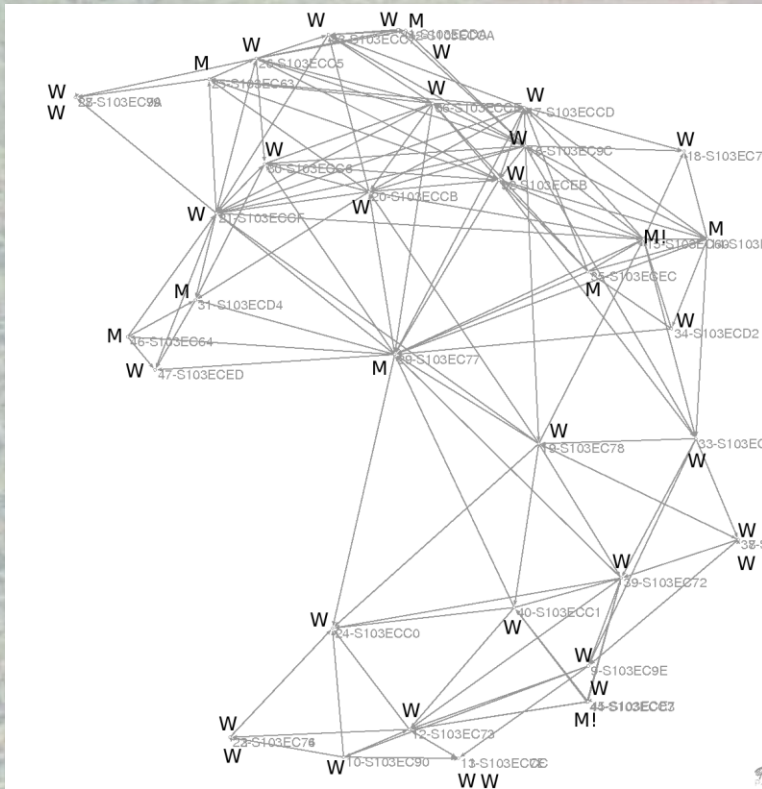# Educational Standard Assignment:
Some Findings Working with CAT & SAT

NSDL 2010 Annual Meeting

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Educational Standard Assignment:
# Some Findings Working with CAT & SAT… Overview

- Need for automated educational standard assignment in TeachEngineering.org.

- Part 1: Comparative analysis of standard assignment by CAT and human catalogers (René & Anne).

- Part 2: What about standard crosswalking? Analysis of 4,790,801 Science SAT alignments (René, Byron and Trevor).

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Automated Standard Alignment in TeachEngineering

- www.teachengineering.org:
  - 578 hands-on science and math K-12 activities.
  - 339 lessons
  - 54 multi-lesson, curricular units
- *Explicit alignments:* by author, supervised by collection catalogers:
  - cover only one state → mean 4.5 stds./document.
- Similar coverage across all states: 917 * 4.5 * 50 = 200,000+ assignments.
  - 200+ per document
  - 917 * 4.5 * 10 = 40,000+ annual updates

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TE, ASN, CAT, TD, NSDL 'Ecosystem'
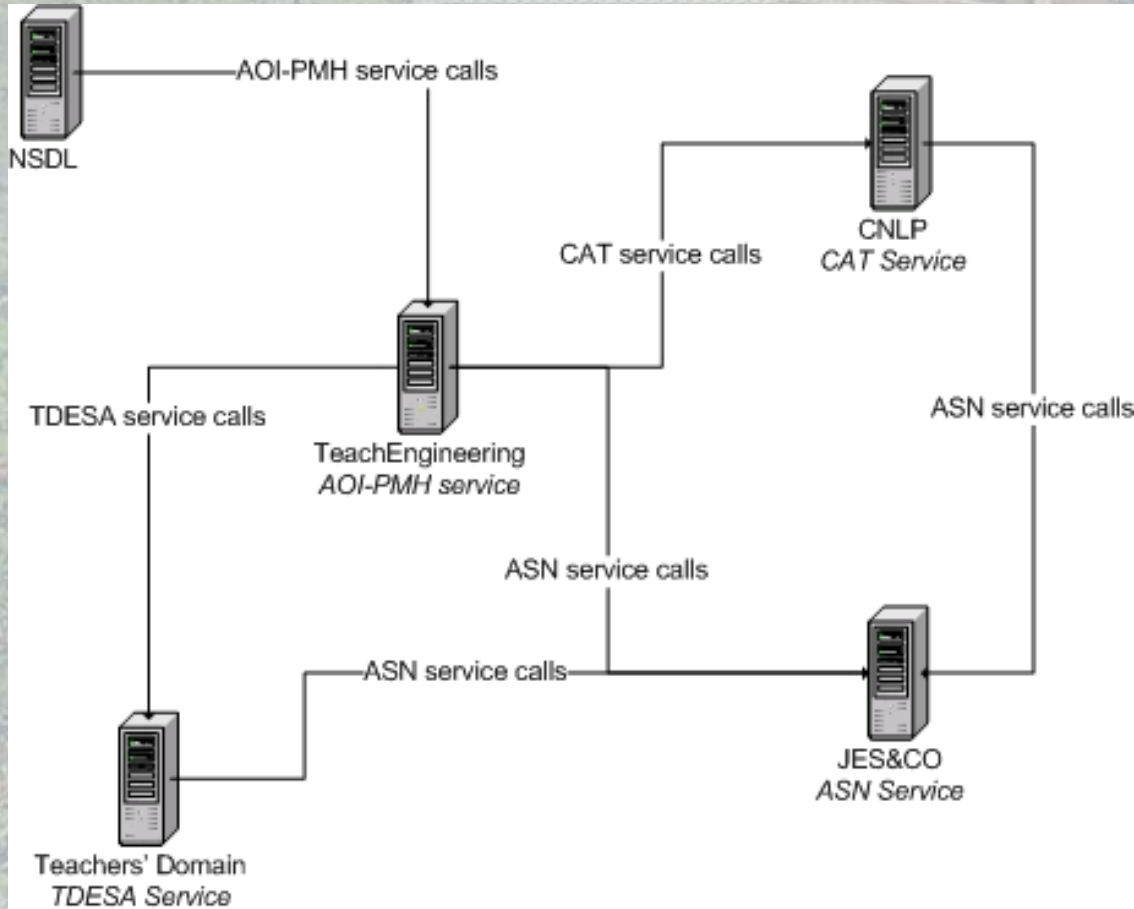
BIG!! thank you to CNLP and friends for CAT.

FYI, 'new' CAT (August 2010) is really fast ☺ and includes ITEEA* & Common Core Math

*Intern. Techn. & Engr. Educators Association

Part 1: Content Assignment Tool (CAT) & Explicit Standard Assignment in TeachEngineering

- 4,165 *explicit* alignments in TE

- 400,000+ (<u>unsupervised</u>) CAT assignments (science, math, ITEEA, common core math).

- Q-1: How are CAT assignments different from human (*explicit*) assignments?

- Q-2: Do the differences tell us something about how humans assign these standards in the first place?

- Q-3: Do the differences inform CAT and/or human improvements?

- BTW: What do we really mean when we say that a standard and a curricular item 'align?' (Reitsma, Marshall, Zarske (IPM – 2010))

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(Inductive) Method & Data

- Approach: build networks of standards; layout the networks, interpret their spatial arrangements:

  - Networks are based on how standards have been assigned to curriculum.

  - Any two jointly assigned standards are considered 'linked.'

- Compare and contrast the networks for clues.

- Data:

  - TeachEngineering collection – Jan. 2009.

  - CAT & human standard assignments of CO 2007 Science standards.

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CO 2007 Science Standard Assignments

	Human Catalogers (CO Curriculum)	CAT (CO curriculum cataloged by humans)
Curricular items assigned	86	86
Assignments	324	139 ★
Mean number of assignments per curricular item	3.78	1.61
Standards covered	63	47
Standard reuse rate	5.14	2.96 ★

CO 2007 Science Standard Assignments... Cont.'d

		CAT assignments (CO curriculum cataloged by humans)		
		Yes	No	Total
Human cataloger assignments	Yes	25	299	324
	No	114	NA	
	Total	139		

– CAT recall = 25 / 324 = .077*

– CAT precision = 25 / 139 = .18*

*if the humans did it right (?)

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'Curricular units'

– Human network is denser and more clustered.

– Human clusters are curricular units

– Human clusters link through common standards.

– CAT: open structure; less clustering. Has no knowledge of curricular units.

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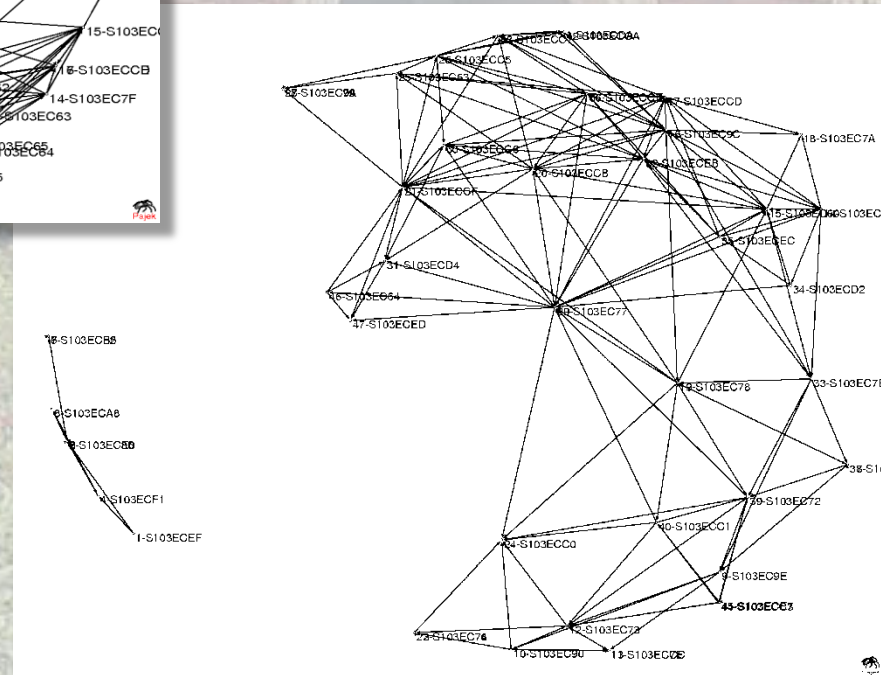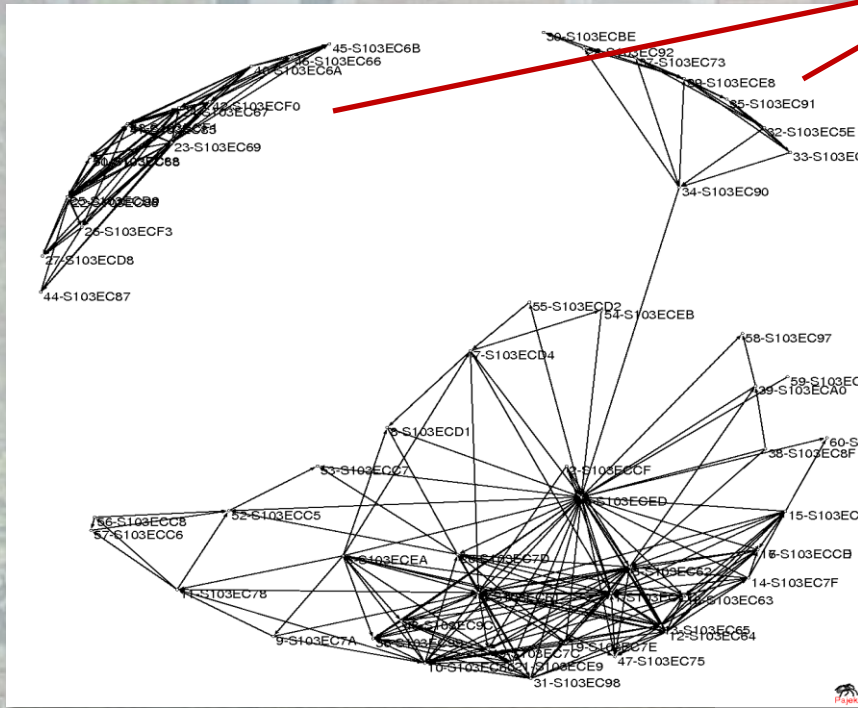
Weighted or unweighted?

- FR diagrams consider the network unweighted; *i.e.*, all links have equal value/weight.

- Two weights:

  - TF/IDF-like: weigh a standard link inversely proportional to the size of its company.

  - 'Fidelity:' weigh a link between standards proportional to their mutual fidelity across the collection.

- Compute the KK network layouts
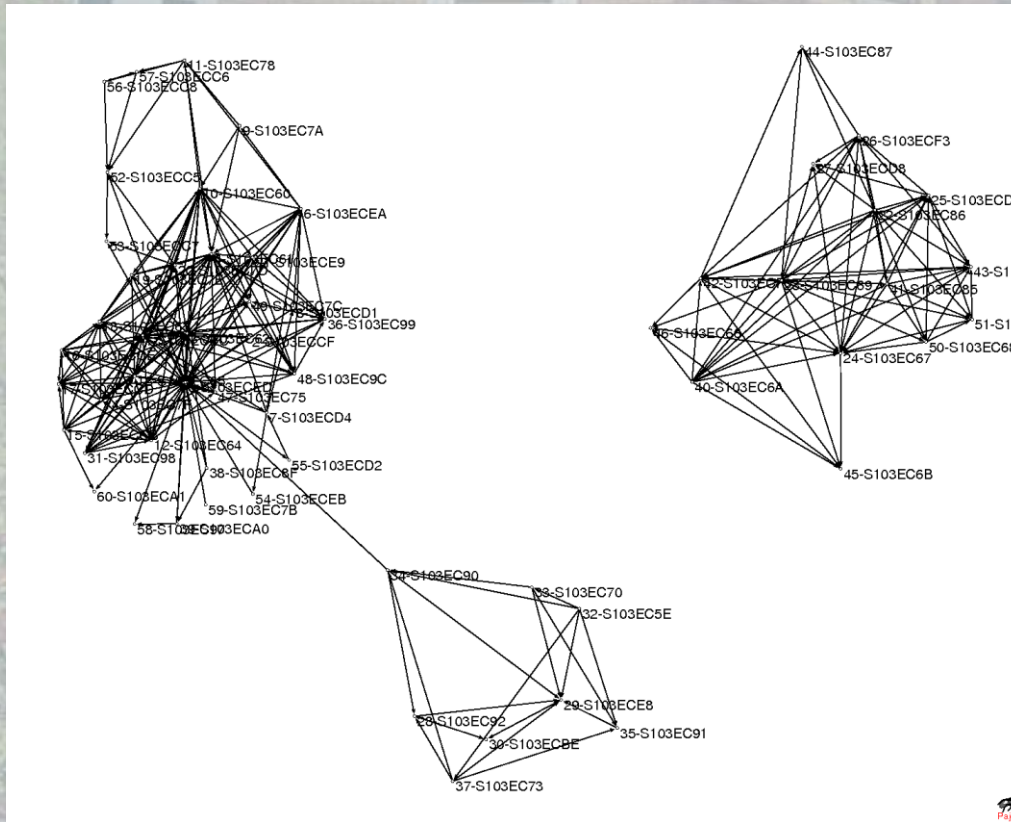
- Resulting KK diagrams showed essentially the same properties as the FR diagrams (hierarchical cluster analysis of two-dimensional positions)

CO Standards: 'Method' *vs*. 'World'

- *World* standards (W): express facts and principles about the empirical world.

  – *E.g.*, S103EC87: *Light and sound waves have distinct properties: frequency, wavelength and amplitude.*

- *Method* standards (M!): express ways and means of conducting science.

  – *E.g.*, S103ECE9: *A controlled experiment must have comparable results when repeated.*

- Some method standards 'contaminated' with world terms and/or examples (M):

  – *E.g.*, S103ECD4: *Technology is needed to explore space (for example: telescopes, spectroscopes, spacecraft, life support systems).*

- Question: How do CAT and human catalogers compare on World *vs*. Method?

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Standards: 'Method' *vs.* 'World…' Cont.'d

	Standards	M & M! standards	M & M! standards %	M! standards	M! standards %
Humans	63	21	33.33	16	25.40
CAT	47	9	19.15	3	6.38

W = *world*
M! = (pure) *method*
M = *method* with world examples
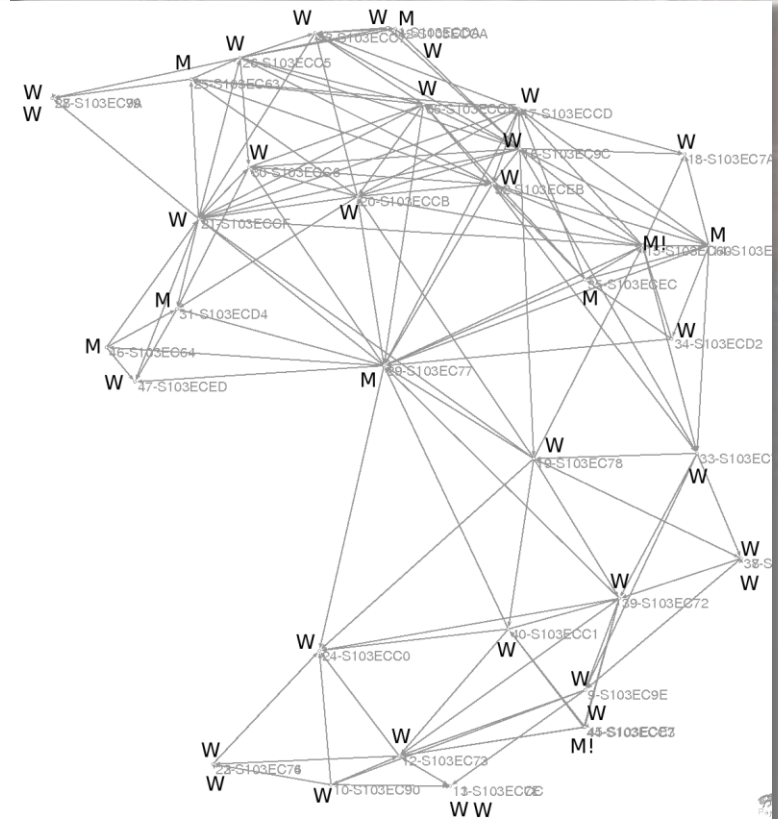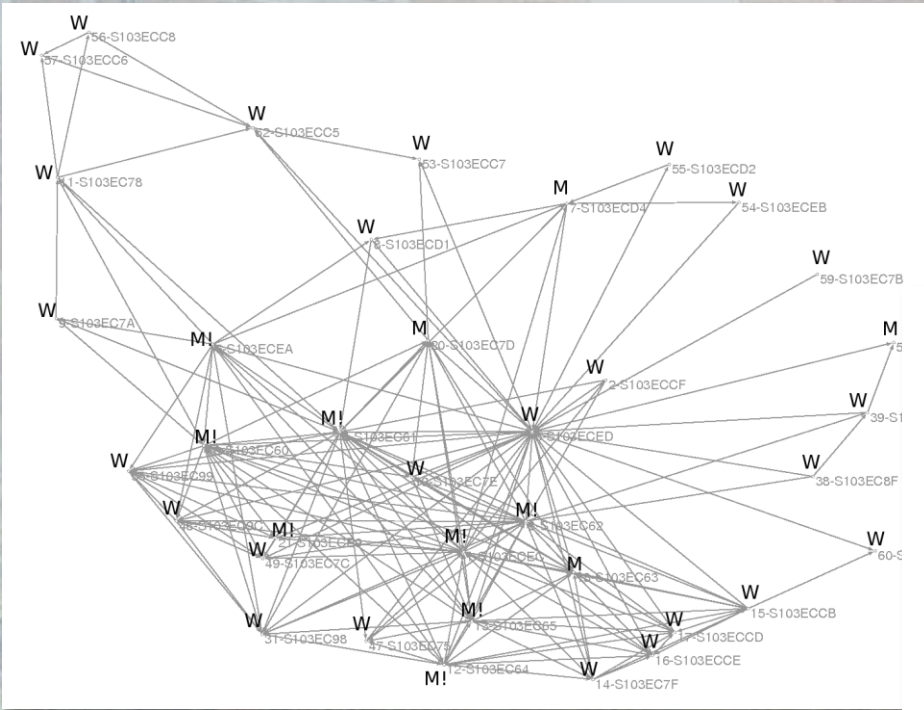
– CAT under-assigned *method*.

– Humans: *method* standards as curricular hubs

– CAT central method hub: S103EC77:

"*physical properties of solids, liquids, gases and the plasma state and their changes can be explained using the particulate nature of matter model*"

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Part 1: TeachEngineering & CAT Conclusions

- Once again, thanks for CAT! TeachEngineering needs it.

- Tools such as CAT can benefit from contextual knowledge; *e.g.*, that certain lessons are part of a larger set of lessons or a curricular unit.

- TeachEngineering curriculum is organized around both *world* and method standards. Hence, it would be nice if tools such as CAT become better at recognizing *method* standards.

- Contrast in standard re-use rate sends a signal to human catalogers not to be 'complacent.'

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