Conceptual Issues

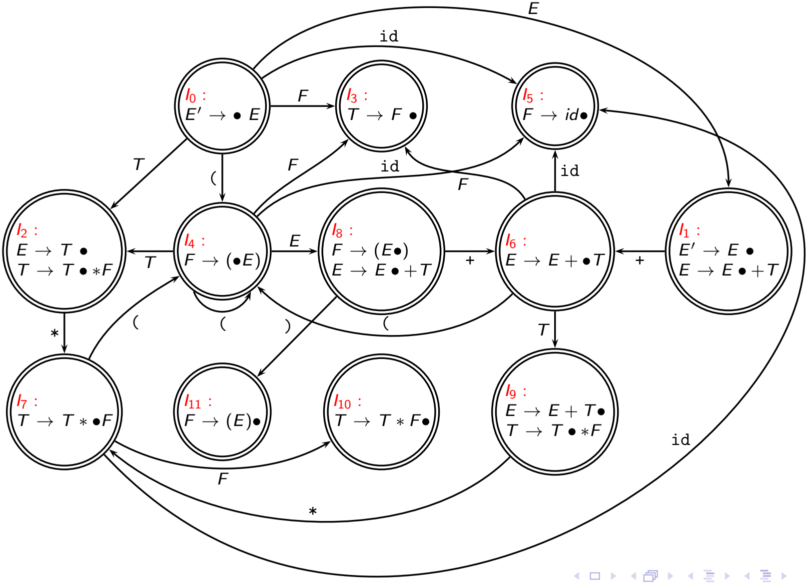
1. What information do the states contain?
2. Where exactly is handle detection taking place in the parser?
3. Why is *FOLLOW* information used to create the reduce entries in the action table ?

To answer these questions, we need to see the canonical collection of LR(0) items as a DFA.

- A node labeled I_i is constructed for each member of C.
- For every nonempty goto$(I_i, X) = I_j$, a directed edge (I_i, I_j) is added labeled with X.
- The graph is a deterministic finite automaton if the node labeled I_0 is treated as the *start* state and all other nodes are made final states.

What does the automaton recognize?

The DFA of an LR parser



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4. For a viable prefix, if is useful to identify the portion of the handle that it contains.

Viable Prefix and Valid Items

A LR(0) item $A \to \beta_1 \bullet \beta_2$ is defined to be *valid* for a viable prefix, $\alpha\beta_1$, provided $S \overset{*}{\Rightarrow}_{rm} \alpha A\ \mathtt{w} \Rightarrow_{rm} \alpha\beta_1\beta_2\ \mathtt{w}$

1. There could be several distinct items which are valid for the same viable prefix γ.
2. It is interesting to note that in above, if $\beta_2 = B\gamma$ and $B \to \delta$, then $B \to \bullet\delta$ is also a valid item for this viable prefix.
3. A particular item may be valid for many distinct viable prefixes.

Viable Prefixes and Valid Items

- For the LR-automaton shown earlier, consider the path labeled by the viable prefix $(E+$ ending in I_6. The items valid for $(E+$ are:
  1. $E' \Rightarrow_{rm} E \Rightarrow T \Rightarrow F \Rightarrow (E) \Rightarrow (E+T)$ shows that $E \rightarrow E + \bullet T$ is a valid item for $(E+$.
  2. $E' \Rightarrow E \Rightarrow T \Rightarrow F \Rightarrow (E) \Rightarrow (E+T) \Rightarrow (E+T*F)$ shows that $T \rightarrow \bullet T * F$ is also a valid item.
  3. $E' \overset{*}{\Rightarrow}_{rm} (E+T) \Rightarrow (E+F)$ shows that $T \rightarrow \bullet F$ is another such item.
  4. $E' \overset{*}{\Rightarrow}_{rm} (E+T) \Rightarrow (E+F) \Rightarrow (E+(E))$ shows that $F \rightarrow \bullet(E)$ is also a valid item for $(E+$.
  5. Finally, $E' \overset{*}{\Rightarrow}_{rm} (E+F) \Rightarrow (E+\texttt{id})$ shows that $F \rightarrow \bullet\ \texttt{id}$ is a valid item for $(E+$.

  It should be noted that are no other valid items for this viable prefix.

Viable Prefixes and Valid Items

Given a LR(0) item, say $T \rightarrow T \bullet *F$, there may be several viable prefixes for which it is valid.

1. $E' \Rightarrow_{rm} E \Rightarrow T \Rightarrow T * F$ shows that this item is valid for the viable prefix T .
2. $E' \Rightarrow E \Rightarrow T \Rightarrow F \Rightarrow (E) \Rightarrow (T) \Rightarrow (T * F)$ shows that it is also valid for (T .
3. $E' \Rightarrow E \Rightarrow T \Rightarrow T * F \Rightarrow T * (E) \Rightarrow T * (T) \Rightarrow T * (T * F)$ shows that it is valid also for T * (T .
4. $E' \Rightarrow E \Rightarrow E + T \Rightarrow E + T * F$ shows validity for $E + T$.

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Theory of LR Parsing

THEOREM : Starting from I_0, if traversing the LR(0) automaton γ results in state j, then set items in I_j are the only valid items for the viable prefix γ.

- The theorem stated without proof above is a key result in LR Parsing. It provides the basis for the correctness of the construction process we learnt earlier.
- An LR parser does not scan the entire stack to determine when and which handle appears on top of stack (compare with shift-reduce parser).
- The state symbol on top of stack provides all the information that is present in the stack.
- In a state which contains a complete item a reduction is called for. However, the lookahead symbols for which the reduction should be applied is not obvious.
- *In SLR(1) parser the FOLLOW information is used to guide reductions.*