CS447: Natural Language Processing

http://courses.grainger.illinois.edu/cs447

Lecture 23: Time and temporal

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ILLINOIS

Where we're at in the class

Language conveys information about (real or imagined, concrete or abstract) entities; events and facts, their properties and relations.

Entities and **events** may exist/take place in time and space.

What kind of information about (entities/events/time/space/…) do we need/want to represent?

How is that information expressed in language?

How can a **meaning representation capture that information**?

Time and temporal reasoning

United Airlines said **Friday** it has increased fares by $6 per round trip on flights to some cities also served by lower-cost carriers.
American Airlines, a unit of AMR Corp., **immediately** matched the move, spokesman Tim Wagner said.
United, a unit of UAL Corp., said the increase took effect **Thursday**

Temporal expressions: Friday, Thursday, 3:30pm, last July, today, ….

Can we **normalize** these expressions (map them to calendar dates/times)?

What is the **temporal sequence** of events described here?

Key questions for today

Language conveys information about entities, events and facts that take place in **time**

What kind of *temporal information* do we need to represent to capture that aspect of language?

How does *language* express temporal information?

How can a *meaning representation* capture that information?

Temporal expressions in language

References to **points** in time:

July 1, 2023; 9:00am;
today; *last week; next year; the week before;*

References to **intervals** of time:

one hour; fifteen minutes; a decade, …

References to **temporal relations**:

first, …then; after; during;….
every hour; once a week;
the first…;

Representing temporal relations

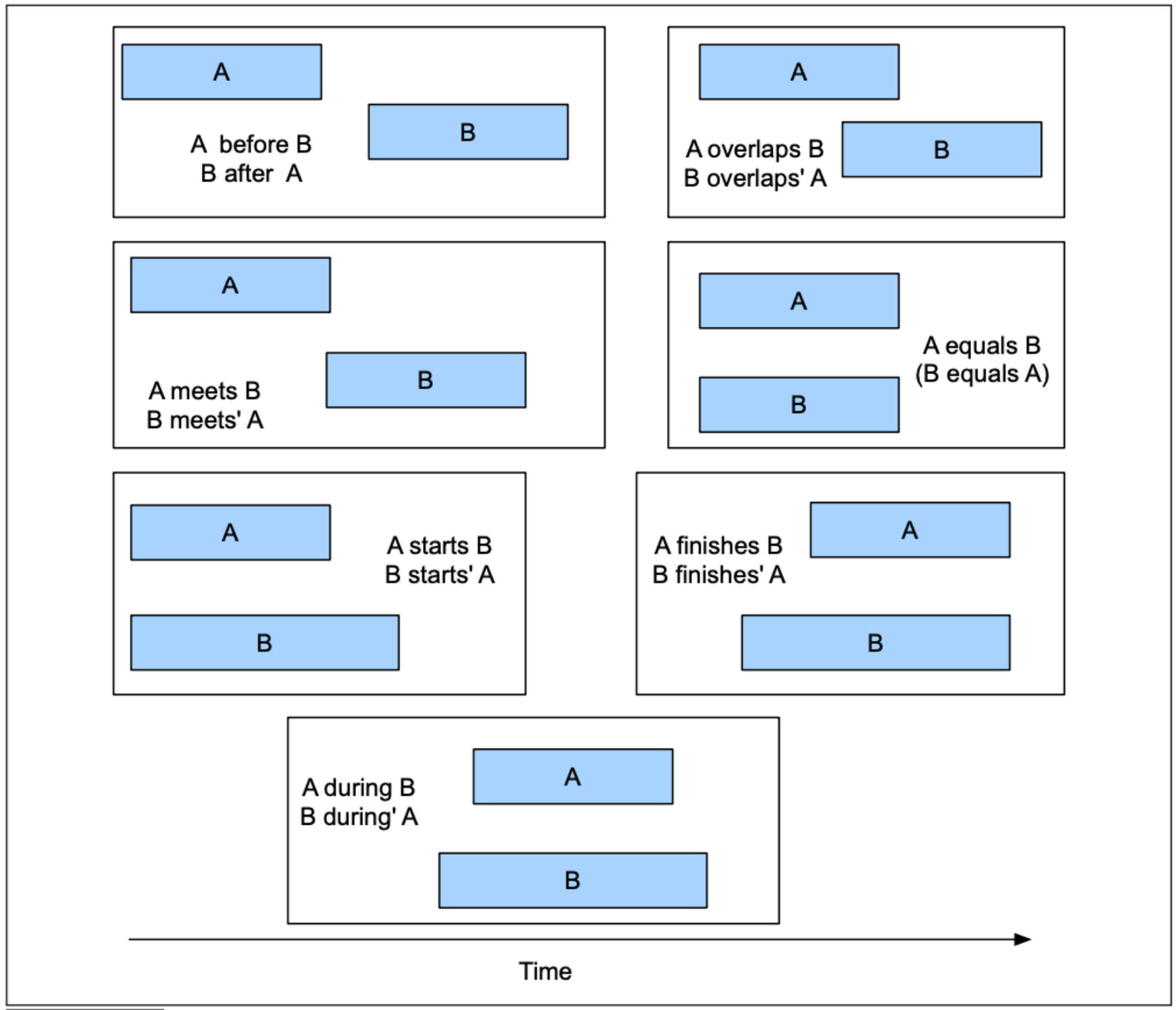


Figure 22.1 The 13 temporal relations from Allen (1984).

TimeML

A markup language for temporal information, based on Allen's intervals

Three kinds of basic objects:

Event: represents events and states

Time: for time expressions (e.g. dates)

Link: relations between times/events

- **tlink**: temporal relations
- **alink**: aspectual relations
- **slink**: factual relations

Oct 26, 1989

Delta Air Lines earnings **soared** 33% to a record in **the fiscal first quarter**, **bucking** the industry trend toward **declining** profits.

Times:

1989-10-26$_{t57}$

the fiscal first quarter$_{t58}$

Events:

soared$_{e1}$

bucking$_{e3}$

declining$_{e4}$

Relations:

Soared$_{e1}$ is ***before*** **1989-10-26**$_{t57}$

Soared$_{e1}$ is ***included*** in **the fiscal first quarter**$_{t58}$

Soared$_{e1}$ is ***simultaneous*** with the **bucking**$_{e3}$

Soared$_{e1}$ is ***included*** in **Declining**$_{e4}$

<TIMEX3
tid=“t57"
type="DATE"
value=“1989-10-26”
functionInDocument=“**CREATION_TIME**”>
10/26/89
</TIMEX3>
Delta Air Lines earnings
<EVENT
eid="e1"
class="**OCCURRENCE**">
soared
</EVENT>
33% to a record in
<TIMEX3
tid="t58"
type=“DATE"
value="1989-Q1"
anchorTimeID="t57">
the fiscal first quarter
</TIMEX3>
,
<EVENT
eid="e3"
class=“OCCURRENCE">
bucking
</EVENT>
the industry trend toward
<EVENT
eid=“e4"
class=“OCCURRENCE”>
declining
</EVENT>
profits.

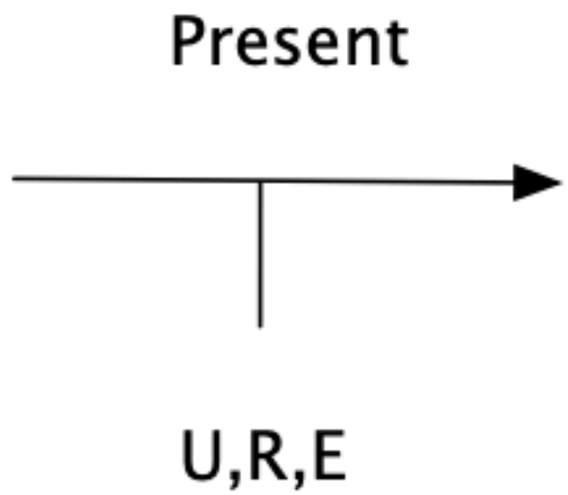
Tense

Present tense: *I walk*
Past perfect: *I had walked*
Simple past: *I walked*
Present perfect: *I have walked*
Simple future: *I will walk*
Future perfect: *I will have walked*

Reichenbach (1947): We have to distinguish between:

— the time of the **utterance** (U)
— the time of the **event** that is described (E)
— the **reference** point (R) relative to which the event is described

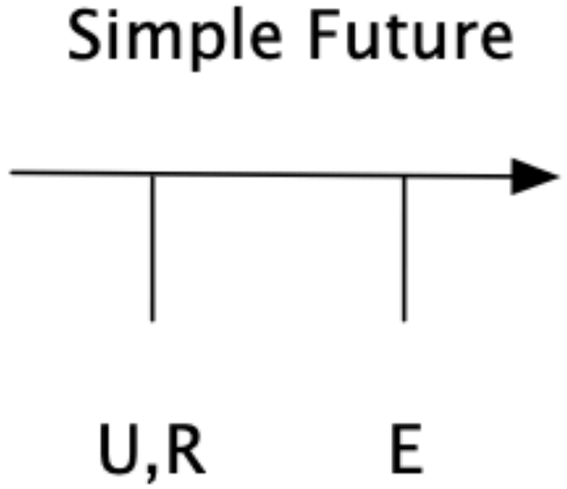
Present tense: *I walk*



The **Utterance** time is the **Reference** point.

The **Event** happens during the **Reference** point.

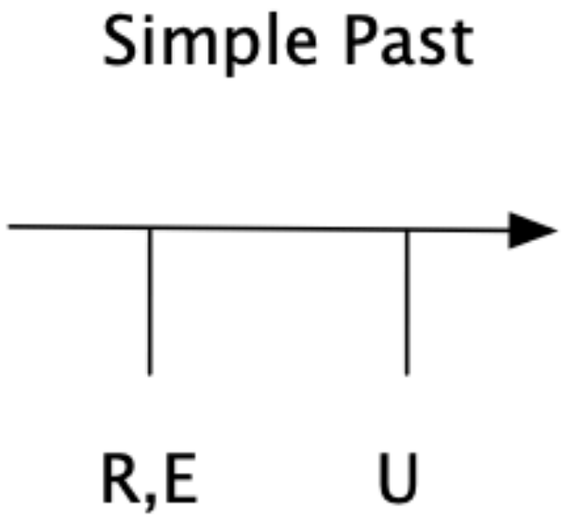
Simple future: *I will walk*



The **Utterance** time is the **Reference** point

The **Event** happens after the **Reference** point

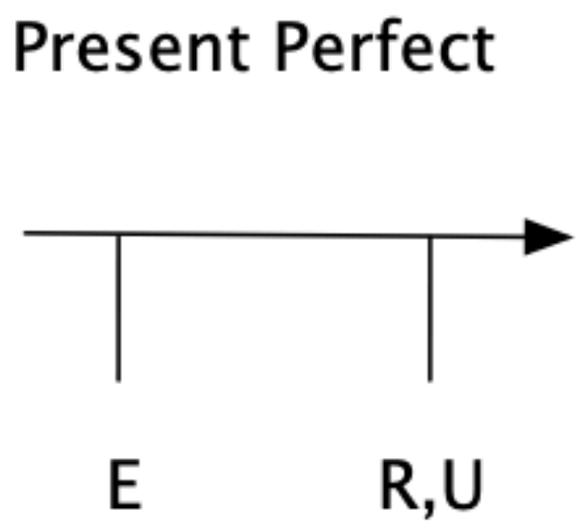
Simple Past: *I walked*



The **Reference** point precedes the **Utterance**

The **Event** overlaps with the **Reference**

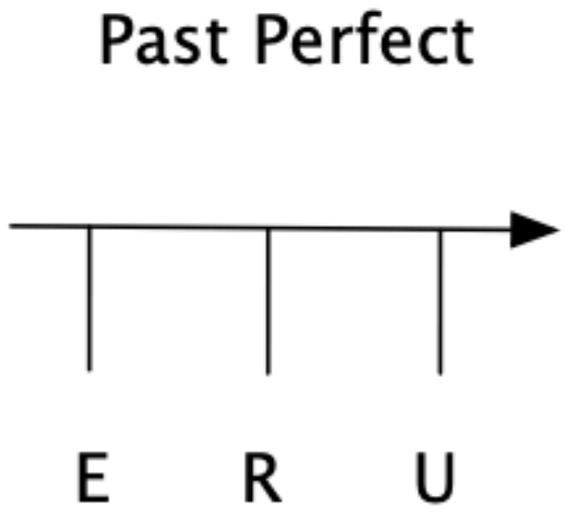
Present perfect: *I have walked*



The **utterance** is the **reference** point.

The **event** precedes the **reference**.

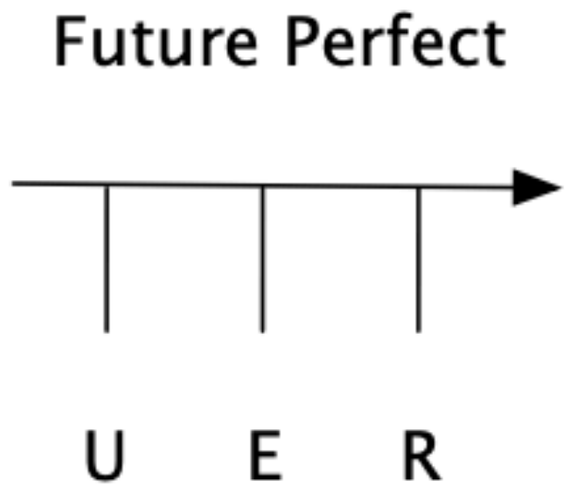
Past perfect: *I had walked*



The **reference** point precedes the **utterance**.

The **event** precedes the **reference**.

Future perfect: *I will have walked*



The **reference** point comes after the **utterance**.

The **event** precedes the **reference**
(but comes after the utterance)

Aktionsarten

Stative expressions: describe a particular state or property that is unchanging at some point in time

It is/was raining.
Sue is sleeping.

I used to hate it, but now I like classical music

Urbana is in Illinois

Eventive expressions describe events

Activity: occurs over a span of time:
She drove a Mazda

Accomplishment: occurs over a span of time, has an end point, and results in some state

He read the book [in an hour]; it took him an hour to read the book

Achievement: describe the culmination point of an activity
She reached Chicago. She won the competition