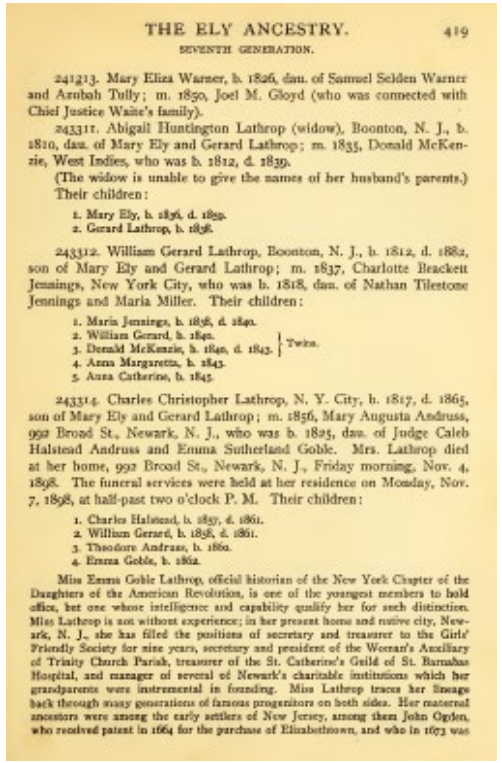


THE ELY ANCESTRY. 419

SEVENTH GENERATION.

241313. Mary Eliza Warner, b. 1826, dau. of Samuel Selden Warner and Anubah Tully; m. 1850, Joel M. Gloyd (who was connected with Chief Justice Waite's family).

243311. Abigail Huntington Lathrop (widow), Boonton, N. J., b. 1810, dau. of Mary Ely and Gerard Lathrop; m. 1835, Donald McKenzie, West Indies, who was b. 1812, d. 1839.

(The widow is unable to give the names of her husband's parents.)

Their children:

1. Mary Ely, b. 1836, d. 1859.
2. Gerard Lathrop, b. 1838.

243312. William Gerard Lathrop, Boonton, N. J., b. 1812, d. 1882, son of Mary Ely and Gerard Lathrop; m. 1837, Charlotte Brackett Jennings, New York City, who was b. 1818, dau. of Nathan Tilestone Jennings and Maria Miller. Their children:

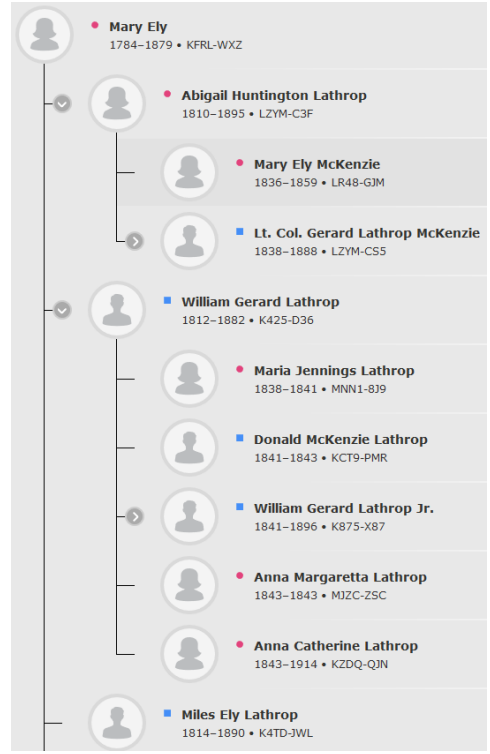
1. Maria Jennings, b. 1838, d. 1841.
2. William Gerard, b. 1840. } Twins.
3. Donald McKenzie, b. 1840, d. 1843. }
4. Anna Margaretta, b. 1843.
5. Anna Catherine, b. 1845.

243314. Charles Christopher Lathrop, N. Y. City, b. 1817, d. 1865, son of Mary Ely and Gerard Lathrop; m. 1856, Mary Augusta Andruss, 992 Broad St., Newark, N. J., who was b. 1825, dau. of Judge Caleb Halstead Andruss and Emma Sutherland Goble. Mrs. Lathrop died at her home, 992 Broad St., Newark, N. J., Friday morning, Nov. 4, 1898. The funeral services were held at her residence on Monday, Nov. 7, 1898, at half-past two o'clock P. M. Their children:

1. Charles Halstead, b. 1857, d. 1861.
2. William Gerard, b. 1858, d. 1861.
3. Theodore Andruss, b. 1860.
4. Emma Goble, b. 1862.

Miss Emma Goble Lathrop, official historian of the New York Chapter of the Daughters of the American Revolution, is one of the youngest members to hold office, but one whose intelligence and capability qualify her for such distinction. Miss Lathrop is not without experience; in her present home and native city, Newark, N. J., she has filled the positions of secretary and treasurer to the Girls' Friendly Society for nine years, secretary and president of the Woman's Auxiliary of Trinity Church Parish, treasurer of the St. Catherine's Guild of St. Barnabas Hospital, and manager of several of Newark's charitable institutions which her grandparents were instrumental in founding. Miss Lathrop traces her lineage back through many generations of famous progenitors on both sides. Her maternal ancestors were among the early settlers of New Jersey, among them John Ogden, who received patent in 1664 for the purchase of Elizabethtown, and who in 1673 was

Linking Families with Enriched Ontologies



David W. Embley (FamilySearch), *Stephen W. Liddle* (BYU),
Deryle W. Lonsdale (BYU), *Scott N. Woodfield* (BYU & FamilySearch)

Linking Families

who was b. 1822, dau. of William Gillingham and Jane McPherson.

24138. Charles Selden, b. 1816, d. 1871, son of Roger Selden and Mary Schuyler Douglas; m. 1845, Hester Gillingham, dau. of William Gillingham and Jane McPherson; m. 2nd, 1862, Elizabeth Keiffer, who was b. 1839.

24331. Mary Ely, Lebanon, Conn., b. 1784, d. 1879, dau. of Zebulon Ely and Sarah Apame Mills; m. 1809, Gerard Lathrop, New York City,

SIXTH GENERATION.

who was b. 1778, d. 1852, son of Azuriah Lathrop and Abigail Huntington. Their children:

1. Abigail Huntington, b. 1810, m. 1835 Donald McKenzie.
2. William Gerard, b. 1812, d. 1882, m. 1837 Charlotte Brackett Jennings.
3. Mills Ely, b. 1814.
4. Charles Christopher, b. 1817, d. 1865, m. 1856 Mary Augusta Andruss.
5. Ezra Stiles, b. 1818.
6. Mary Cornelia, b. 1820, d. 1879, m. 1840 Jacob Dykeman Vermilye.
7. Charlotte Eliza, b. 1822.

24332. Ezra Stiles Ely, Philadelphia, Pa., b. 1786, d. 1861, son of Zebulon Ely and Sarah Apame Mills; m. 1814, Mary Ann Carswell, who was b. 1792, d. 1842, dau. of Samuel King Carswell and Margaret Means; m. 2nd, 1843, Caroline Thompson Holmes, Virginia, who was b. 1812, dau. of Thompson Holmes and Eliza Allen Stockly. Their children:

1. Margaret Carswell b. 1815, m. 1832 Samuel McClellan.
2. Samuel Carswell, b. 1816, d. 1878.
3. Ezra Stiles, b. 1818.

SEVENTH GENERATION.

241213. Mary Eliza Warner, b. 1826, dau. of Samuel Selden Warner and Azubah Tully; m. 1850, Joel M. Gloyd (who was connected with Chief Justice Waite's family).

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(The widow is unable to give the names of her husband's parents.)

Their children:

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1. Maria Jennings, b. 1838, d. 1840.
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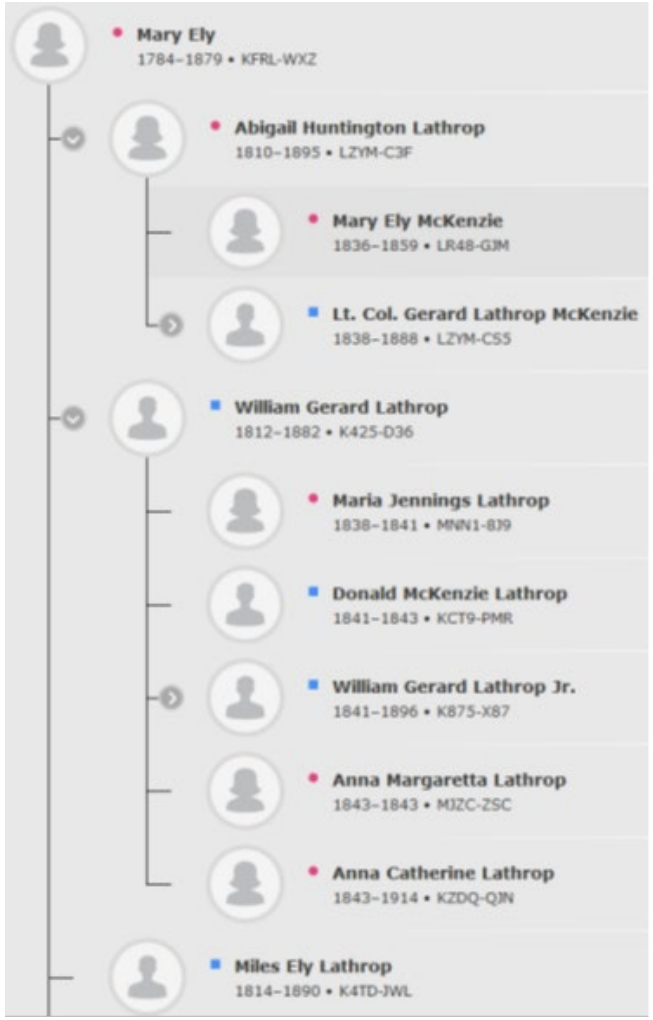
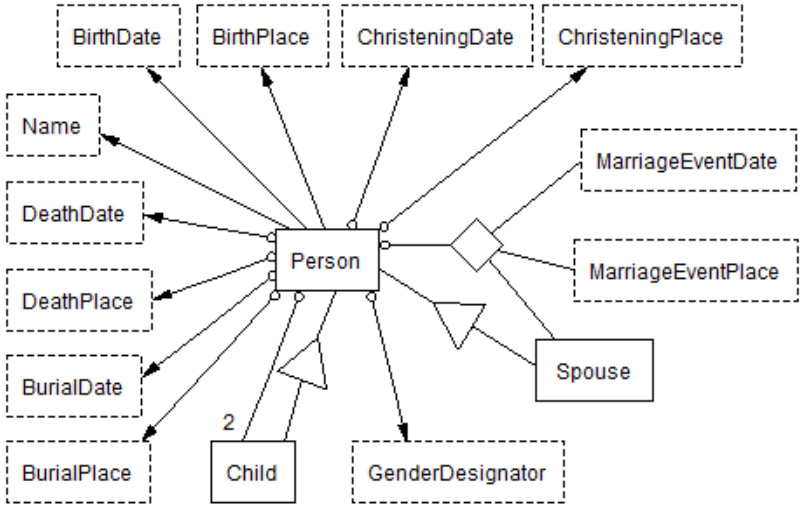


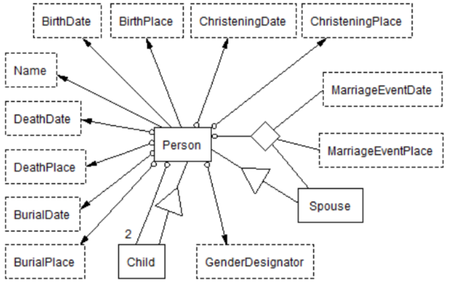
Enriched Ontologies

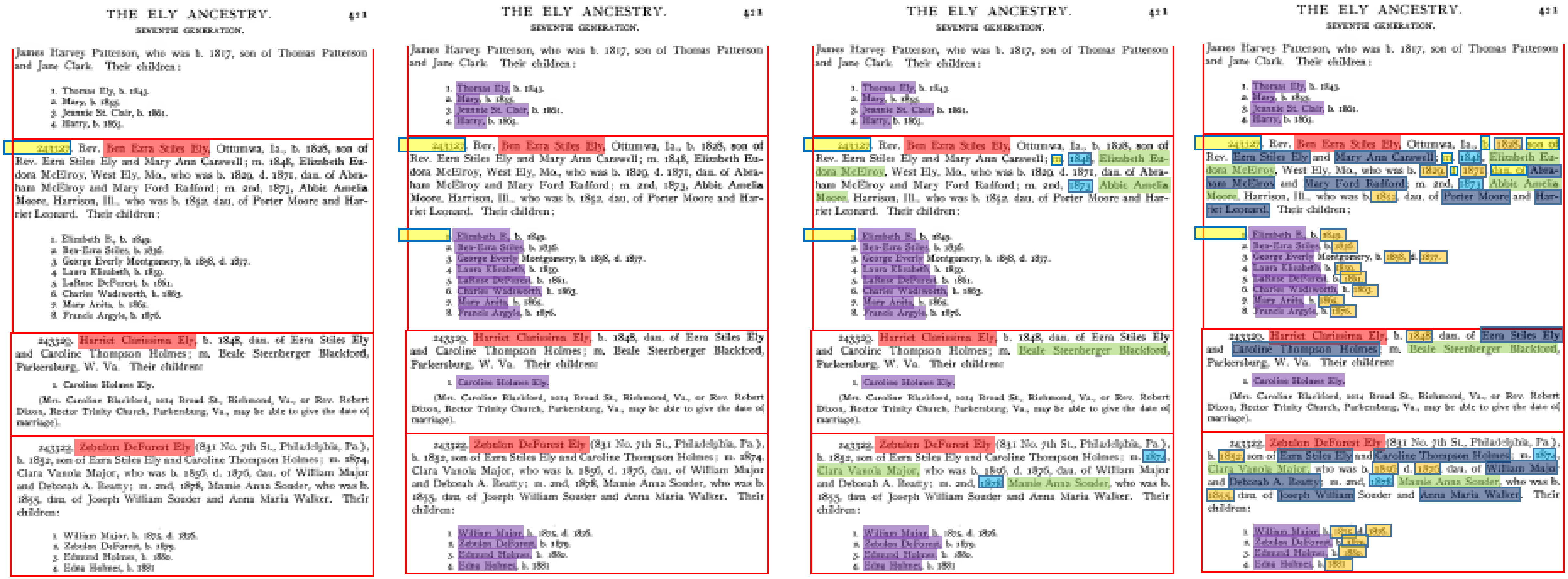
- "An *ontology* is a formal, explicit specification of a shared conceptualization" [Gruber93]
- Conceptual Model
- Enrichments
  - Linguistic Grounding
  - Pragmatic Constraints
  - Cultural Normatives
  - Evidential Reasoning



Linguistic Grounding

(syntactically extract text elements into conceptual components)





THE ELY ANCESTRY. 421

SEVENTH GENERATION.

James Harvey Patterson, who was b. 1817, son of Thomas Patterson and Jane Clark. Their children:

1. Thomas Ely, b. 1843.
2. Mary, b. 1855.
3. Jeannie St. Clair, b. 1861.
4. Harry, b. 1863.

243127. Rev. Ben Ezra Stiles Ely, Ottumwa, Ia., b. 1828, son of Rev. Ezra Stiles Ely and Mary Ann Carswell; m. 1848, Elizabeth Eudora McElroy, West Ely, Mo., who was b. 1829, d. 1871, dau. of Abraham McElroy and Mary Ford Radford; m. 2nd, 1873, Abbie Amelia Moore, Harrison, Ill., who was b. 1852, dau. of Porter Moore and Harriet Leonard. Their children:

1. Elizabeth E., b. 1849.
2. Ben-Ezra Stiles, b. 1856.
3. George Everly Montgomery, b. 1858, d. 1877.
4. Laura Elizabeth, b. 1859.
5. LaRose DeForest, b. 1861.
6. Charles Wadsworth, b. 1863.
7. Mary Anita, b. 1864.
8. Francis Argyle, b. 1876.

243320. Harriet Chrissima Ely, b. 1848, dau. of Ezra Stiles Ely and Caroline Thompson Holmes; m. Beale Steenberger Blackford, Parkersburg, W. Va. Their children:

1. Caroline Holmes Ely.

(Mrs. Caroline Blackford, 2014 Broad St., Richmond, Va., or Rev. Robert Dixon, Rector Trinity Church, Parkersburg, Va., may be able to give the date of marriage).

243322. Zebulon DeForest Ely (831 No. 7th St., Philadelphia, Pa.), b. 1852, son of Ezra Stiles Ely and Caroline Thompson Holmes; m. 1874, Clara Vasola Major, who was b. 1856, d. 1876, dau. of William Major and Deborah A. Beatty; m. 2nd, 1878, Mamie Anna Souder, who was b. 1855, dau. of Joseph William Souder and Anna Maria Walker. Their children:

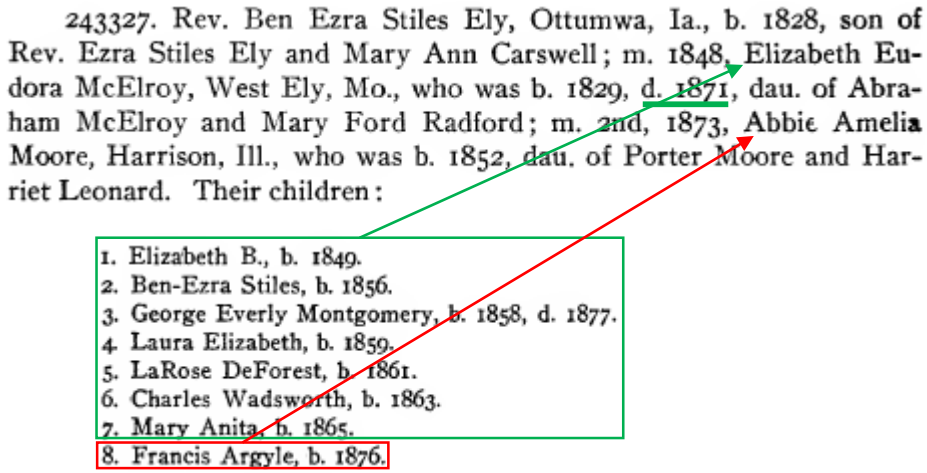
1. William Major, b. 1875, d. 1876.
2. Zebulon DeForest, b. 1879.
3. Edmund Holmes, b. 1880.
4. Edna Holmes, b. 1881

Acknowledgement: George Nagy, RPI

Pragmatic Constraints

(semantic analysis of syntactically extracted information)

Example: A mother cannot give birth to a child after she dies:



243327. Rev. Ben Ezra Stiles Ely, Ottumwa, Ia., b. 1828, son of Rev. Ezra Stiles Ely and Mary Ann Carswell; m. 1848, Elizabeth Eudora McElroy, West Ely, Mo., who was b. 1829, d. 1871, dau. of Abraham McElroy and Mary Ford Radford; m. 2nd, 1873, Abbie Amelia Moore, Harrison, Ill., who was b. 1852, dau. of Porter Moore and Harriet Leonard. Their children:

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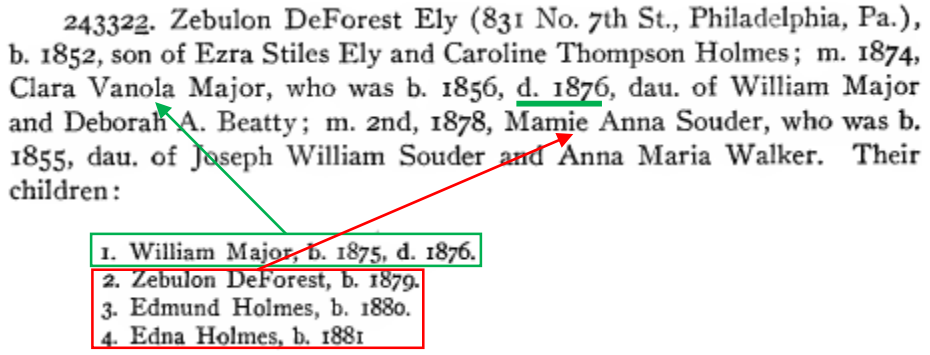

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1. William Major, b. 1875, d. 1876.
2. Zebulon DeForest, b. 1879.
3. Edmund Holmes, b. 1880.
4. Edna Holmes, b. 1881

Example (can't die before being born): John Adams (1756 – i797)

Cultural Normatives

(augment extracted information by inference)

ALBRIGHT, ESTHER R. d 1 Jan 1946 113 Sherman St Dayton OH BD Abbottsville Cem Dke Co OH 3 Jan 1946 b 22 July 1863 Butler Co OH age 82-6-9 f THOMAS BENTON MORRIS Butler Co OH m ANGELINE HARROD Hamilton Co OH housekeeper widow sp WINFIELD S. ALBRIGHT 1 daughter Mrs HENRY RANCH 4 sons HENDERSON of Greenville WILBUR of Greenville GEO of Dayton ELBERT of Dayton 12 grandchildren 2 brothers ARTHUR MORRIS Venice OH & SAM MORRIS Harrison OH 2 sisters Miss ELLA MORRIS Greenville OH & Mrs ADA HARP Tulsa OK

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    <CanonicalValue>Title(s): FirstName(s): Esther R. BirthSurname: Morris MarriedSurname(s): Albright Suffix(es):</CanonicalValue>
    <OriginalText>ALBRIGHT, ESTHER R.</OriginalText>
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(augment extracted information by inference)

ALBRIGHT, ESTHER R. d 1 Jan 1946 113 Sherman St Dayton OH BD Abbottsville Cem Dke Co OH 3 Jan 1946 b 22 July 1863 Butler Co OH age 82-6-9 f THOMAS BENTON MORRIS Butler Co OH m ANGELINE HARROD Hamilton Co OH housekeeper widow sp WINFIELD S. ALBRIGHT 1 daughter Mrs HENRY RANCH 4 sons HENDERSON of Greenville WILBUR of Greenville GEO of Dayton ELBERT of Dayton 12 grandchildren 2 brothers ARTHUR MORRIS Venice OH & SAM MORRIS Harrison OH 2 sisters Miss ELLA MORRIS Greenville OH & Mrs ADA HARP Tulsa OK

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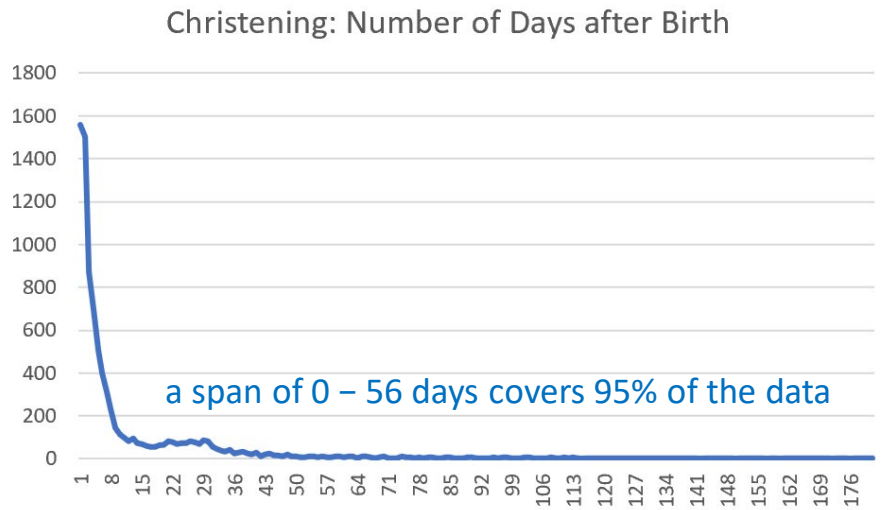
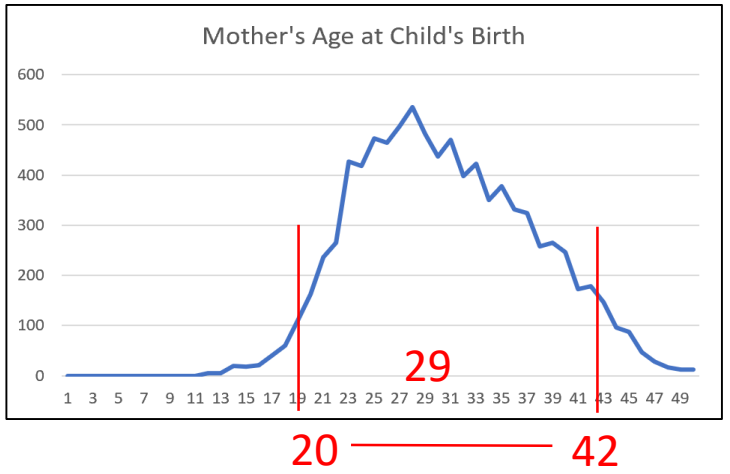


Evidential Reasoning

- Shallow Match Blocking
  -
  -
- Deep Match Equivalence-Class Creation
  -
  -
  -
    -
    -
    -
- Record Merge
- Family Tree Creation

Evidential Reasoning

- Shallow Match Blocking (ordered by info content size)
  - Inferred name parts e.g. TEEGARDEN, WM. WALTER ≈ W. W. TEEGARDEN
  - Extracted/inferred birth dates



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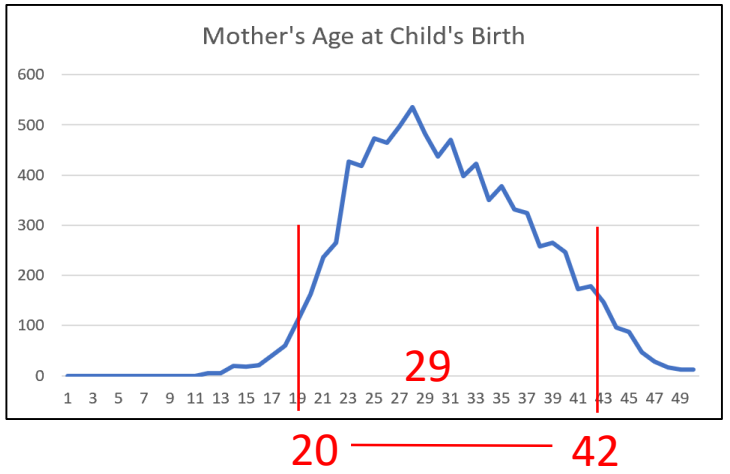

- Deep Match Equivalence-Class Creation
  - Within and across shallow-match blocks
  - Pairwise merge consistency
  - Match odds confidence
    -
    -
    -
- Record Merge
- Family Tree Creation

Evidential Reasoning

- Shallow Match Blocking (ordered by info content size)
  - Inferred name parts e.g. TEEGARDEN, WM. WALTER ≈ W. W. TEEGARDEN
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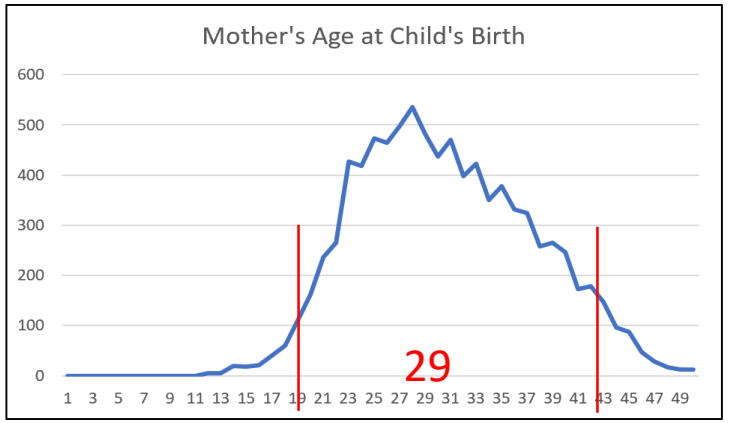
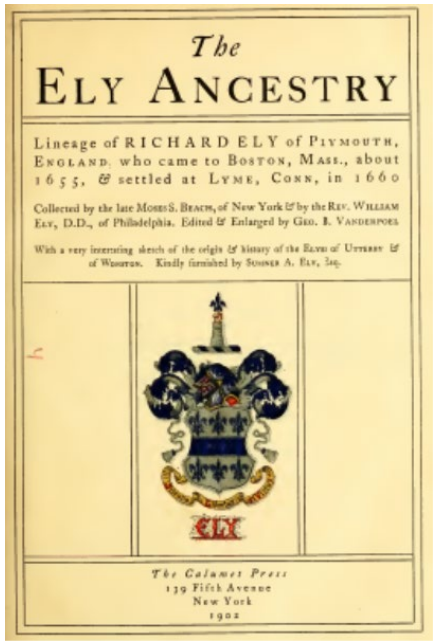


- Deep Match Equivalence-Class Creation
  - Within and across shallow-match blocks
  - Pairwise merge consistency
  - Match odds confidence
    - $P(M|E_1, \ldots, E_n) = P(E_1, \ldots, E_n|M)\ P(M)/P(E_1, \ldots, E_n)$
    - $\log P(E_1, \ldots, E_n|M)\ P(M)/P(E_1, \ldots, E_n) = \cancel{P(M)} + \sum^n_{i=1} \cancel{P(E_i|M)}/P(E_i)$ (= 1) yielding $\sum^n_{i=1} 1/P(E_i)$
    - Odds weight, $1/P(E_i)$, tempered by probability of a match, e.g. P("Waddington" ≈ "Clitheroe")
- Record Merge
- Family Tree Creation



Experimental Results

Table 1. Generation of Shallow Match Equivalence Classes (Blocking).

Book (pages)	# records found	execution time (ms)	surn. inferd birth	surn. inferd mar.	birth dates extr.	birth dates est.	# eq. cls. size 1	# eq. cls. size 2–9	# eq. cls. size 10^+
Ely (432–700)	8,976	16,228	2,731	3,038	4,427	3,895	5,415	1,208	8
Miller (7–395)	11,439	30,037	1,532	2,573	2,818	8,303	7,749	1,554	1
Kilb. (4–127)	8,814	11,087	4,043	2,064	1,103	6,224	5,049	1,174	15

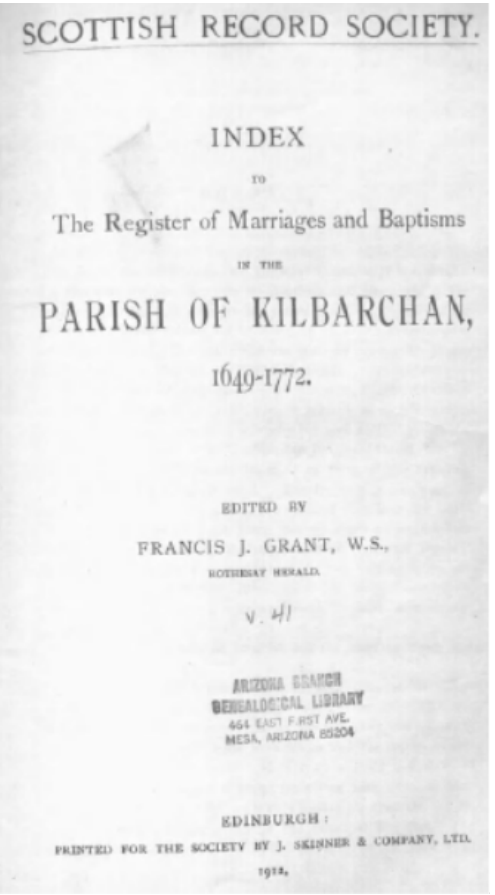
Table 2. Generation of Deep Match Equivalence Classes.

Book (pages)	execution time (ms)	# of size 1	# of size 2–9	# of size 10^+	# recs. rejctd	# recs. pushed across blocks unmrgabl	# recs. pushed across blocks rejctd	# recs. pushed across blocks not confidnt
Ely (432–700)	145,095*	6,479	865	2	146	3,312	1	3,615
Miller (7-395)	120,138	10,164	572	41	0	2,092	5	6,493
Kilb. (4–127)	97,520	8,334	12	0	438	7,819	0	10,955

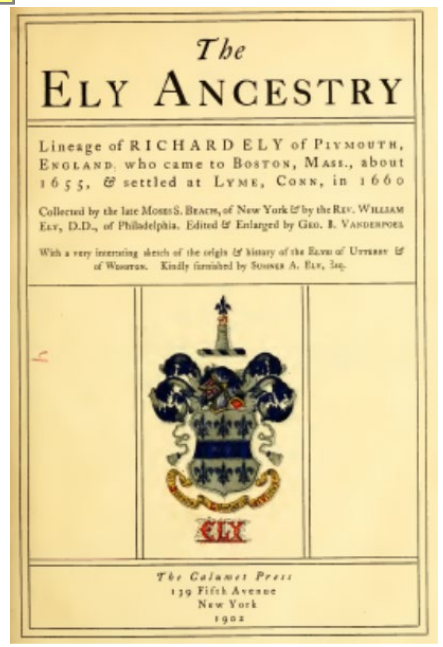
* Without blocking, an estimated 5 days would have been required to process Ely (432-700).

Table 3. Deep Match Equivalence Class Accuracy.

	false positives	false negatives	# checked (Accuracy)	Accuracy Recall	Accuracy Precision	Accuracy F-score
Ely (432–700)	2	16	80	83%	98%	90%
Miller (7-395)	9	4	80	95%	89%	92%
Kilb. (4–127)	12	0	8,346	100%	99.86%	99.93%



Experimental Results



14,000+ inferred birth and married surnames

17,000+ estimated birth dates

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* Without blocking, an estimated 5 days would have been required to process Ely (432-700).

145 seconds vs. 5 days

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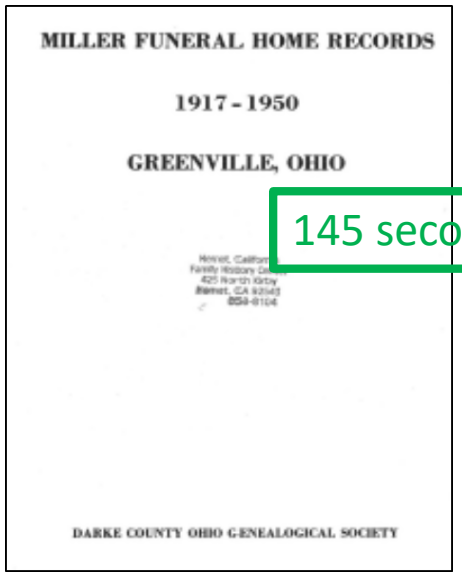
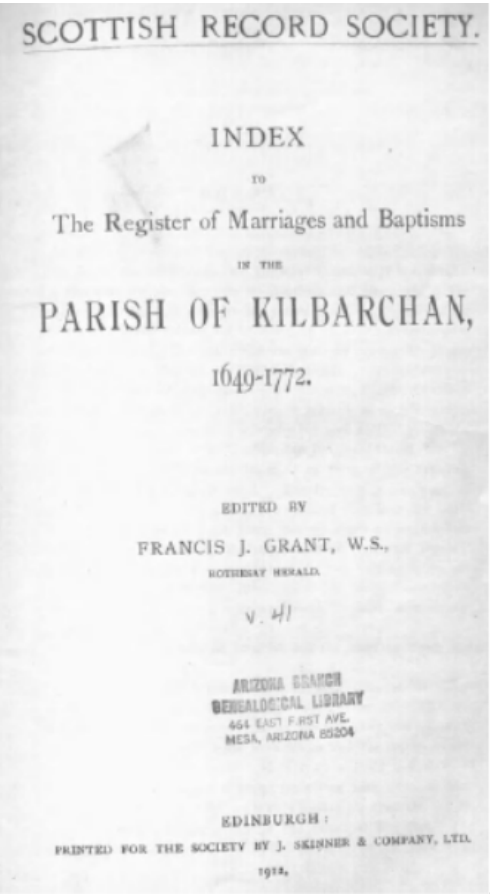
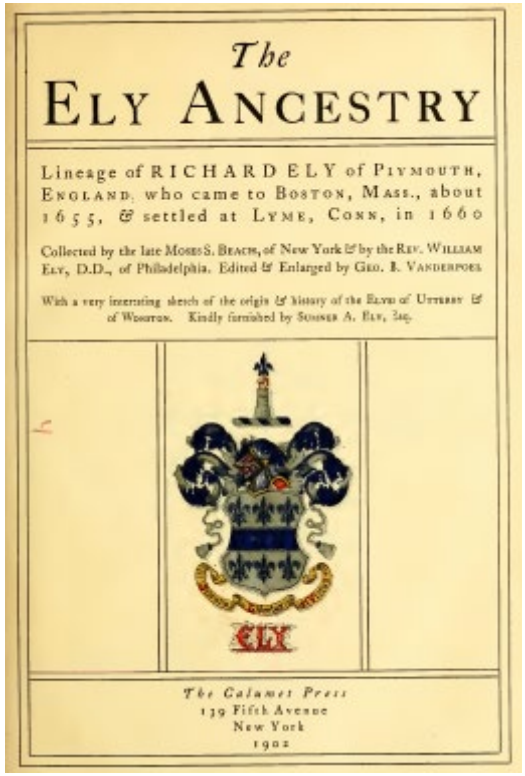
highly accurate: 90%–99%

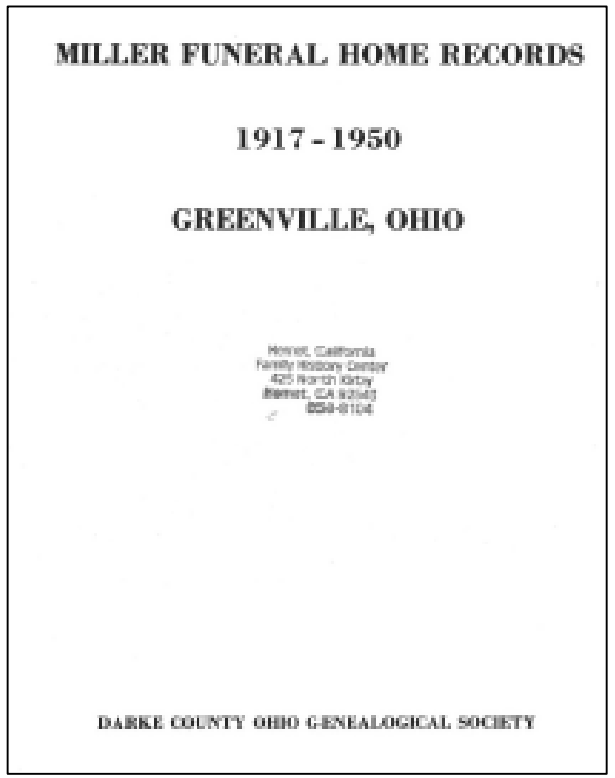


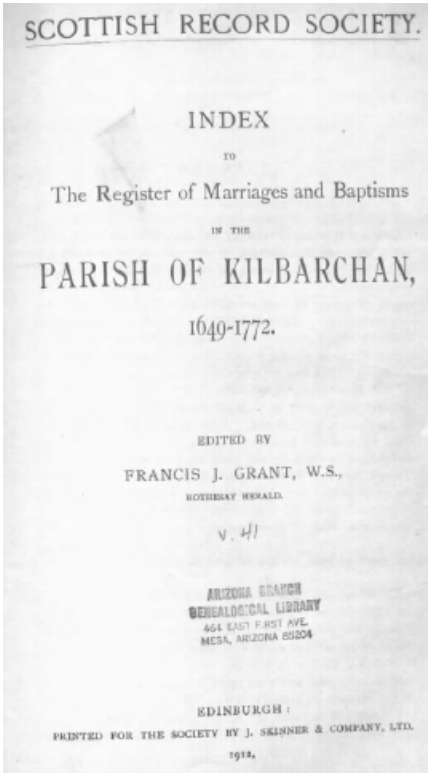


Conclusion

With enriched ontologies, it is possible to extract information from semi-structured documents and create intergenerational family trees with high accuracy (90%–99% F-score).







# Extracted Records:	8,622	11,440	8,724
# Merged Records:	6,594	10,573	8,660
Largest Generated Tree:	2,965	27	16