

$$1) \quad S \rightarrow 0A0 \mid 1B1 \mid BB$$

$$A \rightarrow C$$

$$B \rightarrow S \mid A$$

$$C \rightarrow S \mid \epsilon$$

$$A \rightarrow \emptyset$$

$$A \rightarrow S \mid \epsilon$$

$$B \rightarrow S \mid A$$

$$S \rightarrow 0A0 \mid 00 \mid 1B1 \mid BB$$

$$A \rightarrow S$$

$$B \rightarrow S \mid \epsilon$$

$$\boxed{S \rightarrow 0S0 \mid 00 \mid 1S1 \mid 11 \mid SS}$$

CNF

START:  $S_0 \rightarrow S$

$$S \rightarrow 0S0 \mid 00 \mid 1S1 \mid 11 \mid SS$$

TERM:  $S \rightarrow \epsilon$

$$S_0 \rightarrow S$$

$$S \rightarrow ASA \mid AA \mid BSB \mid BB \mid SS$$

$$A \rightarrow 0$$

$$B \rightarrow 1$$

BIN:

$$S_0 \rightarrow S$$

$$S \rightarrow CA \mid AA \mid DB \mid BB \mid SS$$

$$C \rightarrow AS$$

$$D \rightarrow BS$$

$$A \rightarrow 0$$

$$B \rightarrow 1$$

UNIT:

$$S_1 \rightarrow CA \mid AA \mid DB \mid BB \mid S_1 S_1$$

$$C \rightarrow AS_1$$

$$D \rightarrow BS_1$$

$$A \rightarrow 0$$

$$B \rightarrow 1$$

$$2) \quad S \rightarrow aAa \mid bBb \mid \epsilon$$

$$A \rightarrow C \mid a$$

$$B \rightarrow C \mid b$$

$$C \rightarrow CD \mid \epsilon$$

$$D \rightarrow A \mid B \mid ab$$

$$\begin{array}{l} S \rightarrow aAc \mid bBb \mid \epsilon \\ A \rightarrow CD \mid a \\ B \rightarrow CD \mid b \\ D \rightarrow A \mid B \mid ab \\ C \rightarrow CD \end{array}$$

CNF:

START:

$$S_0 \rightarrow S$$

$$S \rightarrow aAc \mid bBb \mid \epsilon$$

$$A \rightarrow CD \mid a$$

$$B \rightarrow CD \mid b$$

$$C \rightarrow CD$$

$$D \rightarrow A \mid B \mid ab$$

TERM:

$$S_0 \rightarrow S$$

$$S \rightarrow xAx \mid yBy \mid \epsilon$$

$$A \rightarrow CD \mid a$$

$$B \rightarrow CD \mid b$$

$$C \rightarrow CD$$

$$D \rightarrow A|B|ab$$

$$X \rightarrow a$$

$$Y \rightarrow b$$

UNIT:

$$S \rightarrow EX|FY|\epsilon$$

$$A \rightarrow CD|a$$

$$B \rightarrow CD|b$$

$$C \rightarrow CD$$

$$D \rightarrow A|B|ab$$

$$X \rightarrow a$$

$$Y \rightarrow b$$

$$\epsilon \rightarrow xA$$

$$F \rightarrow YB$$