Exercise 1

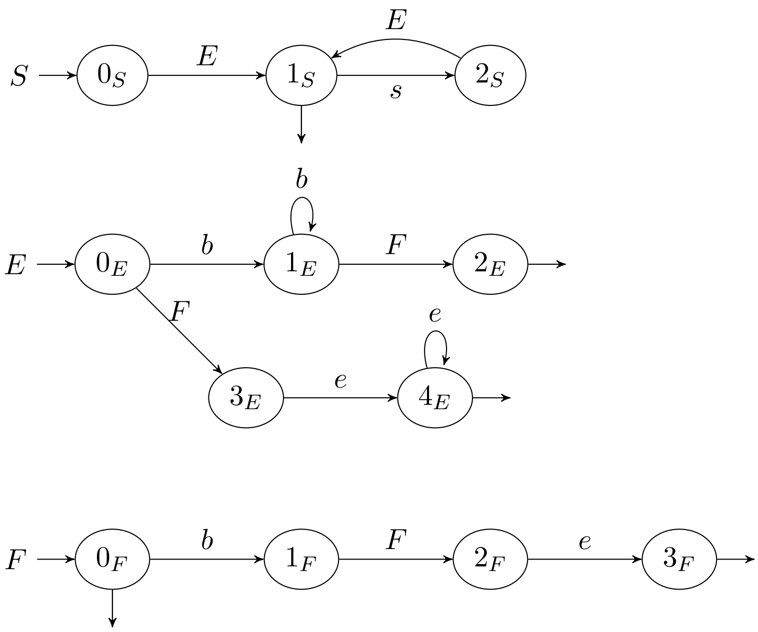
Given the following grammar g in extended BNF form (axiom S)

$$S \rightarrow E\,(\,s\,E\,)^{*}$$
$$E \rightarrow b^{+}\,F \mid F\,e^{+}$$
$$F \rightarrow b\,F\,e \mid \varepsilon$$

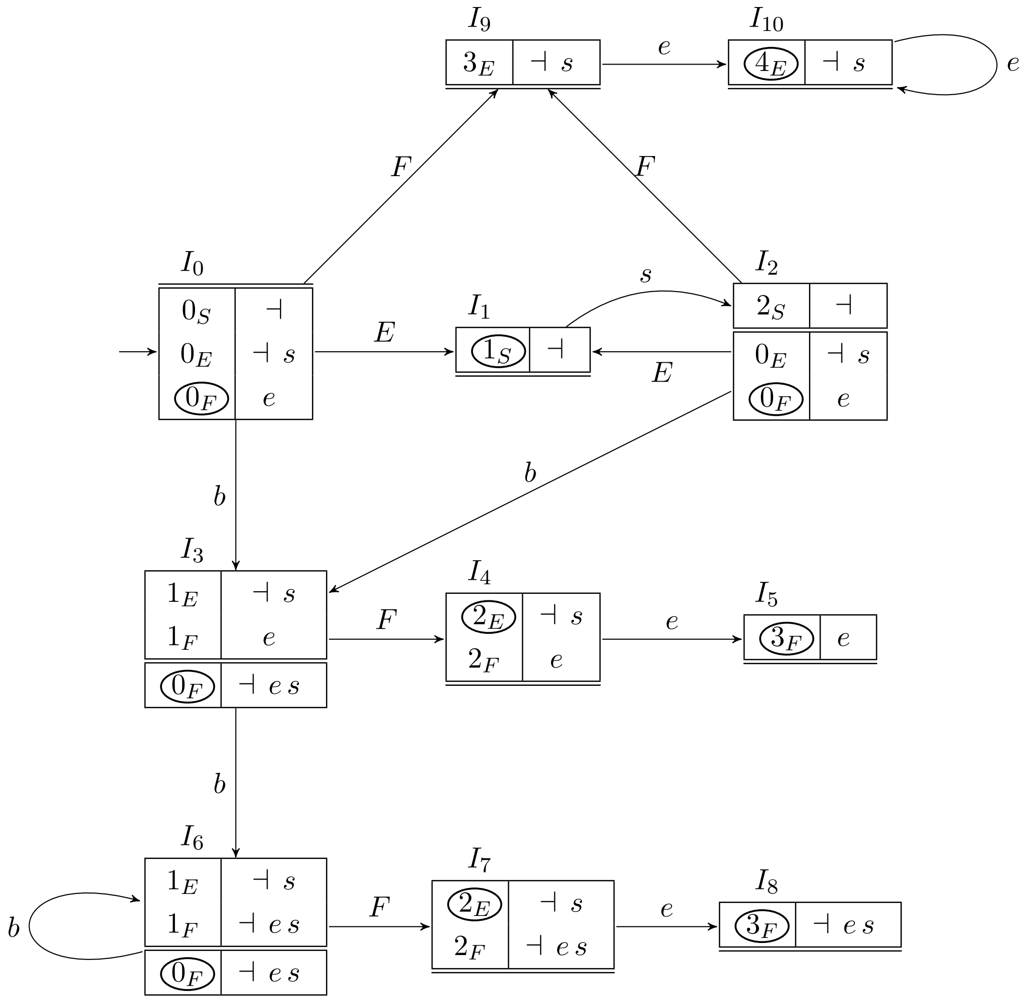
1. Draw the net of recursive machines representing G
2. Draw the pilot automaton of the ELR parser for G and check whether the ELR(1) condition is verified
3. Check if the pilot automaton satisfies the ELL(1) condition
4. Manually emulate the automaton parsing process for the *bee* string

Solution

The net of recursive machines is depicted in the following:



The pilot automaton is the following:



We will now analyse the construction of the I_3 macrostate to recap how this is done. The I_3 macrostate is spawned by the I_0 macrostate when the b terminal is shifted. The machine net states of I_0 for which there exists a transition with b are 0_E and 0_F leading to 1_E and 1_F respectively. Thus we have that $\langle 1_E, \dashv s\rangle$ and $\langle 1_F, e\rangle$ are elements in the base of I_3.

The I_3 macrostate can be completed with the elements belonging to the closure of its base. Both 1_E and 1_F have an exiting transition marked with the nonterminal F, thus in their closure it will be present $\langle 0_F, \eta\rangle$.

Let U_F be the set of transitions $q_i \xrightarrow{F} r_I$ exiting from the states of the candidates in the base $\langle q_i, \rho_i \rangle$. We have that:

$$\eta = \bigcup_{i \in U_F} \eta_i$$

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$$\eta_i = Ini(L(r_A)) \cup \begin{cases} \rho_i & \text{se } L(r_A) \text{ è annullabile} \\ \emptyset & \text{altrimenti} \end{cases}$$

In this case, consider the transitions $t_0 : 1_E \xrightarrow{F} 2_E$ and $t_1 : 1_F \xrightarrow{F} 2_F$: thus $\eta_{t_0} = \{\dashv, s\}$, while $\eta_{t_1} = \{e\}$ so $\eta = \{\dashv, e, s\}$.

Note that the I_6 has the same kernel of I_3 (the only actual difference is in the lookahead sets) note that the candidate $\langle 1_F, \dashv\ e\, s \rangle$ is derived from the transition marked with the b terminal in 0_F belonging to I_3 thus the lookahead set is the same.

The ELR(1) condition holds since :

- There are no shift-reduce conflicts
- There are no reduce-reduce conflicts
- There are no convergent transitions

Note that the MTP property is verified: in the I_3 macrostate, for both 1_E and 1_F there is a transition in the machine pertaining the F nonterminal. However, thereis no convergence as the transitions are coming from different machines. Since the MTP property holds, the STP property does not, thus the ELL(1) condition is not verified.

In the following, the configuration of the ELR(1) stack is depicted during the recognition of the string *bee*:

[0] 0_S ⊥ 0_E ⊥ 0_F ⊥							$bee\dashv$	shift
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	b	[3] 1_E #2 1_F #3 0_F ⊥					$ee\dashv$	reduce $\varepsilon \rightsquigarrow F$
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	b	[3] 1_E #2 1_F #3 0_F ⊥	F				$ee\dashv$	non terminal shift
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	b	[3] 1_E #2 1_F #3 0_F ⊥	F	[4] 2_E #1 2_F #2			$ee\dashv$	shift
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	b	[3] 1_E #2 1_F #3 0_F ⊥	F	[4] 2_E #1 2_F #2	e	[5] 3_F #2	$e\dashv$	reduce $bFe \rightsquigarrow F$
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	F						$e\dashv$	non terminal shift
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	F	[6] 3_E #2					$e\dashv$	shift
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	F	[9] 3_E #2	e	[10] 4_E #1			$\dashv$	reduce $Fe \rightsquigarrow E$
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	E						$\dashv$	non terminal shift
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	E	[0] 1_S #1					$\dashv$	reduce $E \rightsquigarrow S$
[0] 0_S ⊥ 0_E ⊥ 0_F ⊥	S						$\dashv$	accept