## Palindromes

```
grammar Palindrome_full
     nonterminal P(2), S(0);
                 a(2), b(2);
     terminal
     start
                 s;
     S() ::= P(x,y)
                                       [init]
     P(x,y) ::= a(x,u) a(v,y) P(u,v)
                                       [aPa]
             | b(x,u) b(v,y) P(u,v)
                                       [bPb]
             | a(x,u) a(u,y)
                                       [aa]
             | b(x,u) b(u,y)
                                       Гъъ]
             | a(x,y)
                                       [a]
             | b(x,y)
                                       [b]
 end
State q_0(a, b)
```

 $\mathsf{S}() \rightarrow \mathsf{P}(\boldsymbol{a}, \boldsymbol{b})$  $\overline{\mathsf{P}(a,b)} 
ightarrow \mathsf{a}(a,b)$  $\mathsf{P}(\boldsymbol{a}, \boldsymbol{b}) \rightarrow \mathsf{.a}(\boldsymbol{a}, n_1) \mathsf{a}(n_1, \boldsymbol{b})$  $\mathsf{P}(\boldsymbol{a},\boldsymbol{b}) \rightarrow \operatorname{La}(\boldsymbol{a},n_2)\operatorname{a}(n_3,\boldsymbol{b})\operatorname{P}(n_2,n_3)$  $\mathsf{P}(\boldsymbol{a},\boldsymbol{b}) \rightarrow \mathsf{.b}(\boldsymbol{a},\boldsymbol{b})$  $\mathsf{P}(\boldsymbol{a}, \boldsymbol{b}) \rightarrow \mathsf{.b}(\boldsymbol{a}, n_4) \mathsf{b}(n_4, \boldsymbol{b})$  $\mathsf{P}(\boldsymbol{a}, \boldsymbol{b}) \rightarrow \mathsf{L} \mathsf{b}(\boldsymbol{a}, n_5) \mathsf{b}(n_6, \boldsymbol{b}) \mathsf{P}(n_5, n_6)$  $P(n_0, n_1)$  $n_0 = \boldsymbol{a}, n_1 = \boldsymbol{b}$   $q_{11}(n_0, n_1)$  $\mathsf{a}(n_0,n_1)$  $\begin{array}{c} \underline{a_1(n_0,n_1)} \\ n_0 = \boldsymbol{a}, n_1 = \boldsymbol{b} \end{array} q_3(n_0,n_1)$  $a(n_0, n_1)$  $\longrightarrow q_1(n_0, \boldsymbol{b}, n_1, \boldsymbol{b})$  $n_0 = \boldsymbol{a}, n_1 \uparrow$  $b(n_0, n_1)$  $n_0 = \boldsymbol{a}, n_1 = \boldsymbol{b}$   $q_2(n_0, n_1)$  $b(n_0, n_1)$  $\longrightarrow q_4(n_0, \boldsymbol{b}, n_1, \boldsymbol{b})$  $n_0 = \boldsymbol{a}, n_1 \uparrow$ State  $q_1(a, b, c, b)$  $\mathsf{P}({m a},{m b}) 
ightarrow \mathsf{a}({m a},{m c})$  .  $\mathsf{a}({m c},{m b})$  $\mathsf{P}(\boldsymbol{a},\boldsymbol{b}) \to \mathsf{a}(\boldsymbol{a},\boldsymbol{c}) \cdot \mathsf{a}(n_1,\boldsymbol{b}) \mathsf{P}(\boldsymbol{c},n_1)$  $a(n_0, n_1)$  $n_0 = \boldsymbol{c}, n_1 = \boldsymbol{b} \rightarrow q_6(\boldsymbol{a}, n_1, n_0)$  $a(n_0, n_1)$  $\longrightarrow q_5(\boldsymbol{a}, n_1, \boldsymbol{c}, n_0)$  $n_0\uparrow, n_1 = \boldsymbol{b}$ State  $q_2(a, b)$ [b] $| \mathsf{P}(\boldsymbol{a}, \boldsymbol{b}) \rightarrow \mathsf{b}(\boldsymbol{a}, \boldsymbol{b}).$ State  $q_3(a, b)$  $\mathsf{P}(\boldsymbol{a},\boldsymbol{b}) 
ightarrow \mathsf{a}(\boldsymbol{a},\boldsymbol{b})$  . [a]State  $q_4(a, b, c, b)$  $\mathsf{P}(\boldsymbol{a},\boldsymbol{b}) \rightarrow \mathsf{b}(\boldsymbol{a},\boldsymbol{c})$  .  $\mathsf{b}(n_1,\boldsymbol{b}) \mathsf{P}(\boldsymbol{c},n_1)$  $\mathsf{P}(\boldsymbol{a},\boldsymbol{b}) 
ightarrow \mathsf{b}(\boldsymbol{a},\boldsymbol{c})$  .  $\mathsf{b}(\boldsymbol{c},\boldsymbol{b})$  $b(n_0, n_1)$  $\underbrace{n_0 = \boldsymbol{c}, n_1 = \boldsymbol{b}}_{\boldsymbol{c}} \rightarrow q_7(\boldsymbol{a}, n_1, n_0)$  $b(n_0, n_1)$  $\xrightarrow{\mathbf{s}(n_0, n_1)}{n_0 \uparrow, n_1 = \mathbf{b}} q_8(\mathbf{a}, n_1, \mathbf{c}, n_0)$ State  $q_5(a, b, c, d)$  $\mathsf{P}(\boldsymbol{a},\boldsymbol{b}) 
ightarrow \mathsf{a}(\boldsymbol{a},\boldsymbol{c}) \,\mathsf{a}(\boldsymbol{d},\boldsymbol{b})$  .  $\mathsf{P}(\boldsymbol{c},\boldsymbol{d})$  $\mathsf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \mathtt{a}(\boldsymbol{c},\boldsymbol{d})$  $\mathsf{P}(\boldsymbol{c}, \boldsymbol{d}) \rightarrow \mathsf{a}(\boldsymbol{c}, n_1) \mathsf{a}(n_1, \boldsymbol{d})$  $\mathsf{P}(\boldsymbol{c}, \boldsymbol{d}) \rightarrow \mathsf{a}(\boldsymbol{c}, n_2) \mathsf{a}(n_3, \boldsymbol{d}) \mathsf{P}(n_2, n_3)$  $\mathsf{P}(\boldsymbol{c}, \boldsymbol{d}) \rightarrow \mathsf{.b}(\boldsymbol{c}, \boldsymbol{d})$  $\mathsf{P}(\boldsymbol{c}, \boldsymbol{d}) \rightarrow \mathsf{Lb}(\boldsymbol{c}, n_4) \mathsf{b}(n_4, \boldsymbol{d})$  $\mathsf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \mathsf{Lb}(\boldsymbol{c},n_5) \, \mathsf{b}(n_6,\boldsymbol{d}) \, \mathsf{P}(n_5,n_6)$   $\begin{array}{c} \begin{array}{c} \mathsf{P}(n_0,n_1) \\ \hline n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d} \end{array} \neq q_9(\boldsymbol{a}, \boldsymbol{b}, n_0, n_1) \\ \hline \boldsymbol{a}(n_0,n_1) \\ \hline n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d} \end{array} \neq q_3(n_0,n_1) \\ \hline \boldsymbol{a}(n_0,n_1) \\ \hline n_0 = \boldsymbol{c}, n_1 \uparrow \end{array} \neq q_1(n_0, \boldsymbol{d}, n_1, \boldsymbol{d}) \\ \hline \begin{array}{c} \mathsf{b}(n_0,n_1) \\ \hline n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d} \end{array} \neq q_2(n_0,n_1) \\ \hline \begin{array}{c} \mathsf{b}(n_0,n_1) \\ \hline n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d} \end{array} \neq q_4(n_0, \boldsymbol{d}, n_1, \boldsymbol{d}) \end{array}$ 

 $\begin{array}{l} \textbf{State } \boldsymbol{q_6}(\boldsymbol{a},\boldsymbol{b},\boldsymbol{c}) \\ \hline \mathsf{P}(\boldsymbol{a},\boldsymbol{b}) \rightarrow \mathsf{a}(\boldsymbol{a},\boldsymbol{c}) \, \mathsf{a}(\boldsymbol{c},\boldsymbol{b}) \, \boldsymbol{.} \quad [aa] \end{array}$ 

 $\begin{array}{c} \textbf{State } \boldsymbol{q_7}(\boldsymbol{a},\boldsymbol{b},\boldsymbol{c}) \\ \hline \mathsf{P}(\boldsymbol{a},\boldsymbol{b}) \rightarrow \mathsf{b}(\boldsymbol{a},\boldsymbol{c}) \, \mathsf{b}(\boldsymbol{c},\boldsymbol{b}) \, \boldsymbol{.} \quad [bb] \end{array}$ 

 $\begin{array}{c} \textbf{State } \boldsymbol{q_8}(\boldsymbol{a},\boldsymbol{b},\boldsymbol{c},\boldsymbol{d}) \\ \hline \textbf{P}(\boldsymbol{a},\boldsymbol{b}) \rightarrow \textbf{b}(\boldsymbol{a},\boldsymbol{c})\,\textbf{b}(\boldsymbol{d},\boldsymbol{b}) \cdot \textbf{P}(\boldsymbol{c},\boldsymbol{d}) \\ \hline \textbf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \boldsymbol{.a}(\boldsymbol{c},\boldsymbol{d}) \\ \textbf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \boldsymbol{.a}(\boldsymbol{c},n_1)\,\textbf{a}(n_1,\boldsymbol{d}) \\ \textbf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \boldsymbol{.a}(\boldsymbol{c},n_2)\,\textbf{a}(n_3,\boldsymbol{d})\,\textbf{P}(n_2,n_3) \\ \textbf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \boldsymbol{.b}(\boldsymbol{c},\boldsymbol{d}) \\ \textbf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \boldsymbol{.b}(\boldsymbol{c},\boldsymbol{d}) \\ \textbf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \boldsymbol{.b}(\boldsymbol{c},\boldsymbol{d}) \\ \textbf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \boldsymbol{.b}(\boldsymbol{c},n_4)\,\textbf{b}(n_4,\boldsymbol{d}) \\ \textbf{P}(\boldsymbol{c},\boldsymbol{d}) \rightarrow \boldsymbol{.b}(\boldsymbol{c},n_5)\,\textbf{b}(n_6,\boldsymbol{d})\,\textbf{P}(n_5,n_6) \end{array}$ 

$$\begin{array}{c} \underline{\mathsf{P}(n_0, n_1)} \\ n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d} \end{array} q_{10}(\boldsymbol{a}, \boldsymbol{b}, n_0, n_1) \\ \hline \boldsymbol{a}(n_0, n_1) \\ n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d} \end{array} q_3(n_0, n_1) \\ \hline \boldsymbol{a}(n_0, n_1) \\ n_0 = \boldsymbol{c}, n_1 \uparrow \end{array} q_1(n_0, \boldsymbol{d}, n_1, \boldsymbol{d}) \\ \hline \boldsymbol{b}(n_0, n_1) \\ n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d} \end{array} q_2(n_0, n_1) \\ \hline \boldsymbol{b}(n_0, n_1) \\ n_0 = \boldsymbol{c}, n_1 \uparrow \longrightarrow q_4(n_0, \boldsymbol{d}, n_1, \boldsymbol{d}) \end{array}$$

 $\begin{array}{c} \textbf{State } \boldsymbol{q_9}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d}) \\ \hline \mathsf{P}(\boldsymbol{a}, \boldsymbol{b}) \rightarrow \mathsf{a}(\boldsymbol{a}, \boldsymbol{c}) \, \mathsf{a}(\boldsymbol{d}, \boldsymbol{b}) \, \mathsf{P}(\boldsymbol{c}, \boldsymbol{d}) \boldsymbol{.} \quad [aPa] \end{array}$ 

 $\begin{array}{l} \textbf{State } q_{10}(a,b,c,d) \\ \hline \mathsf{P}(a,b) \rightarrow \mathsf{b}(a,c) \, \mathsf{b}(d,b) \, \mathsf{P}(c,d) \, \textbf{.} \quad [bPb] \end{array}$ 

State  $q_{11}(a, b)$  $S() \rightarrow P(a, b)$ . [init]