

Step	Algorithm: $C := AB + C$ where A is symmetric and stored in the lower triangular part
1a	$\{C = \hat{C}$
4	$A \rightarrow \left(\begin{array}{c c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right), B \rightarrow \left(\begin{array}{c} B_T \\ B_B \end{array} \right), C \rightarrow \left(\begin{array}{c} C_T \\ C_B \end{array} \right)$ where A_{TL} is 0×0 , B_T has 0 rows, C_T has 0 rows
2	$\left\{ \left(\begin{array}{c} C_T \\ C_B \end{array} \right) = \left(\begin{array}{c} A_{BL}^T B_B + \hat{C}_T \\ A_{BL} B_T + A_{BR} B_B + \hat{C}_B \end{array} \right) \right\}$
3	while $m(A_{TL}) < m(A)$ do
2,3	$\left\{ \left(\begin{array}{c} C_T \\ C_B \end{array} \right) = \left(\begin{array}{c} A_{BL}^T B_B + \hat{C}_T \\ A_{BL} B_T + A_{BR} B_B + \hat{C}_B \end{array} \right) \wedge m(A_{TL}) < m(A) \right\}$
5a	$\left(\begin{array}{c c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right) \rightarrow \left(\begin{array}{c c} A_{00} & a_{01} \ A_{02} \\ \hline a_{10}^T & \alpha_{11} \ a_{12}^T \\ A_{20} & a_{21} \ A_{22} \end{array} \right), \left(\begin{array}{c} B_T \\ B_B \end{array} \right) \rightarrow \left(\begin{array}{c} B_0 \\ b_1^T \\ B_2 \end{array} \right), \left(\begin{array}{c} C_T \\ C_B \end{array} \right) \rightarrow \left(\begin{array}{c} C_0 \\ c_1^T \\ C_2 \end{array} \right)$ where α_{11} is 1×1 , b_1 has 1 row, c_1 has 1 row
6	$\left\{ \left(\begin{array}{c} C_0 \\ c_1^T \\ C_2 \end{array} \right) = \left(\begin{array}{c} A_{20}^T B_2 + \hat{C}_0 \\ a_{21}^T B_2 + \hat{c}_1^T \\ A_{20} B_0 + a_{21} b_1^T + A_{22} B_2 + \hat{C}_2 \end{array} \right) \right\}$
8	$C_0 := A_{00} B_0 + (a_{10}^T)^T b_1^T + A_{20}^T B_2 + C_0$ $c_1^T := a_{10}^T B_0 + \alpha_{11} b_1^T + a_{21}^T B_2 + c_1^T$ $C_2 := A_{20} B_0 + a_{21} b_1^T + A_{22} B_2 + C_2$
7	$\left\{ \left(\begin{array}{c} C_0 \\ c_1^T \\ C_2 \end{array} \right) = \left(\begin{array}{c} (a_{10}^T)^T b_1^T + A_{20}^T B_2 + \hat{C}_0 \\ a_{10}^T B_0 + \alpha_{11} b_1^T + a_{21}^T B_2 + \hat{c}_1^T \\ A_{20} B_0 + a_{21} b_1^T + A_{22} B_2 + \hat{C}_2 \end{array} \right) \right\}$
5b	$\left(\begin{array}{c c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right) \leftarrow \left(\begin{array}{c c} A_{00} \ a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} \ a_{12}^T \\ A_{20} & a_{21} \ A_{22} \end{array} \right), \left(\begin{array}{c} B_T \\ B_B \end{array} \right) \leftarrow \left(\begin{array}{c} B_0 \\ b_1^T \\ B_2 \end{array} \right), \left(\begin{array}{c} C_T \\ C_B \end{array} \right) \leftarrow \left(\begin{array}{c} C_0 \\ c_1^T \\ C_2 \end{array} \right)$
2	$\left\{ \left(\begin{array}{c} C_T \\ C_B \end{array} \right) = \left(\begin{array}{c} A_{BL}^T B_B + \hat{C}_T \\ A_{BL} B_T + A_{BR} B_B + \hat{C}_B \end{array} \right) \right\}$
	endwhile
2,3	$\left\{ \left(\begin{array}{c} C_T \\ C_B \end{array} \right) = \left(\begin{array}{c} A_{BL}^T B_B + \hat{C}_T \\ A_{BL} B_T + A_{BR} B_B + \hat{C}_B \end{array} \right) \wedge \neg(m(A_{TL}) < m(A)) \right\}$
1b	$\{C = AB + \hat{C}$

Step	Algorithm: $C := AB + C$ where A is symmetric and stored in the lower triangular part
1a	{
4	
	where
2	{
3	while do
2,3	{
	\wedge
5a	
	where
6	{
8	$A_{00}B_0 + A_{20}^T B_2 +$ $a_{21}^T B_2 +$ $C_2 := A_{20}B_0 + a_{21}b_1^T + A_{22}B_2 + C_2$
7	{
5b	
2	{
	endwhile
2,3	{
	$\wedge \neg($
1b	{

Step	Algorithm: $C := AB + C$ where A is symmetric and stored in the lower triangular part
1a	{ $C = \hat{C}$ }
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7	{
5b	
2	{
	endwhile
2,3	{ $\wedge \neg($) }
1b	{ $C = AB + \hat{C}$ }

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	where
2	$\left\{ \begin{pmatrix} C_T \\ C_B \end{pmatrix} = \begin{pmatrix} A_{BL}^T B_B + \widehat{C}_T \\ A_{BL} B_T + A_{BR} B_B + \widehat{C}_B \end{pmatrix} \right\}$
3	while do
2,3	$\left\{ \begin{pmatrix} C_T \\ C_B \end{pmatrix} = \begin{pmatrix} A_{BL}^T B_B + \widehat{C}_T \\ A_{BL} B_T + A_{BR} B_B + \widehat{C}_B \end{pmatrix} \wedge \right.$
5a	
	where
6	$\left\{ \right.$
8	$\begin{aligned} &A_{00}B_0 + &A_{20}^T B_2 + \\ &&a_{21}^T B_2 + \\ C_2 := &A_{20}B_0 + a_{21}b_1^T + A_{22}B_2 + C_2 \end{aligned}$
7	$\left\{ \right.$
5b	
2	$\left\{ \begin{pmatrix} C_T \\ C_B \end{pmatrix} = \begin{pmatrix} A_{BL}^T B_B + \widehat{C}_T \\ A_{BL} B_T + A_{BR} B_B + \widehat{C}_B \end{pmatrix} \right\}$
	endwhile
2,3	$\left\{ \begin{pmatrix} C_T \\ C_B \end{pmatrix} = \begin{pmatrix} A_{BL}^T B_B + \widehat{C}_T \\ A_{BL} B_T + A_{BR} B_B + \widehat{C}_B \end{pmatrix} \wedge \neg(\quad) \right\}$
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	where
2	$\left\{ \left(\frac{C_T}{C_B} \right) = \left(\frac{A_{BL}^T B_B + \widehat{C}_T}{A_{BL} B_T + A_{BR} B_B + \widehat{C}_B} \right) \right\}$
3	while $m(A_{TL}) < m(A)$ do
2,3	$\left\{ \left(\frac{C_T}{C_B} \right) = \left(\frac{A_{BL}^T B_B + \widehat{C}_T}{A_{BL} B_T + A_{BR} B_B + \widehat{C}_B} \right) \wedge m(A_{TL}) < m(A) \right\}$
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2	$\left\{ \left(\begin{array}{c} C_T \\ C_B \end{array} \right) = \left(\begin{array}{c} A_{BL}^T B_B + \widehat{C}_T \\ A_{BL} B_T + A_{BR} B_B + \widehat{C}_B \end{array} \right) \right\}$
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8	$A_{00} B_0 +$ $A_{20}^T B_2 +$ $a_{21}^T B_2 +$ $C_2 := A_{20} B_0 + a_{21} b_1^T + A_{22} B_2 + C_2$
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3	while $m(A_{TL}) < m(A)$ do
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8	$A_{00} B_0 + A_{20}^T B_2 + a_{21}^T B_2 + C_2 := A_{20} B_0 + a_{21} b_1^T + A_{22} B_2 + C_2$
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5b	$\left(\begin{array}{c c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right) \leftarrow \left(\begin{array}{c cc} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ A_{20} & a_{21} & A_{22} \end{array} \right), \left(\begin{array}{c} B_T \\ \hline B_B \end{array} \right) \leftarrow \left(\begin{array}{c} B_0 \\ \hline b_1^T \\ B_2 \end{array} \right), \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right) \leftarrow \left(\begin{array}{c} C_0 \\ \hline c_1^T \\ C_2 \end{array} \right)$
2	$\left\{ \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right) = \left(\begin{array}{c} A_{BL}^T B_B + \widehat{C}_T \\ \hline A_{BL} B_T + A_{BR} B_B + \widehat{C}_B \end{array} \right) \right\}$
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3	while $m(A_{TL}) < m(A)$ do
2,3	$\left\{ \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right) = \left(\begin{array}{c} A_{BL}^T B_B + \widehat{C}_T \\ \hline A_{BL} B_T + A_{BR} B_B + \widehat{C}_B \end{array} \right) \wedge m(A_{TL}) < m(A) \right\}$
5a	$\left(\begin{array}{c c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right) \rightarrow \left(\begin{array}{c cc} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ A_{20} & a_{21} & A_{22} \end{array} \right), \left(\begin{array}{c} B_T \\ \hline B_B \end{array} \right) \rightarrow \left(\begin{array}{c} B_0 \\ \hline b_1^T \\ B_2 \end{array} \right), \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right) \rightarrow \left(\begin{array}{c} C_0 \\ \hline c_1^T \\ C_2 \end{array} \right)$ <p>where α_{11} is 1×1, b_1 has 1 row, c_1 has 1 row</p>
6	$\left\{ \left(\begin{array}{c} C_0 \\ \hline c_1^T \\ C_2 \end{array} \right) = \left(\begin{array}{c} A_{20}^T B_2 + \widehat{C}_0 \\ \hline a_{21}^T B_2 + \widehat{c}_1^T \\ A_{20} B_0 + a_{21} b_1^T + A_{22} B_2 + \widehat{C}_2 \end{array} \right) \right\}$
8	$C_0 := A_{00} B_0 + (a_{10}^T)^T b_1^T + A_{20}^T B_2 + \widehat{C}_0$ $c_1^T := a_{10}^T B_0 + \alpha_{11} b_1^T + a_{21}^T B_2 + \widehat{c}_1^T$ $C_2 := A_{20} B_0 + a_{21} b_1^T + A_{22} B_2 + \widehat{C}_2$
7	$\left\{ \left(\begin{array}{c} C_0 \\ \hline c_1^T \\ C_2 \end{array} \right) = \left(\begin{array}{c} (a_{10}^T)^T b_1^T + A_{20}^T B_2 + \widehat{C}_0 \\ \hline a_{10}^T B_0 + \alpha_{11} b_1^T + a_{21}^T B_2 + \widehat{c}_1^T \\ A_{20} B_0 + a_{21} b_1^T + A_{22} B_2 + \widehat{C}_2 \end{array} \right) \right\}$
5b	$\left(\begin{array}{c c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right) \leftarrow \left(\begin{array}{c cc} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ A_{20} & a_{21} & A_{22} \end{array} \right), \left(\begin{array}{c} B_T \\ \hline B_B \end{array} \right) \leftarrow \left(\begin{array}{c} B_0 \\ \hline b_1^T \\ B_2 \end{array} \right), \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right) \leftarrow \left(\begin{array}{c} C_0 \\ \hline c_1^T \\ C_2 \end{array} \right)$
2	$\left\{ \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right) = \left(\begin{array}{c} A_{BL}^T B_B + \widehat{C}_T \\ \hline A_{BL} B_T + A_{BR} B_B + \widehat{C}_B \end{array} \right) \right\}$
	endwhile
2,3	$\left\{ \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right) = \left(\begin{array}{c} A_{BL}^T B_B + \widehat{C}_T \\ \hline A_{BL} B_T + A_{BR} B_B + \widehat{C}_B \end{array} \right) \wedge \neg(m(A_{TL}) < m(A)) \right\}$
1b	$\{C = AB + \widehat{C}$

	Algorithm: $C := AB + C$ where A is symmetric and stored in the lower triangular part
	$A \rightarrow \left(\begin{array}{c c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right), B \rightarrow \left(\begin{array}{c} B_T \\ \hline B_B \end{array} \right), C \rightarrow \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right)$ <p>where A_{TL} is 0×0, B_T has 0 rows, C_T has 0 rows</p>
	while $m(A_{TL}) < m(A)$ do
	$\left(\begin{array}{c c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right) \rightarrow \left(\begin{array}{c cc} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ A_{20} & a_{21} & A_{22} \end{array} \right), \left(\begin{array}{c} B_T \\ \hline B_B \end{array} \right) \rightarrow \left(\begin{array}{c} B_0 \\ \hline b_1^T \\ B_2 \end{array} \right), \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right) \rightarrow \left(\begin{array}{c} C_0 \\ \hline c_1^T \\ C_2 \end{array} \right)$ <p>where α_{11} is 1×1, b_1 has 1 row, c_1 has 1 row</p>
	$C_0 := A_{00}B_0 + (a_{10}^T)^T b_1^T + A_{20}^T B_2 + C_0$ $c_1^T := a_{10}^T B_0 + \alpha_{11} b_1^T + a_{21}^T B_2 + c_1^T$ $C_2 := A_{20}B_0 + a_{21} b_1^T + A_{22}B_2 + C_2$
	$\left(\begin{array}{c c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right) \leftarrow \left(\begin{array}{c cc} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ A_{20} & a_{21} & A_{22} \end{array} \right), \left(\begin{array}{c} B_T \\ \hline B_B \end{array} \right) \leftarrow \left(\begin{array}{c} B_0 \\ \hline b_1^T \\ B_2 \end{array} \right), \left(\begin{array}{c} C_T \\ \hline C_B \end{array} \right) \leftarrow \left(\begin{array}{c} C_0 \\ \hline c_1^T \\ C_2 \end{array} \right)$
	endwhile

Algorithm: $C := AB + C$ where A is symmetric and stored in the lower triangular part

$$A \rightarrow \left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right), B \rightarrow \left(\begin{array}{c} B_T \\ B_B \end{array} \right), C \rightarrow \left(\begin{array}{c} C_T \\ C_B \end{array} \right)$$

where A_{TL} is 0×0 , B_T has 0 rows, C_T has 0 rows

while $m(A_{TL}) < m(A)$ do

$$\left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right) \rightarrow \left(\begin{array}{c|c} A_{00} & a_{01} \ A_{02} \\ \hline a_{10}^T & \alpha_{11} \ a_{12}^T \\ A_{20} & a_{21} \ A_{22} \end{array} \right), \left(\begin{array}{c} B_T \\ B_B \end{array} \right) \rightarrow \left(\begin{array}{c} B_0 \\ b_1^T \\ B_2 \end{array} \right), \left(\begin{array}{c} C_T \\ C_B \end{array} \right) \rightarrow \left(\begin{array}{c} C_0 \\ c_1^T \\ C_2 \end{array} \right)$$

where α_{11} is 1×1 , b_1 has 1 row, c_1 has 1 row

$$C_0 := (a_{10}^T)^T b_1^T + C_0$$

$$c_1^T := a_{10}^T B_0 + \alpha_{11} b_1^T + c_1^T$$

$$\left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array} \right) \leftarrow \left(\begin{array}{c|c} A_{00} \ a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} \ a_{12}^T \\ A_{20} & a_{21} \ A_{22} \end{array} \right), \left(\begin{array}{c} B_T \\ B_B \end{array} \right) \leftarrow \left(\begin{array}{c} B_0 \\ b_1^T \\ B_2 \end{array} \right), \left(\begin{array}{c} C_T \\ C_B \end{array} \right) \leftarrow \left(\begin{array}{c} C_0 \\ c_1^T \\ C_2 \end{array} \right)$$

endwhile