

3x3 Matrices Multiplications

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \times \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} =$$

$$\begin{bmatrix} a_{11}b_{11} + a_{12}b_{21} + a_{13}b_{31} & a_{11}b_{12} + a_{12}b_{22} + a_{13}b_{32} & a_{11}b_{13} + a_{12}b_{23} + a_{13}b_{33} \\ a_{21}b_{11} + a_{22}b_{21} + a_{23}b_{31} & a_{21}b_{12} + a_{22}b_{22} + a_{23}b_{32} & a_{21}b_{13} + a_{22}b_{23} + a_{23}b_{33} \\ a_{31}b_{11} + a_{32}b_{21} + a_{33}b_{31} & a_{31}b_{12} + a_{32}b_{22} + a_{33}b_{32} & a_{31}b_{13} + a_{32}b_{23} + a_{33}b_{33} \end{bmatrix}$$

$$= \begin{bmatrix} Y_{11} & Y_{12} & Y_{13} \\ Y_{21} & Y_{22} & Y_{23} \\ Y_{31} & Y_{32} & Y_{33} \end{bmatrix}$$

main memory :

		18	a_{11}	19	a_{11}	76
17	a_{11}	68	17	a_{12}	68	17
16	a_{12}	64	16	a_{13}	64	16
15	a_{13}	60	15	a_{21}	60	15
14	a_{21}	56	14	a_{22}	56	14
13	a_{22}	52	13	a_{23}	52	13
12	a_{23}	48	12	a_{31}	48	12
11	a_{31}	44	11	a_{32}	44	11
10	a_{32}	40	10	a_{33}	40	10
9	a_{33}	36	9	b_{11}	36	9
8	b_{11}	32	8	b_{12}	32	8
7	b_{12}	28	7	b_{13}	28	7
6	b_{13}	24	6	b_{21}	24	6
5	b_{21}	20	5	b_{22}	20	5
4	b_{22}	16	4	b_{23}	16	4
3	b_{23}	12	3	b_{31}	12	3
2	b_{31}	8	2	b_{32}	8	2
1	b_{32}	4	1	b_{33}	4	1
SP \Rightarrow	b_{33}	SP \Rightarrow	y_{11}	SP \Rightarrow	y_{12}	y_{13}
	y_{11}		y_{12}			

$$y_{11} = a_{11}b_{11} + a_{12}b_{21} + a_{13}b_{31}$$

$$= (SP + 68)(SP + 32) + (SP + 64)(SP + 20) + (SP + 60)(SP + 8)$$

$$= [SP + (17)4][SP + (8)4] + [SP + (16)4][SP + (5)4] + [SP + (15)4][SP + (2)4]$$

$$y_{12} = a_{11}b_{12} + a_{12}b_{22} + a_{13}b_{32}$$

$$= [SP + (18)4][SP + (8)4] + [SP + (17)4][SP + 5(4)] + [SP + (16)4][SP + 2(4)]$$

$$y_{13} = a_{11}b_{13} + a_{12}b_{23} + a_{13}b_{33}$$

$$= [SP + (19)4][SP + (8)4] + [SP + (18)4][SP + (5)4] + [SP + (17)4][SP + (2)4]$$

$$y_{21} = a_{21}b_{11} + a_{22}b_{21} + a_{23}b_{31}$$

$$= [SP + (17)4][SP + (11)4] + [SP + (16)4][SP + (8)4] + [SP + (15)4][SP + (5)4]$$

$$y_{22} = a_{21}b_{12} + a_{22}b_{22} + a_{23}b_{32}$$

$$= (18)4 \cdot (11)4 + (17)4 \cdot (8)4 + (16)4 \cdot (5)4$$

$$y_{23} = a_{21}b_{13} + a_{22}b_{23} + a_{23}b_{33}$$

$$= (19) \cdot (11) + (18) \cdot (8) + (17) \cdot (5)$$

$$y_{31} = a_{31}b_{11} + a_{32}b_{21} + a_{33}b_{31}$$

$$= [SP + (17)4][SP + (14)4] + [SP + (16)4][SP + (11)4] + [SP + (15)4][SP + (8)4]$$

		23	a_{11}	92
		22	a_{12}	88
		21	a_{13}	84
		20	a_{21}	80
20	a_{11}	80	19	a_{22}
19	a_{12}	76	18	a_{23}
18	a_{13}	72	17	a_{31}
17	a_{21}	68	16	a_{32}
16	a_{22}	64	15	a_{33}
15	a_{23}	60	14	b_{11}
14	a_{31}	56	13	b_{12}
13	a_{32}	52	12	b_{13}
12	a_{33}	48	11	b_{21}
11	b_{11}	44	10	b_{22}
10	b_{12}	41	9	b_{23}
9	b_{13}	36	8	b_{31}
8	b_{21}	32	7	b_{32}
7	b_{22}	28	6	b_{33}
6	b_{23}	24	5	y_{11}
5	b_{31}	20	4	y_{12}
4	b_{32}	16	3	y_{13}
3	b_{33}	12	2	y_{21}
2	y_{11}	8	1	y_{22}
1	y_{12}	4		y_{23}
SP \Rightarrow		SP \Rightarrow		y_{31}
		y_{13}		
		y_{21}		

$$\begin{aligned}
 y_{21} &= a_{21}b_{11} + a_{22}b_{21} + a_{23}b_{31} \\
 &= [SP + (17)4][SP + (11)4] + [SP + (16)4][SP + (8)4] + [SP + (15)4][SP + (5)4]
 \end{aligned}$$

$$\begin{aligned}
 y_{31} &= a_{31}b_{11} + a_{32}b_{21} + a_{33}b_{31} \\
 &= [SP + (17)4][SP + (14)4] + [SP + (16)4][SP + (11)4] + [SP + (15)4][SP + (8)4]
 \end{aligned}$$

$$\begin{aligned}
 y_{11} &= a_{11}b_{11} + a_{12}b_{21} + a_{13}b_{31} \\
 &= [SP+68][SP+32] + [SP+64][SP+20] + [SP+60][SP+8] \\
 &= [SP+(17)4][SP+(8)4] + [SP+(16)4][SP+(5)4] + [SP+(15)4][SP+(2)4]
 \end{aligned}$$

$$\begin{aligned}
 y_{12} &= a_{11}b_{12} + a_{12}b_{22} + a_{13}b_{32} \\
 &= [SP+(18)4][SP+(8)4] + [SP+(17)4][SP+5(4)] + [SP+(16)4][SP+2(4)]
 \end{aligned}$$

$$\begin{aligned}
 y_{13} &= a_{11}b_{13} + a_{12}b_{23} + a_{13}b_{33} \\
 &= [SP+(19)4][SP+(8)4] + [SP+(18)4][SP+(5)4] + [SP+(17)4][SP+(2)4]
 \end{aligned}$$

$$\begin{aligned}
 y_{21} &= a_{21}b_{11} + a_{22}b_{21} + a_{23}b_{31} \\
 &= [SP+(17)4][SP+(11)4] + [SP+(16)4][SP+(8)4] + [SP+(15)4][SP+(5)4]
 \end{aligned}$$

$$\begin{aligned}
 y_{22} &= a_{21}b_{12} + a_{22}b_{22} + a_{23}b_{32} \\
 &= (8)4 \cdot (11)4 + (17)4 \cdot (8)4 + (16)4 \cdot (5)4
 \end{aligned}$$

$$\begin{aligned}
 y_{23} &= a_{21}b_{13} + a_{22}b_{23} + a_{23}b_{33} \\
 &= (19) \cdot (11) + (18) \cdot (8) + (17) \cdot (5)
 \end{aligned}$$

$$\begin{aligned}
 y_{31} &= a_{31}b_{11} + a_{32}b_{21} + a_{33}b_{31} \\
 &= [SP+(17)4][SP+(14)4] + [SP+(16)4][SP+(11)4] + [SP+(15)4][SP+(8)4]
 \end{aligned}$$

$$\begin{aligned}
 y_{32} &= a_{31}b_{12} + a_{32}b_{22} + a_{33}b_{32} \\
 &= [SP+(18)4][SP+(14)4] + [SP+(17)4][SP+(11)4] + [SP+(16)4][SP+(8)4]
 \end{aligned}$$

$$\begin{aligned}
 y_{33} &= a_{31}b_{13} + a_{32}b_{23} + a_{33}b_{33} \\
 &= [SP+(19)4][SP+(14)4] + [SP+(18)4][SP+(11)4] + [SP+(17)4][SP+(8)4]
 \end{aligned}$$