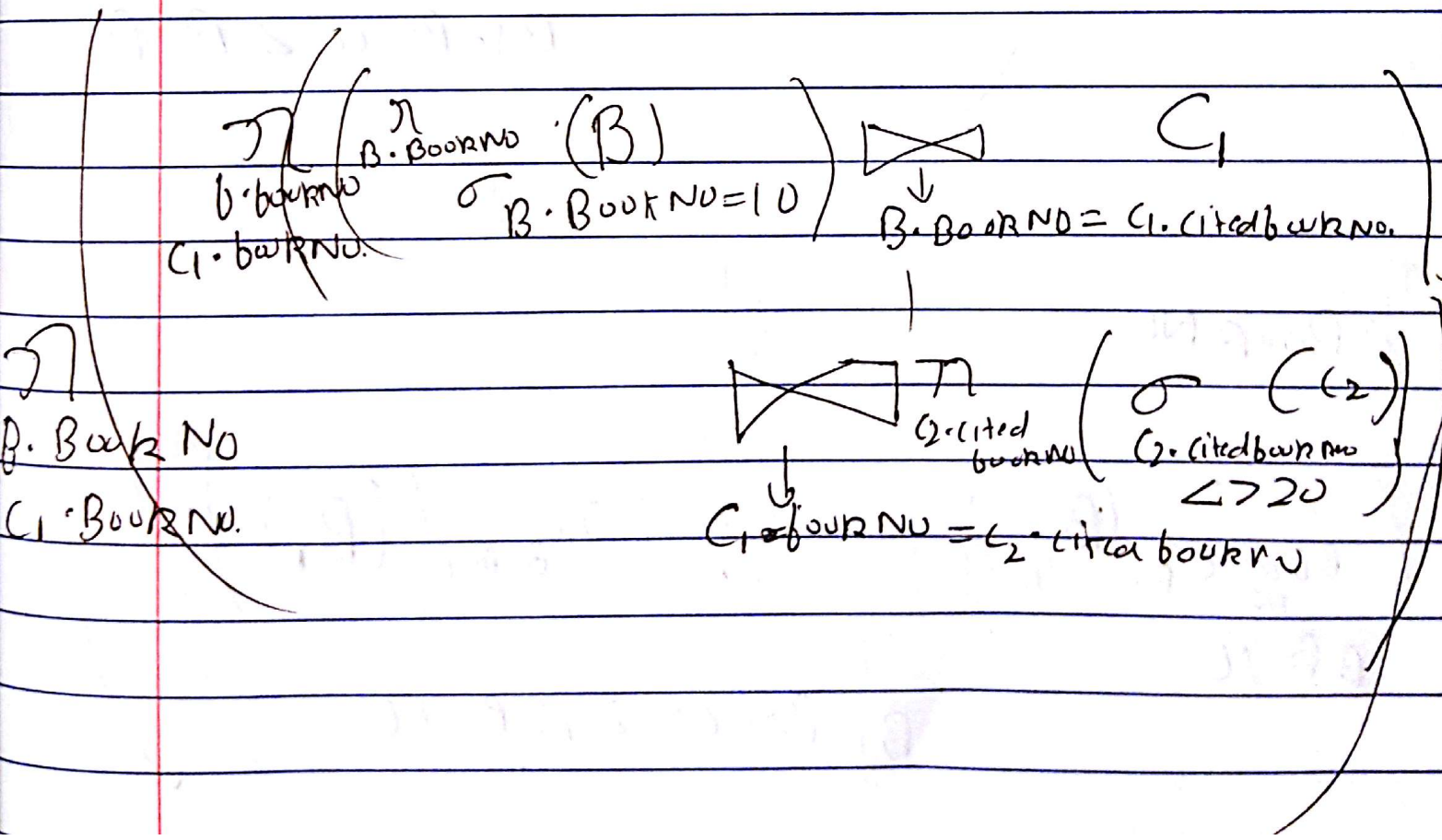
(1)

$\Pi_{B.BOOKNO, C_1.BOOKNO}$ $\left(\sigma_{B.BOOKNO = C_1.citedBookNO \text{ and } C_1.bookNO = C_2.citedbookNO \text{ and } B.bookNO = 10 \text{ and } C_2.citedbookNO <> 20} (B \times C_1 \times C_2)\right)$

optimized



(2)

$\Pi_{B.BookNo.}\left(\sigma_{B1.Price < B.Price \text{ and } B.Title='A2'}(B \times B_1)\right)$

optimized

$\Pi_{B.BookNo}\left(\sigma_{B.Title='A1'}(B) \bowtie B_1\right)$

$B1.Price < B.Price$

$\Pi_{B.BookNo.}$

$\left(\Pi_{B.BookNo, B.Price}\left(\sigma_{B.Title='A1'}(B)\right) \bowtie \Pi_{B1.Price}\left(B_1\right)\right)$

$B1.Price \geq B.Price$

(3)

$$\pi_{B.BookNu}\left[(B \times T) - \sigma_{T.BOORNU = B.BOORNU}(B \times T)\right]$$

Optimized

$$\left[\pi_{B.BookNo.}(B) - \pi_{B.BookNo}\left(\pi_{B.BOUKNU}(B) \bowtie \left(\pi_{T.BoukNu}(T)\right)\right)\right]$$

$B.BOUKNU = T.BOUKNU.$

$\downarrow$

$\pi_{B.BoukNu}$

4)

$$\pi_{\text{BOOK NO.}}\left[B - \pi_{\substack{B.\text{bookNo.}\\ B.\text{Title}\\ B.\text{Price}}}\left(\sigma_{B_1.\text{Price} < B.\text{Price}}(B \times B_1)\right)\right]$$

Optimized

$$\pi_{B.\text{BookNo.}}\left[\pi_{(B).\text{BookNo}} - \pi_{B.\text{BookNo.}}\left(\pi_{\substack{(B)\\ B.\text{BookNo.}\\ B.\text{Price}}} \bowtie_{B_1.\text{Price} < B.\text{Price}} \pi_{\substack{(B_1)\\ B_1.\text{Price}}}\right)\right]$$

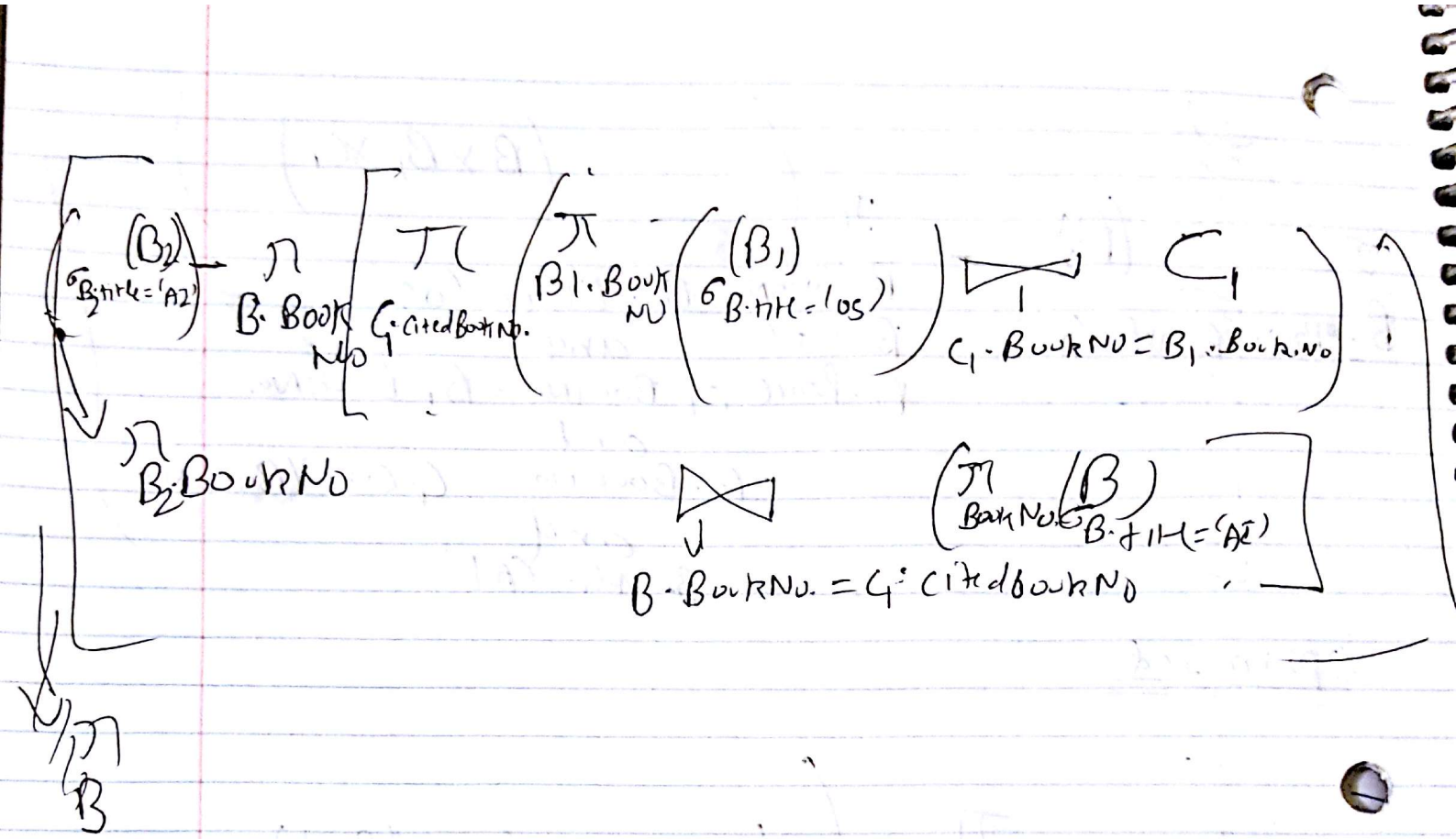
5)

$$\Pi_{B_2.BookNo}\left(\sigma_{B_2.title='AI'}(B_2) - \Pi_{B.BookNo,\ B.title,\ B.Price}\left(\sigma_{B1.title='OS'\ \text{and}\ C_1.BookNo=B_1.BookNo\ \text{and}\ B.BookNo=C_1.CitedBookNo\ \text{and}\ B.title='AI'}(B \times B_1 \times C_1)\right)\right)$$

Optimized

$$\Pi_{B.BookNo}\left(B_2 - \Pi_{B.BookNo,\ B.title,\ B.Price}\left(\left(C_1 \bowtie \left(\sigma_{B1.title='OS'}(B_1)\right)\right) \bowtie \left(\sigma_{B.title='AI'}(B)\right)\right)\right)$$

$B.BookNo = C_1.CitedBookNo$



(6)

$$\Pi_{S.Sid}\left[\left(\sigma_{\substack{S.Sid=M.Sid \\ \text{and} \\ M.major='CS' \\ \text{and} \\ S.Sname <> 'John'}}(S \times M)\right)\right]$$

$$\Pi\left(\begin{array}{l} S.Sid, \\ S.Sname, \\ M.Sid \\ M.major \end{array}\right)\left[\left(\sigma_{\substack{S.Sid=M.Sid \\ \text{and} \\ S.name <> 'John' \\ \text{and} \\ S.Sid=T.Sid \\ \text{and} \\ M.major='CS'}}\left(S \times M\left(T \rtimes \left(\sigma^{(B)}_{B.Price<20}\right)\right)\right)\right)\right]$$

Optimized

$$\pi_{S.sid}\left[\left(\sigma_{S.sname<>'Jim'}(S)\right) \bowtie_{S.sid=M.sid} \left(\sigma_{M.major='CS'}(M)\right)\right]$$

$$\pi_{S.sid,\ S.sname,\ M.sid,\ M.major}\left[\left(\sigma_{S.sname<>'Jim'}(S)\right) \bowtie_{S.sid=M.sid} \left(\sigma_{M.major='CS'}(M)\right) \bowtie_{S.sid=T.sid} \left(T \bowtie \left(\sigma_{B.Price<30}(B)\right)\right)\right]$$

Optimized

$$\pi_{S.sid}\left[\left[\pi_{sid}\left(\sigma_{S.sname <> 'John'}(S)\right)\right] \bowtie_{S.sid = M.sid} \pi_{M.sid}\left[\sigma_{M.major = 'CS'}(M)\right]\right]$$

=

$$\pi_{S.sid}\left[\left[\pi_{S.sid}\left(\sigma_{S.sname <> 'John'}(S)\right)\right] \bowtie_{S.sid = M.sid} \left[\pi_{M.sid}\left(\sigma_{M.major = 'CS'}(M)\right)\right]\right]$$

$$\bowtie_{S.sid = T.sid} \pi_{T.sid}\left(T \bowtie \left(\pi_{B.BookNo}\left(\sigma_{B.Price < 30}(B)\right)\right)\right)$$

(7)

$$\Pi_{S_1.sid}\left(\sigma_{S_1.sid <> S_2.sid \text{ and } T_1.BookNO = T_2.BookNo}\left[\left(\sigma_{S_1.Sname='John' \text{ and } S_1.sid = T_1.sid}(T_1 \times S_1)\right) \times \left(\sigma_{S_2.sid = T_2.sid}(T_2 \times S_2)\right)\right]\right)$$

Optimized

$$\Pi_{S_1.sid}\left[\left(T_1 \bowtie_{S_1.sid = T_1.sid} \left(\sigma_{S_1.name='John'}(S_1)\right)\right) \bowtie_{S_1.sid <> S_2.sid \text{ and } T_1.BOOKNO = T_2.BookNo} \left(T_2 \bowtie_{S_2.sid = T_2.sid} S_2\right)\right]$$

Optimized

$$\Pi_{S_1.sid}\left(\left(\Pi_{S_1.sid,\ T_1.BookNo.}\left(T_1 \bowtie_{S_1.sid = T_1.sid} \Pi_{S_1.sid}\left(\sigma_{S_1.name='John'}(S_1)\right)\right)\right) \cup \left(\Pi_{S_1.sid,\ T_2.BookNo.}\left(\Pi_{S_2.sid}(S_2) \bowtie_{S_2.sid = T_2.sid} T_2\right) \bowtie_{S_1.sid <> S_2.sid \text{ and } T_1.BookNo = T_2.BookNo} \Pi_{S_2.sid}(S_2)\right)\right)$$