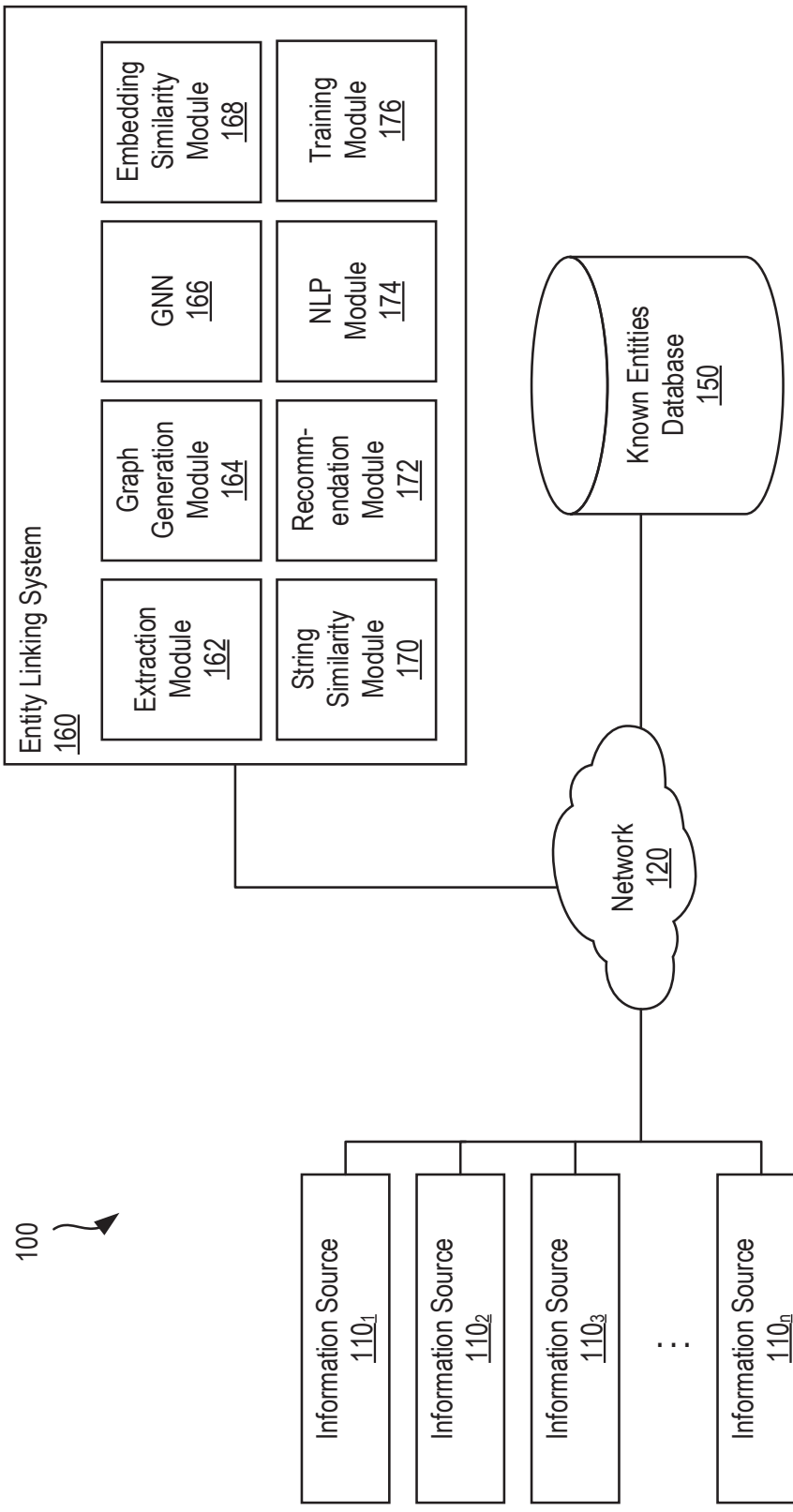

100
Entity Linking System
160
Extraction Module
162
Graph Generation Module
164
GNN
166
Embedding Similarity Module
168
String Similarity Module
170
Recomm-endation Module
172
NLP Module
174
Training Module
176
Known Entities Database
150
Network
120
Information Source
110₁
Information Source
110₂
Information Source
110₃
Information Source
110ₙ

FIG. 1

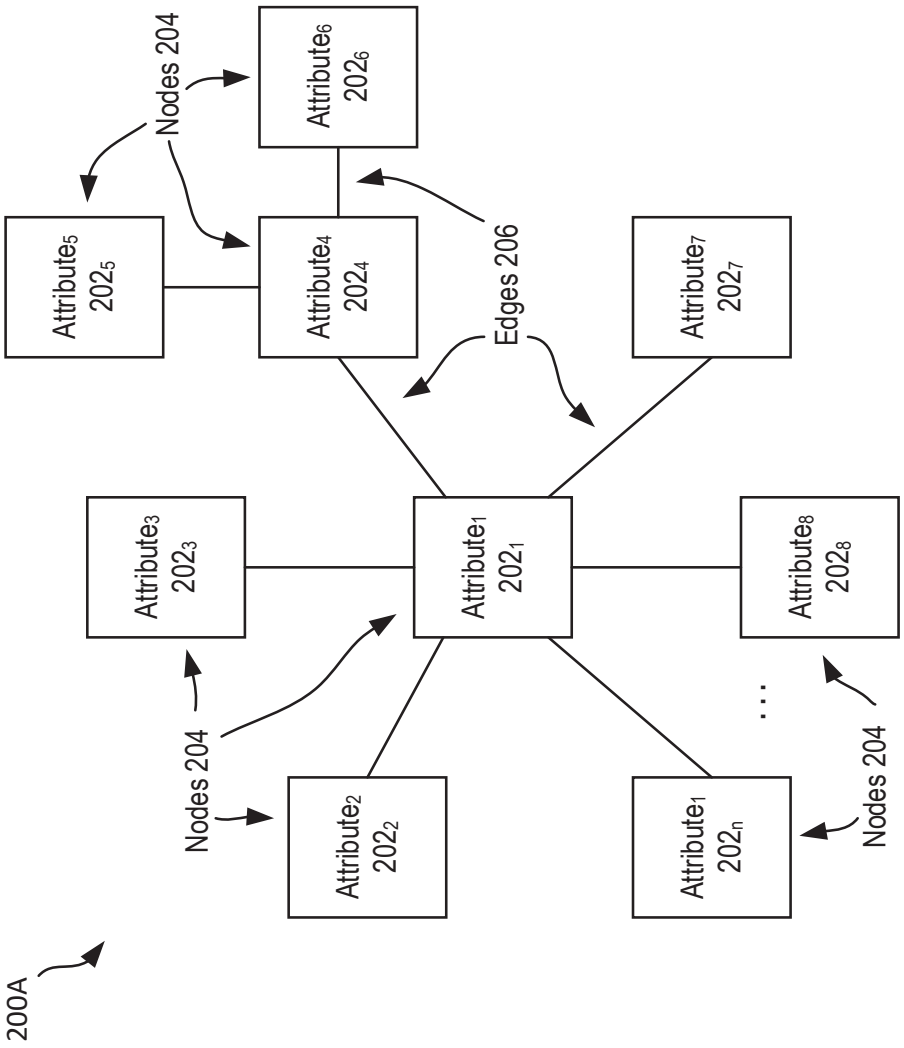

200A
Nodes 204
Attribute1 202n
Attribute2 202₂
Attribute3 202₃
Nodes 204
Attribute1 202₁
Attribute4 202₄
Attribute5 202₅
Nodes 204
Attribute6 202₆
Edges 206
Attribute7 202₇
Attribute8 202₈
Nodes 204
...

FIG. 2A

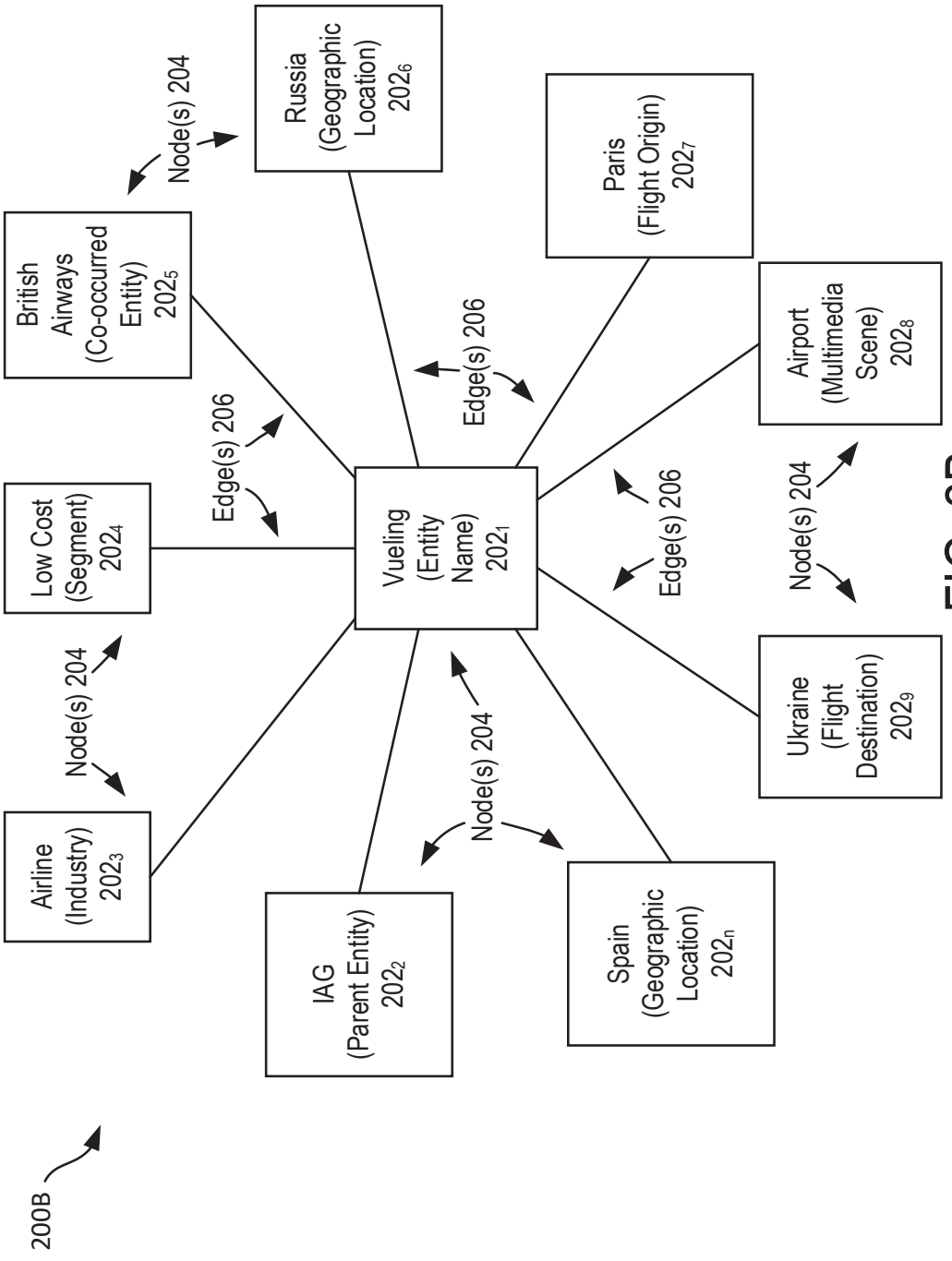

200B
Vueling (Entity Name) 202₁
Airline (Industry) 202₃
IAG (Parent Entity) 202₂
Spain (Geographic Location) 202ₙ
Low Cost (Segment) 202₄
British Airways (Co-occurred Entity) 202₅
Russia (Geographic Location) 202₆
Paris (Flight Origin) 202₇
Airport (Multimedia Scene) 202₈
Ukraine (Flight Destination) 202₉
Node(s) 204
Edge(s) 206

FIG. 2B

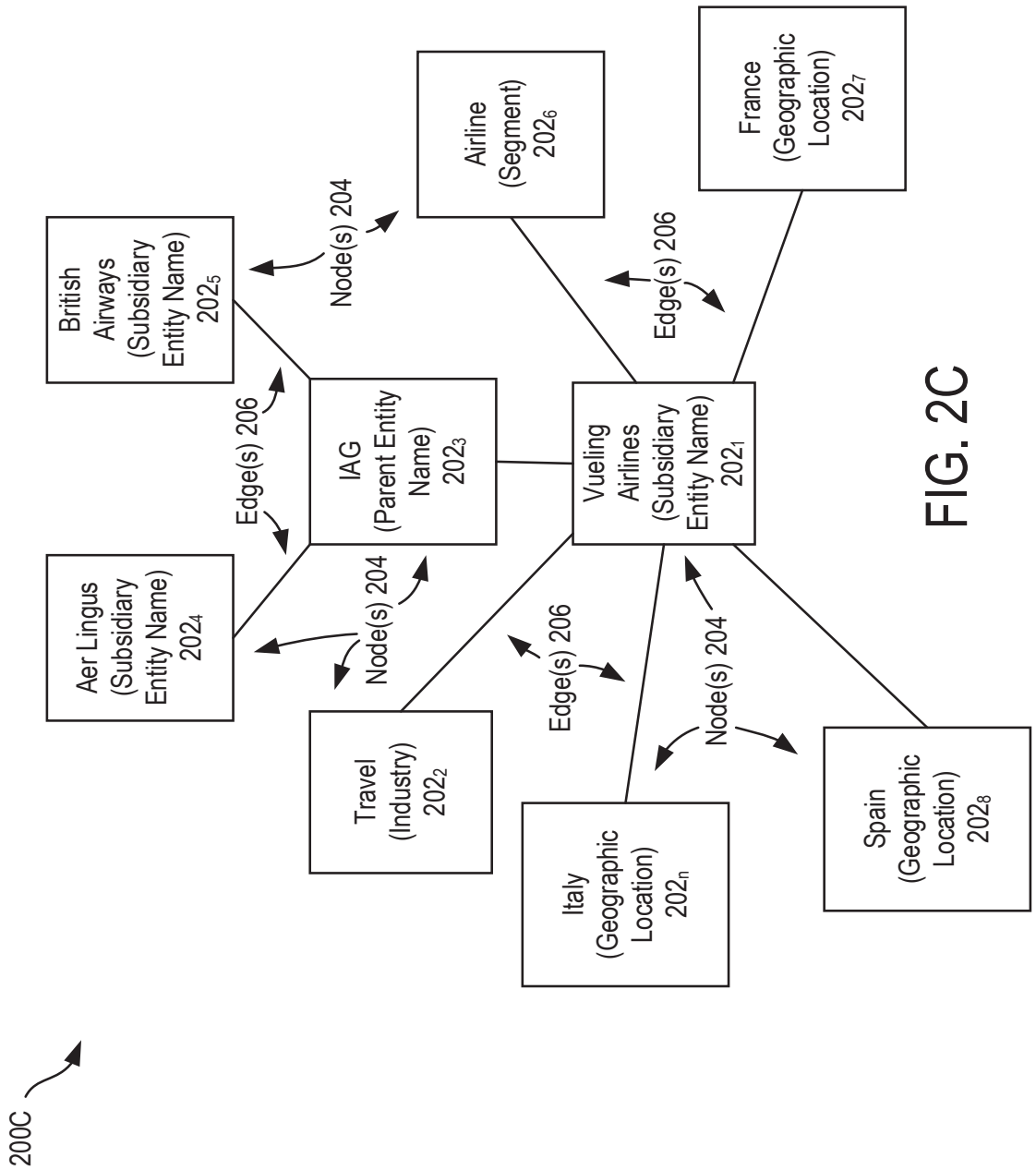

200C
Vueling Airlines (Subsidiary Entity Name) 202$_1$
Travel (Industry) 202$_2$
IAG (Parent Entity Name) 202$_3$
Aer Lingus (Subsidiary Entity Name) 202$_4$
British Airways (Subsidiary Entity Name) 202$_5$
Airline (Segment) 202$_6$
France (Geographic Location) 202$_7$
Spain (Geographic Location) 202$_8$
Italy (Geographic Location) 202$_n$
Node(s) 204
Edge(s) 206
Node(s) 204
Edge(s) 206
Node(s) 204
Edge(s) 206

FIG. 2C

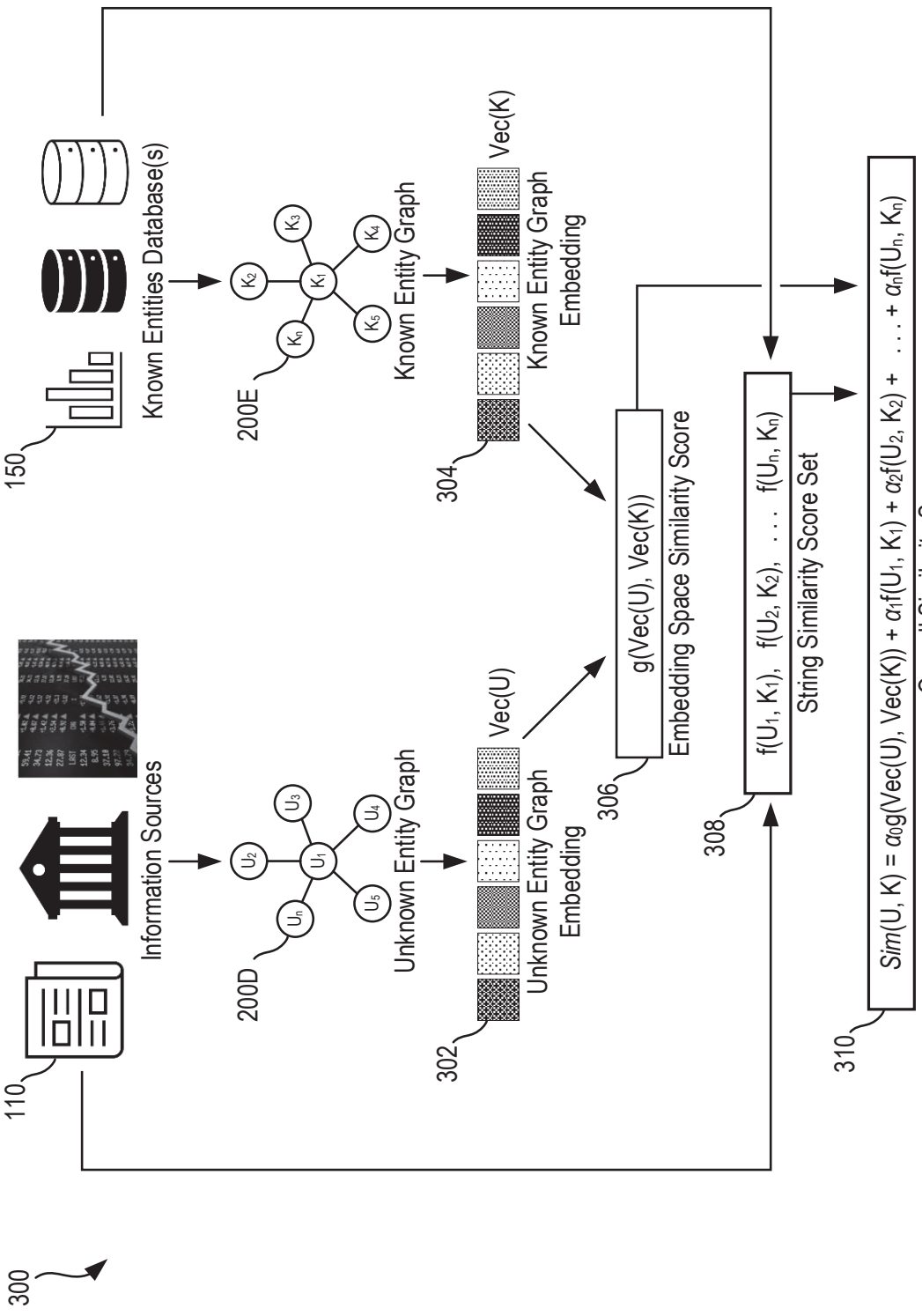

300
110
Information Sources
200D
Unknown Entity Graph
302
Vec(U)
Unknown Entity Graph Embedding
150
Known Entities Database(s)
200E
Known Entity Graph
304
Vec(K)
Known Entity Graph Embedding
306
g(Vec(U), Vec(K))
Embedding Space Similarity Score
308
f(U1, K1), f(U2, K2), . . . f(Un, Kn)
String Similarity Score Set
310
Sim(U, K) = α0g(Vec(U), Vec(K)) + α1f(U1, K1) + α2f(U2, K2) + . . . + αnf(Un, Kn)
Overall Similarity Score

FIG. 3

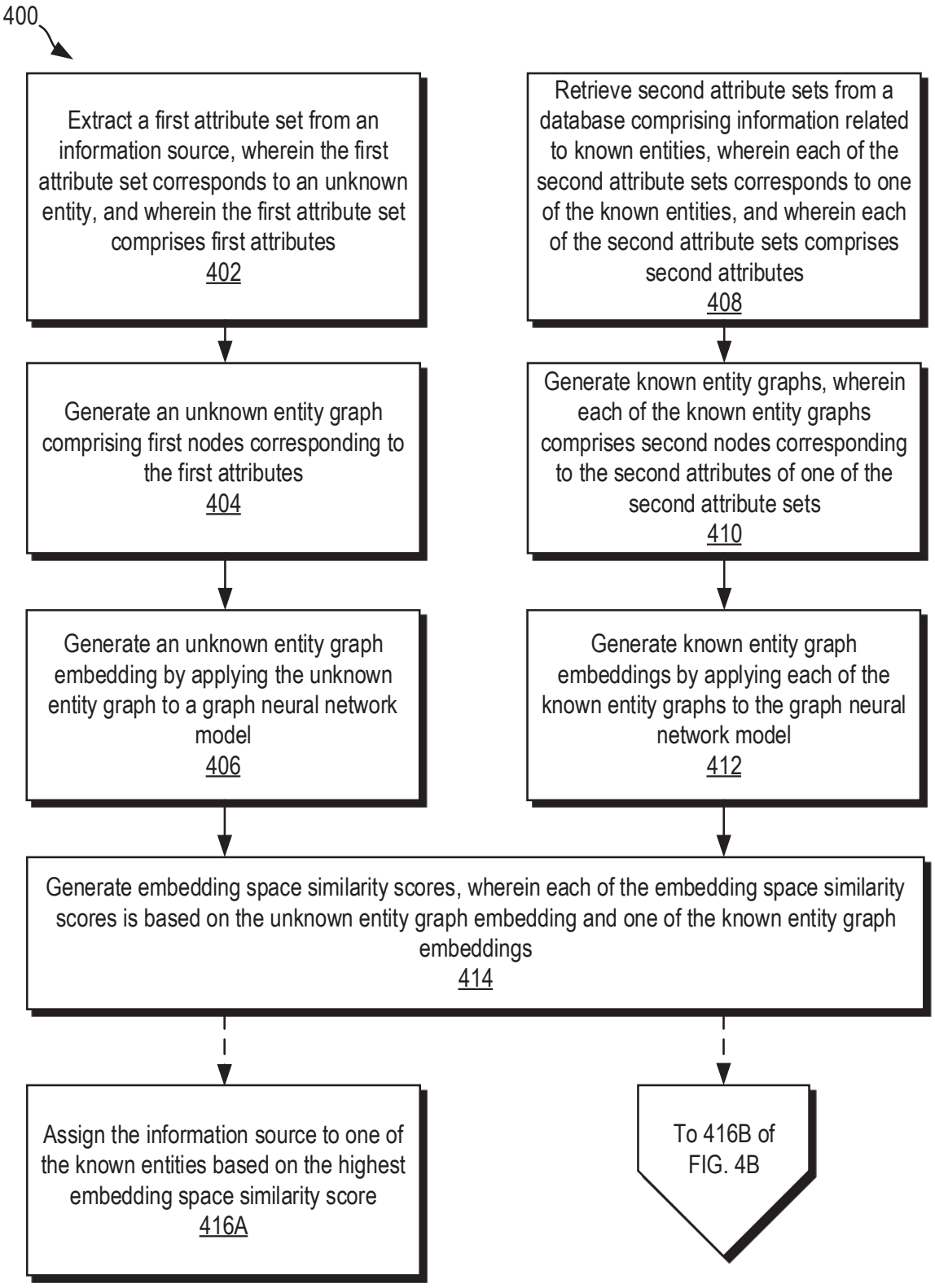

400
Extract a first attribute set from an information source, wherein the first attribute set corresponds to an unknown entity, and wherein the first attribute set comprises first attributes
402
Retrieve second attribute sets from a database comprising information related to known entities, wherein each of the second attribute sets corresponds to one of the known entities, and wherein each of the second attribute sets comprises second attributes
408
Generate an unknown entity graph comprising first nodes corresponding to the first attributes
404
Generate known entity graphs, wherein each of the known entity graphs comprises second nodes corresponding to the second attributes of one of the second attribute sets
410
Generate an unknown entity graph embedding by applying the unknown entity graph to a graph neural network model
406
Generate known entity graph embeddings by applying each of the known entity graphs to the graph neural network model
412
Generate embedding space similarity scores, wherein each of the embedding space similarity scores is based on the unknown entity graph embedding and one of the known entity graph embeddings
414
Assign the information source to one of the known entities based on the highest embedding space similarity score
416A
To 416B of FIG. 4B

FIG. 4A

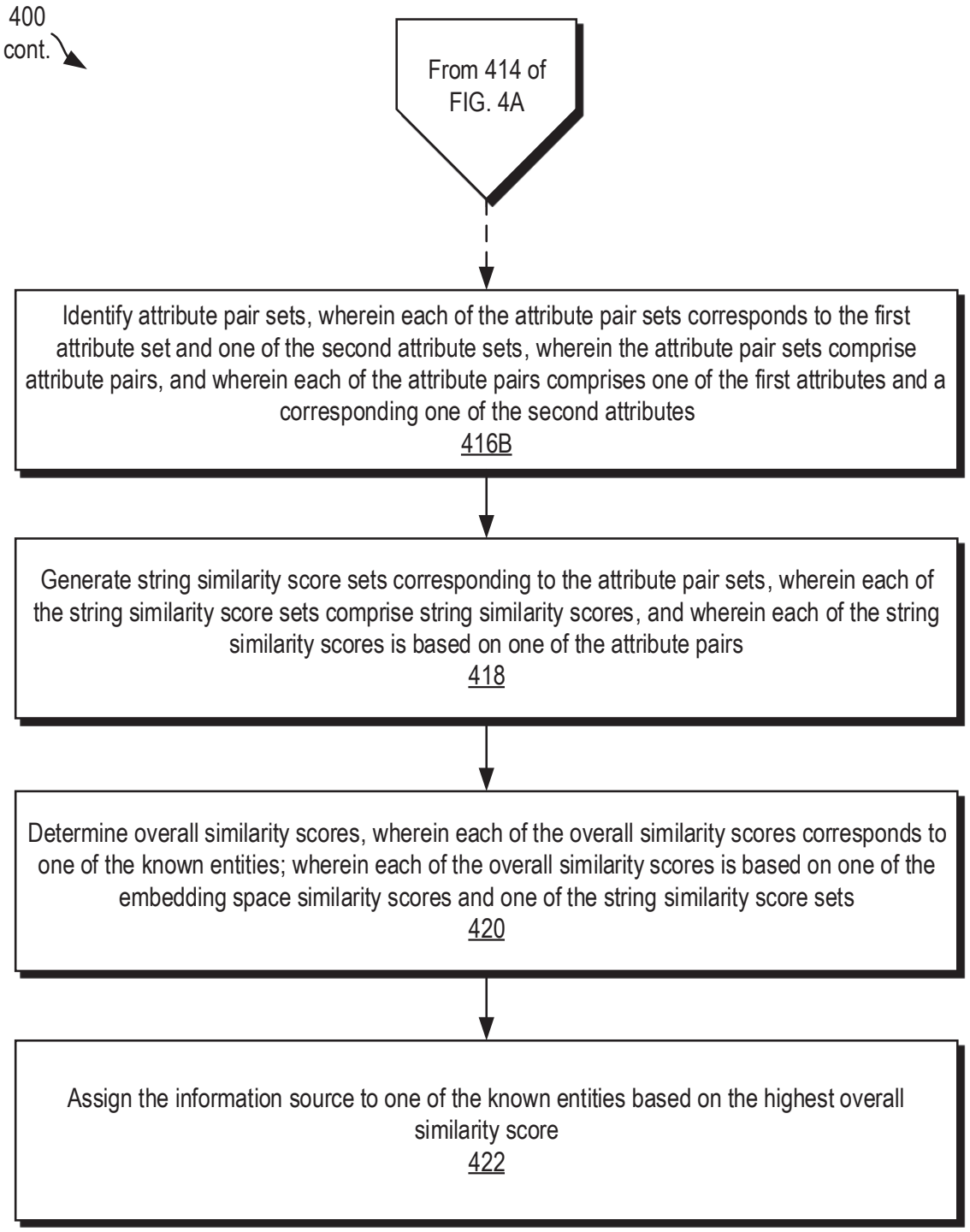

400
cont.
From 414 of FIG. 4A
Identify attribute pair sets, wherein each of the attribute pair sets corresponds to the first attribute set and one of the second attribute sets, wherein the attribute pair sets comprise attribute pairs, and wherein each of the attribute pairs comprises one of the first attributes and a corresponding one of the second attributes
416B
Generate string similarity score sets corresponding to the attribute pair sets, wherein each of the string similarity score sets comprise string similarity scores, and wherein each of the string similarity scores is based on one of the attribute pairs
418
Determine overall similarity scores, wherein each of the overall similarity scores corresponds to one of the known entities; wherein each of the overall similarity scores is based on one of the embedding space similarity scores and one of the string similarity score sets
420
Assign the information source to one of the known entities based on the highest overall similarity score
422

FIG. 4B

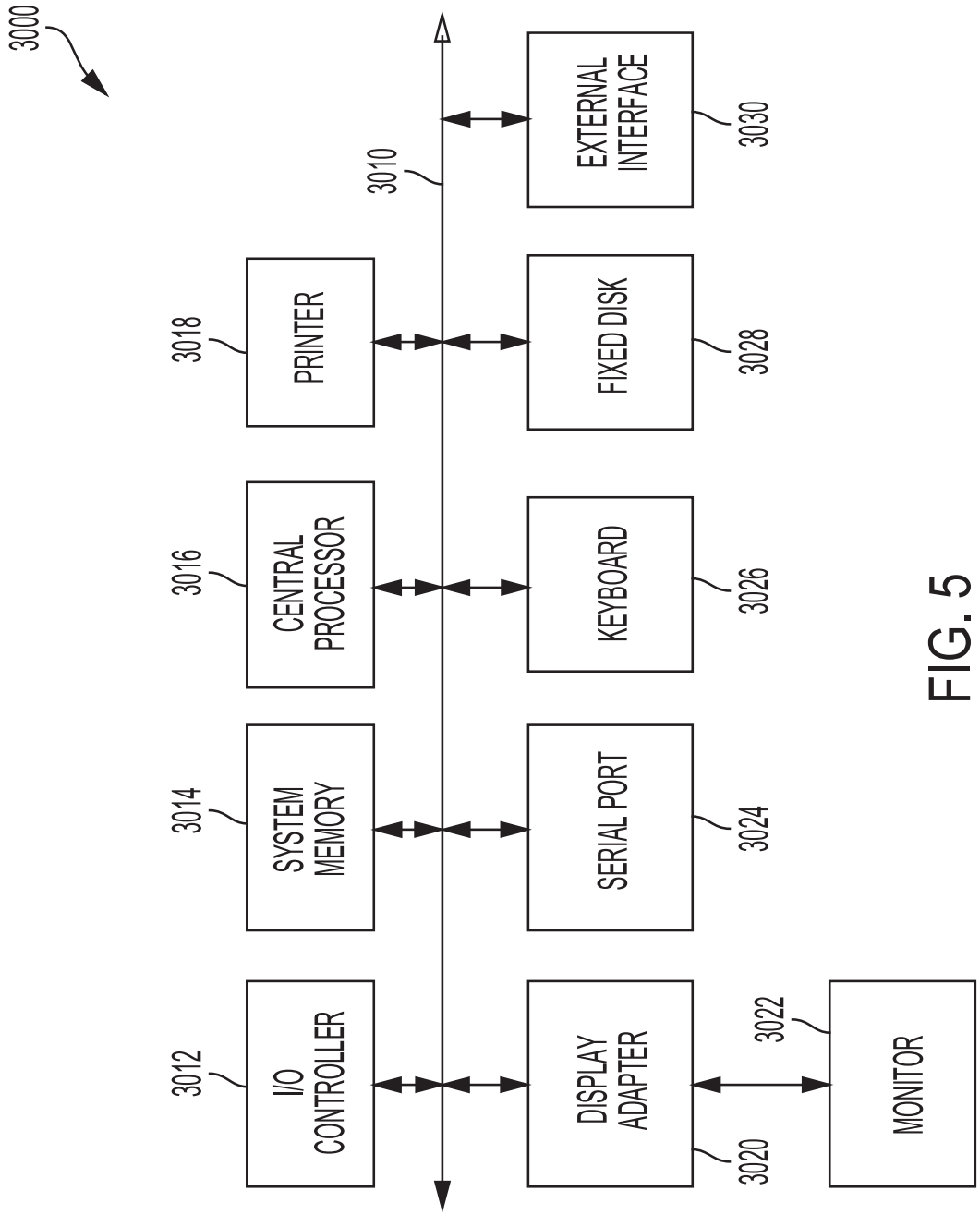

3000
3010
3012
I/O CONTROLLER
3014
SYSTEM MEMORY
3016
CENTRAL PROCESSOR
3018
PRINTER
3020
DISPLAY ADAPTER
3022
MONITOR
3024
SERIAL PORT
3026
KEYBOARD
3028
FIXED DISK
3030
EXTERNAL INTERFACE

FIG. 5

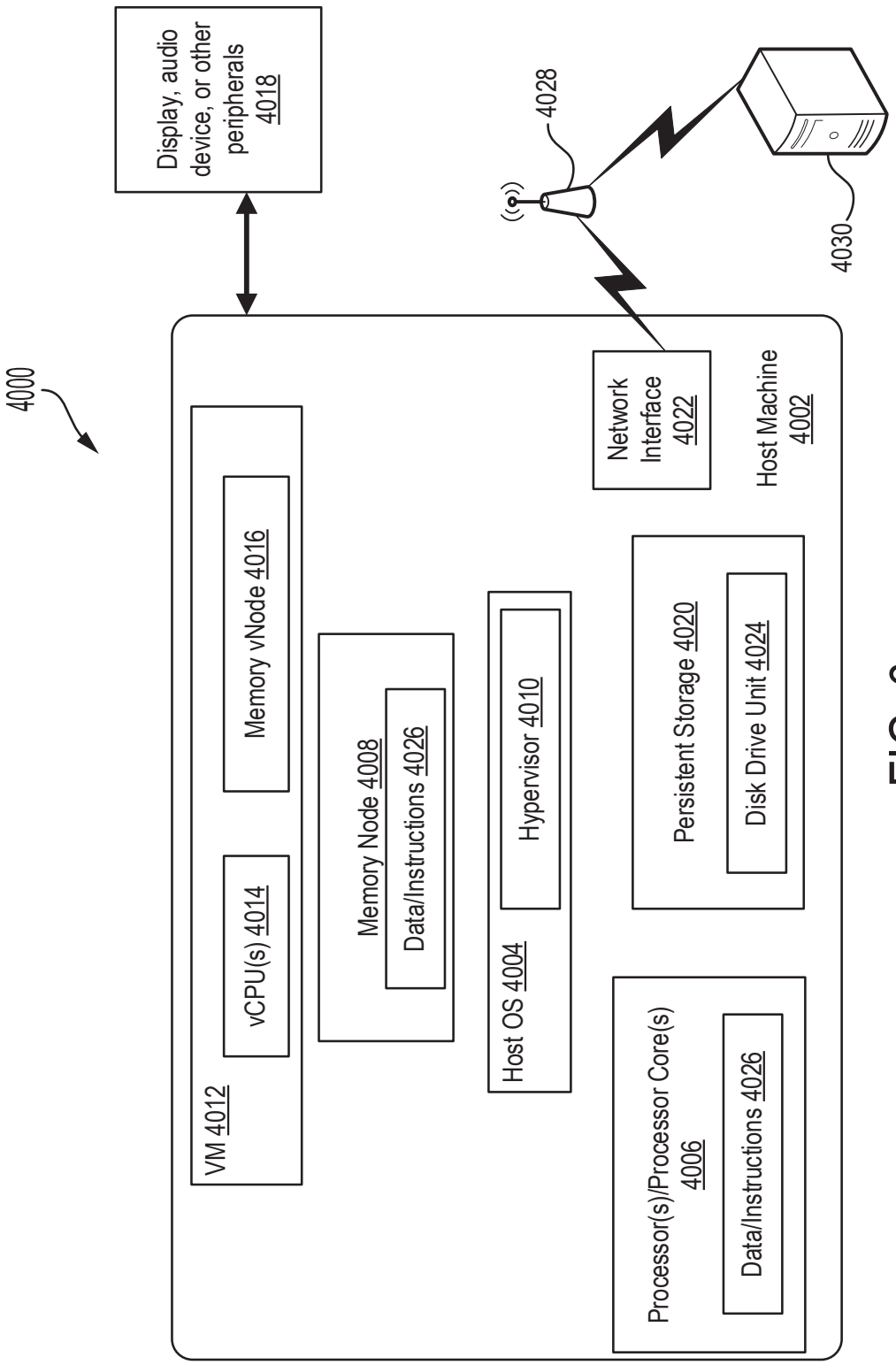

4000
Display, audio device, or other peripherals 4018
4028
4030
Network Interface 4022
Host Machine 4002
VM 4012
vCPU(s) 4014
Memory vNode 4016
Memory Node 4008
Data/Instructions 4026
Host OS 4004
Hypervisor 4010
Persistent Storage 4020
Disk Drive Unit 4024
Processor(s)/Processor Core(s) 4006
Data/Instructions 4026

FIG. 6