

RESOURCE ALLOCATION METHODS AND APPARATUSES

TECHNICAL FIELD

[0001] One or more embodiments of the present specification relate to the computer
5 field, and in particular, to resource allocation methods and apparatuses.

BACKGROUND

[0002] In a plurality of technical scenarios in the Internet background, a requirement for allocating a network resource to a user exists. In addition, for service experience, an economic budget, or a technical reason, an allocatable network resource
10 is usually limited. For example, in an electronic payment/loan platform, a deduction request usually needs to be sent to a bank account of a borrowing user. Due to network bandwidth, a quantity of deduction requests sent within a specific time period is limited. For another example, to improve service quality, various service platforms usually push recommended content to a user, for example, a product, an article, and music that the
15 user can be interested in. In consideration of service experience of reducing disturbance to the user, a quantity of push times actively initiated within a specific time period is also limited.

[0003] Therefore, when a network resource is limited, how to properly allocate the network resource to a user and use the limited network resource to implement a better
20 resource return becomes a problem to be alleviated.

SUMMARY

[0004] One or more embodiments of the present specification describe network resource allocation methods and apparatuses, so a network resource can be more properly allocated to a user when the network resource is limited.

25 [0005] According to a first aspect, a resource allocation method is provided, including: obtaining resource limit information and time period information of a

network resource corresponding to target future duration, where the time period information includes a first ranking of a plurality of time period types included in the target future duration based on resource return rates; obtaining group estimation information, including an estimated resource return in a case in which each user group
5 in a plurality of user groups obtains a network resource of each candidate share for each time period type; and determining, under a plurality of constraint conditions, a resource share allocated to each user group in a time period of each time period type based on the group estimation information with a goal of maximizing a sum of estimated resource returns in the target future duration, where the plurality of constraint conditions include:
10 a total allocated resource share satisfies the resource limit information, and resource allocation for each time period type satisfies the first ranking.

[0006] According to an implementation, the network resource is a deduction request for a borrowing user, a single resource share corresponds to sending a deduction request once, and the resource return rate is a probability of successful deduction.

15 **[0007]** In an embodiment of the previous implementation, the previous method further includes: determining a current time period type corresponding to a current time period; and sending a deduction request to each user group based on a determined resource share allocated to the user group in the current time period type.

[0008] In a specific embodiment, the time period is day, and the plurality of time
20 period types include payday, workday, and rest day.

[0009] According to an implementation, the plurality of user groups have a second ranking based on users' resource return rates; and the plurality of constraint conditions further include: resource allocation for each user group satisfies the second ranking.

[0010] According to an implementation, the plurality of user groups are obtained
25 by: using a scoring model to score the resource return rate for each user in a total user set; and separately classifying the users into the plurality of user groups based on a score range.

[0011] According to an implementation, the resource limit information includes a total resource share amount; and that the total allocated resource share satisfies the
30 resource limit information includes: the total allocated resource share is less than or equal to the total resource share amount.

[0012] According to another implementation, the resource limit information includes a total resource share amount and a reserved share ratio for a total user set formed by the plurality of user groups; and that the total allocated resource share

satisfies the resource limit information includes: the total allocated resource share is less than or equal to an available resource share, where the available resource share is a difference between the total resource share amount and a total reserved share amount, and the total reserved share amount is determined based on a total quantity of users in the total user set and the reserved share ratio.

[0013] Further, in an embodiment, the method further includes: the plurality of constraint conditions further include: obtaining a predetermined frequency parameter, where the frequency parameter is related to a resource coverage frequency at which a user obtains the network resource; and in this case, the plurality of constraint conditions further include: for any time period type, a ratio of a quantity of covered users allocated with the network resource in a single time period corresponding to the time period type to a total quantity of users is greater than a specified target threshold, where the target threshold depends on a product of the frequency parameter and the reserved share ratio.

[0014] According to an implementation, the resource limit information includes a resource share upper limit and a resource share lower limit specified for each time period type; and correspondingly, the plurality of constraint conditions further include: for any time period type, a sum of single time period shares allocated to the plurality of user groups in a single time period corresponding to the time period type is not less than a resource share lower limit for the time period, and is not greater than a corresponding resource share upper limit.

[0015] In an embodiment, the obtaining group estimation information includes obtaining the group estimation information based on a historical record by using a statistical model.

[0016] According to an implementation, a resource share allocated to each user group in a time period of each time period type is determined by using a linear integer programming algorithm.

[0017] According to a second aspect, a resource allocation apparatus is provided, including: an acquisition unit, configured to obtain resource limit information and time period information of a network resource corresponding to target future duration, where the time period information includes a first ranking of a plurality of time period types included in the target future duration based on resource return rates; a group estimation unit, configured to obtain group estimation information, including an estimated resource return in a case in which each user group in a plurality of user groups obtains a network resource of each candidate share for each time period type; and a share

determining unit, configured to determine, under a plurality of constraint conditions, a resource share allocated to each user group in a time period of each time period type based on the group estimation information with a goal of maximizing a sum of estimated resource returns in the target future duration, where the plurality of constraint conditions include: a total allocated resource share satisfies the resource limit information, and resource allocation for each time period type satisfies the first ranking.

[0018] According to a third aspect, a computer readable storage medium that stores a computer program is provided, and when the computer program is executed in a computing device, the computing device performs the method of the first aspect.

[0019] According to a fourth aspect, a computing device is provided and includes a memory and a processor. Executable code is stored in the memory, and when executing the executable code, the processor implements the method of the first aspect.

[0020] According to the method and the apparatus provided in the embodiments of the present specification, a total set of target users is divided into a plurality of user groups, and duration corresponding to a resource limit is further divided into time periods of different types. As such, network resource allocation is converted into determining an allocation matrix between a user group and a time period type, that is, determining a resource share allocated to each user group j in a time period of each type i . An optimization objective of the allocation matrix is to make a total resource return as large as possible when a resource limit is satisfied. In addition, in some embodiments, some constraints are further imposed when the allocation matrix is optimized, so a resource allocation share satisfies specific monotonicity with a time period type. Further, the constraint condition can further constraint that the resource allocation share is monotonic with a user group. In addition, the constraint condition can further constraint that a user coverage rate satisfies a specific condition, so as to alleviate a coverage problem of a tail user.

BRIEF DESCRIPTION OF DRAWINGS

[0021] To describe the technical solutions in the embodiments of the present disclosure more clearly, the following briefly describes the accompanying drawings needed for describing the embodiments. Clearly, the accompanying drawings in the following description show merely some embodiments of the present disclosure, and a

person of ordinary skill in the art can still derive other drawings from these accompanying drawings without creative efforts.

[0022] FIG. 1 is a schematic diagram of allocating a resource to a user and a resource return;

5 [0023] FIG. 2 is a schematic diagram of network resource allocation according to an embodiment;

[0024] FIG. 3 is a flowchart of a resource allocation method according to an embodiment; and

[0025] FIG. 4 is a schematic diagram of a resource allocation apparatus according to an embodiment.

DESCRIPTION OF EMBODIMENTS

[0026] The following describes the solutions provided in the present specification with reference to the accompanying drawings.

[0027] As described above, in various technical scenarios, there is a requirement for allocating a limited network resource to a user. To make better use of the limited resource, resource allocation can be performed based on a resource return situation of a user, so as to obtain a better total resource return. The resource return can be positive feedback related to the user. For example, in a scenario in which a network resource is a deduction request for a borrowing user, a resource return of the user is successful deduction. In a scenario of pushing content to a user, a resource return of the user can be that the user accepts the pushed content, for example, purchases a recommended product, collects recommended music, or reads a recommended article. In another scenario, a network resource can be in another form, for example, traffic or network disk space. A corresponding resource return can be positive feedback from the user such as acceptance, use, or purchase of the corresponding network resource.

[0028] FIG. 1 is a schematic diagram of allocating a resource to a user and a resource return. In the scenario in FIG. 1, assume that a limited resource share, for example, seven network resources, needs to be allocated to eight users. The seven network resources can be, for example, seven deduction requests or seven push opportunities. A circle in FIG. 1 indicates positive feedback from a user, that is, a resource return is generated. "X" indicates that the user has no positive feedback, and no resource return is generated. In the example of FIG. 1, after one network resource is

allocated to a user U1, the user U1 does not generate a resource return. After two network resources are allocated to a user U3, one piece of positive feedback is generated. After three network resources are allocated to a user U4, one piece of positive feedback is generated. After one resource is allocated to a user U5, a resource return is generated.

5 The remaining users are not assigned with a network resource. As such, FIG. 1 shows a case of a total obtained resource return in a resource allocation method.

[0029] In a solution, to obtain a better resource return, a resource return rate of a user is evaluated, and resource allocation is performed based on the resource return rate. The resource return rate can be a probability of obtaining positive feedback from a user after a resource is allocated to the corresponding user, for example, a probability of successful deduction after a deduction request is sent to the user, or a probability that the user accepts pushed content after the content is pushed to the user. In a specific solution, a resource return rate is scored and ranked for each user in a total set of target users in advance, a resource limit in specific duration is equally allocated to each time period, and a resource is preferentially allocated to a user with a higher ranking in each time period. However, in such a solution, it is always difficult to cover a user with a lower ranking (that is, a tail user), and consequently, a long-term resource return is not ideal.

[0030] In addition, the inventor finds, through further research, that a resource return status of a user is different in each time period, and therefore is associated with a time period type of each time period. For example, when a deduction request is sent, a probability of successful deduction on a payday is greater than that on a non-payday. In non-paydays, a probability of successful deduction after sending a deduction request on a workday is greater than that on a non-workday, including weekends and holidays.

25 In a content push scenario, a probability that a user accepts pushed content in a leisure time period (for example, a time of 20:00-23:00 after dinner) is greater than that in a work time period (for example, 9:00-12:00 or 14:00-18:00).

[0031] Based on this, a solution of allocating a network resource over time is provided in embodiments of the present specification. FIG. 2 is a schematic diagram of network resource allocation according to an embodiment. As shown in FIG. 2, a total set of target users is divided into a plurality of user groups based on a range of a resource return rate, for example, m user groups. In addition, duration corresponding to a resource limit is divided into time periods of different types, for example, s types of time periods. As such, network resource allocation is converted into determining an

allocation matrix X between a user group and a time period type, where an element x_{ij} represents a resource share allocated to a user group j in a time period of a type i . An optimization objective of the allocation matrix is to make a total resource return as large as possible when a resource limit is satisfied. In addition, in some embodiments, some constraints are further imposed when the allocation matrix is optimized, so a resource allocation share satisfies specific monotonicity with a time period type. Further, the constraint condition can further constraint that the resource allocation share is monotonic with a user group. In addition, the constraint condition can further constraint that a user coverage rate satisfies a specific condition, so as to alleviate a coverage problem of a tail user.

[0032] The following describes in detail a specific implementation process under the previous concept.

[0033] FIG. 3 is a flowchart of a resource allocation method according to an embodiment. The step procedure shown in FIG. 3 can be performed by using any apparatus, device, platform, or device cluster that has computing and processing capabilities. The following describes in detail a specific execution process of each step shown in FIG. 3 with reference to a specific example.

[0034] As shown in FIG. 3, in step 31, obtain resource limit information and time period information of a network resource corresponding to target future duration, where the time period information includes a first ranking of a plurality of time period types included in the target future duration based on resource return rates.

[0035] In different embodiments, based on a specific setting of a target scenario, the target future duration can be a time length with a resource limit that is set in a corresponding scenario, for example, one month, one week, or one day. As described above, considering that the resource return status of the user varies in different time periods, the target future duration can be divided into a plurality of time periods, each time period can have a different time period type, and different time period types have different resource return statuses. Further, the plurality of time period types can be ranked based on resource return rates to obtain the first ranking. The first ranking can be set based on experience, or can be obtained by collecting statistics about an average resource return status of the user in a corresponding time period type.

[0036] Specifically, when the target scenario is sending a deduction request, a limit on a total quantity of requests is usually set for one month. Correspondingly, the target future duration can be one month. In this case, one month can be divided into 30 days,

that is, a time period is selected as day. Correspondingly, a plurality of time period types can include payday, workday, and rest day. Both the workday and the rest day are time except the payday, and the rest day can include weekends and other holidays. Still further, the first ranking can be in descending order of resource return rates: payday > 5 workday > rest day.

[0037] In another example, the target scenario is content recommendation. In this scenario, a total quantity of recommendation times is usually set for one week. In this case, the target future duration can be one week. In this case, each day of one week can be separately divided into a plurality of time period types, including a dining time 10 period, a work time period, a leisure and entertainment time period, and a rest time period. Further, the first ranking of the plurality of time periods can be set as: leisure and entertainment time period > dining time period > work time period > rest time period.

[0038] In another scenario, the target future duration, a time period size, the time 15 period type, etc. can be set based on a specific target scenario, and are not enumerated one by one here. Subsequent embodiments are described only with reference to an example scenario of sending a deduction request, and examples of various scenarios are not expanded one by one. However, it should be understood that the technical idea can be applied to another scenario.

[0039] It should be further understood that the resource limit information and the 20 time period information can be recorded in a configuration file of a resource allocation system. Therefore, the resource limit information and the time period information can be obtained by reading the configuration file. In an embodiment, the resource allocation system has an interface, and a manager can generate or modify the configuration file by 25 using the interface, so as to set or modify the resource limit information and the time period information. In another embodiment, the resource limit information and the time period information can alternatively be obtained in another method, for example, obtained from the manager in a real-time interaction method, which is not limited here. In addition, in step 32, obtain group estimation information, including an estimated 30 resource return in a case in which each user group in a plurality of user groups obtains a network resource of each candidate share for each time period type.

[0040] Before the group estimation information is obtained, each user in the total user set can be grouped in advance to obtain the plurality of user groups.

[0041] In an embodiment, the resource return rate can be scored for each user in the total user set by using a pre-trained scoring model. Then, the users are classified into the plurality of user groups based on a score range. The scoring model can be obtained by training a sample user, where the sample user has a label indicating whether to give a resource return, or a label indicating a resource return amount. After the scoring model is trained based on the sample user, when a user feature of a to-be-measured user is input into the scoring model, the scoring model can score the to-be-measured user. A higher score indicates a higher probability of resource return, or a larger estimated resource return amount. Therefore, the users can be classified into the plurality of user groups based on ranges within which scores of the users fall.

[0042] In another embodiment, the users can alternatively be directly classified into the plurality of user groups by using a multi-classification model. Similarly, the multi-classification model can be obtained by training a sample user, and the sample user has a group tag of a user group to which the sample user belongs. After the multi-classification model is trained based on such a sample user, when a user feature of a to-be-measured user is input into the multi-classification model, the multi-classification model can directly output a user group to which the to-be-measured user belongs.

[0043] In another embodiment, other methods such as a clustering method and a rule-based method can alternatively be used to classify the users in the total user set into the plurality of user groups. A specific quantity of user groups obtained through division is determined based on a scenario, and is not limited here. For example, in a case in which the total set of target users is borrowing users, the target users can be divided into 20 user groups.

[0044] Based on the plurality of obtained user groups, grouping evaluation can be performed on the plurality of user groups, to obtain group estimation information. Specifically, a grouping evaluation process can include: for any time period type i , determining an estimated resource return $p_{i,j,k}$ for any user group j when k network resources are obtained. In one example, grouping evaluation can be performed using a statistical model, such as statistical analysis based on historical records of resource allocation and returns, and determining the estimated resource return described above based on a statistical value. In another example, the estimated resource return can be obtained through prediction by using a pre-trained machine learning model.

[0045] According to the obtained group estimation information, in step 33, determine, under a plurality of constraint conditions, a resource share allocated to each

user group in a time period of each time period type based on the group estimation information with a goal of maximizing a sum of estimated resource returns in the target future duration.

[0046] As described with reference to FIG. 2, x_{ij} can be used to represent the resource share allocated to the user group j in the time period of the type i . As such, an optimization objective can be represented as:

$$\text{Max} \sum_i t_i \sum_j p_{i,j,x_{i,j}} n_j \quad (1)$$

where n_j is a quantity of users in the user group j ; t_i indicates a quantity of time periods of the type i included in the target future duration. For example, if the target future duration is one month, and $i=3$ indicates that the time period type is rest day, t_3 indicates a quantity of rest days in the coming month. Therefore, double summation in equation (1) is separately corresponding to summation of estimated resource returns of all user groups and all time periods, and an obtained result is a sum of estimated resource returns in the target future duration. Therefore, a core objective of resource allocation is converted into determining each x_{ij} , so the summation result in equation (1) is as large as possible.

[0047] In an embodiment, each x_{ij} is limited to an integer in a specific interval. For example, in a scenario in which a quantity of deduction requests of each user group per day is determined for a coming month, each x_{ij} can be limited to belong to $\{0, 1, 2, 3\}$. While maximizing a sum of the previous resource returns, each determined x_{ij} further needs to satisfy several specified constraint conditions. A primary constraint condition is that the total allocated resource share satisfies the previous resource limit information.

[0048] In an embodiment, the resource limit information is a total resource share amount T_0 in the target future duration. In this case, that the total allocated resource share satisfies the resource limit information can be represented as:

$$\sum_i t_i \sum_j x_{i,j} n_j \leq T_0 \quad (2)$$

[0049] The left-side summation in equation (2) represents a total resource share allocated to each x_{ij} in the target future duration. The constraint condition of the resource limit requires that the total resource share is less than or equal to the specified total resource share amount T_0 .

[0050] In another embodiment, in addition to the total resource share amount T_0 , the resource limit information further includes a reserved share ratio $K\%$ of a total user set formed by the plurality of user groups. The reserved share ratio represents a resource share ratio that is reserved in a unit time period and that is used to cover the total user set. In this case, the constraint condition of the resource limit information can be represented as:

$$\sum_i t_i \sum_j x_{i,j} n_j \leq T_0 - K\% \sum_i t_i \sum_j n_j \quad (3)$$

[0051] According to equation (3), it is required that the total resource share allocated in the target future duration is less than or equal to an available resource share shown on the right, where the available resource share is a difference between the total resource share amount T_0 and a total reserved share amount, and the total reserved share amount is determined based on a total quantity of users (summation for n_j) in the total user set and the reserved share ratio $K\%$.

[0052] In addition to constraints on the resource limit information, in this embodiment of the present specification, because different time period types are introduced, it is further required that a ranking of resource share allocation is monotonic relative to a time period type, so a resource allocation solution is more service-explanatory. As described above, a plurality of time period types can be ranked based on resource return rates, so as to have the first ranking. According to the previous monotonicity requirement, resource allocation for each time period type needs to satisfy the first ranking. The constraint condition can be represented as:

$$x_{i,j} \geq x_{i',j} \quad \forall j, \forall i < i' \quad (4)$$

[0053] That is, for any user group j , a resource share x_{ij} allocated to a higher-ranked time period type i ($i < i'$, that is, i is ranked higher) is greater than or equal to a resource share $x_{i'j}$ of a lower-ranked time period type i' .

[0054] Corresponding to FIG. 2, if a ranking of time period types from top to bottom in FIG. 2 is the first ranking of resource return rates from high to low, in the matrix X shown in FIG. 2, each column needs to satisfy monotonical decrease of elements from top to bottom.

[0055] In addition, in an embodiment, constraints on network resource allocation further include monotonicity with respect to the user group. It can be understood that the previous plurality of user groups are obtained by grouping based on resource return

rates of users, and different user groups are corresponding to different resource return rate intervals. Therefore, the plurality of user groups can be ranked based on the resource return rates of the users, and therefore have a second ranking. A monotonicity constraint condition for the user group requires that resource allocation for each user group complies with the second ranking. The constraint condition can be represented as:

$$x_{i,j} \geq x_{i,j'} \quad \forall i, \forall j < j' \quad (5)$$

[0056] That is, for any time period i , a resource share x_{ij} allocated to a higher-ranked user group j ($j < j'$, that is, j is ranked higher) is greater than or equal to a resource share $x_{ij'}$ of a lower-ranked user group j' .

[0057] Corresponding to FIG. 2, if the ranking of the user groups from left to right in FIG. 2 is the second ranking of the resource return rates from high to low, in the matrix X shown in FIG. 2, each row needs to satisfy monotonical decrease of elements from left to right.

[0058] In an embodiment, the resource limit information further includes a resource share upper limit U_i and a resource share lower limit L_i specified for each time period type i . In this case, the constraint condition for each allocated share x_{ij} further includes: for any time period type i , a sum of single time period shares allocated to the plurality of user groups in a single time period corresponding to the time period type is not less than a resource share lower limit L_i for the time period, and is not greater than a corresponding resource share upper limit U_i . The constraint condition can be represented as the following equations (6) and (7):

$$\sum_j x_{i,j} n_j \leq U_i \quad (6)$$

$$\sum_j x_{i,j} n_j \geq L_i \quad (7)$$

[0059] Equation (6) defines that the sum of single time period shares is not greater than the resource share upper limit. Equation (7) defines that the sum of single time period shares is not less than the resource share lower limit.

[0060] In an embodiment, on the basis that the reserved share ratio $K\%$ is specified for the total user set as shown in equation (3), a frequency parameter λ is further predetermined, where the frequency parameter λ is related to a resource coverage frequency at which the user obtains the network resource. In this case, the constraint condition for each allocated share x_{ij} further includes a coverage frequency constraint

condition. The constraint condition requires that for any time period type i , a ratio of a quantity N of covered users allocated with the network resource in a single time period corresponding to the time period type i to a total quantity of users is greater than a specified target threshold, where the target threshold depends on a product of the frequency parameter λ and the reserved share ratio $K\%$.

[0061] As an example, the constraint condition can be represented as:

$$\sum_j \min\{x_{i,j}, 1\} n_j \geq (1 - \lambda K\%) \sum_j n_j \quad \forall i \quad (8)$$

[0062] In equation (8), if a resource share ($x_{ij} \geq 1$) is allocated to a user group j , $\min\{x_{ij}, 1\} * n_j = n_j$ is a quantity of users in the user group j . If the user group j is not allocated with a resource share, the result of this item is 0 and is not included in statistics. Therefore, the left side of equation (8) is the quantity N of covered users allocated with the network resource in the time period type i , and $(1 - \lambda K\%)$ is corresponding to the target threshold.

[0063] On the basis that equation (3) constrains reservation of a specific proportion of network resources to cover the total user set, equation (8) further constrains a coverage frequency of the total user set by using the frequency parameter λ . For example, in a case in which the time period is day, a value of λ corresponds to a quantity of days during which allocation of network resources covers the total user set once. As such, a coverage problem of a tail user is better alleviated, and a long-term resource return is more favorable.

[0064] It should be understood that, when a plurality of constraint conditions are specified, a resource share x_{ij} allocated to each user group in a time period of each time period type can be determined by using a plurality of algorithms, so when the plurality of constraint conditions are satisfied, a sum of estimated resource returns is as large as possible. Typically, each resource share x_{ij} is determined by using a linear integer programming algorithm.

[0065] On the basis of determining the resource allocation method for the target future duration, that is, each resource share, in an embodiment, a current time period type c corresponding to a current time period can be determined. For example, in a deduction request scenario, a type (payday, workday, or rest day) of a current day on which the previous method is performed is determined. Then, a deduction request is sent to each user group j based on a determined resource share x_{cj} allocated to each user group j in the current time period type c . The previous method can be performed at a

specific time interval, for example, once a day or once a week, so as to dynamically update the resource allocation solution and better satisfy a resource allocation requirement.

[0066] According to another embodiment, a resource allocation apparatus is further provided, and the apparatus can be deployed on any device or platform that has computing and processing capabilities. FIG. 4 is a schematic diagram of a resource allocation apparatus according to an embodiment. As shown in FIG. 4, the apparatus 400 includes:

an acquisition unit 41, configured to obtain resource limit information and time period information of a network resource corresponding to target future duration, where the time period information includes a first ranking of a plurality of time period types included in the target future duration based on resource return rates;

a group estimation unit 42, configured to obtain group estimation information, including an estimated resource return in a case in which each user group in a plurality of user groups obtains a network resource of each candidate share for each time period type; and

a share determining unit 43, configured to determine, under a plurality of constraint conditions, a resource share allocated to each user group in a time period of each time period type based on the group estimation information with a goal of maximizing a sum of estimated resource returns in the target future duration, where the plurality of constraint conditions include: a total allocated resource share satisfies the resource limit information, and resource allocation for each time period type satisfies the first ranking.

[0067] According to an implementation, the network resource is a deduction request for a borrowing user, a single resource share corresponds to sending a deduction request once, and the resource return rate is a probability of successful deduction.

[0068] In an embodiment of the previous implementation, the apparatus further includes an allocation unit (not shown), configured to: determine a current time period type corresponding to a current time period; and send a deduction request to each user group based on a determined resource share allocated to the user group in the current time period type.

[0069] In a specific embodiment, the time period is day, and the plurality of time period types include payday, workday, and rest day.

[0070] According to an implementation, the plurality of user groups have a second ranking based on users' resource return rates; and the plurality of constraint conditions further include: resource allocation for each user group satisfies the second ranking.

[0071] According to an implementation, the plurality of user groups are obtained
5 by: using a scoring model to score the resource return rate for each user in a total user set; and separately classifying the users into the plurality of user groups based on a score range.

[0072] According to an implementation, the resource limit information includes a total resource share amount; and that the total allocated resource share satisfies the
10 resource limit information includes: the total allocated resource share is less than or equal to the total resource share amount.

[0073] According to another implementation, the resource limit information includes a total resource share amount and a reserved share ratio for a total user set formed by the plurality of user groups; and that the total allocated resource share
15 satisfies the resource limit information includes: the total allocated resource share is less than or equal to an available resource share, where the available resource share is a difference between the total resource share amount and a total reserved share amount, and the total reserved share amount is determined based on a total quantity of users in the total user set and the reserved share ratio.

[0074] Further, in an embodiment, the acquisition unit 41 is further configured to obtain a predetermined frequency parameter, where the frequency parameter is related to a resource coverage frequency at which a user obtains the network resource; and in this case, the plurality of constraint conditions further include: for any time period type, a ratio of a quantity of covered users allocated with the network resource in a single
20 time period corresponding to the time period type to a total quantity of users is greater than a specified target threshold, where the target threshold depends on a product of the frequency parameter and the reserved share ratio.

[0075] According to an implementation, the resource limit information includes a resource share upper limit and a resource share lower limit specified for each time
30 period type; and correspondingly, the plurality of constraint conditions further include: for any time period type, a sum of single time period shares allocated to the plurality of user groups in a single time period corresponding to the time period type is not less than a resource share lower limit for the time period, and is not greater than a corresponding resource share upper limit.

[0076] In an embodiment, the group estimation unit 42 is configured to obtain the group estimation information based on a historical record by using a statistical model.

[0077] According to an implementation, the share determining unit 43 is configured to determine, by using a linear integer programming algorithm, a resource share
5 allocated to each user group in a time period of each time period type.

[0078] According to the previous apparatus, a network resource can be more properly allocated to a user when the network resource is limited.

[0079] According to an embodiment of another aspect, a computer readable storage medium is further provided, on which a computer program is stored. When the
10 computer program is executed in a computer, the computer is caused to perform the method described with reference to FIG. 3.

[0080] According to an embodiment of still another aspect, a computing device is further provided and includes a memory and a processor. Executable code is stored in the memory, and when executing the executable code, the processor implements the
15 method with reference to FIG. 3.

[0081] A person skilled in the art should be aware that in the previous one or more examples, functions described in the present disclosure can be implemented by hardware, software, firmware, or any combination thereof. When the present disclosure is implemented by software, the functions can be stored in a computer readable medium
20 or transmitted as one or more instructions or code in the computer readable medium.

[0082] The objectives, technical solutions, and benefits of the present disclosure are further described in detail in the earlier-described specific implementations. It should be understood that the earlier-described descriptions are merely specific implementations of the present disclosure, but are not intended to limit the protection
25 scope of the present disclosure. Any modification, equivalent replacement, or improvement made based on the technical solutions of the present disclosure shall fall within the protection scope of the present disclosure.

CLAIMS

What is claimed is:

1. A resource allocation method, comprising:
obtaining resource limit information and time period information of a network
5 resource corresponding to target future duration, wherein the time period information
comprises a first ranking of a plurality of time period types comprised in the target
future duration based on resource return rates;
obtaining group estimation information, comprising an estimated resource return
in a case in which each user group in a plurality of user groups obtains a network
10 resource of each candidate share for each time period type; and
determining, under a plurality of constraint conditions, a resource share allocated
to each user group in a time period of each time period type based on the group
estimation information with a goal of maximizing a sum of estimated resource returns
in the target future duration, wherein the plurality of constraint conditions comprise: a
15 total allocated resource share satisfies the resource limit information, and resource
allocation for each time period type satisfies the first ranking.
2. The method according to claim 1, wherein the network resource is a deduction
request for a borrowing user, a single resource share corresponds to sending a deduction
request once, and the resource return rate is a probability of successful deduction.
- 20 3. The method according to claim 2, further comprising:
determining a current time period type corresponding to a current time period;
and
sending a deduction request to each user group based on a determined resource
share allocated to the user group in the current time period type.
- 25 4. The method according to any one of claims 1-3, wherein the time period is day,
and the plurality of time period types comprise payday, workday, and rest day.
5. The method according to claim 1, wherein the plurality of user groups have a
second ranking based on users' resource return rates; and the plurality of constraint
conditions further comprise: resource allocation for each user group satisfies the second
30 ranking.
6. The method according to claim 1 or 5, wherein the plurality of user groups are
obtained by:

using a scoring model to score the resource return rate for each user in a total user set; and

separately classifying the users into the plurality of user groups based on a score range.

5 7. The method according to claim 1, wherein the resource limit information comprises a total resource share amount; and

that the total allocated resource share satisfies the resource limit information comprises: the total allocated resource share is less than or equal to the total resource share amount.

10 8. The method according to claim 1, wherein the resource limit information comprises a total resource share amount and a reserved share ratio for a total user set formed by the plurality of user groups; and

that the total allocated resource share satisfies the resource limit information comprises: the total allocated resource share is less than or equal to an available
15 resource share, wherein the available resource share is a difference between the total resource share amount and a total reserved share amount, and the total reserved share amount is determined based on a total quantity of users in the total user set and the reserved share ratio.

20 9. The method according to claim 8, further comprising: obtaining a predetermined frequency parameter, wherein the frequency parameter is related to a resource coverage frequency at which a user obtains the network resource; and

the plurality of constraint conditions further comprise: for any time period type, a ratio of a quantity of covered users allocated with the network resource in a single time period corresponding to the time period type to a total quantity of users is greater than
25 a specified target threshold, wherein the target threshold depends on a product of the frequency parameter and the reserved share ratio.

10. The method according to claim 1, wherein the resource limit information comprises a resource share upper limit and a resource share lower limit specified for each time period type; and

30 the plurality of constraint conditions further comprise: for any time period type, a sum of single time period shares allocated to the plurality of user groups in a single time period corresponding to the time period type is not less than a resource share lower limit for the time period, and is not greater than a corresponding resource share upper limit.

11. The method according to claim 1, wherein the obtaining group estimation information comprises obtaining the group estimation information based on a historical record by using a statistical model.

12. The method according to claim 1, wherein the determining a resource share
5 allocated to each user group in a time period of each time period type comprises:
determining the allocated resource share by using a linear integer programming algorithm.

13. A resource allocation apparatus, comprising:
an acquisition unit, configured to obtain resource limit information and time
10 period information of a network resource corresponding to target future duration,
wherein the time period information comprises a first ranking of a plurality of time
period types comprised in the target future duration based on resource return rates;
a group estimation unit, configured to obtain group estimation information,
comprising an estimated resource return in a case in which each user group in a plurality
15 of user groups obtains a network resource of each candidate share for each time period
type; and
a share determining unit, configured to determine, under a plurality of constraint
conditions, a resource share allocated to each user group in a time period of each time
period type based on the group estimation information with a goal of maximizing a sum
20 of estimated resource returns in the target future duration, wherein the plurality of
constraint conditions comprise: a total allocated resource share satisfies the resource
limit information, and resource allocation for each time period type satisfies the first
ranking.

14. A computer readable storage medium that stores a computer program, wherein
25 when the computer program is executed in a computing device, the computing device
performs the method according to any one of claims 1 to 12.

15. A computing device, comprising a memory and a processor, wherein the
memory stores executable code, and when executing the executable code, the processor
implements the method according to any one of claims 1 to 12.

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