IIT Jodhpur

Biological Vision and Applications Module 07-05: Qualitative spatial and temporal relations

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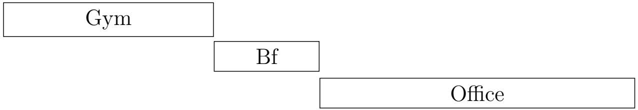
Allen's Interval Algebra

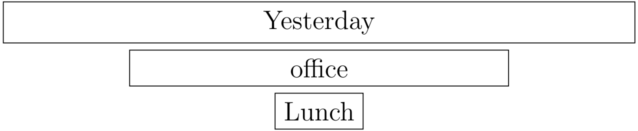
- Consider three 1D interval events: `A`, `B`, `C`
  1. `A` r_{AB} `B`
  2. `B` r_{BC} `C`
- Can we infer the relation between `A` and `C` ?
  - `A` r_{AC} `C`
  - Given r_{AB}, r_{BC}, can we find r_{AC} ?

An Intuitive Introduction



- Consider the statements:
  1. I went to gym just before having my breakfast: Gym m Bf
  2. I went to office immediately after the breakfast: Bf m Office
- We can conclude
  - Temporal relation between Gym and Office: Gym b Office
- Transition rule: $(m, m) \rightarrow b$
- **An example of temporal sequencing**

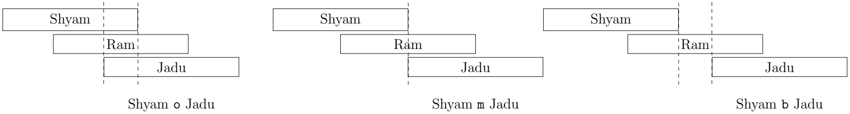
An Intuitive Introduction (contd)



- Consider the statements:
  1. I attended office some time during yesterday: Office d Yday
  2. I ate my lunch while at office: Lunch d Office
- We can conclude
  - Temporal relation between Lunch and Yesterday: Lunch d Yday
- Transition rule: $(d, d) \rightarrow d$
- **An example of hierarchical decomposition**

An Intuitive Introduction (contd)

1. Ram came in the room while Shyam was there and continued after Shyam left:
   - Shyam o Ram
2. Jadu came into the room when Ram was there and continued after Ram left:
   - Ram o Jadu



- The temporal relation between Shyam and Jadu cannot be uniquely resolved
  - Shyam b, m, o Jadu
- Transition rule: $(o, o) \rightarrow \{b, m, o\}$

Allen's temporal algebra

- Given that $\texttt{A}\ r_{AB}\ \texttt{B}$ and $\texttt{B}\ r_{BC}\ \texttt{C}$
  1. where r_{XY} is one of the Allen's relation
- Temporal constraint between $\texttt{A}$ and $\texttt{C}$: $\texttt{A}\ R_{AC}\ \texttt{C}$
  - where R_{AC} is a subset of Allen's relation
- Mapping $r \times r \xrightarrow{T} R$ is defined over a transitivity table
  - $R \leftarrow T(r_1, r_2)$
  - 13×13 entries in transitivity table

Allen's transitivity table

Allen's Interval Algebra

Generalizing ...

- R_{ij}, R_{jk}, R_{ik}: Temporal constraints between event-pairs
- $(\mathtt{E}_i, \mathtt{E}_j)$, $(\mathtt{E}_j, \mathtt{E}_k)$ and $(\mathtt{E}_i, \mathtt{E}_k)$
  - In general, each is a subset of Allen's relations
- The algorithm for computing $\mathit{Constraint}(R_{ij}, R_{jk}) \neq R_{ik}$:

Algorithm 18: Computing relational constraint

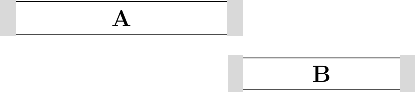
```
procedure Constraint(R_ij, R_jk)
    C = ∅;
    for each p ∈ R_ij do
        for each q ∈ R_jk do
            C ← C ∪ T(p,q);
        end
    end
    return C;
end
```

Uncertainty with the endpoints

- Where do the shore ends and the sea starts

- A man is walking – He falls
- When does he start falling and when does he end falling ?

- Measurement error

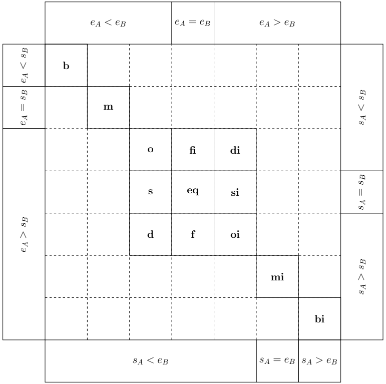


$\mathbf{A}$ $before$ $\mathbf{B}$?
$\mathbf{A}$ $meets$ $\mathbf{B}$?
$\mathbf{A}$ $overlaps$ $\mathbf{B}$?

Approximate qualitative relations

Conceptual neighborhood

- Relations organized in 2D defines conceptual neighbors
- Ambiguity in boundary / Measurement error may lead to a relation to be misclassified in it's conceptual neighborhood
- A set of relations in a conceptual neighborhood defines an "approximate relation"
- For fuzzy representation, see book



Semantics of Allen's relations

Quiz

No quiz for module 07-05

End of Module 07-05