Arguing in Groups

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Motivation

- We are interested in using data-mining techniques, specifically Association Rule Mining (ARM), to support argumentation.
- We call this *arguing from experience* where the data repository to be mined represents the experience of each individual participant.
- The principal advantage is that the use of data mining techniques does not require reference to a "knowledge base", hence:
  - No knowledge acquisition bottleneck; arguments can be generated (mined) dynamically.
  - Most recent data can be used.

Presentation Overview

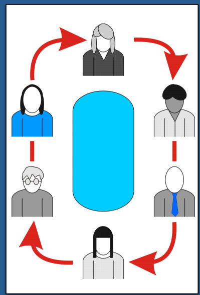
- Background
- Association Rule Mining
- Evaluation
- Arguing in groups issues
- Role of group leader
- Intergroup dialogue
- Evaluation
- Summary and conclusions

Background

- PADUA: A two agent arguing from experience framework (COMMA'08).
- PISA: Extension of PADUA to form a multi-agent arguing from experience framework (ArgMAS'09).
- Work presented here is an extension of PISA.

PISA

- Six possible moves: [SA1] propose rule, [SA2] add antecedent (decrease confidence), [SA3] add unwanted consequents, [SA4] counter rule, [SA5] add antecedent (increase confidence), [SA6] remove unwanted consequents.
- Not every move can follow on from every other move.
- Three strategies: [T1] attack whenever possible, [T2] attack only when needed, [T3] attack to prevent forecasted threat.
- Argumentation tree.



Association Rule Mining (ARM)

- Given a set of binary valued attributes A, a data set D, comprising m records $\{t_1, t_2, \ldots, t_m\}$, can be defined over A such that each t_i is some subset of A.
- ARM is principally concerned with the identification of probabilistic relationships, called Association Rules (ARs), of the form X−>Y where X and Y are disjoint subsets of A, which can be interpreted as *"if X true then then there is good reason to believe that Y is also true"*.

Association Rule Mining (ARM)

[SA1]	X->Y	
[SA2]		Decrease confidence
	X∧x->Y	
[SA5]		Increase confidence
[SA3]	X->Y∧y	
[SA6]	X->Y'	
[SA4]	A->B	

confidence(X−>Y) = support(X union Y)/support(X)

Evaluation (Classification)

- Both PADUA and PISA have been evaluated using classification scenarios; given a particular "case" we wish to "argue" this case belongs to a specific class.
- Thus each PADUA/PISA participants argues for a given class.
- Therefore the number of participants is equivalent to the number of available classes.
- With respect to classification our attribute set A is defined as follows $\{a_1, a_2, \ldots, a_n, c_1, \ldots, c_k\}$, where n is the number of attributes and k is the number of classes. The consequent, Y, of any AR generated, always includes one (and only one) member of the set of class $C=\{c_1, \ldots, c_k\}$.

Arguing in Groups: Issues

- **Group creation**. Framework requires participants arguing for same class to "join forces".
- **Selecting a Group Leader (GL)**. Selected according to experience (data set size, and strategy).
- **Intra-group consultation**. Group members suggest moves (targeted broadcasting).

Arguing in Groups: Role of GL

- **Move Selection**. Selecting best move at each round.
- **Enforcing a strategy**. GL may require group members to adopt the GLs strategy.
- **Direct moves**. GL may require group members to focus on a particular move proposed by another participant (group).

Arguing in Groups: Intergroup Dialogue

For each round:

GL consults the argumentation tree (if GL's strategy requires this). If participating in the round:

1. Group members, including GL, generate and propose moves where possible.
2. GL compares proposed moves with own move, and either:
   a) Selects move according to strategy, or
   b) Request alternative moves.

If no appropriate move available no move will be played.

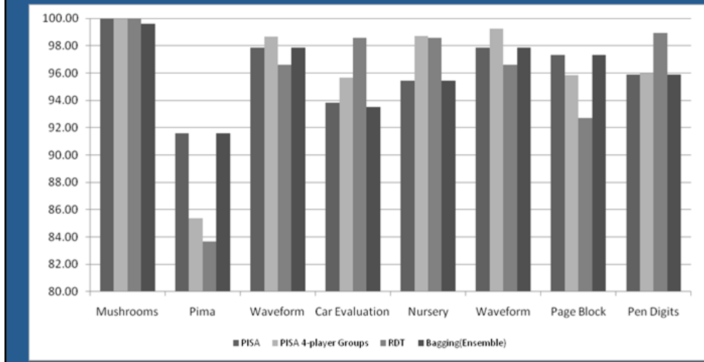
Evaluation (1)

1. Effectiveness of PISA. Used data sets from UCI repository. Operation of PISA compared to established classifiers (C4.5, Classification rule miners, etc). Results of comparable accuracy obtained.
2. Effectiveness of groups in argumentation. Used data set from the UCI repository (Mushroom, Pima, Waveform, Pen digits, etc). Compared operation of groups to no use of groups. Found that groups worked better. Exceptions is where there is only a small amount of data.
3. Effect of number of participants in a group (2, 4, 6, 8, 10) and data divided equally amongst groups (i.e. amount of data available to individuals decreases). Used Housing benefits dataset (fictional dataset). Accuracy of classification increases up to an optimum and then starts to fall as size of data diminishes to a level no longer adequate for ARM.

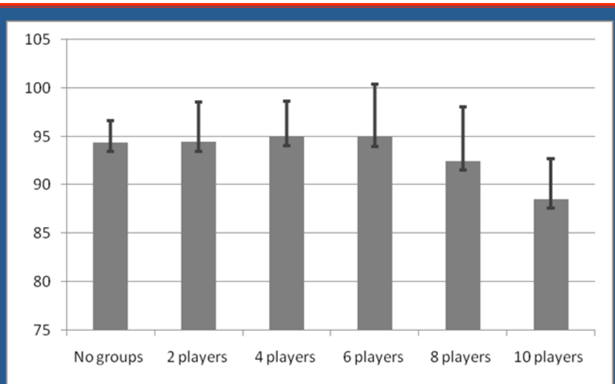
Evaluation (2)

4. Effect of number of participants in a group (data available to each member held constant). So amount of data available to group increases as size of group increases. Housing benefits dataset. Found, as expected, that the more data the better.
5. Effect of unbalanced groups. Because large groups with large datasets have an advantage this might influence the result in the event of unbalanced groups. Housing benefits dataset. This was indeed the case.
6. Effect of noise. Data from UCI repository seeded with increasing amounts of noise. PISA operates extremely well in the presence of noise outperforming alternative classifiers. Interesting result.

Evaluation (3)



Evaluation (4)



Housing benefit data set

Summary

- Presented mechanism for arguing from experience with groups using PISA.
- Experiments suggest:
  1. Operation of PISA, in the context of classification, is comparable to other classifies.
  2. Arguing with groups works better than with individuals.
  3. There is an optimal size for the data available to each participant.
  4. The more data the better the argument.
  5. Unbalanced groups should be avoided.
  6. System works well in the presence of noise.

Conclusions

- The proposed arguing from experience framework using groups works well (especially in the presence of noise).

- For future work we intend to investigate:
  1. Dynamic groups.
  2. Coalitions.