# CYK Parsing

## Description

CYK (Cocke-Younger-Kasami) is a parsing algorithm used to determine if a string can be generated by a given context-free grammar. The algorithm works by filling up a table with partial derivations and recursively combining them until the final string is found or determined to not be in the language. It has a time complexity of O(n^3) where n is the length of the input string.

### The following are a few sentences that will be parsed using CKY in this project :

I want to book a hotel in Tokyo

we're flying to NewYork

renting a car is expensive in Califonia

can you recommend a good restaurant in Miami

the beach in Tokyo is beautiful

we booked a flight to NewYork and a hotel in Manhattan

an Airbnb is cheaper than a hotel in Miami

I want to visit the Empire State Building in NewYork

the food in Miami is delicious

we're flying to Califonia and renting a car to drive to NewYork

the flight from NewYork to Miami is long

I need to book a table at a fancy restaurant in Miami

we're going to the beach in Miami and the Golden Gate Park in San Francisco

renting a car in Miami and driving to Key West is a popular option

the hotel in Califonia has a great view of the Cambridge

### CFG :

S -> NP VP

NP -> Pronoun | ProperNoun | Determiner Nominal

Nominal -> Noun | Adjective Nominal

VP -> Verb | Verb NP | Verb NP PP | Verb PP | VP Conjunction VP

PP -> Preposition NP

ProperNoun -> 'Califonia' | 'NewYork' | 'Tokyo' | 'Miami' | 'Manhattan'

Determiner -> 'a' | 'an' | 'the'

Noun -> 'hotel' | 'flight' | 'car' | 'restaurant' | 'beach'

Adjective -> 'beautiful' | 'delicious' | 'expensive' | 'cheap' | 'long'

Verb -> 'book' | 'fly' | 'rent' | 'visit' | 'eat'

Preposition -> 'to' | 'in' | 'at'

Pronoun -> 'I' | 'we' | 'you' | 'it'

Conjunction -> 'and' | 'or'

### CNF:

ProperNoun -> 'K'

    VP@$@VP -> Conjunction VP

    Nominal -> Adjective Nominal

    NP -> 'we'

    VP -> 'is'

    NP -> 'Airbnb'

    Adjective -> 'beautiful'

    VP -> Verb PP

    Nominal -> 'car'

    VP -> 'drive'

    Verb -> 'rent'

    Adjective -> 'delicious'

    VP@$@Verb -> NP PP

    Pronoun -> 'you'

    Nominal -> 'beach'

    NP -> 'Miami'

    NP -> 'Califonia'

    Determiner -> 'a'

    Noun -> 'table'

    Noun -> 'renting'

    ProperNoun -> 'Califonia'

    Verb -> 'recommend'

    VP -> VP VP@$@VP

    NP -> 'you'

    PP -> Preposition NP

    Adjective -> 'long'

    ProperNoun -> 'Airbnb'

    Conjunction -> 'and'

    Conjunction -> 'or'

    Preposition -> 'in'

    Adjective -> 'cheap'

    VP -> 'eat'

    Noun -> 'flight'

    VP -> 'visit'

    S -> NP VP

    Verb -> 'drive'

    Nominal -> 'renting'

    Noun -> 'restaurant'

    Determiner -> 'an'

    ProperNoun -> 'Miami'

    NP -> 'NewYork'

    Preposition -> 'at'

    NP -> 'I'

    VP -> 'book'

    VP -> 'fly'

    NP -> 'Tokyo'

    ProperNoun -> 'NewYork'

    VP -> 'need'

    Nominal -> 'flight'

    ProperNoun -> 'Tokyo'

    Preposition -> 'from'

    Noun -> 'car'

    Verb -> 'is'

    Pronoun -> 'I'

    Adjective -> 'good'

    Noun -> 'food'

    Nominal -> 'table'

    Determiner -> 'the'

    Noun -> 'hotel'

    Verb -> 'eat'

    VP -> Verb VP@$@Verb

    Verb -> 'visit'

    VP -> 'rent'

    Adjective -> 'expensive'

    NP -> 'it'

    NP -> 'Manhattan'

    Preposition -> 'to'

    ProperNoun -> 'Manhattan'

    Pronoun -> 'we'

    VP -> Verb NP

    Pronoun -> 'it'

    Nominal -> 'food'

    Verb -> 'book'

    NP -> 'fancy'

    Verb -> 'fly'

    NP -> Determiner Nominal

    Nominal -> 'restaurant'

    Verb -> 'need'

    Nominal -> 'hotel'

    VP -> 'recommend'

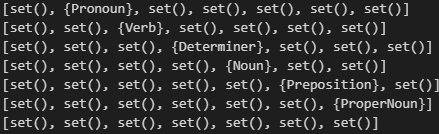
    ProperNoun -> 'fancy'

    NP -> 'K'

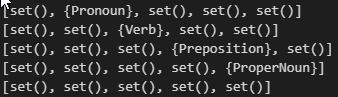
    Noun -> 'beach'

### CYK Tables for Valid Sentences:

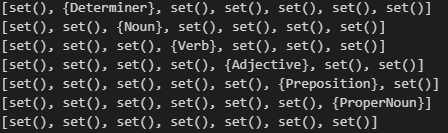
1. I book a hotel in Tokyo



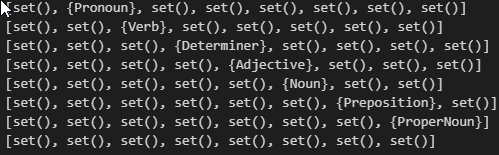
1. we fly to NewYork



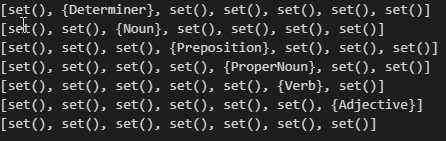
1. a car is expensive in Califonia



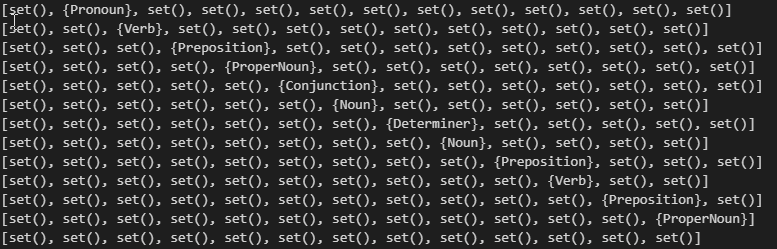
1. you recommend a good restaurant in Miami



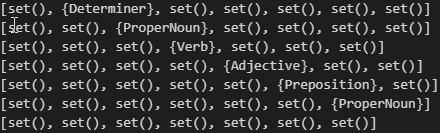
1. the beach in Tokyo is beautiful



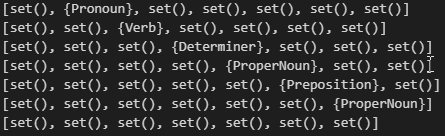
1. we book a flight to NewYork and a hotel in Manhattan



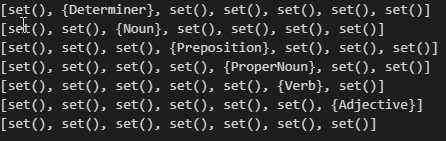
1. an Airbnb is cheap in Miami



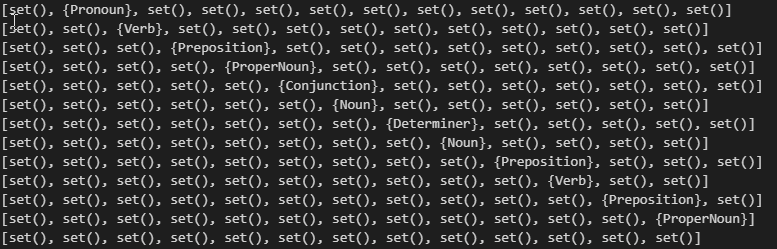
1. I visit the K in NewYork



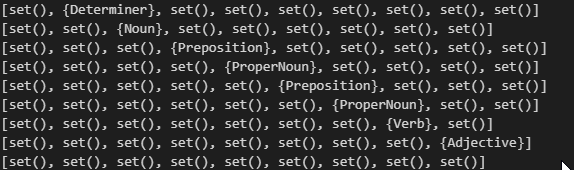
1. the food in Miami is delicious



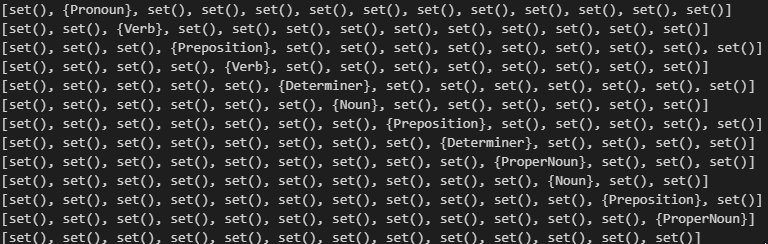
1. we fly to Califonia and renting a car to drive to NewYork



1. the flight from NewYork to Miami is long

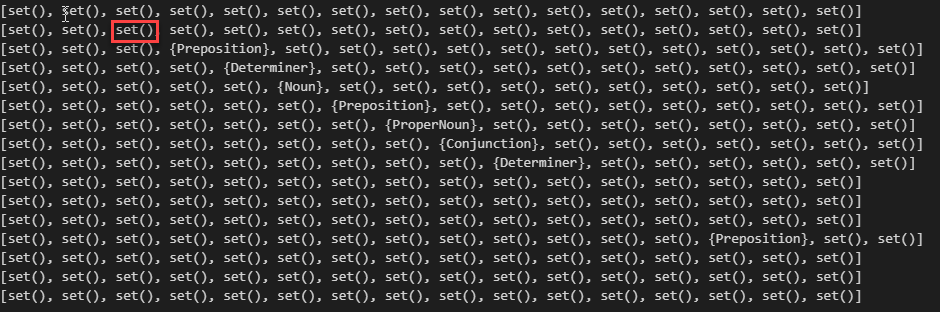


1. I need to book a table at a fancy restaurant in Miami

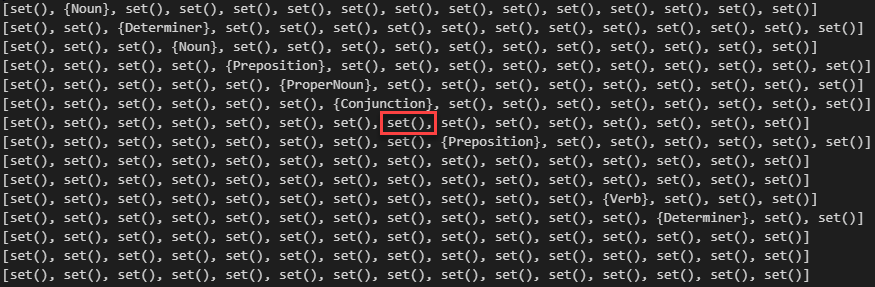


### CYK Tables for Invalid Sentences:

1. we're going to the beach in Miami and the Golden Gate Park in San Francisco



1. renting a car in Miami and driving to Key West is a popular option



1. the hotel in Califonia has a great view of the Cambridge

