Redefine Success, Redefine Relevance.

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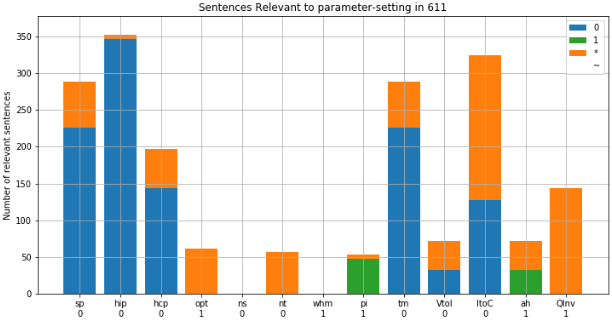
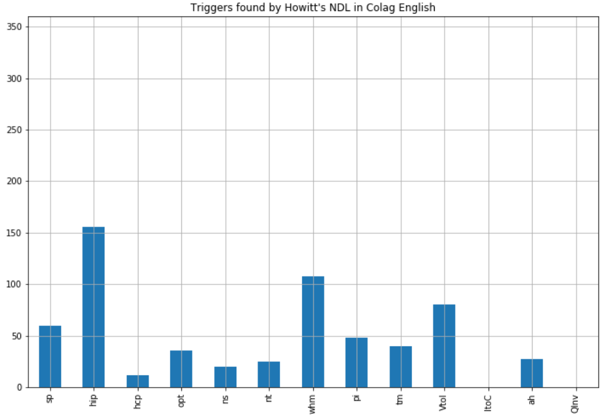
March 14, 2018

So much irrelevance



- Read the left-most bar of this graph like this: "Out of the 360 colag english sentences, there were 225 global triggers for SP=0, and 100ish sentences that were ambiguously relevant to its value-setting. The rest were irrelevant."
- Notably, "There are no languages in Colag English relevant to Null Subject or Wh-movement."

But look, the NDL can see NS and WHM!



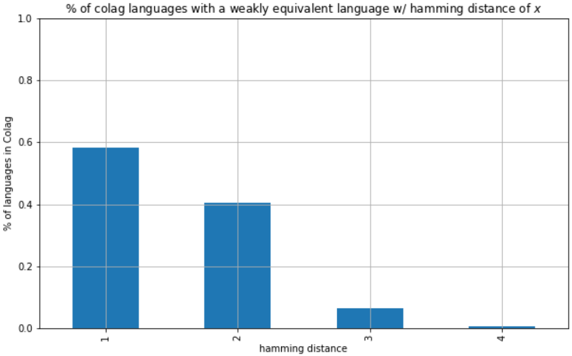
Our definition of irrelevant

- Our algorithm considers a sentence s irrelevant to a parameter p when it fails to find a single example of where toggling p in any of the grammars that license s, causes s to no longer be licensed.

$$
\begin{aligned}
G_{sent} &= \text{the set of grammars that license sentence } sent \\
g_p &= \text{The value of param } p \text{ in grammar } g \\
pair_p^g &= \text{The minimal pair of } g \text{ on param } p \text{ (aka } g \text{ with } p \text{ toggled)} \\
Trig(sent) &= \left[Trig(sent, p) : p \in 1..13 \right] \\
Trig(sent, p) &= \left\{ \begin{array}{lll} 0 & \iff & \{g_p : g \in G_{sent}\} = \{0\} \\ 1 & \iff & \{g_p : g \in G_{sent}\} = \{1\} \\ Irrel?(G_{sent}, p) & \iff & \{g_p : g \in G_{sent}\} = \{0, 1\} \end{array} \right\} \\
Irrel?(G_{sent}, p) &= \left\{ \begin{array}{lll} Ambig & \iff & \exists g \in G_{sent} : (pair_p^g \notin G_{sent}) \cap (pair_p^g \in G) \\ Irrel & & \iff otherwise \end{array} \right\}
\end{aligned}
$$

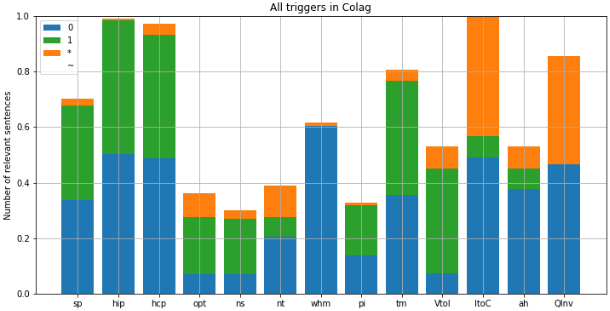
Weakly equivalent, hamming distance of 1

- But this means any language L with a weakly equivalent language L', where then hamming distance between L and L' $= 1$, will cause lots of irrelevance in sentences.



- which describes 60% of the languages in Colag.

Learning g exactly



- What we're really saying is, if we define successful learning to mean "seeing a sample of $L(g)$ and arriving at g exactly", then these are how many strong, ambiguous, and irrelevant triggers exist for arriving at that hypothesis.

Learning g exactly

- But that requires our learner to be able to differentiate between weakly equivalent languages [1]
- We don't claim our learners can actually do this (besides the TLA?), so perhaps we should relax our definition of successful learning when computing the per-parameter triggers.

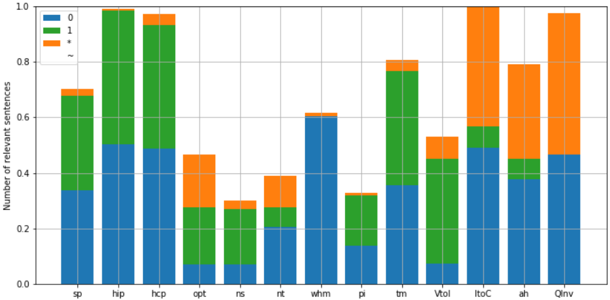
[1] languages where $L(g) = L(g')$ - the set of sentences generated by g and g' are exactly the same (though not necessarily the parses of those sentences).

Learning g or a Weak Equivalent

- This algorithm finds s irrelevant to p when it fails to find a single example of when toggling p in any of the *non-g-equivalent-grammars* that license s, causes s to no longer be licensed.

$$\begin{aligned}
G_{sent} &= \text{the set of grammars that license sentence } sent \\
W_g &= \text{the set of grammars weakly equivalent to } g \\
\bar{W}^g_{sent} &= \text{the grammars that license } sent\text{, excluding } W_g \\
g_p &= \text{The value of param } p \text{ in grammar } g \\
pair^g_p &= \text{The minimal pair of } g \text{ on param } p \text{ (aka } g \text{ with } p \text{ toggled)} \\
Trig(sent) &= \left[Trig(sent, p) : p \in 1..13\right] \\
Trig(sent, p) &= \left\{ \begin{array}{lcl} 0 & \iff & \{g_p : g \in G_{sent}\} = \{0\} \\ 1 & \iff & \{g_p : g \in G_{sent}\} = \{1\} \\ Irrel?(G_{sent}, p) & \iff & \{g_p : g \in G_{sent}\} = \{0, 1\} \end{array} \right\} \\
Irrel?(G_{sent}, p) &= \left\{ \begin{array}{lcl} Ambig & \iff & \exists g \in G_{sent} : (pair^g_p \notin \bar{W}^g_{sent}) \cap (pair^g_p \in G) \\ Irrel & \iff & otherwise \end{array} \right\}
\end{aligned}$$

Learning g or a Weak Equivalent

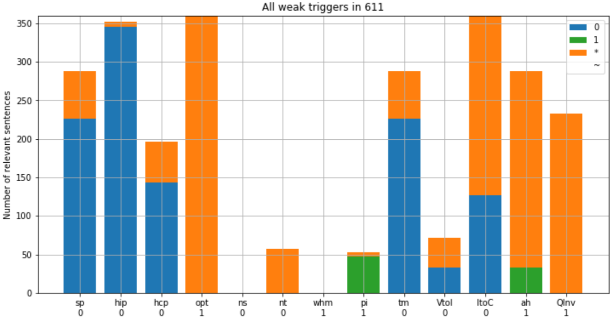


- If we settle for learning either G or a weakly equivalent language, then the following number of sentences go from irrelevant to ambiguously relevant.

opt	ItoC	ah	QInv
5047	71	12,591	5732

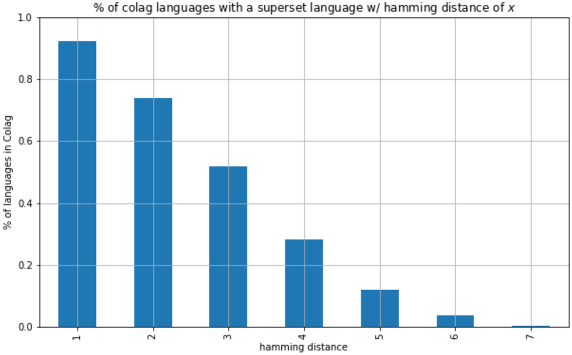
Learning g or a Weak Equivalent

- Here's how Colag English looks under that definition:



Superset relation, hamming distance of 1

- It's also the case that any g with a hamming-distance-1 superset language will cause irrelevance to be assigned to many sentences:

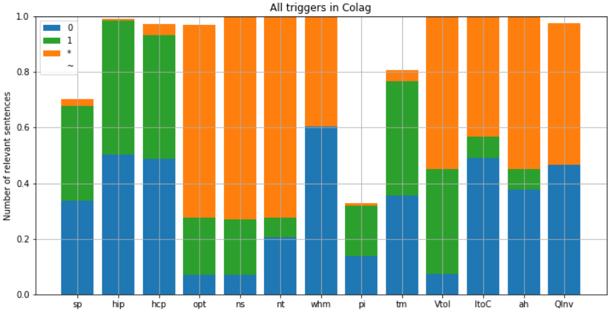


Learning g or any Superset

- We could lower the bar even further and say that we've succeeded if we learn g or any of its subset languages.
- This algorithm finds s irrelevant to p when it fails to find a single example of when toggling p in any of the *non-g-subset-grammars* that license s, causes s to no longer be licensed.

$$
\begin{aligned}
G_{sent} &= \text{the set of grammars that license sentence } sent \\
S_g &= \text{the set of grammars in superset relation to } g \\
\bar{S}^g_{sent} &= \text{the grammars that license } sent\text{, excluding } S_g \\
g_p &= \text{The value of param } p \text{ in grammar } g \\
pair^g_p &= \text{The minimal pair of } g \text{ on param } p \text{ (aka } g \text{ with } p \text{ toggled)} \\
Trig(sent) &= \left[Trig(sent, p) : p \in 1..13\right] \\
Trig(sent, p) &= \left\{ \begin{array}{lll} 0 & \iff & \{g_p : g \in G_{sent}\} = \{0\} \\ 1 & \iff & \{g_p : g \in G_{sent}\} = \{1\} \\ Irrel?(G_{sent}, p) & \iff & \{g_p : g \in G_{sent}\} = \{0, 1\} \end{array} \right\} \\
Irrel?(G_{sent}, p) &= \left\{ \begin{array}{lll} Ambig & \iff & \exists g \in G_{sent} : (pair^g_p \notin \bar{S}^g_{sent}) \cap (pair^g_p \in G) \\ Irrel & \iff & otherwise \end{array} \right\}
\end{aligned}
$$

Learning g or any Superset



- Here's how many relevant sentences we "gain" by doing that:

opt	ns	nt	whm	Vtol	ItoC	ah	QInv
29,195	33,629	29,429	18,421	22,647	71	22,647	5,732

Learning g or any Superset

- Here's how Colag English looks under that definition: