The 2017 KIT IWSLT Speech-to-Text Systems for English and German

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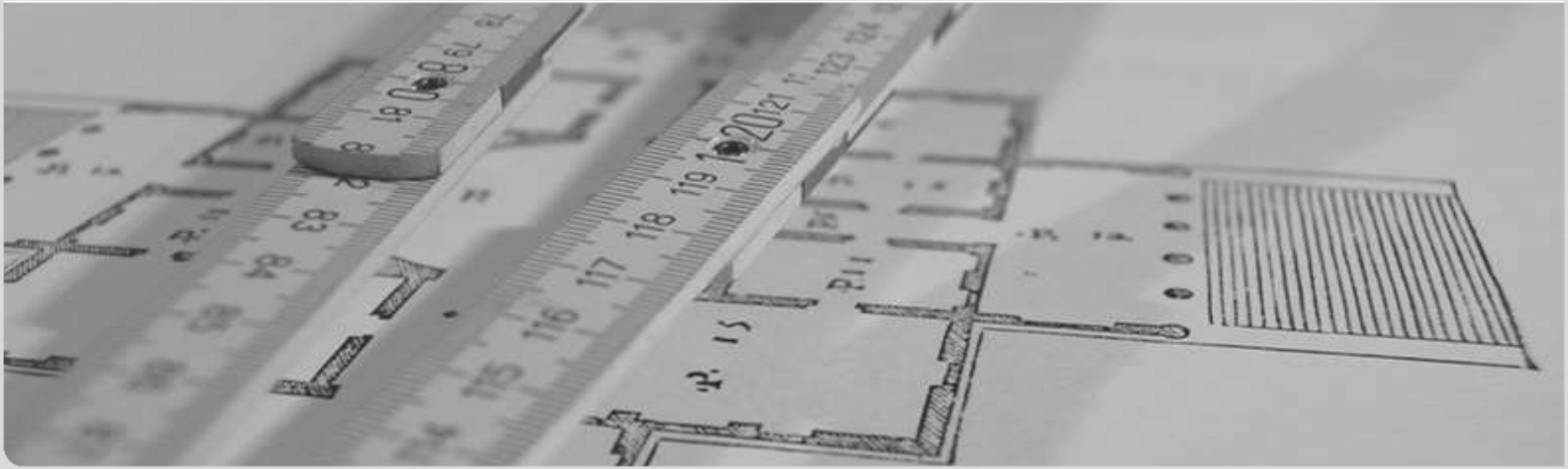


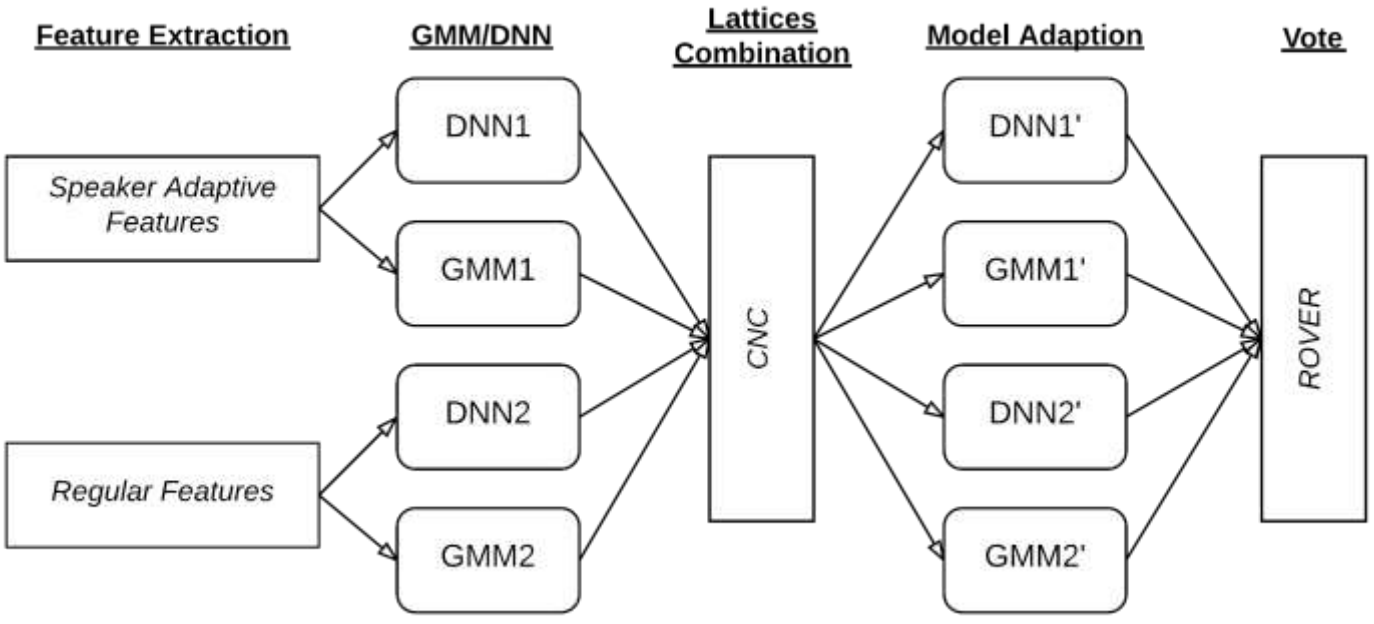
Outline

- IWSLT 2017 ASR Tasks
- System Overview
- Setups
  - Feature Extraction
  - 4-gram and FFNN LM
  - GMM & DNN Systems
  - Speaker Adaption Models
- Results and Discussions
- Conclusion

IWSLT 2017 ASR

- English and German Lecture task
  - TED talks and lecture talks.
  - Various topics, spontaneous speaking style
  - Not segmented

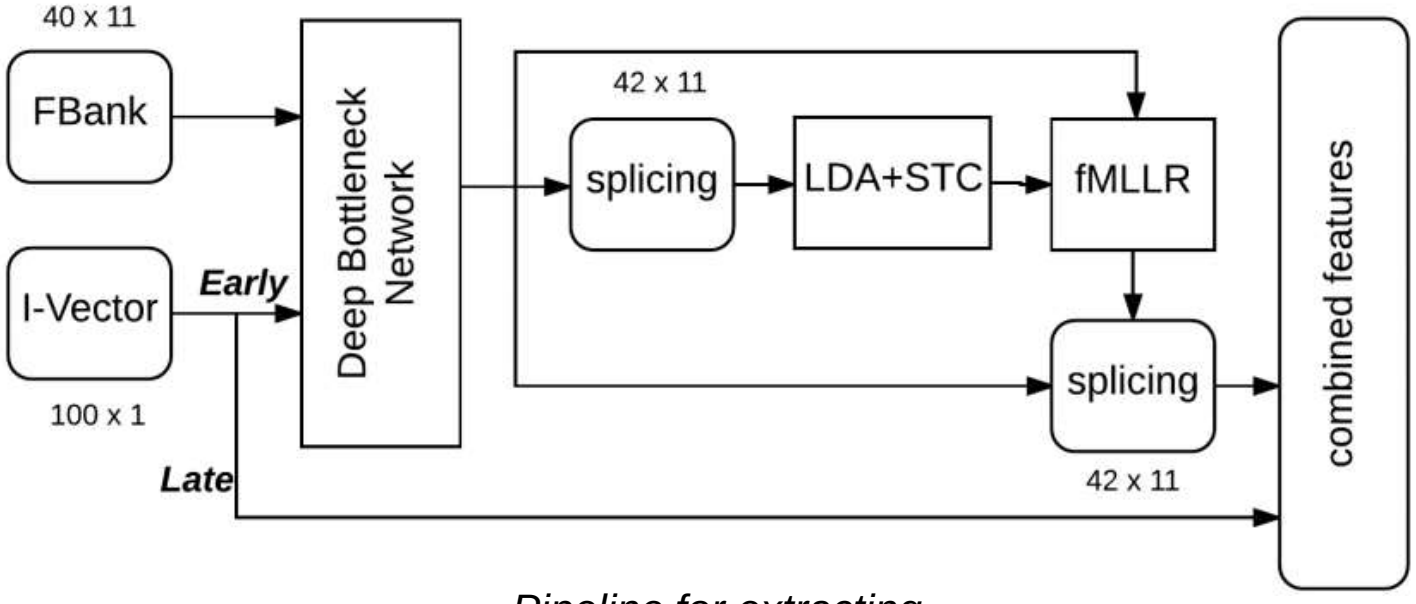
System Overview



Setups

- Feature Extraction
  - Bottleneck features
  - Speaker adaptive feature (SAF)
- Speaker Adaption Models
  - GMMs and DNNs using SAF
- Language Models
  - 4-gram LM
  - Feed-forward LM

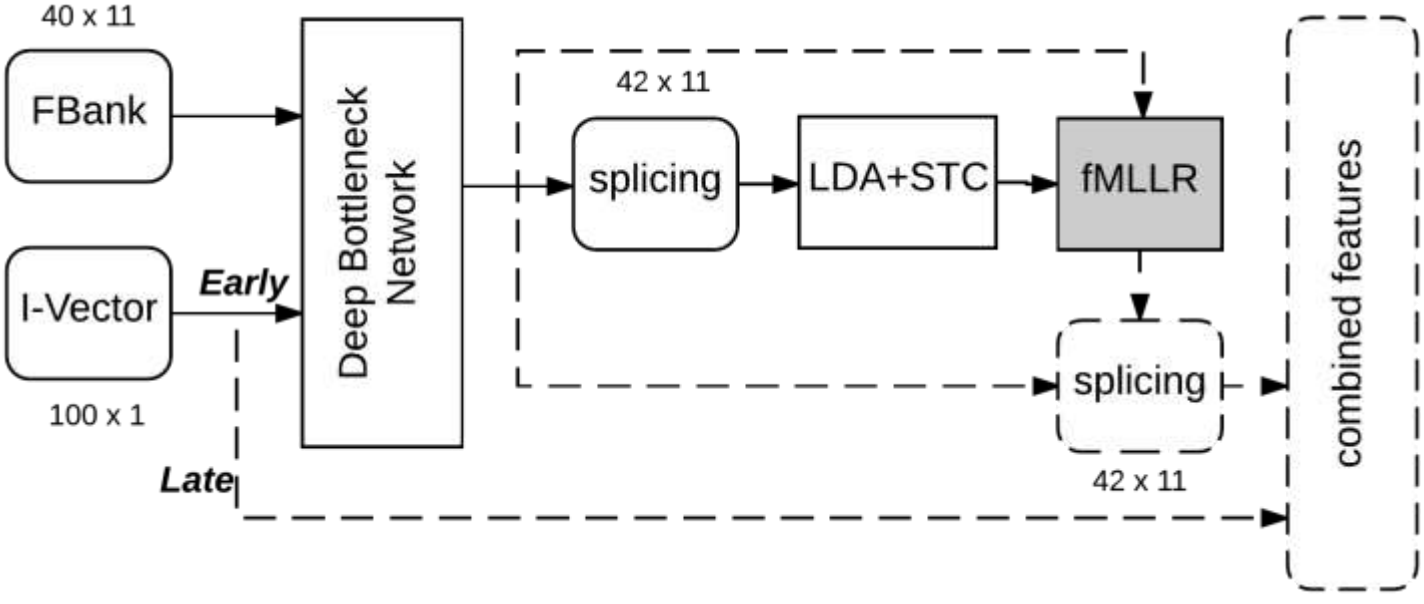
Feature Extraction



Pipeline for extracting
Speaker Adaptive Feature (SAF)

Input Features for GMMs

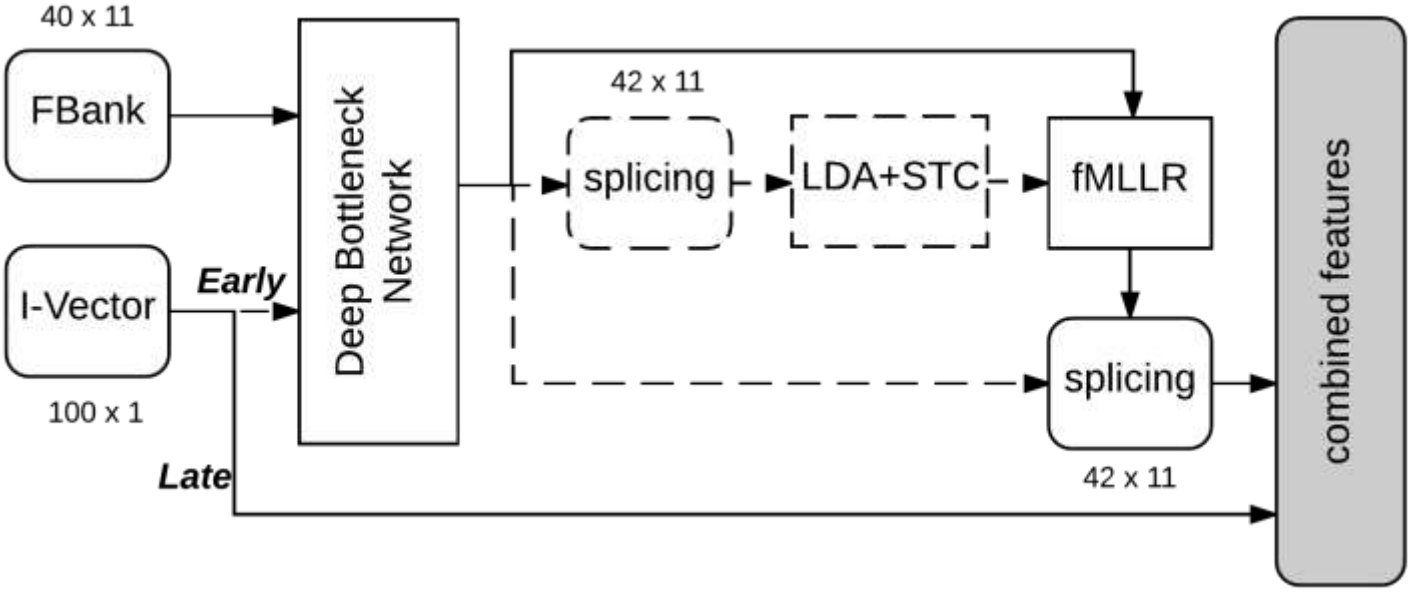
- We used FBank and MFCC features to build two GMMs



Feature Extraction for GMMs

Input Features for DNNs

- Also FBank and MFCC features for DNNs



Feature Extraction for DNNs

DNN & GMM Models

- ***FFNNs***
  - 8k states of CD-Phone for English systems, 18k states for German systems
  - *SAF-lMEL* and *SAF-MFCC*
- ***GMMs***
  - The same number of CD-Phone states
  - The same front-ends

Model Adaption

- Use transcriptions from the CNC system
- Align and eliminate the frames with confidence score less than 0.7
- GMMs
  - MLLR
- DNNs
  - An adapted DNN per speaker
  - Training one more epoch on the adaption data with a small learning rate

Training Data

- *About **480 hours** and **360 hours** for acoustic modeling of English and German systems*

Source	# Amount
Quaero from 2010 to 2012	200 hours
Broadcast news [8]	80 hours
TED-LIUM v2 [9] excluding disallowed talks	203 hours
Total	483 hours

English acoustic modeling data

Source	# Amount
Quaero from 2009 to 2012	180 hours
Broadcast news	24 hours
Baden-Württemberg parliament	160 hours
Total	364 hours

German acoustic modeling data

System Training

- ***Deep bottleneck network and FFNN network***
  - Input layer of 11-15 stacked frames
  - 5-6 hidden layers with 2000 units per layer
  - Bottleneck layer of 42 units
  - Fine-tuning with cross-entropy loss function
  - Newbob training schedule

Language Models

- ***4-gram LM*** from 7B words for English (150k vocab) and 2B words for German (300k vocab)
- ***Feed-forward Neural Network LM***
  - 4 sigmoid layers of 600 units
  - 200-dimensional word embedding for the vocabulary size of 20k
  - To be used directly while decoding

English Lecture Task

System	tst2015
DNN(lMEL)	12.9
GMM(SAF-MFCC)	11.6
DNN(SAF-lMEL)	10.2
DNN(SAF-MFCC)	11.2
CNC	9.4
GMM(SAF-MFCC) adapted	9.3
DNN(SAF-lMEL) adapted	8.8
DNN(SAF-MFCC) adapted	9.3
Kaldi 4-gram LM rescored	9.3
ROVER	8.3

Results for English lecture task on tst2015 testset

German Lecture Task

System	dev2017
18k DNN(BSV BN-lMEL+T) NNLM	26.7
18k DNN(Mod-M2+lMEL+T)	27.1
10k DNN(SAF-BN-M2+T) NNLM	25.2
10k DNN(SAF-BN-lMEL+T) NNLM	25.7
CNC	24.5

Results for German lecture task on dev2017

Conclusion

- Used techniques
  - Speaker Adaptive Feature
  - Model Adaption
  - System Combinations
- WER results:
  - *8.3%* on English tst2015
  - *24.5%* on German dev2017