LOGISTIC CLIENT-SERVER SYSTEM

GRADUATE WORK
(EDUCATIONAL QUALIFICATION LEVEL MASTER)
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Topicality

- Transport tasks play a special role in the reduced transport costs of the enterprise. This is a pressing issue in a market economy, where any costs must be minimized, while costs are covered by a smaller share of profits, and it is allowed to reduce its own products in the market, which makes the company more competitive.

Purpose, object and subject of research

- **The purpose** of this work is using optimization methods to develop an optimal transport plan for a certain number of consumers from a certain number of suppliers.
- **The object** of research is the process of creating a client-server system for solving the transport problem.
- **The subject** of research is the method of potentials and the method of the north-west corner.

Research objectives

- analyze the basic concepts of transport problems;
- develop a transport solution algorithm;
- software implementation of the developed algorithms;
- analyze the technology of creating a client part using Angular and ReactNative technologies
- explore the technology of creating a server part using the php programming language and MySQL database management system;

Statement of the transport problem

- Mathematically formulating the logistic problem, the solution algorithm developed in this paper can be as follows: let there be m points of production of an existing homogeneous product and n points of its location. For each production point i = 1,2,…, m and for each accommodation point j = 1,2,…, n the following values are set: production volume $\boldsymbol{ai}$ at production point i, volume of residence $\boldsymbol{bj}$ at residence j, transportation costs units of product $\boldsymbol{cij}$ from point of production to point of residence j. It is necessary to make a translation plan that will allow you to fully withdraw the products of all manufacturers, which requires all consumers and who have a minimum of total transportation costs. Denote by x$\boldsymbol{ij}$ the volume of the transition from installation to consumer j.

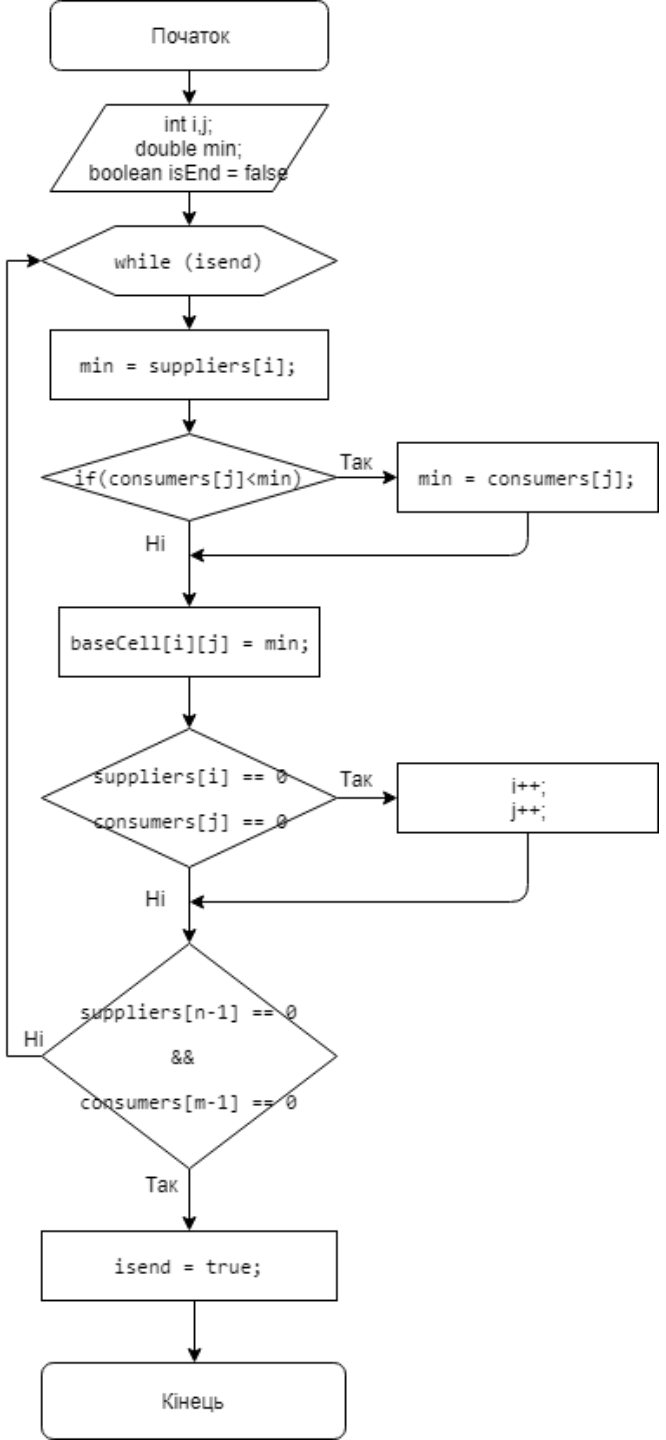
$$\sum_{j=1}^{n} x_{ij} = a_i, i = 1,2,\dots,m$$

$$\sum_{i=1}^{m} x_{ij} = b_j, j = 1,2,\dots,n$$

$$\sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}x_{ij} \to min$$

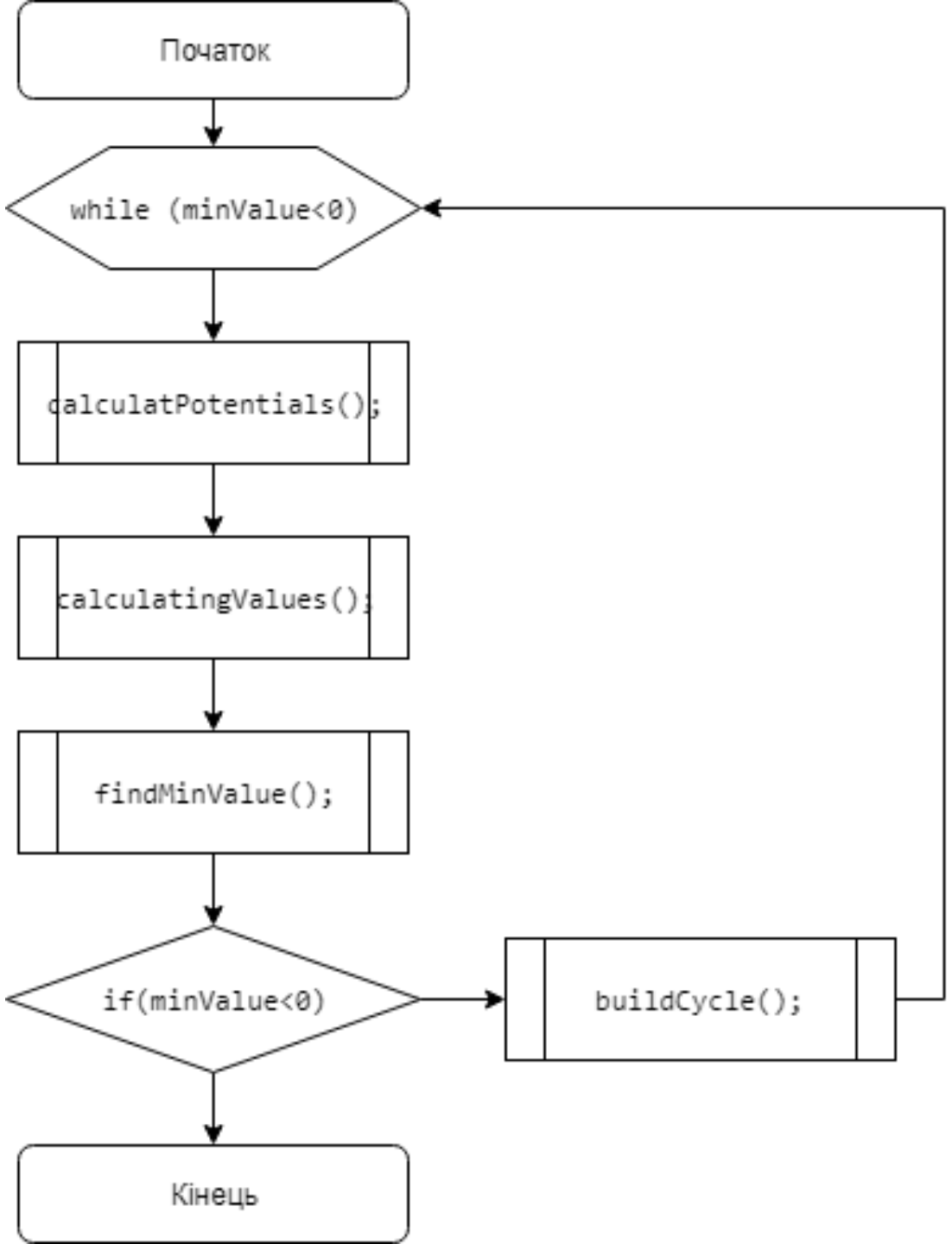
Northwest angle method

- The method consists in sequentially sorting the rows and columns of the transport table, starting from the left column and the top row, and writing the maximum possible shipments in the appropriate cells of the table so as not to exceed the stated capabilities of the supplier or consumer needs.

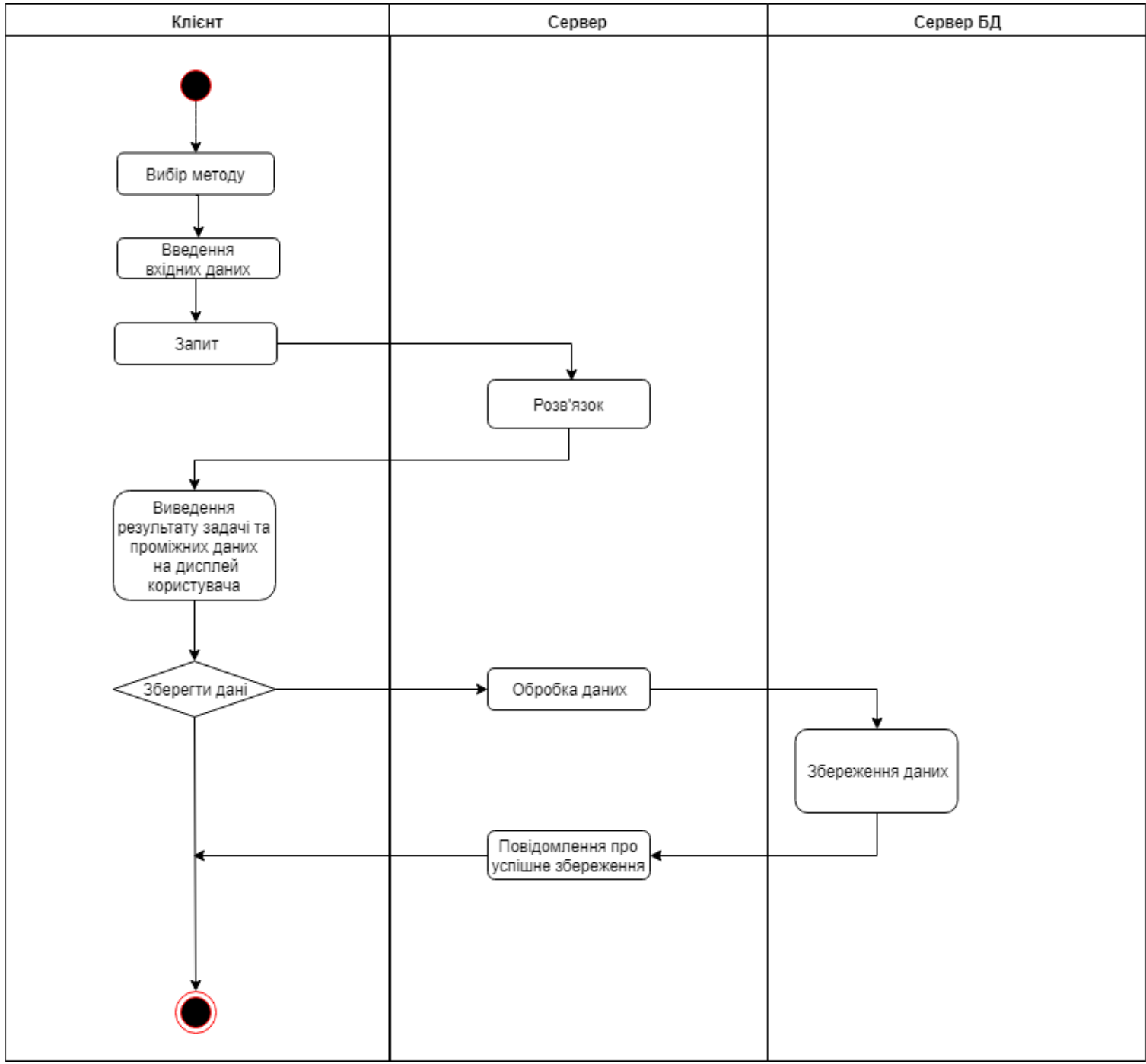


Potential method

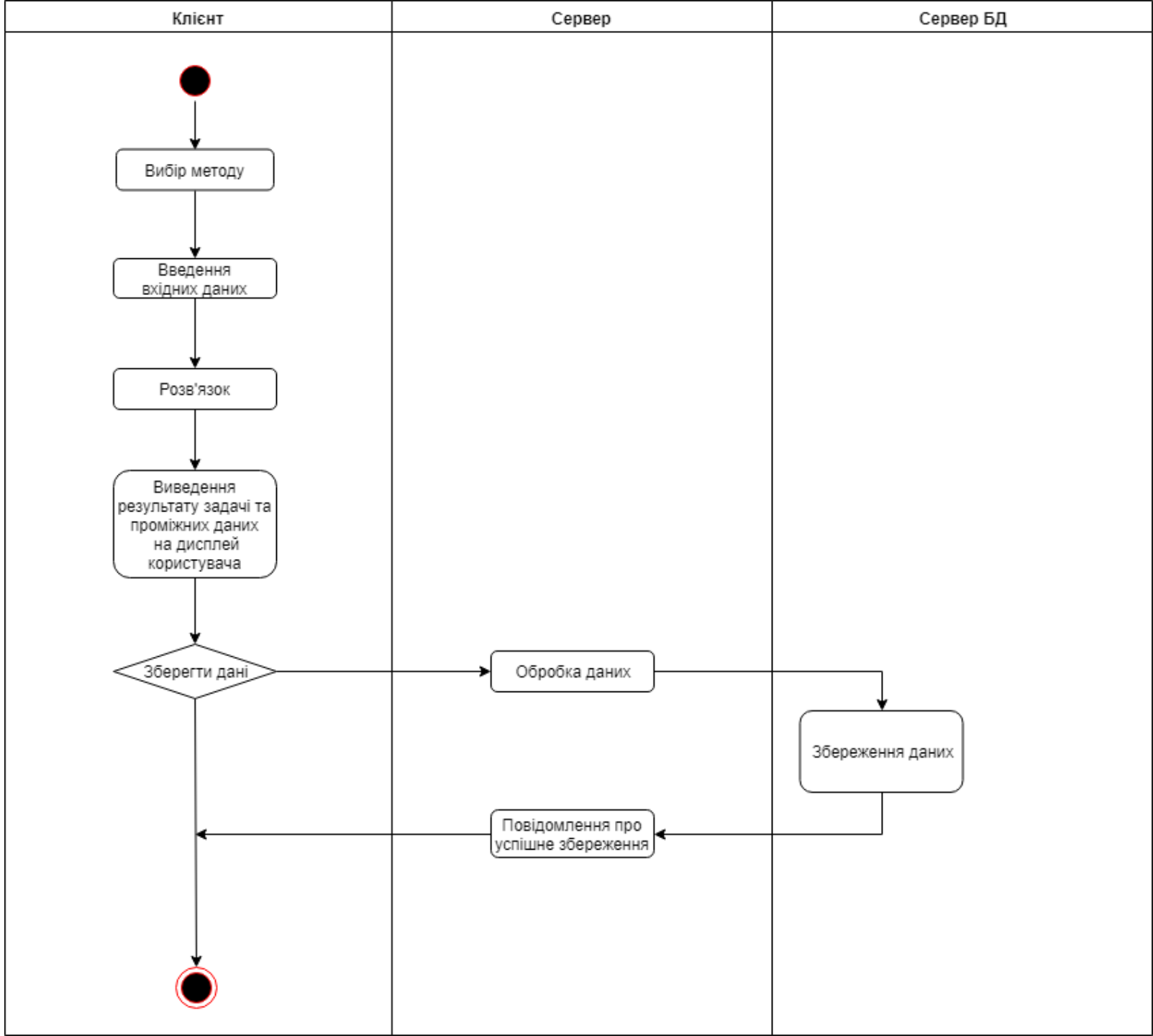
- The general principle of determining the optimal plan of the transport problem by this method is similar to the principle of solving the linear programming problem by the simplex method, namely: first find the reference plan of the transport problem, and then consistently improve it to obtain the optimal plan.



UML-diagram of the distribution of functionality when placing the solution algorithm on the server



UML-diagram of the distribution of functionality when placing the solution algorithm on the client side



UML diagram of user interaction with the system

Entering input data

HMA **Online Calculator: Potential Method** EN B

- Game Theory
- Simplex Method
- Hungarian Method
- Potential Method
- Dual Simplex
- Traveling Salesman Problem
- Dynamic Programming

Number of suppliers: 4

Number of consumers: 4

A \ B	B1	B2	B3	B4	S
A1	1	9	7	5	30
A2	3	1	5	5	40
A3	6	8	3	4	70
A4	2	3	1	3	60
C	35	80	25	70	

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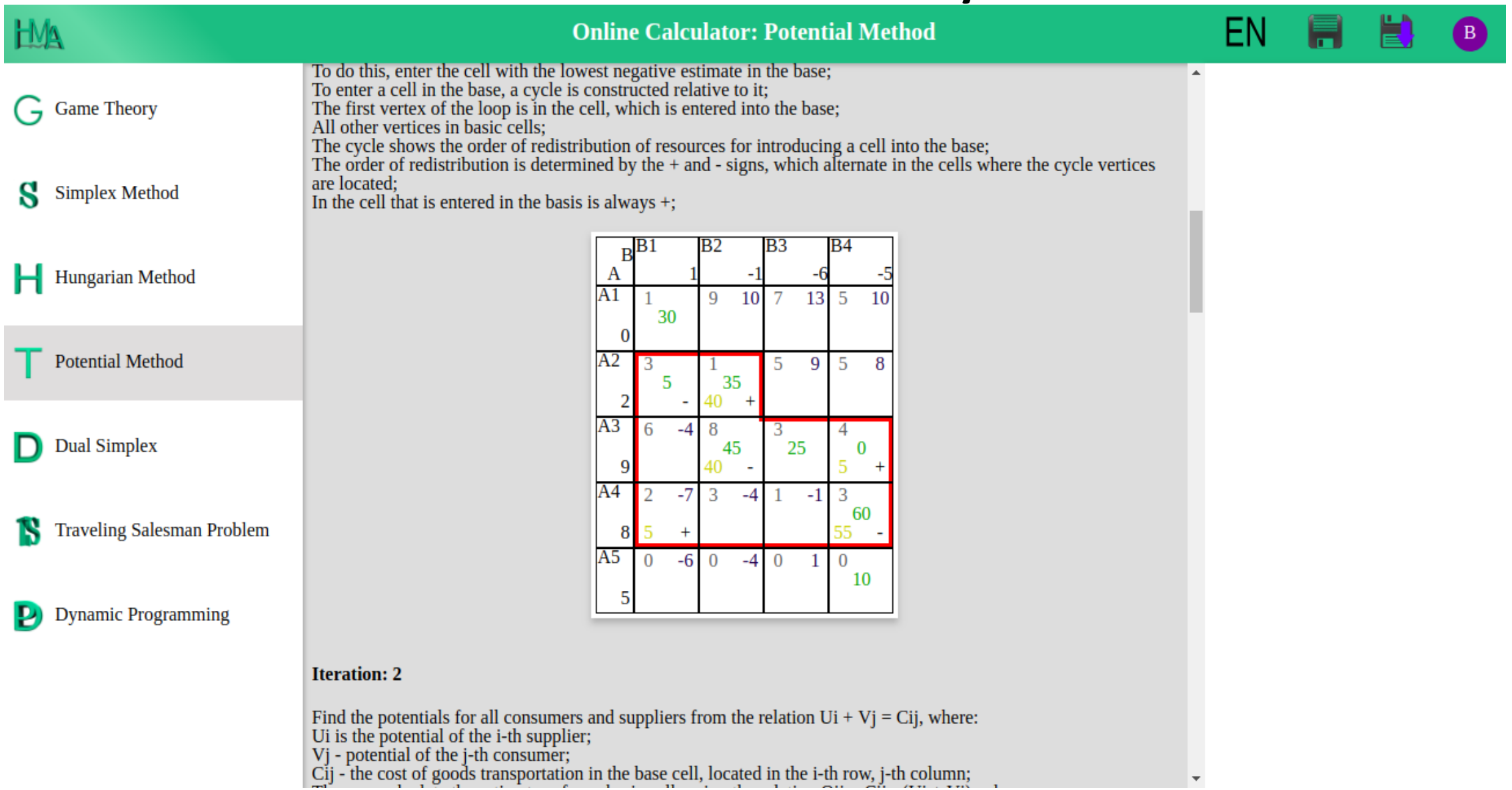
Graphical display of the resource redistribution cycle



The result of the solution

HMA **Online Calculator: Potential Method** EN B

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Find the potentials for all consumers and suppliers from the relation Ui + Vj = Cij, where:
Ui is the potential of the i-th supplier;
Vj - potential of the j-th consumer;
Cij - the cost of goods transportation in the base cell, located in the i-th row, j-th column;
Then we calculate the estimates of non-basic cells using the relation Oij = Cij - (Ui + Vj), where
Oij - the cost of goods transportation in the corresponding non-basic cell;

Since there are no negative values among the estimates, the support plan can be considered optimal;

B / A	B1 (1)	B2 (2)	B3 (0)	B4 (2)
A1 (0)	1 **30**	9 7	7 7	5 3
A2 (-1)	3 3	1 **40**	5 6	5 4
A3 (2)	6 3	8 4	3 1	4 **70**
A4 (1)	2 **5**	3 **30**	1 **25**	3 0
A5 (-2)	0 1	0 **10**	0 2	0 **0**

Result:

(30 * 1) + (40 * 1) + (70 * 4) + (5 * 2) + (30 * 3) + (25 * 1) + (10 * 0) + (0 * 0) = 475

Conclusions

- In the course of this work, a client-server system was developed to solve the transport problem
- Algorithms have been developed that, using optimization methods, build an optimal transport plan for connections of a certain number of consumers from a certain number of suppliers.
- The server part of the system, which is responsible for solving the problem, has been developed.
- Developed a client part with a user-friendly intuitive interface, which is presented on WEB, Android and iOS platforms.

Approbation

- The results of the work were tested at the XLVIII scientific and technical conference of faculty, staff and students of VNTU (March 2019)