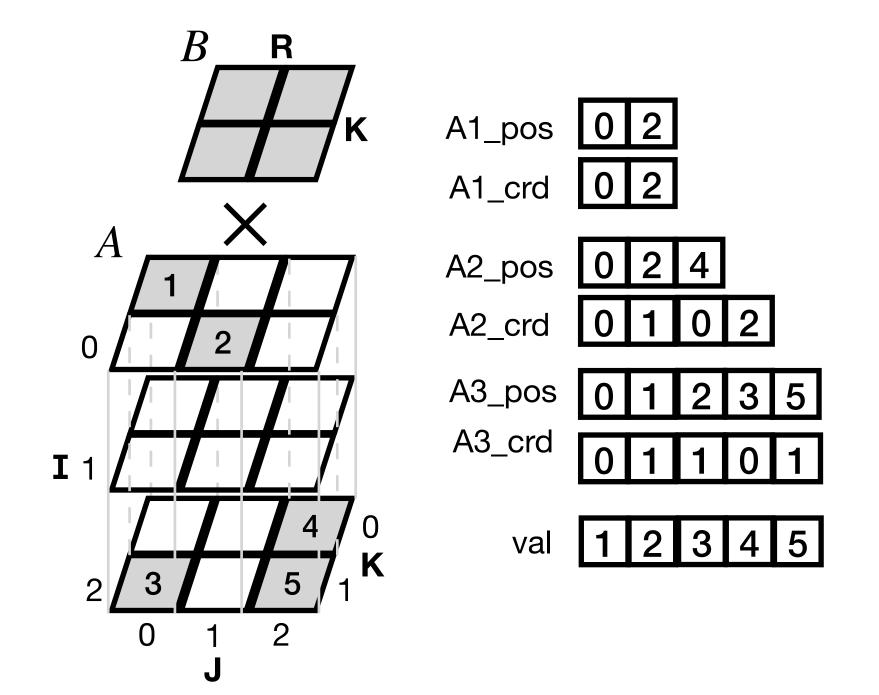


$$D(i,j) = \sum_{k} A(i,j) * B(i,k) * C(k,j)$$

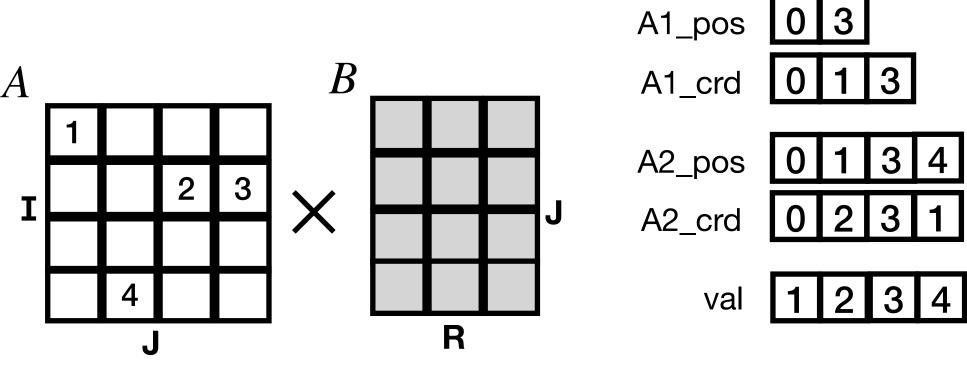
```
for ip in A1_pos:
i = A1_crd[ip]
for jp in range(A2_pos[ip], A2_pos[ip+1]):
    j = A2_crd[jp]
    for k in range(K):
    tmp += B[i][k] * C[k][j]
    D[i][j] = val[jp] * tmp
```

## (a) SDDMM



$$C(i,j,r) = \sum_{k} A(i,j,k) * B(k,r)$$

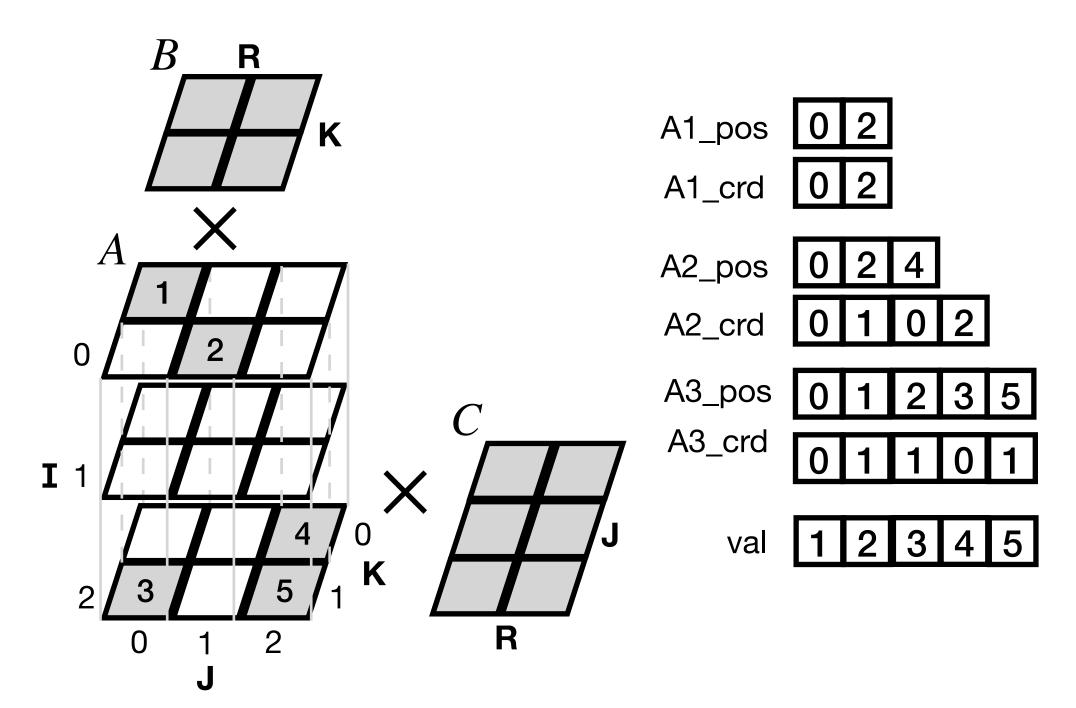
```
for ip in A1_pos:
i = A1_crd[ip]
for jp in range(A2_pos[ip], A2_pos[ip+1]):
    j = A2_crd[jp]
    for kp in range(A3_pos[jp], A3_pos[jp+1]):
        k = A3_crd[kp]
        val_1[0:R] += val[kp] * B[k][0:R]
        C[i,j,0:R] += val_1[0:R]
```



$$C(i,r) = \sum_{j} A(i,j) * B(j,r)$$

```
for ip in A1_pos:
i = A1_crd[ip]
for jp in range(A2_pos[ip], A2_pos[ip+1]):
    j = A2_crd[jp]
    val_1[0:R] += val[jp] * B[j][0:R]
    C[i,0:R] = val_1[0:R]
```

## (b) SpMM



$$D(i,r) = \sum_{j} \sum_{k} A(i,j,k) * B(k,r) * C(j,r)$$

```
for ip in A1_pos:
i = A1_crd[ip]
for jp in range(A2_pos[ip], A2_pos[ip+1]):
    j = A2_crd[jp]
    for kp in range(A3_pos[jp], A3_pos[jp+1]):
        k = A3_crd[kp]
        val_2[0:R] += val[kp] * B[k][0:R]
    val_1[0:R] += val_2[0:R] * C[j][0:R]
    D[i,0:R] = val_1[0:R]
```

(C) TTM (d) MTTKRP