Module #10a:
Temporal Data Visualization

Objectives

- Identify different types of temporal data
  - discrete, interval, linear, cyclic, continuous, ordinal, branching
- List potential tasks for temporal data analysis
- Familiarity with basic temporal representations
  - Line graph, spiral chart, bubble tracks
- Discuss the benefits & limitations of all the technique

Taxonomy of Data Types

1. 1D/Linear
   - lists of data items, organized by a single feature (e.g., alphabetical order)
2. 2D/Planar (incl. Geospatial)
   - maps
3. 3D/Volumetric
   - medical imaging
4. Temporal
   - T=time series
5. nD/Multidimensional
   - category proportions
6. Tree/Hierarchical
   - Computer file structure
7. Network
   - internet

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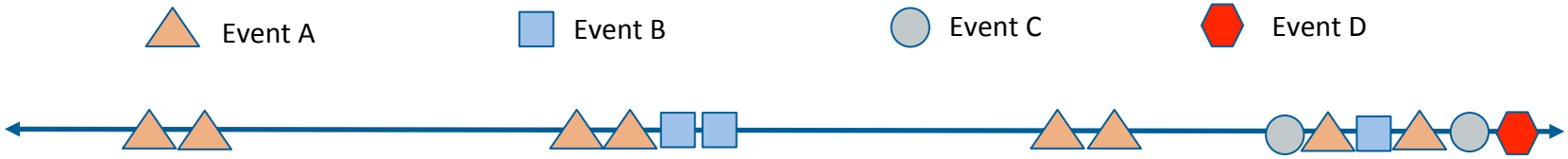
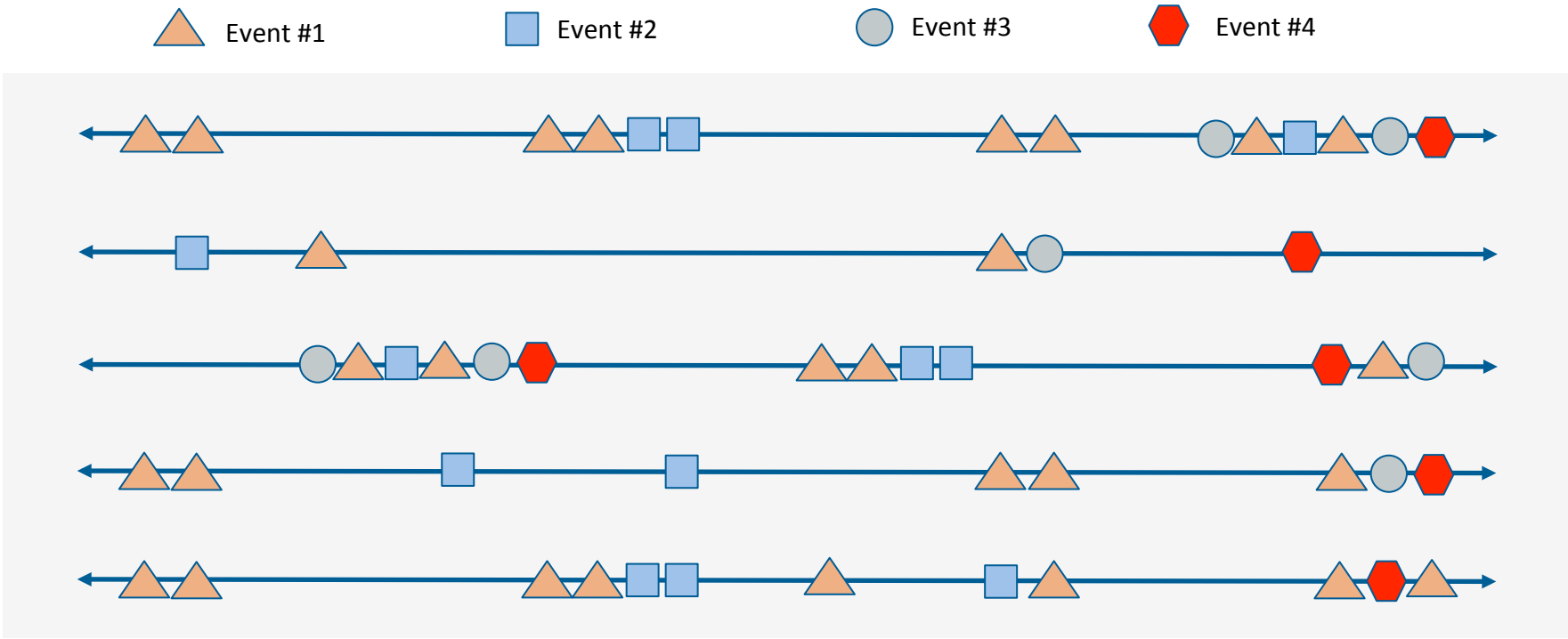
Temporal dataset

- Sequence of time stamped events arranged in temporal order
  - $S_i = <E_1, \ldots, E_m>$



Temporal dataset

- Dataset of Sequences:
  - $D = \{S_0, \ldots, S_n\}$



Sample Tasks

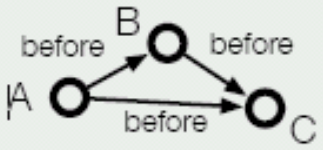
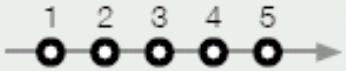
- What happened at time X?
- What are the changes & patterns over time?
- When does variable x hit an extreme?
- What are the intervals of time represented in the data?
- Find a variable whose changes/pattern match some pattern.
- Find correlations of particular events.
- What will variable x do in the future?
- How do two variables relate over time?
- What is a variable's frequency distribution over time?
- How many events of type x occur in a certain time?

Taxonomy

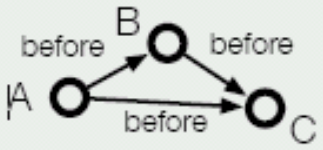
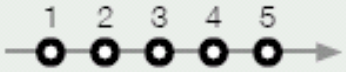
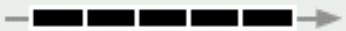
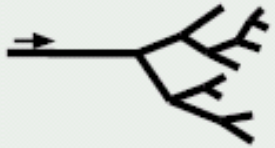
- Discrete points vs. interval points
- Linear time vs. cyclic time
- Ordinal time vs. continuous time
- Ordered time vs. branching time vs. time with multiple perspectives

CHARACTERIZING AND MODELING TIME

Modeling time

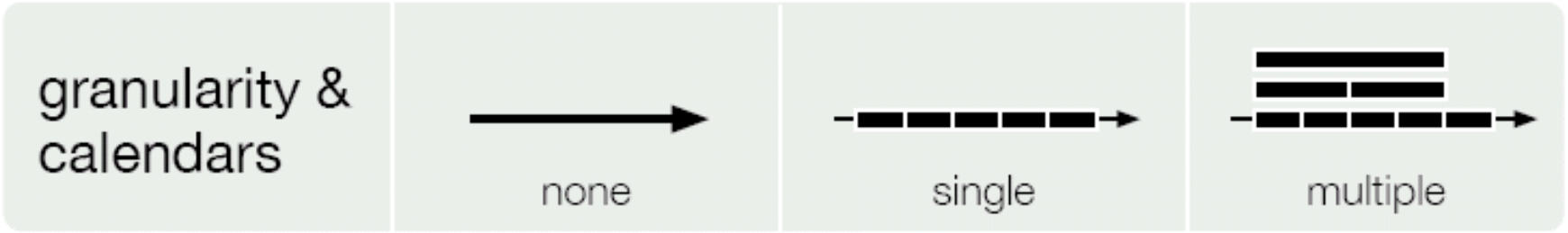
scale	ordinal	discrete	continuous
			

Modeling time

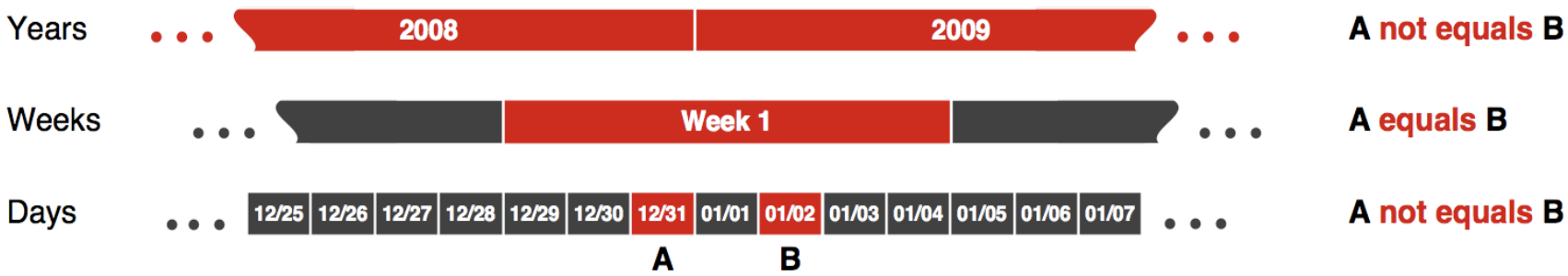
scale	 ordinal	 discrete	 continuous
scope	 point-based	 interval-based	
arrangement	 linear	 cyclic	
viewpoint	 ordered	 branching	 multiple perspectives

Modeling time

Abstractions



Relationship of A and B:



Modeling time

Abstractions

granularity & calendars	 none	 single	 multiple
time primitives	 instant	 interval	 span

Modeling time

Abstractions

granularity & calendars	 none	 single	 multiple
time primitives	 instant	 interval	 span
determinacy	 determinate	 indeterminate	

Modeling data & time

scale	3.14 3.27 4.88 quantitative	coconut banana apple qualitative
frame of reference	 abstract	 spatial
kind of data	 events	 states
number of variables	 univariate	 multivariate

Modeling data & time

internal time inherent in the data model	 non-temporal	 temporal
external time extrinsic to the data model	 static	 dynamic