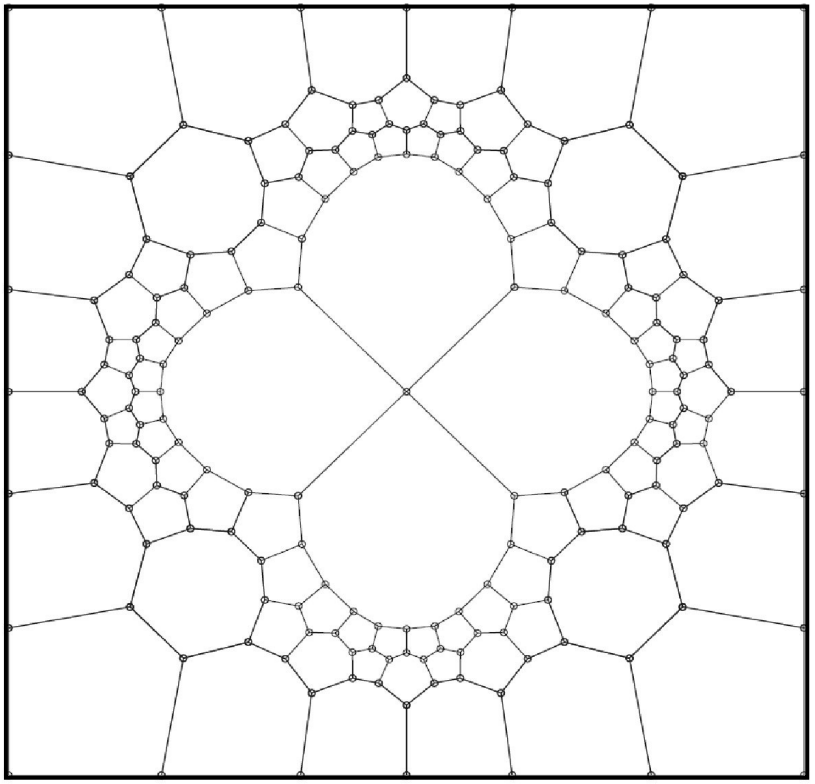
Circular Partitions



Partition of a polygon P in $P_1, \ldots, P_n$

$\gamma_{\text{partition}} = \max \{ \gamma(P_1), \ldots, \gamma(P_n) \}$

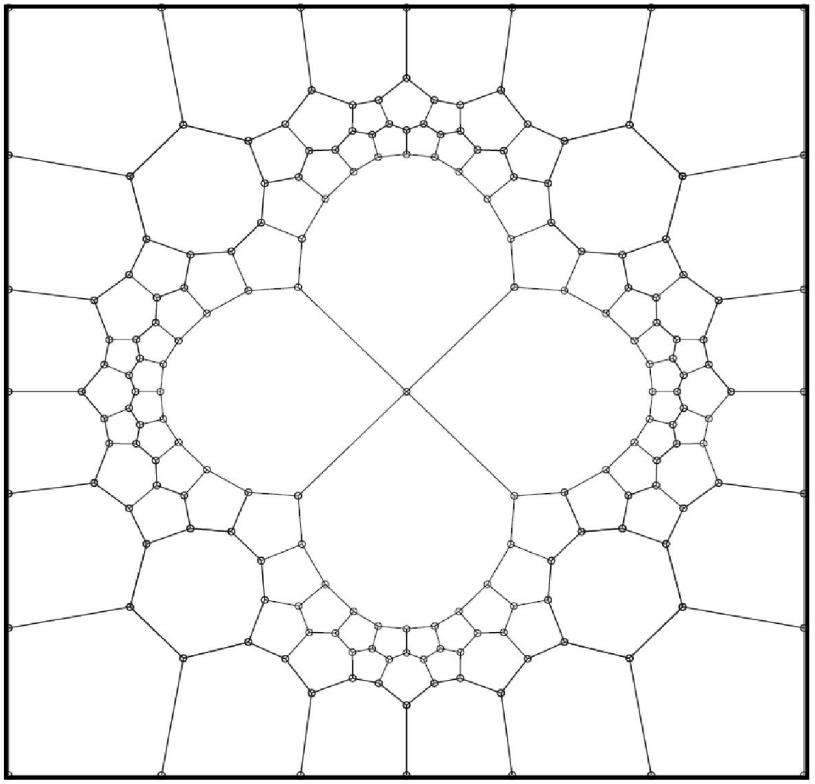
Circular Partition into Convex Polygons



Best so far [DIO03]
$\gamma = 1.29950$

[DIO03] Mirela Damian-Iordache and Joseph O'Rourke. Partitioning regular polygons into circular pieces I: Convex partitions. CoRR, cs.CG/0304023, 2003.

Circular Partition into Convex Polygons



Best so far [DIO03]
$\gamma = 1.29950$

Lower bound
$\gamma = 1.28868$

Our question: Is some improvement possible?

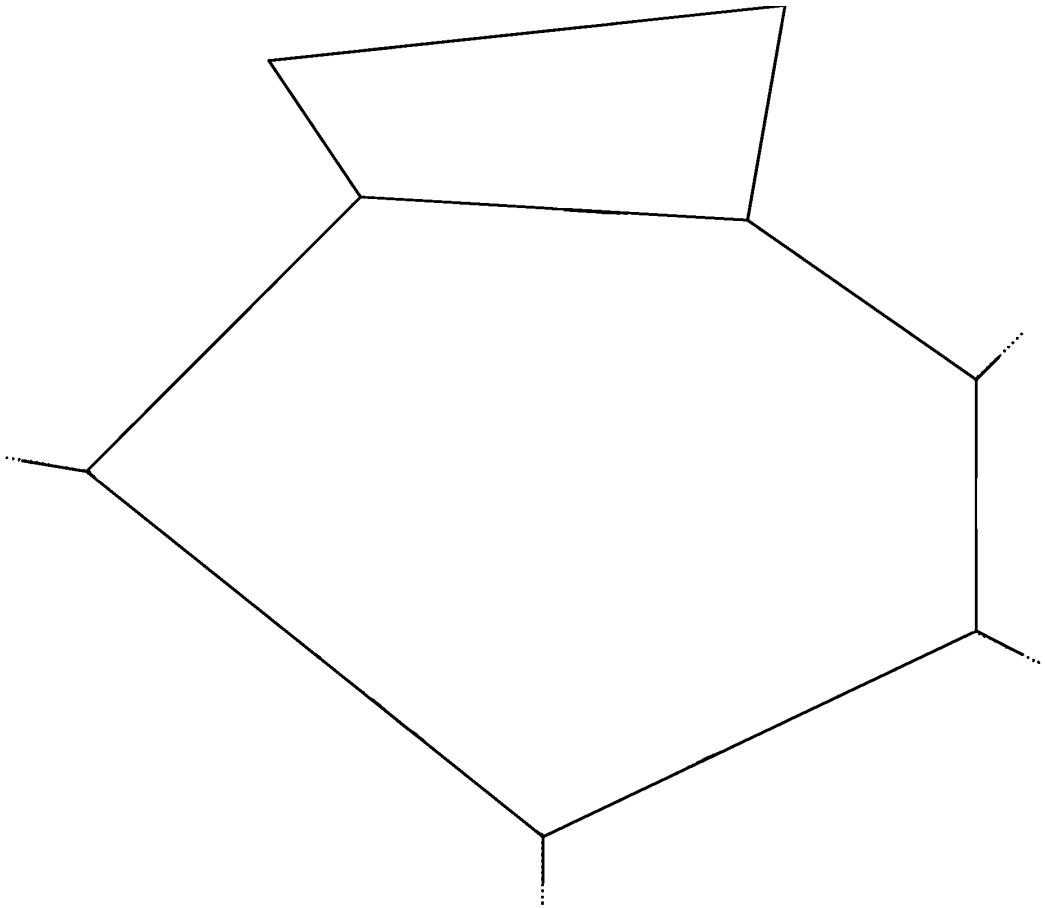
Evolutionary Algorithm

1. Representation
2. Fitness Function
3. Selection Mechanism
4. Initial Population

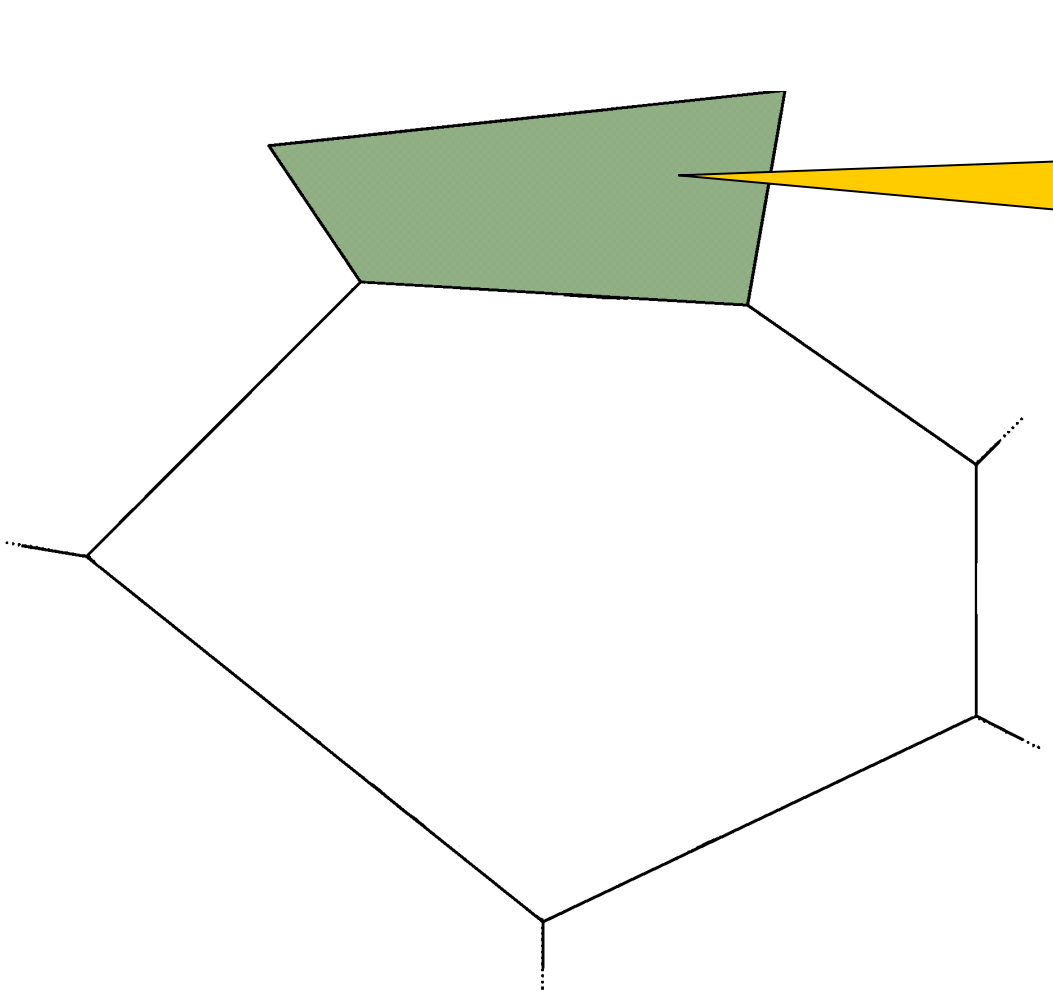
Operators

- Push Operator
  mutates vertices
- **Tile Operator**
  mutates non-circular polygons
- Star Operator
  mutates concave polygons
- Crossover Operator

Tile Operator



Tile Operator



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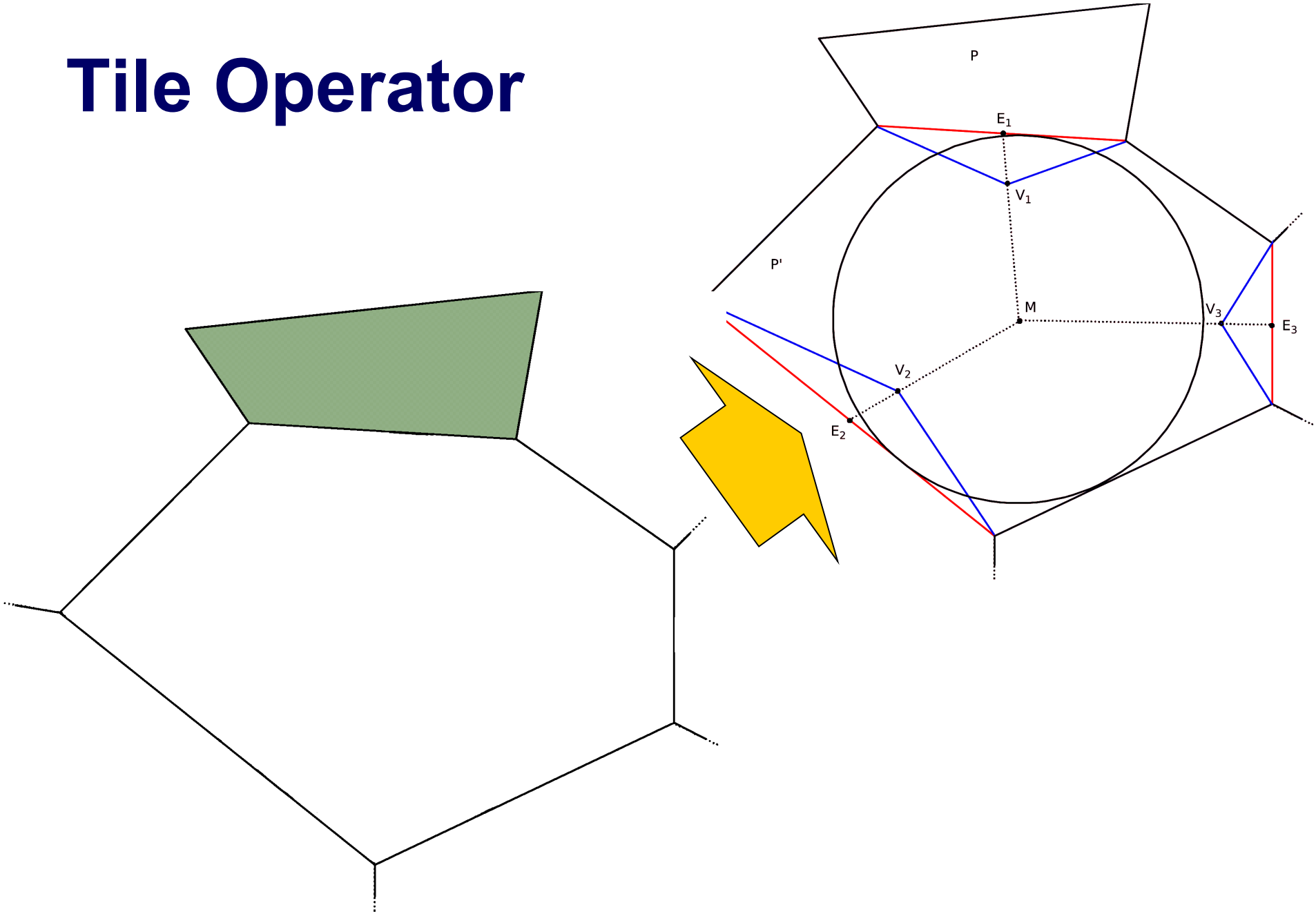
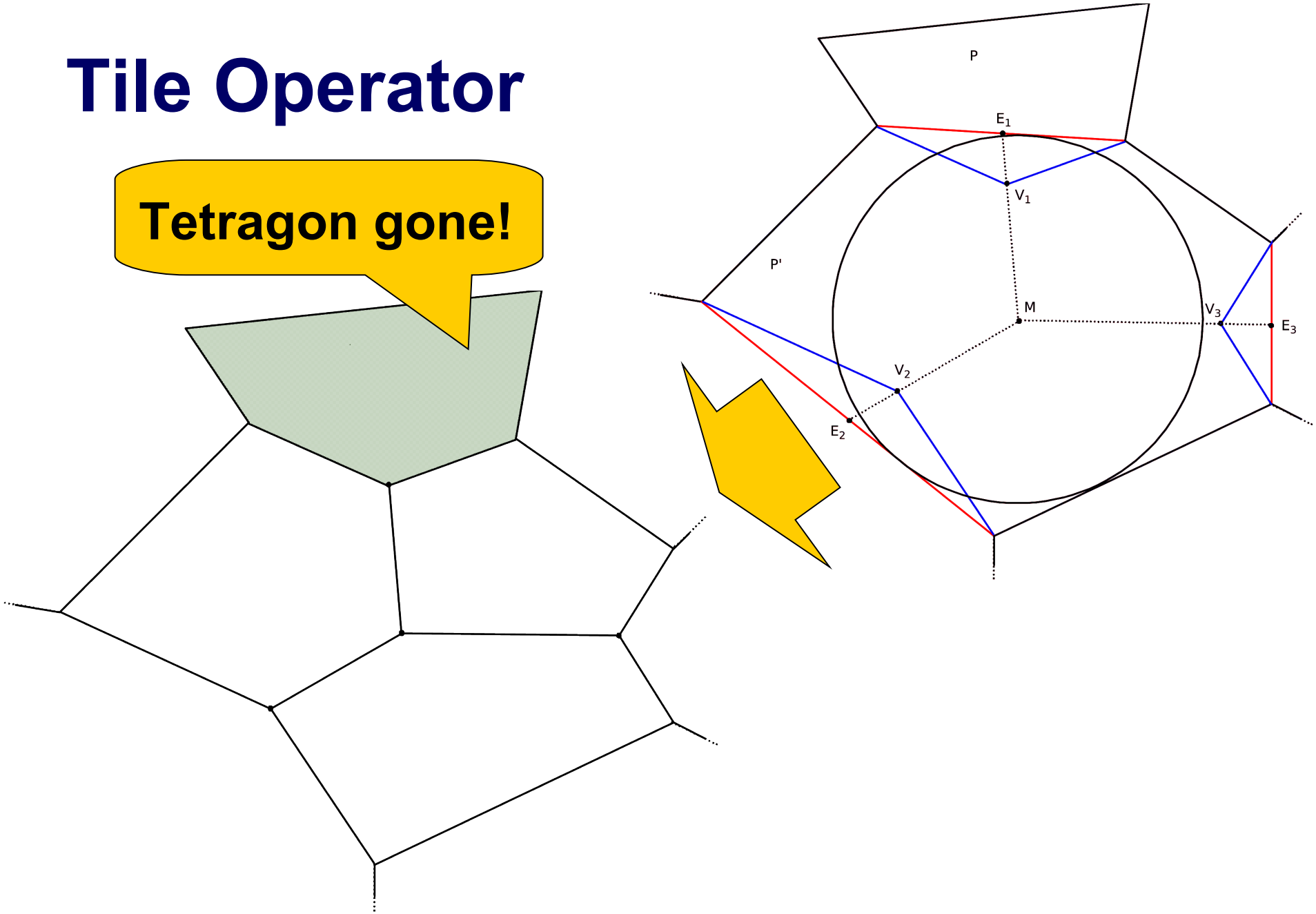
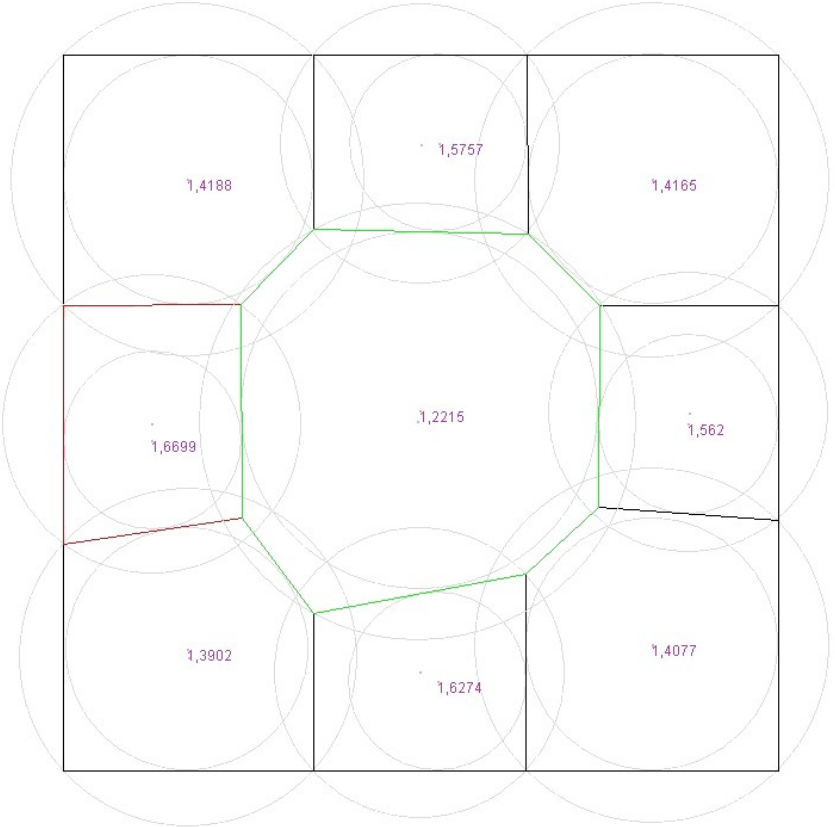
Tile Operator

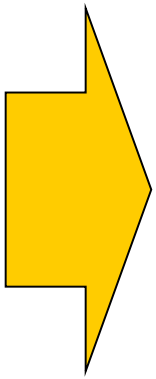


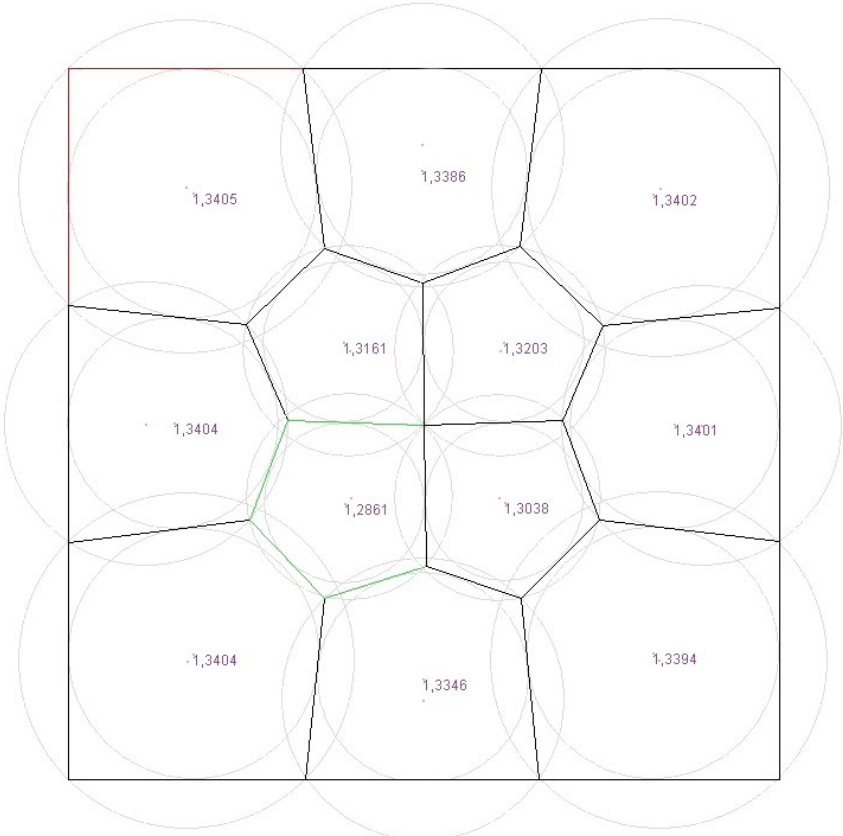
Tile Operator



Short Run Results







γ = 1.6699

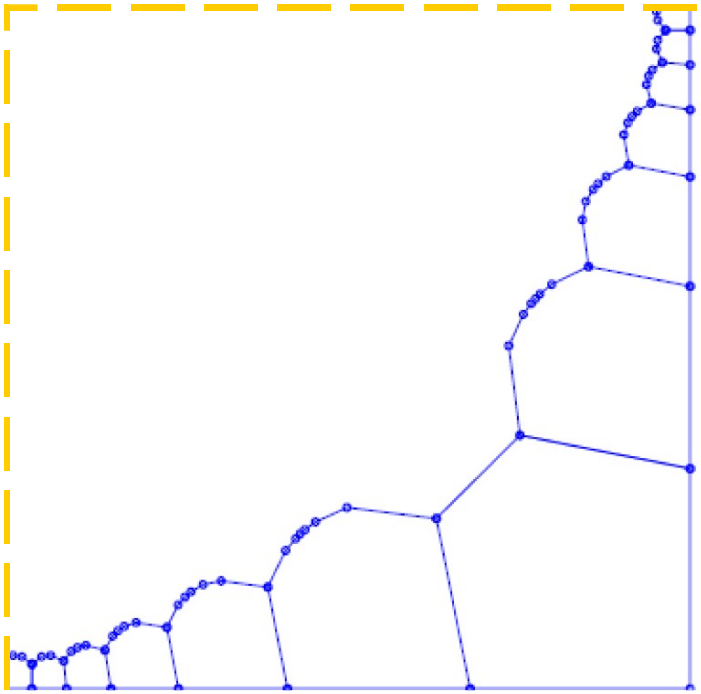
γ = 1.3405

(optimal: γ = 1.3396)

Long way to γ = 1.2995

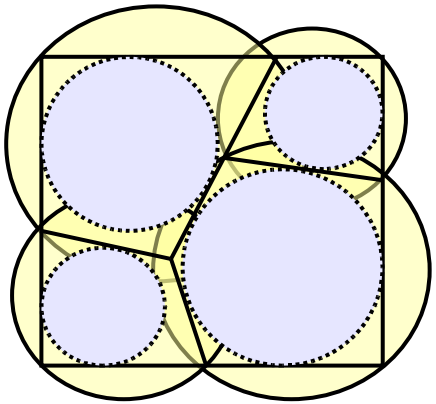
Discussion

Long run experiments:
No improvement
over [DIO03] (γ = 1.29950)

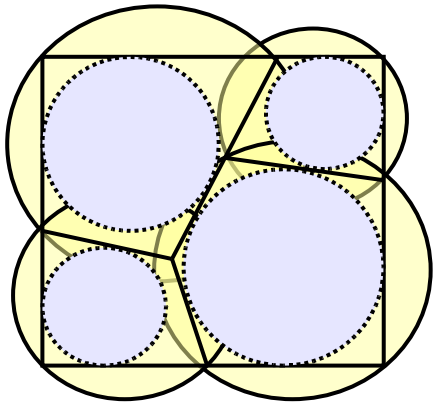


γ = 1.28898

- Seeding crucial
- Not trivial to leave local minima
- Search space
- High level of epistasis



Thank you!



Personal Note

I'm looking for a PhD position ☺

Thank you!