

Synchronicity: Pattern Authoring Tool

A General Guide

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Setup

The tool is run on a local server using Node.JS. Once the repository is cloned, simple go to the directory and start the server.

Requirements

- git
- OS: Linux/Mac OS
 - Tool was designed and used in unix environment
 - Tool has been shown to run on Windows if the file parsing code is changed to use windows line endings, but we cannot guarantee that that is the only issue.
- Node.JS + Node Package Manager
- (Optional) A multiscreen setup or large display is recommended for optimal performance

Steps

1. Clone the tool from <https://github.com/cognitiveailab/Synchronicity>.
`git clone https://github.com/cognitiveailab/Synchronicity.git`
2. Move to the tool/ directory.
`cd synchronicity/tool/`
3. Install Node dependancies
`npm install`
4. Start the local server that hosts the tool
`node server.js`
5. Go to the address <http://localhost:8080/patternGen.html> in your web browser.

Overview

Full Tool

Synchronicity: Pattern Authoring Tool

66 9219 Q 2439 38 38 344 0 60 31 0 409 Refresh Server Status

[MAT COS] Change of State (Generic)

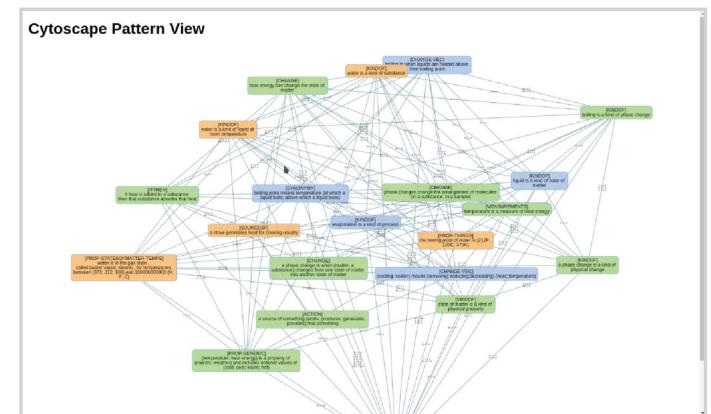
Dataset 0 Pattern (d) [MAT COS] Change of State (Generic)

Mark Pattern (C) (C+G) (F) Sort by: TermFreq Include Hints Add Row Rename Pattern Copy Pattern Publish Changes

Role	Count	Row Text
CENTRAL	5	boiling is a kind of phase change [KINDOF]
CENTRAL	5	state of matter is a kind of physical property [KINDOF]
CENTRAL	5	a phase change is a kind of physical change [KINDOF]
CENTRAL	42	temperature is a measure of heat energy [MEASUREMENTS]
CENTRAL	4	if heat is added to a substance then that substance absorbs that heat [IFTHEN]
CENTRAL	4	phase changes change the arrangement of molecules (in a substance; in a sample) [CHANGE]

#	Buttons	Count	Ratio Central	Row Text
1		40	● 1.0	(boiling; evaporation) means (matter; a substance) changes from a liquid into a gas by increasing heat energy [CHANGE] melting means (matter; a substance) changes from a solid into a liquid by increasing heat energy condensing means (matter; a substance) changes from a gas into a liquid by decreasing heat energy freezing means (matter; a substance) changes from a liquid into a solid by decreasing heat energy (desublimation; deposition) means (matter; a substance) changes from a gas into a solid by decreasing heat energy ... Notes: Core change of state
2		10	● 0.4	a phase change is when (matter; a substance) changes from one state of matter into another state of matter [CHANGE] Notes: core
3		16	● 0.6	(temperature; heat energy) is a property of (objects; weather) and includes ordered values of (cold; cool; warm; hot) [PROP-GENERIC] Notes: Core (SOM depends on temperature)
4		2	● 1.0	boiling point means temperature (at which a liquid boils; above which a liquid boils) [SYNONYMY] freezing point means temperature (at which a liquid freezes; below which a liquid freezes) melting point means temperature (at which a solid melts; above which a solid melts) Notes: Core
5		4	● 1.0	phase changes change the arrangement of molecules (in a substance; in a sample) [CHANGE] Notes: Core
6		16	● 0.7	water is in the gas state , called (water vapor; steam) , for temperatures between (373; 212; 100) and 1000000000000 (K; F; C) [PROP-STATESOFMATTER-TEMPS] water is in the liquid state , called liquid water , for temperatures between (273; 32; 0) and (373; 212; 100) (K; F; C) water is in the solid state , called ice , for temperatures between (0; -459; -273) and (273; 32; 0) (K; F; C) No Q: Grounding -- this is the ideal "Substance X is in SOM Y" table, rather than the kindof (e.g. "X is kind of SOM")
7		10	● 0.6	a stove generates heat for cooking usually [SOURCEOF] a hot plate is a source of heat a hand dryer produces heat

Notes Generic change of state



Questions Related to Central and Grounding seed rows of pattern "[MAT COS] Change of State (Generic)"

#	Topic	QID	Row Overlap	Question	Answer
0	MAT COS BOILING	Mercury SC 401227	6	The boiling of water results in a physical change in matter from (A) solid to liquid. (B) gas to liquid. (C) solid to gas. (D) liquid to gas.	(D) A log goes off heat and light as it burns. (B) A tree grows from a seed. (C) water changes from liquid to gas. (A) Bees and cracks on a cold night.
1	MAT CHANGES PHYSICAL	MCAS 2007 8 5167	5	Which of the following is an example of a physical change but not a chemical change?	(A) The heat of the sun warms the earth. (B) The cold water absorbed heat from the pot. (C) The cold water caused the cold to the surrounding air.
2	MAT COS BOILING	MCAS 2008 8 5717	5	A pot of cold water was heated on a stove until the water boiled. Which of the following best explains why the water was able to boil?	(A) The water absorbed heat from the ground. (B) The water changes from one form to another. (C) The water becomes more dense. (D) Both are caused by changes in heat energy.
3	MAT COS EVAP	Mercury 185430	5	Which of the following sentences best explains what happens when puddles evaporate?	(A) Both cause decreases in air temperature. (B) Both are caused by the warming of the air. (C) Both are caused by changes in heat energy. (D) Both are caused by changes in heat energy.
4	MAT COS EVAP-MAT CONDENSING	NCEOGA 2013 5 4	5	In which way are evaporation and condensation similar?	(A) ice melting (B) rain moving (C) clouds moving (D) evaporation
5	MAT COS MELTING, MAT CHANGES PHYSICAL	Mercury 402613	5	Which is an example of a physical change?	(A) water (B) ice (C) steam (D) water vapor
6	MAT CHANGES PHYSICAL	Mercury 401376	4	Which of these is not an example of a physical change of state?	(A) water (B) ice (C) steam (D) water vapor
7	MAT COS BOILING	NCEOGA 2013 8 21	4	What happens to water molecules during the boiling process?	(A) They move faster and move farther apart as they absorb heat. (B) They never move and remain static. (C) They move slowly and move closer together as they absorb heat. (D) They move farther and move closer as they lose heat.

Pattern Overlap View ([MAT COS] Change of State (Generic))

Rank	Jump	Dif1	Dif2	Pattern Rows
0	→	0.71	0.05	[MAT COS] Phase Changes - Physical Changes 0: melting means (matter; a substance) changes from a solid into a liquid by increasing heat energy 1: water is in the solid state , called ice , for temperatures between (0; -459; -273) and (273; 32; 0) (K; F; C) 2: water is in the liquid state , called (water vapor; steam) , for temperatures between (273; 32; 0) and 10000000000 (K; F; C) 3: water is in the gas state , called liquid water , for temperatures between (273; 32; 0) and (373; 212; 100) and 10000000000 (K; F; C) 4: a phase change is a kind of physical change 5: heat energy can change the state of matter 6: liquid is a kind of state of matter 7: melting can cause phase changes 8: solid is a kind of state of matter 9: substances are made of matter 10: water is in the liquid state
1	→	0.71	0.15	[MAT COS] Sublimation 0: sublimation means (matter; a substance) changes from a solid into a gas by increasing heat energy 1: a phase change is when (matter; a substance) changes from one state of matter into another state of matter 2: water is in the solid state , called ice , for temperatures between (0; -459; -273) and (273; 32; 0) (K; F; C) 3: water is in the liquid state , called (water vapor; steam) , for temperatures between (273; 32; 0) and 10000000000 (K; F; C) 4: water is in the gas state , called liquid water , for temperatures between (273; 32; 0) and (373; 212; 100) and 10000000000 (K; F; C) 5: a phase change is when (matter; a substance) changes from one state of matter into another state of matter 6: heat energy can change the state of matter 7: solid is a kind of state of matter 8: sublimation can cause phase changes 9: temperature changing can cause phase changes 10: water is a kind of substance 11: substances are made of matter
				[MAT COS] Freezing 0: freezing means (matter; a substance) changes from a liquid into a solid by decreasing heat energy 1: a phase change is when (matter; a substance) changes from one state of matter into another state of matter 2: (temperature; heat energy) is a property of (objects; weather) and includes ordered values of (cold; cool; warm; hot)

Dashboard

Graph View of Inference Pattern

Question View Displays questions that use current Inference Pattern

Overlap View Shows related Inference Patterns and their overlap

Filter Patterns by Keyword Filter Patterns By Marking

The screenshot shows the top navigation bar with 'Dataset' set to '0 - Sample Dataset' and 'Pattern' set to '(d) [MAT COS] Change of State (Generic)'. Below the navigation are several buttons for marking patterns: 'Done' (checkmark), 'Good' (like), 'Unsure' (question mark), 'Bad' (sad face), and 'Redundant' (square). There are also refresh buttons: '(C)' for central rows, '(C+G)' for central and grounding rows, and '(F)' for all rows. A 'Sort by' dropdown is set to 'TermFreq'. Other buttons include 'Include Hints', 'Add Row', 'Rename Pattern', 'Copy Pattern', 'Publish Changes', and navigation arrows. Two arrows point down from the top right towards the 'Filter Patterns by Keyword' and 'Filter Patterns By Marking' sections.

<u>Pattern Marking</u>	<u>Refreshing</u>	<u>Change how rows are sorted</u>	<u>Toggle usage of hint rows when refreshing</u>	<u>Misc Authoring Buttons</u>	<u>Navigation Buttons</u>
<input checked="" type="checkbox"/> Done <input checked="" type="checkbox"/> Good <input type="checkbox"/> Unsure <input type="checkbox"/> Bad <input type="checkbox"/> Redundant	<input type="button" value="↻ (C)"/> <input type="button" value="↻ (C+G)"/> <input type="button" value="↻ (F)"/>	Query the explanation corpus using only the central rows Query the explanation corpus using central and grounding rows Remove all unmarked rows from viewer	<input type="checkbox"/> Add Row <input checked="" type="checkbox"/> Rename Pattern <input type="button" value="Copy Pattern"/> <input type="button" value="Publish Changes"/>	Manual add a row from the tablestore Give the pattern a name Create a new pattern that is a duplicate of this one Publish current changes to GitHub	<input checked="" type="checkbox"/> Add Row <input checked="" type="checkbox"/> Rename Pattern <input type="button" value="Copy Pattern"/> <input type="button" value="Publish Changes"/>

Usage

Main View

- Annotate the pattern
- Pattern begins with initial seed rows
- Query the explanations to discover more potential rows for this pattern, by refreshing with the refresh options
 - Key based voting follows the order of the buttons + an 8th option to clear the role for that row.
- Step through each row and vote by annotating a [role](#) for that row in the patterns
- Double-click on a row to add hint rows
- Macros are present for the following operations

<u>Operation</u>	<u>Keybinding</u>
Voting by key	Key based voting follows the order of the buttons + an 8th option to clear the role for that row
Table Navigation	Up and Down arrow keys will step through the rows of the table
Refresh (Central)	ctrl-r
Refresh (Central+Grounding)	ctrl-shift-r
Marking Pattern	f1-f5 will mark the pattern in the order of the buttons
Pattern Navigation	Left and Right arrow keys will progress forward and backwards through the patterns
Rename	ctrl-x
Save	ctrl-s
Copy Pattern	ctrl-c
Add Row To Pattern	ctrl-a
Close Hint-Row Interface	esc

- Visualize the graph being formed by this pattern
- Check to see if any facts are disconnected from the graph
- NOTE: In practice, automatic graph population is not perfected so the graph seen is an approximation

Questions View

- See what questions this pattern is overlapping with
- Provides contexts to the annotator so that they can generalize the pattern

Overlap View

- View other patterns that overlap with the current one
- Verify that the pattern is not redundant

Role Breakdown

Central

Facts that are central to the inference pattern, and also unlikely to change across different instantiations of the pattern. For example, in the *Changes in State of Matter* pattern, the fact “*a phase change is when matter changes from one state to another state*” is unlikely to change whether a particular instantiation of the pattern is about *melting, boiling, freezing, or condensing*.

Central Switchable

Facts that are central to the inference pattern, but are likely to be swapped between a small set of related facts depending on the needs of an inference. For example, a given inference involving *Changes in State of Matter* may require knowing about the specific phase change happening (e.g. *melting, boiling, freezing, or condensing*). The node representing this knowledge would be rated as *central (switchable)*, and given the value of a particular fact (e.g. “*melting means changing from a solid to a liquid by adding heat energy*”).

Grounding

Facts that relate the central concepts of the inference pattern with specific examples that may be involved in a particular question, such as “*water in the solid state is called ice*”.

Lexical Glue

Facts used to express synonymy relations that bridge the gap between two related facts that don't strictly share any words (e.g. “*fall means autumn*”).

Peripheral

Facts that may infrequently be relevant to a given inference, but were marked as potentially being relevant in some cases by the annotator.

Optional

The optional flag allows specifying that a given node is not necessarily required for all inferences, but may add extra information to an inference pattern when available. The optional flag is in addition to the explanatory role that a given node takes.

Bad

Row should not be included in this pattern.

Edge Cleaner

- Since the edge populating algorithm is not perfected, a smaller tool was created to go through the edges manually.
- Generally the edges to look out for are the ones that connect facts on words that are part of compound phrases (e.g. Kinetic Energy is not the same as Potential Energy).
- **Before running the cleaning process the edges have to be generated and stored locally using a script in the /patterns/<data_set>/edge_tables/ folder "populateEdgeTables.py"**
 - run: python populateEdgeTables.py
 - requires 'pandas' library
- Found here: [edgeCleaner.html](#)

[LIFE REPROD] Characteristic X is a result of Y

344 seen 0 unseen

```

graph TD
    ACTION["ACTION  
an organism's environment affects that organism's acquired characteristics"] --- PROP_INHERITEDLEARNED["PROP-INHERITEDLEARNED  
the condition of parts of an organism are acquired  
preferences are generally learned  
the length of the hair of an animal is an acquired"]
    PROP_INHERITEDLEARNED --- PROPIH_LEARNED["PROPIH-LEARNED  
the length of the hair of an animal is an acquired"]
    PROPIH_LEARNED --- KINDOF["KINDOF  
a food preference is a kind of preference"]
    PROPIH_LEARNED --- PROP_INHERITEDLEARNED["PROP-INHERITEDLEARNED  
preferences are generally learned"]
    KINDOF --- PROP_INHERITEDLEARNED
    ACTION --- OBJECT_PROPERTY["OBJECT/PROPERTY [10] <-> INHERITED/LEARNED [8]"]
    ACTION --- INHERITED_LEARNED["INHERITED/LEARNED [8] <-> INHERITED/LEARNED [8]"]
    ACTION --- HYPONYM["OBJECT/PROPERTY [10] <-> HYPONYM [1]"]
    ACTION --- HYPERNYM["OBJECT/PROPERTY [10] <-> HYPERNYM [4]"]
    PROPIH_LEARNED --- INHERITED_LEARNED
    PROPIH_LEARNED --- HYPONYM
    PROPIH_LEARNED --- HYPERNYM
    PROPIH_LEARNED --- AGENT["AGENT [3] <-> HYPONYM [1]"]
    PROPIH_LEARNED --- AGENT["AGENT [3] <-> HYPERNYM [4]"]
    PROP_INHERITEDLEARNED --- HYPONYM
    PROP_INHERITEDLEARNED --- HYPERNYM
    PROP_INHERITEDLEARNED --- AGENT
    PROP_INHERITEDLEARNED --- AGENT
  
```

Role	Count	Row Text
CENTRAL	5	preferences are generally learned characteristics [PROP-INHERITEDLEARNED]
CENTRAL	3	an organism's environment affects that organism's acquired characteristics [ACTION]
CENTRAL	1	the length of the hair of an animal is an acquired characteristic [PROP-INHERITEDLEARNED]
CENTRAL	1	a learned characteristic is a kind of acquired characteristic [KINDOF]
CENTRALSW	1	the condition of parts of an organism are acquired characteristics [PROP-INHERITEDLEARNED]
GROUNDING	5	a food preference is a kind of preference [KINDOF]

+/-	#	Edge
[+]	2	[ACTION] an organism's environment affects [that organism's acquired characteristics]
[+]	2	[PROP-INHERITEDLEARNED] the condition of parts of an organism are [acquired] preferences are generally [learned] the length of the hair of an animal is an [acquired]
[+]	2	[PROP-INHERITEDLEARNED] the condition of parts of an organism are [acquired] preferences are generally [learned] the length of the hair of an animal is an [acquired]
[+]	2	[KINDOF] a learned characteristic is a kind of [acquired characteristic]
[+]	2	[PROP-INHERITEDLEARNED] the condition of parts of an organism are [acquired] preferences are generally [learned] the length of the hair of an animal is an [acquired]
[+]	2	[PROP-INHERITEDLEARNED] the length of the hair of an animal is an [acquired]
[+]	0	[ACTION] an organism's environment affects [that organism's acquired characteristics]
[+]	0	[KINDOF] a [learned characteristic] is a kind of acquired characteristic
[+]	0	[ACTION] an organism's environment affects [that organism's acquired characteristics]
[+]	0	[KINDOF] a learned characteristic is a kind of [acquired characteristic]
[+]	0	[ACTION] an organism's environment affects [that organism's acquired characteristics]
[+]	0	[PROP-INHERITEDLEARNED] the length of the hair of an animal is an [acquired]
[+]	0	[KINDOF] a [learned characteristic] is a kind of acquired characteristic
[+]	0	[PROP-INHERITEDLEARNED] preferences are generally [learned]
[+]	0	[KINDOF] a learned characteristic is a kind of [acquired characteristic]
[+]	0	[PROP-INHERITEDLEARNED] the length of the hair of an animal is an [acquired]
[+]	0	[PROP-INHERITEDLEARNED] [preferences] are generally learned

Pattern File Format

The tool requires initial pattern seeds to begin use.

To seed the tool; patterns must be initialized in the following tab-delimited format:
 (Note that all columns after ROLE_count are managed by the tool, so they will be blank at the start)

Notes													
isDone	isGood	isUncertain	isBad	isRedundant									
RATING	TABLE	ROW	UID	BACKGROUND_count	CENTRAL_count	GROUNDING_count	LEXGLUE_count	ROLE_count	lastCount	hintRowUUIDs	hintWords	rowNotes	OPTIONAL
...
...

- Notes Row
 - **Notes:** Space reserved for annotator notes
- Flag Row
 - **isDone:** Pattern is complete
 - **isGood:** Pattern is good, but not verified
 - **isUncertain:** Annotator is unsure of the pattern quality
 - **isBad:** Pattern is bad
 - **isRedundant:** Pattern already exists in dataset
- Header row
 - **RATING:** Row ratings
 - **TABLE:** Table each row is from
 - **ROW:** Row text
 - **UID:** Row UIDs
 - **BACKGROUND_count:** Number of times each row was used in BACKGROUND role
 - **CENTRAL_count:** Number of times each row was used in BACKGROUND role
 - **GROUNDING_count:** Number of times each row was used in GROUNDING role
 - **LEXGLUE_count:** Number of times each row was used in LEXGLUE role
 - **ROLE_count:** Number of times each row was used in ROLE role
 - **lastCount:** Number of times each row was used in other patterns
 - **hintRowUUIDs:** Comma seperated list of uids that could replace each row
 - **hintWords:** Comma seperated list of words that relate to each row
 - **rowNotes:** Annotator notes for each row
 - **OPTIONAL:** Flag to mark each row as optional

Example Seed Pattern:

	false	false	false	false	false									
RATING	TABLE	ROW	UID	BACKGROUND_count	CENTRAL_count	GROUNDING_count	LEXGLUE_count	ROLE_count	lastCount	hintRowUUIDs	hintWords	rowNotes	OPTIONAL	
UNRATED	MADEOF	blood is a vehicle for carrying oxygen from the lungs to the cells; rest of the body	419c-cd03-a464-39af	0	0	2	0	0						
UNRATED	KINDOF	oxygen is a kind of element	936b-92a1-0e96-0846	1	0	3	0	0						
UNRATED	PROCESSROLES	In the (cellular respiration; animal respiration) process carbon dioxide is a waste product	3f31-824e-6866-4db7	0	0	1	0	0						

Edge Table File Format

The edges for each pattern are generated semi-automatically, and stored in the edge_tables/ folder of the dataset. Generation is performed in two steps:

1. Automatically generating edges by running populateEdgeTables.py inside patterns/<data_set>/edge_tables/
2. Cleaning up the edges with the [edgeCleaner](#)

The edges tables are stored in patterns/<data_set>/edge_tables/*.tsv

- The table files are grids that show connections from each node to each other node
- Nodes are represented with the 16 character UID of their table row
- Each element of the table lists the constraints from one node to another in comma delimited format
 - Constraints are read from left to right, denoting where lexical overlap is required from one node to another; along with a flag for turning off/on the constraints
 - (e.g. 2:3:Y defines lexical overlap from column 2 of node_0 to column 3 of node_1; and has been marked as a good connection)
 - Elements of the table are read as FROM grid col -> TO grid row | node_0 -> node_1
 - (Note: Edges are bidirectional, so they are only stored and read in one direction for simplicity)
- The first element of the grid (i.e. position 0,0) is a flag for marking the pattern as checked though the edge cleaner

true	31d9-98d7-6a10-9053	1cca-1ac1-5bea-5cf6	b356-ece6-5dc7-8973	27ac-0696-3449-6bd2	d1e5-99a8-b08b-6e3d	66df-2200-f730-17c3	0b7b-cf23-e64f-4200
31d9-98d7-6a10-9053							
1cca-1ac1-5bea-5cf6	2:2:Y,6:11:Y,9:2:Y,11:4:Y						
b356-ece6-5dc7-8973	3:6:Y,9:2:N,9:16:N,10:20:Y,11:6:Y,11:21:Y						
27ac-0696-3449-6bd2	11:10:Y	9:2:N,10:6:Y	6:10:Y				
d1e5-99a8-b08b-6e3d	3:2:Y		6:2:Y				
66df-2200-f730-17c3	3:2:Y,6:6:Y	9:9:N,10:10:Y,11:6:Y	6:2:Y	2:9:Y,6:10:Y	2:2:Y		