CS 4650/7650: Natural Language Processing

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Lecture 8: Finite-state architectures

September 11, 2014

Michael Jordan on Reddit AMA

I'd use the billion dollars to build a NASA-size program focusing on natural language processing (NLP), in all of its glory (semantics, pragmatics, etc).
Intellectually I think that NLP is fascinating, allowing us to focus on highly-structured inference problems, on issues that go to the core of "what is thought" but remain eminently practical, and on a technology that surely would make the world a better place.

`http://www.reddit.com/r/MachineLearning/comments/2fxi6v/ama_michael_i_jordan/`

Homework

Swahili

1.	atanipenda	‘s/he will like me’
2.	atakupenda	‘s/he will like you’
3.	atampenda	‘s/he will like him/her’
4.	atatupenda	‘s/he will like us’
5.	atawapenda	‘s/he will like them’
6.	nitakupenda	‘I will like you’
7.	nitampenda	‘I will like him/her’
8.	nitawapenda	‘I will like them’
9.	utanipenda	‘you will like me’
10.	utampenda	‘you will like him/her’
11.	tutampenda	‘we will like him/her’
12.	watampenda	‘ they will like him/her’
13.	wametulipa	‘they have paid us’
14.	tulikulipa	‘we paid you’
15.	atanipiga	‘s/he will beat me’
16.	atakupiga	‘s/he will beat you’
17.	atampiga	‘s/he will beat him/her’
18.	ananipiga	‘s/he is beating me’
19.	anakupiga	‘s/he is beating you’
20.	anampiga	‘s/he is beating him/her’
21.	amekupiga	‘s/he has beaten you’
22.	amenipiga	‘s/he has beaten me’
23.	amempiga	‘s/he has beaten him/her’
24.	alinipiga	‘s/he beat me’
25.	alikupiga	‘s/he beat you’
26.	alimpiga	‘s/he beat him/her’
27.	atakusumbua	‘s/he will annoy you’
28.	unamsumbua	‘you are annoying him/her’

Homework

Protesters took to the streets of Barcelona on Thursday to demand that the Spanish government allow its Catalonia region to vote for independence.

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- Protest+er+s

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- Protest+er+s
- street+s

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- Protest+er+s
- street+s
- govern+ment

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- Protest+er+s
- street+s
- govern+ment
- in+depend+ence

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- Protest+er+s
- street+s
- govern+ment
- in+depend+ence
- journalist $\rightarrow$ journal+ist $\stackrel{?}{\rightarrow}$ jour+nal+ist

Weighted finite-state acceptors for NLP

- Edit distance
- Derivational morphology
- Language models

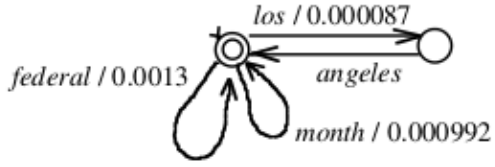
Some semirings

Name	$\mathbb{K}$	$\oplus$	$\otimes$	$\bar{0}$	$\bar{1}$	Applications
Boolean	$\{0, 1\}$	$\vee$	$\wedge$	0	1	identical to an unweighted FSA
Probability	$\mathbb{R}_+$	$+$	$\times$	0	1	sum of probabilities of all paths
Log-probability	$\mathbb{R} \cup -\infty \cup \infty$	$\oplus_{\log}$	$+$	$-\infty$	0	log marginal probability
Tropical	$\mathbb{R} \cup -\infty \cup \infty$	min	$+$	∞	0	best single path

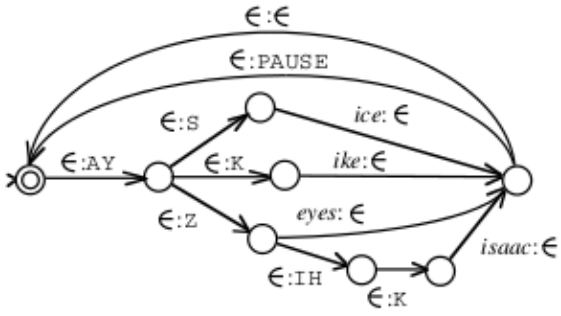
Finite-state transducers for NLP

- Edit distance
- Simple translation
- Transliteration
- Stemming
- Morphological analysis
- Sequence labeling

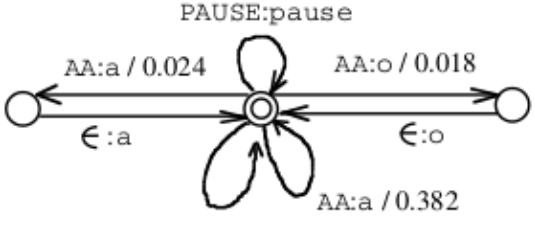
Transliteration



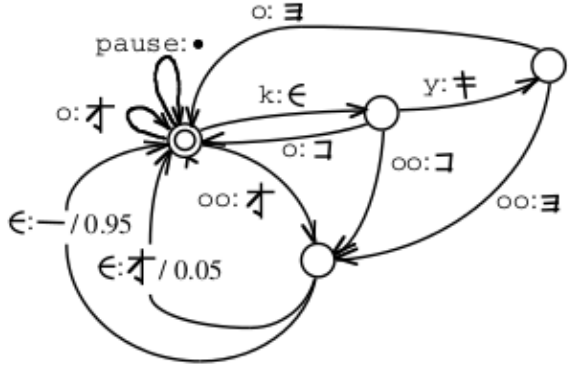
a WFSA A: Produce an English phrase



b WFST B: Convert English phrase to English sounds

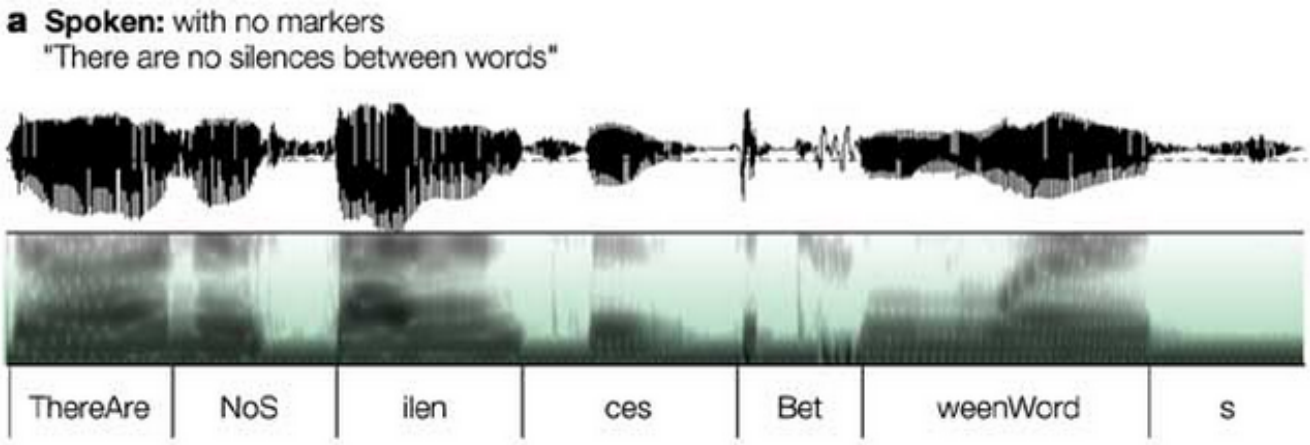


c WFST C: Convert English sounds to Japanese sounds



d WFST D: Convert Japanese sounds to Katakana

Segmentation



original, un-segmented text

再往远些看，随着汉字识别和语音识别技术的发展，
中文计算机用户将跨越语言差异的鸿沟，
在录入上走向中西文求同的道路。

separated word entities after segmentation

再 往 远 些 看 ， 随着 汉字 识别 和 语音 识别 技术 的 发展 ，
中文 计算机 用户 将 跨越 语言 差异 的 鸿沟 ，
在 录入 上 走 向 中 西文 求 同 的 道路 。