



Ellen Riloff:
Hey Hal, what happens
If there are classes
in the new domain
That don't exist
In the old domain?



Hal (c. 2007):
Meh? No clue.
Does that really
Happen in practice?



Hal (c. 2014):
Ok. Yeah.
It's a problem.
It's a big problem.

the... of new labels
multitask learning
at #nips2014

Language does have many flavors!

- Can you guess what domain each of these sentences is drawn from?

News

Many factors contributed to the French and Dutch objections to the proposed EU constitution

Parliament

Please rise, then, for this minute's silence

Medical

Latent diabetes mellitus may become manifest during thiazide therapy

Science

Statistical machine translation is based on sets of text to build a translation model

Step-mother

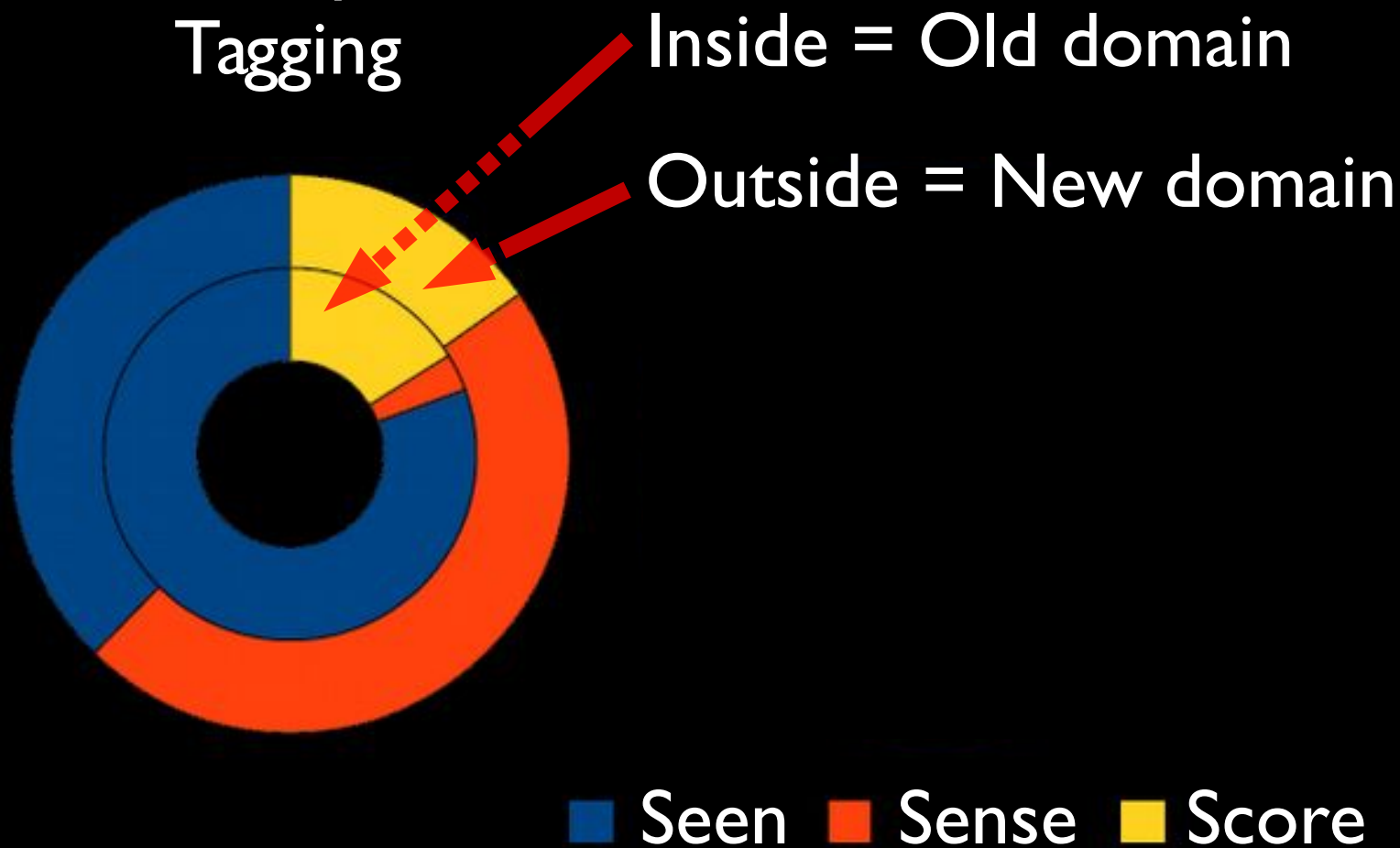
I forgot to mention in yesterday's post that I also trimmed an overgrown HUGE hedge that spams the entire length of the front of my house and is about 3' accrossed.

S4 taxonomy of adaptation effects

- **Seen:** Never seen this word before
 - News to medical: “diabetes mellitus”
- **Sense:** Never seen this word used in this way
 - News to technical: “monitor”
- **Score:** The wrong output is scored higher
 - News to medical: “manifest”
- **Search:** Decoding/search erred

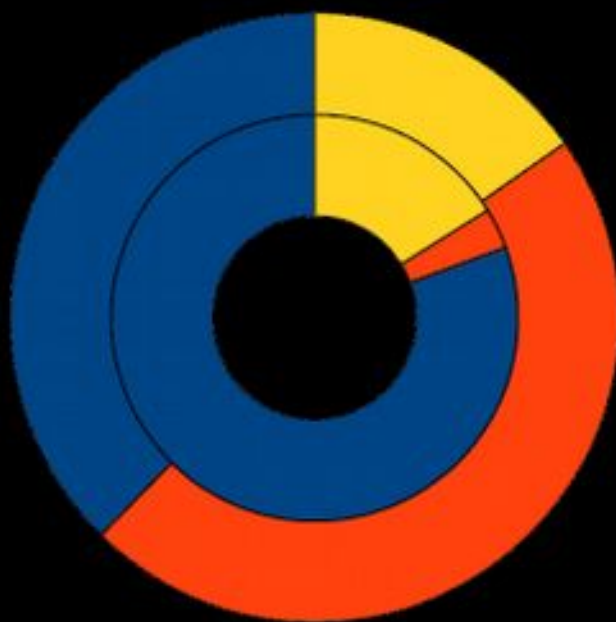
S4 applied to "easy" NLP problems...

Part of Speech Tagging

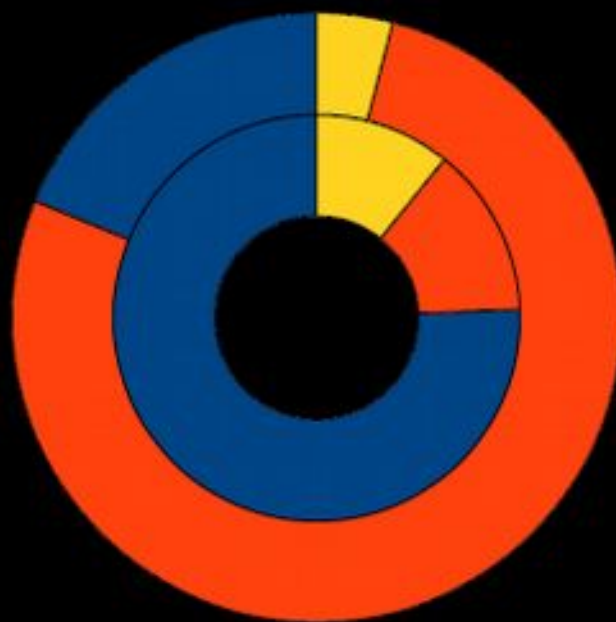


S4 applied to "easy" NLP problems...

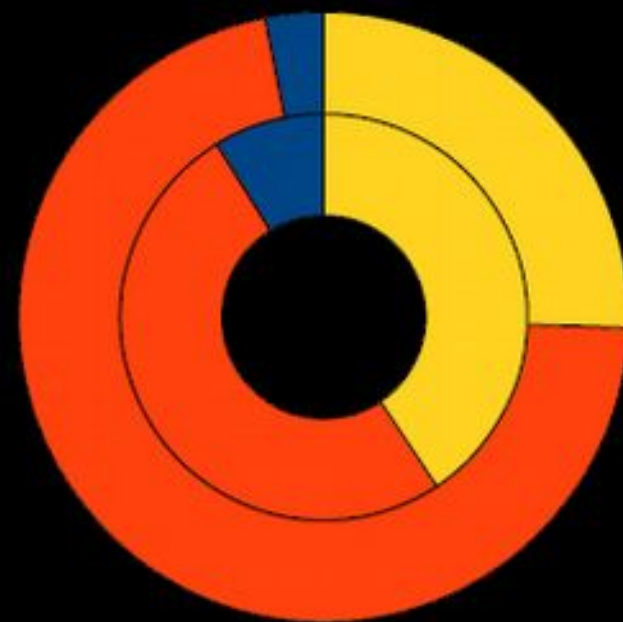
Part of Speech Tagging



Shallow Parsing



Named Entity Recognition



■ Seen ■ Sense ■ Score

Inside = Old domain

Outside = New domain

Is this a problem for harder tasks?

The screenshot shows the Google Translate interface. At the top is the Google logo. Below it is the word "Translate" in red. The source language is set to "French - detected" and the target language is "English". The input text is "Kitchenaid en parfait état" and "Anti adhésif encore parfait". The output text is "Kitchenaid in perfect condition" and "Anti Obama still perfect". The interface includes a "Translate" button, a "Swap" button, and various icons for audio, speech, and sharing.

Google

Translate

English Spanish French French - detected

Kitchenaid en parfait état
Anti adhésif encore parfait

English Spanish Arabic Translate

Kitchenaid in perfect condition
Anti Obama still perfect

Translating across domains is hard

Old Domain (Parliament)

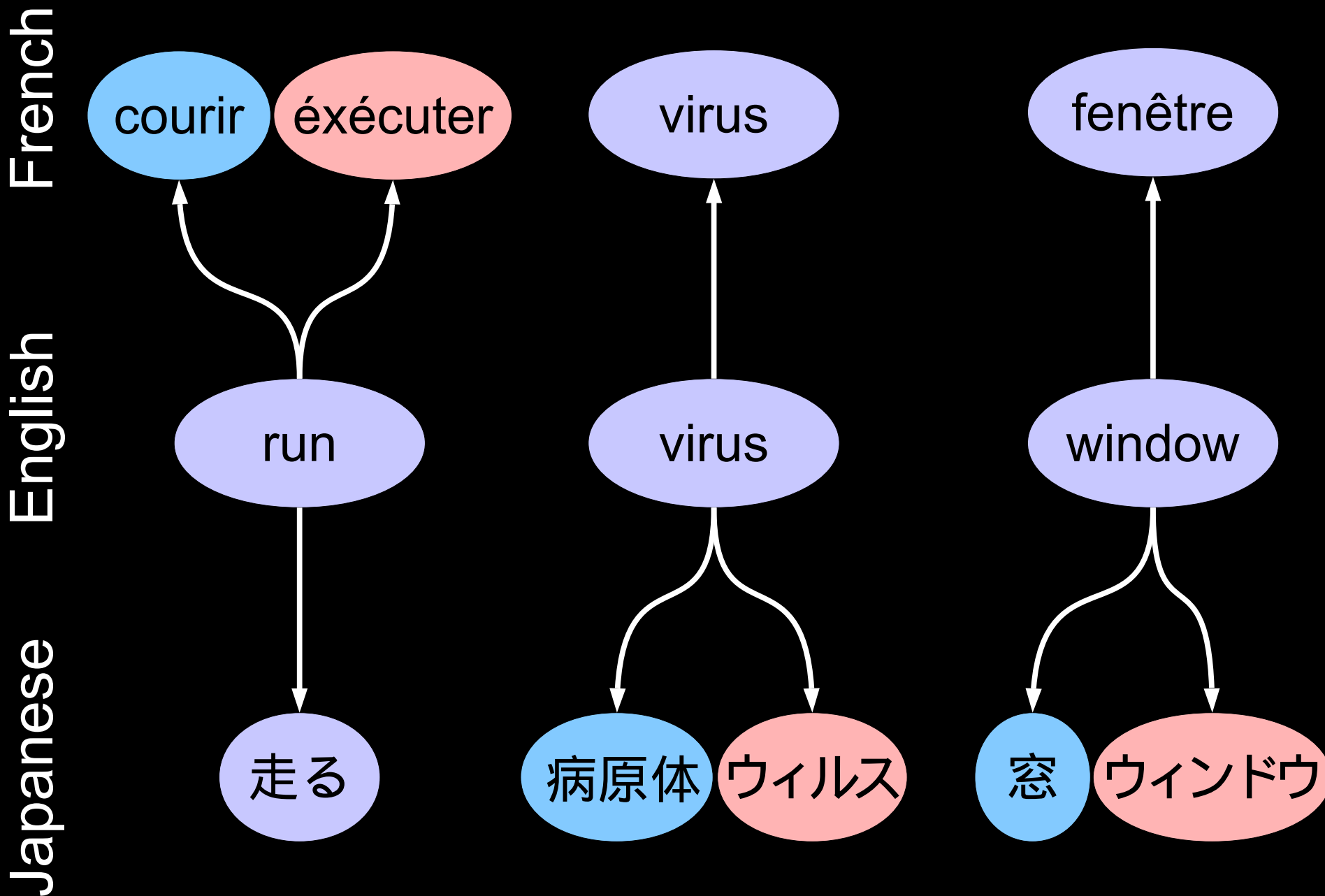
Original	monsieur le président, les pêcheurs de homard de la région de l'atlantique sont dans une situation catastrophique.
Reference	mr. speaker, lobster fishers in atlantic canada are facing a disaster.
System	mr. speaker, the lobster fishers in atlantic canada are in a mess.

New Domain

Original	mode et voie(s) d'administration
Reference	method and route(s) of administration
System	fashion and voie(s) of directors

Key Question: What went wrong?

Senses are domain/language specific



Domain Shift Setting

Old domain: Hansard parliamentary proceedings

Sentences		Tokens	Types
8m	fr	162m	192k
	en	145m	187k

French to English phrase-based translation system

Compare old domain model

With mixed old+new model as pseudo-oracle

New Domain Datasets

Domain

Sentences

Tokens

Types



News

135k

fr

4m

63k

en

3m

52k



Medical

472k

fr

7m

35k

en

6m

30k



Science

139k

fr

4m

118k

en

4m

114k



Subtitles

19,000k

fr

155m

362k

en

174m

293k

Old domain

8,000k

fr

162m

192k

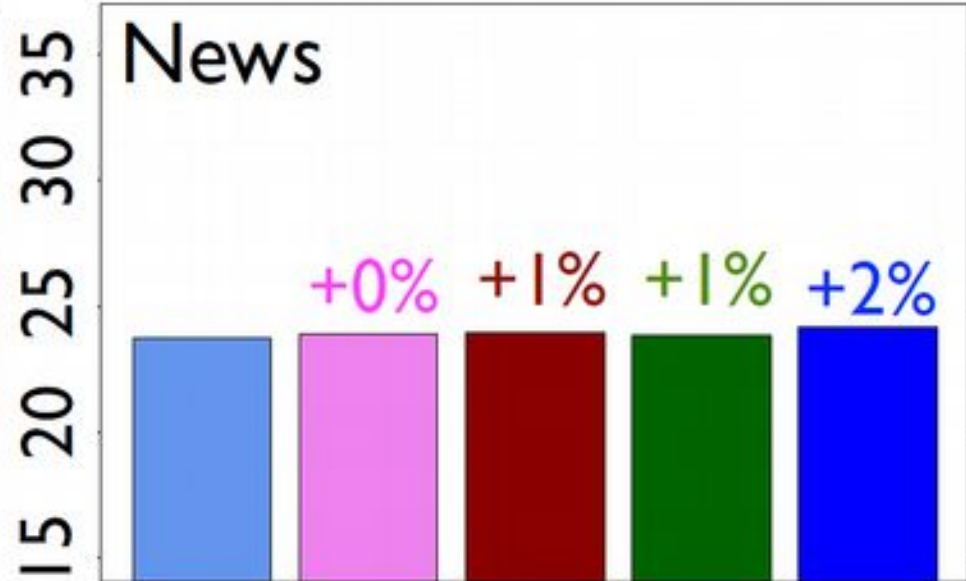
en

145m

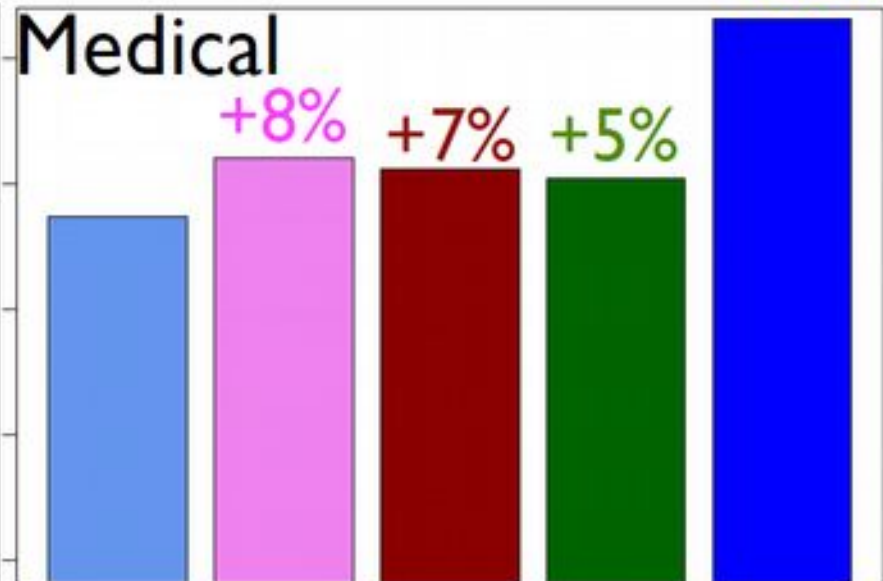
187k



BLEU



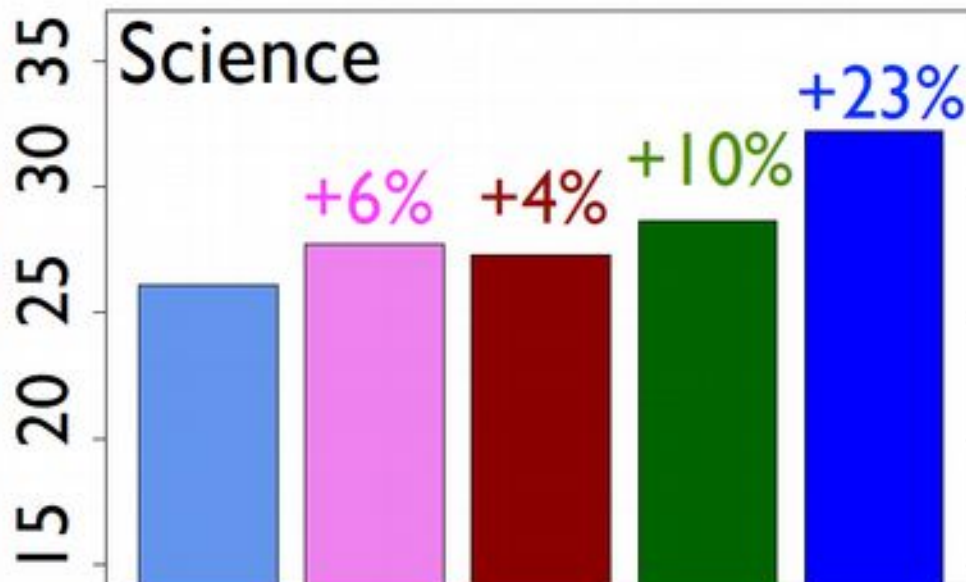
OLD +Seen +Sense +Score Mixed



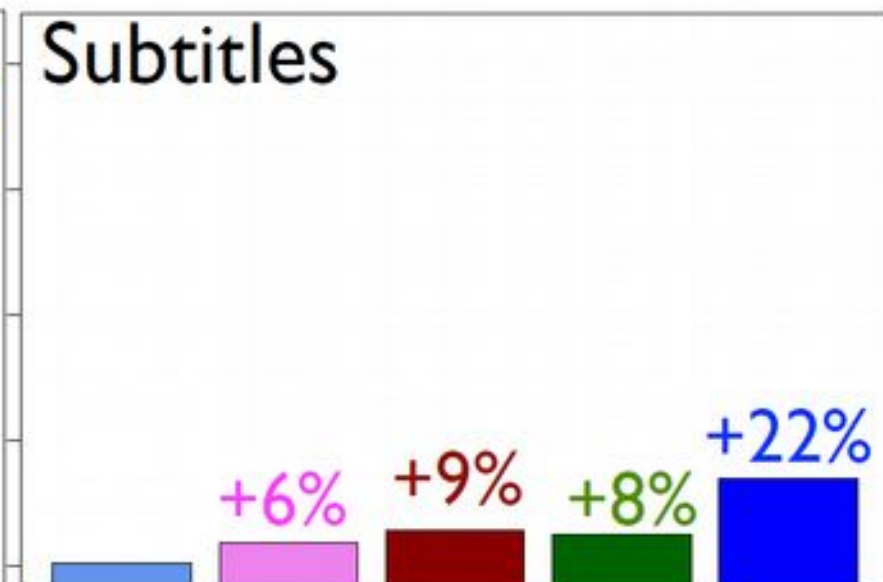
OLD +Seen +Sense +Score Mixed



BLEU



OLD +Seen +Sense +Score Mixed



OLD +Seen +Sense +Score Mixed



SenseSpotting

Never let your parallel data
tie you to an old domain

- Spotting new *words* is easy
- Spotting words with new *translations* is hard
- Binary classification problem:
 - +ve: French token has previously unseen sense
 - -ve: French token is used in a known way
- 16 fold cross validation *at the type level*
 - *Never test on a word type seen in training!*
 - train on *mode, administration*; test on *rapport*

Test vocabulary

ramenez	ramification	rapport	rapportez
recevez	recherchée	rechercher	recherchés
recouvrement	réflexes	refuges	refuserais
rendez	rends	rendu	reportés
rigidité	rigueur	rompre	rond
scalaire	sébastien	service	signalant
sorties	souches	souhaitée	soulèvement
stériles	subissant	substituant	suis

remontent
flux
frayer
glissement
humour
immobilier
induisent
introduits
inutilisés
lâchez
laissent
lots
sloups
manuscrit
marche
mémoire
menacer
milieu
milieux
montage
morte
navets
navette
oeuvre
office
par
comie
paré
patron
patrons
peuplement
pharmaceutique
place
plaisantes
pompe
ponderosa
pratiqué
pratiqués
pression
prévues
quantitative
quartier
rapports
ratio
rechuter
écidive
régime
règle
requête
requis
rossignol
rubriques
similitudes
socle
souplesse
source
superpositions
supposée
témoignent
témoin
traduisant
train
vierge
vigilant
voilà
volets

figure
fonctions
froideur
grammes
implication
informations
inventaires
lampes
lumière
marché
méninges
mineur
motif
niac
ombrage
parenté
pays
pharmaceutiques
plan
portées
prélèvement
prierai
quartiers
rayons
récidives
réglementation
ressentez
rupture
solicitations
souris
supposés
témoins
travaux
vigueur
vue

fond
frottement
grands
impulsions
inscrit
isolant
liaison
m.
marquées
mentionné
mestérielles
motifs
notée
opposition
parles
pêche
phyllis
plane
porteurs
premier
primo
quittes
réaction
récoltées
régler
restauration
sang
solution
spatiaux
surveillance
terre
tronçon
viré
vue des enfants

formalisme
galaxies
granules
impur
installation
issues
liaisons
machine
matérielle
mentionnée
misères
moules
notice
oppression
parole
pêche
pièce
plans
posteriori
premières
principes
radiation
réalisations
récoltés
relèvement
retrouver
sapin
sommets
spécialité
survenue
tiens
trouble
virer
zut

formation
garde
graphique
imputabilité
instaurer
jeté
libre
maillage
matérielles
mentions
modèles
mousse
nouveau
organe
partenaire
peine
pied
plaque
post
prendrai
priori
raie
récepteur
reconstituées
relèvement
retrouverai
saute
sommets
spectres
sylvestre
tiges
tonique
virus
visage

fourchette
genre
gueule
incidences
interdite
jetés
lité
majorés
matrices
mesure
module
moyen
occasion
ouvertures
passage
perfusion
pieux
plateau
poules
présentations
procréer
ramenez
recevez
recouvrement
rendez
rigidité
scalaire
sorties
stériles
tableaux
titres
unite
visage

fixation
fours
genre
homologues
indiquez
interrompez
joël
localiser
manquerais
mélangées
métalliques
moelle
nature
occurrence
ovules
pathologie
perturbations
pigé
poids
pratique
président
provenance
rapport
rechercher
refuges
rends
rompre
service
souhaitée
substituant
taux
tourbière
véhicule
vivement
franchit
genres
humain
indispensables
intrus
labor
localité
manus
membres
métriques
mondy
navet
octroi
paquets
patient
petits
piste
point
pratiq
pressez
putain
rapportez
recherchés
refuserais
reportés
rond
signalant
soulèvement
suis
taxons
toxicologie
vidange
voie

poules	poussant	pratique	pratiq
présentations	présentiez	président	pressez
procréer	pronostic	provenance	putain
ramenez	ramification	rapport	rapportez
recevez	recherchée	rechercher	recherchés
recouvrement	réflexes	refuges	refuserais
rendez	rends	rompre	reportés

Automatically identifying new senses

- **Context + existence of translations in comparable data**

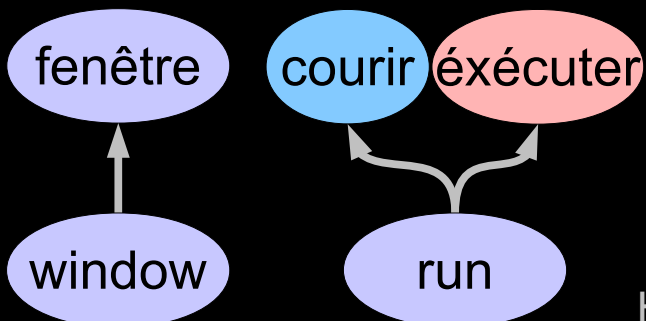
is a **window** of opportunity
have a **window** of opportunity
in the **run** up to
, we **run** the risk

via une **fenêtre** insérée .
vers ma **fenêtre** ou vers
voulons pas **courir** le risque
, sans **courir** le risque

the browser **window** ' s
in the **window** to give
time to **run** when applied
or have **run** vcvars.bat ,

dans la **fenêtre** . cet
dans la **fenêtre** . </s>

courir not found



ne pouvez **éxecuter** que les
pour l' **éxecuter** elle va

New Sense Indicators

New senses alter corpus-level word frequency

New senses alter document-level context topic distribution

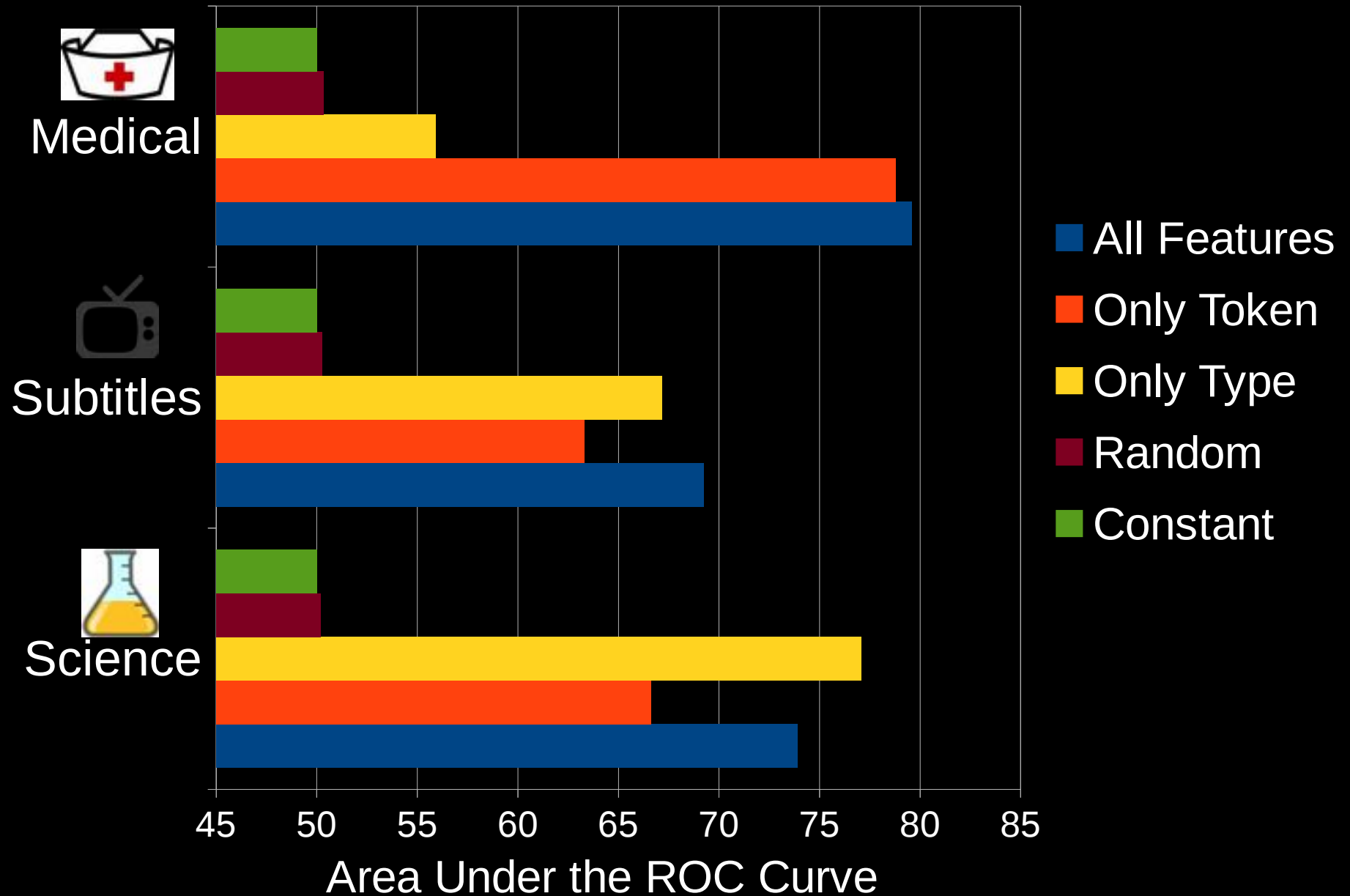
New senses alter local context

n-gram language model

distributional similarity

context-dependent translation model




SenseSpotting Results



Indicators to reach peak performance

New senses alter corpus-level word frequency  

New senses alter document-level context
topic distribution  

New senses alter local context
n-gram language model   

distributional similarity  

context-dependent translation model  

Computed at both type and token levels

SenseSpotting summary

new task motivated by cross-domain machine translation errors

free **token**-level annotation from parallel text

minimal new domain parallel text required

AUC as high as 80%

on word types **never seen** during training

requires both type and token level indicators

Simultaneously solving seen+sense

- Idea:

- We have good knowledge of *translations* in the old domain
- We have good knowledge of raw word frequencies in a new domain in each language individually
- Can we “nudge” the translation probabilities to match these raw frequencies

- Assumptions:

- Old domain parallel data
- New domain comparable data

Marginal matching for "sense" errors

Given:

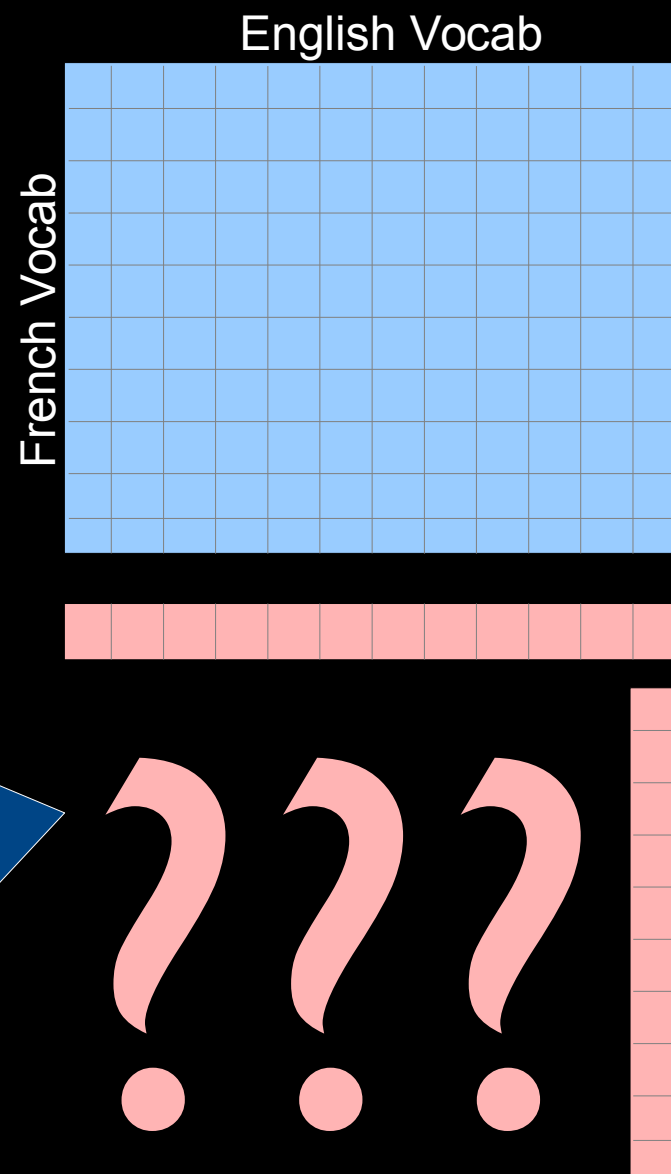
- A joint $p(x,y)$ in the old domain
- Marginals $q(x)$ and $q(y)$ in the new domain

Recover:

- Joint $q(x,y)$ in the new domain

We formulate as a LI-regularized linear program

Easier: *many* $q(x)$ and $q(y)$ s



Marginal matching

	house	place	pregnant	dress	$q^{old}(s)$
enceinte	0.30	0.40	0.10	0	0.80
habiller	0	0	0	0.20	0.20
$q^{old}(t)$	0.30	0.40	0.10	0.20	

(a) OLD-Domain Joint

	house	place	pregnant	dress	girl	$q(s)$
enceinte	?					0.60
habiller						0.20
file						0.20
$q(t)$	0.12	0.08	0.40	0.20	0.20	

(b) NEW-Domain Marginals

	house	place	pregnant	dress	girl	$q^{new}(s)$
enceinte	0.12 ↓	0.08 ↓	0.40 ↑	0	0	0.60
habiller	0	0	0	0.20 =	0	0.20
file	0	0	0	0	0.20 ↑	0.20
$q^{new}(t)$	0.12	0.08	0.40	0.20	0.20	

(c) Inferred NEW-Domain Joint

Matched
Marginals

Additional features

Sparsity: # of non-zero entries should be small

Distributional: document co-occurrence \leftrightarrow translation pair

Spelling: Low edit dist \leftrightarrow translation pair

Frequency: Rare words align to rare words;
common words align to common words

Marginal matching details

$\Omega(p)$: regularization term

$f(p)$: edit distance penalty

$$p^{new} = \arg \min_p \|p - p^{old}\|_1 + \Omega(p) + f(p)$$

subject to:

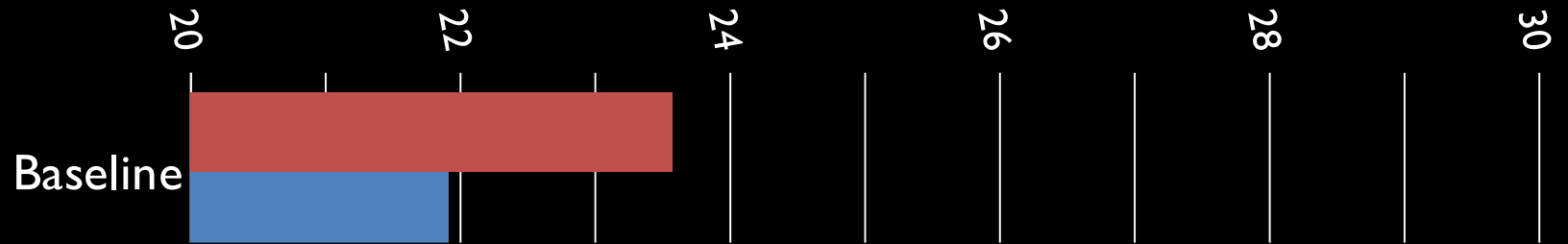
$$\sum_{s,t} p(s,t) = 1, \quad p(s,t) \geq 0$$

$$\sum_s p(s,t) = q(t), \quad \sum_t p(s,t) = q(s)$$

Example Learned Translations

French	Correct	Learned Translations
cisaillement	shear	viscous crack shear
chromosomes	chromosomes	chromosomes chromosome chromosomal
caractérisation	characterization	characterization characteristic π
araignées	spiders	spiders ant spider
tiges	stems	usda centimeters flowering

BLEU Scores



Discussion

- Machine translation adaptation has lots of challenges:
 - New words appear all the time
 - Words gain new senses all the time
 - ... and the usual (new scores)
- S4 as a (qualitative) measure of divergence
- SenseSpotting helps when new classes arise
- Marginal matching: learning on comparable data

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Thanks! Questions?