Joshua
Baker

1. $\pi_{s.sid, sname, b.bookno, b.title} (S \times b \bowtie_{c_1} bu))$

With student as S, Book as b, buys as bu
and $c_1 = ((s.sname = 'ERic' \lor s.sname = 'Anna')$
$\qquad \land s.sid = bu.sid \land b.price > 20$
$\qquad \land t.bookno = b.bookno$

Optimized

$\pi_{b.bookno, b.title, sid, sname} (\sigma_{b.price > 20} (B) \bowtie$
$bu \bowtie (\sigma_{s.sname = 'Eric' \lor s.sname = 'Anna'} S))$

2. Initial

$\pi_{s.sid} (S \times b \bowtie_{(s.sname = 'Eric' \lor s.sname = 'Anna')}$
$\land s.sid = bu.sid \land b.price > 20 \land t.bookno = b.bookno} bu)$

Optimized
$\qquad$ with b as $\pi_{b.bookno} (\sigma_{price > 20} (Book))$,
$\qquad\qquad S$ as $\pi_{s.sid} (\sigma_{s.sname = 'Anna' \lor s.sname = 'Eric'} (Student))$

$\pi_{sid} (S \times buys \times b)$

Initial

3. $\pi_{s.sid, b1.price, b2.price}$ $((\pi_{s.sid}(\sigma_{s.sname <> 'Eric'}))$
$\times Book b1 \bowtie_{c_1} Book b2 \bowtie_{c_2} buys t1 \bowtie_{c_3} buys t2)$

with c_1 as $(b1.bookno <> b2.bookno \wedge b1.price > 60$
$\wedge b2.price >= 50)$,
c_2 as $(t1.bookno = b1.bookno \wedge t1.sid = s.sid)$,
c_3 as $(t2.bookno = b2.bookno \wedge t2.sid = s.sid)$

Optimized

With $p1$ as $\pi_{price, bookno}(buys \bowtie ($
$\pi_{bookno}(\sigma_{b.price >= 50}(Book)))$,
$p2$ as $\pi_{price, bookno}(buys \bowtie ($
$\pi_{bookno}(\sigma_{b.price > 60}(Book)))$
S as $\pi_{sid}(\sigma_{s.name <> 'Eric'} Student)$
$\pi_{sid, price1, price2}(S \bowtie p1 \bowtie_{(s.sid = p2.sid \wedge}$
$p2.bookno <> p1.bookno}$

4. Initial
$(S = Student)$
$\pi_{sid}((\pi_{s.sid, sname}(S)) - (\pi_{s.sid,}$
$s.sname \bowtie_{s.sid = t.sid} Buys \bowtie_{t.bookno =}$
$b.bookno \wedge b.price > 50 Book)$

Final
$\pi_{sid}((\pi_{sid}(S)) - (\pi_{sid}(Buys \bowtie$
$(\pi_{bookno}(\sigma_{bookno > 50}(Book)))))$

5. Original

$$\pi_{sid,sname}\left(\left(\pi_{sid,sname,2007}(S)\right)\times Book \cup \left(\pi_{sid,sname,bookno}\left(S\times Book \bowtie_{c_i} Buys\right)\right)\right)$$

with c_i as $(t.sid = s.sid \wedge t.bookno = b.bookno \wedge b.price < 25)$

Optimized

$$\pi_{sid,sname}\left(\pi_{sid,sname}\left(S \bowtie \left(\pi_{sid,sname}\left(Buys \bowtie \left(\pi_{bookno}\left(\pi_{bookno}\left(\sigma_{bookno=2007 \wedge price<25} Book\right)\right)\right)\right)\right)\right)\right)$$

6. Original

$$\pi_{bookno}\left(\pi_{sid,sname,bookno,title}\left(S\times Book - \left(\pi_{sid,sname,bookno,title}\left(S\times Book \bowtie_{c_i} Buys\right)\right)\right)\right)$$

with c as $(s.sid = t.sid \wedge t.bookno = b.bookno \wedge b.price < 20)$

Optimized

$$\pi_{bookno}\left(\pi_{sid,bookno}(S\times Book) - \left(\pi_{sid,bookno}\left(Buys \bowtie \left(\pi_{bookno}\left(\sigma_{price<20}(Book)\right)\right)\right)\right)\right)$$