说话人识别学习报告

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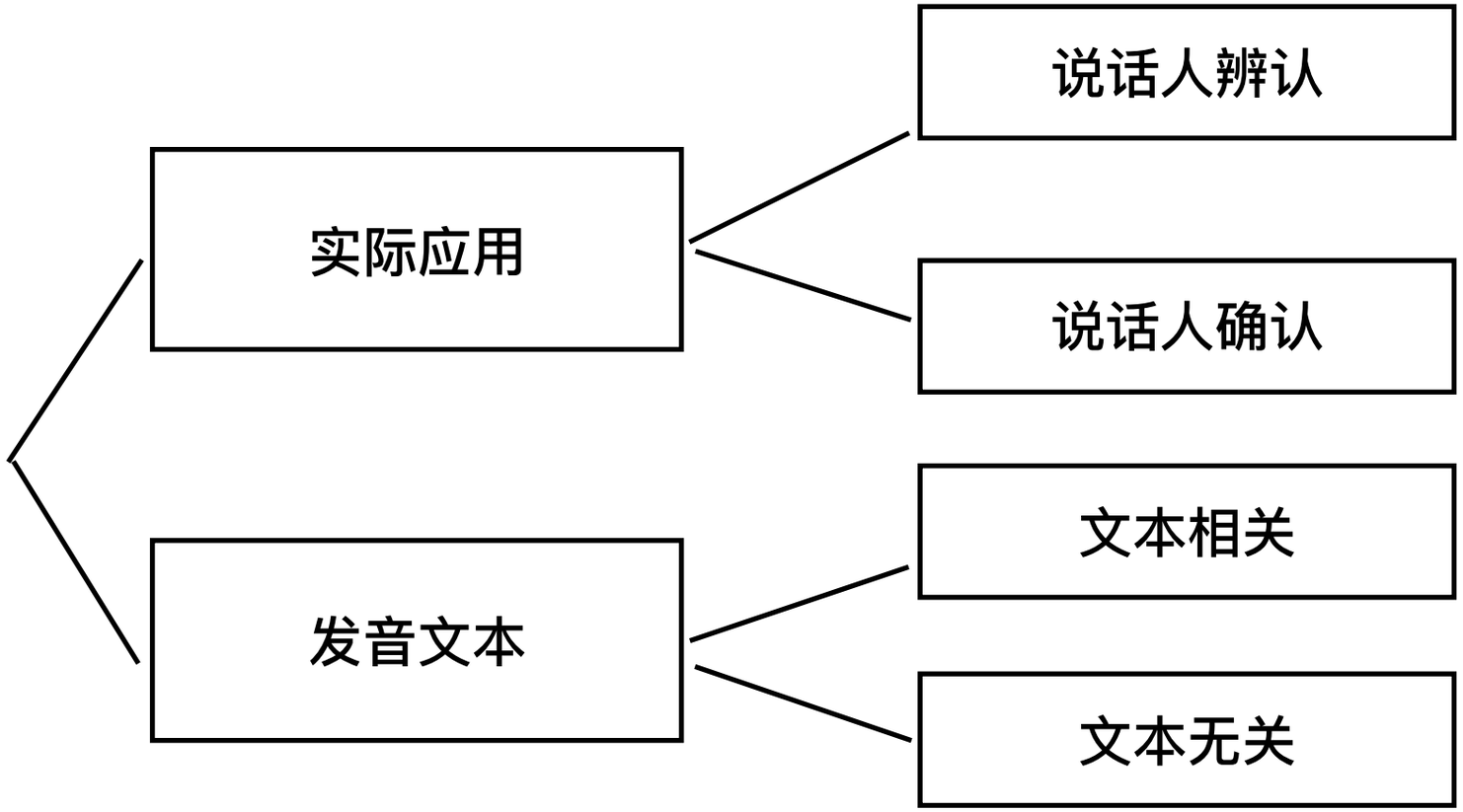
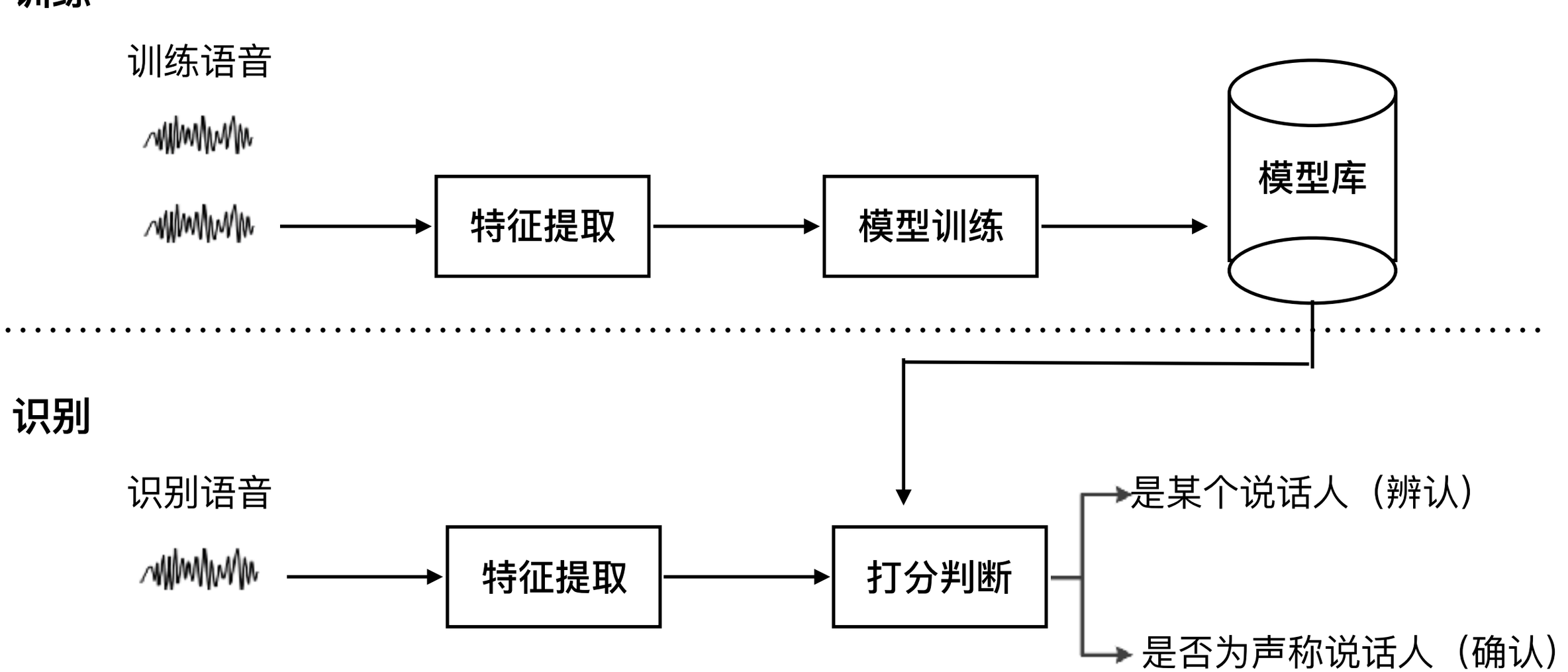
目录

说话人识别

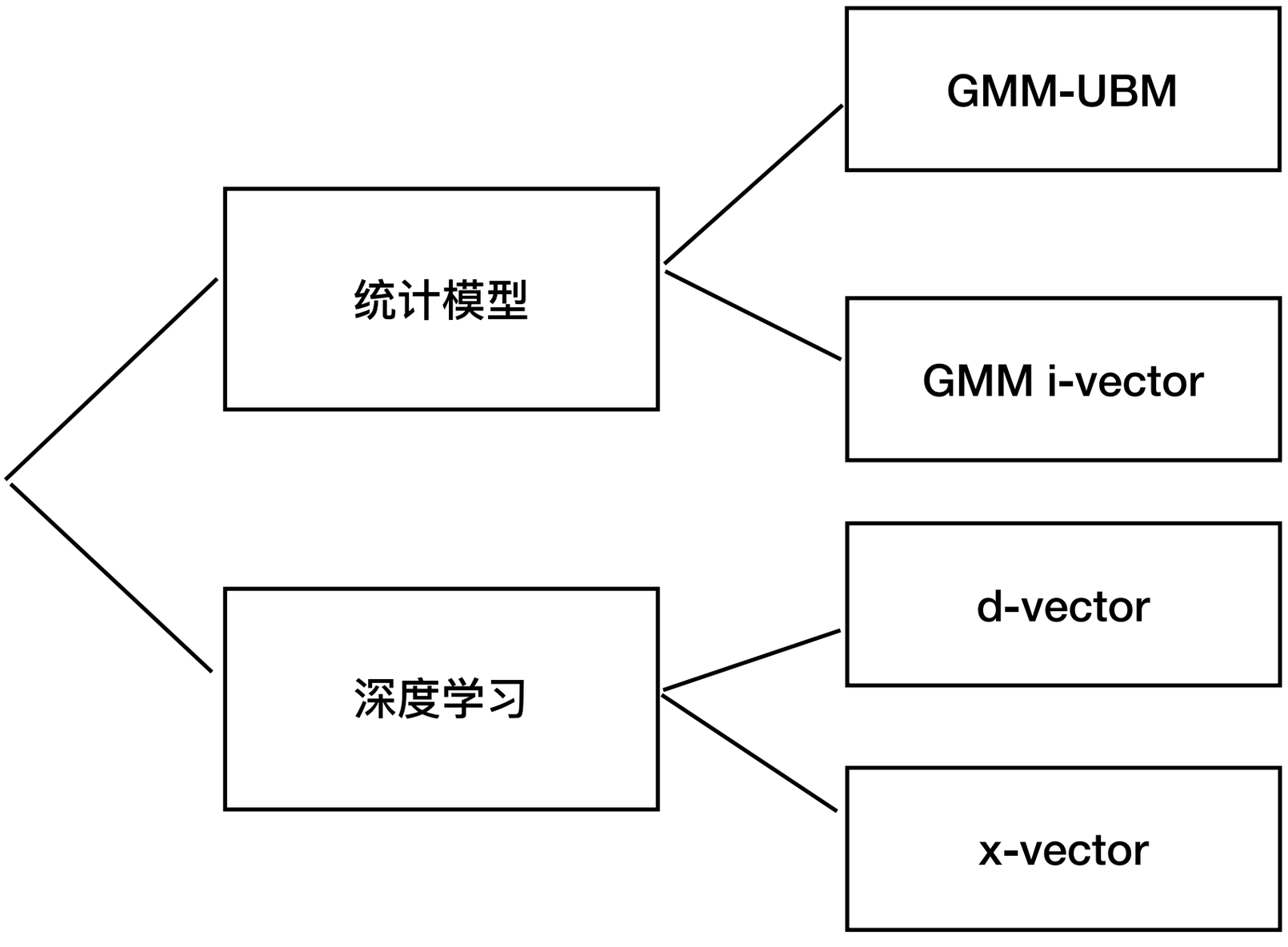
- 定义：根据说话人语音信号确认说话人身份
- 分类



说话人识别系统结构

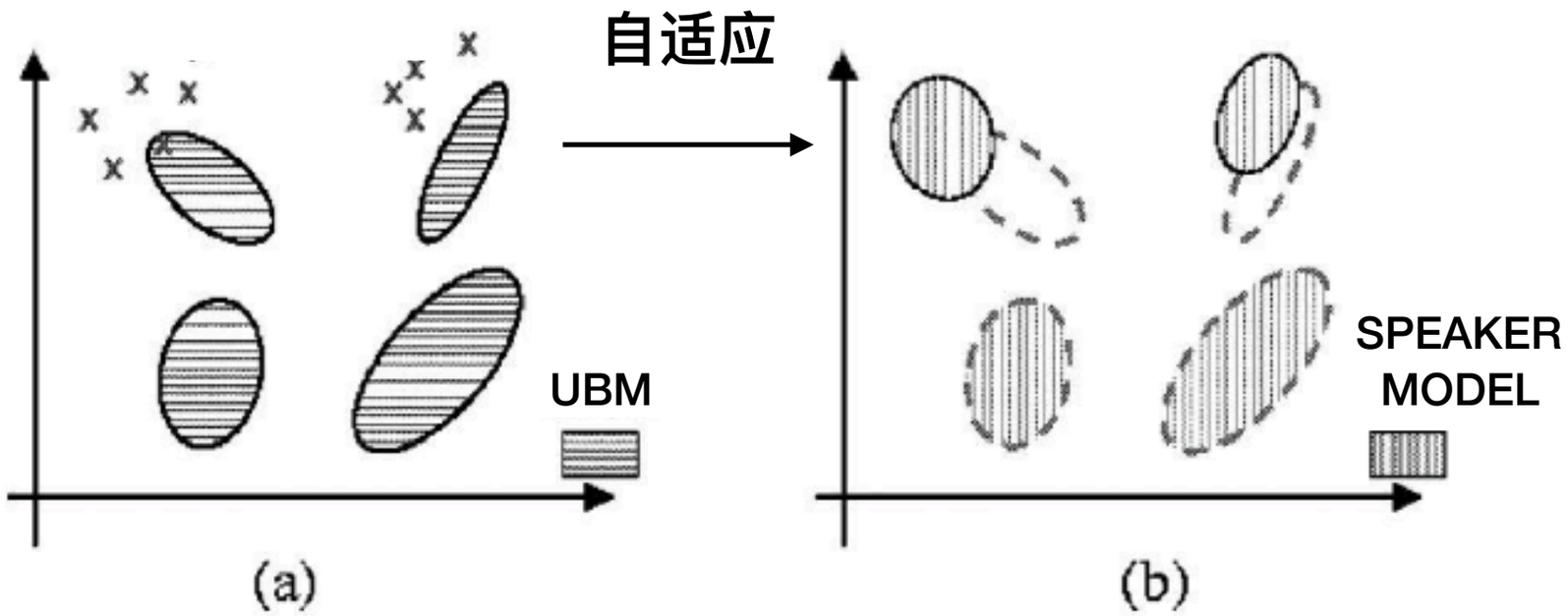


方法



统计模型

GMM-UBM



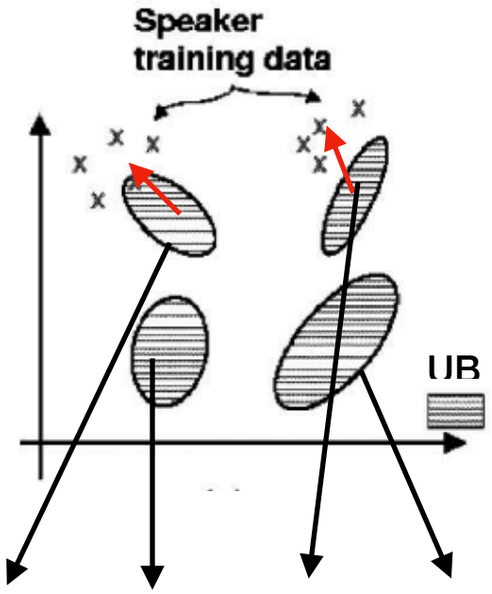
说话人建模：

- **使用大量的其他不同说话人语音数据训练出UBM**
- **基于最大后验估计算法，用说话人语音数据自适应得到说话人的GMM**

i-vector的提出

GMM-UBM: $M = \mathrm{m} + \mathrm{s}$

缺点：独立同分布假设过强，分量含有大量冗杂；既含有说话人相关信息，又包含了大量说话人无关信息

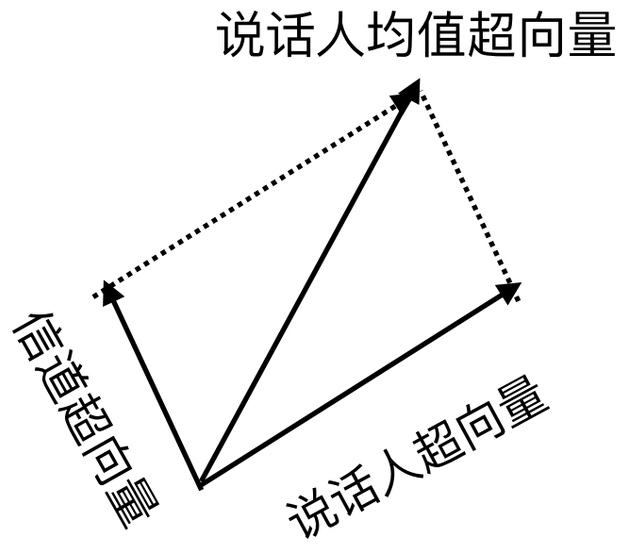


说话人均值超向量：

JFA: $M = \mathrm{m} + \mathrm{V}y + \mathrm{U}x + Dz$

说话人因子　信道因子　残差因子

缺点：很难将说话人空间和信道空间划分出来



i-vector

均值超矢量：

i-vector：

400～600维

公式：$M = m + Tw$　　T：全局差异空间矩阵

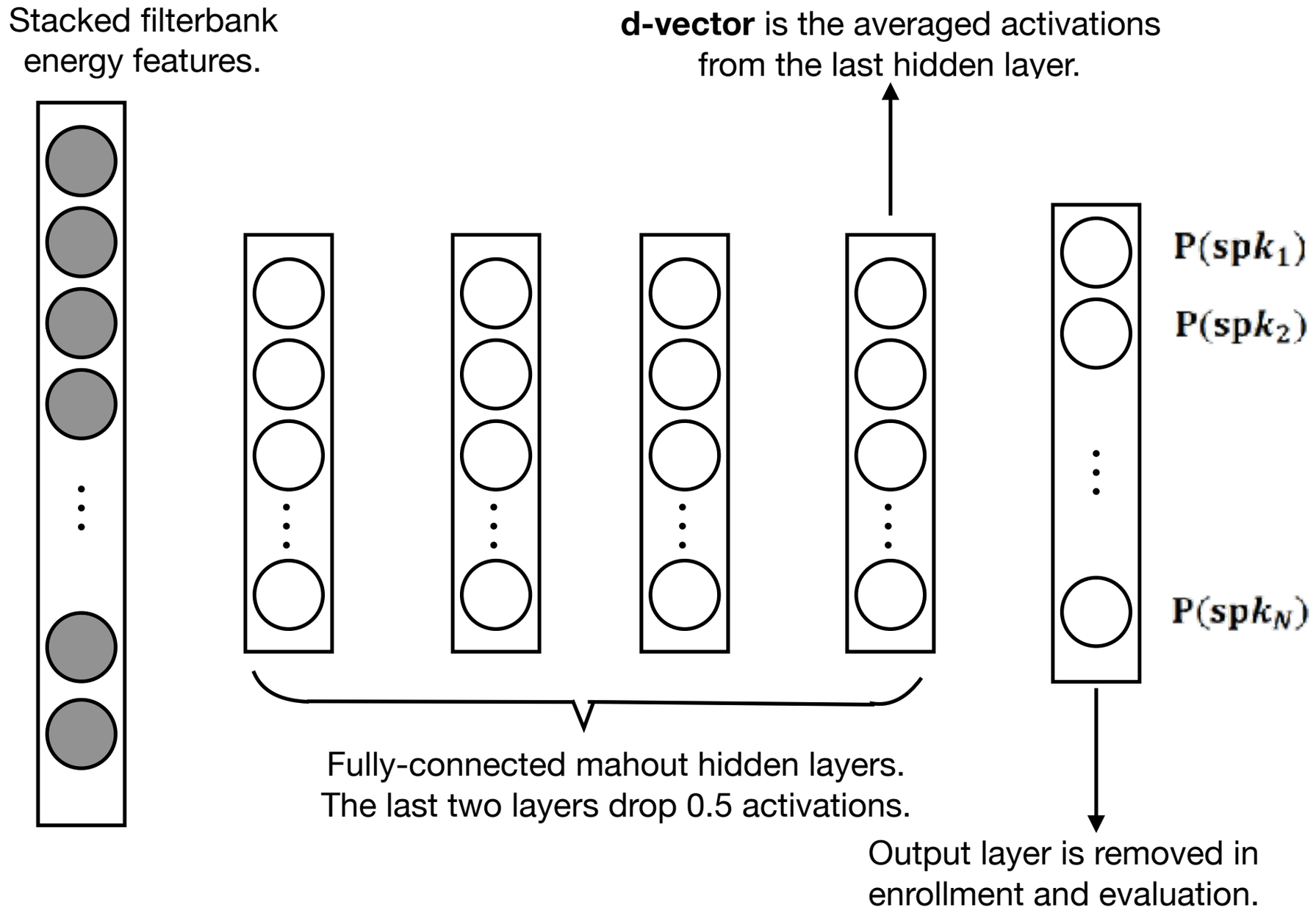
思想：基于因子分析，将均值超向量映射到一个低维的子空间，该子空间同时描述说话人信息和信道信息

深度学习

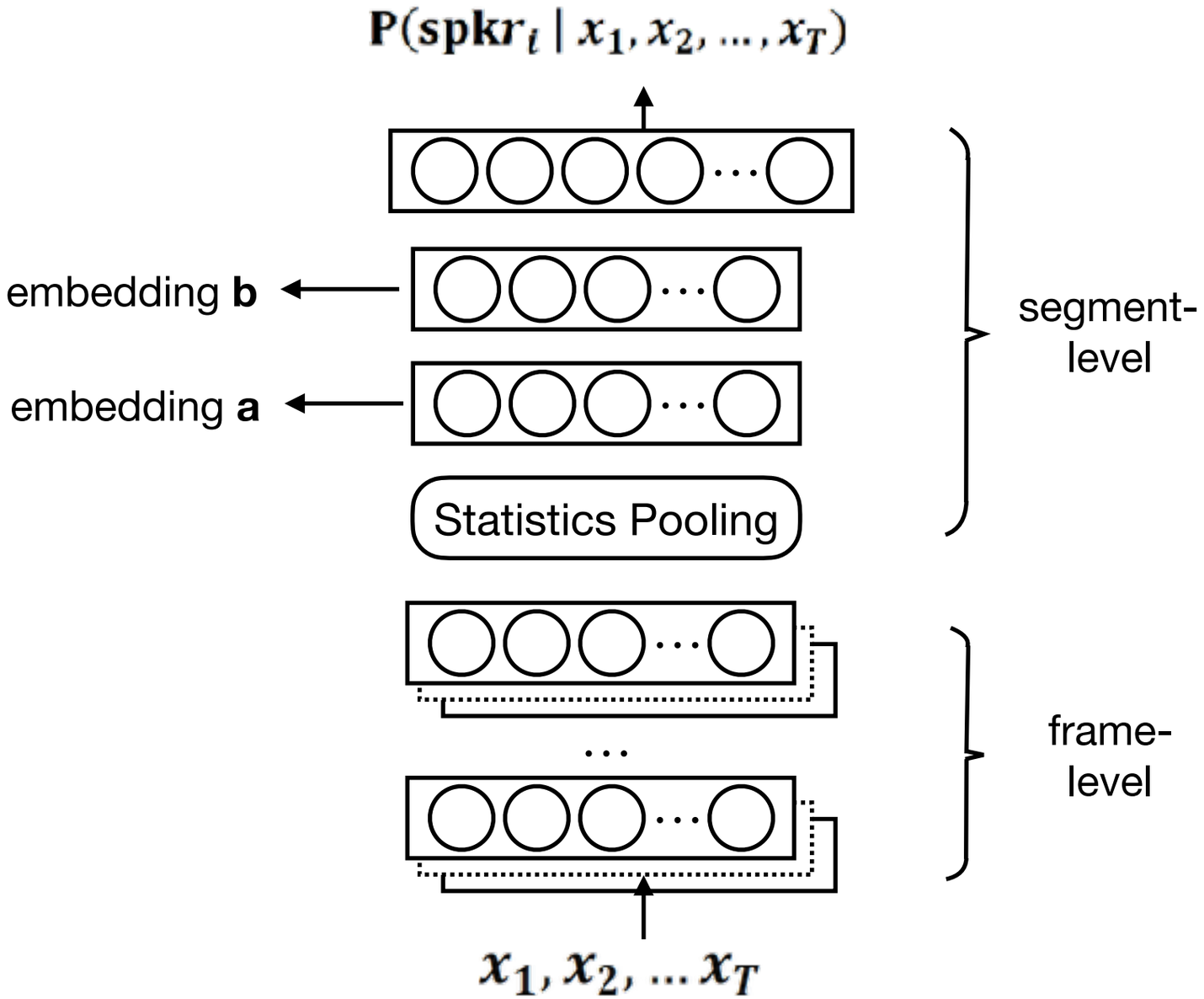
深度学习的理由

- **统计模型的缺点**
  - 原始特征（MFCC）受非说话人因素影响显著，变动性强
  - 线性高斯模型先验假设过强
- **深度学习的优点**
  - 无需人为设计特征，任务导向
  - 函数表达能力强
  - 多层结构，特征学习能力强

d-vector


Stacked filterbank energy features.
d-vector is the averaged activations from the last hidden layer.
P(spk1)
P(spk2)
P(spkN)
Fully-connected mahout hidden layers.
The last two layers drop 0.5 activations.
Output layer is removed in enrollment and evaluation.

x-vector


$\mathbf{P}(\mathbf{spkr}_i \mid x_1, x_2, \ldots, x_T)$
embedding **b**
embedding **a**
Statistics Pooling
segment-level
frame-level
$x_1, x_2, \ldots x_T$

Kaldi实验

i-vector

数据准备

UBM训练

i-vector extractor训练

数据增强

提取i-vector

打分模型训练

打分

x-vector

数据准备

数据增强

x-vector特征准备

网络训练

打分模型训练

打分

数据集

数据集：thchs30

data set	utterance
eval	2495
dev	893
train	10000

utt	train set
before augmenttation	10000
after augmentation	50000

实验结果

EER%	i-vector
Cosine	9.54
LDA	7.12
PLDA	6.27

EER%	x-vector
Cosine	12.09
LDA	10.62
PLDA	7.08

现象与分析

- **实验现象**
  - x-vector和i-vector的表现并不是很好
- **原因分析**
  - x-vector：训练时未收敛，而是从中选择了一个模型作为最终测试的模型
  - i-vector：由于电脑配置问题，分量数选择得比较小
  - 使用的数据集比较小，换用更大的数据集效果可能会更好一些

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Thanks