

# Fundamentals of Speech Recognition

Dong Wang

2014-10-19

# Basic tasks of speech processing

- Speech recognition
- Speech production
- Speaker recognition
- Language recognition
- Speech perceptron
- Speech signal analysis (VAD, denoising, segmentation, beamforming, DOA, enhancement, prosody,...)
- Multimodal speech processing
- Speech information retrieval

# Related areas

- Signal processing
- Pattern recognition & machine learning
- Artificial intelligence
- Linguistics
- Semantic computing
- Psychology
- Neural computing
- Information retrieval

# Speech recognition

- Given speech signals, infer words
- Three perspectives
  - Signal processing: match signals?
  - Pattern recognition: signal match models?
  - Machine intelligence: knowledge generate signals?

# Focus of speech recognition

- Training & inference
  - Pipeline of signal processing
  - Feature modeling
  - Decoding

# Fundamental research questions

- How to deal with variability?
- How to represent signals with appropriate models?
- How to involve multiple information(n-gram, syntactic, semantic)?

# Some research topics

- Robust feature extraction
- Discriminative modeling
- Dynamic modeling
- Fast & robust decoding
- Model adaptation
- Language modeling
- Syntactic & Semantic re-ranking
- Language adaptation

# Some acronyms you want to know...

- ASR
- MFCC, GMM, DNN, HMM, Viterbi
- LDA, PCA, MLLT, fMLLR, fMPE, VTLN
- ML, MPE, MMI, MLLR, SAT, MAP



# Requested abilities

- Linear algebra
- Statistics and probabilistic theory
- Probabilistic modeling
- Abstract reasoning
- Imaginary power
- Diligent and intelligent

# Recent advances

- DNN-based ASR
  - RNN AM/LM (O-6-1,O-10-1,O-10-3,O17-3)
  - Max-out activation + drop out (P-8-1)
  - Modulation features and histogram equalization (O-9-1)
  - Robust by DNN mapping (O-9-2)
- Multi lingual ASR & Low-resource ASR
  - Shared BN feature (P-8-1)
  - NN-based LM(p-25-3)
- Muti-domain ASR based on DNN
  - ASR+speaker recognition
  - ASR+IR (P10-2)
  - ASR+image
- Semi supervised training