Parsing

Stephen A. Edwards

Columbia University

Fall 2015

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

$$
\begin{aligned}
\textit{sum} &\rightarrow \textit{number} \\
\textit{sum} &\rightarrow \textit{sum} + \textit{number}
\end{aligned}
$$

Context-Free Grammars

$$
\begin{array}{rcl}
\mathit{sum} & \rightarrow & \mathit{number} \\
\mathit{sum} & \rightarrow & \mathit{sum} + \mathit{number}
\end{array}
$$

$$
\begin{array}{rcl}
\mathit{sum} & \rightarrow & \mathit{product} \\
\mathit{sum} & \rightarrow & \mathit{sum} + \mathit{product} \\
\mathit{product} & \rightarrow & \mathit{number} \\
\mathit{product} & \rightarrow & \mathit{product} * \mathit{number}
\end{array}
$$

Context-Free Grammars

$$
\begin{array}{rcl}
\mathit{sum} & \rightarrow & \mathit{number} \\
\mathit{sum} & \rightarrow & \mathit{sum} + \mathit{number}
\end{array}
$$

$$
\begin{array}{rcl}
\mathit{sum} & \rightarrow & \mathit{product} \\
\mathit{sum} & \rightarrow & \mathit{sum} + \mathit{product} \\
\mathit{product} & \rightarrow & \mathit{number} \\
\mathit{product} & \rightarrow & \mathit{product} * \mathit{number}
\end{array}
$$

$$
\begin{array}{rcl}
\mathit{sum} & \rightarrow & \mathit{product} \\
\mathit{sum} & \rightarrow & \mathit{sum} + \mathit{product} \\
\mathit{product} & \rightarrow & \mathit{term} \\
\mathit{product} & \rightarrow & \mathit{product} * \mathit{term} \\
\mathit{term} & \rightarrow & \mathit{number} \\
\mathit{term} & \rightarrow & (\ \mathit{sum}\ )
\end{array}
$$