Chronology Statements for nodegoat: a temporal topology to interface with vague, relational, and actionable dates

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Abstract

The open-source software nodegoat (https://nodegoat.net/) is a research environment that allows historians to model, create, analyse, and visualise datasets that are temporally and spatially attributed. nodegoat is in use at over 150 institutes by more than 2000 historians. Together they have amassed millions of data points stored in decentralised linked data stores. Data from these stores can be published as JSON-LD.

nodegoat offers various tools to guarantee the sustainability and reusability of stored data. In this paper we present a new feature of nodegoat that allows historians to create source-driven date statements that express ambiguity, uncertainty, and incompleteness. Using these 'Chronology Statements' historians do not need to resort to intransparent statements like 'circa' or '?', but are able to explicitly state how uncertain a date is, e.g. 'the date point is between 10 years before the begin of 1800 and 10 years after the end of 1800'. Chronology Statements propose an approach that aims to model and quantify temporal vagueness.[1]

Interoperable Data Models
While historians are free to create their own data model in nodegoat, the software provides them with a system template in which object types are to be defined. For every object type a set of contexts can be created that assign temporal and spatial attributes to an object.[2] Because of this basic structure, mapping nodegoat data to other ontologies is straightforward.

nodegoat
Type Person [65]
Object Ľudovít Štúr [ngHu7Z37tIeP3HeEaIR75UuZqIb]
Sub-Object Birth [341]
Date 28-10-1815
Location Uhrovec [ngRX8l26jR463DdIzQnY6]

Wikidata
Item Ľudovít Štúr [Q315222]
instance of [P31] Human [Q5]
date of birth [P569] 28-10-1815
place of birth [P19] Uhrovec [Q749646]

CIDOC CRM

*Speaker

E21 Person Ľudovít Štúr
E67 Birth
P4 has time-span 28-10-1815
P7 took place at Uhrovec

To use complex and ambiguous geographies in nodegoat, users can store geometry data (in the GeoJSON format) in the Sub-Object Location element. This allows historians to use the rich resources that have been developed by the HGIS community.

Chronology Statements
nodegoat has recently been expanded to facilitate the storage of complex, ambiguous, and relational temporal data. To ensure that the level of ambiguity can be communicated, and to be able to use these dates in diachronic analyses and visualisations, the statements need to be actionable. This means that a date may not include qualifications like 'circa' or '?', as these values cannot be used for computation. EDTF proved to be not suitable as it relies on a rough level of granularity.[3]

To produce date statements that are both vague and actionable, we developed 'Chronology Statements'. Chronology Statements implement a human and computational interpretable temporal topology.

Chronology Statements provide objects with a position in time by means of statements that combine operators, cyclic periodisation, relationality, and additional offsetting. This system allows historians to be exhaustive in terms of documenting the source and its possible uncertainty. The logical implementation of the system can compute actual dates while providing access to its underlying uncertainty or vagueness. These statements can both be expressed by scholars and understood by computation.

A Chronology Statement has two modes that can either describe events that occur at a single instance in time (a date point) or have a duration (a date period). A point in time can be described by one or two statements and would eventually result in a date range (vague) or a date time (exact). A period can be described by two, three, or four statements with varying levels of attribution that assemble the quantification of its vagueness. A fully utilised Chronology Statement of a period contains 42 attributes that can be used to compute its start and end.[4]

Chronology Statements apply operators similar to Allen operators and are in line with the computational efficiency of, for instance, temporal relational primitives.[5]

Offsetting in time is expressed by specifying an offset amount in combination with an offset unit. Offsets can also be expressed by self-defined cycles. Users are able to define geographically dependent cycles, e.g. seasons (northern/southern hemisphere), or cycles that change over time and space, e.g. semesters (spring semester in Basel vs. summer semester in Leipzig).[6]

Chronology Statements enable temporal relationality by allowing users to select a reference to another stored Chronology Statement instead of specifying a date. This feature allows historians to position an object after, before, or between objects (e.g. 'letter x was sent after letter y was received', or 'letter x was sent between when letter y was received and letter z was sent').[7] Historians can also import datasets from iDAI.chronontology or PeriodO into their nodegoat environment and use this data to date their objects.[8]

Chronology Statements are formatted in JSON, for which the ChronoJSON format has been developed. ChronoJSON can be mapped to various systems with varying levels of detail. Computed date ranges can also be outputted using EDTF.

Examples

A common expression in scholarly output is 'circa 1800'. Only the author knows what is meant by 'circa', no peer or software will be able to parse this statement. Chronology Statements allow the scholar to make a statement that reads as 'the date point is between 10 years before the begin of 1800 and 10 years after the end of 1800'. In ChronoJSON, this statement is formatted as:

{
"type": "point",
"start": {
"start": {
"offset_amount": 10,
"offset_unit": "year",
"date_value": "1800",
"date_direction": "< ——"
},
"end": {
"offset_amount": 10,
"offset_unit": "year",
"date_value": "1800",
"date_direction": "——> "
}
}
}

This statement is translated to a range from 1790 to 1810.

This ChronoJSON states that a letter has been sent three months after another letter was sent:

{
"type": "point",
"start": {
"start": {
"offset_amount": 3,
"offset_unit": "month",
"date_object_sub_id": 15646020,
"date_direction": "——> "
}
}
}

This statement is translated to a date point three months after the referenced statement. When publishing this data, the internal date_object_sub_id will be replaced by its corresponding URI.

To come back to the example shown in the comparison between data models: when the statement would not be 'born on 28-10-1815 in Uhrovec', but 'around 1815 in western upper Hungary', the Sub-Object 'Birth' that combines GeoJSON and ChronoJSON reads:

Type Person [65]
Object Ľudovít Štúr [ngHu7Z37tIeP3HeEaIR75UuZqIb]
Sub-Object Birth [341]
Date

{

"type": "point",
"start": {
"start": {
"offset_amount": 2,
"offset_unit": "year",
"date_value": "1815",
"date_direction": "< ——"
},
"end": {
"offset_amount": 2,
"offset_unit": "year",
"date_value": "1815",
"date_direction": "——> "
}
}
}
Location
{
"type": "Polygon",
"coordinates": [
[17.54791259765625,48.823140892101684
,[19.69573974609375,48.219182942479165],[19.88800048828125,49.18349869228674],[18.81683349609375,49.5252083
]
}

We are keen to receive feedback from the D4H-community on this proposal and look forward to exploring paths for further data and format exchanges.

Michael Piotrowski, 'Accepting and Modeling Uncertainty', in: Andreas Kuczera, Thorsten Wübbena, Thomas Kollatz (ed.), Die Modellierung des Zweifels – Schlüsselideen und -konzepte zur graphbasierten Modellierung von Unsicherheiten (Wolfenbüttel 2019), doi: 10.17175/sb004_006a.

These 'sub-objects' follow a similar logic as the CIDOC CRM E92 Spacetime Volume.

https://www.loc.gov/standards/datetime/

https://nodegoat.net/guides/chronologystatements.

J.F. Allen, 'Maintaining knowledge about temporal intervals', Communication of ACM (1983) 832-843. http://www.cidoc-crm.org/sites/default/files/CIDOC%20CRM_v6.2.7_Definition_esIP.pdf. Emmanuel Papadakis, and Martin Doerr. "Temporal Primitives, an Alternative to Allen Operators." EMF-CRM@TPDL (2015).

https://nodegoat.net/guides/cycles.

https://nodegoat.net/guides/relationalchronologystatements.

https://chronontology.dainst.org/. https://perio.do/.

Keywords: date, chronology, ambiguity, vagueness