

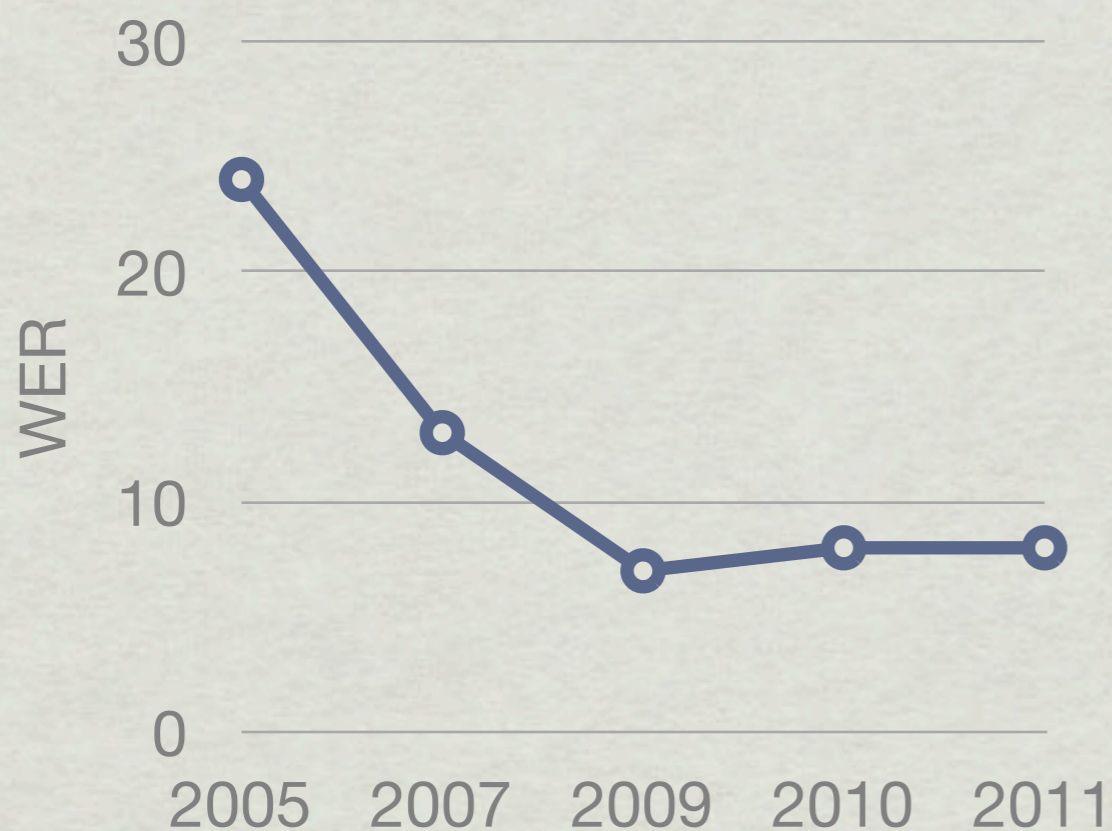
The A2iA Arabic Handwritten Text Recognition System at the OpenHaRT2013 Evaluation

Christopher Kermorvant, A2iA, Paris

A2iA ATR research group : J. Louradour, T. Bluche, B. Moysset,
F. Benzeghiba, Maxime Knibbe

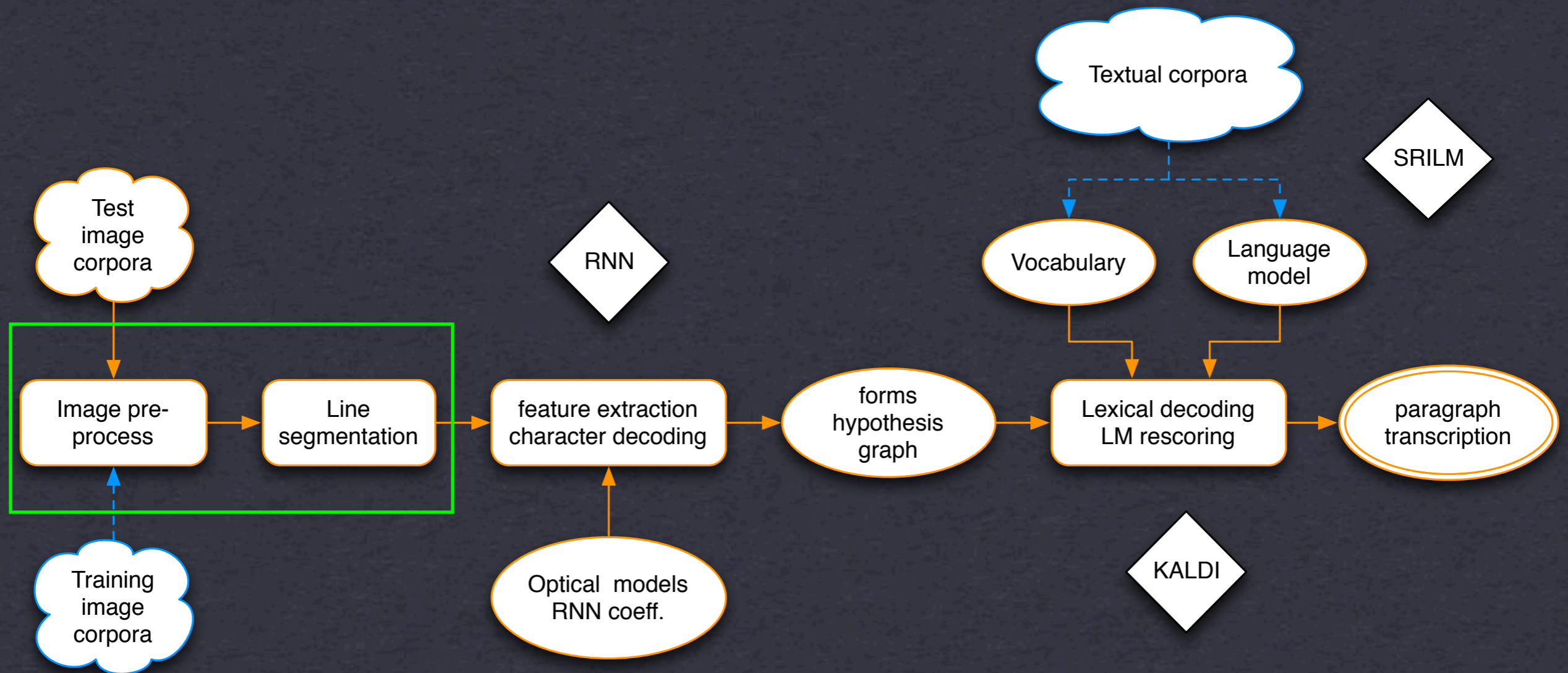
Arabic Handwriting Evaluations

Small vocabulary isolated word recognition has reached a plateau in 2009 (IFN-ENIT evaluations)



أولاد حقوز	أولاد حقوز	أولاد حقوز
أولاد حقوز	أولاد حقوز	أولاد حقوز
أولاد حقوز	أولاد حقوز	أولاد حقوز
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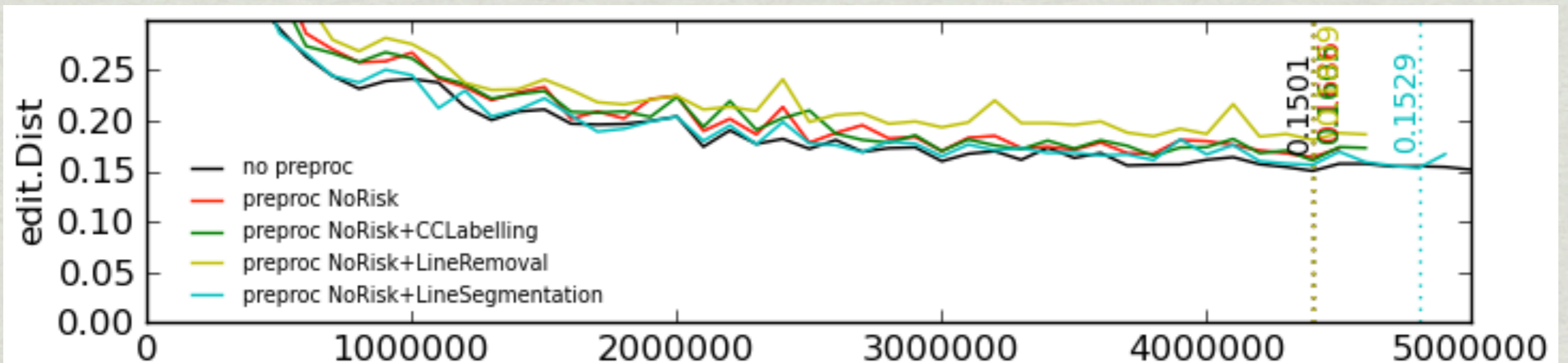
OPENHART IS THE REFERENCE EVALUATION FOR ARABIC HTR



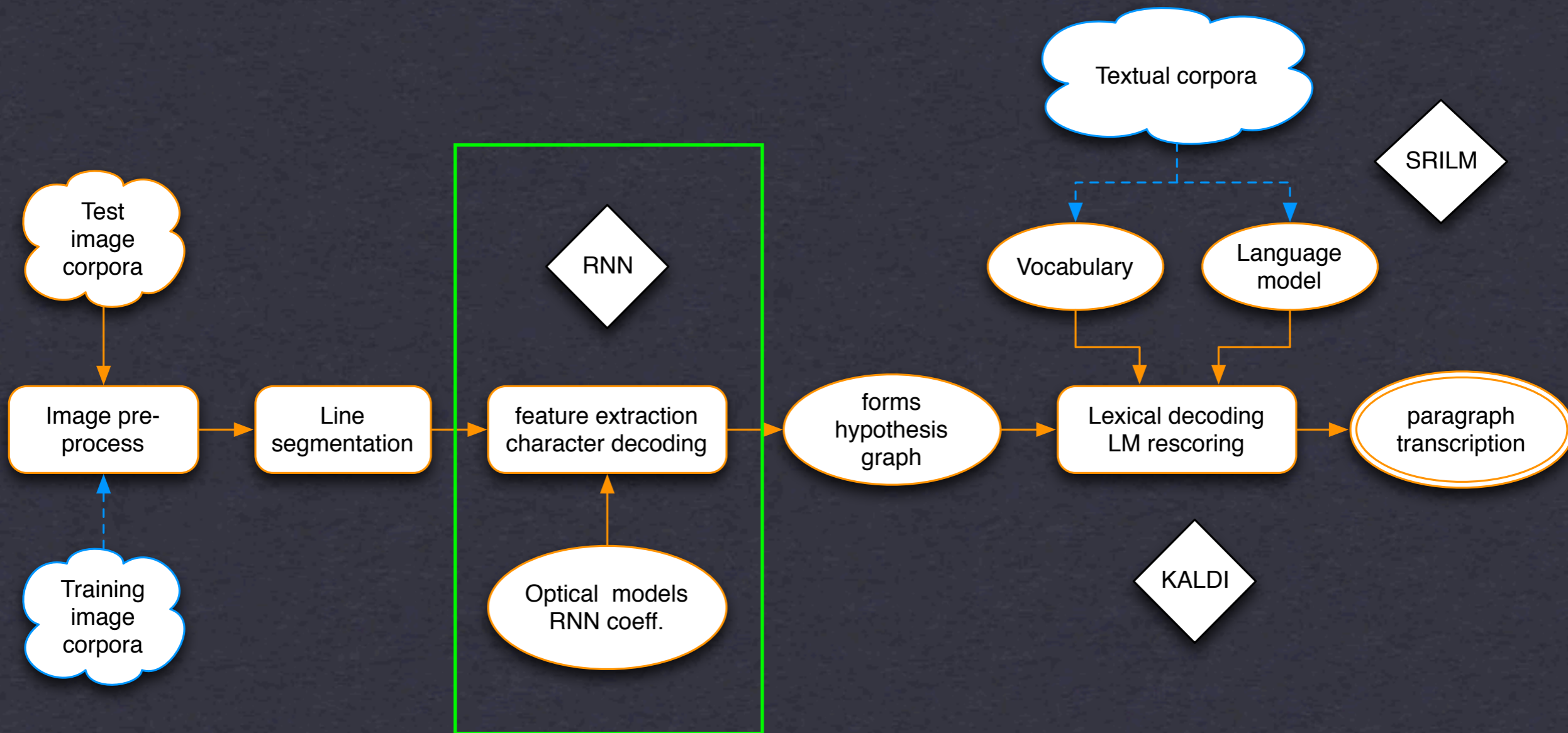
Overview of Azia's system

Image pre-processing

- NoRisk pre-processing
 - upscale in 600 DPI
 - Gaussian denoising
 - Deskew
 - Deslant
- Suppl. pre-processing
 - Line re-detection
 - Rule line removal
 - CC cleaning

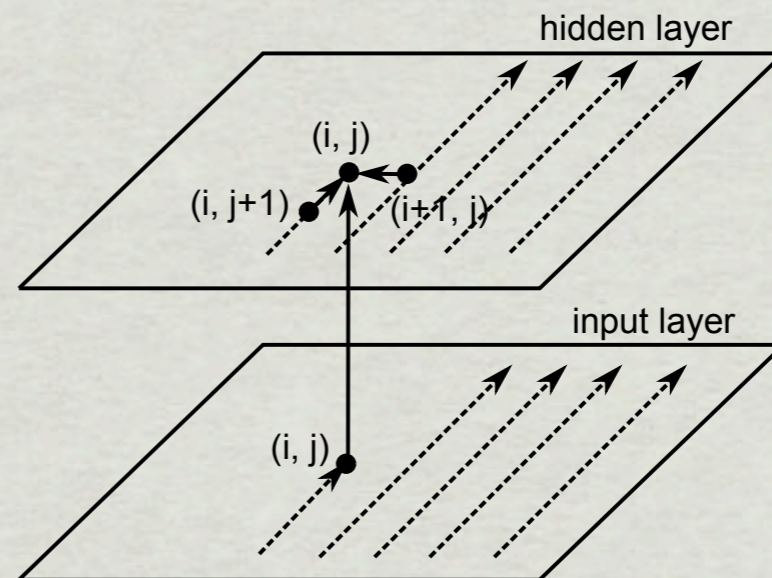
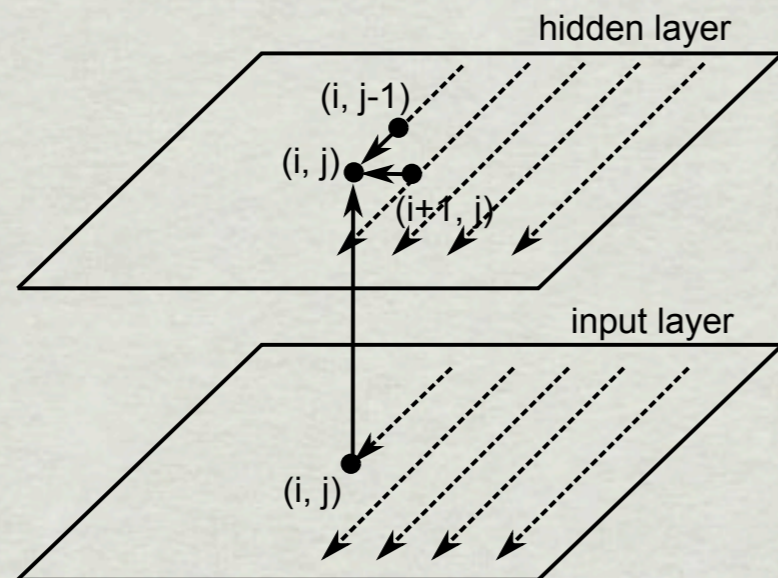
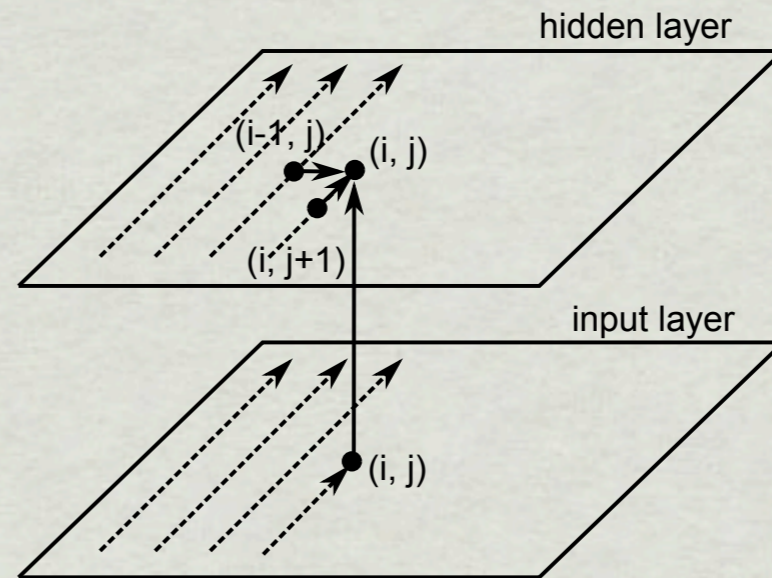
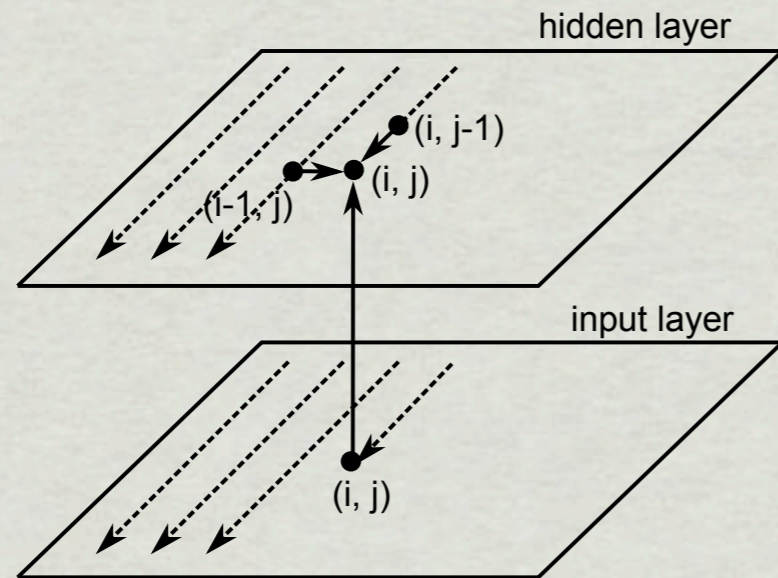


THE PRE-PROCESSING USEFULL IN 2010 WITH FEATURE-BASED GMM ARE NOT USEFULL WITH RNN

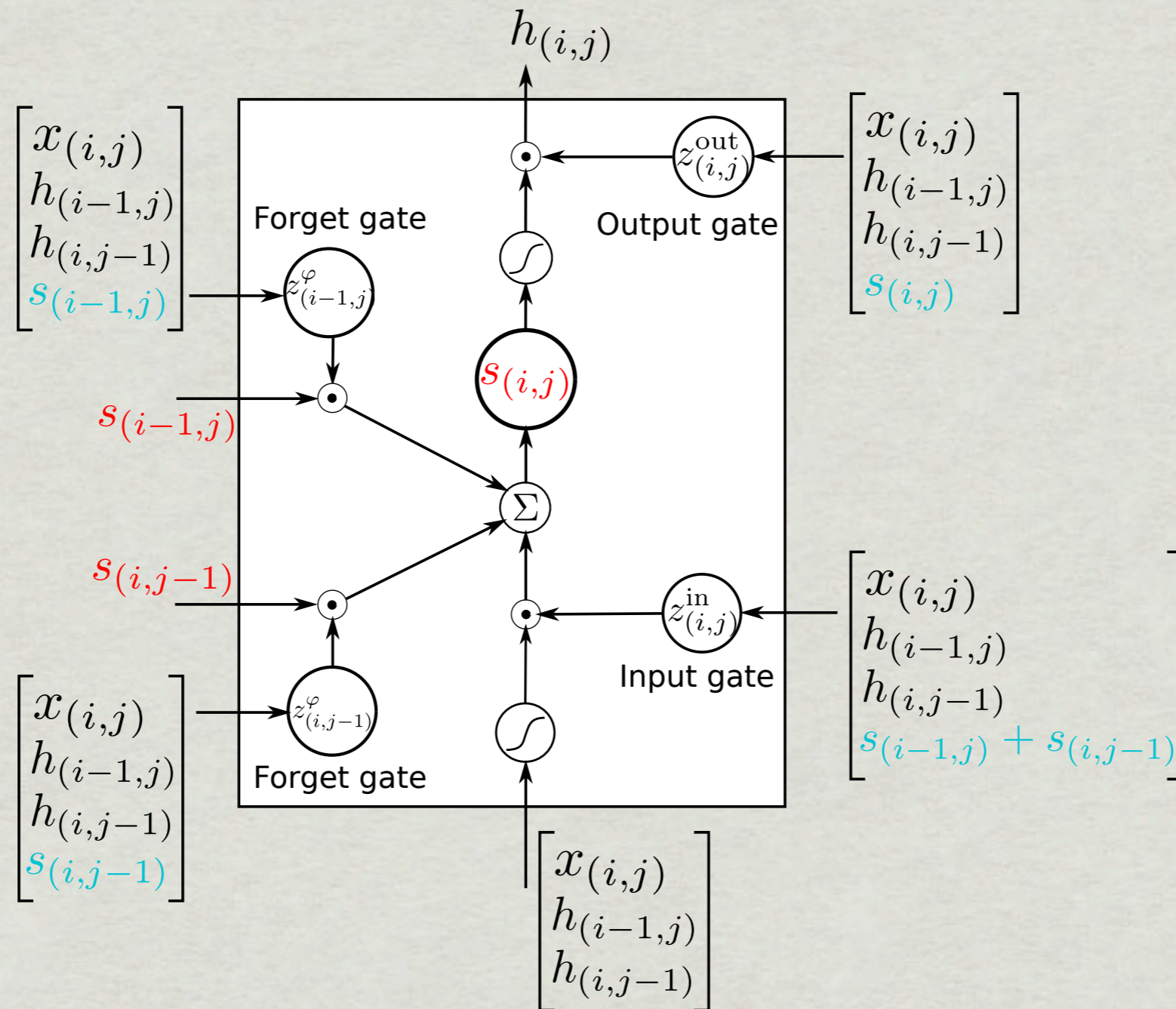


Overview of Azia's system

Optical Model : 2D-LSTM RNN

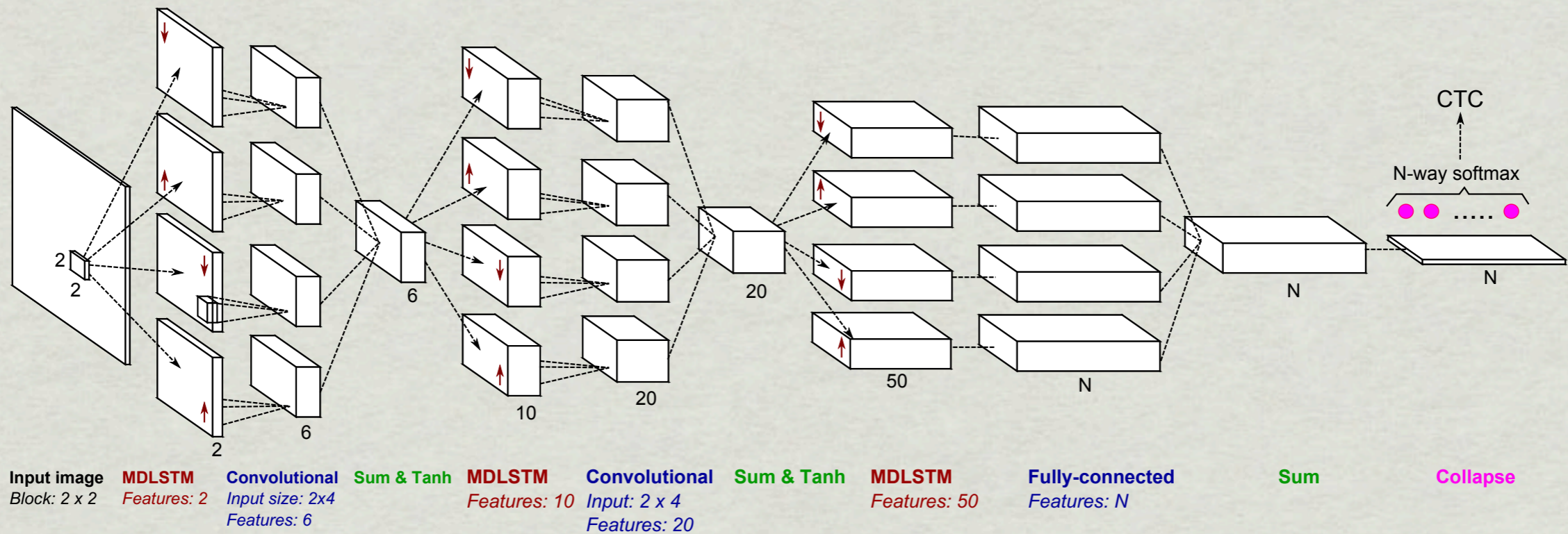


Optical Model : 2D-LSTM RNN



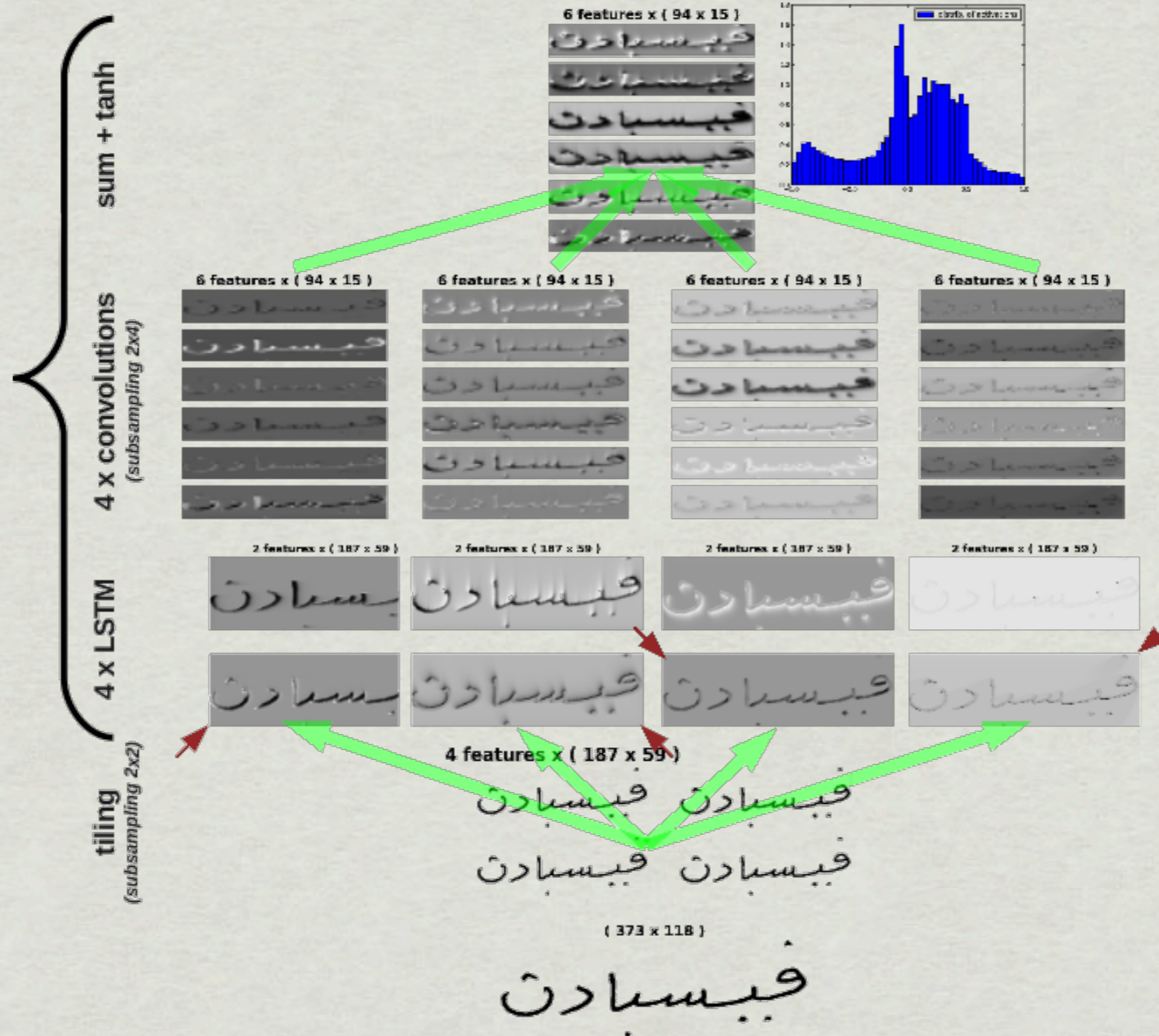
Note : peephole connections (in blue) not used

Optical Model : 2D-LSTM RNN



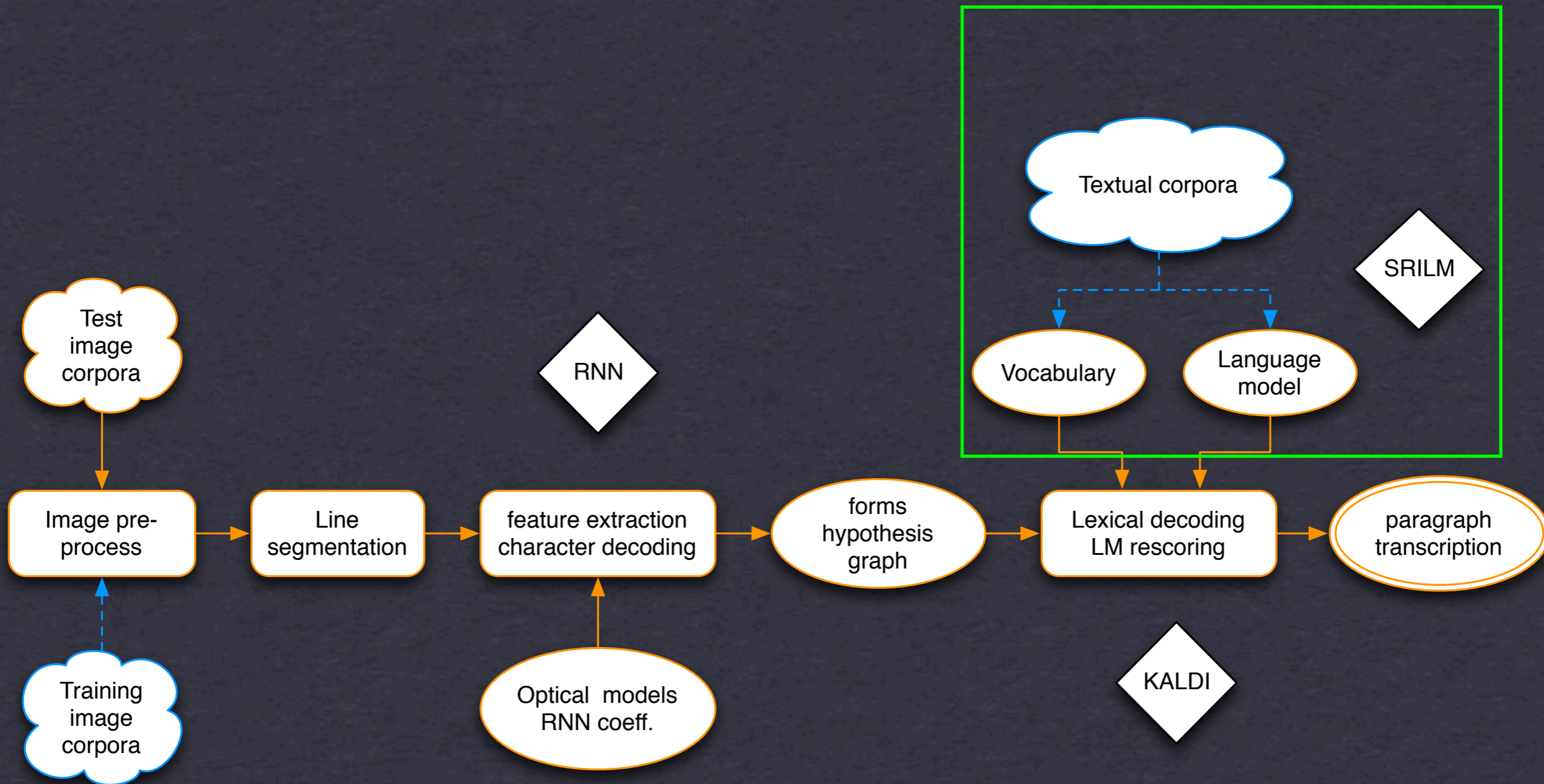
DEEP RECURRENT NEURAL NETWORKS

Optical Model : 2D-LSTM RNN



Optical Model : training several RNN

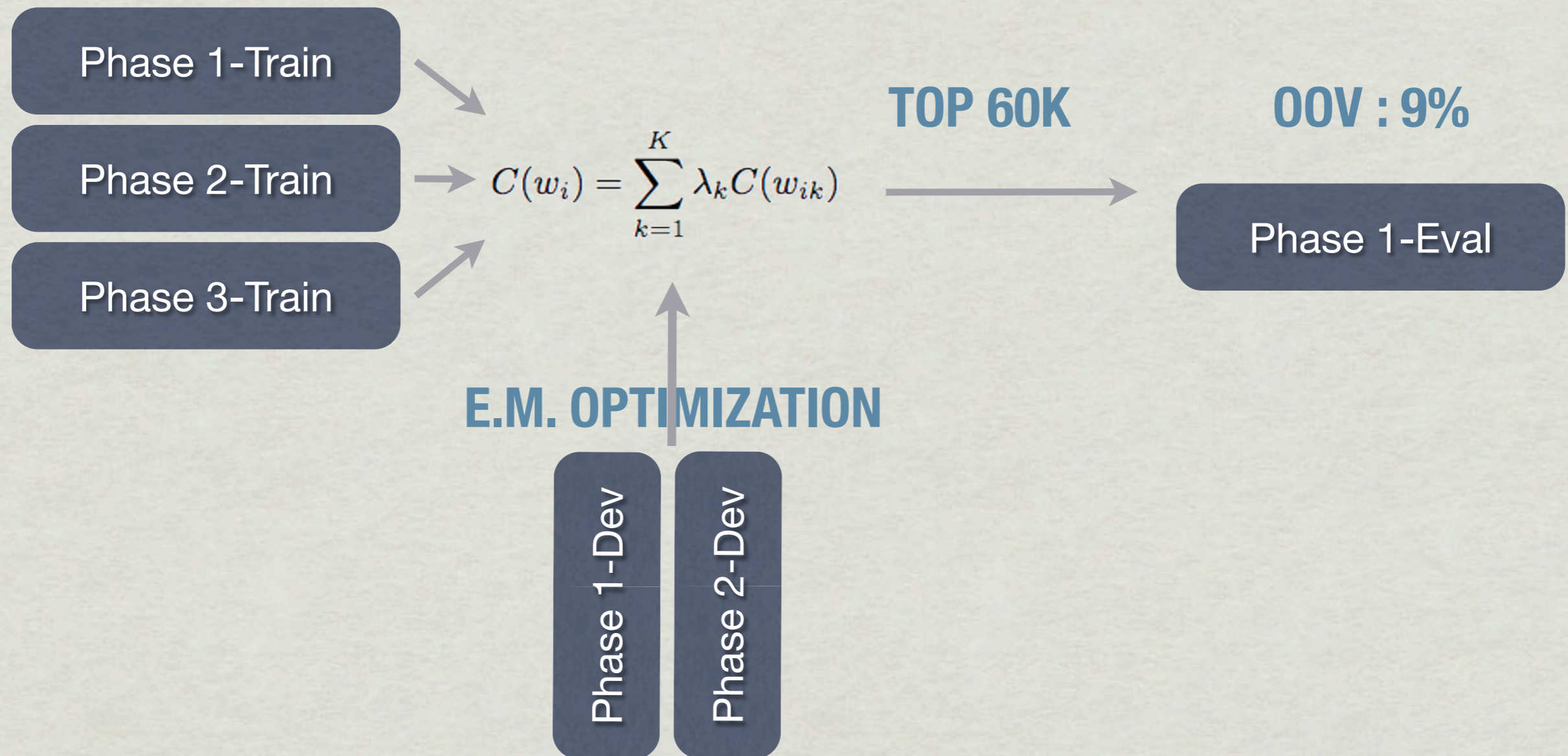




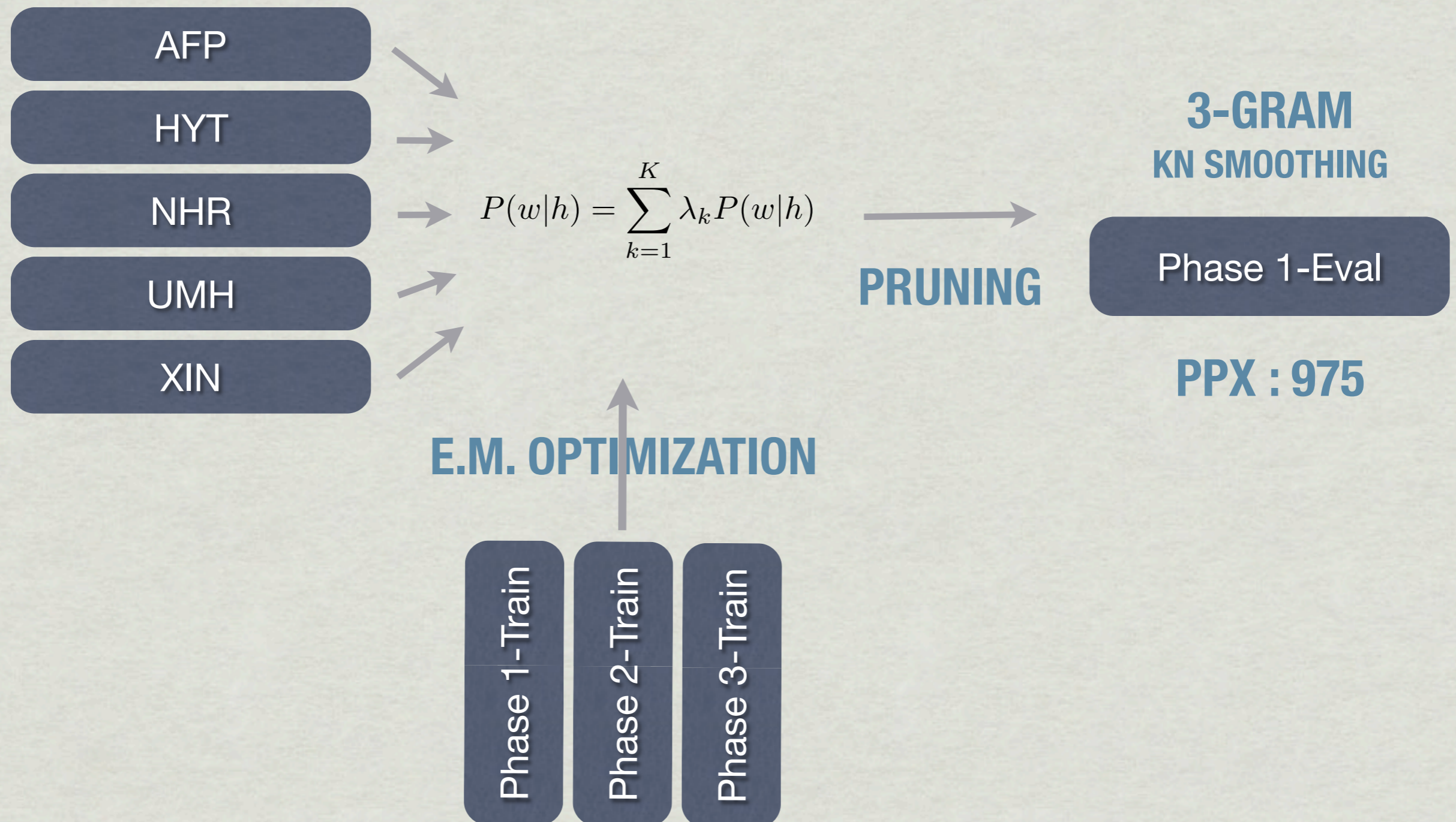
Overview of Azia's system

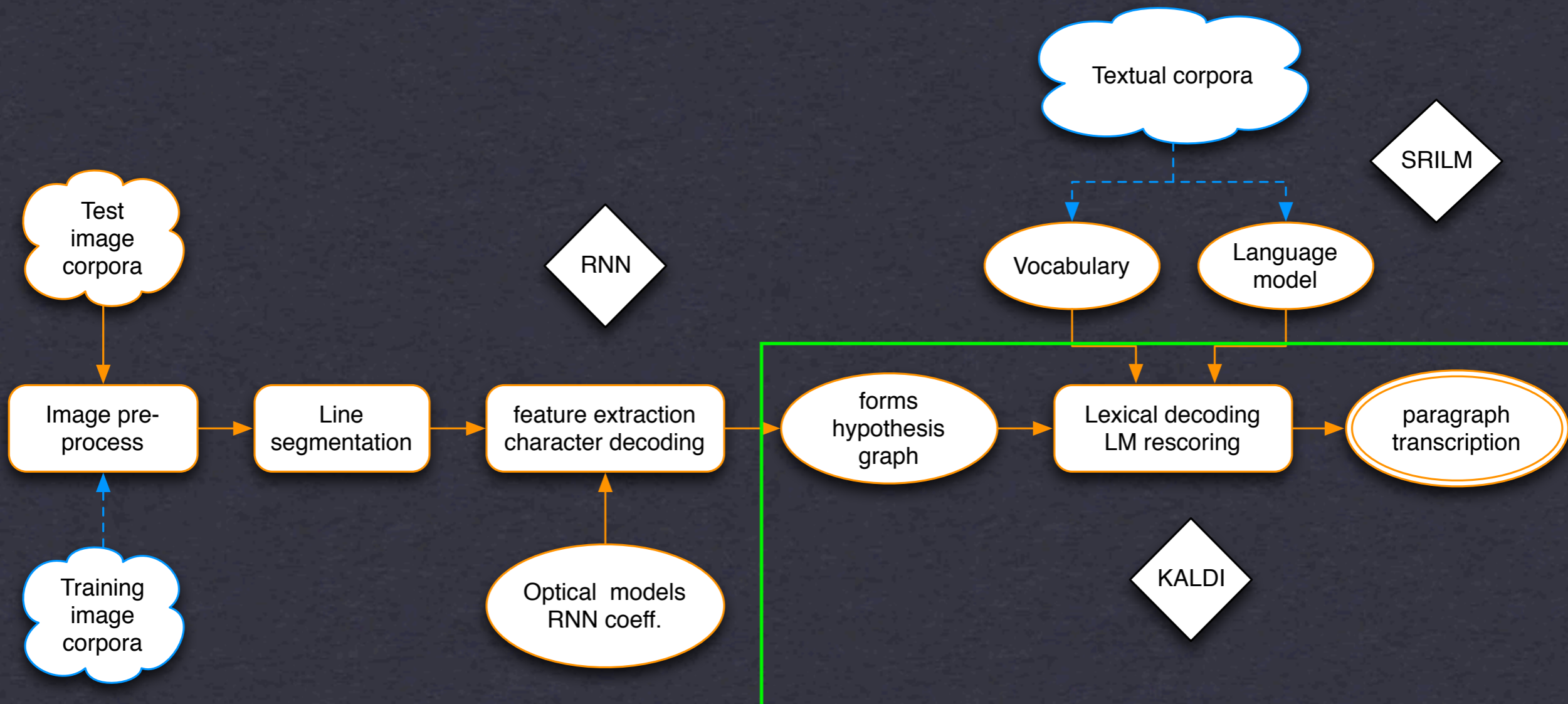
Language Model : vocabulary selection

OPENHART



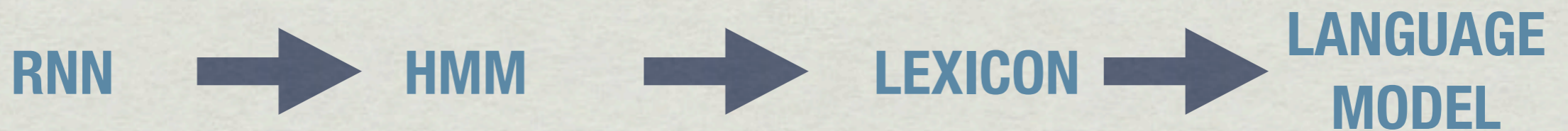
Language Model : N-gram interpolation



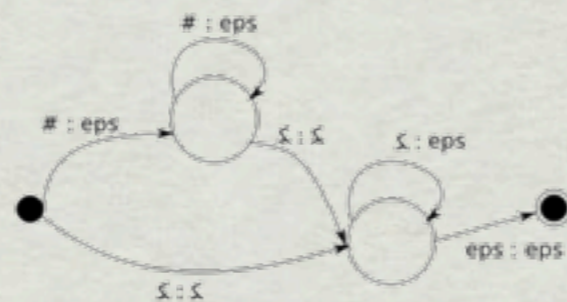


Overview of Azia's system

Decoding : composition of WFST



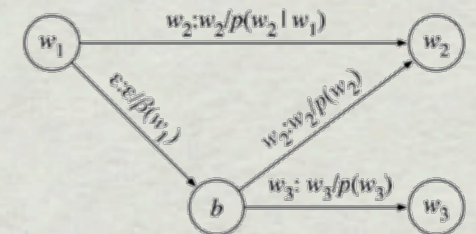
RNN OUTPUTS
FORMS+WHITE
+SPECIAL



RNN OUTPUT->FORMS

GNU
FRIBIDI

FORMS->WORDS



WORDS->WORDS

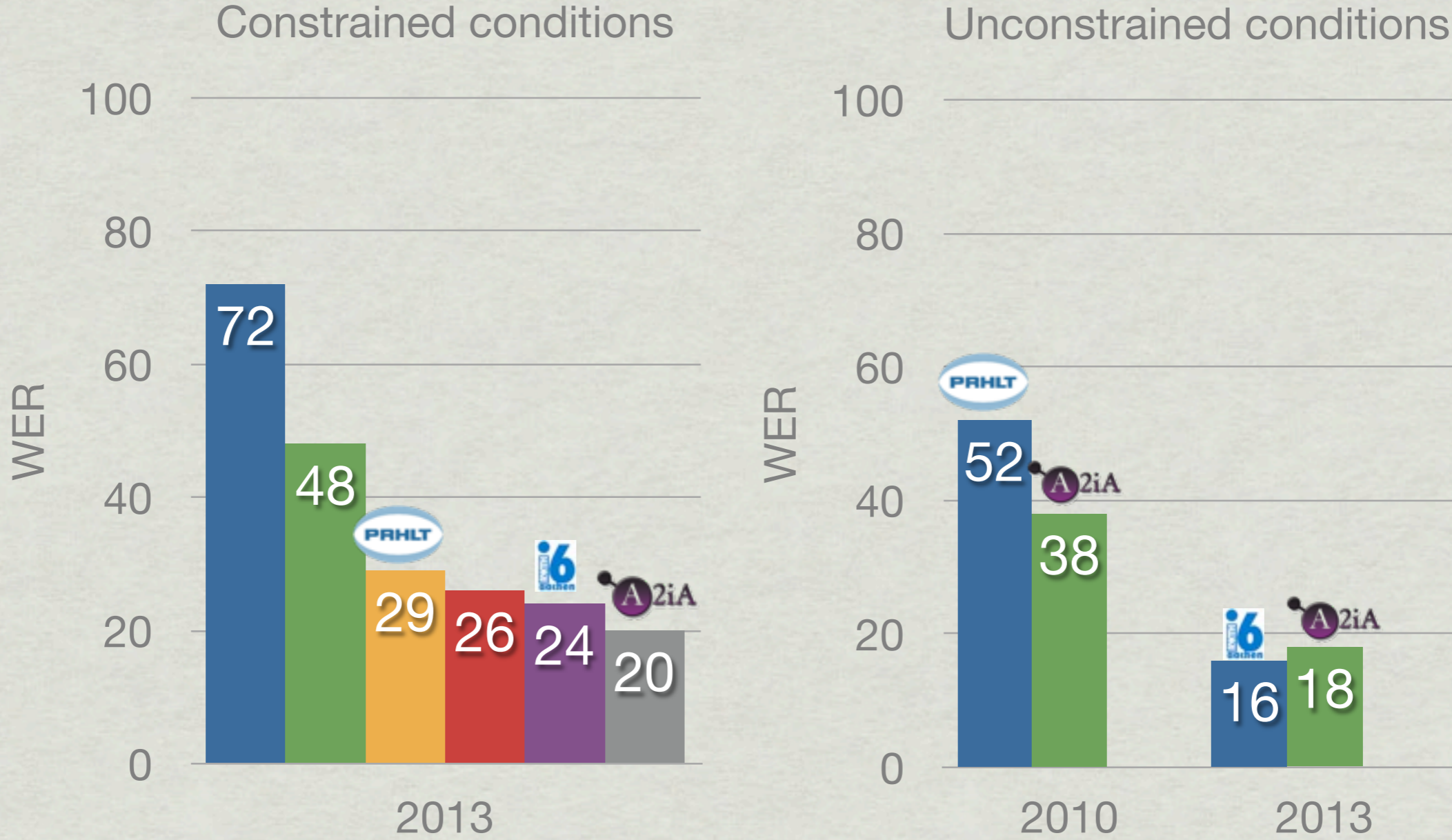
WFST COMPOSITION AND DECODING WITH KALDI

Rover Combination

- Usually, combining several RNN helps a lot
- We had many variants (RNN initialization, hyper-parameters, etc)
- Best Single recognizer : 25% WER (Phase 1-Eval)
- Best ROVER combination : 23.3% WER

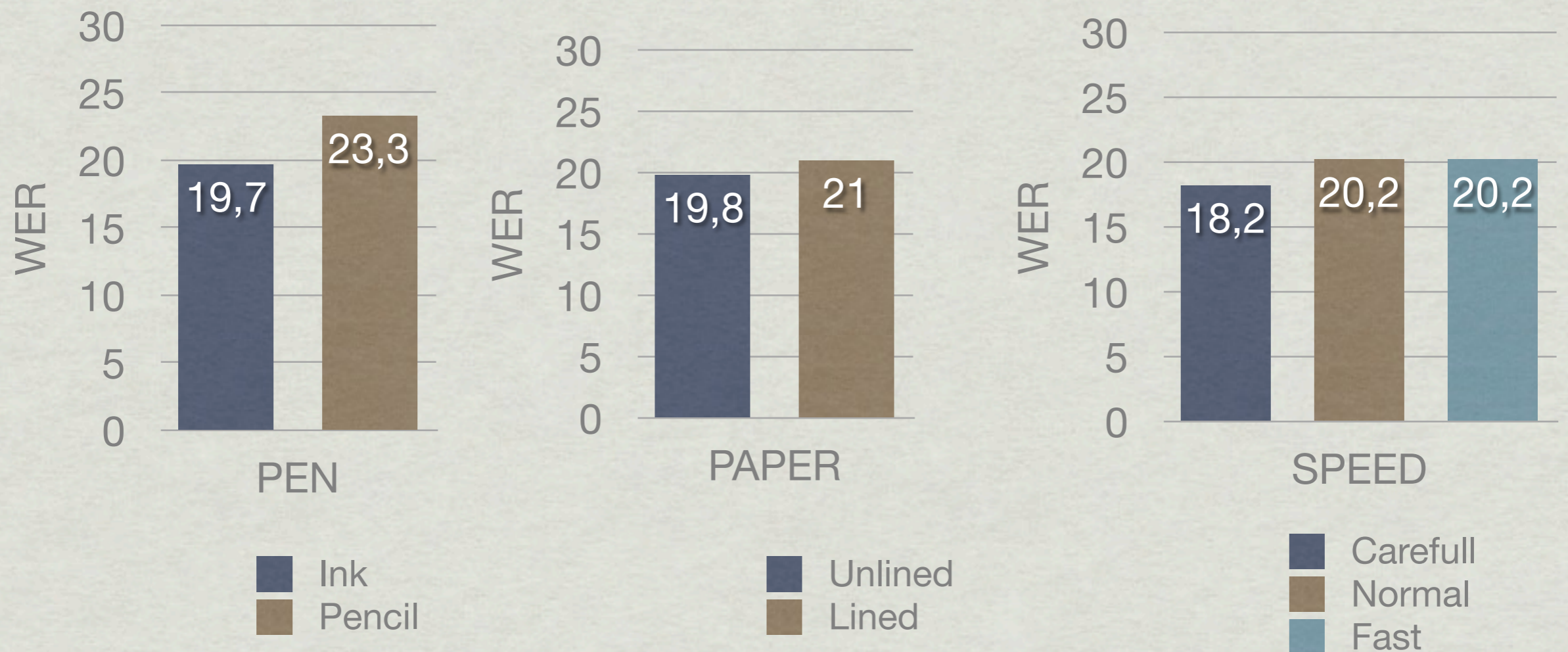
SMALL IMPROVEMENT WITH ROVER

OpenHaRT'13 Evaluation

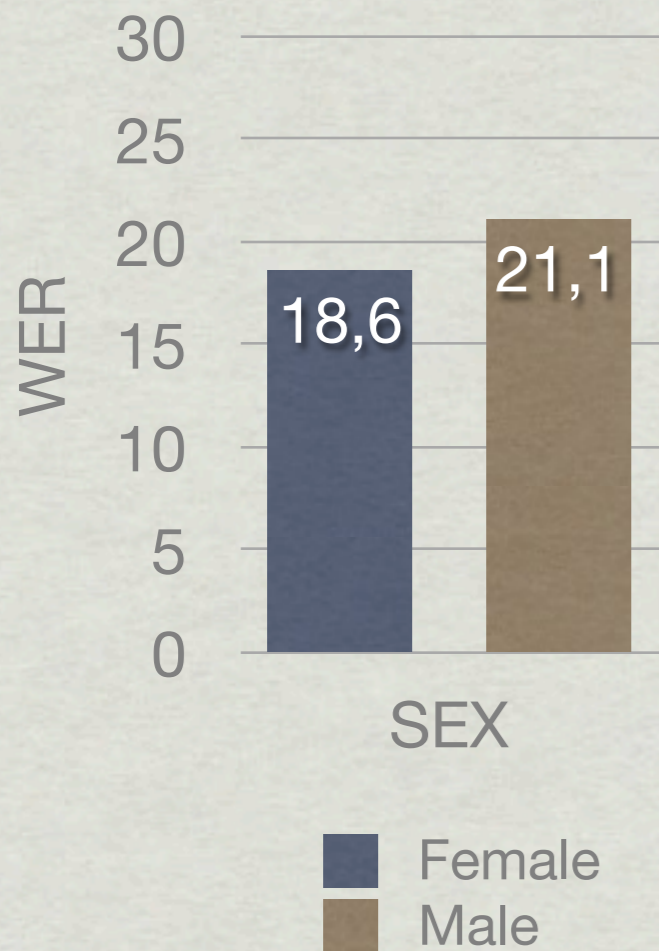


WER DIVIDED BY 2 SINCE 2010

Error analysis : writing conditions

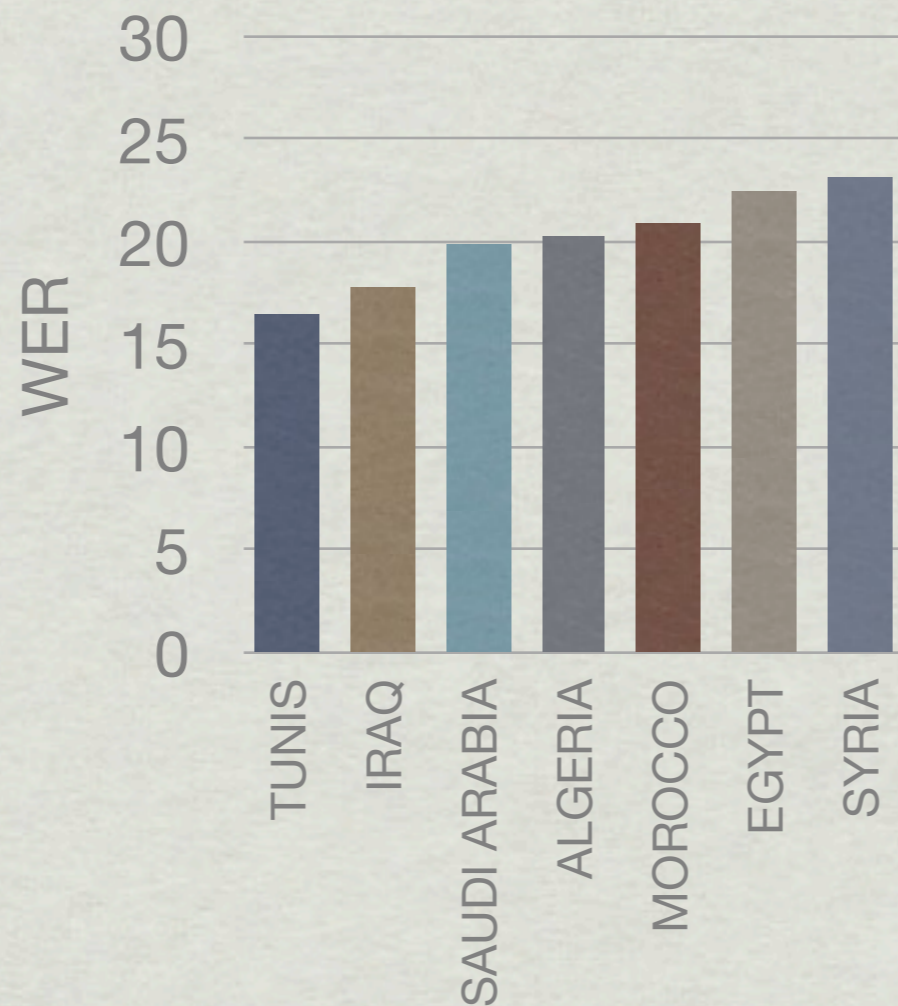


Error analysis : scribes



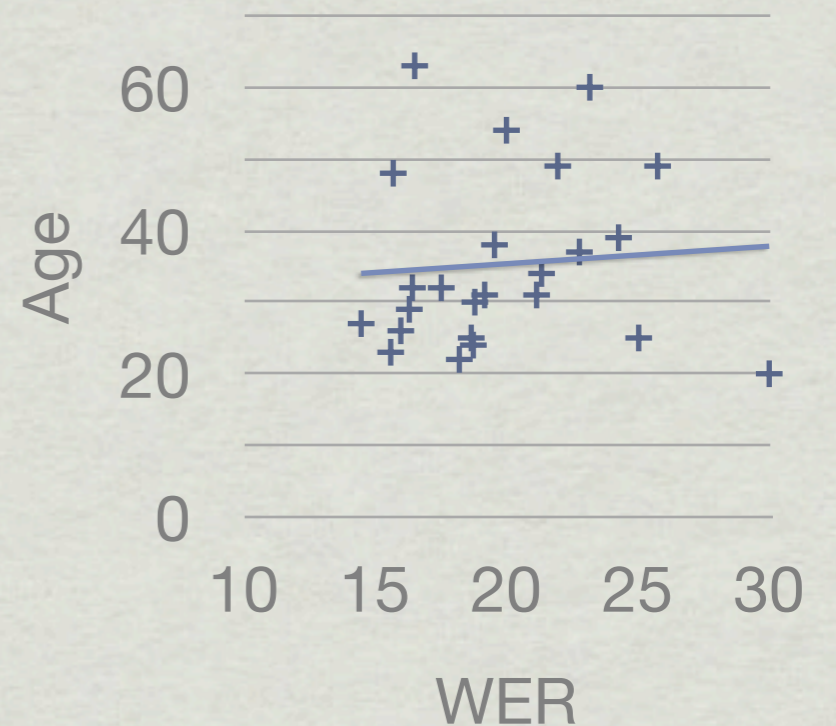
* not statistically significant

SEX



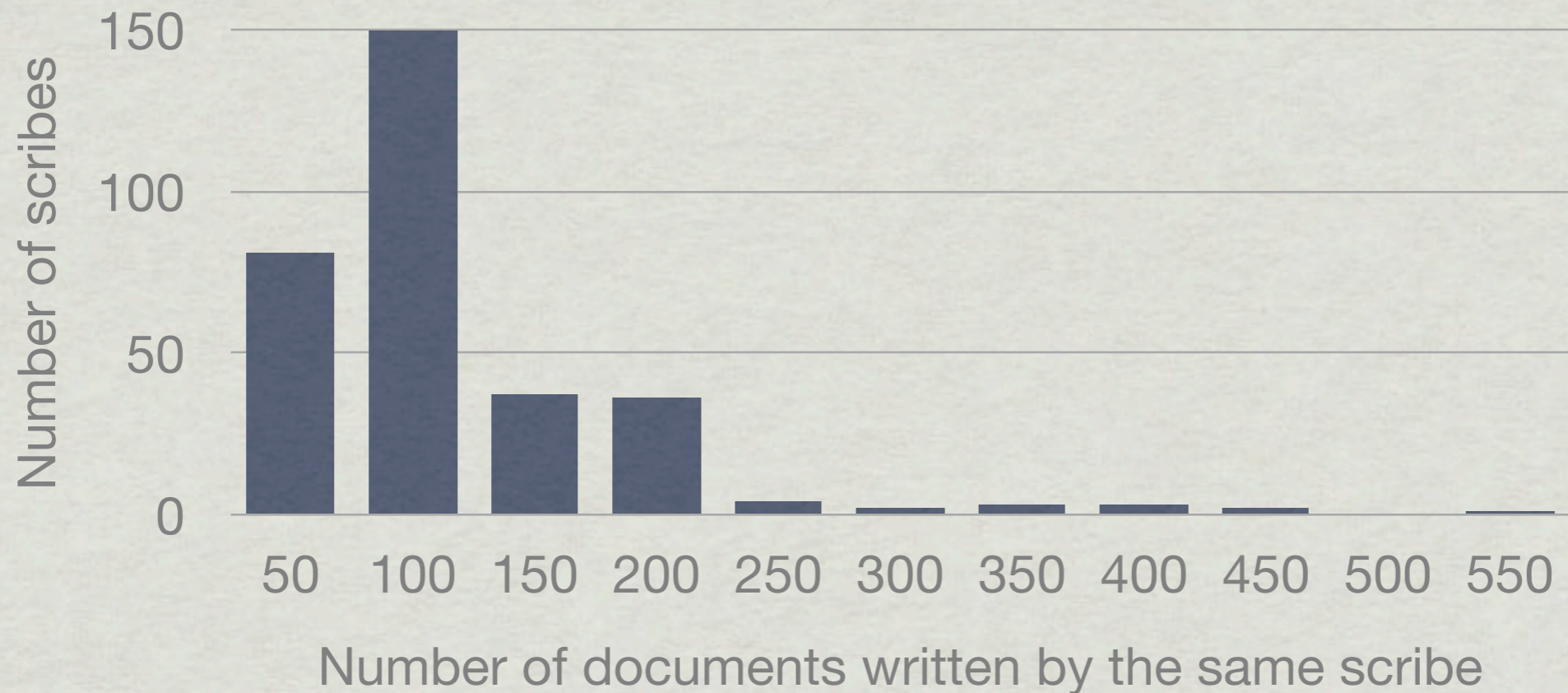
* not statistically significant

COUNTRY



AGE

OpenHaRT Evaluation



Evaluation conditions closer to historical document processing (US Census) than to digital mailroom (mail sorting in companies)

➡ See the Maurdor Evaluation

Thank you !