Functional Distributional Semantics

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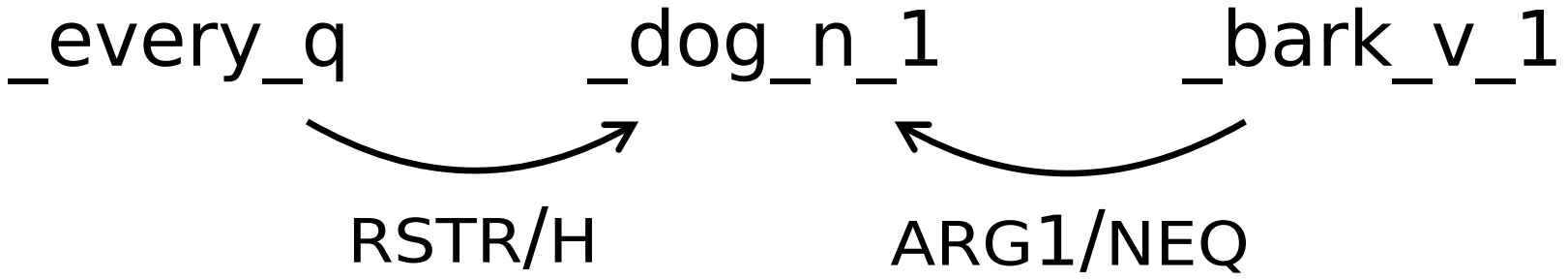
Delph-in 2016

What is Lexical Semantics?

“Every dog barks”



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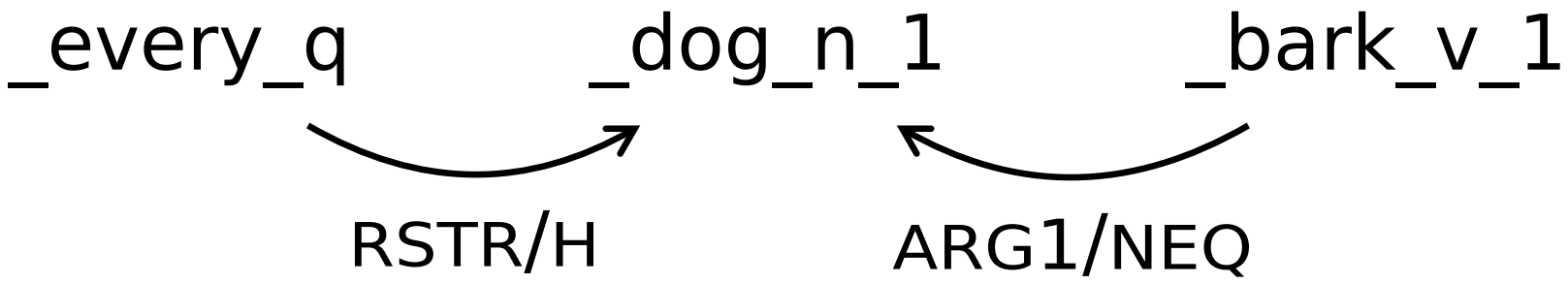


$$\forall x \exists e \; \_dog\_n\_1(x) \Rightarrow (\_bark\_v\_1(e) \wedge \text{ARG1}(e, x))$$

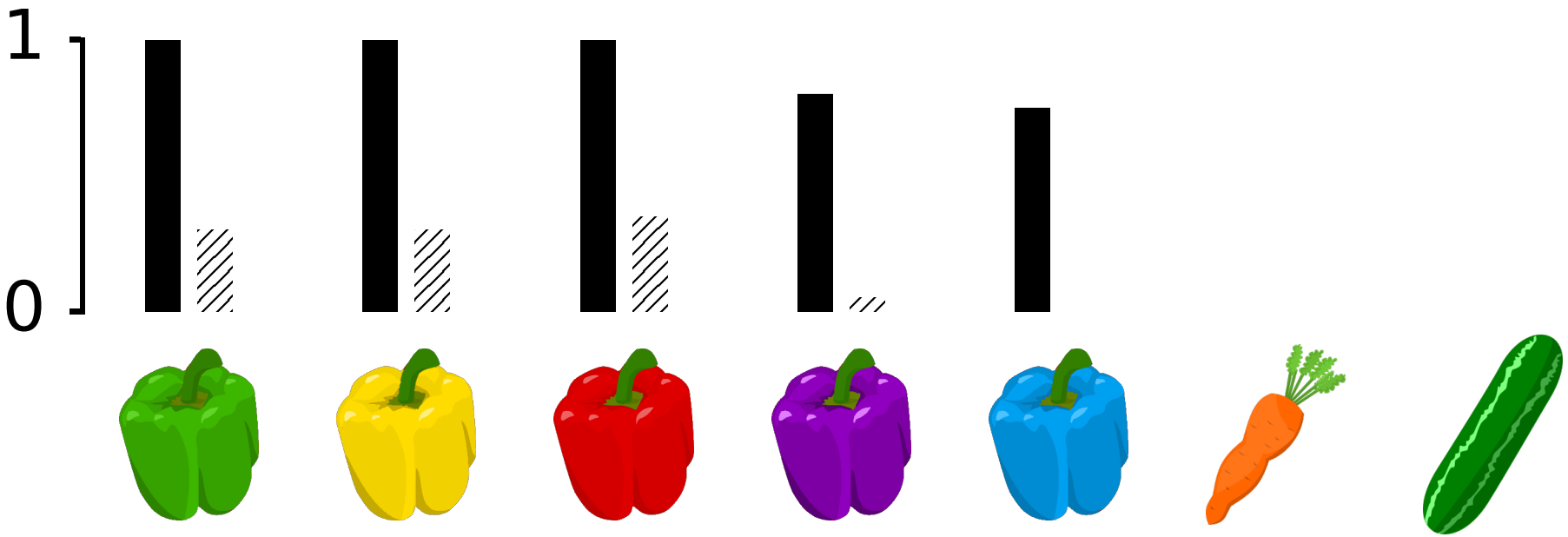
Definition of a Semantic Function

$$f : \mathcal{X} \rightarrow [0, 1]$$

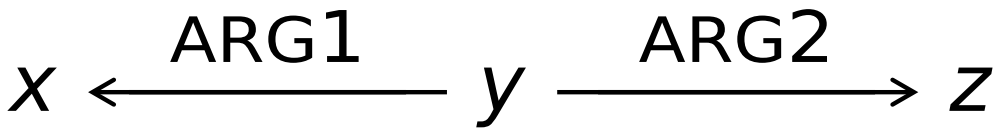
space of possible entities

values between 0 and 1

Example: simple discrete space

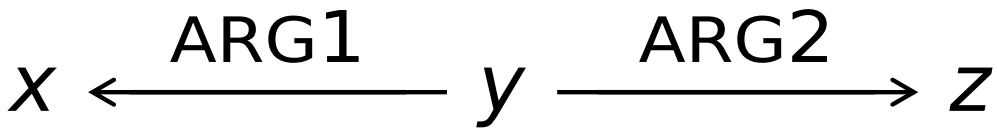


Integration with MRS



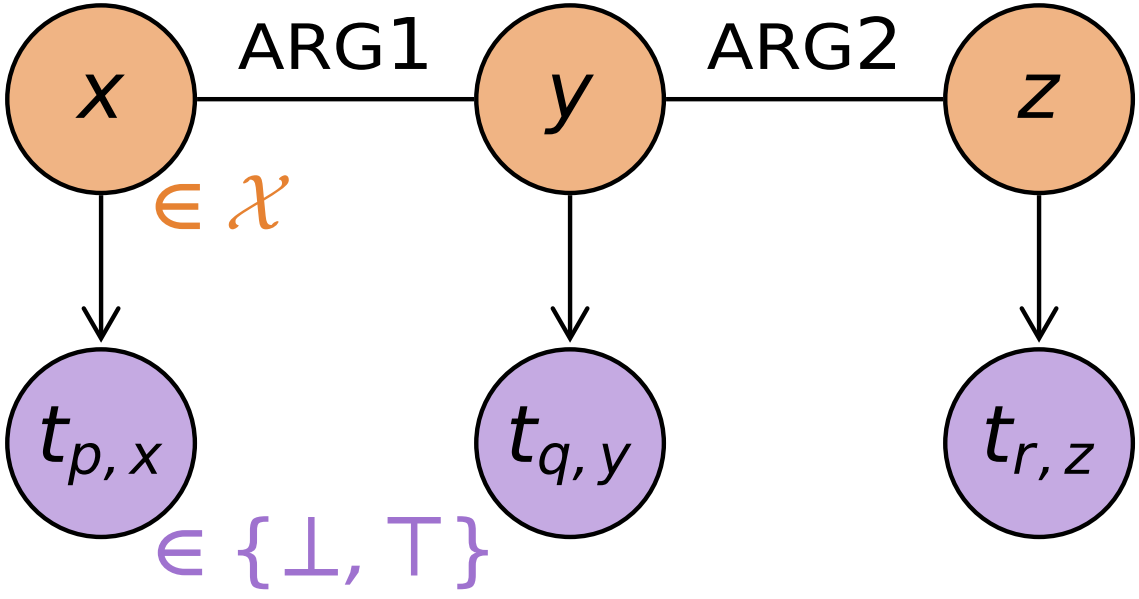
_dog_n_1(x) _chase_v_1(y) _cat_n_1(z)

Integration with MRS



p(x) q(y) r(z)

Integration with MRS



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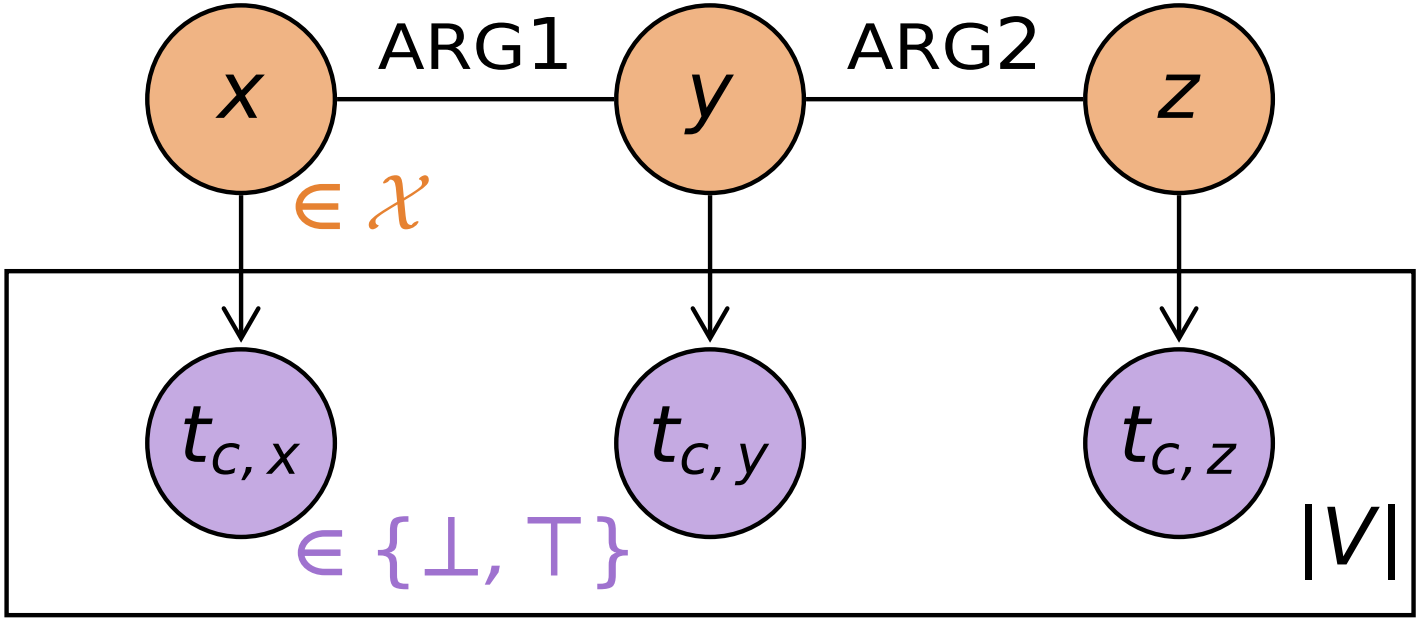

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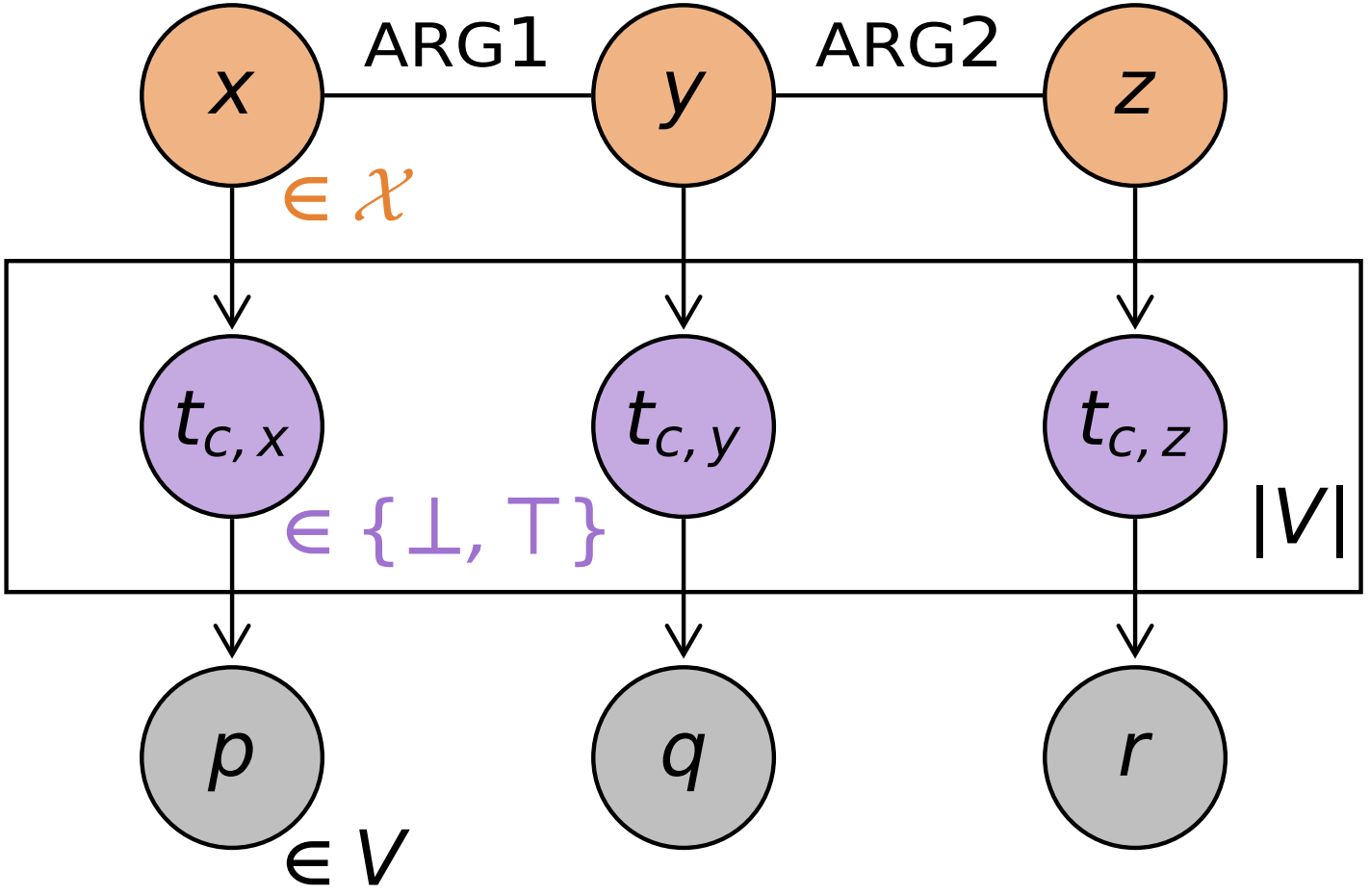


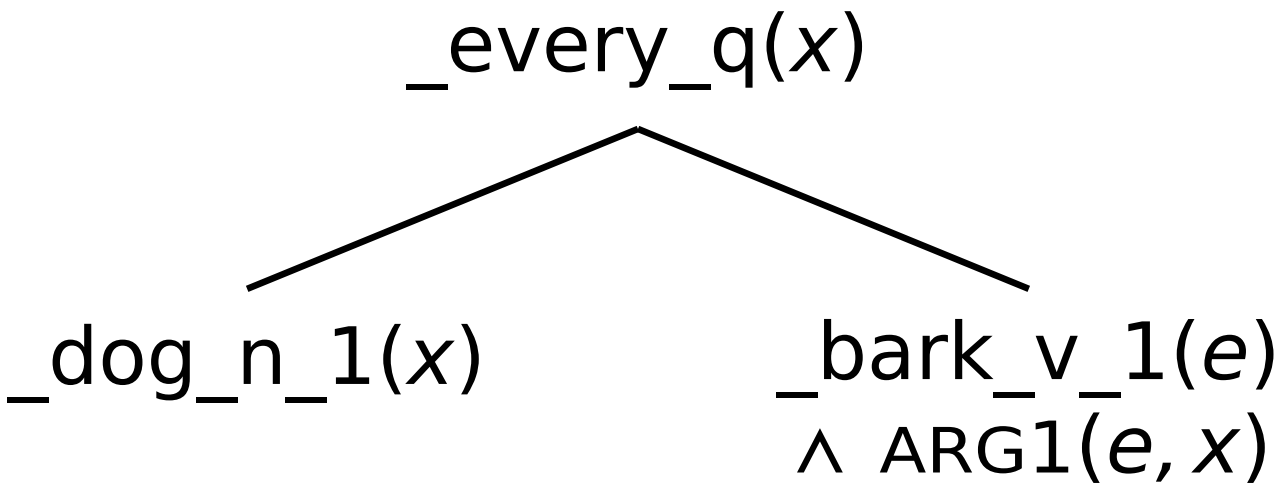
Results

Model	SL noun	SL verb	WS sim	WS rel
Word2Vec (10-word)	.28	.11	*.70?*	*.46?*
Word2Vec (2-word)	.30	.16	*.65?*	*.35?*
SVO Word2Vec	.44	.18	.61	.24
Sparse SVO W2Vec	**.45**	**.27**	**.63**	.30
Semantic Functions	.26	.14	.34	**.01**

Example Similarity Scores

flood / water	related verb and noun	.06
flood / water	related nouns	.43
law / lawyer	related nouns	.44
sadness / joy	near-antonyms	.77
happiness / joy	near-synonyms	.78
aunt / uncle	differ in a single feature	.90
cat / dog	differ in many features	.92

Composition



Generalised Quantifiers

$Q(x, R, B)$ depends on:

$|R|$, $|R \wedge B|$

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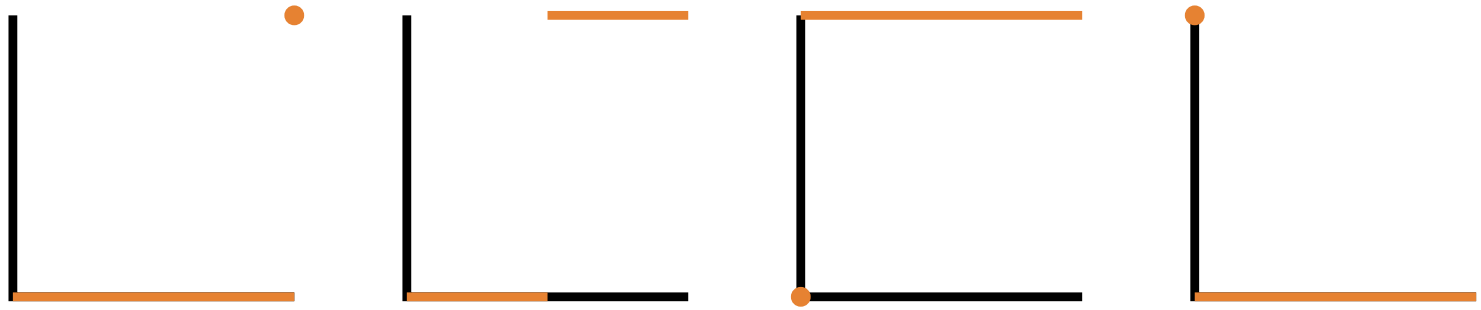
$$P(R),\ P(R \wedge B)$$

$$P(B|R) = \frac{P(R \wedge B)}{P(R)}$$

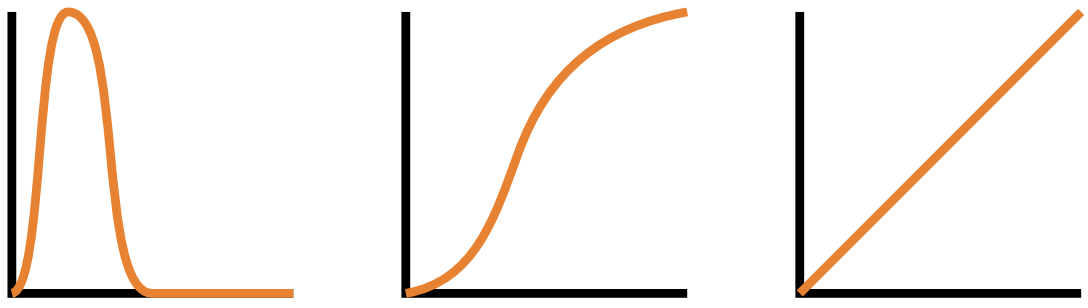
Generalised Quantifiers

every	$P(B\|R) = 1$
most	$P(B\|R) > \frac{1}{2}$
some	$P(B\|R) > 0$
no	$P(B\|R) = 0$

Generalised Quantifiers



every most some no



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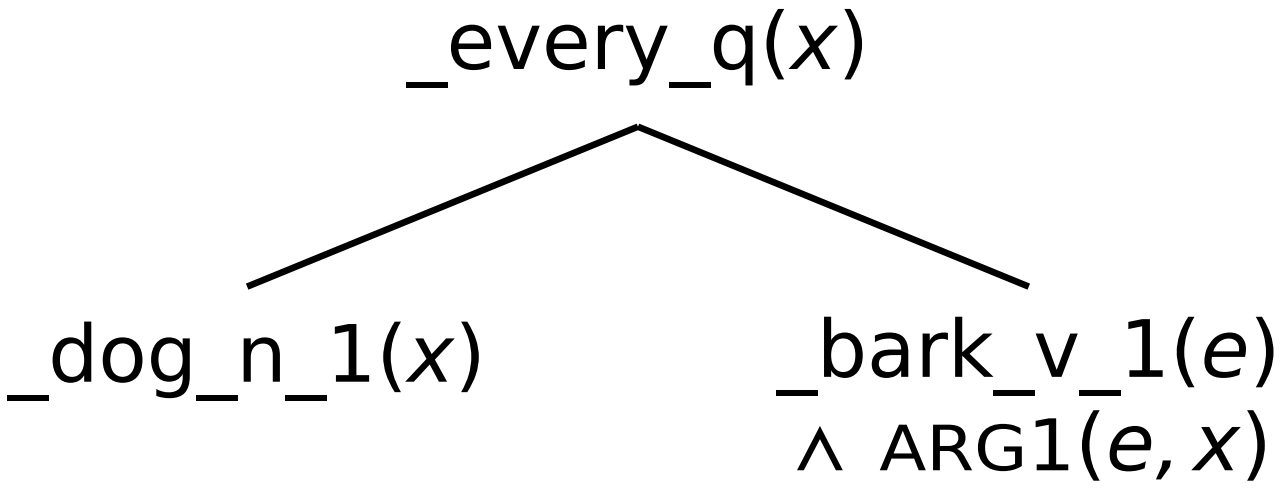
Composition



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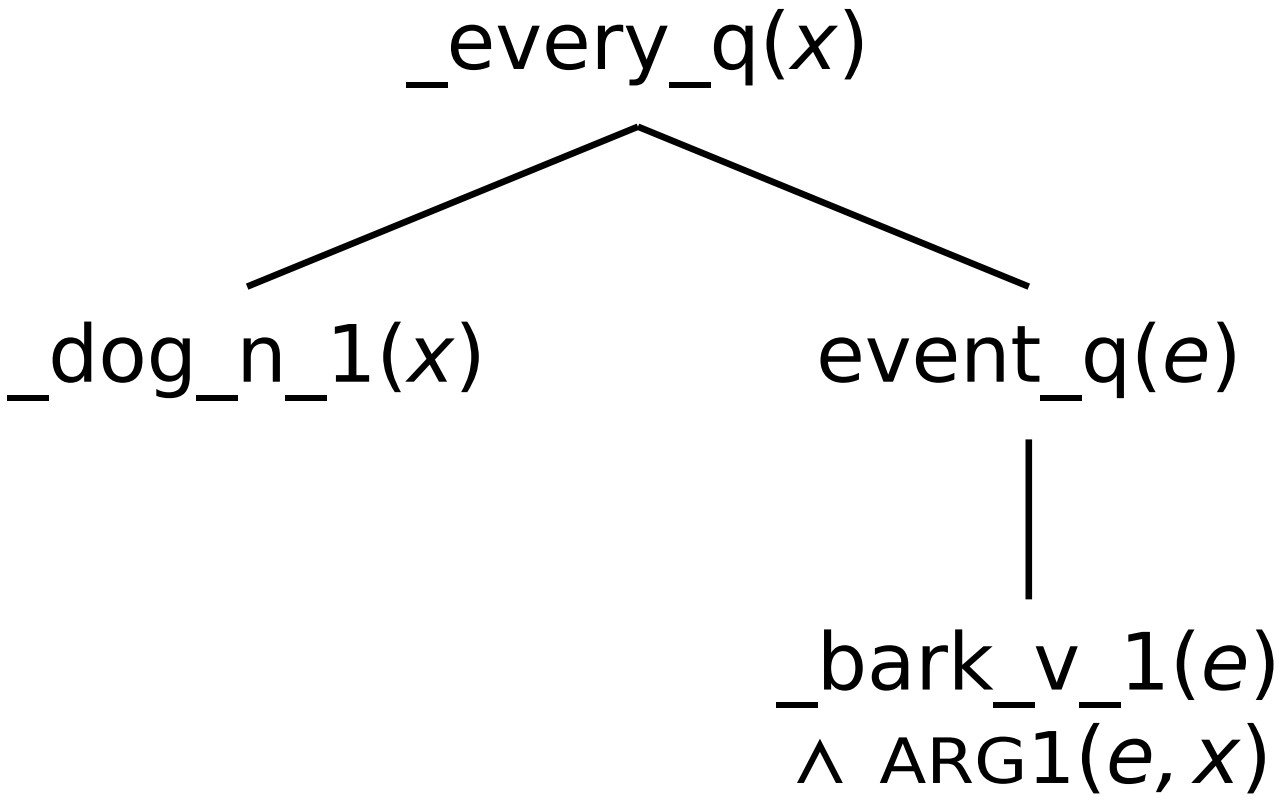

Composition