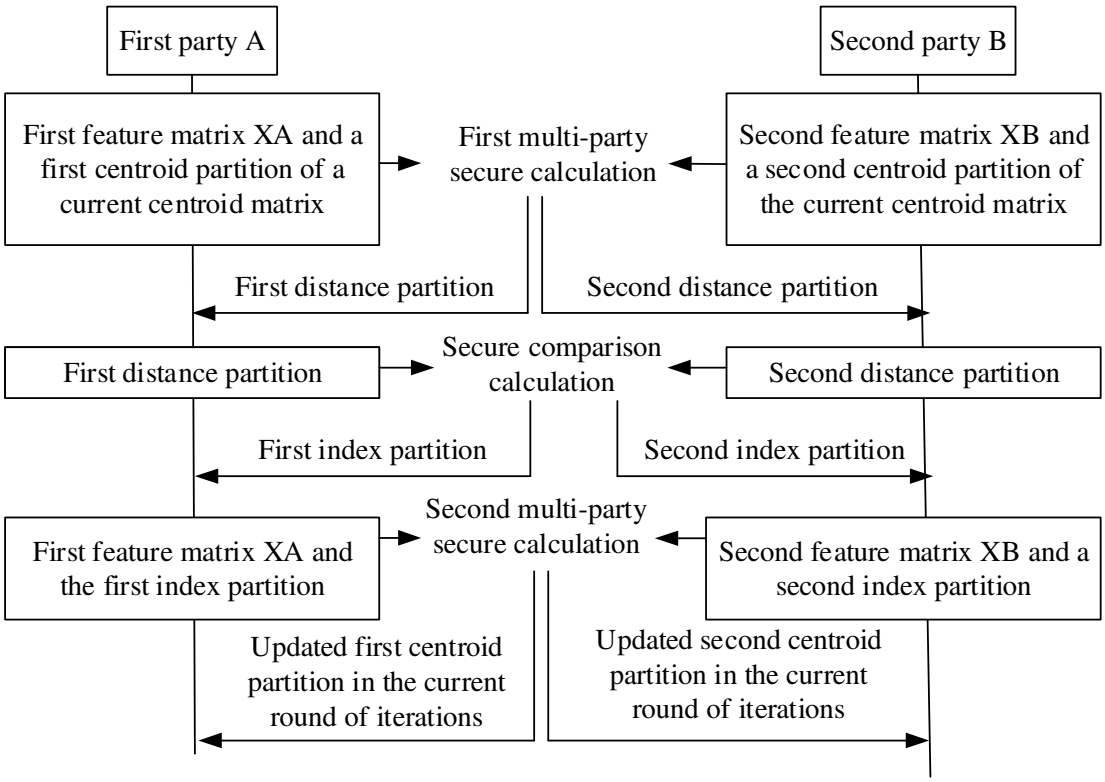

First party A
Second party B
First feature matrix XA and a first centroid partition of a current centroid matrix
First multi-party secure calculation
Second feature matrix XB and a second centroid partition of the current centroid matrix
First distance partition
Second distance partition
First distance partition
Secure comparison calculation
Second distance partition
First index partition
Second index partition
First feature matrix XA and the first index partition
Second multi-party secure calculation
Second feature matrix XB and a second index partition
Updated first centroid partition in the current round of iterations
Updated second centroid partition in the current round of iterations

FIG. 1

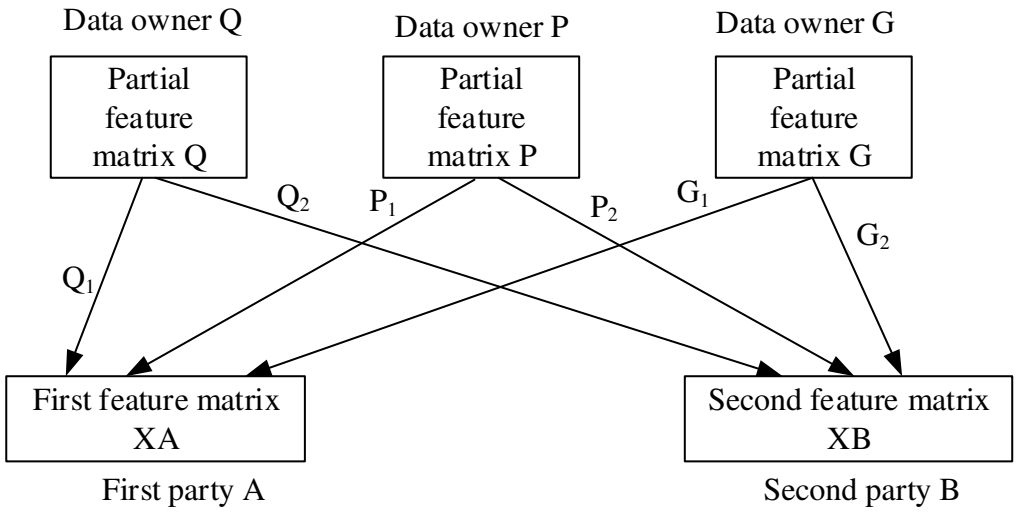

Data owner Q
Data owner P
Data owner G
Partial feature matrix Q
Partial feature matrix P
Partial feature matrix G
Q_2
P_1
P_2
G_1
G_2
Q_1
First feature matrix XA
Second feature matrix XB
First party A
Second party B

FIG. 2A

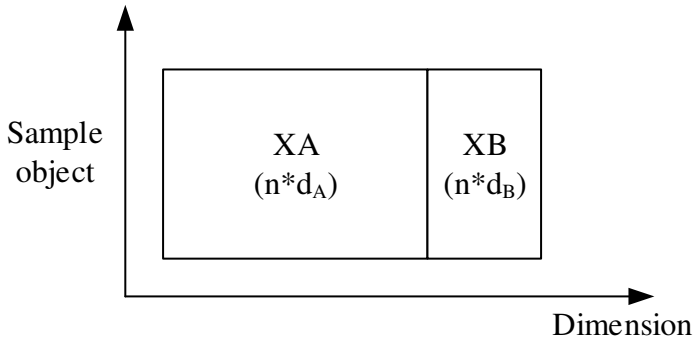

Sample object
XA
(n*d_A)
XB
(n*d_B)
Dimension

FIG. 2B

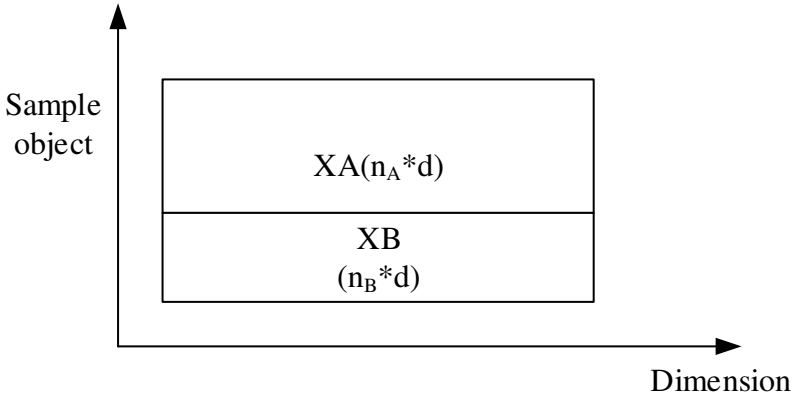

Sample object
XA(n_A*d)
XB
(n_B*d)
Dimension

FIG. 2C

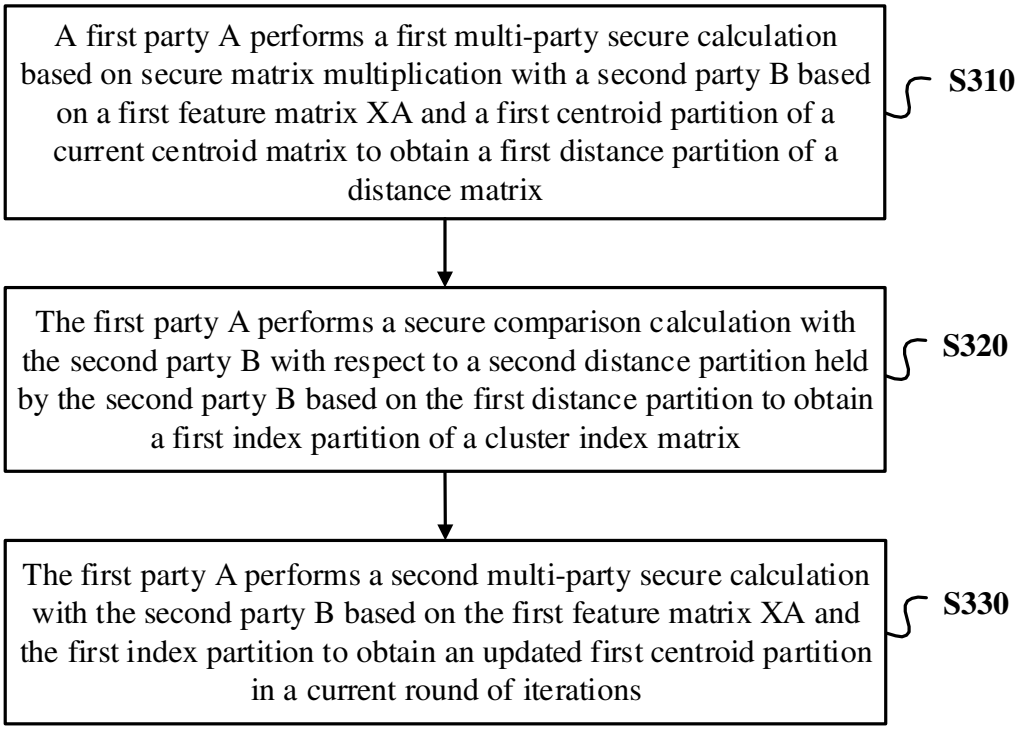

A first party A performs a first multi-party secure calculation based on secure matrix multiplication with a second party B based on a first feature matrix XA and a first centroid partition of a current centroid matrix to obtain a first distance partition of a distance matrix
S310
The first party A performs a secure comparison calculation with the second party B with respect to a second distance partition held by the second party B based on the first distance partition to obtain a first index partition of a cluster index matrix
S320
The first party A performs a second multi-party secure calculation with the second party B based on the first feature matrix XA and the first index partition to obtain an updated first centroid partition in a current round of iterations
S330

FIG. 3

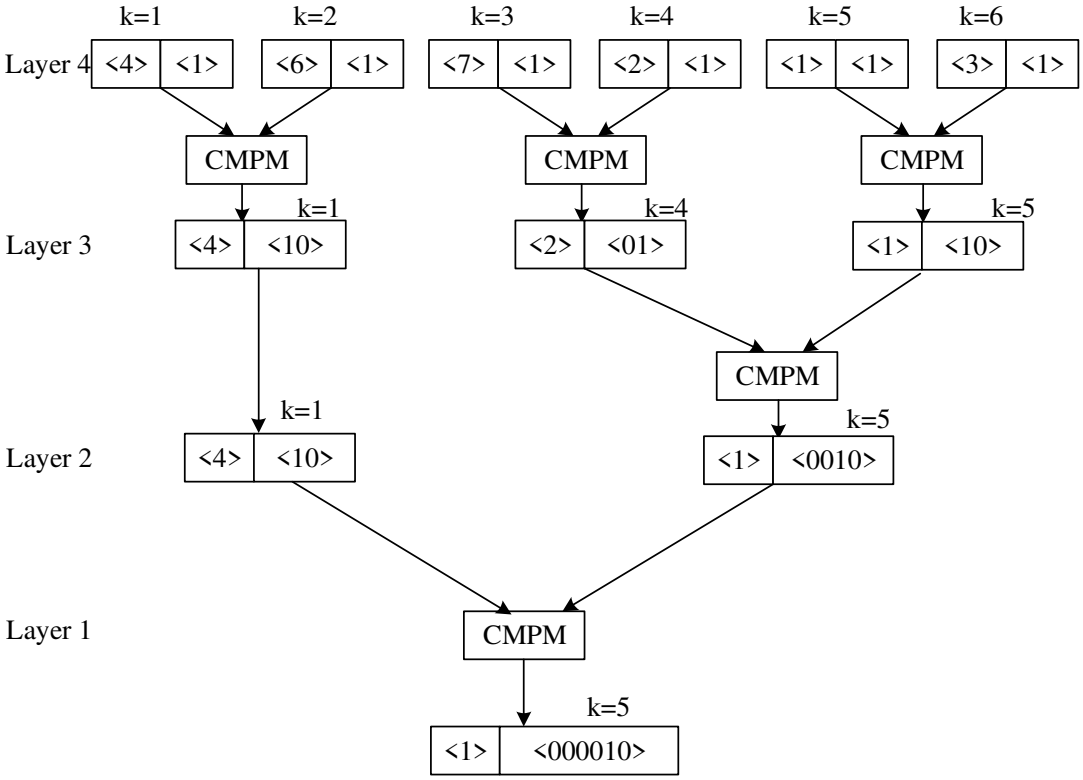

k=1
k=2
k=3
k=4
k=5
k=6
Layer 4
<4> <1>
<6> <1>
<7> <1>
<2> <1>
<1> <1>
<3> <1>
CMPM
CMPM
CMPM
k=1
k=4
k=5
Layer 3
<4> <10>
<2> <01>
<1> <10>
CMPM
k=1
k=5
Layer 2
<4> <10>
<1> <0010>
Layer 1
CMPM
k=5
<1> <000010>

FIG. 4

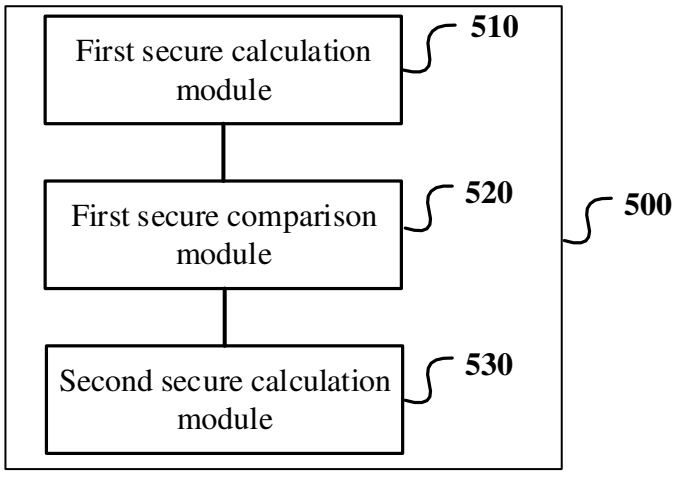

First secure calculation module
510
First secure comparison module
520
500
Second secure calculation module
530

FIG. 5