Scheduling Agents

Database Research Lab.
Oh, ChangMin

Question

- What is(are) the condition(s) that makes an agent useful in scheduling meeting ? (explain with examples…)

Contents

- Scheduling of Meetings
- Scheduling Agents
- Calendar Apprentice – decision tree based
- Learning interface agent
  - Memory-based learning
- Some Calendaring Systems
- Conclusion

Scheduling of Meetings(1/2)

- Features
  - Meeting Type, Attendees, Date, Time, Duration, Location, Confirmation, etc.
- Actions
  - Accept/reject.
  - Schedule.
  - Reschedule.
  - Negotiate meeting times.

Scheduling Agents(2/2)

- A learning interface agent
- Automating the scheduling task according to the unique habits of the user
- Conditions*
  - Involve a substantial amount of repetitive behavior of user
  - And, this repetitive behavior is potentially different for different users

*Ref. Maes,P. [3]

Calendar Apprentice*(1/6)

- Typical Training Example of a Calendar Meeting
  - User-entered information

request-5-27-1992-48:
attendees: thrun
event-type:meeting
date: (29 5 1992)
time:1430
duration:30
location:weh5309
confirmed?: yes

*Ref. Dent et al. [2]

Calendar Apprentice(2/6)

– Automatically collected information

displayed-week: (25 5 1992)
action-time: 2915977709
action-date: (27 5 1992)
previous-request: request-5-27-1992-13
previous-prompt: confirmed=yes

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Calendar Apprentice(3/6)

– Additional features inferred by the system

position-attendees:project-scientist
previous-attendees-meeting: request-5-20-1992-1
next-attendees-meeting: none
lunchtime?:no
number-of-attendees:1
cmu-attendees?:yes
day-in-week:Friday
attendees-in-toms-group?:yes
known-attendees?: yes
day-in-week: Friday
end-time: 1500
busyness-of-attendees: 2
single-attendee?: yes

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Calendar Apprentice(4/6)

- Rules from those training example

If Position-of-attendees is Grad-Student, and
Single-attendee? is Yes, and
Sponsor-of-attendees is Mitchell;
Then Duration is 60.
[Training: 6/11 Test: 51/86]

If Group-name is EDRC-Directors;
Then Duration is 90.
[Training: 6/6 Test: 31/38]

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Calendar Apprentice(5/6)

- Learning Procedure
  - Update the performance statistics
  - Window-Examples : the most recent 180 training example meetings
  - Training-Examples : 120 examples selected at random from Window-Examples
  - Test-Examples : Window-Examples – Training-Examples

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Calendar Apprentice(6/6)

- Learning Procedure(cont')
  - For each feature f in {Duration, Location, Time, Day-of-week}
    - Learn a decision tree to predict values of feature f → using "ID3 algorithm "" applied to Training-Examples
    - Convert each path of the learned decision tree into a rule
    - Remove any rule preconditions not decreasing performance for this rule over the Window-Examples
    - Record the number of positive and negative examples it matches from window-examples for each new rule
    - Sort each rule into the previous rules for feature f, based on their accuracy

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Learning Interface Agent*

- Memory-Based Learning
  - Situation-action pairs
  - Distance of features
  - Confidence of agent about prediction
- Reinforcement Learning
- Suggesting a meeting time

*Ref. Kozierok,R. [1]

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Memory-Based Learning(1/4)

– Distance between a new situation and a memorized situation
  - Score : $\sum_{s \in S} \frac{1}{d_s}$
  - d_s : weighted sum of distances between the values
  - S : the set of memorized situations
  - Selecting highest score
  - Computation of weight and distance metrics when new situation being added → time-consuming $O(n^2)$

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Memory-Based Learning(2/4)

- Confidence of prediction

$$\left(1 - \frac{\frac{d_{predicted}}{n_{predicted}}}{\frac{d_{other}}{n_{other}}}\right) \times \frac{n_{other}}{m}$$

  - m : the number of situations considered in making a decision
  - $d_{predicted}$: distance to the closest situation with the same action as the predicted one.
  - d_{other} :distance to the closest situation with a different action from the predicted one.

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Memory-Based Learning(3/4)

- Confidence of prediction(cont')
  - $n_{predicted}$: the number of the closest m situations with distances less than a given maximum with the same action as the predicted one
  - n_{other} : minimum 1 or the number of the closest m situations with distances within the same maximum with different actions than the predicted
  - $n_{total} = n_{predicted} + n_{other}$

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Memory-Based Learning(4/4)

- Reinforcement Learning in Scheduling meeting
  – Priority Weighting

A \ P	Accept	Decline
Accept	–	Positive
Decline	Negative	–

  – P : prediction of agent, A: action of user

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Suggesting A Meeting Time

– Candidate times $t_1, t_2, \ldots, t_m$
– People $p_1, p_2, \ldots, p_n$
– Preferences r_{ij} : p_i's preference rating for t_j
– Priorities q_{ij} : p_i's assessment of the relative importance of person p_j ($\forall i\ q_{ii} = 0$) in the range [-100, +100]
– Convenience of any given time t_k

$$t_k = \sum_{i=1}^{n} \left(r_{ik} \sum_{j=1}^{n} q_{ji} \right)$$

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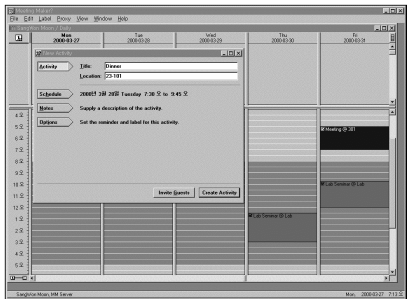
Meeting Maker TM*(1/5)



New Activity

*Ref. [5]

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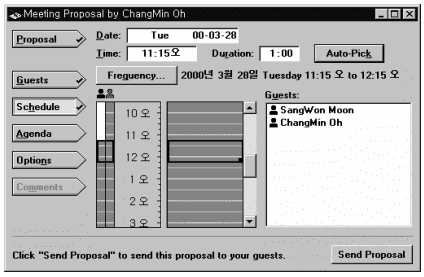
Meeting Maker TM(2/5)



Meeting Proposal

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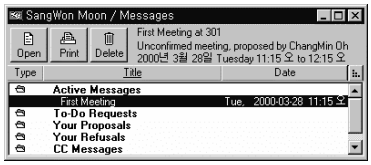
Meeting Maker TM(3/5)



Proposal message

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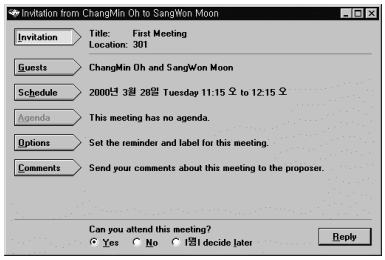
Meeting Maker TM(4/5)



Reply to Proposal

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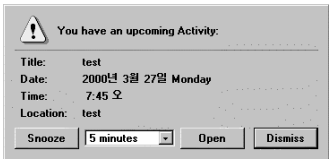
Meeting Maker TM(5/5)



Alert Scheduling

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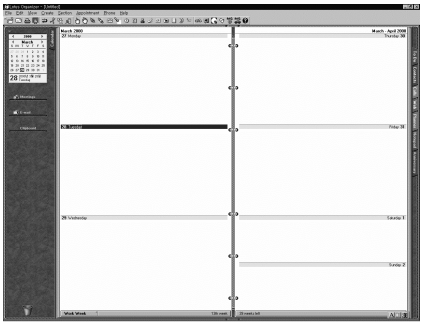
Lotus Organizer*(1/9)



*Ref. [7]

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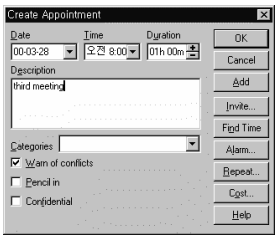
Lotus Organizer(2/9)



Create meeting

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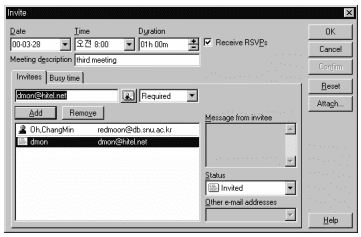
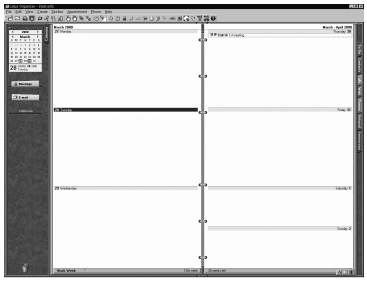
Lotus Organizer(3/9)



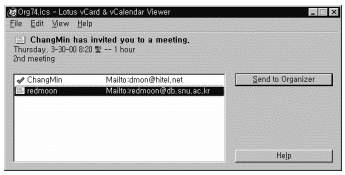
Invite

Lotus Organizer(4/9)



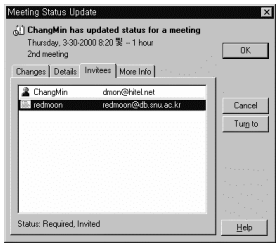
Communication via e-mail

Lotus Organizer(5/9)



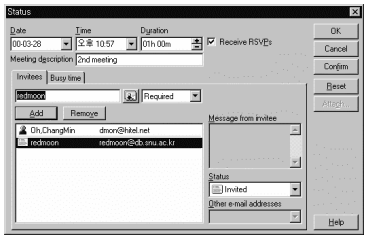
Inviting message

Lotus Organizer(6/9)



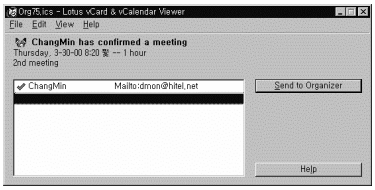
Status Update

Lotus Organizer(7/9)



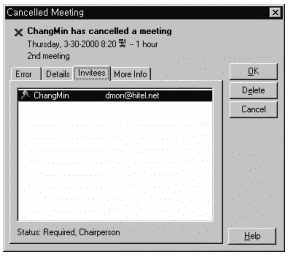
Confirming invitation

Lotus Organizer(8/9)



Confirmation message

Lotus Organizer(9/9)



Canceling

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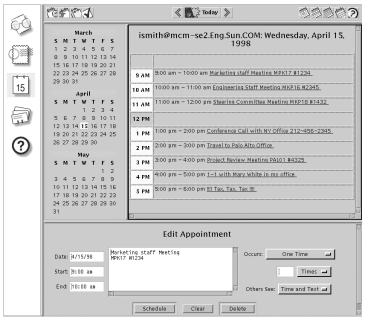
Sun Calendar Server*



*Ref. [8]

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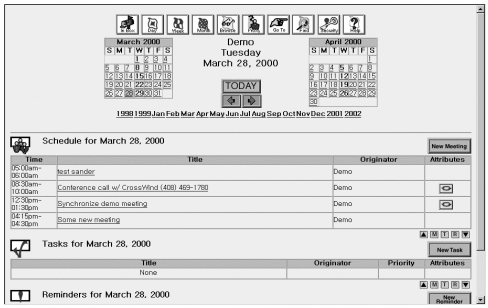
Crosswind Synchronize(web-based)*



*Ref. [9]

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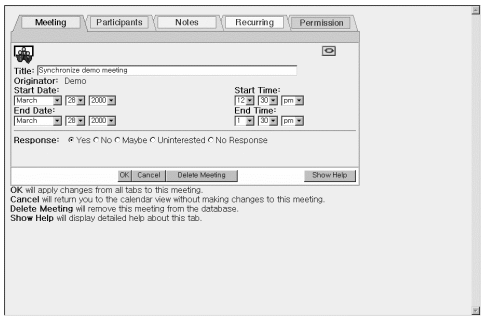
Crosswind Synchronize(web-based)



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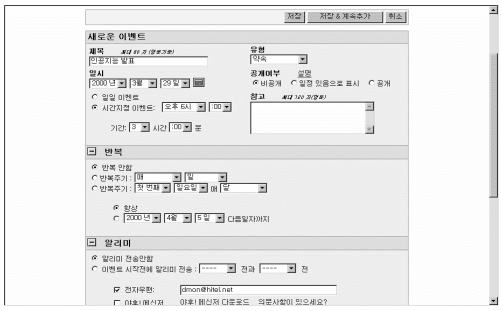
Yahoo! Calendar*



*Ref. [10]

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Yahoo! Calendar

Others

- Crosswind Synchronize
  - http://www.crosswind.com/sitemap.htm#sync
- Web-based
  - Oscal
    - http://www.obsidian.co.za/text/demo.html
  - Bantu
    - http://www4.bantu.com/

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Conclusion

- Agent's learning method
  - Decision tree
  - Memory-based learning
- Commercial complete agents
  - not yet found ☹
- Weakness of web-based scheduling meeting
  - Response time, user-interface

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References(1/2)

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- [2]Dent, L., Boticario, J., McDermott, J., Mitchell, T. and Zabowski, D. A personal learning apprentice. In Proceedings of AAAI-92, AAAI Press/The MIT Press, 1992, pp.96-103
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- [6]http://www.softwarestudio.org/FreeAssociation/ : web-based calendar agent's detailed specifications
- [7] http://www.lotus.com/home.nsf/welcome/organizer

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- [9] http://www.crosswind.com/feature3.htm
- [10] http://calendar.yahoo.com/

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