



MONASH University

The Context-dependent Additive Recurrent Neural Net

Quan Hung Tran ^{1,2}, Tuan Manh Lai ², Gholamreza Haffari ¹, Ingrid Zukerman ¹, Trung Bui ², Hung Bui ³

¹ Faculty of Information Technology, Monash University

² Adobe Research, San Jose, CA

³ Deep Mind, Mountain View, CA



CARNN: a novel computationally efficient RNN unit

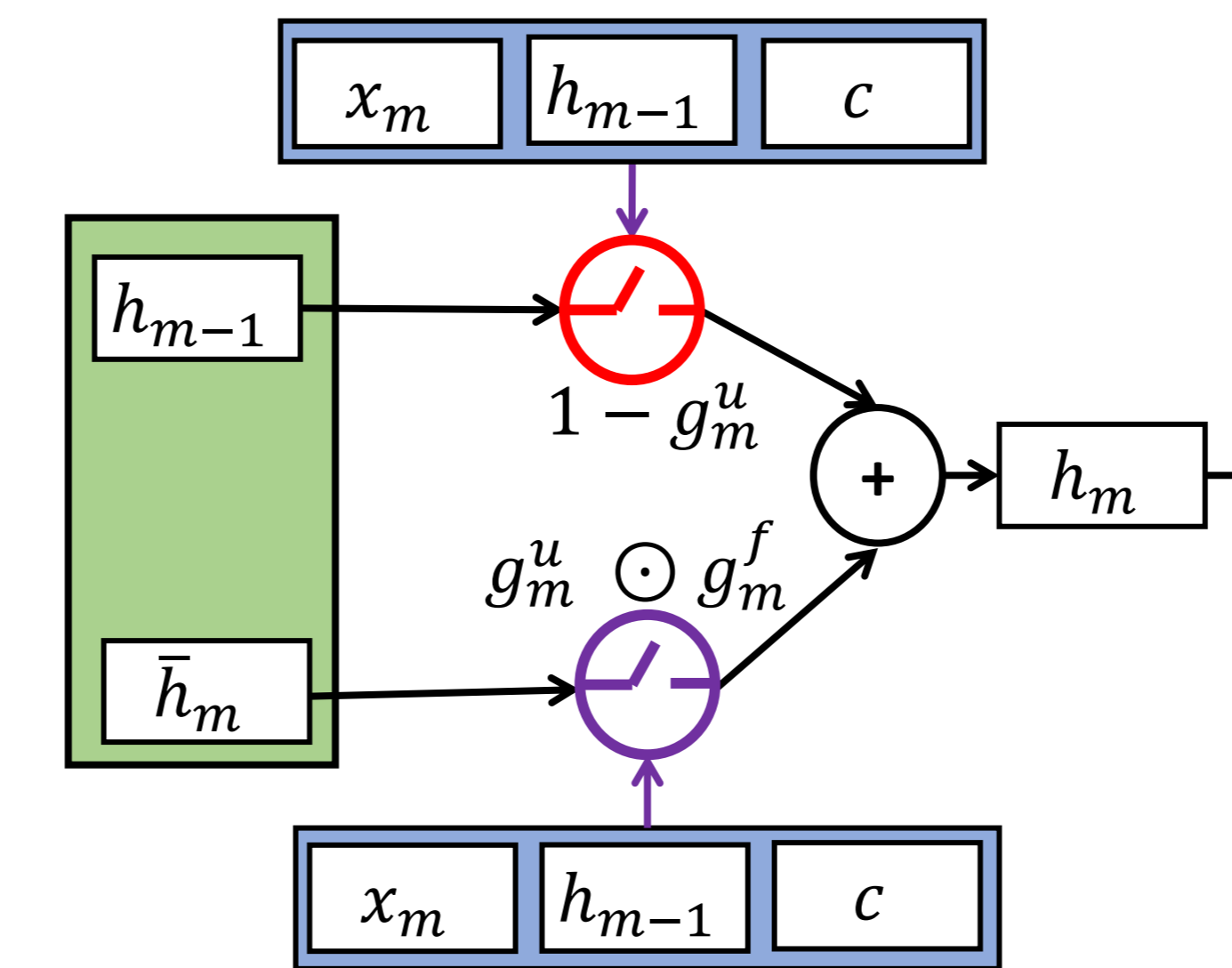
Computational efficiency

Identify/Retain only core computational units
Avoid excessive non-linearity (akin to RELU)

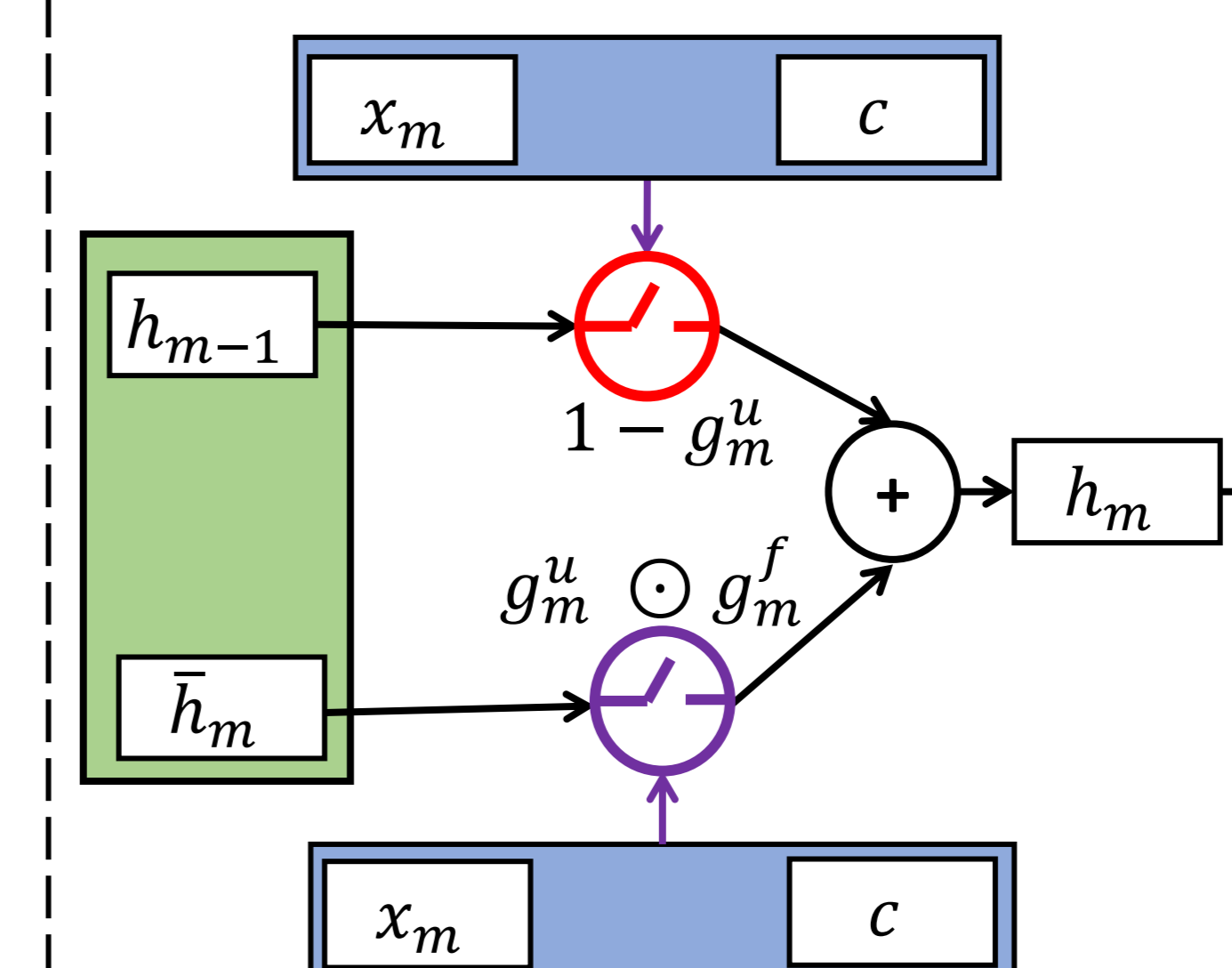
Contextual information

Embed context into gate computation => contextual representation at low level
Parallel gate computation => reduce training time (up to 40%)
Combining multiple sources of information

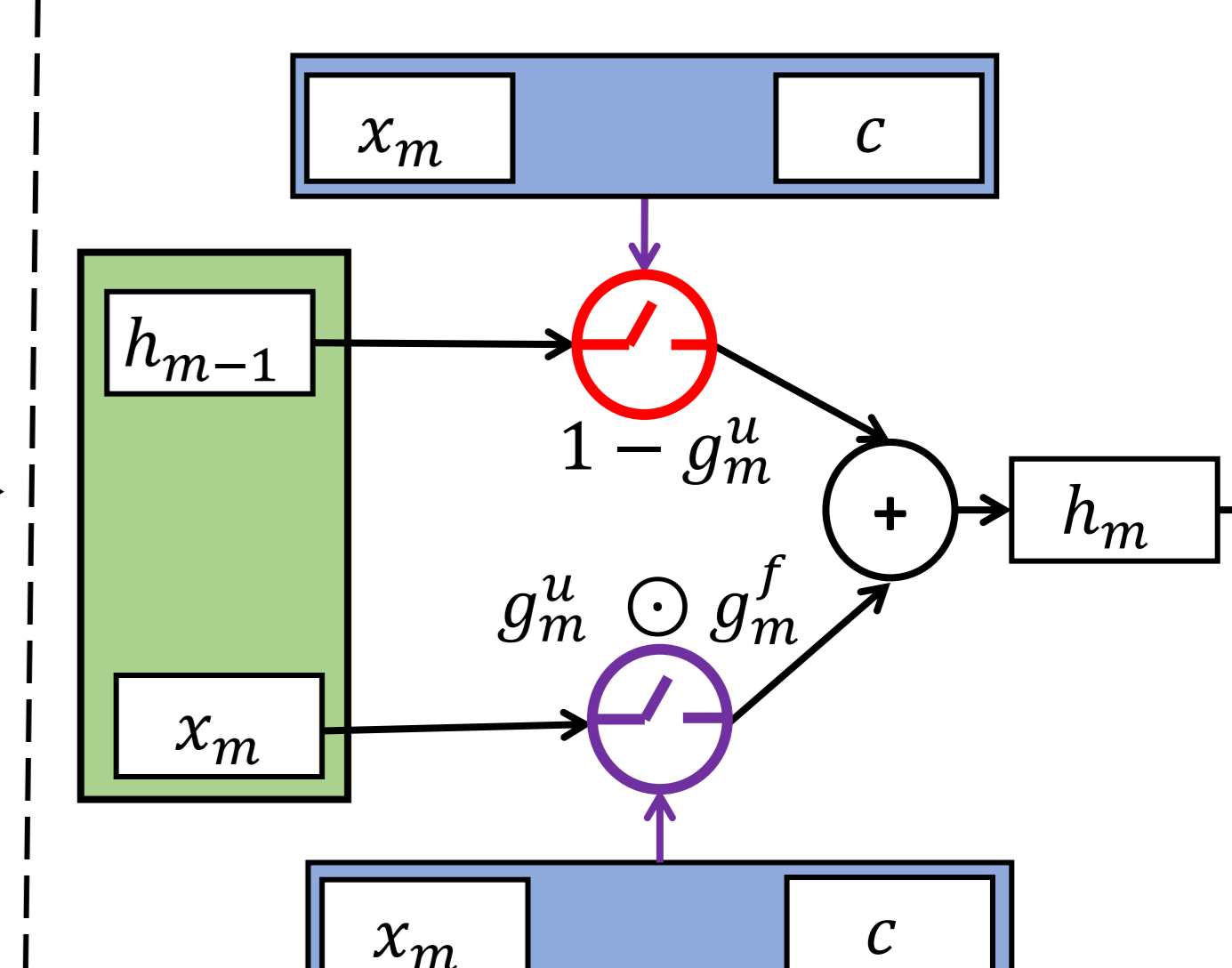
Variants of CARNNs



nCARNN – the original version of CARNN with two gates

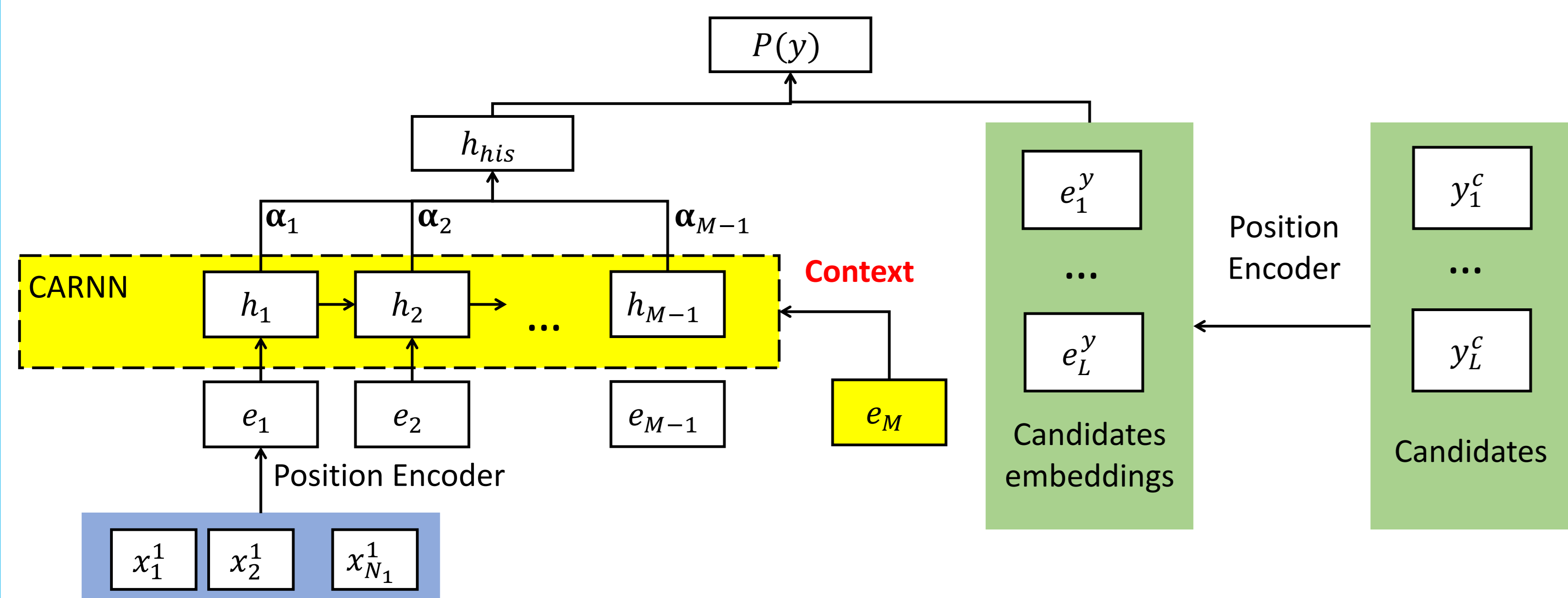


iCARNN – the 1st improvement with parallel gates (remove h_{m-1} from gate computations)



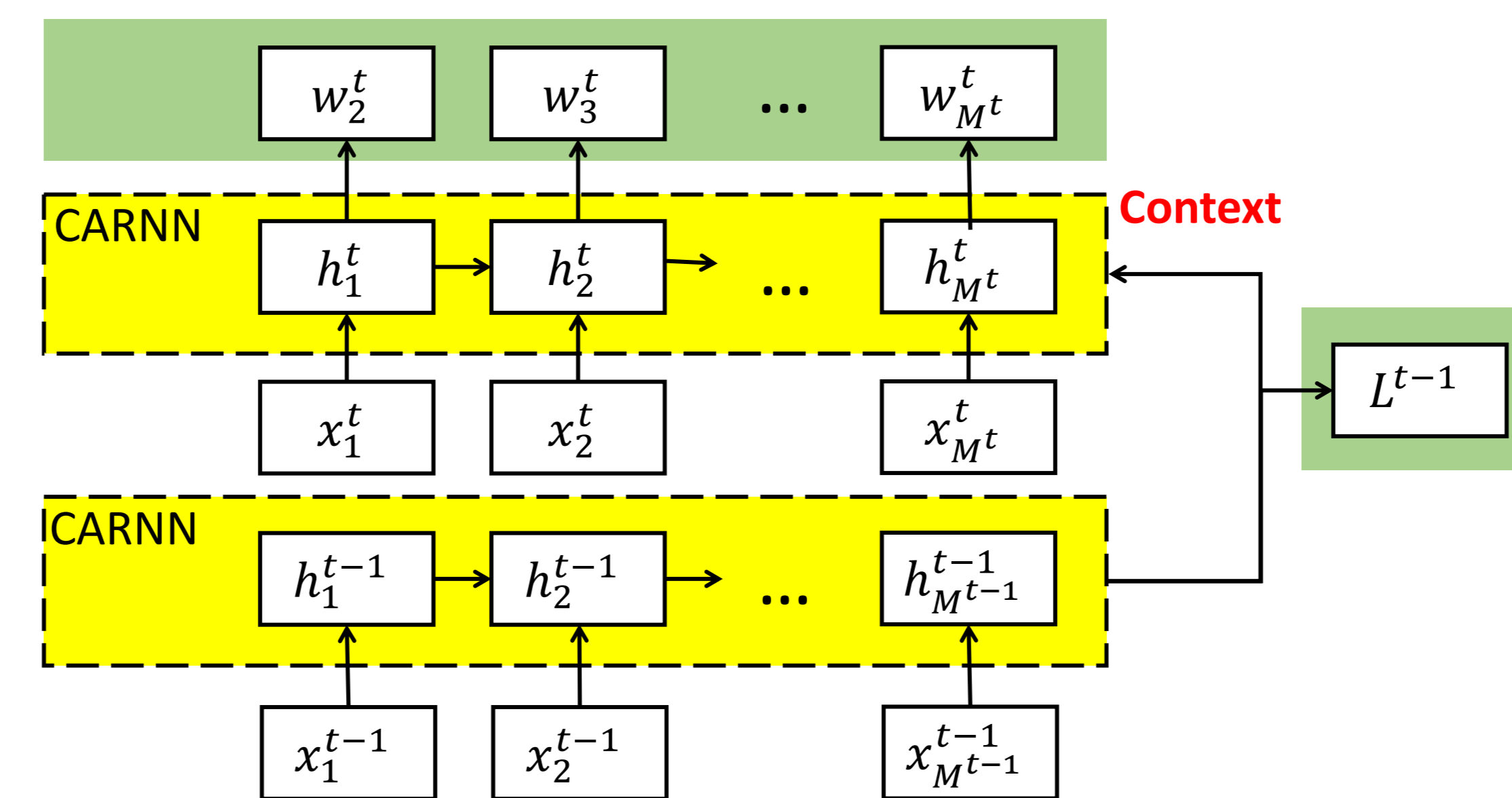
sCARNN – the 2nd improvement with simplified candidate updates: $\bar{h}_m = x_m$

CARNN for End-to-End dialogs



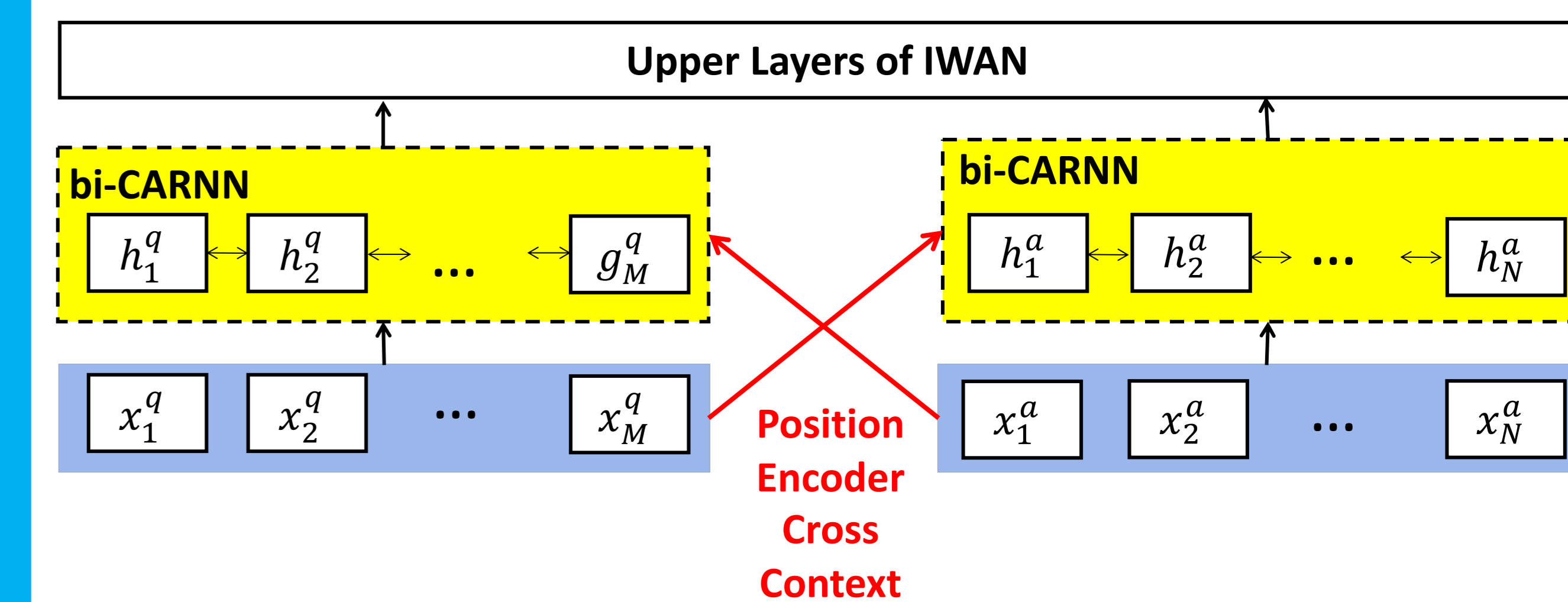
Position Encoder (2016) is a weighted sum technique that summarizes a collection of embeddings with the weights depends on the position of the input, and size of the sentence/ embeddings

CARNN for Contextual LM



L can be the discourse relations between sentences or the Dialog act classes of the previous sentence

CARNN for Question Answering



IWAN (Inter-Weighted Alignment Network. Shen et al. 2017) architecture relies on word-similarity matrix and alignment layers to compute the similarity between sentences

CARNN models performance

CARNN for End-to-End dialogs

	Babi dataset	Babi reduced
Memory network (2016)	41.1 %	--
Gated Memory Network (2017)	47.4 %	54.1
Query reduction network (2017)	46.8 %	54.7
CARNN with voting	53.2 % *	56.9 % *

Dialog Accuracy

The Babi dataset is the benchmark End-to-end Dialog dataset. The data is about restaurant booking
* Indicates statistical significance

CARNN for Contextual LM

	Penn Tree Bank	Switchboard
RNNLM + previous sentence (2016)	112.2	45.3
RNNLM + previous sentence + latent (2017)	108.3	39.6
CARNN + previous sentence	87.4	30.2
CARNN + previous sentence + latent	86.7	29.7

Test set perplexity

Penn Discourse Tree Bank is a part of the news corpus in Penn Tree Bank with discourse relations
Switchboard is a general conversation corpus with Dialog Act annotations

CARNN for Question Answering

	MAP	MRR
IWAN (our implementation LSTM)	0.794	0.879
Compare-Aggregate (2017)	0.821	0.899
BiMPM (2017)	0.802	0.875
IWAN + CARNN	0.829	0.907

Test set MAP and MRR

The TrecQA answer selection data is the benchmark data for Answer sentence selection.