

Problems 1: Top-down parsing

1. Convert the following grammar to LL(1) form. The start symbol is E and the other non-terminal symbols are S and D .

1. $E \rightarrow S^*$
2. $S \rightarrow S D$
3. $S \rightarrow D$
4. $D \rightarrow [D]$
5. $D \rightarrow x$

1. $E \rightarrow D S' ^*$
2. $S' \rightarrow D S'$
3. $S' \rightarrow$
4. $D \rightarrow [D]$
5. $D \rightarrow x$

2. For the LL(1) grammar in Q1, compute nullable, FIRST, and FOLLOWS.

$\text{nullable}(E) = \text{false}$, $\text{nullable}(S') = \text{true}$, $\text{nullable}(D) = \text{false}$.

$\text{FIRST}(E) = \{ [, x \}$

$\text{FIRST}(S') = \{ [, x \}$

$\text{FIRST}(D) = \{ [, x \}$

$\text{FOLLOW}(E) = \{ \}$

$\text{FOLLOW}(S') = \{ ^* \}$

$\text{FOLLOW}(D) = \{], [, x \}$

3. For the LL(1) grammar in Q1, compute the predictive parsing table.

| | * | x | $[$ | $]$ |
|------|------------------|-------------------------|-------------------------|-----|
| E | | $E \rightarrow D S' ^*$ | $E \rightarrow D S' ^*$ | |
| S' | $S' \rightarrow$ | $S' \rightarrow D S'$ | $S' \rightarrow D S'$ | |
| D | | $D \rightarrow x$ | $D \rightarrow [D]$ | |

4. For the LL(1) grammar in Q1, apply the LL(1) parsing algorithm on the string

$x[x]^*$

For each parsing step show the stack, the input, and the output.

| a | X | Output | Stack |
|---|------|------------------------|------------|
| x | E | $E \rightarrow D S' *$ | $D S' *$ |
| x | D | $D \rightarrow x$ | $x S' *$ |
| x | x | | $S' *$ |
| [| S' | $S' \rightarrow D S'$ | $D S' *$ |
| [| D | $D \rightarrow [D]$ | $[D] S' *$ |
| [| [| | $D] S' *$ |
| x | D | $D \rightarrow x$ | $x] S' *$ |
| x | x | | $] S' *$ |
|] |] | | $S' *$ |
| * | S' | $S' \rightarrow$ | * |
| * | * | | |