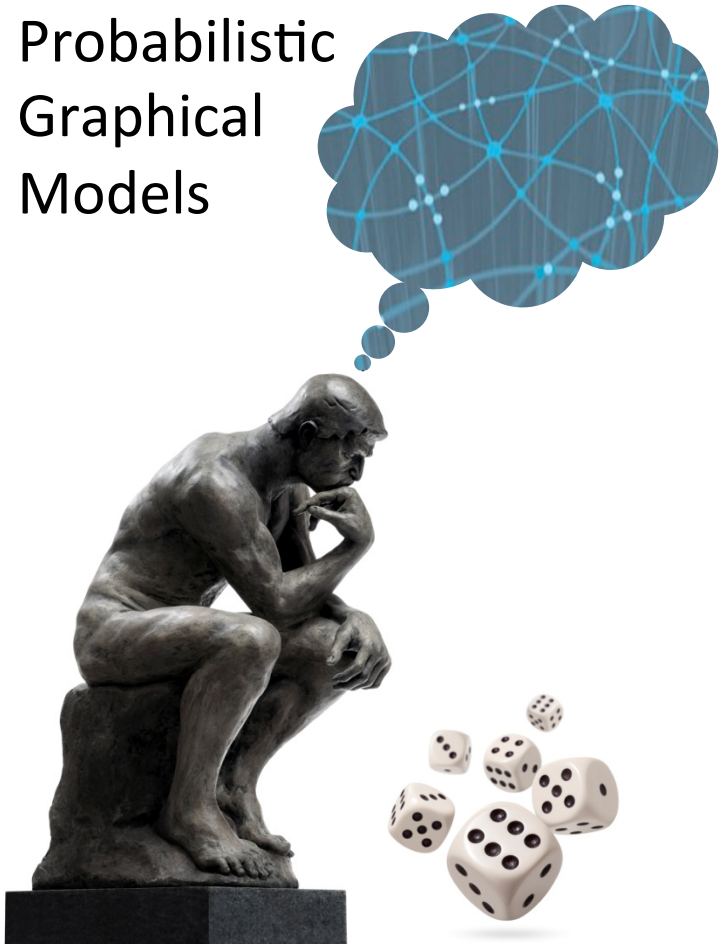
Probabilistic Graphical Models

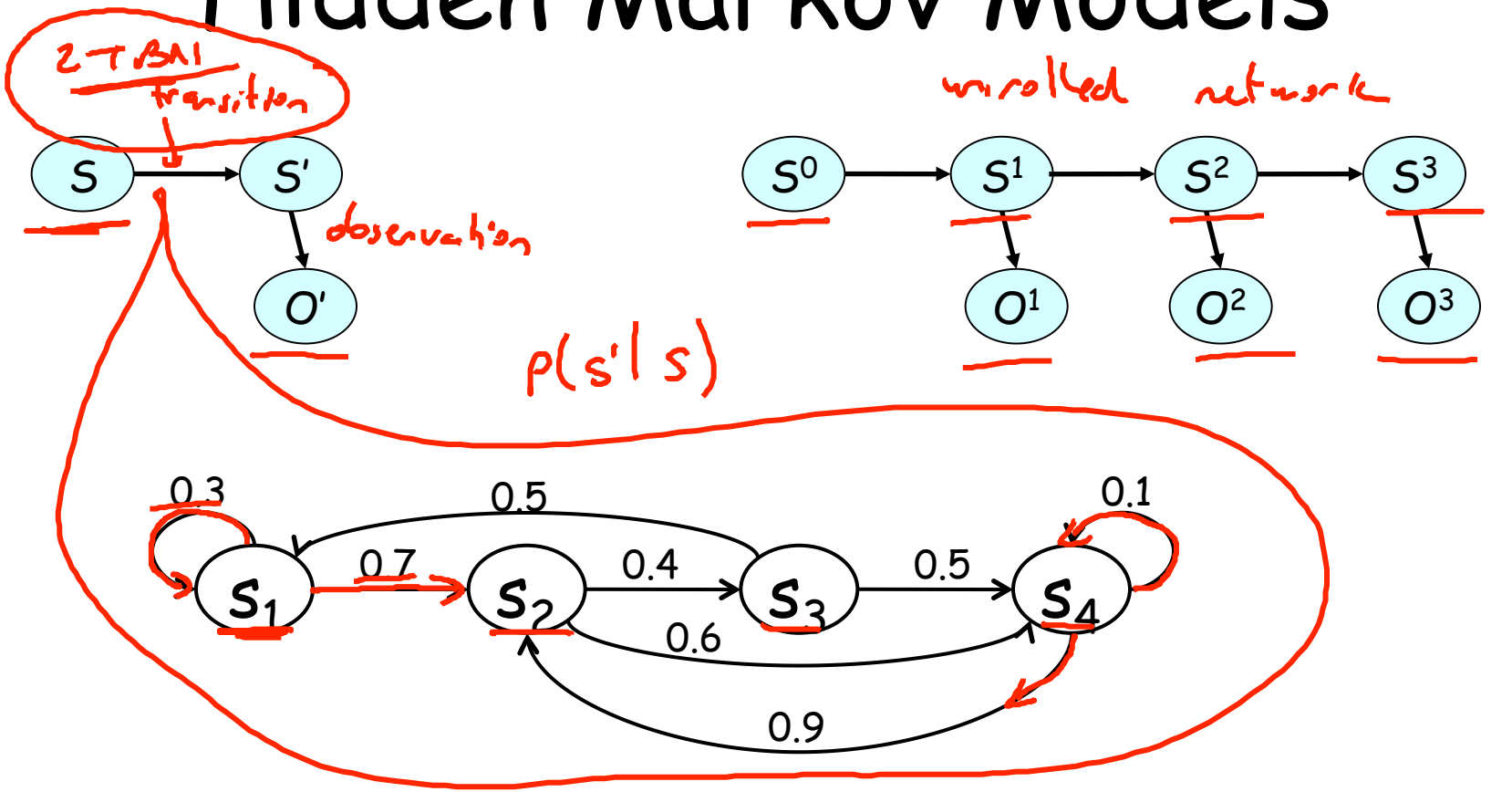


Representation

Template Models

Hidden Markov Models

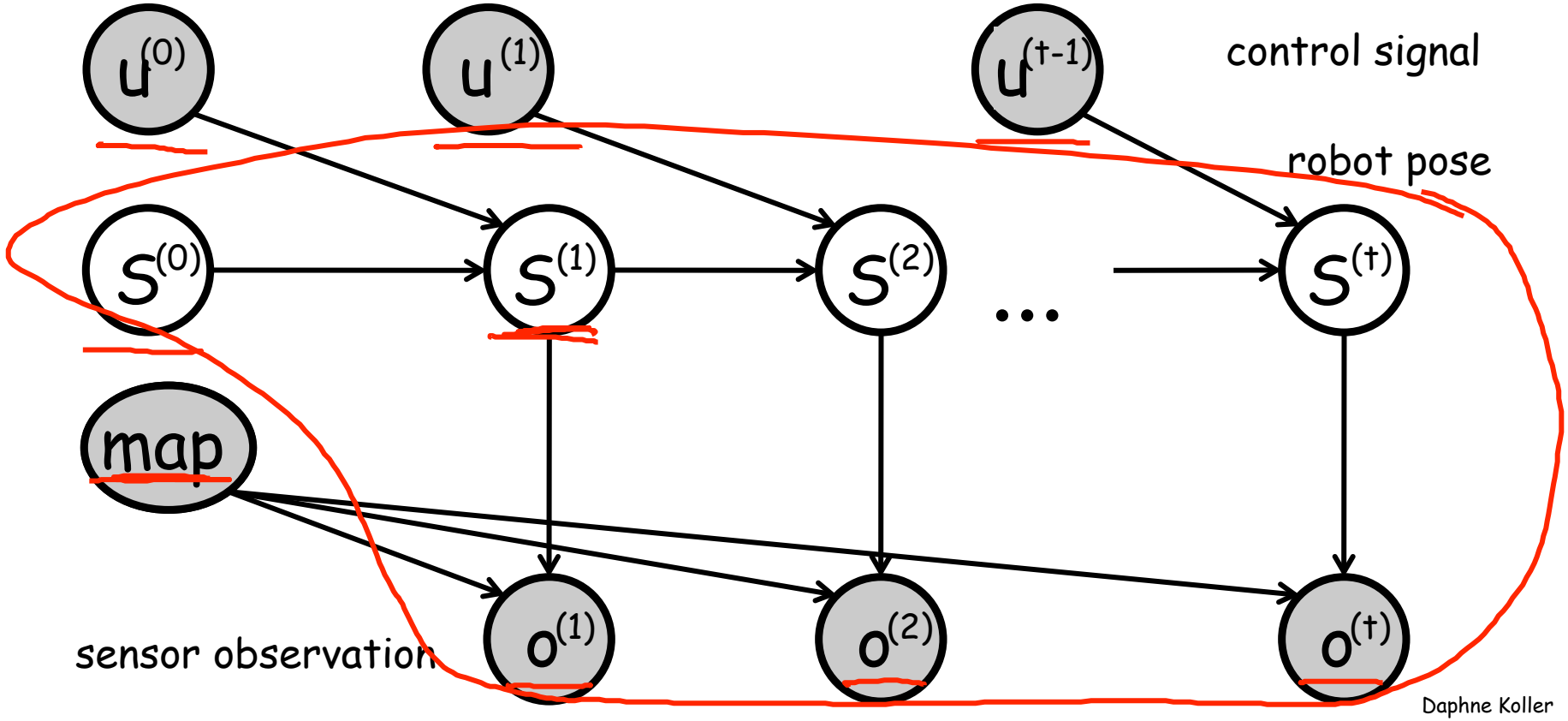
Hidden Markov Models



Numerous Applications

- Robot localization
- Speech recognition
- Biological sequence analysis
- Text annotation

Robot Localization



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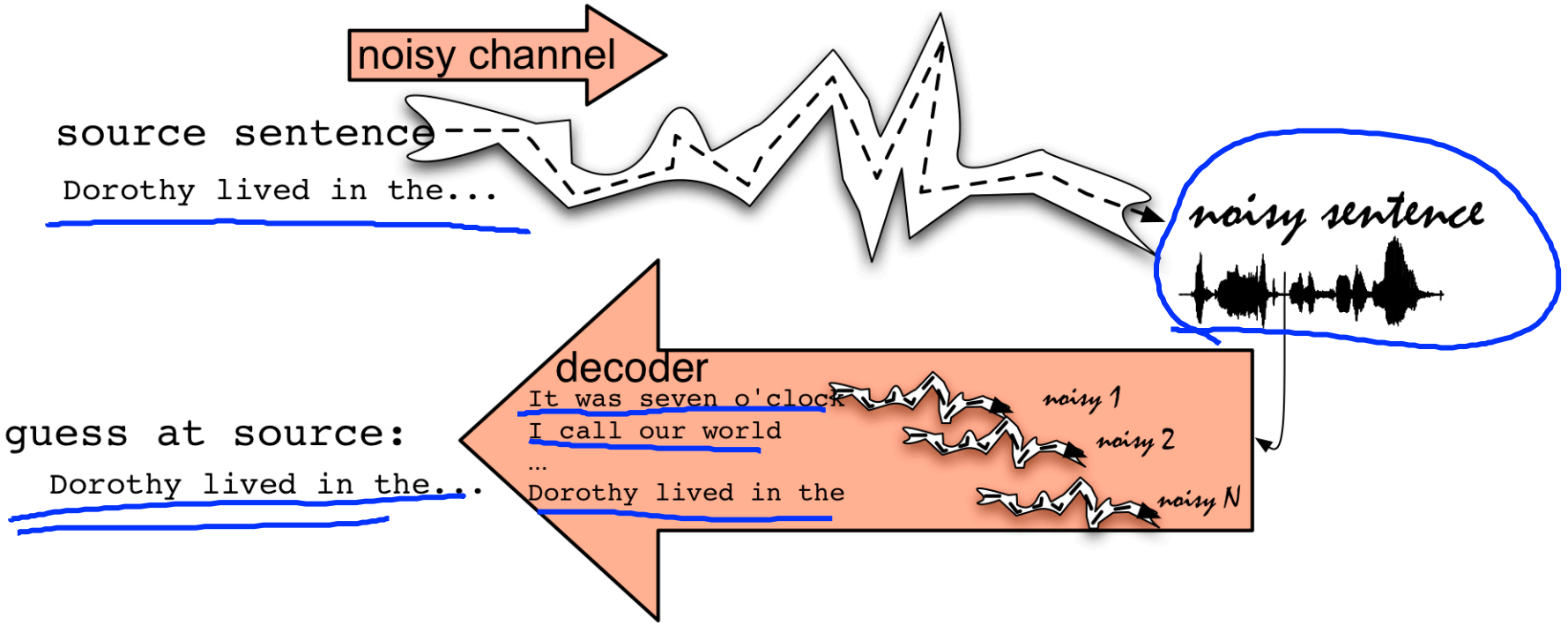
Speech Recognition



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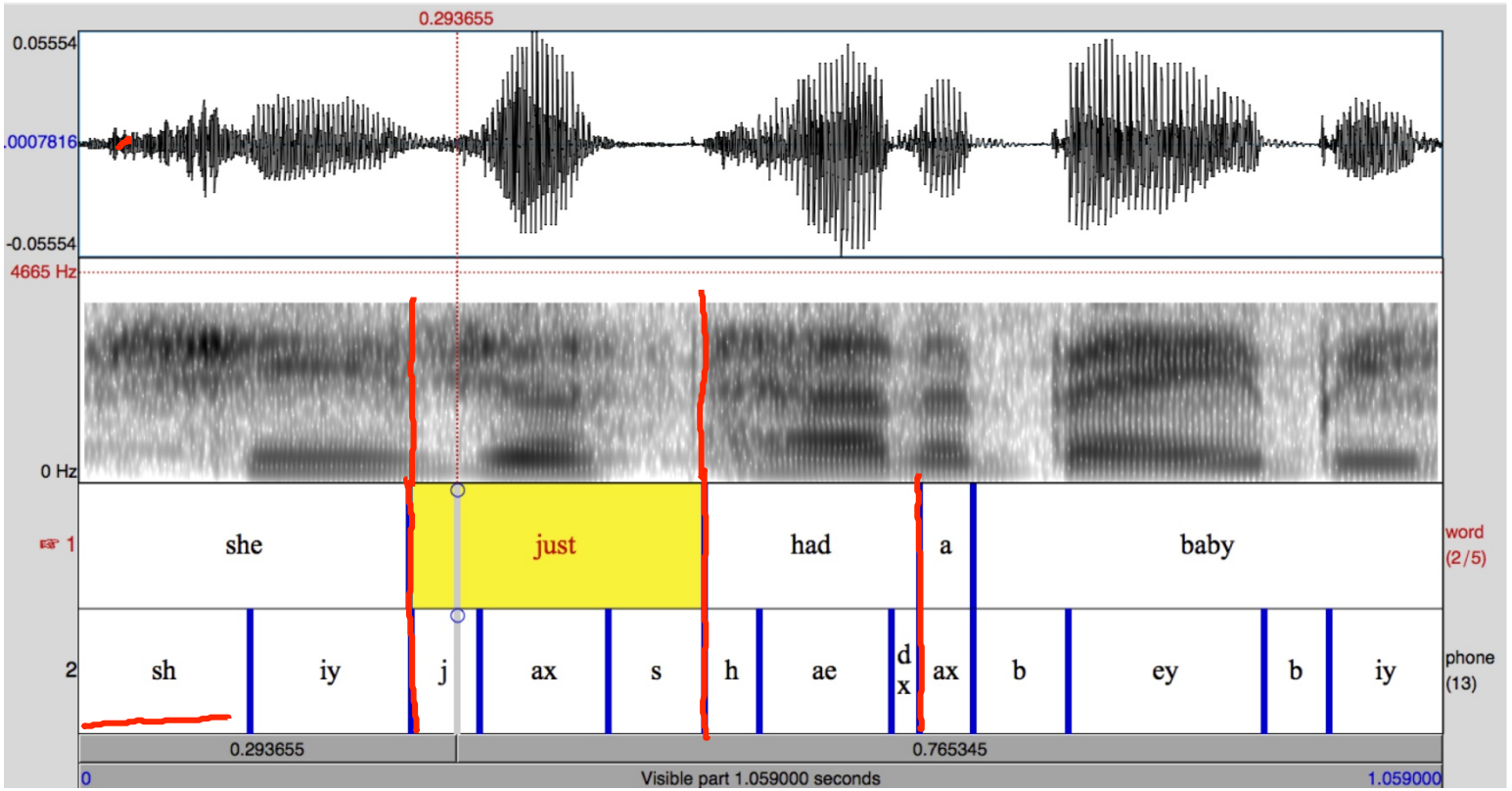
Segmentation of Acoustic Signal



phones

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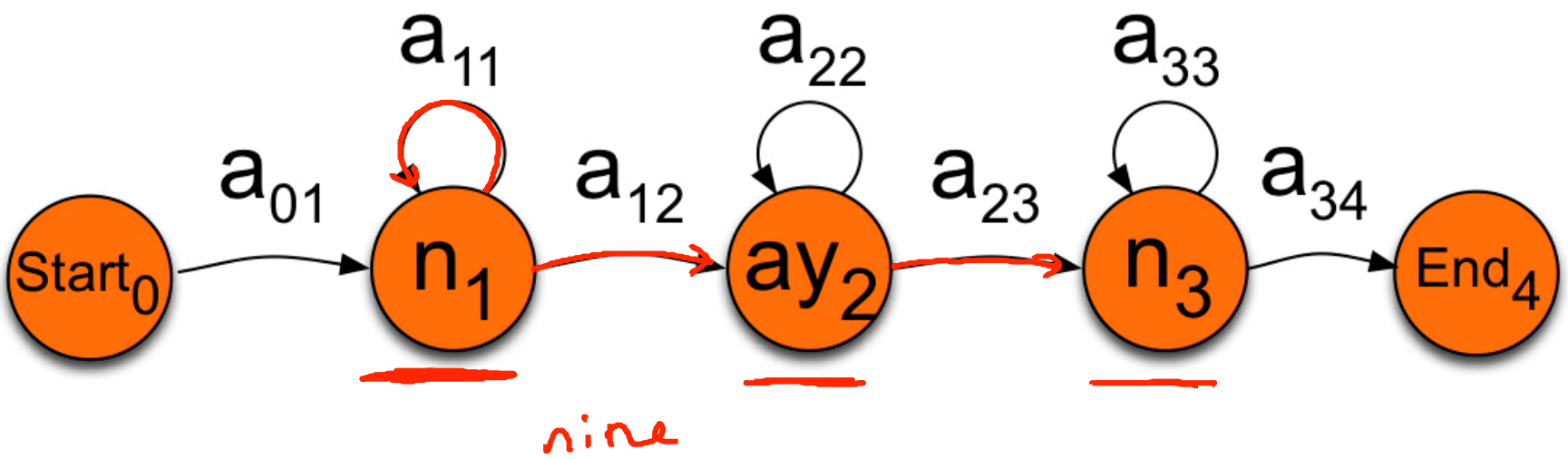
Phonetic Alphabet

AA	odd	AA D
AE	at	AE T
AH	hut	HH AH T
AO	ought	AO T
AW	cow	K AW
AY	hide	HH AY D
B	be	B IY
CH	cheese	CH IY Z
D	dee	D IY
DH	thee	DH IY
EH	Ed	EH D
ER	hurt	HH ER T
EY	ate	EY T
F	fee	F IY
G	green	G R IY N
HH	he	HH IY
IH	it	IH T
IY	eat	IYT
JH	gee	JH IY
K	key	K IY
L	lee	L IY
M	me	M IY
N	knee	N IY
NG	ping	P IH NG
OW	oat	OW T
OY	toy	T OY
P	pee	P IY
R	read	R IY D
S	sea	S IY
SH	she	SH IY
T	tea	T IY
TH	theta	TH EY T AH
UH	hood	HH UH D
UW	two	T UW
V	vee	V IY
W	we	W IY
Y	yield	Y IY L D
Z	zee	Z IY
ZH	seizure	S IY ZH ER

http://www.speech.cs.cmu.edu/cgi-bin/cmudict

The CMU Pronouncing Dictionary

Word HMM



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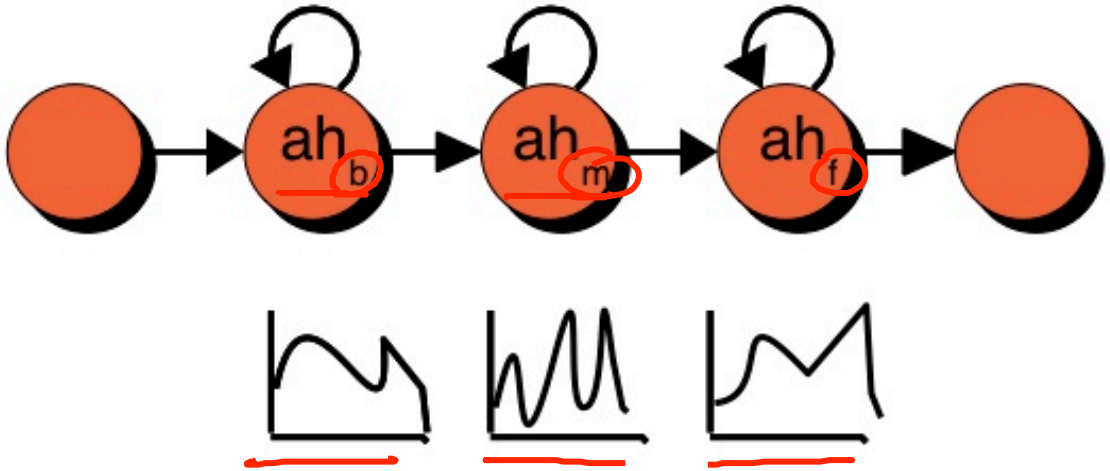
Phone HMM



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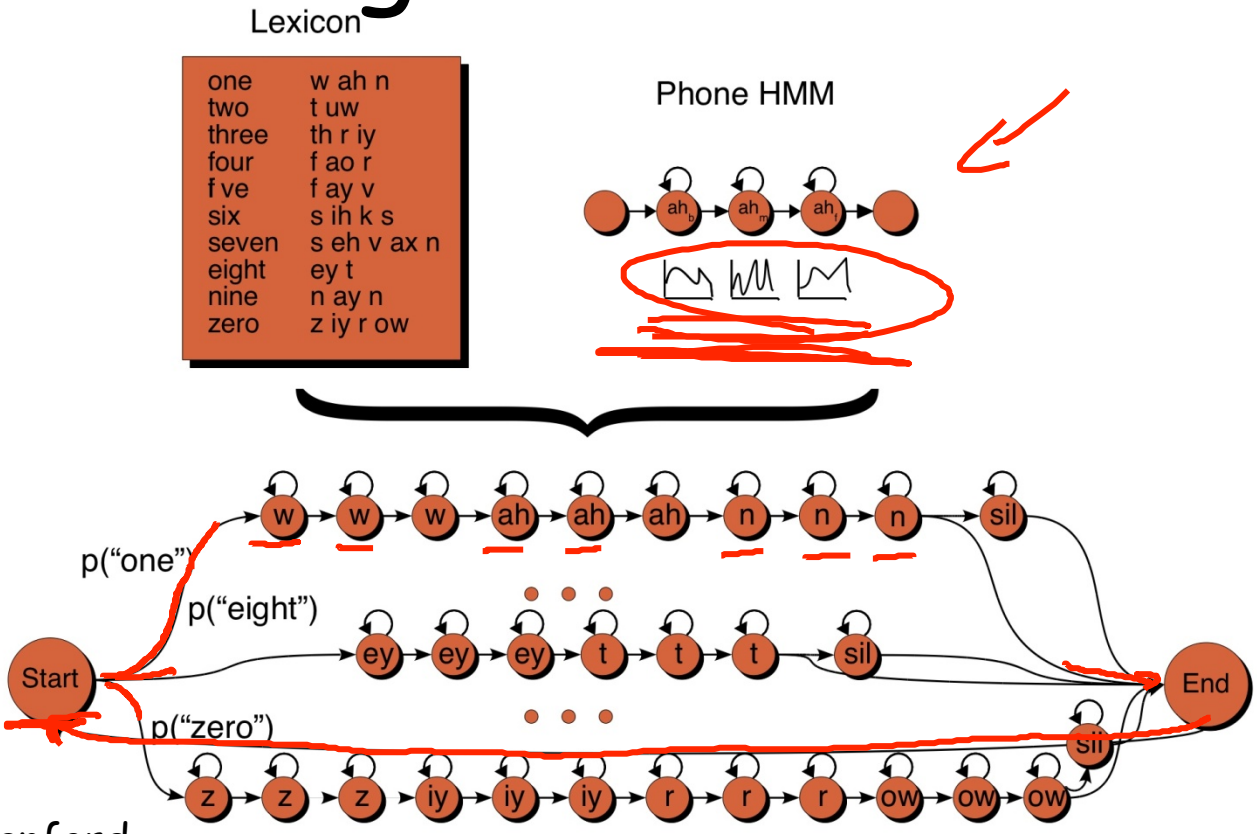
Recognition HMM



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Summary

- HMMs can be viewed as a subclass of DBNs
- HMMs seem unstructured at the level of random variables
- HMM structure typically manifests in sparsity and repeated elements within the transition matrix
- HMMs are used in a wide variety of applications for modeling sequences