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(a)

1. $D_{\bar{\circ}J}$

2. $D\bar{\circ}I$

$$A(I+1, \ 2*J) \xrightarrow{(0,1)} = A(I, \ 2*J) + B(J,I) + 10$$

$(0,2)$ $\downarrow (0,1)$ $\uparrow (0,1)$

$$A(I, \ 2*J+1) = A(I-1, 2*J) + B(J, I+1)$$

(b) (c) reference groups.

For loop J.

$\left\{ \begin{array}{c} A(I+1, 2J), \ A(I, 2J) \\ A(I-1, 2J) \end{array} \right\}$ ① $\qquad \frac{N+1}{2} \cdot N = \frac{N(N+1)}{2}$

$\left\{ A(I, 2*J+1) \right\}$ ② $\qquad \frac{N+1}{2} \cdot N = \frac{N(N+1)}{2}$

$\left\{ B(J,I) \right\}$ ③ $\qquad \dfrac{\frac{N+1}{2}}{\frac{4}{4}} \cdot N = \frac{N(N+1)}{2}$

$\left\{ B(J, I+1) \right\}$ ④ $\qquad \dfrac{\frac{N+1}{2}}{\frac{4}{4}} \cdot N = \frac{N(N+1)}{2}$

For J: trip $l = (N-1+2)/2$

stride $= 2*2 = 4$

let $c l s = 4$

total $2N(N+1)$

For loop I

$\left\{ \begin{array}{c} A(I+1, 2J), \ A(I-1, 2J) \\ A(I, 2J) \end{array} \right\}$ ① $\qquad \frac{N}{4} \cdot \frac{N+1}{2} = \frac{N(N+1)}{8}$

$\left\{ A(I, 2*J+1) \right\}$ ② $\qquad \frac{N}{4} \cdot \frac{N+1}{2} = \frac{N(N+1)}{8}$

$\left\{ B(J, I+1), B(J,I) \right\}$ ③ $\qquad N \cdot \frac{N+1}{2}$

For I: trip $= (N-1+1)/1 = N$

stride $= 1$.

let $c l s = 4$

total: $\frac{3}{4} N(N+1)$

Interchge wouldn't improve

outter

The loop interchange is legal. Since $\frac{3}{4} N(N+1) < 2N(N+1)$. So put J to ~~I~~ is better

d).

pruned dependence graph.

$(0,1)$

$A(I+1, 2J) = A(I-2J) + B(J, I) + 10$

$(0,2)$

$(0,1)$

$A(I, 2J+1) = A(I-1, 2J) + B(J, I+1).$

the generators are

$A(I, 2J+1)$ $A(I+1, 2J)$ $B(J, I+1).$

ignore tt.

Determine number of registers

$A(I+1, 2J)$ need 3. register

$B(J, I+1)$ need 2 register.

Replace references and Insert ~~copie~~ copies.

```
        Do J = 1, N, 2
          Do I = 1, N

            A$0$0 = A$0$1 + B$1$1 + 10
            A(I+1, 2J) = A$0$0.

            B$1$0 = B(J, I+1)

            A(I, 2J+1) = A$0$2 + B$1$0
            A$0$2  = A$0$1
            A$0$1  = A$0$0
            B$1$1  = B$1$0
          ENDDO
```

Initialisation and Loop unrolling

peel $3-1=2$

unroll loop by 3.

which means $I = 1, 2$

Do $I = 3, N, 3$

Do $J = 1; N, 2$

! Iteration 1, $I = 1$

$A\$0\$0 = A(1, 2J) + B(J, 1) + 10$

$A(2, 2J) = A\$0\$0$

$B\$1\$0 = B(J, 2)$

$A(1, 2J+1) = A(0, 2J) + B\$1\$0$

$A\$0\$1 = A\$0\$0$

$B\$1\$1 = B\$1\$0$

! Iteration 2, $I = 2$

$A\$0\$0 = A\$0\$1 + B\$1\$1$

$A(3, 2J) = A\$0\$0$

$B\$1\$0 = B(J, 3)$

$A(2, 2J+1) = A(1, 2J) + B\$1\$0$

$A\$0\$2 = A\$0\$1$

$A\$0\$1 = A\$0\$0$

$B\$1\$1 = B\$1\$0$.

Do $I = 3, N, 3$

$A\$0\$0 = A\$0\$1 + B\$1\$1 + 10$

$A(I+1, 2J) = A\$0\$0$

$B\$1\$0 = B(J, I+1)$

$A(I, 2J+1) = A\$0\$2 + B\$1\$0$

$A\$0\$2 = A\$0\$0 + B\$1\$0 + 10$

$A(I+2, 2J) = A\$0\$2$

$B\$1\$0 = B(J, I+2)$

$A(I+1, 2J+1) = A\$0\$1 + B\$1\$0$

$A\$0\$1 = A\$0\$2 + B\$1\$0$

~~A\$0\$1~~ =

$A(I+3, 2J) = A\$0\$1$

$B\$1\$0 = B(J, I+3)$

$A(I+2, 2J+1) = A\$0\$0 + B\$1\$0$

$B\$1\$1 = B\$1\$0$

ENDDO

ENDDO

2).

According to B.

$S_1 \Rightarrow S_2$

K J I

$B(I, J, K)$

$= B(I, 100-J, K)$

K=1 J*100-J 1≤I

$(= \quad * \quad \geq)$

{ > <=} { > =}

$\{ = = =)$

$S_1 \delta_\infty S_2$

$(= < =)$
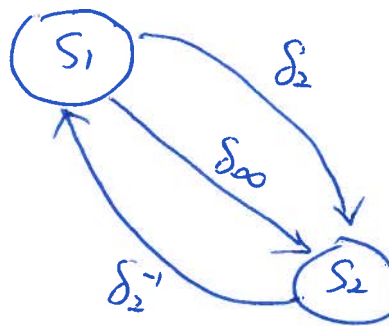
$S_1 \delta_2^* S_2$

$(= > =)$

$S_2 S_2^{-1} S_1$

According to A.

$S_2 \Rightarrow S_1$

K J I

$= A(I \cdot J-1, K)$

$A(I+1, J, K)$

K=1 J>J-1 I+1>1

$(= < <)$

no dependence

according to Advanced Vectorization algorithm.

S_1 need vectorize $P(\pi_i) - K + 1 = 2-3+1 = 0$. no change dimensions

S_2 need vectorise $P(\pi_i) - K + 1 = 3-3+1 = 1$ dimensions.

So code would be like.

Do K=1, 100.

Do J=1. 100

$B(I, J, K) = A(I, J-1, K)$.

$A(2:101, J, K) = B(1:100, 100-J, K) + C$

ENDDO