CS 378 Lecture 14
Shift-reduce parsing, review

MIDTERM TUESDAY in class

A3 due today

Recap Dependencies

The cat jumped and landed on the desk
(ROOT)
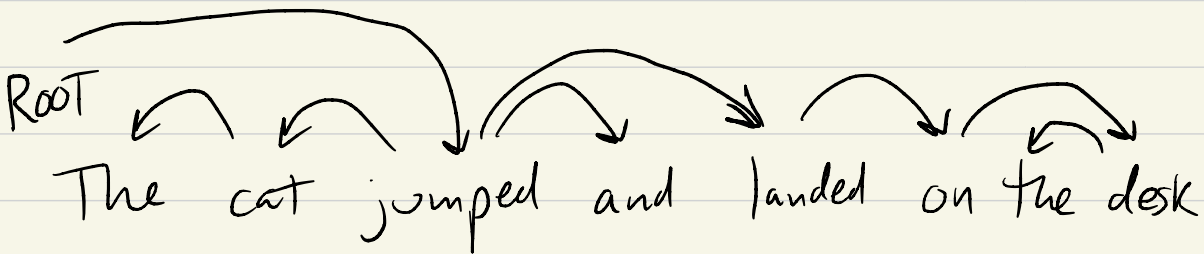
- Verbs are heads of clauses/sentences
- Verbs have nouns/prepositions as children
- Nouns are modified by stuff

<u>Today</u> Shift-reduce parsing
       State-of-the-art parsers
                   (in video on
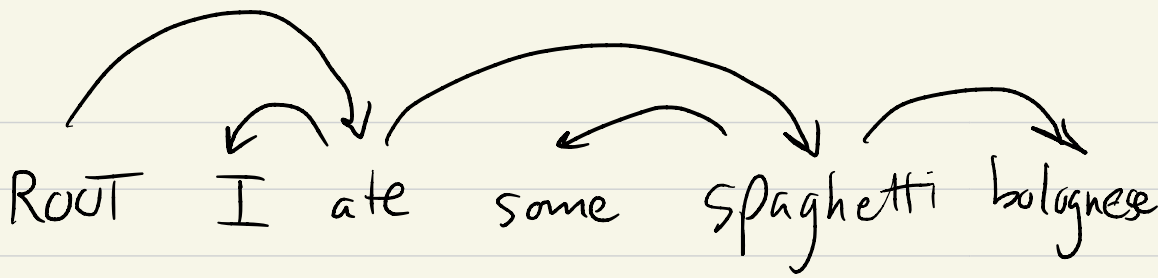   website)

Move through a sentence and
make decisions <u>greedily</u>

Input: sentence
Output: dep parse

Stack: partial parse trees
Buffer: remaining words of the
              sentence

ROOT I ate some spaghetti bolognese

Initial state:

Stack [ROOT]

Buffer [I ate some spa bo]

Operations: (arc-standard)

① Shift: first word of buf
→ end of stack

② Left-arc: take top two
words from stack,

③ Right-arc: add an arc, add
back to the stack

What is the correct (oracle)
sequence of operations to
build this tree?

S [ROOT]$^\beta$[I ate some spa bo]

① Shift

S [ROOT I] [ate some spa bo]

② Shift

S [ROOT I ate] [some spa bo]

③ Left-arc

S [^{①}ROOT ^{②}ate] [some spa bo]

$$\downarrow$$
I

④⑤ Shifts

S [ROOT ate some spa]   [bo]
            ↓
            I

⑥ Left-arc

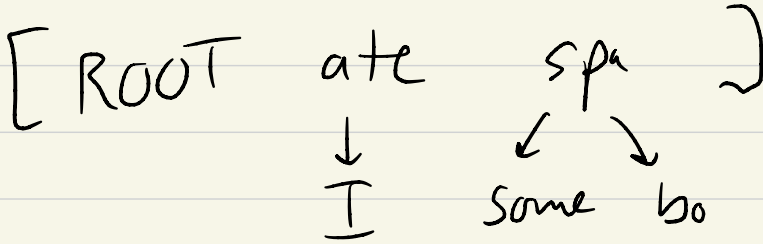S [ROOT ate   spa]   [bo]
            ↓   ↓
            I   some
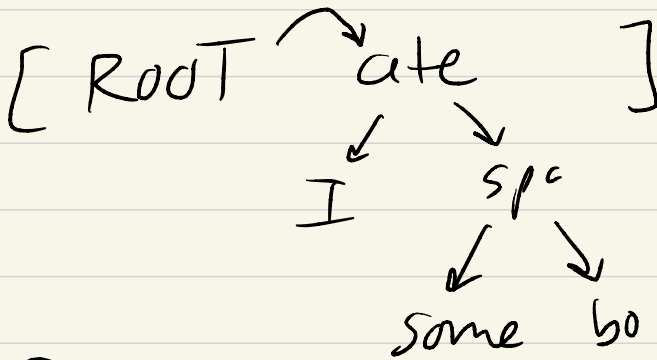
Can't Right-arc yet because
spaghetti isn't "finished"

⑦ Shift

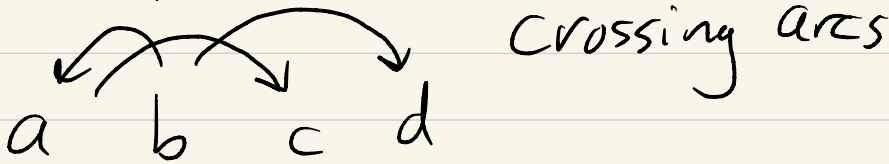S [ROOT ate spa bo]
            ↓   ↓
            I   some

⑧ Right—arc

[ROOT   ate   spa   ⟩
                 ↓   ↙ ↘
                 I   Some bo

⑨ Right—arc

[ROOT ⌒ate   ]
            ↙   ↘
         I   spa
                 ↙ ↘
              Some   bo

⑩ R—A

<u>Property</u> Arc-standard can build
any <u>projective</u> tree

(non-projective)

crossing arcs

a   b   c   d

<u>Building shift-reduce parsers</u>

Parser is a classifier

Maps from (stack, buffer)
$\rightarrow$ {S, LA, RA}   3-class

Features $f(S, B)$

Feats are very complex

S [ROOT ate spa] [bo]
                ↓   ↓
                I   Some

R-A? How do we know it's
    wrong?

Still need spa
              ↘bo

feature (S[-1], B[0])

feature (S[-2], S[-1])

Look at a lot of signals:
- first few of buffer
- last few of stack
- children of stack [1, some]

Lots of indicator features

(In tagging: PrevWord = X)

ⓐ Stack Last = X

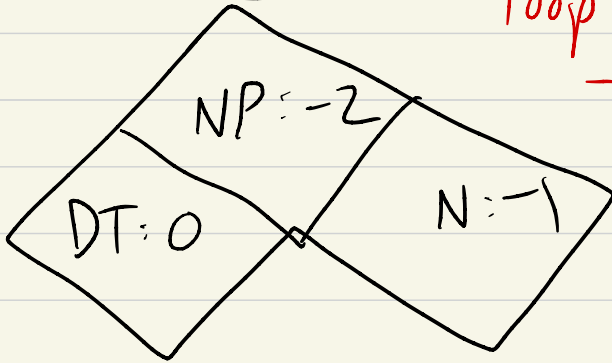ⓑ Stack Last = X & Buf First = Y

ⓒ Stack Last Tag = N & Buf First = Adj

⋮

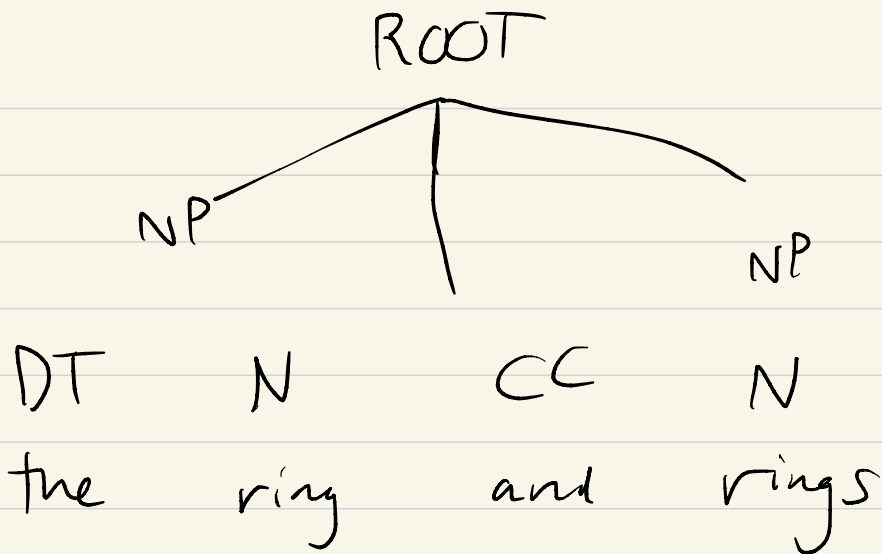many types of features

CKY again

Fall '21 / HMMS

Sp 20   (Q6)
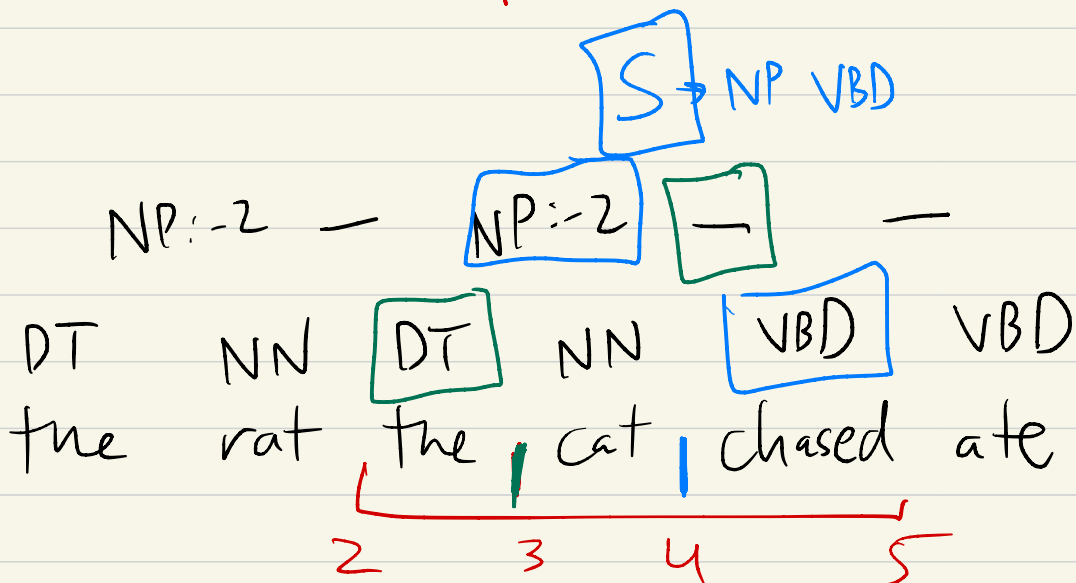
K=1 only option
loop over rules:
    — binary rule

$$NP: -2$$

$$DT: 0$$ $$N: -1$$

DT N

NP → DT N

the   ring

0   1   2

ROOT

NP

DT   N   CC   N   NP

the   ring   and   rings

$k=3$ ✗

$k=4$

S → NP VBD

NP:-2 —   NP:-2   —   —

DT   NN   DT   NN   VBD   VBD

the   rat   the   cat   chased   ate

2   3   4   5

$W_h = (0,0)$ $W_{sc} = (0,0)$ $W_{sp} = (2,2)$

$$W_{po} = (2,2)$$

$(1,0)$ $y = \text{health}$ $y_{pred} = \text{sports}$

new weights: $(\begin{array}{cccc} 1\,0 & 0\,0 & 1\,2 & 2\,2 \end{array})$

$\quad\quad\quad\quad\quad\quad\quad h \quad\quad sc \quad\quad sp \quad po$

$(0,1)$ $y = \text{science}$ $y_{pred} = \text{sports}$

new weights: $(\begin{array}{cccc} 1\,0 & 0\,1 & 1\,1 & 2\,2 \end{array})$

$\quad\quad\quad\quad\quad\quad\quad h \quad\quad sc \quad\quad sp \quad\quad po$