

Challenges of visually representing rich temporal information of the clinical narrative

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Challenges of visually representing rich temporal information of the clinical narrative

- Clinical Narrative: Not structured data. “Free text” written or dictated by the physician
- Rich Temporal Information: Not only Events
- Challenges: Not solutions

Clinical Narrative

The patient had anesthesia before surgery.

The patient experienced bleeding during surgery.

The patient had no pain after surgery.

The patient had surgery last Tuesday.

The patient started taking Vicodin.

Dr. Geico Caveman, 12/20/2000

Narrative Times

The patient had anesthesia before surgery.

The patient experienced bleeding during surgery.

The patient had no pain after surgery.

The patient had surgery last Tuesday.

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Dr. Geico Caveman, 12/20/2000

Narrative Events

The patient had anesthesia before surgery.

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Dr. Geico Caveman, 12/20/2000

Narrative Temporal Relations

The patient had anesthesia before surgery.

The patient experienced bleeding during surgery.

The patient had no pain after surgery.

The patient had surgery last Tuesday. ?

The patient started taking Vicodin. ?

Temporal Relations

- An Event alone is impossible to place on a timeline
- An Event that has reference to a specific time can be placed on a timeline
- There is a large ... degree of freedom ...

Relation Types

- Before
- Contains
- Overlap
- Begins-on
- Ends-on

Relation Types (cont.)

- Before
 - Order of two events or times ... in time
 - “He visited Dr. Smith after the biopsy”
 - “biopsy” is Before “visited”
- Contains
 - Composition of two events or times ... in time
 - “Nurse Bob applied sponging during surgery”
 - “surgery” Contains “sponging”

Relation Types (cont.)

- Overlap
 - Simultaneous or Similar in time
 - “The patient experienced bleeding, mostly last night”
 - “bleeding” Overlaps “last night”

Relation Types (cont.)

- Begins-On
 - Begins at (the end?) of another Event or Time
 - “There has been itching since the scab formed”
 - “itching” Begins-On “scab formed”
- Ends-On
 - Ends at (the beginning?) of another Event or Time
 - “Once the gauze was removed, pressure stopped”
 - “pressure” Ends-On “gauze was removed”

Relation Coverage

- Not all Events will be in a Relation
- Not all Events will be in a Relation with a Time
 - Can have Event A Before Event B
- We attempt to “close” such gaps and infer all possible Relations between Events and Times
 - given Event A Before Event B, and
 - given Event B Before Time X,
 - infer Event A Before Time X

Relation Reciprocals

- We want Relations of Events to Times
 - “Tuesday” Before “Surgery”
 - “Surgery” After “Tuesday”
- Leads to reciprocal Relation types
 - After, Contained-By

Document Relative Time

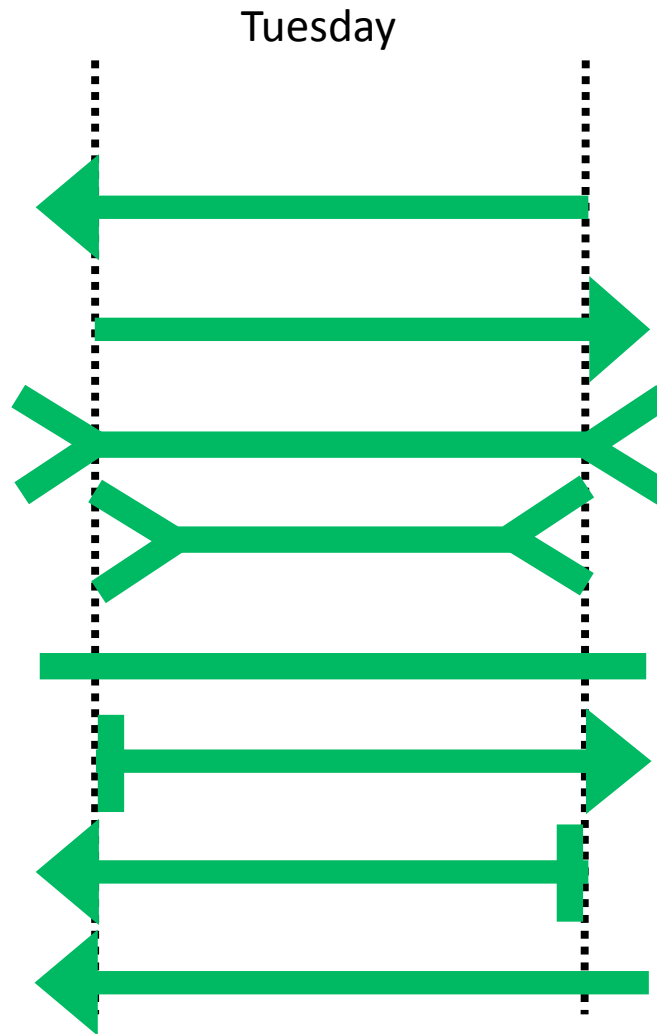
- Not all Events have Relations to a Time
- We always have a Document Time
- All Events are given a Relation to the Document Time
 - Before, After, Overlap, Before-Overlap

Representation

- Can't directly represent an Event on a timeline
- Must represent an Event's Relation to a Time
- Represent Time Spans (Intervals), not Points

Representation (cont.)

- Before
- After
- Contains
- Contained-By
- Overlap
- Begins-On
- Ends-On
- Before-Overlap

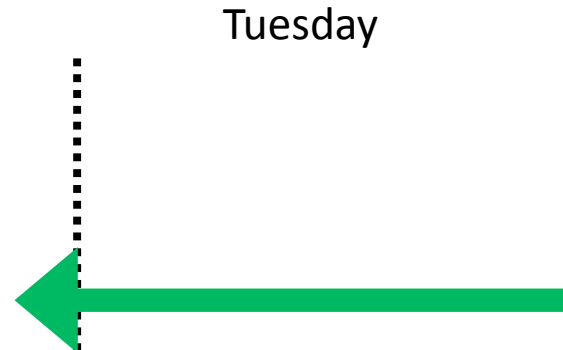


Combination Complication

- Pain Before Surgery
- Tuesday Contains Surgery
- Pain Before Surgery Contained-by Tuesday
- How do we display the complex relation of Pain to Tuesday?

Combination Complication

- Pain Before Tuesday



- Pain Contained-by Tuesday

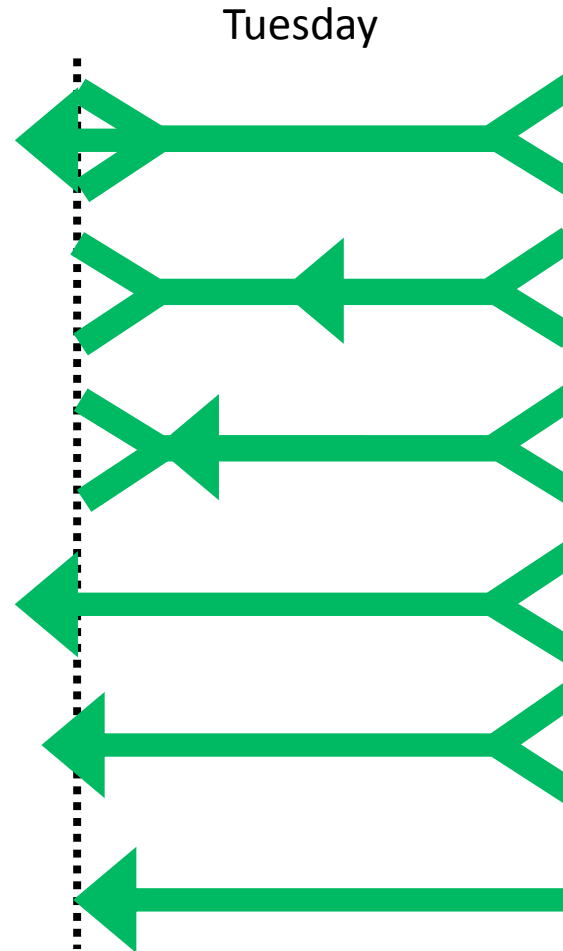


- Pain Overlaps Tuesday



Combination Complication

- Pain Before Contained-by
- Pain Before Contained-by
- Pain Before Contained-by
- Pain Before Contained-by
- Pain Before Contained-by
- Pain Before Contained-by

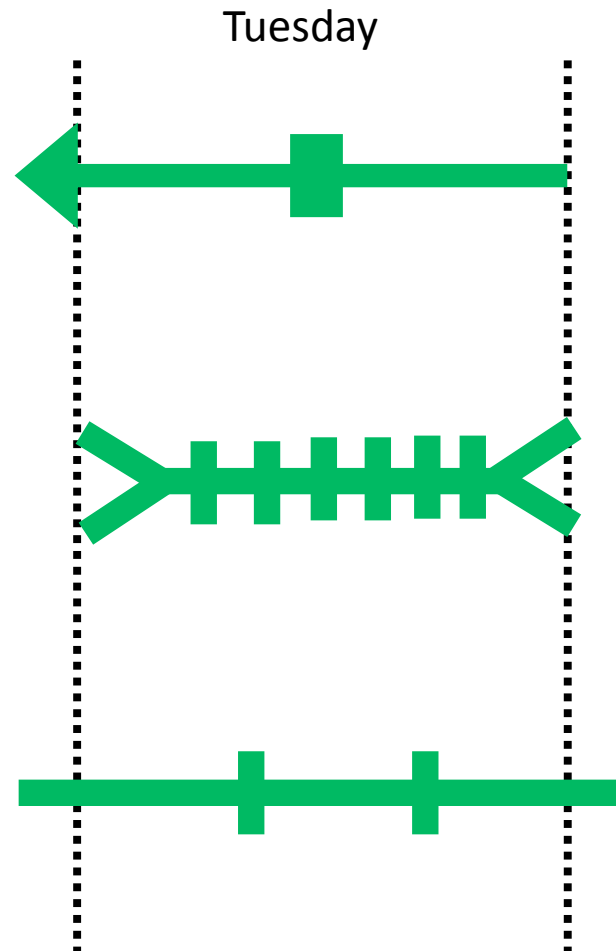


Time Types

- Date
- Time
- Duration
- Quantifier
- Pre- Post- Expression
- Set

Relations and Time Types

- Before Tuesday, for an hour
- Contained-by Tuesday, twice an hour
- Overlaps Tuesday, twice

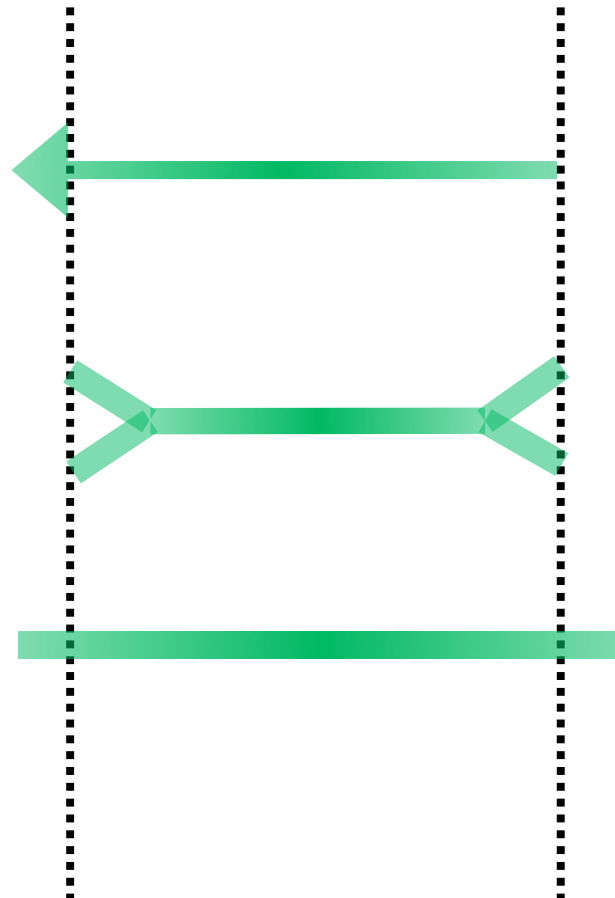


Shading

- Just add shading to indicate uncertainty in Event's actual Time!
- We are already using shading for fuzzy Times

Time Expressions

- Before “A year ago”
- Contained-by “Winter”
- Overlaps “lately”



Coloring

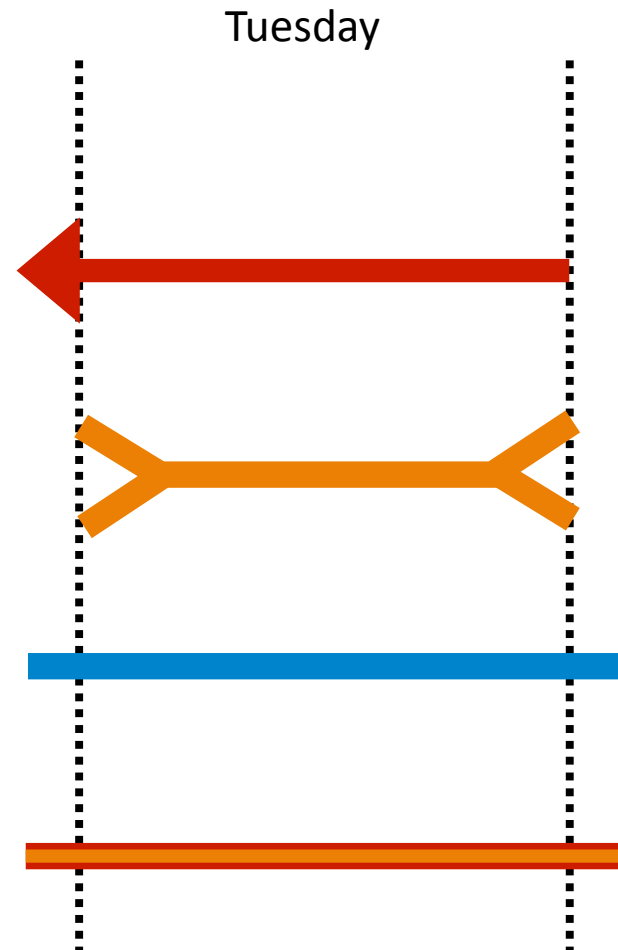
- Just use a color for each Relation type and mix colors as appropriate ...
- We are already using colors for Event Modifiers

Event Modifiers

- Negated
The Patient had no pain.
- Hedged (Uncertain)
The Patient might have had pain.
- Hypothetical
The patient was warned of possible post-operative pain.
- Generic (“Textbook”)
Post-operative pain is normal.

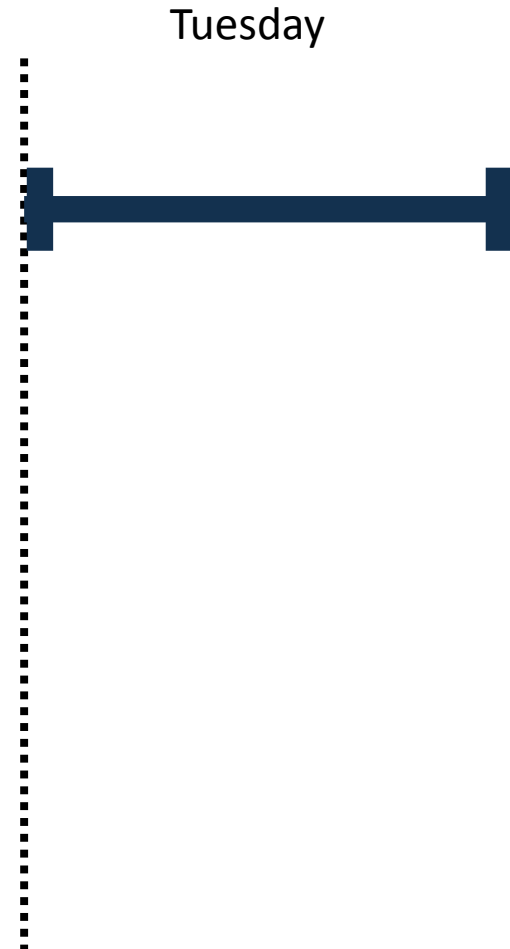
Modifier Coloring

- Negated
- Hedged, Hypothetical
- Generic
- “might not have pain”



Good grief, there's more?

- Orphan Time Span
 - No Related Events



Summary

- Trying to display [Events on a Timeline by way of their Relations to Times]
- Attempting to fully utilize
 - Symbols (shapes),
 - Shading (transparency),
 - Colors
- Desiring a vehicle that conveys non-trivial information in an intuitive manner
- Getting a tad frustrated

I want feedback!

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Natural Language Processing Lab

<http://chip.org>

NLP Software: Apache cTAKES

ctakes.apache.org