

# Handout 19: Movement

## 1. Handling movement

```
1 % start Root
2
3 ### Grammar
4 NP[f=?f] -> Det[f=?f] N[f=?f]
5 Root -> S[-gap]
6 Root -> Aux[f=?f, s=?v] NP[f=?f] VP[f=?v, -gap]
7 Root -> Wh Aux[f=?f, s=?v] NP[f=?f] VP[f=?v, +gap]
8 S[gap=?g] -> NP[f=?f] VP[f=?f, gap=?g]
9 VP[f=?f, -gap] -> V[f=?f, -t, s=0]
10 VP[f=?f, -gap] -> V[f=?f, +t, s=0] NP
11 VP[f=?f, +gap] -> V[f=?f, +t, s=0]
12 VP[f=?f, gap=?g] -> Aux[f=?f, s=?v] VP[f=?v, gap=?g]
13
14 ### Lexicon
15 Det[f=sg] -> 'a'
16 Det -> 'the'
17 N[f=sg] -> 'cat' | 'dog'
18 N[f=pl] -> 'cats' | 'dogs'
19 Aux[f=sg, s=ing] -> 'is' | 'was'
20 V[f=sg, -t, s=0] -> 'barks'
21 V[f=pl, -t, s=0] -> 'bark'
22 V[f=ing, -t, s=0] -> 'barking'
23 V[f=sg, +t, s=0] -> 'chases'
24 V[f=ing, +t, s=0] -> 'chasing'
25 Wh -> 'who'
```

## 2. Examples

### a. the dog is barking

```
1 (Root[]
2   (S[-gap]
3     (NP[f='sg'] (Det[] the) (N[f='sg'] dog))
4     (VP[f='sg', -gap]
5       (Aux[f='sg', s='ing'] is)
6       (VP[f='ing', -gap] (V[f='ing', s=0, -t] barking))))))
```

### b. is the dog barking

```
1 (Root[]
2   (Aux[f='sg', s='ing'] is)
3   (NP[f='sg'] (Det[] the) (N[f='sg'] dog))
4   (VP[f='ing', -gap] (V[f='ing', s=0, -t] barking)))
```

c. is the dog chasing

1 ☐ Number of trees: 0

d. who is the dog chasing

```
1 ☐ (Root []
2 ☐   (Wh [] who)
3 ☐   (Aux[f='sg', s='ing'] is)
4 ☐   (NP[f='sg'] (Det[] the) (N[f='sg'] dog))
5 ☐   (VP[f='ing', +gap] (V[f='ing', s=0, +t] chasing)))
```

e. who the dog is chasing

1 ☐ Number of trees: 0

3. How do we modify the grammar to handle the following?

a. the dog that the cat chases barks

b. who do you think the dog chases

c. who do you want to chase

d. who did you give the present to

e. the dog that I gave the present to

4. “to whom did you give the present”

a. Alternative to  $\pm\text{gap}$ :

1 ☐ Root  $\rightarrow$  WhNP            Aux[f=?f, s=?v] NP[f=?f] VP[f=?v, g=NP]

b. Recall (“give the present to the dog”):

1 ☐ VP[f=?f]  $\rightarrow$  V[f=?f, +t, s=?p] NP PP[f=?p]

c. Need to keep track of the preposition that was moved (“to whom ... give the present”)

1 ☐ VP[f=?f, g=?p]  $\rightarrow$  V[f=?f, +t, s=?p] NP

2 ☐ Root  $\rightarrow$  WhPP[f=?p] Aux[f=?f, s=?v] NP[f=?f] VP[f=?v, g=?p]

d. “give the present to”

1 ☐ VP[f=?f, g=?g]  $\rightarrow$  V[f=?f, +t, s=?p] NP PP[f=?p, g=?g]

2 ☐ PP[f=?p, g=NP]  $\rightarrow$  P[f=?p]

## 5. Grammar 2

```

1      % start Root
2
3      ### Grammar
4      Root -> S[g=0]
5      Root -> Aux[f=?f, s=?v] NP[f=?f] VP[f=?v, g=0]
6      Root -> WhNP Aux[f=?f, s=?v] NP[f=?f] VP[f=?v, g=NP]
7      Root -> WhPP[f=?g] Aux[f=?f, s=?v] NP[f=?f] VP[f=?v, g=?g]
8      S[g=?g] -> NP[f=?f] VP[f=?f, g=?g]
9      VP[f=?f, g=?g] -> Aux[f=?f, s=?v] VP[f=?v, g=?g]
10
11     VP[f=?f, g=0] -> V[f=?f, -t, s=0]
12
13     VP[f=?f, g=0] -> V[f=?f, +t, s=0] NP
14     VP[f=?f, g=NP] -> V[f=?f, +t, s=0]
15
16     VP[f=?f, g=?g] -> V[f=?f, -t, s=?p] PP[f=?p, g=?g]
17     VP[f=?f, g=?p] -> V[f=?f, -t, s=?p]
18
19     VP[f=?f, g=?g] -> V[f=?f, +t, s=?p] NP PP[f=?p, g=?g]
20     VP[f=?f, g=NP] -> V[f=?f, +t, s=?p] PP[f=?p, g=0]
21     VP[f=?f, g=?p] -> V[f=?f, +t, s=?p] NP
22
23     NP[f=?f] -> Det[f=?f] N[f=?f]
24     PP[f=?p, g=0] -> P[f=?p] NP
25     PP[f=?p, g=NP] -> P[f=?p]
26     WhPP[f=?p] -> P[f=?p] WhNP
27
28     ### Lexicon
29     Det[f=sg] -> 'a'
30     Det -> 'the'
31     N[f=sg] -> 'cat' | 'dog' | 'present'
32     N[f=pl] -> 'cats' | 'dogs'
33     Aux[f=sg, s=ing] -> 'is' | 'was'
34     Aux[f=pl, s=pl] -> 'did' | 'do'
35     V[f=sg, -t, s=0] -> 'barks'
36     V[f=pl, -t, s=0] -> 'bark'
37     V[f=ing, -t, s=0] -> 'barking'
38     V[f=sg, +t, s=0] -> 'chases'
39     V[f=ing, +t, s=0] -> 'chasing'
40     V[f=pl, +t, s=to] -> 'give'
41     NP -> 'you'
42     WhNP -> 'who' | 'whom' | 'what'
43     P[f=to] -> 'to'
44     P[f=about] -> 'about'

```

## 6. Examples

- a. you give the present to the dog
- b. did you give the present to the dog
- c. (\*)did you give the present
- d. what did you give to the dog
- e. \*what did you give the present to the dog
- f. to whom did you give the present
- g. \*to whom did you give to the dog
- h. \*to whom did you give the present to the dog
- i. \*about whom did you give the present
- j. who did you give the present to
- k. \*you give the present to

## 7. Slash

- a. Kind of gap: np, to, about, ...

- b. Special syntax

```
1   Root -> WhNP V[f=?f, s=?v] NP[f=?f] VP[f=?v]/np
2   VP[f=?f]/?g -> Aux[f=?f, s=?v] VP[f=?v]/?g
3   VP[f=?f] -> V[f=?f, +t, s=0] NP
4   VP[f=?f]/np -> V[f=?f, +t, s=0]
```

- c. Alternatively:

```
1   VP[f=?f]/?g -> V[f=?f, +t, s=0] NP/?g
2   NP/np ->
```

- d. “give the present to”

```
1   VP[f=?f]/?g -> V[f=?f, +t, s=?p] NP PP[f=?p]/?g
2   PP[f=?p]/?g -> P[f=?p] NP/?g
```

- e. “to whom ... give the present”

```
1   Root -> WhPP[f=?g] V[f=?f, s=?v] NP[f=?f] VP[f=?v]/?g
2   VP[f=?f]/?g -> V[f=?f, +t, s=?p] NP PP/?g
3   PP[f=?p]/?p ->
```

## 8. Grammar 3

```

1      % start Root
2
3      ### Grammar
4      Root -> S
5      Root -> Aux[f=?f, s=?v] NP[f=?f] VP[f=?v]
6      Root -> WhNP Aux[f=?f, s=?v] NP[f=?f] VP[f=?v]/np
7      Root -> WhPP[f=?g] Aux[f=?f, s=?v] NP[f=?f] VP[f=?v]/?g
8
9      S      -> NP[f=?f] VP[f=?f]
10     S/?g -> NP[f=?f] VP[f=?f]/?g
11
12     VP[f=?f] -> Aux[f=?f, s=?v] VP[f=?v]
13     VP[f=?f]/?g -> Aux[f=?f, s=?v] VP[f=?v]/?g
14
15     VP[f=?f] -> V[f=?f, -t, s=0]
16
17     VP[f=?f] -> V[f=?f, +t, s=0] NP
18     VP[f=?f]/?g -> V[f=?f, +t, s=0] NP/?g
19
20     VP[f=?f] -> V[f=?f, -t, s=?p] PP[f=?p]
21     VP[f=?f]/?g -> V[f=?f, -t, s=?p] PP[f=?p]/?g
22
23     VP[f=?f] -> V[f=?f, +t, s=?p] NP PP[f=?p]
24     VP[f=?f]/?g -> V[f=?f, +t, s=?p] NP PP[f=?p]/?g
25     VP[f=?f]/?g -> V[f=?f, +t, s=?p] NP/?g PP[f=?p]
26
27     NP/np ->
28     NP[f=?f] -> Det[f=?f] N[f=?f]
29     PP[f=?p] -> P[f=?p] NP
30     PP[f=?p]/?g -> P[f=?p] NP/?g
31     PP[f=?p]/?p ->
32     WhPP[f=?p] -> P[f=?p] WhNP
33
34     ### Lexicon
35     Det[f=sg] -> 'a'
36     Det -> 'the'
37     N[f=sg] -> 'cat' | 'dog' | 'present'
38     N[f=pl] -> 'cats' | 'dogs'
39     Aux[f=sg, s=ing] -> 'is' | 'was'
40     Aux[f=pl, s=pl] -> 'did' | 'do'
41     V[f=sg, -t, s=0] -> 'barks'
42     V[f=pl, -t, s=0] -> 'bark'
43     V[f=ing, -t, s=0] -> 'barking'
44     V[f=sg, +t, s=0] -> 'chases'

```

```
45 V[f=ing, +t, s=0] -> 'chasing'
46 V[f=pl, +t, s=to] -> 'give'
47 NP -> 'you'
48 WhNP -> 'who' | 'whom' | 'what'
49 P[f=to] -> 'to'
50 P[f=about] -> 'about'
```