

Validating a Peer-to-Peer Evolutionary Algorithm

*J.L.J. Laredo**, P. Bouvry, S. Mostaghim, J.J. Merelo

P2P Optimization

What?

Parallelization of time-consuming meta-heuristics in P2P systems:

- ▶ Branch&Bound
- ▶ PSO
- ▶ EA
- ▶ ...

Why?



Massive Scalability



Shorten convergence time

BUT!!

✘ So far... simulation based experimentation

Outline

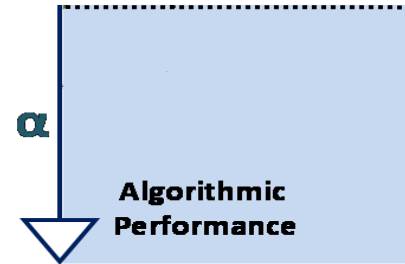
- ▶ **Introduction**
 - ▶ The Curse of Dimensionality
 - ▶ Parallel vs. Sequential
- ▶ **P2P EC Model**
 - ▶ Viability
- ▶ **Validation in a real-environment**
 - ▶ Simulations
 - ▶ Algorithmic results
 - ▶ Massive scalability
- ▶ **Conclusions**

The Curse of Dimensionality

0 1 L=2



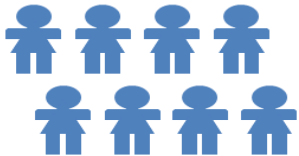
L^α



0 1 1 0 L=4

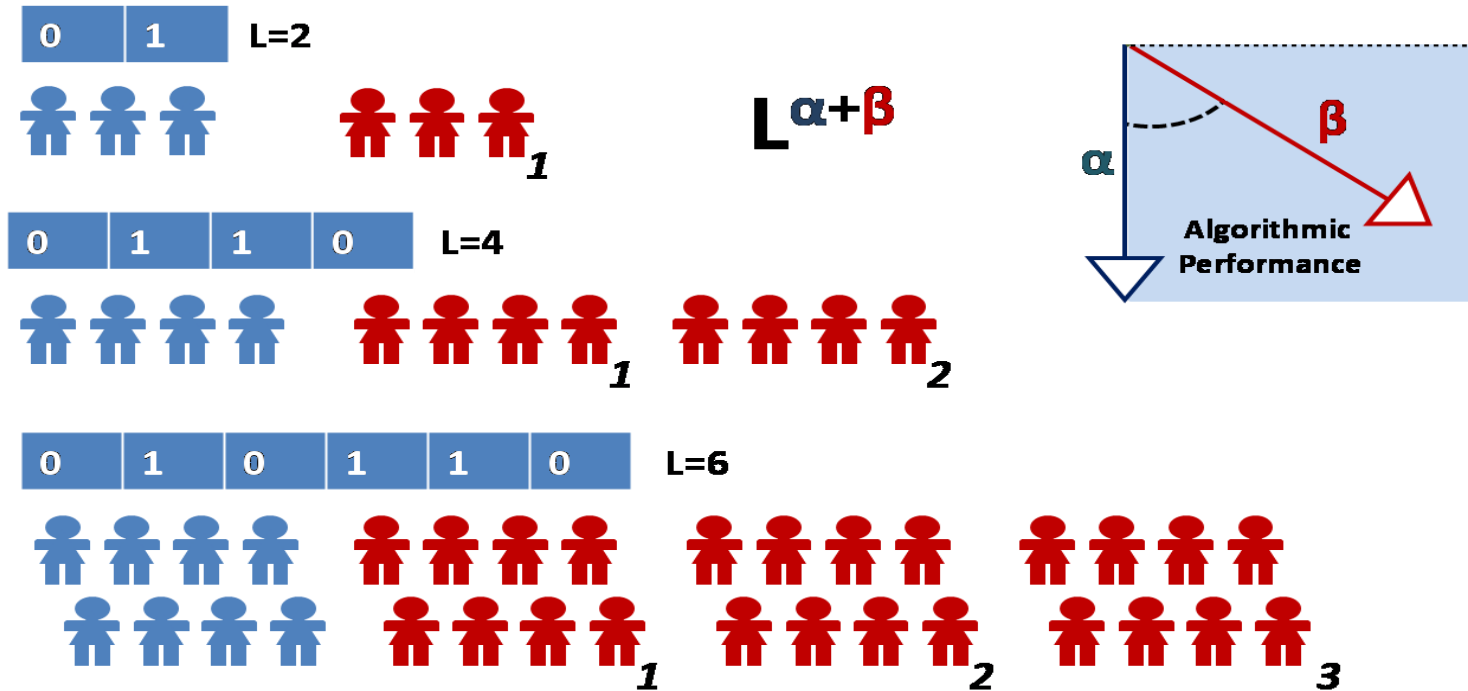


0 1 0 1 1 0 L=6



Goldberg,02

The Curse of Dimensionality



Goldberg,02
Fernandes,08

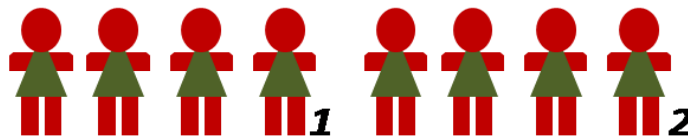
The Curse of Dimensionality

0 1 L=2

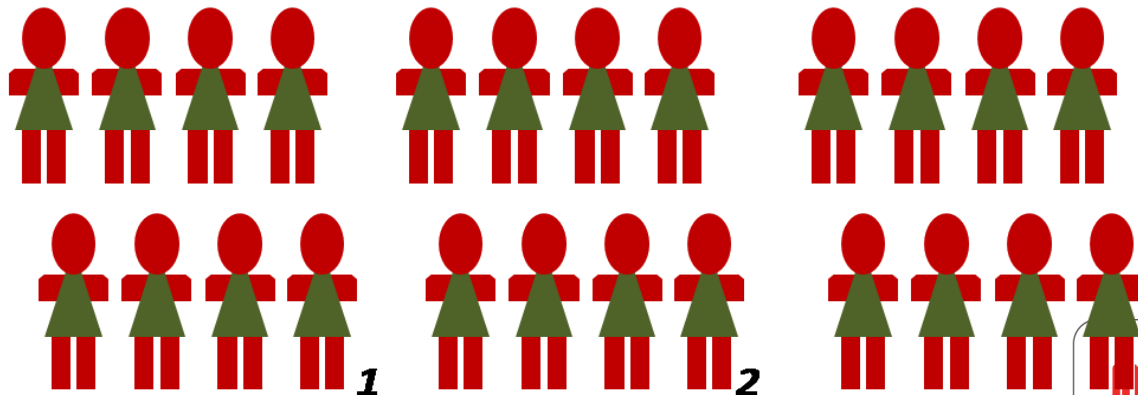
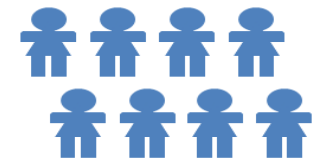


$$L^{\alpha+\beta+\zeta}$$

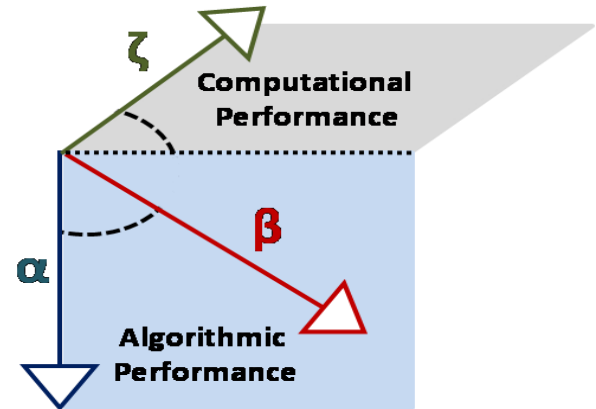
0 1 1 0 L=4



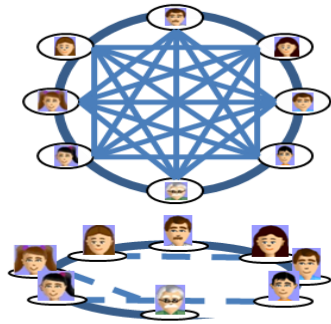
0 1 0 1 1 0 L=6



Goldberg,02
Fernandes,08
Gagné,03



Parallel vs. Sequential

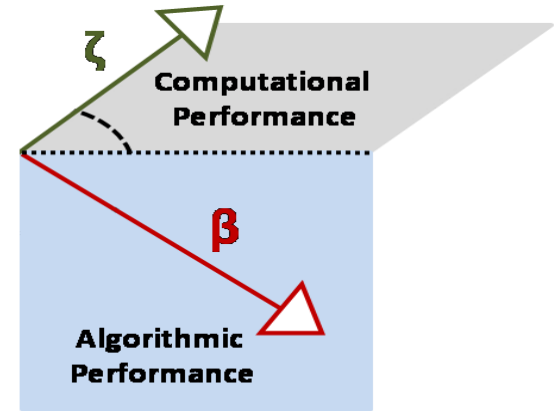


Sequential

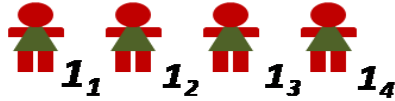
$$L^{\alpha+\beta+\zeta}$$

Parallel

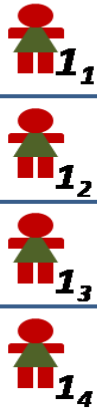
$$L^{\beta+\zeta}$$



Sequential

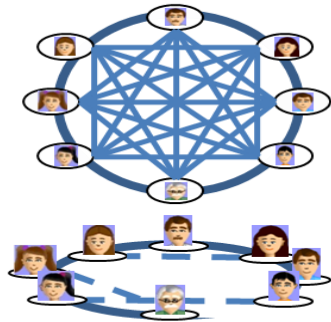


Parallel



Time

Parallel vs. Sequential

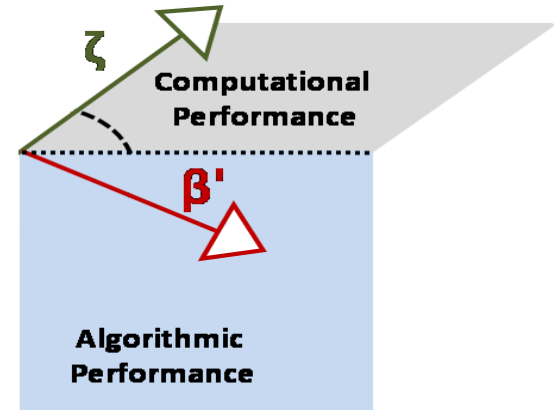


Sequential

$$L \alpha + \beta + \zeta$$

Parallel

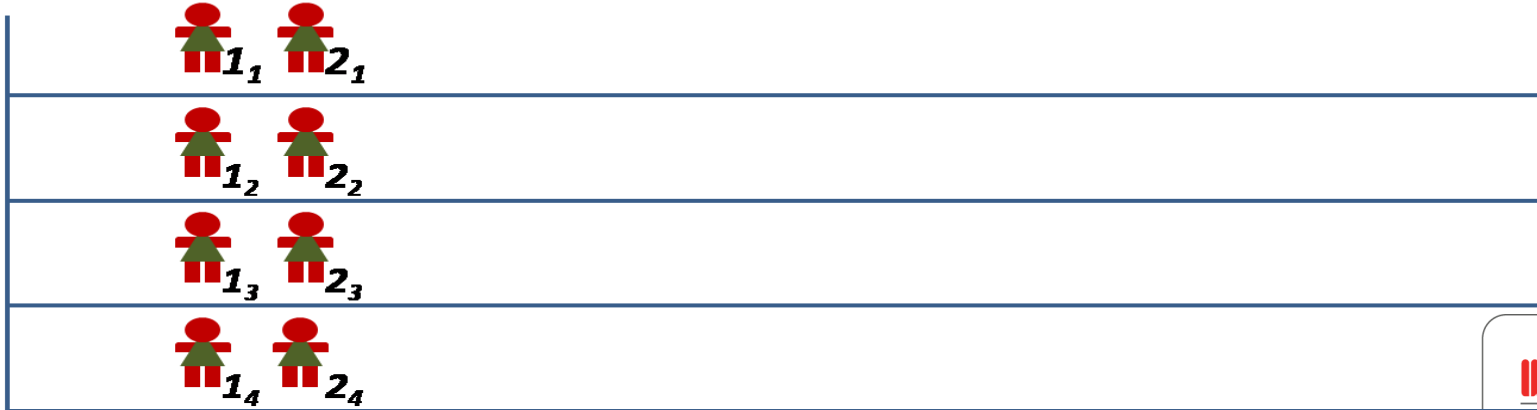
$$L \beta' + \zeta$$



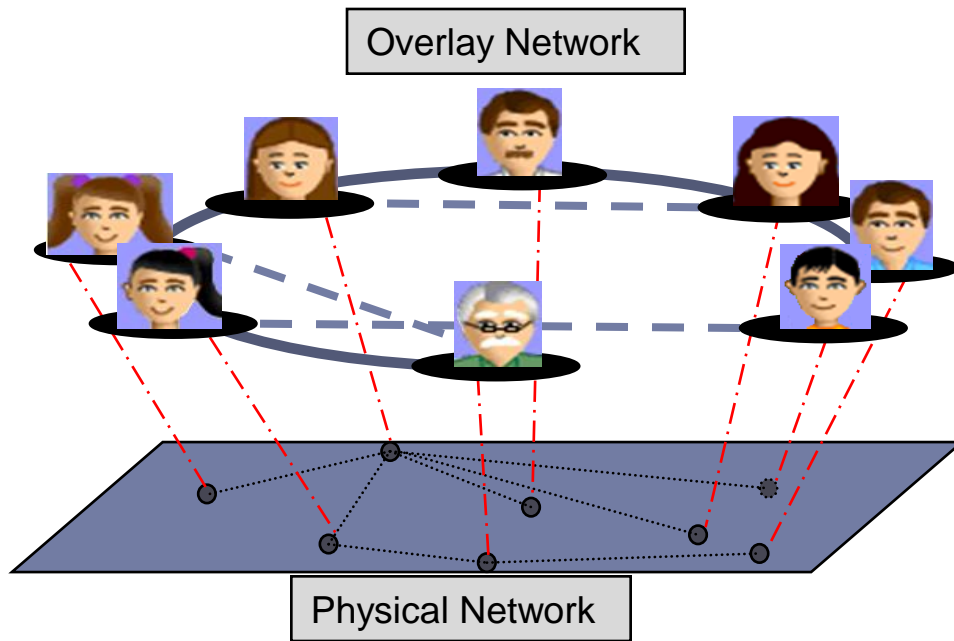
Sequential



Parallel

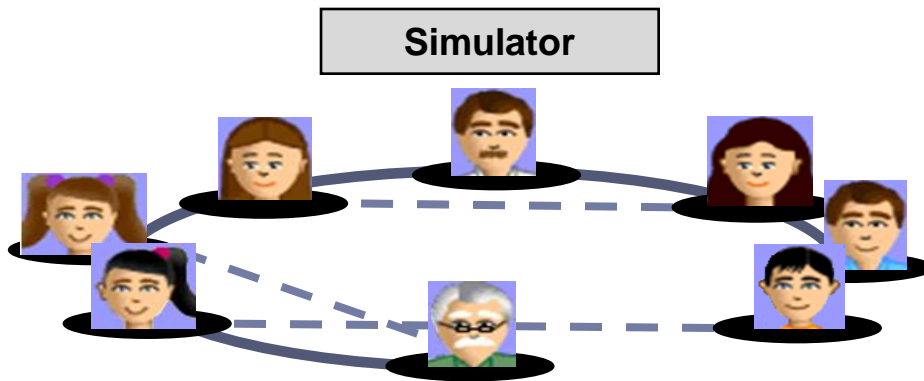


Evolvable Agent

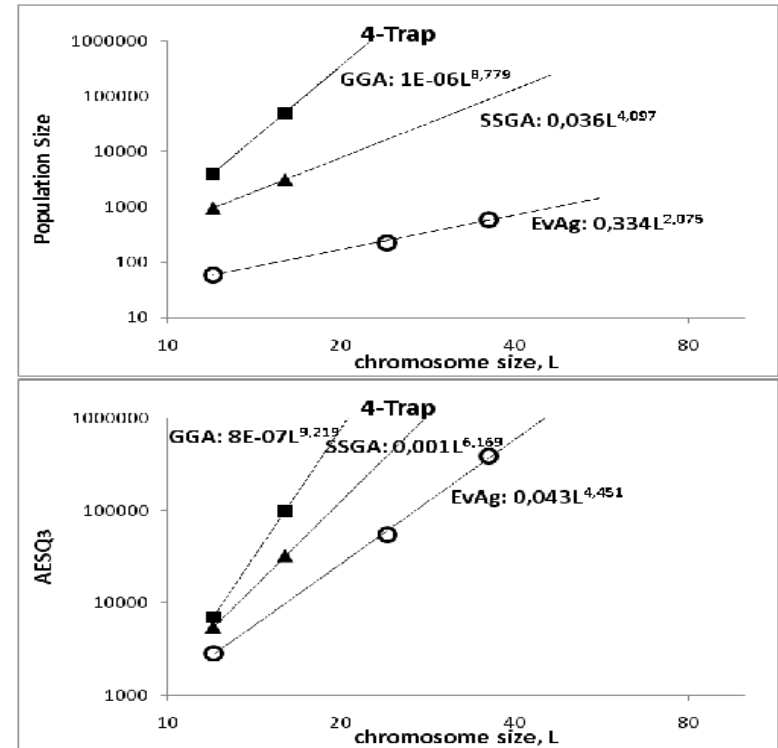


- ▶ Agent-based approach
- ▶ Fine-grain parallelization
- ▶ Spatially structured EA
- ▶ Local Selection

Viability



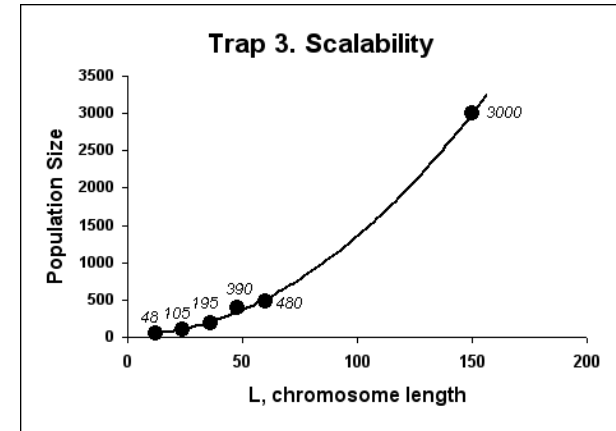
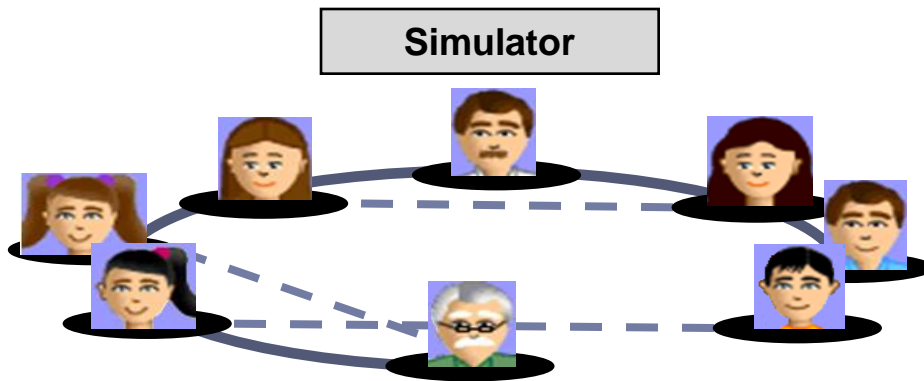
Simulator conducted experimentation!!!



J.L.J. Laredo, A.E. Eiben, M. van Steen, J. J. Merelo.

EvAg: a scalable peer-to-peer evolutionary algorithm.
Genetic Programming and Evolvable Machines, 11(2):227-246. 2010.

Simulations

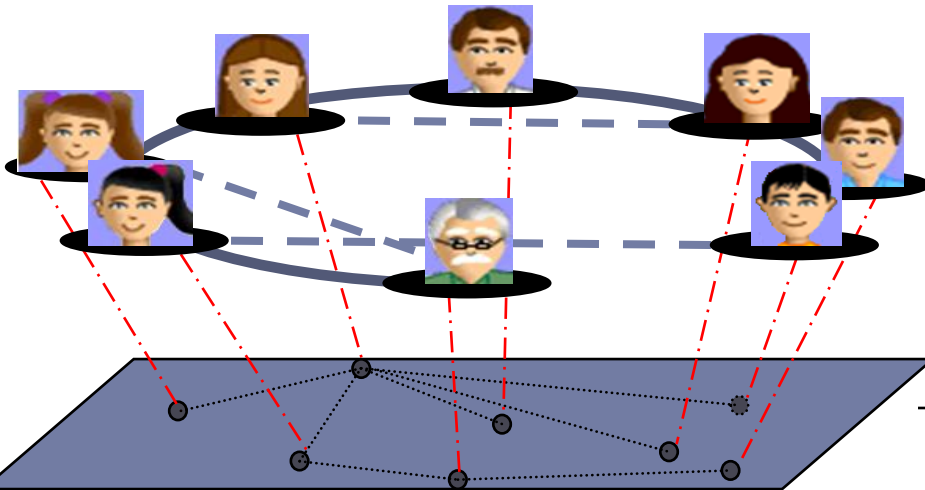


Simulator conducted experimentation!!!

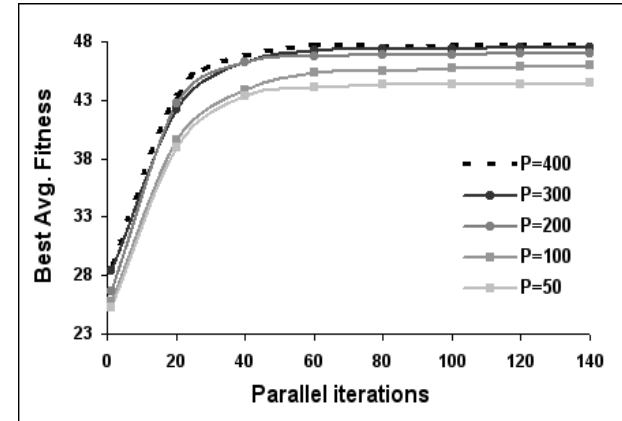
Instance	P	Avg. N. Gen	Max. N. Gen.
L=48	390	85	140
L=150	3000	173	250

Algorithmic Results

<https://forja.rediris.es/svn/geneura/drmWrapper>



<http://www.hirs.de/systems/platforms/nec-nehalem-cluster>

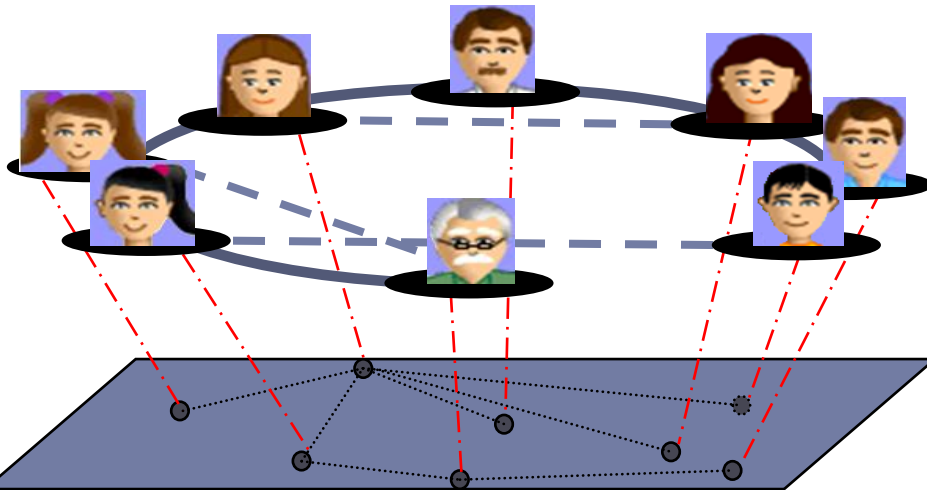


Instance	P	Avg. N. Gen	Max. N. Gen.
L=48	390	85	140

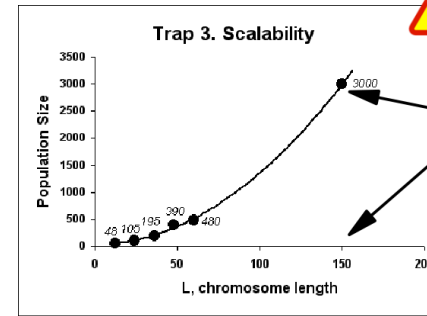


Massive Scalability

<https://forja.rediris.es/svn/geneura/drmWrapper>



<http://www.hirs.de/systems/platforms/nec-nehalem-cluster>



L=150

P=3000, SR=0.98

Assumption:

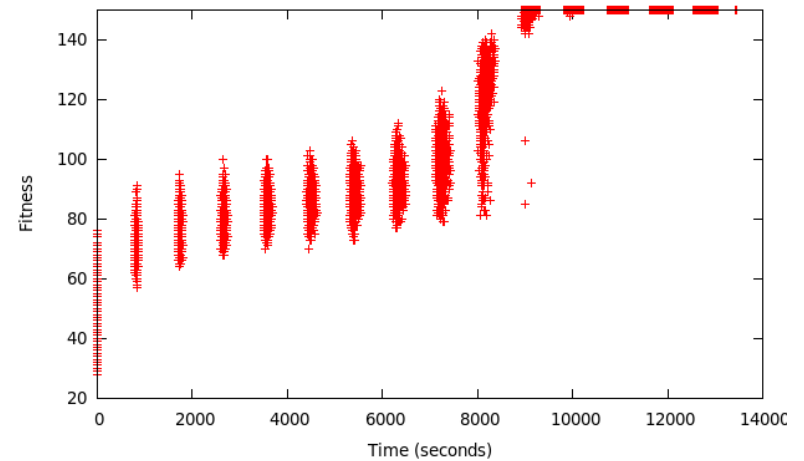
3000 ind. x

300 eval. x

16 sec.

~ 167 days of seq. computation

3-Trap L=150 P=3008



Conclusions

- ▶ 1st large parallel P2P EA experiment
 - ▶ 188 computers x 8 cores x 2 threads = 3008 agents



- ▶ Seamless scalability
- ▶ Conducted experimentation meets simulations

	Generations	Pop. Size	S.R.
Simulator	85	390	0.98
Parallel	40-80	400	0.8

- ▶ Massive scalability: $Speed\ -\ up = \frac{T_{seq}}{T_{par}} \approx 1000$

Thanks for your attention!!