Ensemble Case-Based Reasoning: Collaboration Policies for Multiagent Cooperative CBR [2]

Todor Stoyanov

February 23, 2007

Motivation

There are a few reasons to choose to distribute CBR

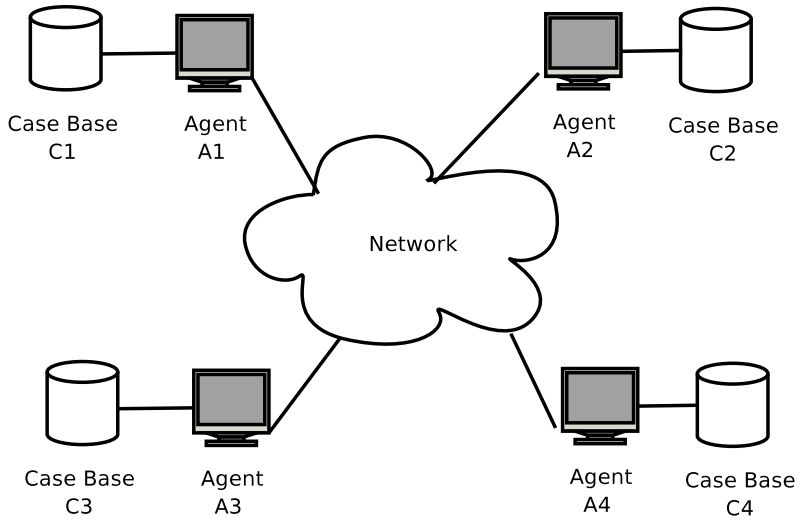
- Large databases
- Privacy concerns

This paper presents three aproaches to distribute CBR, while taking in maintaining

- Agent ability to make independet decisions
- Privacy of the aagent case database

The set-up

- We assume to have n Agents
- Thus the Multiagent System is $M = \{A_i, C_i\}_{i=1..n}$



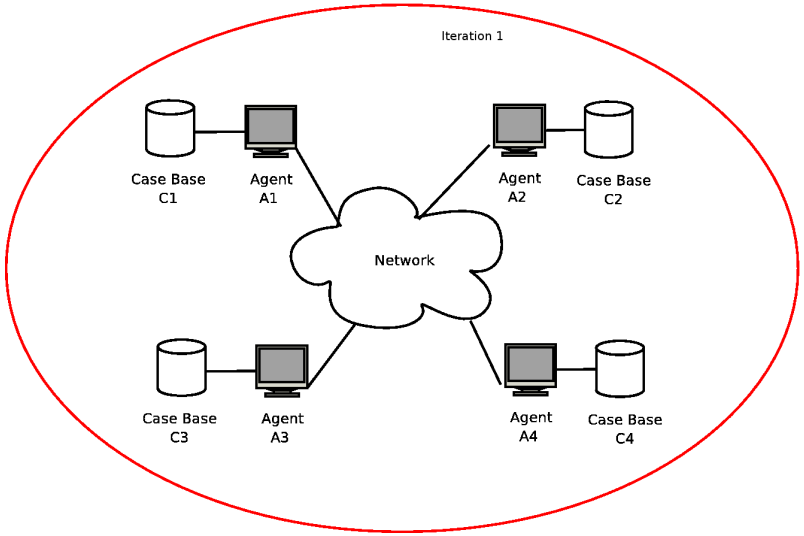
The Voting Algorithm

- Each Agent can process a specific problem P and returns a Solution Endorsment Record(SER).
- A SER is of the form $\{\{S_k, E_k^j\}, P, A_j\}$
- In order to decide which is the "best" solution Each A_i is given one vote, that can be split amongst several SER's
- Each Solution S_k generated by A_j gets a vote

$$Vote(S_k, A_j) = \frac{E_k^j}{c + \sum_{r=1}^{k} E_r^j}$$

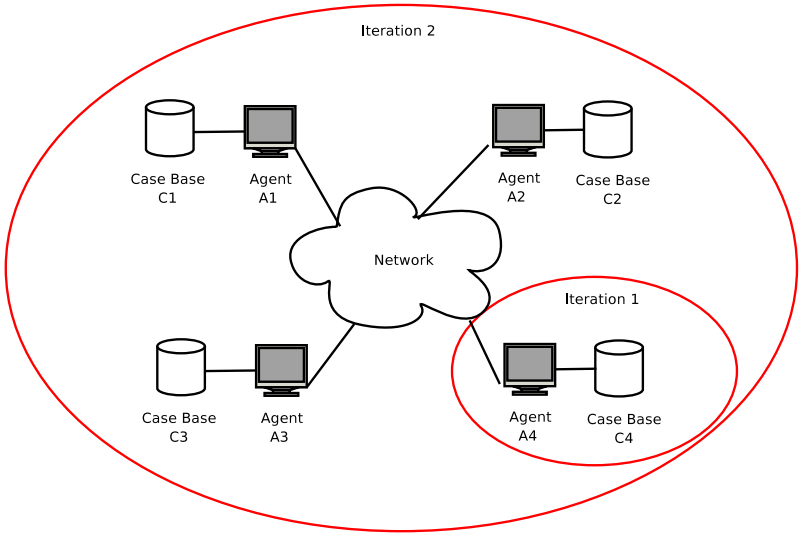
- Summing the Votes for S_k produces the overall Ballot. The solution with the best Ballot is then chosen

- The Comitee Policy directly passes the Problem towards the other Comitee members.
- The solution with the best Ballot is then chosen



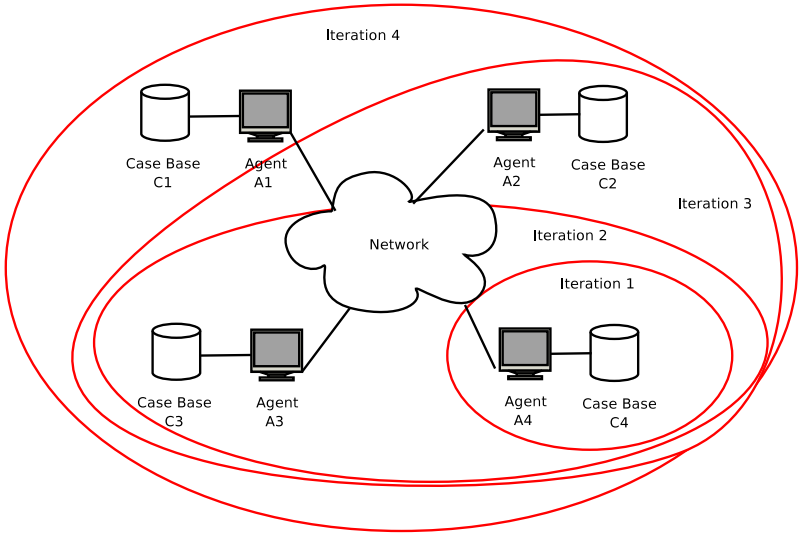
- This framework only requires one iteration

- The Peer Counsel Policy tries to solve the problem localy. If no "good" solution is found, it passes it to the other peers
- The solution is deemed "good" if it passes a *Self-competence* test



- This framework requires up to two iterations

- The Bounded Counsel Policy also tries to solve the problem localy. If no "good" solution is found, it passes it to the other peers, one at a time.
- A termination condition is enforced and the solution is returned if it's vote is η times better then the rest



- This framework requires up to n iterations

The LID Method in a Nutshel

- The terms in the Problem are processed as *Feature terms*
- Case relevance is assesed using a heuristic that minimizes RLM [1] distance
- The LID method is essentially A^* search on the case space, using the RLM distance as a heuristic

Experiment Design

- A database with 280 cases about 3 different orders of marine sponges was distributed among 3 to 7 Agents
- The agents were ran on one machine, with disjoined case bases
- 28 Problems were selected as test cases and randomly distributed to the agents
- 10 Test runs were performed

Results

Policy	3 Agents		4 Agents		5 Agents		6 Agents		7 Agents	
	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ
Isolated Agents	83.21	6.71	82.50	6.44	79.43	8.44	77.93	7.55	75.78	6.82
Bounded Counsel	87.29	6.1	86.71	6.47	85.07	6.29	85.00	7.25	84.14	7.04
Peer Counsel	87.28	5.72	86.79	6.67	85.85	6.68	85.50	5.86	84.71	6.75
Committee	88.36	5.98	88.29	5.72	88.36	5.41	88.14	6.04	87.93	5.86

- In all cases the Comitee Policy outperforms the rest
- The average number of Agents used however is the reverse
- The same is true for the average computation time spent

Conclusion

- The framework provided satisfies the design decissions
- Agents can cooperate to solve problems, without entirely loosing their autonomy
- Future work includes
  - Competence Models
  - Design of case-base sharing approaches
- Some critique:
  - The approaches require fine-tuned parameters
  - Isolated Agents
  - Networking aspect is disregarded in the experiments

Enric Plaza, Josep Lluis Arcos, and Francisco J. Martin.

Cooperative case-based reasoning.

In *ECAI '96: Selected papers from the Workshop on Distributed Artificial Intelligence Meets Machine Learning, Learning in Multi-Agent Environments*, pages 180–201, London, UK, 1997. Springer-Verlag.

Enric Plaza and Santiago Ontañón.

Ensemble case-based reasoning: Collaboration policies for multiagent cooperative cbr.

In *ICCBR*, pages 437–451, 2001.