CLAIMS

1. A computer implemented method for generating recommendations, the method comprising:

determining, by a client device, a local user gradient value based on a current user preference vector, wherein the client device is associated with a user in a recommendation system, wherein the current user preference vector is determined by scores that users in the recommendation system assign to items in the recommendation system, wherein each of the scores represents a preference degree that each of the users has toward each of the items, wherein the recommendation system recommends the items to the users based on the scores, and wherein two users in the recommendation system can assign their respective scores to an item in the recommendation system at two different times;

determining, by the client device, a local item gradient value based on a current item feature vector, wherein the current item feature vector is determined by the scores that the users in the recommendation system assign to the items in the recommendation system;

updating, by the client device, a user preference vector by using the local user gradient value;

updating, by the client device, an item feature vector by using the local item gradient value;

determining, by the client device, a neighboring client device based on a predetermined adjacency relationship, wherein the predetermined adjacency relationship comprises an adjacency relationship determined based on a geographical location distance between client devices;

sending, by the client device to the neighboring client device, the local item gradient value;

receiving, by the client device, a neighboring item gradient value sent by the neighboring client device, wherein the neighboring item gradient value is a local item gradient value of the neighboring client device calculated at the neighboring client device;

updating, by the client device, the item feature vector by using the neighboring item gradient value; and

in response to determining, by the client device, that a predetermined iteration stop

condition is satisfied, wherein each iteration step comprises updating the user preference vector using the local user gradient value, updating the item feature vector using the local item gradient value, and updating the item feature vector using the neighboring item gradient value, outputting, by the client device, recommendations of the items to the users based on the user preference vector and the item feature vector.

2. The computer implemented method of claim 1, further comprising:

receiving, by the client device, a trigger to initiate a training process, the client device being configured to store score information of a user for an item, the user preference vector of the user, and the item feature vector, and being configured to implement matrix decomposition through a collaborative training.

3. The computer implemented method of claim 1, wherein the neighboring client device comprises one or more client devices in a network.

4. The computer implemented method of claim 1, wherein updating the item feature vector by using the neighboring item gradient value comprises:

updating the item feature vector by using all or a portion of a plurality of neighboring item gradient values.

5. The computer implemented method of claim 1, wherein the neighboring client device that receives the local item gradient value and a neighboring client device that sends the neighboring item gradient value are in a same client set or in different client sets.

6. The computer implemented method of claim 2, wherein:

the collaborative training comprises a process of searching for a group of user preference vector and item feature vectors, to minimize a loss function;

the loss function is determined based on a mean square error function of the user preference vector and the item feature vectors;

the loss function comprises a loss regularization item of the user preference vector and the item feature vectors; or

the loss regularization item comprises a restraint coefficient.

7. A non-transitory, computer-readable medium storing one or more instructions executable by a computer system to perform operations comprising:

determining, by a client device, a local user gradient value based on a current user preference vector, wherein the client device is associated with a user in a recommendation system, wherein the current user preference vector is determined by scores that users in the recommendation system assign to items in the recommendation system, wherein each of the scores represents a preference degree that each of the users has toward each of the items, wherein the recommendation system recommends the items to the users based on the scores, and wherein two users in the recommendation system can assign their respective scores to an item in the recommendation system at two different times;

determining, by the client device, a local item gradient value based on a current item feature vector, wherein the current item feature vector is determined by the scores that the users in the recommendation system assign to the items in the recommendation system;

updating, by the client device, a user preference vector by using the local user gradient value;

updating, by the client device, an item feature vector by using the local item gradient value;

determining, by the client device, a neighboring client device based on a predetermined adjacency relationship, wherein the predetermined adjacency relationship comprises an adjacency relationship determined based on a geographical location distance between client devices;

sending, by the client device to the neighboring client device, the local item gradient value;

receiving, by the client device, a neighboring item gradient value sent by the neighboring client device, wherein the neighboring item gradient value is a local item gradient value of the neighboring client device calculated at the neighboring client device;

updating, by the client device, the item feature vector by using the neighboring item gradient value; and

in response to determining, by the client device, that a predetermined iteration stop

condition is satisfied, wherein each iteration step comprises updating the user preference vector using the local user gradient value, updating the item feature vector using the local item gradient value, and updating the item feature vector using the neighboring item gradient value, outputting, by the client device, recommendations of the items to the users based on the user preference vector and the item feature vector.

8. The non-transitory, computer-readable medium of claim 7, further comprising one or more instructions to:

receive, by the client device, a trigger to initiate a training process, the client device being configured to store score information of a user for an item, the user preference vector of the user, and the item feature vector, and being configured to implement matrix decomposition through a collaborative training.

9. The non-transitory, computer-readable medium of claim 7, wherein the neighboring client device comprises one or more client devices in a network.

10. The non-transitory, computer-readable medium of claim 7, wherein updating the item feature vector by using the neighboring item gradient value comprises:

updating the item feature vector by using all or a portion of a plurality of neighboring item gradient values.

11. The non-transitory, computer-readable medium of claim 7, wherein the neighboring client device that receives the local item gradient value and a neighboring client device that sends the neighboring item gradient value are in a same client set or in different client sets.

12. The non-transitory, computer-readable medium of claim 8, wherein:

the collaborative training comprises a process of searching for a group of user preference vector and item feature vectors, to minimize a loss function;

the loss function is determined based on a mean square error function of the user preference vector and the item feature vectors;

the loss function comprises a loss regularization item of the user preference vector and

the item feature vectors; or

the loss regularization item comprises a restraint coefficient.

13. A computer-implemented system, comprising:

one or more computers; and

one or more computer memory devices interoperably coupled with the one or more computers and having tangible, non-transitory, machine-readable media storing one or more instructions that, when executed by the one or more computers, perform one or more operations comprising:

determining, by a client device, a local user gradient value based on a current user preference vector, wherein the client device is associated with a user in a recommendation system, wherein the current user preference vector is determined by scores that users in the recommendation system assign to items in the recommendation system, wherein each of the scores represents a preference degree that each of the users has toward each of the items, wherein the recommendation system recommends the items to the users based on the scores, and wherein two users in the recommendation system can assign their respective scores to an item in the recommendation system at two different times;

determining, by the client device, a local item gradient value based on a current item feature vector, wherein the current item feature vector is determined by the scores that the users in the recommendation system assign to the items in the recommendation system;

updating, by the client device, a user preference vector by using the local user gradient value;

updating, by the client device, an item feature vector by using the local item gradient value;

determining, by the client device, a neighboring client device based on a predetermined adjacency relationship, wherein the predetermined adjacency relationship comprises an adjacency relationship determined based on a geographical location distance between client devices;

sending, by the client device to the neighboring client device, the local item gradient value;

receiving, by the client device, a neighboring item gradient value sent by the neighboring client device, wherein the neighboring item gradient value is a local item gradient value of the neighboring client device calculated at the neighboring client device;

updating, by the client device, the item feature vector by using the neighboring item gradient value; and

in response to determining, by the client device, that a predetermined iteration stop condition is satisfied, wherein each iteration step comprises updating the user preference vector using the local user gradient value, updating the item feature vector using the local item gradient value, and updating the item feature vector using the neighboring item gradient value, outputting, by the client device, recommendations of the items to the users based on the user preference vector and the item feature vector.

14. The computer-implemented system of claim 13, further comprising one or more instructions to:

receive, by the client device, a trigger to initiate a training process, the client device being configured to store score information of a user for an item, the user preference vector of the user, and the item feature vector, and being configured to implement matrix decomposition through a collaborative training.

15. The computer-implemented system of claim 13, wherein the neighboring client device comprises one or more client devices in a network.

16. The computer-implemented system of claim 13, wherein updating the item feature vector by using the neighboring item gradient value comprises:

updating the item feature vector by using all or a portion of a plurality of neighboring item gradient values.

17. The computer-implemented system of claim 13, wherein the neighboring client device that receives the local item gradient value and a neighboring client device that sends the neighboring item gradient value are in a same client set or in different client sets.