

# Parsing

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## An Add-Only Calculator

$$12 + 57 + 8 + 10 =$$

# An Add-Only Calculator

12 + 57 + 8 + 10 =

```
S = 0
do {
  get next token
  if (token is not a number) error
  add token to S
  get next token
} while (token is "+")
if (token is not "=") error
return S
```

## Adding and Multiplying

$$12 + 57 * 8 + 10 * 5 * 3 + 2 =$$

# Adding and Multiplying

$$12 + 57 * 8 + 10 * 5 * 3 + 2 =$$

```
S = 0
do {
  P = 1
  do {
    get next token
    if (token is not a number) error
    multiply P by token
    get next token
  } while (token is "*")
  add P to S
} while (token is "+")
if (token is not "=") error
return S
```

## Parentheses

$$12 + 57 * (8 + 3 * 2) + 10 * 5 * 3 + 2 =$$

## Parentheses

12 + 57 \* (8 + 3 \* 2) + 10 \* 5 \* 3 + 2 =

```
int expr() {
    S = sop()
    if (token is not "=") error
    return S
}
int sop() {
    S = 0
    do {
        P = 1
        do {
            get next token
            if (token is "(") {
                N = sop()
                if (token is not ")") error
            } else if (token is a number)
                N = token
            else if (token is not a number) error
            multiply P by N
            get next token
        } while (token is "*")
        add P to S
    } while (token is +)
    return S
}
```

## Context-Free Grammars

*sum* → *number*

*sum* → *sum* + *number*



# Context-Free Grammars

*sum* → *number*

*sum* → *sum* + *number*

*sum* → *product*

*sum* → *sum* + *product*

*product* → *number*

*product* → *product* \* *number*

# Context-Free Grammars

$sum \rightarrow number$   
 $sum \rightarrow sum + number$

$sum \rightarrow product$   
 $sum \rightarrow sum + product$   
 $product \rightarrow number$   
 $product \rightarrow product * number$

$sum \rightarrow product$   
 $sum \rightarrow sum + product$   
 $product \rightarrow term$   
 $product \rightarrow product * term$   
 $term \rightarrow number$   
 $term \rightarrow ( sum )$