LR(0) Items

- *LR(0) item* : An LR(0) item for a grammar G is a production rule of G with the symbol $\bullet$ (read as *dot* or *bullet*) inserted at some position in the rhs of the rule.
- Example of LR(0) items : For the rule given below

$$decls \rightarrow decls\ decl$$

the possible LR(0) items are :

$$I_1 : decls \rightarrow \bullet decls\ decl$$
$$I_2 : decls \rightarrow decls\ \bullet decl$$
$$I_3 : decls \rightarrow decls\ decl \bullet$$

n+1 items, if n symbols in RHS

The rule $decls \rightarrow\ \epsilon$ has only one LR(0) item,

$$I_4 : decls \rightarrow\ \bullet$$

LR(0) Items

- An LR(0) item is *complete* if the $\bullet$ is the last symbol in the rhs.
  Example : I_3 and I_4 are complete items and I_1 and I_2 are incomplete items.
- An LR(0) item is called a *kernel item*, if the dot is not at the left end. However the item $S' \rightarrow \bullet S$ is an exception and is defined to be a kernel item.
  Example : I_1, I_2, I_3 are all kernel items and I_4 is a non-kernel item.

Canonical Collection of LR(0) Items

The construction of the SLR parsing table requires two functions *closure* and *goto*.

closure: Let U be the collection of all LR(0) items of a cfg G. Then $closure : U \rightarrow 2^U$.

1. $closure(I) = \{I\}, \ for \ I \in U$
2. If $A \rightarrow \alpha \bullet B\beta \in closure(I)$, then the item $B \rightarrow \bullet\eta$ is added to $closure(I)$.
3. Apply step (ii) above repeatedly till no more new items can be added to $closure(I)$.

Example: Consider the grammar $A \rightarrow A \text{ a} \mid \text{b}$

$$closure(A \rightarrow \bullet A \text{ a}) = \{A \rightarrow \bullet A \text{ a}, \ A \rightarrow \bullet \text{b}\}$$

Steps to Compute Closure:
1. Start with the initial item:
2. Look at the symbol immediately after the dot (•): here, the symbol after the dot is A, which is a non-terminal.
3. Add all productions of A to the closure.
4. No further expansion is needed because the new items do not have a non-terminal immediately after the dot.

Canonical Collection of LR(0) Items

goto: $goto : U \times X \to 2^U$, where X is a grammar symbol.

$goto(A \to \alpha \bullet X\beta, X) = closure(A \to \alpha X \bullet \beta)$.

Example: $goto(A \to \bullet A\text{a}, A) = closure(A \to A \bullet \mathtt{a}) = \{A \to A \bullet \mathtt{a}\}$
closure and *goto* can be extended to a set S of $LR(0)$ items by appropriate generalizations

- $closure(S) = \bigcup_{\mathtt{I} \in \mathtt{S}} \{closure(I)\}$
- $goto(S, X) = \bigcup_{\mathtt{I} \in \mathtt{S}} \{goto(I, X)\}$