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# LECTURE 23: TIME AND TEMPORAL

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Adapted from Julia Hockenmaier, NLP S2023 - course material  
<https://courses.grainger.illinois.edu/cs447/sp2023/>



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# 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**?

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# 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?

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# 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?

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# 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, ...*

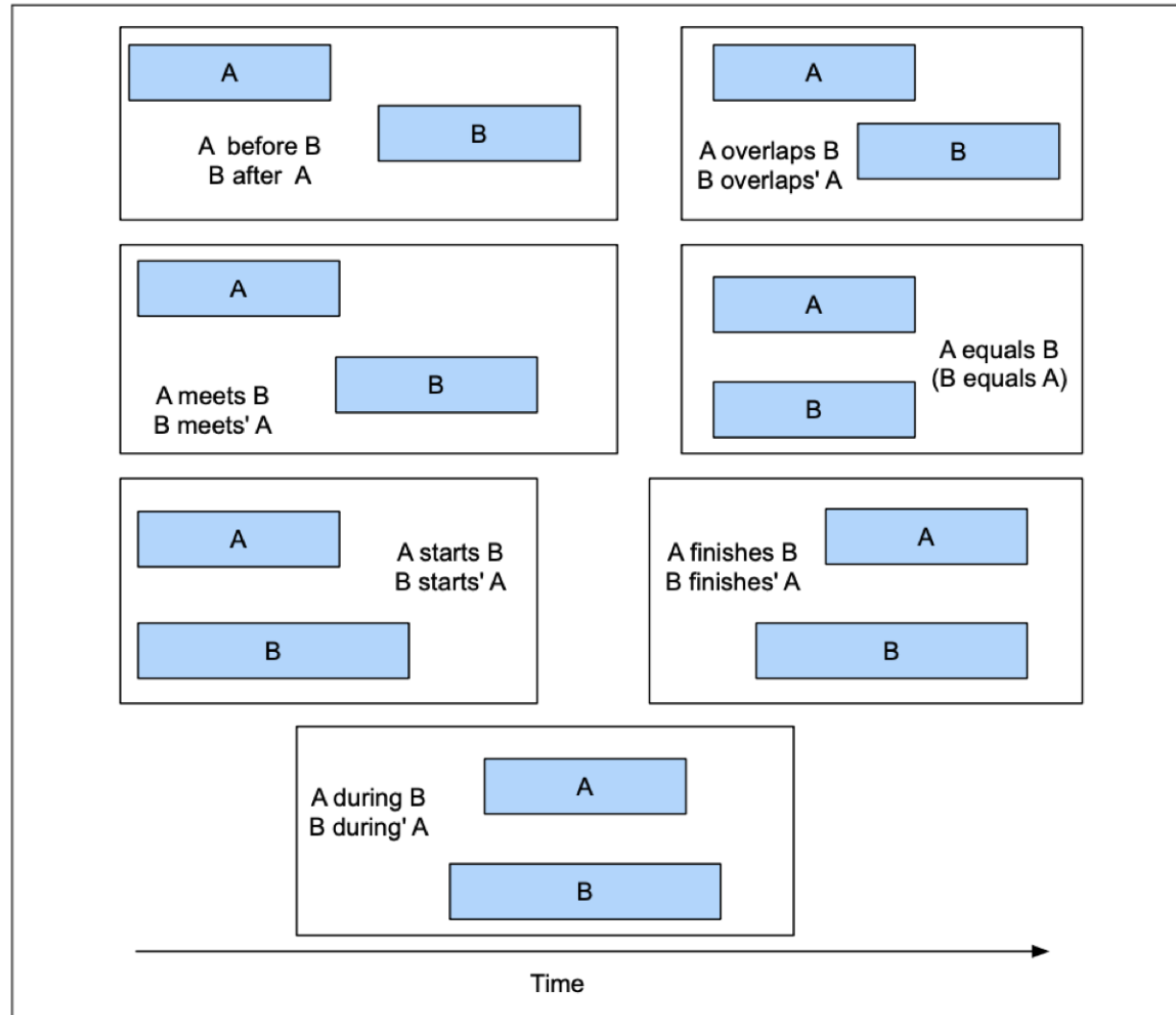


References to **temporal relations**:

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

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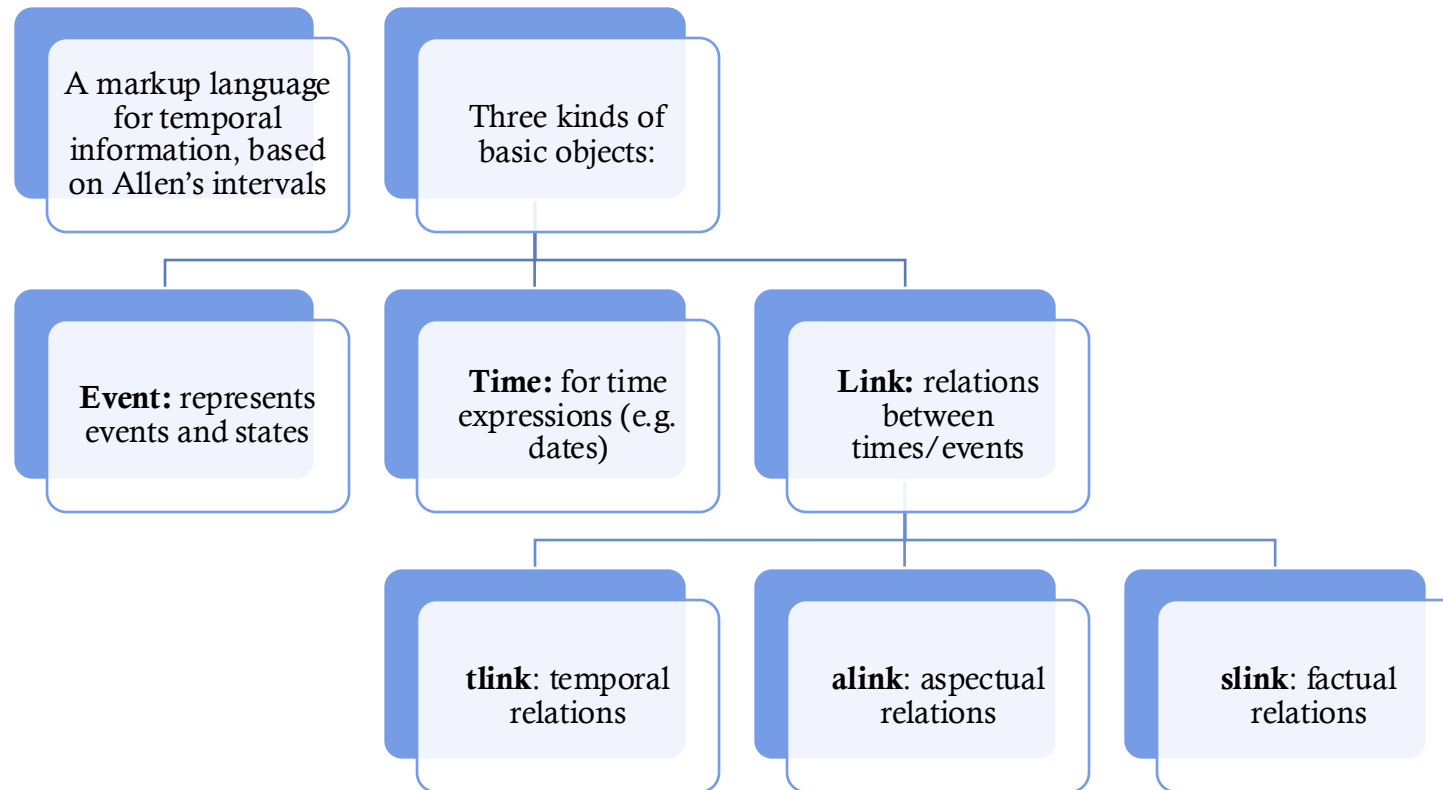
# REPRESENTING TEMPORAL RELATIONS



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

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# TIMEML



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**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**<sub>t57</sub>

**the fiscal first quarter**<sub>t58</sub>

**Events:**

**soared**<sub>e1</sub>

**bucking**<sub>e3</sub>

**declining**<sub>e4</sub>

**Relations:**

**Soared**<sub>e1</sub> is *before* **1989-10-26**<sub>t57</sub>

**Soared**<sub>e1</sub> is *included* in **the fiscal first quarter**<sub>t58</sub>

**Soared**<sub>e1</sub> is *simultaneous* with the **bucking**<sub>e3</sub>

**Soared**<sub>e1</sub> is *included* in **Declining**<sub>e4</sub>

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```
<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.**

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# TENSE

**Present tense:** *I walk*

**Past perfect:** *I had walked*

**Simple past:** *I walked*

**Present perfect:** *I have walked*

**Simple future:** *I will walk*

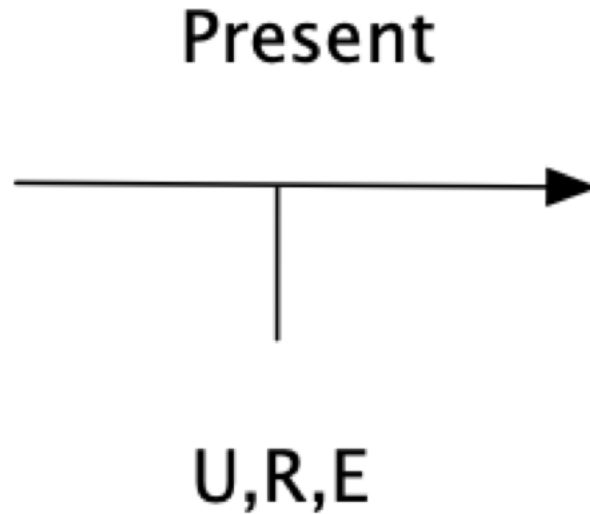
**Future perfect:** *I will have walked*

**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

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# PRESENT TENSE: I WALK



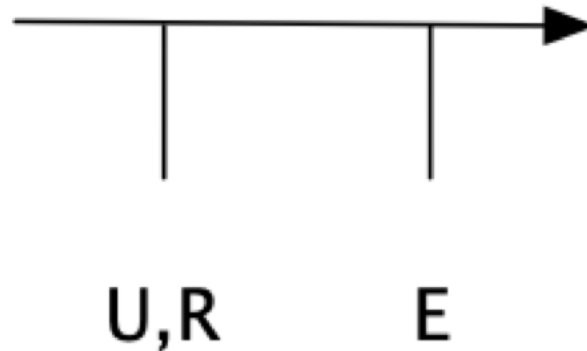
The **Utterance** time is the **Reference** point.  
The **Event** happens during the **Reference** point.

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# SIMPLE FUTURE: I WILL WALK

Simple Future



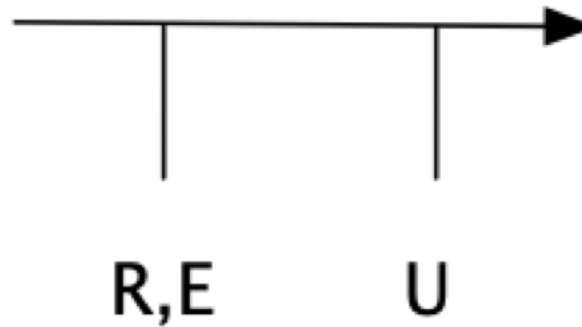
The **Utterance** time is the **Reference** point

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

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# SIMPLE PAST: I WALKED

Simple Past



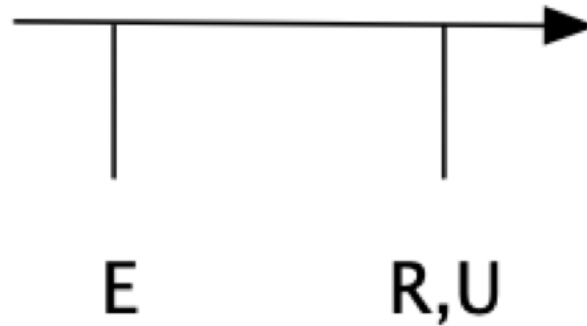
The **Reference** point precedes the **Utterance**

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

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# PRESENT PERFECT: I HAVE WALKED

Present Perfect

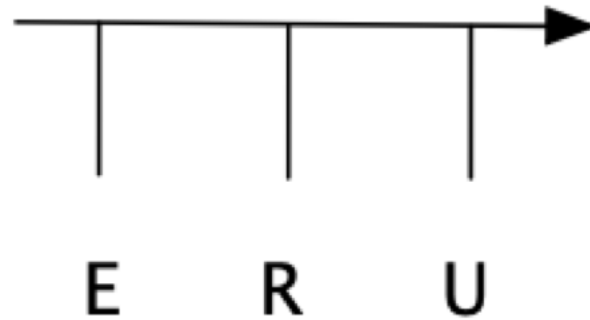


The **utterance** is the **reference** point.  
The **event** precedes the **reference**.

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# PAST PERFECT: I HAD WALKED

Past Perfect



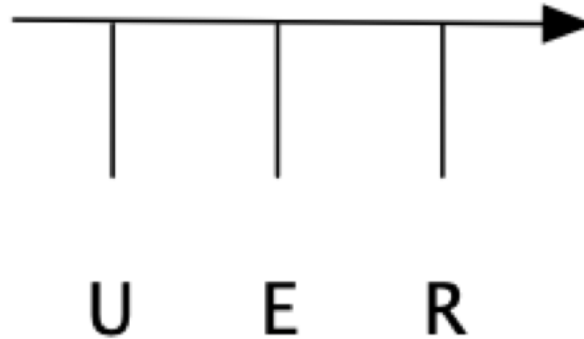
The **reference** point precedes the **utterance**.  
The **event** precedes the **reference**.

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# FUTURE PERFECT: I WILL HAVE WALKED

Future Perfect



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



# AKTIONSPORTEN

**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*