

Step	Algorithm:
1a	
4	where
2	
3	while do
2,3	$\wedge$
5a	where
6	
8	
5b	
7	
2	
	endwhile
2,3	$\wedge \neg( \quad )$
1b	

Step	Algorithm: $[C] := \text{SYR2K\_LT\_UNB}(A, B, C)$
1a	$C = \widehat{C}$
4	$A \rightarrow \left( A_L \middle  A_R \right), B \rightarrow \left( B_L \middle  B_R \right), C \rightarrow \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right)$ where $A_L$ has 0 columns, $B_L$ has 0 columns, $C_{TL}$ is $0 \times 0$
2	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} A_L^T B_L + B_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right)$
3	while $n(A_L) < n(A)$ do
2,3	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} A_L^T B_L + B_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right) \wedge n(A_L) < n(A)$
5a	$\left( A_L \middle  A_R \right) \rightarrow \left( A_0 \middle  a_1 \middle  A_2 \right), \left( B_L \middle  B_R \right) \rightarrow \left( B_0 \middle  b_1 \middle  B_2 \right), \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \rightarrow$ $\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$ where $a_1$ has 1 column, $b_1$ has 1 column, $\gamma_{11}$ is $1 \times 1$
6	$\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right) = \left( \begin{array}{c c c} A_0^T B_0 + B_0^T A_0 + \widehat{C}_{00} & 0 & 0 \\ \hline \widehat{c}_{10}^T & \widehat{\gamma}_{11} & 0 \\ \hline \widehat{C}_{20} & \widehat{c}_{21} & \widehat{C}_{22} \end{array} \right)$
8	$c_{10}^T := a_1^T B_0 + b_1^T A_0 + \widehat{c}_{10}^T$ $\gamma_{11} := a_1^T b_1 + b_1^T a_1 + \widehat{\gamma}_{11}$
5b	$\left( A_L \middle  A_R \right) \leftarrow \left( A_0 \middle  a_1 \middle  A_2 \right), \left( B_L \middle  B_R \right) \leftarrow \left( B_0 \middle  b_1 \middle  B_2 \right), \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \leftarrow$ $\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$
7	$\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right) = \left( \begin{array}{c c c} A_0^T B_0 + B_0^T A_0 + \widehat{C}_{00} & 0 & 0 \\ \hline a_1^T B_0 + b_1^T A_0 + \widehat{c}_{10}^T & a_1^T b_1 + b_1^T a_1 + \widehat{\gamma}_{11} & 0 \\ \hline \widehat{C}_{20} & \widehat{c}_{21} & \widehat{C}_{22} \end{array} \right)$
2	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} A_L^T B_L + B_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right)$
	endwhile
2,3	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} A_L^T B_L + B_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right) \wedge \neg(n(A_L) < n(A))$
1b	$[C] = \text{Syr2k\_lt}(A, B, \widehat{C})$

**Algorithm:**  $[C] := \text{SYR2K\_LT\_UNB}(A, B, C)$

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

**where**  $A_L$  has 0 columns,  $B_L$  has 0 columns,  $C_{TL}$  is  $0 \times 0$

**while**  $n(A_L) < n(A)$  **do**

$$\left( A_L \middle| A_R \right) \rightarrow \left( A_0 \middle| a_1 \middle| A_2 \right), \left( B_L \middle| B_R \right) \rightarrow \left( B_0 \middle| b_1 \middle| B_2 \right), \left( \begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \rightarrow \left( \begin{array}{c|c|c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$$

**where**  $a_1$  has 1 column,  $b_1$  has 1 column,  $\gamma_{11}$  is  $1 \times 1$

$$c_{10}^T := a_1^T B_0 + b_1^T A_0 + \widehat{c_{10}^T}$$

$$\gamma_{11} := a_1^T b_1 + b_1^T a_1 + \widehat{\gamma_{11}}$$

$$\left( A_L \middle| A_R \right) \leftarrow \left( A_0 \middle| a_1 \middle| A_2 \right), \left( B_L \middle| B_R \right) \leftarrow \left( B_0 \middle| b_1 \middle| B_2 \right), \left( \begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \leftarrow \left( \begin{array}{c|c|c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$$

**endwhile**

Step	Algorithm: $[C] := \text{SYR2K\_LT\_UNB}(A, B, C)$
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2,3	$\wedge$
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	where
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3	while do
2,3	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} A_L^T B_L + B_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right) \wedge$
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3	while $n(A_L) < n(A)$ do
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Step	<b>Algorithm:</b> $[C] := \text{SYR2K\_LT\_UNB}(A, B, C)$
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2	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} A_L^T B_L + B_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right)$
3	<b>while</b> $n(A_L) < n(A)$ <b>do</b>
2,3	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} A_L^T B_L + B_L^T A_L + \widehat{C}_{TL} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right) \wedge n(A_L) < n(A)$
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	<b>endwhile</b>
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5b	$\left( A_L \middle  A_R \right) \leftarrow \left( A_0 \middle  a_1 \middle  A_2 \right), \left( B_L \middle  B_R \right) \leftarrow \left( B_0 \middle  b_1 \middle  B_2 \right), \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \leftarrow$ $\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$
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5b	$\left( A_L \middle  A_R \right) \leftarrow \left( A_0 \middle  a_1 \middle  A_2 \right), \left( B_L \middle  B_R \right) \leftarrow \left( B_0 \middle  b_1 \middle  B_2 \right), \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \leftarrow$ $\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$
7	$\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right) = \left( \begin{array}{c c c} \frac{A_0^T B_0 + B_0^T A_0 + \hat{C}_{00}}{a_1^T B_0 + b_1^T A_0 + \hat{c}_{10}^T} & 0 & 0 \\ \hline \frac{a_1^T B_0 + b_1^T A_0 + \hat{c}_{10}^T}{\hat{C}_{20}} & a_1^T b_1 + b_1^T a_1 + \hat{\gamma}_{11} & 0 \\ \hline \hat{C}_{20} & \hat{c}_{21} & \hat{C}_{22} \end{array} \right)$
2	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} \frac{A_L^T B_L + B_L^T A_L + \hat{C}_{TL}}{\hat{C}_{BL}} & \hat{C}_{TR} \\ \hline \hat{C}_{BR} & \end{array} \right)$
	endwhile
2	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} \frac{A_L^T B_L + B_L^T A_L + \hat{C}_{TL}}{\hat{C}_{BL}} & \hat{C}_{TR} \\ \hline \hat{C}_{BR} & \end{array} \right) \wedge \neg(n(A_L) < n(A))$
1b	$[C] = \text{Syr2k\_lt}(A, B, \hat{C})$

Step	Algorithm: $[C] := \text{SYR2K\_LT\_UNB}(A, B, C)$
1a	$C = \widehat{C}$
4	$A \rightarrow \left( A_L \middle  A_R \right), B \rightarrow \left( B_L \middle  B_R \right), C \rightarrow \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right)$ where $A_L$ has 0 columns, $B_L$ has 0 columns, $C_{TL}$ is $0 \times 0$
2	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} \frac{A_L^T B_L + B_L^T A_L + \widehat{C}_{TL}}{\widehat{C}_{BL}} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right)$
3	while $n(A_L) < n(A)$ do
2,3	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} \frac{A_L^T B_L + B_L^T A_L + \widehat{C}_{TL}}{\widehat{C}_{BL}} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right) \wedge n(A_L) < n(A)$
5a	$\left( A_L \middle  A_R \right) \rightarrow \left( A_0 \middle  a_1 \middle  A_2 \right), \left( B_L \middle  B_R \right) \rightarrow \left( B_0 \middle  b_1 \middle  B_2 \right), \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \rightarrow$ $\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$ where $a_1$ has 1 column, $b_1$ has 1 column, $\gamma_{11}$ is $1 \times 1$
6	$\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right) = \left( \begin{array}{c c c} \frac{A_0^T B_0 + B_0^T A_0 + \widehat{C}_{00}}{\widehat{C}_{20}} & 0 & 0 \\ \hline \widehat{C}_{20} & \widehat{\gamma}_{11} & 0 \\ \hline \widehat{C}_{20} & \widehat{c}_{21} & \widehat{C}_{22} \end{array} \right)$
8	$c_{10}^T := a_1^T B_0 + b_1^T A_0 + \widehat{c}_{10}^T$ $\gamma_{11} := a_1^T b_1 + b_1^T a_1 + \widehat{\gamma}_{11}$
5b	$\left( A_L \middle  A_R \right) \leftarrow \left( A_0 \middle  a_1 \middle  A_2 \right), \left( B_L \middle  B_R \right) \leftarrow \left( B_0 \middle  b_1 \middle  B_2 \right), \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \leftarrow$ $\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$
7	$\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right) = \left( \begin{array}{c c c} \frac{A_0^T B_0 + B_0^T A_0 + \widehat{C}_{00}}{a_1^T B_0 + b_1^T A_0 + \widehat{c}_{10}^T} & 0 & 0 \\ \hline \widehat{C}_{20} & \widehat{c}_{21} & \widehat{C}_{22} \end{array} \right)$
2	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} \frac{A_L^T B_L + B_L^T A_L + \widehat{C}_{TL}}{\widehat{C}_{BL}} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right)$
	endwhile
2,3	$\left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) = \left( \begin{array}{c c} \frac{A_L^T B_L + B_L^T A_L + \widehat{C}_{TL}}{\widehat{C}_{BL}} & \widehat{C}_{TR} \\ \hline \widehat{C}_{BL} & \widehat{C}_{BR} \end{array} \right) \wedge \neg(n(A_L) < n(A))$
1b	$[C] = \text{Syr2k\_lt}(A, B, \widehat{C})$

Step	Algorithm: $[C] := \text{SYR2K\_LT\_UNB}(A, B, C)$
	$A \rightarrow \left( A_L \middle  A_R \right), B \rightarrow \left( B_L \middle  B_R \right), C \rightarrow \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right)$ <p>where <math>A_L</math> has 0 columns, <math>B_L</math> has 0 columns, <math>C_{TL}</math> is <math>0 \times 0</math></p>
	while $n(A_L) < n(A)$ do
	$\left( A_L \middle  A_R \right) \rightarrow \left( A_0 \middle  a_1 \middle  A_2 \right), \left( B_L \middle  B_R \right) \rightarrow \left( B_0 \middle  b_1 \middle  B_2 \right), \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \rightarrow$ $\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$ <p>where <math>a_1</math> has 1 column, <math>b_1</math> has 1 column, <math>\gamma_{11}</math> is <math>1 \times 1</math></p>
	$c_{10}^T := a_1^T B_0 + b_1^T A_0 + \widehat{c_{10}^T}$ $\gamma_{11} := a_1^T b_1 + b_1^T a_1 + \widehat{\gamma_{11}}$
	$\left( A_L \middle  A_R \right) \leftarrow \left( A_0 \middle  a_1 \middle  A_2 \right), \left( B_L \middle  B_R \right) \leftarrow \left( B_0 \middle  b_1 \middle  B_2 \right), \left( \begin{array}{c c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \leftarrow$ $\left( \begin{array}{c c c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$
	endwhile

**Algorithm:**  $[C] := \text{SYR2K\_LT\_UNB}(A, B, C)$

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

**where**  $A_L$  has 0 columns,  $B_L$  has 0 columns,  $C_{TL}$  is  $0 \times 0$

**while**  $n(A_L) < n(A)$  **do**

$$\left( A_L \middle| A_R \right) \rightarrow \left( A_0 \middle| a_1 \middle| A_2 \right), \left( B_L \middle| B_R \right) \rightarrow \left( B_0 \middle| b_1 \middle| B_2 \right), \left( \begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \rightarrow \left( \begin{array}{c|c|c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$$

**where**  $a_1$  has 1 column,  $b_1$  has 1 column,  $\gamma_{11}$  is  $1 \times 1$

$$c_{10}^T := a_1^T B_0 + b_1^T A_0 + \widehat{c_{10}^T}$$

$$\gamma_{11} := a_1^T b_1 + b_1^T a_1 + \widehat{\gamma_{11}}$$

$$\left( A_L \middle| A_R \right) \leftarrow \left( A_0 \middle| a_1 \middle| A_2 \right), \left( B_L \middle| B_R \right) \leftarrow \left( B_0 \middle| b_1 \middle| B_2 \right), \left( \begin{array}{c|c} C_{TL} & C_{TR} \\ \hline C_{BL} & C_{BR} \end{array} \right) \leftarrow \left( \begin{array}{c|c|c} C_{00} & c_{01} & C_{02} \\ \hline c_{10}^T & \gamma_{11} & c_{12}^T \\ \hline C_{20} & c_{21} & C_{22} \end{array} \right)$$

**endwhile**