ACQUIRING USER TRADEOFF STRATEGIES AND PREFERENCES FOR NEGOTIATING AGENTS: A DEFAULT-THEN-ADJUST METHOD

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Antti Knutas
OVERVIEW

• Introduction: Acquiring knowledge for negotiating agents
  • Representing user preferences
  • Knowledge acquiring algorithm
• Test prototype: Accommodation renting scenario
  • Implementation
  • Results
  • Analysis
• Future work and Conclusions
INTRODUCTION

• Negotiation: A key form of interaction between complex systems
  • Web, peer-to-peer, e-business

• Efficient negotiating algorithms only half of the picture. Agents must acquire:
  • User’s interests
  • Strategies
  • Preferences
NEGOTIATING STRATEGIES

• Main negotiating strategy: *Tradeoff*

  • Combination of attribute values where decrease in one leads to increase in another

• Set of tradeoffs: *Tradeoff strategy*

• Some tradeoffs are more preferred than others: *Tradeoff preference*

• Users’ tradeoff preferences can be found out by a series of questions and other input methods
NEGOTIATING STRATEGIES

• Example: Apartment distance from city center and rental rate

• Users have different preferences, but have often difficulties expressing preferences in single values

• Users find it easier to indicate which sort of value combinations they like more when presented with options
DEFAULT-THEN-ADJUST APPROACH

• Basic steps:
  • Structured interview with user
  • Ask user to adjust the suggested default curve
  • Adjust the suggested default preference on tradeoff alternatives by adjusting the parameters
DEFAULT-THEN-ADJUST APPROACH

• Benefits:
  • The choice of tradeoff is not apparent
  • The system can provide an adviser which has the appropriate knowledge
  • The system lessens user workload by using default knowledge.
  • If user preferences are close to default knowledge, then the work needed to do the adjustments is small
REPRESENTING USER PREFERENCES

• User preferences can be presented as a set of conditions:
  • Continuity
  • Monotonicity
  • Boundary condition

• They also can be presented as a set of degrees of satisfactions:
  • Complete dissatisfaction
  • Satisfaction increasing
  • Complete satisfaction
  • Satisfaction decreasing
REPRESENTING USER PREFERENCES

EXAMPLE

Tradeoff strategy between rate $r$ and distance $d$, where $d = t(r)$

$$p(r, t(r)) = \begin{cases} 
0 & \text{if } 200 \leq r < a_{rate}, \\
\frac{r - a_{rate}}{b_{rate} - a_{rate}} & \text{if } a_{rate} \leq r < b_{rate}, \\
1 & \text{if } b_{rate} \leq r \leq c_{rate}, \\
\frac{d_{rate} - r}{d_{rate} - c_{rate}} & \text{if } c_{rate} < r \leq d_{rate}, \\
0 & \text{if } d_{rate} < r \leq 380,
\end{cases}$$
KNOWLEDGE ACQUIRING ALGORITHM

• Default-then-adjust acquisition steps:

1. Query user about choice features in order to determine which attributes to tradeoff

2. Start with a default, and then take the role of a seller. Make a number of concessions and asks the user for limits for worsening the other attribute

3. User can reshape the default tradeoff preference

4. After several tradeoff preference adjustments, user can return to adjusting the strategy
ACQUISITION PROCESS SUPPORT

• Two knowledge bases

  • Choice rules are used to choose the attributes between which tradeoffs can be made

    • From business negotiation theory: For example price and quality

  • Adjustment questions are used to help users to obtain their desired tradeoff strategy

    • For example: What is the maximum distance to the university the student is willing to accept if it lowers rate from £290 to £230 pcm?
ACQUISITION PROCESS INTERACTIONS

• Acquisition process functionality
  • Ask user to answer a choice question
  • Tell the user to adjust default tradeoff strategy and preferences
  • Show the user reshaped strategy and reshaped preference
• User can additionally
  • Start adjustment and reshaping
  • Reset to default strategy or preference
  • Restart or end the acquisition process
PROTOTYPE IMPLEMENTATION
PROTOTYPE ANALYSIS, QUALITATIVE

• Set of goals that a knowledge acquisition should possess:
  • Acquire knowledge directly from the user
  • A tutorial ability
  • Ability to analyze work in progress so that the users can detect inconsistencies and gaps in knowledge
  • A user friendly interface
  • Prototype passes the goals
PROTOTYPE ANALYSIS, EMPIRICAL METHOD

• Lack of well-established evaluation approaches

• Criteria used in the study:
  • Whether it is easy for the users to understand and master the system
  • Whether the system is helpful for the users to specify their tradeoff strategies and preferences
  • Whether the system is efficient in accurately acquiring the tradeoff strategies and preferences
PROTOTYPE ANALYSIS, EMPIRICAL RESULTS

- Clear
- Reliable
- Friendly
- Easy to use
- Convincing
- Professional
- Helpful
- Like it

The chart shows the percentage of respondents agreeing (red), neither agreeing nor disagreeing (yellow), and disagreeing (green) with each of the statements.
FUTURE WORK

• The method used still needs to be examined over wider range of domains in order to ensure that it is sufficiently generic

• The possibility of objectively evaluating an acquired model needs to be researched

• The algorithm might benefit from a heuristic function, especially in regards to preference ordering

• Acquisition of more types of tradeoffs, like non-linear preferences
CONCLUSIONS

• For autonomous agents to negotiate on behalf of humans, it’s critical to elicit tradeoff strategies and preferences from their owners.

• The paper presents a prototype which demonstrates the functionality of one knowledge acquisition method developed for solving the problem.

• The method is consistent with standard negotiation theory, and additionally:
  • Effective
  • Flexible
  • Efficient