

```

tokens = ["3", "+", "5", "*", "(", "2", "+", "4", ")"]
position = 0
def match(token_type):
    global position
    if position < len(tokens) and tokens[position] == token_type:
        position += 1
        return True
    return False
def match_integer():
    global position
    if position < len(tokens) and tokens[position].isdigit():
        position += 1
        return True
    return False

def parse_expression():
    global position
    initial_pos = position

    if parse_term():
        while True:
            if match("+"):
                if not parse_term():
                    position = initial_pos
                    return False
            else:
                break
        return True
    position = initial_pos
    return False

def parse_term():
    global position
    initial_pos = position
    if parse_factor():
        while True:
            if match("*"):
                if not parse_factor():
                    position = initial_pos
                    return False
            else:
                break
        return True
    position = initial_pos
    return False

def parse_factor():
    global position
    initial_pos = position

    if match("("):
        if parse_expression() and match(")"):
            return True
    elif match_integer():
        return True

    position = initial_pos
    return False

result = parse_expression() and position == len(tokens)

if result:
    print("The expression is valid.")
else:
    print("The expression is invalid.")

```

 The expression is valid.

```

grammar = {
    "S": [("NP", "VP")],
    "NP": [("Det", "N")],
    "VP": [("V", "NP")],
    "Det": [("the",)],
    "N": [("cat",), ("dog",)],

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    "V": [("chased",), ("saw",)],
}

tokens = ["the", "cat", "chased", "the", "dog"]
n = len(tokens)

chart = [set() for _ in range(n + 1)]

chart[0].add(("S", (), ("NP", "VP"), 0))

pos = 0
while pos <= n:
    new_states = set()
    for state in chart[pos]:
        lhs, seen, unseen, origin = state

        if not unseen:
            for prev_state in chart[origin]:
                if prev_state[2] and prev_state[2][0] == lhs:
                    new_state = (prev_state[0], prev_state[1] + (lhs,), prev_state[2][1:], prev_state[3])
                    new_states.add(new_state)

        elif unseen[0] in grammar:
            for production in grammar[unseen[0]]:
                new_state = (unseen[0], (), production, pos)
                new_states.add(new_state)

        elif pos < n and unseen[0] == tokens[pos]:
            new_state = (lhs, seen + (unseen[0],), unseen[1:], origin)
            chart[pos + 1].add(new_state)

    chart[pos].update(new_states)

    pos += 1

valid = any(state == ("S", ("NP", "VP"), (), 0) for state in chart[n])

if valid:
    print("The sentence is valid.")
else:
    print("The sentence is invalid.")

```

➡ The sentence is invalid.

```

import nltk
from nltk import CFG
from nltk.tree import Tree

grammar = CFG.fromstring("""
S -> NP VP
NP -> Det N | Det N PP
VP -> V NP | VP PP
PP -> P NP
Det -> 'the' | 'a'
N -> 'cat' | 'dog' | 'telescope' | 'park'
V -> 'saw' | 'chased'
P -> 'in' | 'with'
""")

sentence = "the cat saw the dog in the park".split()

parser = nltk.ChartParser(grammar)

for tree in parser.parse(sentence):
    print(tree)
    tree.pretty_print()

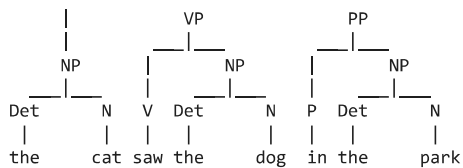
```

➡

```

(S
  (NP (Det the) (N cat))
  (VP
    (VP (V saw) (NP (Det the) (N dog)))
    (PP (P in) (NP (Det the) (N park)))))

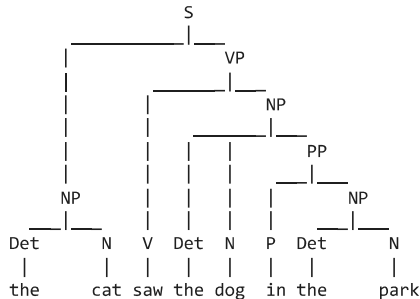
```



```

(S
  (NP (Det the) (N cat))
  (VP
    (V saw)
    (NP (Det the) (N dog) (PP (P in) (NP (Det the) (N park))))))

```



```

import nltk
from nltk import CFG

grammar = CFG.fromstring("""
  S -> NP_SG VP_SG | NP_PL VP_PL

  NP_SG -> Det N_SG
  NP_PL -> Det N_PL

  VP_SG -> V_SG NP | V_SG
  VP_PL -> V_PL NP | V_PL

  Det -> 'the' | 'a'
  N_SG -> 'cat' | 'dog'
  N_PL -> 'cats' | 'dogs'
  V_SG -> 'chases' | 'sees'
  V_PL -> 'chase' | 'see'
""")

parser = nltk.ChartParser(grammar)

def check_agreement(sentence):
    tokens = sentence.split()
    try:
        parse_trees = list(parser.parse(tokens))
        if parse_trees:
            print("The sentence is grammatically correct with agreement.")
            for tree in parse_trees:
                print(tree)
        else:
            print("The sentence has a grammatical error (agreement issue).")
    except ValueError:
        print("The sentence has a grammatical error (agreement issue).")

sentence1 = "the cat chases the dog"
sentence2 = "the cats chase the dog"
sentence3 = "the cat chase the dogs"
sentence4 = "the dogs sees the cat"
print("Checking:", sentence1)
check_agreement(sentence1)
print("\nChecking:", sentence2)
check_agreement(sentence2)
print("\nChecking:", sentence3)
check_agreement(sentence3)
print("\nChecking:", sentence4)
check_agreement(sentence4)

```

➡ Checking: the cat chases the dog
The sentence has a grammatical error (agreement issue).

Checking: the cats chase the dog
The sentence has a grammatical error (agreement issue).

Checking: the cat chase the dogs
The sentence has a grammatical error (agreement issue).

Checking: the dogs sees the cat
The sentence has a grammatical error (agreement issue).

```
import nltk
from nltk import PCFG
from nltk.parse import ViterbiParser
```

```
pcfg_grammar = PCFG.fromstring("""
S -> NP VP [1.0]
NP -> Det N [0.5] | Det N PP [0.5]
VP -> V NP [0.5] | VP PP [0.5]
PP -> P NP [1.0]
Det -> 'the' [0.8] | 'a' [0.2]
N -> 'cat' [0.5] | 'dog' [0.5]
V -> 'chased' [0.6] | 'saw' [0.4]
P -> 'with' [0.6] | 'in' [0.4]
""")
```

```
parser = ViterbiParser(pcfg_grammar)
```

```
sentence = "the cat chased the dog".split()
```

```
for tree in parser.parse(sentence):
    print(tree)
    tree.pretty_print()
```

