- Good if parse tree is deep

Breadth First parsing

- Try all rules at the same time

- Can be faster

- Order of rules is not important

- Good if tree is flat

▶ Definite Clause Grammars (DCG)

A grammar written with logical sentences is called a logical grammar.

DCG rules may be written as PROLOG clauses and the PROLOG interpreter is used to perform top-down, depth-first parsing.

BNF	FOPL
S → NP VP	NP(s1) ∧ VP(s2) ⇒ S(append(s1,s2))
NP → Noun	Noun(s) ⇒ NP(s)
Noun → stench	Verb(s) ⇒ VP(s)
Noun → wumpus	(s = "stench" ∨ s = "wumpus") ⇒
VP → Verb	Noun(s)
Verb → smells	(v = "smells" ∨ v = "kills") ⇒
Verb → kills	Verb(v)

▶ Augmenting the DCG

- Nonterminals can be augmented with extra arguments, e.g., to verify grammatical correctness or attach semantics

- Add logical tests in the grammar rule – the rule fires only if the tests are true

▶ *Add one extra argument for the semantics – see also semantic analysis further on*

DCG	FOPL
S(sem) → NP(sem1) VP(sem2) {compose(sem1, sem2, sem)}	NP(s1, sem1) ∧ VP(s2, sem2) ⇒ S(append(s1, s2)), compose(sem1, sem2, sem)

Compositional semantics

▶ Verify grammatical correct sentences

Problem: the previous grammar will generate sentences that are not grammatically correct.

- NL is not a context free language

- We must deal with

- cases

- agreement between subject and main verb in the sentence (predicate)

- verb subcategorization: the complements that a verb can accept

CASES

Nominative case (subjective case) + agreement

I take the bus	Je prends l'autobus
You take the bus	Tu prends l'autobus
He takes the bus	Il prend l'autobus

Accusative case (objective case)

He gives me the book	Il me donne le livre

Dative case

You are talking to me	Il parle avec moi

Solution to cases: new categories, e.g. NPS, NPO - not very efficient, too many rules

▶ Augment the DCG with a new parameter to describe the case

S → NP(Subjective) VP

NP(case) → Pronoun (case) | Noun | Article Noun // I

VP → VP NP(Objective) // believe him

VP → VP PP // turn to the right

VP → VP Adjective

VP → Verb

PP → Preposition NP(Objective)

Pronoun(Subjective) → I | you | he | she

Pronoun(Objective) → me | you | him | her

▶ Augment the DCG with a new parameter to describe the verb subcategorization

Verb subcategories – specify which verb can be followed by which other categories each verb has a list of complements

Augment VP to take a subcategorization argument

VP(subcat) → {subcat = np} VP(np) NP(Objective)

    | {subcat = adj} VP(adj) Adjective

    | {subcat = pp} VP (pp) PP

    | Verb

change S so that it has a VP with subcategories

S → NP(Subjective) VP(subcat)

Add adjuncts to VP – verb phrases that may follow any verb, regardless of the subcategory

VP(subcat) → VP(subcat) PP
| VP(subcat) Adverb   *I smell the wumpus now*

Resulting augmented DCG

S → NP(Subjective) VP(subcat)
NP(case) → Pronoun (case) | Noun | Article Noun
Pronoun(Subjective) → I | you | he | she
Pronoun(Objective) → me | you | him | her