

Evolving P2P overlay networks with Tags, SLAC and SLACER for Cooperation and possibly other things...

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Saarbrücken SP6 workshop July 19-20th 2005





- Bologna (UniBO) involved in SP4, SP5 and SP6 directly
- People with some involvement in DELIS:
 - Ozalp Babaoglu DELIS site leader
 - David Hales DELIS postdoc (SP4..6 evolving networks)
 - Stefano Arteconi PhD student (SP5 evolving P2P networks)
 - Mark Jelasity BISON postdoc (SP6 distributed ranking)
 - Edoardo Mollona Faculty / DELIS (economics SP4)





- Ideas from Computational Social Science show how boundly rational simple greedy optimizers can, via their interactions, come to behave in a socially cooperative way
- Many mechanisms, some simple, some complex
- My interest: Tags (Holland, Riolo, Axelrod Michigan group)
- Created mean-field single-round PD version (TagWorld)
- So far: adapted a mean-field abstract model (playing PD) into:
- simple network scenario playing PD (NetWorld)
- Into a more realistic P2P file-sharing / query scenario (FileWorld)
- Adapted to show that same technique can support cooperative specialization (SkillWorld)



- The basic idea behind Tags is that agents interact within subpopulations (groups, cliques, niches, tribes or whatever)
- But, agents can compare their utility in some way with agents in other tribes and move to them if they appear to be doing better also copying better agents behavior in some way
- The "tag" is just the identifier that indicates which tribe the agent is in. Hence agents sharing the same tag inhabit the same tribe and hence interact (rather than interacting randomly or directly with other tribes)
- When translated into P2P overlay networks the tag becomes simply the neighbour list or view – because nodes sharing the same neighbour lists form a cluster of interaction
- Recent thought: This kind of thing can be compared to "adhesion" mechanisms in Biology



- If you let nodes in a network try to optimise their individual utility by copying the views and behaviours of other randomly chosen nodes (with a little mutation) from the network with higher utility then...
- Counter intuitive things happen....
- In a range of scenarios, high levels of cooperation and altruistic like social behaviours and structures emerge
- But why?
- Since the copying and mutation process is analogus to replication in evolution, a kind of evolutionary process occurs
- This process favours cooperative tribes (since nodes in poorly performing tribes will tend to move away)
- A kind of weak "cultural group selective" process



Outline of the SLAC protocol (W=1)

Dynamically Evolving, Large-scale Information Systems

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Active thread:	Passive thread:
i ← this node periodically with prob. P reproduce: j ← SelectRandom(node) j.GetState(n1) if i.Utility ≤ j.Utility i ← CopyStatePartial(j) Mutate(i)	j ← this node GetState(i): Send j.Utility to i Send j.Links to i Send j.Strategy to i
Function CopyStatePartial(j):	Function Mutate(i):
i.Strategy ← j.Strategy drop each link from i with prob. W i.Links ← j.Links	with prob. M mutate i.Strategy with prob. MR mutate i.Links: drop each link with prob i.addLink(SelectRandor

). W n(node))



SLAC and SLACER

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- Selfish Link Adaptation for Cooperation (SLAC)
- Used in the previous scenarios (NetWorld, FileWorld, SkillWorld)
- But produced disconnected components (okay for these scenarios)
- To get a fully connected network overlapping cooperative clusters or tribes...
- Selfish Link Adaptation for Cooperation Excluding Rewiring
- SLACER is just SLAC but with W=0.9 (or some value < 1)
- Marginally less cooperation (98-99% not 99-100% of nodes)
- Creates a kind of "Artificial Social Network" small worldish (high C and low L compared to random)
- But different from real social networks....
- Recently been looking at "Connected Cooperative Clusters" (CCC's) – the number of CCC's >= number of components
- This seems like a useful measure for some possible tasks



- Random sampling of the network solution = NEWSCAST (Jelasity et al) already tested in simulation and works well
- Why should a node transmit the correct Utility, Strategy, Links?
 - Cleaver Greedy Cheating Liars (CGCL's) interestingly, it is in the objective interests of CGCL's to support cooperation some experiments, net can tolerate quite a lot of CGCL's
 - Nasty Nihilists Nodes (N3's) could destroy cooperation experiments pending.
- More general solution move to a Satisfying model and drop utility comparisons, could be fruitful since each node could have it's own "preferred service level"
- This could make the technique less general however...





















- Develop further the "saticficing" approach...?
- Find a good SP6 relevant specific scenario:
- Stopping query flooding?
- Stopping Malicious content, non-cooperative node behaviors?
- Encouraging overlay topology to evolve in a useful way?
- Clustering (forming tribes) around semantic interests?
- Encouraging altruistic node behaviors storing data and processing queries when producing little?
- Exploiting existing altruistic nodes topologically?
- IDEAS? > dave@davidhales.com

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Fini.

PS.

A lot of the detail of the discussed models will be presented at the Paris Complex Systems Workshop

The SkillWorld will be presented at the ESOA Workshop located with AAMAS2005 in Utrecht next week.

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