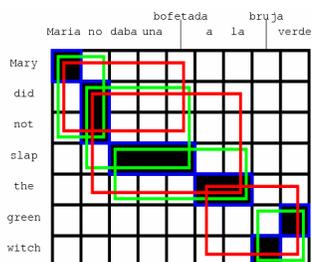
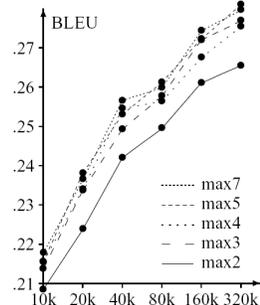
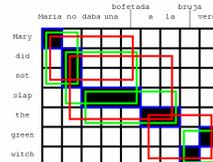


Extracting Phrases

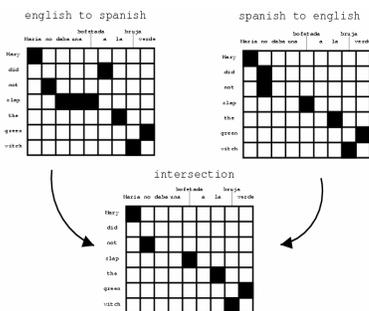


Phrase Size

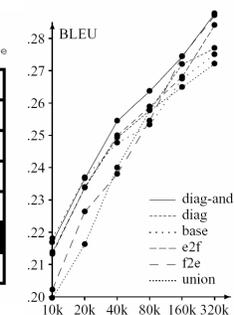
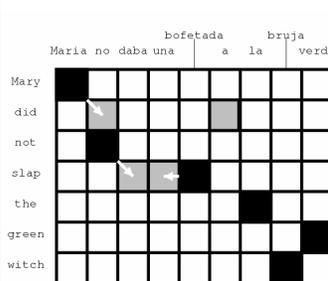
- Phrases do help
 - But they don't need to be long
 - Why should this be?



Bidirectional Alignment

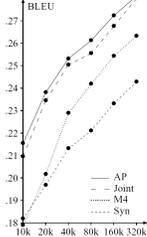
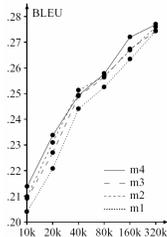


Alignment Heuristics



Sources of Alignments

Method	Training corpus size					
	10k	20k	40k	80k	160k	320k
AP	84k	176k	370k	736k	1536k	3152k
Joint	125k	220k	400k	707k	1254k	2214k
Syn	19k	24k	67k	105k	217k	373k



Lexical Weighting

$$\phi(\bar{f}_i | \bar{e}_i) = \frac{\text{count}(\bar{f}_i, \bar{e}_i)}{\text{count}(\bar{e}_i)} p_w(\bar{f}_i | \bar{e}_i)$$

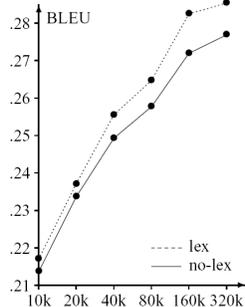
	f1	f2	f3
NULL	--	--	##
e1	##	--	--
e2	--	##	--
e3	--	--	##

$$p_w(\bar{f} | \bar{e}, a) = p_w(f_1 f_2 f_3 | e_1 e_2 e_3, a)$$

$$= w(f_1 | e_1)$$

$$\times \frac{1}{2} (w(f_2 | e_2) + w(f_2 | e_3))$$

$$\times w(f_3 | \text{NULL})$$



The Pharaoh Decoder

Maria	no	dio	una	bofetada	a	la	bruja	verde
Mary	did not	give	a	slap	to	the	witch	green
	did not	slap	by	the	green	witch		
	no	slap		to	the			
	did not give			to				
				slap	the	the	witch	

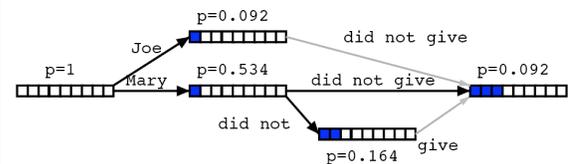
Maria no dio una bofetada a la bruja verde

Mary did not slap the green witch

- Probabilities at each step include LM and TM

Hypothesis Lattices

Maria	no	dio	una	bofetada	a	la	bruja	verde
Mary	did not	give	a	slap	to	the	witch	green
	did not	slap	by	the	green	witch		
	no	slap		to	the			
	did not give			to				
				slap	the	the	witch	



Pruning

Maria no dio una bofetada a la bruja verde

e: Mary did not
f: **-----
p: 0.154

better
partial
translation

e: the
f: -----**--
p: 0.354

covers
easier part
--> lower cost

- Problem: easy partial analyses are cheaper
 - Solution 1: use beams per foreign subset
 - Solution 2: estimate forward costs (A*-like)

WSD?

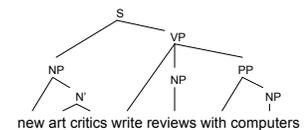
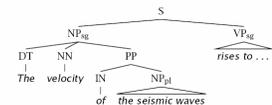
- Remember when we discussed WSD?
 - Word-based MT systems rarely have a WSD step
 - Why not?

What's Next?

- Modeling syntax
 - PCFGs and phrase structure
 - Syntactic parsing
 - Grammar induction
 - Syntactic language and translation models

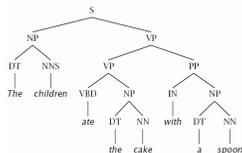
Phrase Structure Parsing

- Phrase structure parsing organizes syntax into *constituents* or *brackets*
- In general, this involves nested trees
- Linguists can, and do, argue about details
- Lots of ambiguity
- Not the only kind of syntax...



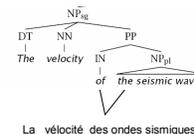
Constituency Tests

- How do we know what nodes go in the tree?
- Classic constituency tests:
 - Substitution by *proform*
 - Question answers
 - Semantic reference
 - Dislocation
- Cross-linguistic arguments, too



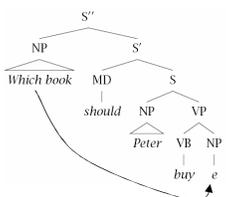
Conflicting Tests

- Constituency isn't always clear
 - Units of transfer:
 - think about ~ penser à
 - talk about ~ hablar de
 - Phonological reduction:
 - I will go → I'll go
 - I want to go → I wanna go
 - a le centre → au centre



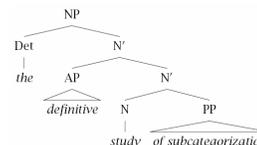
Non-Local Phenomena

- Dislocation / gapping
 - Why did the postman think that the neighbors were home?
 - A debate arose which continued until the election.
- Binding
 - Reference
 - The IRS audits itself
 - Control
 - I want to go
 - I want you to go

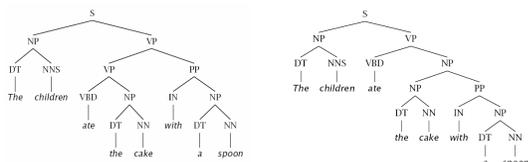


Regularity of Rules

- Argumentation
- Adjunction
- Coordination
- X' Theory



PP Attachment



The board approved [its acquisition] [by Royal Trustco Ltd.] [of Toronto] [for \$27 a share] [at its monthly meeting].

PP Attachment

V	N1	P	N2	Attachment
join	board	as	director	V
is	chairman	of	N.V.	N
using	crocidolite	in	filters	V
bring	attention	to	problem	V
is	asbestos	in	products	N
making	paper	for	filters	N
including	three	with	cancer	N

Method	Accuracy
Always noun attachment	59.0
Most likely for each preposition	72.2
Average Human (4 head words only)	88.2
Average Human (whole sentence)	93.2

Attachment is a Simplification

- I cleaned the dishes from dinner
- I cleaned the dishes with detergent
- I cleaned the dishes in the sink

Syntactic Ambiguities I

- **Prepositional phrases:**
They cooked the beans in the pot on the stove with handles.
- **Particle vs. preposition:**
*A good pharmacist dispenses with accuracy.
The puppy tore up the staircase.*
- **Complement structures**
*The tourists objected to the guide that they couldn't hear.
She knows you like the back of her hand.*
- **Gerund vs. participial adjective**
*Visiting relatives can be boring.
Changing schedules frequently confused passengers.*

Syntactic Ambiguities II

- **Modifier scope within NPs**
*impractical design requirements
plastic cup holder*
- **Multiple gap constructions**
*The chicken is ready to eat.
The contractors are rich enough to sue.*
- **Coordination scope:**
Small rats and mice can squeeze into holes or cracks in the wall.

Treebank Sentences

```
( (S (NP-SBJ The move)
  (VP followed
    (NP (NP a round)
      (PP of
        (NP (NP similar increases)
          (PP by
            (NP other lenders))
          (PP against
            (NP Arizona real estate loans))))))
    (S-ADV (NP-SBJ *)
      (VP reflecting
        (NP (NP a continuing decline)
          (PP-LOC in
            (NP that market))))))
  .))
```

Human Processing

▪ Garden pathing:

the man who hunts ducks out on weekends
the cotton shirts are made from grows in Mississippi
the old train the young
the daughter of the king's son loves himself

▪ Ambiguity maintenance

Have the police ... eaten their supper?
come in and look around.
taken out and shot.