Step	Algorithm: $[C] := \text{SYRK\_LT\_UNB\_VAR3}(A, C)$
1a	$\{C = \widehat{C}\}$
4	$C \rightarrow \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right)$, $A \rightarrow \left(\begin{array}{c\|c} A_L & A_R \end{array}\right)$ where C_{TL} is 0×0, A_L has 0 columns
2	$\left\{ \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) = \left(\begin{array}{c\|c} A_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline A_R^T A_L + \widehat{C}_{BL} & \widehat{C}_{BR} \end{array}\right) \right\}$
3	while $m(C_{TL}) < m(C)$ do
2,3	$\left\{ \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) = \left(\begin{array}{c\|c} A_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline A_R^T A_L + \widehat{C}_{BL} & \widehat{C}_{BR} \end{array}\right) \wedge m(C_{TL}) < m(C) \right\}$
5a	$\left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \rightarrow \left(\begin{array}{c\|cc} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ C_{20} & c_{21} & C_{22} \end{array}\right)$, $\left(\begin{array}{c\|c} A_L & A_R \end{array}\right) \rightarrow \left(\begin{array}{c\|cc} A_0 & a_1 & A_2 \end{array}\right)$ where γ_{11} is 1×1, a_1 has 1 column
6	$\left\{ \left(\begin{array}{c\|cc} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ C_{20} & c_{21} & C_{22} \end{array}\right) = \left(\begin{array}{c\|cc} A_0^T A_0 + \widehat{C}_{00} & \widehat{c}_{01} & \widehat{C}_{02} \\ \hline a_1^T A_0 + \widehat{c}_{10}^T & \widehat{\gamma}_{11} & \widehat{c}_{12}^T \\ A_2^T A_0 + \widehat{C}_{20} & \widehat{c}_{21} & \widehat{C}_{22} \end{array}\right) \right\}$
8	$\gamma_{11} := a_1^T a_1 + \gamma_{11}$ $c_{21} := A_2^T a_1 + c_{21}$
7	$\left\{ \left(\begin{array}{cc\|c} C_{00} & c_{01} & C_{02} \\ c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array}\right) = \left(\begin{array}{cc\|c} A_0^T A_0 + \widehat{C}_{00} & A_0^T a_1 + \widehat{c}_{10}^T & \widehat{C}_{02} \\ a_1^T A_0 + \widehat{c}_{10}^T & a_1^T a_1 + \widehat{\gamma}_{11} & \widehat{c}_{12}^T \\ \hline A_2^T A_0 + \widehat{C}_{20} & A_2^T a_1 + \widehat{c}_{21} & \widehat{C}_{22} \end{array}\right) \right\}$
5b	$\left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \leftarrow \left(\begin{array}{cc\|c} C_{00} & c_{01} & C_{02} \\ c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array}\right)$, $\left(\begin{array}{c\|c} A_L & A_R \end{array}\right) \leftarrow \left(\begin{array}{cc\|c} A_0 & a_1 & A_2 \end{array}\right)$
2	$\left\{ \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) = \left(\begin{array}{c\|c} A_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline A_R^T A_L + \widehat{C}_{BL} & \widehat{C}_{BR} \end{array}\right) \right\}$
	endwhile
2,3	$\left\{ \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) = \left(\begin{array}{c\|c} A_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline A_R^T A_L + \widehat{C}_{BL} & \widehat{C}_{BR} \end{array}\right) \wedge \neg(m(C_{TL}) < m(C)) \right\}$
1b	$\{C = A^T A + \widehat{C}\}$

Step	Algorithm: $[C] := \text{SYRK\_LT\_UNB\_VAR3}(A, C)$
1a	$\{ \qquad \}$
4	where
2	$\left\{ \qquad \right\}$
3	while do
2,3	$\left\{ \qquad \wedge \qquad \right\}$
5a	where
6	$\left\{ \qquad \right\}$
8	
7	$\left\{ \qquad \right\}$
5b	
2	$\left\{ \qquad \right\}$
	endwhile
2,3	$\left\{ \qquad \wedge \neg(\qquad) \qquad \right\}$
1b	$\{ \qquad \}$

Step	Algorithm: $[C] := \textsc{syrk\_lt\_unb\_var3}(A, C)$
1a	$\{C = \widehat{C} \qquad \}$
4	where
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8	
7	$\left\{ \qquad \right\}$
5b	
2	$\left\{ \qquad \right\}$
	endwhile
2,3	$\left\{ \qquad \wedge \neg(\qquad) \qquad \right\}$
1b	$\{C = A^T A + \widehat{C} \qquad \}$

Step	Algorithm: $[C] := \textsc{syrk\_lt\_unb\_var3}(A, C)$
1a	$\{C = \widehat{C}$ $\}$
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3	while do
2,3	$\left\{ \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) = \left(\begin{array}{c\|c} A_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline A_R^T A_L + \widehat{C}_{BL} & \widehat{C}_{BR} \end{array}\right) \wedge \right\}$
5a	where
6	$\left\{ \right\}$
8	
7	$\left\{ \right\}$
5b	
2	$\left\{ \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) = \left(\begin{array}{c\|c} A_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline A_R^T A_L + \widehat{C}_{BL} & \widehat{C}_{BR} \end{array}\right) \right\}$
	endwhile
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	endwhile
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6	$\{ \}$
8	
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5b	$\left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \leftarrow \left(\begin{array}{cc\|c} C_{00} & c_{01} & C_{02} \\ c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array}\right)$, $\left(\begin{array}{c\|c} A_L & A_R \end{array}\right) \leftarrow \left(\begin{array}{cc\|c} A_0 & a_1 & A_2 \end{array}\right)$
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8	
7	$\left\{ \right\}$
5b	$\left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \leftarrow \left(\begin{array}{cc\|c} C_{00} & c_{01} & C_{02} \\ c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array}\right)$, $\left(\begin{array}{c\|c} A_L & A_R \end{array}\right) \leftarrow \left(\begin{array}{cc\|c} A_0 & a_1 & A_2 \end{array}\right)$
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3	while $m(C_{TL}) < m(C)$ do
2,3	$\left\{ \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) = \left(\begin{array}{c\|c} A_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline A_R^T A_L + \widehat{C}_{BL} & \widehat{C}_{BR} \end{array}\right) \wedge m(C_{TL}) < m(C) \right\}$
5a	$\left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \rightarrow \left(\begin{array}{c\|cc} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ C_{20} & c_{21} & C_{22} \end{array}\right)$, $\left(\begin{array}{c\|c} A_L & A_R \end{array}\right) \rightarrow \left(\begin{array}{c\|cc} A_0 & a_1 & A_2 \end{array}\right)$ where γ_{11} is 1×1, a_1 has 1 column
6	$\left\{ \left(\begin{array}{c\|cc} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ C_{20} & c_{21} & C_{22} \end{array}\right) = \left(\begin{array}{c\|cc} A_0^T A_0 + \widehat{C}_{00} & \widehat{c}_{01} & \widehat{C}_{02} \\ \hline a_1^T A_0 + \widehat{c}_{10}^T & \widehat{\gamma}_{11} & \widehat{c}_{12}^T \\ A_2^T A_0 + \widehat{C}_{20} & \widehat{c}_{21} & \widehat{C}_{22} \end{array}\right) \right\}$
8	$\gamma_{11} := a_1^T a_1 + \gamma_{11}$ $c_{21} := A_2^T a_1 + c_{21}$
7	$\left\{ \left(\begin{array}{cc\|c} C_{00} & c_{01} & C_{02} \\ c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array}\right) = \left(\begin{array}{cc\|c} A_0^T A_0 + \widehat{C}_{00} & A_0^T a_1 + \widehat{c}_{10}^T & \widehat{C}_{02} \\ a_1^T A_0 + \widehat{c}_{10}^T & a_1^T a_1 + \widehat{\gamma}_{11} & \widehat{c}_{12}^T \\ \hline A_2^T A_0 + \widehat{C}_{20} & A_2^T a_1 + \widehat{c}_{21} & \widehat{C}_{22} \end{array}\right) \right\}$
5b	$\left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \leftarrow \left(\begin{array}{cc\|c} C_{00} & c_{01} & C_{02} \\ c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array}\right)$, $\left(\begin{array}{c\|c} A_L & A_R \end{array}\right) \leftarrow \left(\begin{array}{cc\|c} A_0 & a_1 & A_2 \end{array}\right)$
2	$\left\{ \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) = \left(\begin{array}{c\|c} A_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline A_R^T A_L + \widehat{C}_{BL} & \widehat{C}_{BR} \end{array}\right) \right\}$
	endwhile
2,3	$\left\{ \left(\begin{array}{c\|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) = \left(\begin{array}{c\|c} A_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline A_R^T A_L + \widehat{C}_{BL} & \widehat{C}_{BR} \end{array}\right) \wedge \neg(m(C_{TL}) < m(C)) \right\}$
1b	$\{C = A^T A + \widehat{C}\}$

Algorithm: $[C] := \text{SYRK\_LT\_UNB\_VAR3}(A, C)$

$$C \rightarrow \left(\begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right), \; A \rightarrow \left(\begin{array}{c|c} A_L & A_R \end{array}\right)$$

where C_{TL} is 0×0, A_L has 0 columns

while $m(C_{TL}) < m(C)$ do

$$\left(\begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \rightarrow \left(\begin{array}{c|cc} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ C_{20} & c_{21} & C_{22} \end{array}\right), \; \left(\begin{array}{c|c} A_L & A_R \end{array}\right) \rightarrow \left(\begin{array}{c|cc} A_0 & a_1 & A_2 \end{array}\right)$$

where γ_{11} is 1×1, a_1 has 1 column

$\gamma_{11} := a_1^T a_1 + \gamma_{11}$

$c_{21} := A_2^T a_1 + c_{21}$

$$\left(\begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \leftarrow \left(\begin{array}{cc|c} C_{00} & c_{01} & C_{02} \\ c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array}\right), \; \left(\begin{array}{c|c} A_L & A_R \end{array}\right) \leftarrow \left(\begin{array}{cc|c} A_0 & a_1 & A_2 \end{array}\right)$$

endwhile

Algorithm: $[C] := \textsc{syrk\_lt\_unb\_var3}(A, C)$

$C \rightarrow \left(\begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right)$, $A \rightarrow \left(\begin{array}{c|c} A_L & A_R \end{array}\right)$

where C_{TL} is 0×0, A_L has 0 columns

while $m(C_{TL}) < m(C)$ do

$$\left(\begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \rightarrow \left(\begin{array}{c|cc} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ C_{20} & c_{21} & C_{22} \end{array}\right), \left(\begin{array}{c|c} A_L & A_R \end{array}\right) \rightarrow \left(\begin{array}{c|cc} A_0 & a_1 & A_2 \end{array}\right)$$

where γ_{11} is 1×1, a_1 has 1 column

$\gamma_{11} := a_1^T a_1 + \gamma_{11}$

$c_{21} := A_2^T a_1 + c_{21}$

$$\left(\begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array}\right) \leftarrow \left(\begin{array}{cc|c} C_{00} & c_{01} & C_{02} \\ c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array}\right), \left(\begin{array}{c|c} A_L & A_R \end{array}\right) \leftarrow \left(\begin{array}{cc|c} A_0 & a_1 & A_2 \end{array}\right)$$

endwhile