

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

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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

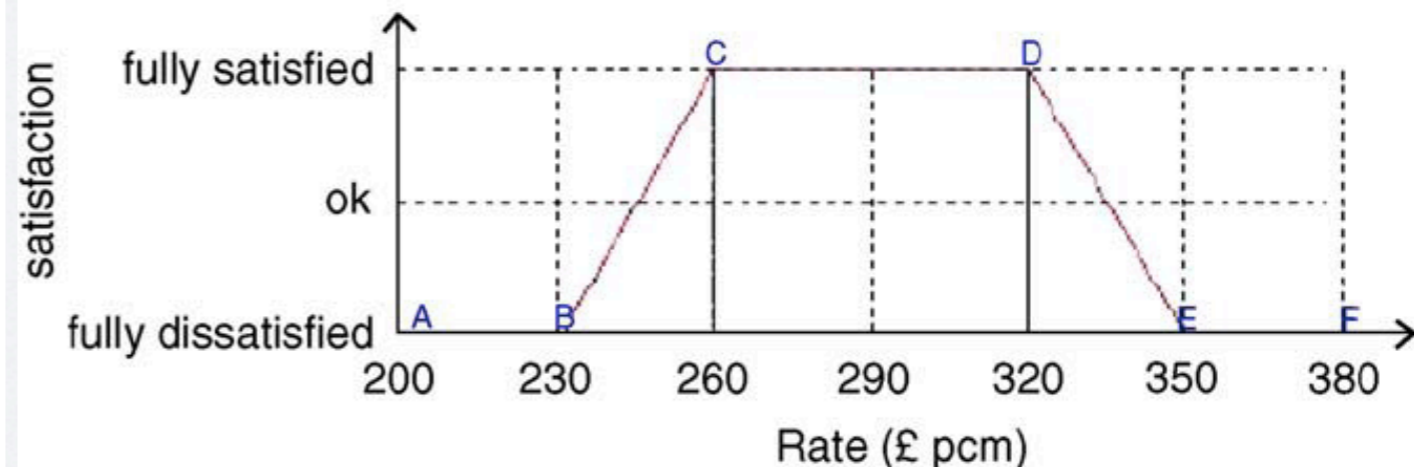
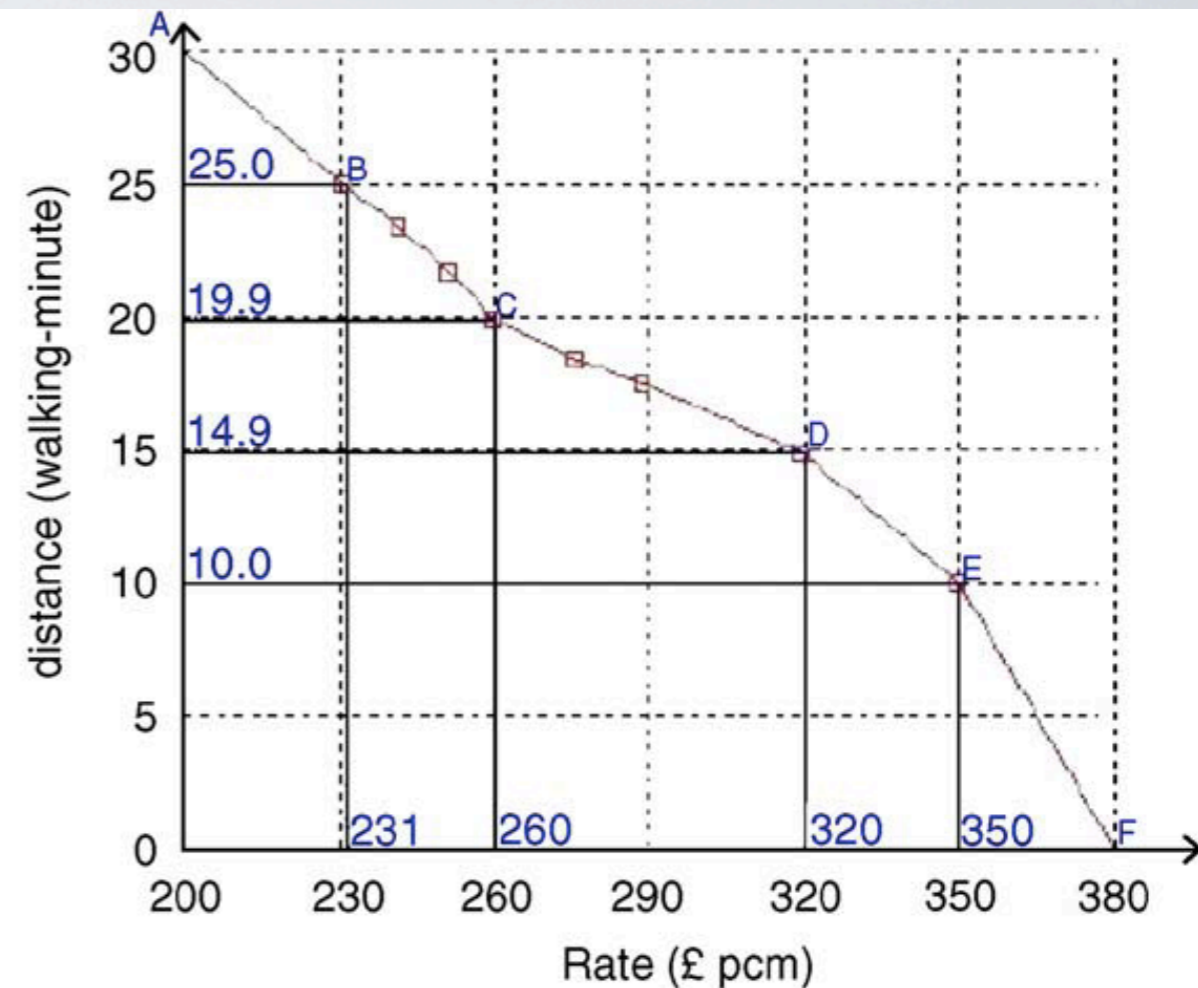
- User preferences can be presented as a set of conditions:
 - Continuity
 - Monotonicity
 - Boundary condition
- They also can be presented as a set of degrees of satisfactions:
 - Complete dissatisfaction
 - Satisfaction increasing
 - Complete satisfaction
 - Satisfaction decreasing

REPRESENTING USER PREFERENCES

EXAMPLE

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

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



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

Tradeoff Preference Acquisition Demo

Choose attributes which tradeoff is made between

Conversation History

SYSTEM: Suppose you are a university student and is looking for accommodation. Suppose you are concerned about three attributes: rental rate, rental period, and walking distance to the university. I can give you some advice on how to reduce rental rate in your accommodation searching. Do you need?

USER: Yes, please.

SYSTEM: In order to get rental rate cheaper, would you rather take accommodation that is further away or do you prefer to rent for a longer period?

USER: No idea.

SYSTEM: Then let me analyse for you. Do you mind moving frequently?

USER: Yes.

SYSTEM: Have you any spare time?

USER: A lot.

SYSTEM: Tradeoff can be made between rate and distance.

USER: Explain.

SYSTEM: Since you mind moving frequently, I won't suggest you that if the rate is very high just take accommodation for a short period first and then find a cheaper one later on. So, it would be better for you to take accommodation further away if the rate is high.

USER: OK.

Adjust the tradeoff relation

Instruction Record

SYSTEM: Then, please adjust the tradeoff relation between distance and rate. You can do this by clicking and drawing a point on the default curve of tradeoff relation. You can do this on other points along the curve again and again until you feel satisfied.

USER: OK.

SYSTEM: Now if the rental rate is decreased from £380 pcm to £350 pcm, at most how far can you accept? Please click the point that is appearing and draw it to your desired position.

USER: OK.

SYSTEM: Then what if the rental rate is further decreased to from £350 pcm to £290 pcm? Adjust it.

Curve of Tradeoff Relation (click and draw to adjust)

Adjust preference on tradeoff alternatives

Default	Explain	OK
Point B		200.0
Point C		260.0
Point D		320.0
Point E		380.0

Message

Then what if the rental rate is further decreased from £350 pcm to £290 pcm? Adjust it.

OK

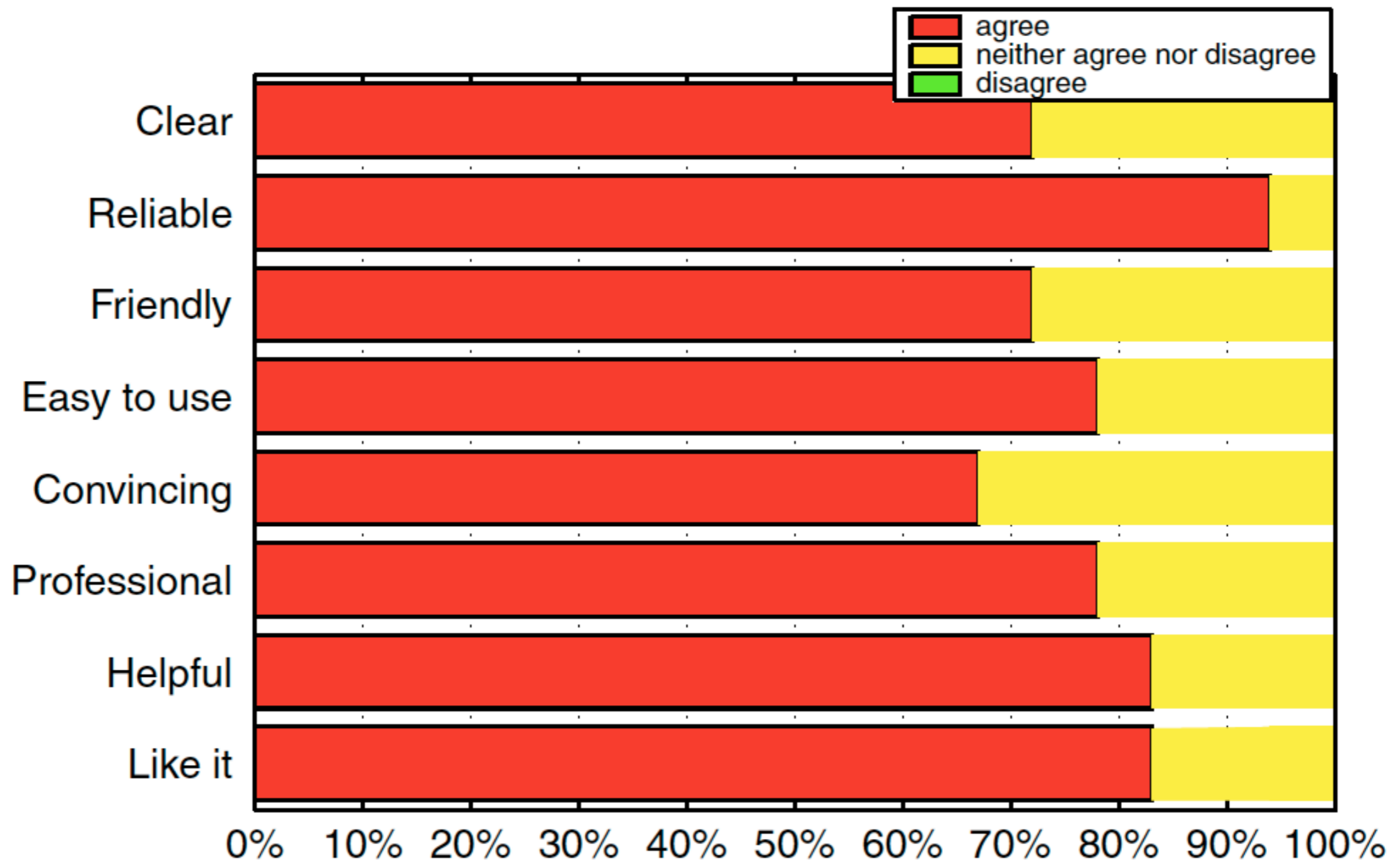
PROTOTYPE ANALYSIS, QUALITATIVE

- 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



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