Lemma 2.15 of Sipser’s text describes a general conversion from PDA’s to CFG’s. We will apply it to the following PDA which accepts the language $\{a^n b^n \mid n \geq 0\}$ and has all the properties required for the direct construction.

For the general construction there would be 9 variables $A_{ij}$ for $i, j \in \{0, 1, 2\}$. However we only need to include those $A_{ij}$ such that there is a path from $i$ to $j$ in the PDA diagram. This means that we only need to include rules involving $A_{00}, A_{01}, A_{02}, A_{11}, A_{12}, A_{22}$.

The start symbol is $A_{02}$. The rules involving only these symbols are:

$$
A_{00} \rightarrow A_{00} A_{00} | \varepsilon \\
A_{01} \rightarrow A_{00} A_{01} | A_{01} A_{11} \\
A_{02} \rightarrow A_{00} A_{02} | A_{01} A_{12} | A_{02} A_{22} \\
A_{11} \rightarrow A_{11} A_{11} | \varepsilon \\
A_{12} \rightarrow A_{11} A_{12} | A_{12} A_{22} \\
A_{22} \rightarrow A_{22} A_{22} | \varepsilon \\
A_{02} \rightarrow a A_{02} b \\
A_{02} \rightarrow A_{02} A_{11}
$$

where the next to last rule comes from pairing up the two self loop arcs and the last rule comes from pairing up the other two arcs.