汽车组装车间流水线物料配送

摘要

汽车制造的工艺车间中，总装车间的占地面积最大、工人数量最多，因此我们对总装环节的相关数据进行计算，并提出了改进意见。汽车生产流水线总装环节的效率不仅受流水线本身效率影响，还受到各工位物料供应效率的影响。如何安排拖车的物料运输任务对提高生产效率至关重要。我们主要研究的是通过改变运输任务的机制，来降低流水线停线时间，提高生产效率。

针对问题一，需要在工位点承包制的条件确定下承包区的分配。首先用弗洛伊德算法计算每两点间的距离。对于每一个分配方案，我们选取所有拖车中的最大行进路径长度作为方案的评判标准。我们首先给定一个初始承包区分配方案，再用模拟退火算法逐步逼近最优解。对于退火过程中的每一个分配方案，我们用深度优先搜索法解决其寻路问题中的最短哈密尔顿通路问题，以便找到该方案下每一辆拖车的最短行进路径长度。结果显示，在我们的最优承包区分配方案下，所有拖车中的最长行进路径长度为703米。

针对问题二，在给定闲置拖车数量以及运输任务的情况下，找到一种任务分配机制，使流水线停线时间尽可能小。在了解流水线运行机制后，我们将所有工位停工时间之和作为流水线的总停线时间。我们采用贪心算法逐一安排任务，将排入当前任务后增加的停线时间作为贪心的依据。对于每一项任务的安排，遍历每一种安排方法，并利用寻路算法找到局部最优解，再整合局部最优解得到全局最优解。按照上述机制分别安排题给的三项任务，其停线时间分别为65.2秒，752.6秒和983秒。此外，我们还自主设计了一套任务并进行了验证。

针对问题三，在对问题二结果分析的基础上进行对流水线运行机制和拖车任务安排机制进行改进，以期减少停线时间或避免停线。研究发现，需求时限紧张、工位物料存储空间小是导致停线的主要因素。我们对此进行了针对性的改进。结果显示，在改进后所有流水线均能使停线时间大幅减少。

此外，我们还对车速和停线时间进行了灵敏度分析。结果显示，适当提高拖车速度对减少停线时间，提高生产效率有显著作用。

**关键词： 模拟退火 最短汉密尔顿通路 动态任务分配**

一、问题重述

**1.1 问题背景**

随着科技的发展，汽车制造业也在显著地提升和进步，与此同时，行业内部的竞争也变得越发激烈、明显。另外，消费者对于汽车制造业也提出了更高的要求，尤其是对汽车的外观和性能的需求。在汽车制造中，有冲压、焊接、涂装和总装这四大关键工艺，其中总装的环节中，受到人工和场地面积因素的限制，需要通过数学模型的技术方案来实现“降本增效”的效果，以更好地满足社会发展和消费者的实际需求，回馈社会对于该行业的期许。

整个总装的流程围绕流水线工作展开，汽车制造业通过拖车来完成生成线组件之间的运输步骤以及时补充工位物料，提高工作效率。拖车运输组件内也主要分为取料、配送两个环节。因此在不超小车装载容量情况下，实现“降本增效”成为现今制造业面临的一个极大的问题。

**1.2 问题提出**

**问题一**：根据问题一的要求和给定的流水线布局图，我们需要考虑10辆拖车的配送任务。题目给出了每辆拖车只能负责一块“承包区”，并且一个承包区不超过5个工位，且承包区不能够重叠的约束条件。我们在此约束条件下，为10辆拖车安排承包区，以实现“降本增效”的目标。

**问题二**：为了进一步实现降本增效，车间打破第一题中承包区的限制，减少拖车数量，根据实际时间条件下的任务需求和拖车数量，形成满足实际需要的拖车配送方案。题目给出了小车行进速度、装卸零件时间和拖车装载量限制条件，要求我们设计一种计算方法。在减少停线风险下，考虑提高实际环境的应用能力，自动生成能够与任务数据相验证的拖车配送路线。

**问题三：**题目要求我们在问题二计算方案的基础上，探讨这种拖车配送计算方法能够防止停线情况的发生。根据结果，阐明可行性与原因，提出一种能够更符合实际，以实现降本增效的方案，并验证其效果。

二、模型假设

1. 假设货物量不会影响拖车的行进速度；

2. 假设几辆拖车在某处相遇不会互相影响；

3. 假设拖车转弯过程中行进速度不会发生改变。

三、符号说明

|  |  |
| --- | --- |
| 符号 | 符号意义 |
|  | 表示一种拖车承包区范围情况下，编号为的拖车，其所对应的运行周期 |
|  | 表示拖车从原点出发行进到完成所有零件运输工作的工位点后返回起始点的路程 |
|  | 表示拖车不受装载量影响的路径进行速度 |
|  | 表示新的状态转移的目标 |
|  | 表示当前状态 |
|  | 表示编号的拖车的一个工位的运输零件承包权 |
|  | 表示目标状态下的代价 |
|  | 表示当前状态下的代价 |
|  | 表示目标状态代价和当前状态代价的差值 |
|  | 表示目标状态服从的分布概率 |
|  | 表示表示装配区流水线的总停线时间 |
|  | 表示I装配区中编号为工位点的停线时间 |
|  | 表示拖车的到达该工位点的所需要的时间 |
|  | 表示该工位点的需求时间 |
|  | 表示上一个循环阶段中对应的每一辆车的最短总停线时间 |
|  | 表示当前每一辆拖车的最短总停线时间 |
|  | 表示按配送顺序相邻的两个工位点的最短路径 |
|  | 表示这两个工位点的需求时间差值 |

注：未列出符号及重复的符号以出现处为准

四、模型的建立与求解

**4.1问题一**

**4.1.1 问题一的分析**

为使流水线保持正常工作，最大限度地减少流水线的停线风险，我们需要尽可能的及时满足每一个工位的物料需求。在各个工位对物料的需求频率相同的情况下，物料需求得到满足所需时间最长的工位将成为整条流水线运行速度的短板，即10辆拖车的最长工作周期决定了整条流水线的工作效率。因此，我们假定每辆拖车每次工作都会将物料从仓库取出再逐一送到各个工位，并且各工位对于物料需求频率相同，拖车装卸货物时间忽略不计，另外拖车的行进速度也不受装载货物的影响。

在此假设下，我们首先要计算每一辆拖车在承包区范围调整情况下的各个运行周期。而整条流水线的周期受拖车中的最长运行周期限制，要使整条流水线效率最高，就要使拖车中的最长运行周期最小。为此，我们可以问题一的求解过程转化为了调整每辆拖车的承包区范围，求解所有拖车最小的最长路径长度。通过求解的答案得到最合理的拖车承包区分配方案。

**4.1.2 问题一的解答**

对于问题一的解答，我们需要先清楚拖车承包区、拖车运行周期的定义，再根据题目要求，明确目标函数并对其进行分析求解，得到拖车承包区和拖车运行周期之间的关系，建立合理的数学模型，从而结合问题中给出的附件坐标数据，利用算法求解出最合理的承包区分配情况。

**4.1.2.1 理论准备**

下面我们对模型中需要用到的一些专用名词做出了解释：

1)拖车承包区

拖车承包区是指每辆拖车负责的若干个工位。在整个总装车间中分为装配区和仓库两部分。为了提高效率，车间采用的是工位点承包制，其中工位号和仓库点编号是一一对应的。而拖车需要将指定点位的零件运送到与之对应的仓库点存放，每辆拖车所需要负责运送零件的指定点位就是该拖车的承包区。

2)拖车运行周期

拖车运行周期就是指拖车从起始点出发，按照算法规划的路径，将其所负责的承包区范围内的工位点上的所有零件，一次性运送到与之一一对应的仓库编号点位置后，返回起始点所需要的总时间。根据问题分析中的假设，我们不考虑拖车装卸零件时的时间，并且其装载容量能够满足将承包区范围内的所有仓库点零件装载后一次性运输到对应的工位点上。因此在计算拖车的运行周期时，只需要考虑拖车在路途中行进所花费的时间。

**4.1.2.2 模型的建立**

我们根据题目要求和分析，通过已知条件得到目标函数，通过相关公式求解各情况下拖车的运行周期，确定满足约束条件下的拖车最短运行周期以及其所对应的各拖车承包区范围，从而为模型的解答奠定理论基础。

1)目标函数的确定

我们将问题中的最合理拖车承包区分配方案定量化的转化为了求解各承包区分配范围下拖车中最长的运行周期的最小值。当拖车中最长运行周期达到最小时，根据木桶短板理论，我们可以求解出最高效的拖车承包区分配方案。因此，我们建立如下的目标函数：

其中表示一种拖车承包区范围情况下，编号为的拖车，其所对应的运行周期。

通过找到拖车最长的运行周期的最小值，我们最终可以解出与之对应情况下的拖车承包区分配方式。

2)各情况下拖车运行周期的计算步骤：

*Step1*.我们运用模拟退火算法列举各种情况的10辆拖车承包区范围。不同的拖车承包区范围分布形式会决定不同的拖车行进路径长度的差异，从而影响拖车的运行周期的长短；

*Step2*.针对第一步中列举出来的各种情况下的拖车承包区范围分布，我们采用深度优先搜索算法计算，寻找每一辆拖车在该种拖车承包区分配方案情况下的最短行进路径长度；

*Step3*.根据问题分析中的行进速度不受拖车装载容量影响和拖车装卸零件时间忽略不计的假设，我们可以建立拖车运行周期与拖车行进路径长度的关系。由于步骤二中通过深度优先搜索算法计算出最短行进路径，因此我们在计算拖车运行周期时，可以通过总的路径长度和行进速度求解，关系如下：

其中，表示拖车从原点出发行进到完成所有零件运输工作的工位点后返回起始点的路程，表示拖车不受装载量影响的路径进行速度。

*Step4*.通过公式，可以求解出各拖车承包区范围情况下的各个编号的拖车的运行周期。

通过目标函数和拖车运行周期计算结果，可以最终求解出最高效、合理的拖车装配区分配方案。

**4.1.2.3 模型的求解**

根据我们的问题分析，题目给的各个数据，我们可以分析得到我们运用到的各参数的变化规律，具体的如下说明：

1)当不考虑装卸零件时间和行进速度变化的情况下，拖车行进周期越短，拖车行进路径越短；

2)在各种拖车承包区分配方案情况下，比较各方案中行进周期最长的拖车，行进时间最短情况下的承包区分配方案就是问题一中最合理的分配方法。

利用模拟退火算法和深度优先搜索算法的具体求解模型和计算结果的步骤和流程图如下所示：

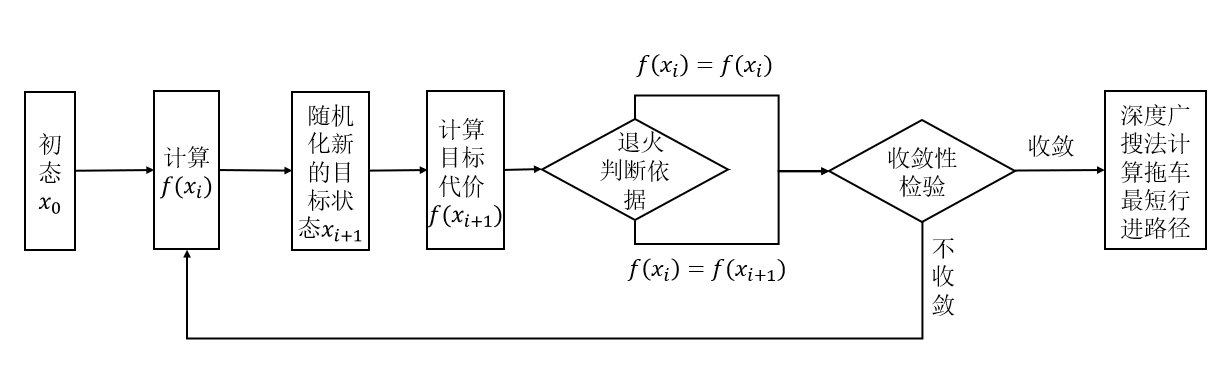


图1 求解模型流程图

1).构造出一个目标函数的初始状态；

2).进入循环的阶段，计算当前状态下的目标函数;

3).对当前模型进行扰动，从而产生新的状态转移的目标状态。根据随机化过程，从转移到，存在两种情况的状态转移方式变化：

a).，表示编号的拖车将一个工位的运输零件承包权转移给另一个编号为的拖车;

b).，表示编号为的拖车将一个工位的运输零件承包权和另一个编号为的拖车的一个工位运输零件承包权互换。

4).计算模拟退火中的代价，即目标状态下的代价;

5).计算目标状态代价和当前状态代价的差值，：

a).若，则新的目标状态被接受；

b).若，则新的目标状态按概率进行接受，为温度。若模型被接受，则，。

6).通过第五步中求出的目标状态，判断新的目标状态是否收敛。

a).若不收敛，则将返回求解步骤中的第二步，重新计算目标函数值，并通过随机化扰动，寻找一个新的状态转移目标；

b).若收敛，则利用深度优先搜索算法。如图3所示，以图中D节点为根节点开始向两端搜索，得到最终的拖车行进最短路径。根据拖车运行周期的计算公式和该行进路径，计算出所有拖车中的最长运行周期以及此在拖车运行周期情况下的拖车承包区分配方案。

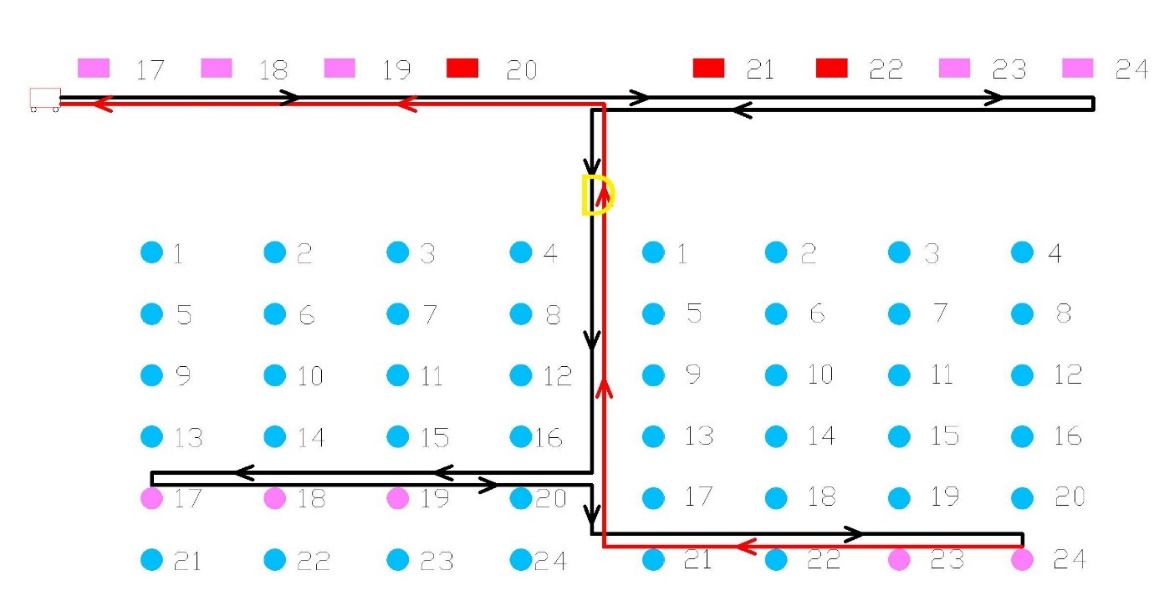


图2寻路结果示例示意图

7).多重复步骤1到步骤6的环节，进行计算，寻找多种拖车承包区情况下的所有拖车中的拖车最长运行周期。求出所有拖车承包区方式中的拖车最长运行周期中的最短运行周期。求解出拖车的最短运行周期所对应的拖车承包区分配方案，即为最合理的拖车承包区分配方案。

**4.1.2.4 模型的结果与分析**

1).结果展示

根据题目要求，通过附件1中的给出的装配区、仓库、路径等坐标点，并结合前文推导出的公式和Dev C++软件计算出求解模型在最优拖车承包区情况下的目标函数、以及各编号拖车行进路径长度。

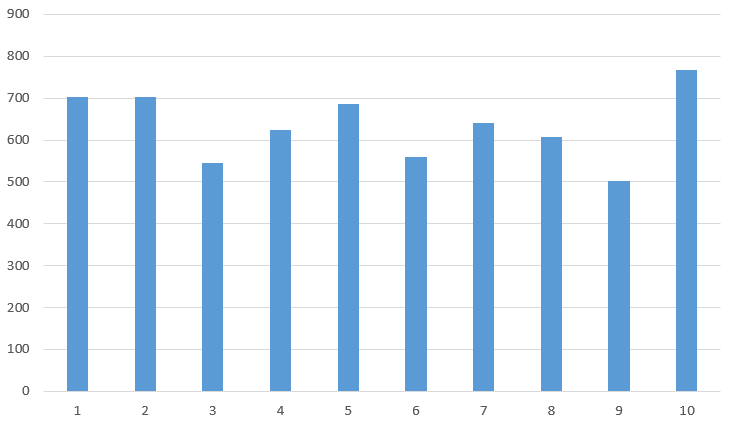


图3 各拖车路径长度统计图

我们通过寻找所有拖车承包区分配方案中，最长的拖车运行周期中的最小值，来确定最优承包区分配方案，以验证拖车的最优运行周期和路径长度的正确性，之后求解在

此结果下的各编号拖车其所负责的具体承包区，结果展示如下：

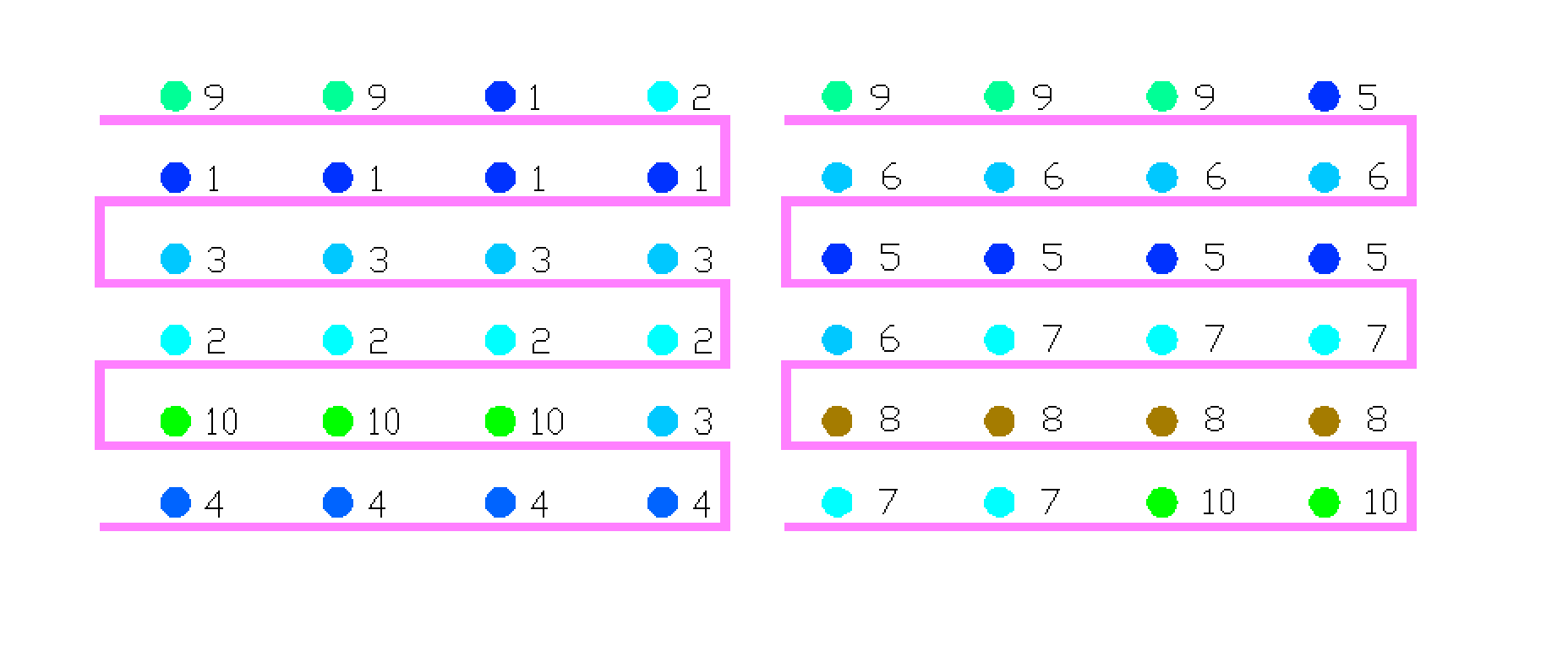


图4 拖车承包区结果示意图

2).结果分析

我们在本问题中的解，没有考虑到装配区中的工位对于零件的需求量和需求紧急程度的影响，缺乏实际环境的应用能力，因此在现实的应用过程中，还需要对算法进行改进；

同时在我们本问题的模型中，可能还会存在停线的情况，从而导致流水线运行效率下降。为了实现题目背景中所要求的“降本增效”的功能。我们在问题二中提出更高效的模型，打破承包制，减少拖车数量，来解决该问题，以更好地满足实际生活环境中的需要。

**4.2问题二**

**4.2.1 问题二的分析**

从问题一的结论中，我们已经可以发现在某些承包区的运输任务还没有完成，进而拖累整条流水线的运行效率。题目提供了包含可用的小车与任务的需求时间和工位的任务单。我们需要给出一种灵活的解决方案，使任务能够通过计算机自动地在小车间进行分配，尽量减少流水线的停线风险。我们考虑的是拖车所有的配送任务是一次性完成的，即拖车一次从仓库区取走所有任务零件，逐一配送到工位点后返回终点，不会在仓库区和装配区来回往返。

具体而言，如果我们能够找到一种方案，使得流水线不必停线，则采用该种方案；但在某些具体示例中，停线风险必然存在的情况下，我们的任务就是，为拖车分配提供一种新的配送分配机制，使任务能够通过计算机自动地在小车间进行分配，尽量减少流水线的停线风险。我们首先对数据进行预处理，求解总装图中任意两点之间的最短距离，然后通过贪心算法和局部最优化排列对已知数据按照需求时间顺序安排拖车的配送任务，以实现两条流水线的停线时间之和最小，尽可能地减少总地停线时间，从而降低停线产生的风险。

**4.2.2 模型的准备与建立**

**4.2.2.1 数据预处理**

根据题目要求，我们需要设计一种能够尽可能减少停线风险的方案。因此在建立模型之前，我们对题目附件中给出的数据做数据的预处理，方便在之后的建模过程和求解中直接应用。

1)求解两点间最短距离

采用弗洛伊德算法求解总装区间图中的任意两点之间最短距离。其目的在于方便对后续的规划路径最短距离求解提供数据。弗洛伊德算法是利用遍历中间节点的形式，逐步更新节点距离。

2)对任务紧急需求度排序

根据题目的要求，为了更好地减少停线风险，我们在对拖车进行派送方案计算时，应该先考虑所有已知任务的紧急需求度。我们用需求时间来衡量紧急需求度，因为当拖车在工位需求时间后到达该工位点，会导致整个流水线发生停线的现象。因此我们将所有任务的需求时间从小到大进行排序，需求时间相对越长的工位点，其需求的紧急程度也相对较低；反之，工位点的需求紧急程度会相对较高。这样方便对于拖车派送方案安排进行计算。

**4.2.2.2 理论准备**

我们根据题目所需的减小停线风险的需求，生成打破承包制，减少拖车数量的拖车派送方案模型。并对在模型求解中需要运用到的专用名词做下分析，以便之后求解过程中直接运用。

1)汉密尔顿通路

汉密尔顿通路是指某条通过且仅通过一次的某条路径。最短汉密尔顿通路指的是所有汉密尔顿通路中最短的那一条通路。求解最短汉密尔顿通路的方案是求解拖车在仓库区取件过程中所能行进的最短路径。因为拖车的速度是恒定的，因此路径越短，花费时间越小，能够在工位点需求时间以前抵达工位点的概率越大，发生停线的风险性也就越低。

**4.2.2.3 模型的建立**

我们通过对问题进行分析，并结合已知条件得到模型的目标函数，利用相关公式求解流水线总停线时间最短情况下的拖车派送方案，细化模型，为之后的求解过程奠定理论基础。

1)目标函数的确定

为了减少流水线停线的风险，我们将这一风险定量化处理，以流水线停线的时间为衡量标准。停线时间越短，停线风险越小。因此我们明确目标函数为两条流水线总的停线时间最短。我们的拖车派送方案算法的制作将以此流水线总的停线时间最短为目标。建立目标函数如下：

其中表示装配区流水线的总停线时间，表示装配区流水线的总停线时间。

我们最终通过目标函数，确定最佳的拖车派送方案，以满足停线风险尽可能小的要求。

2)流水线的停线时间

在本题的总装车间中，包含了两块装配区，因此要对这两块区域分别求停线时间。而流水线的停线时间是由该流水线上的工位点的停线时间所决定的，所以我们需要通过计算工位点的停线时间来计算每条流水线的停线时间。我们建立了流水线停线时间的计算公式：

其中表示一装配区中编号为工位点的停线时间；表示二装配区中编号为工位点的停线时间。

我们最终可以通过公式求解出流水线的总停线时间，并以此作为来制作拖车配送方案。

3)工位点的停线时间

我们通过题目给出的已知数据和信息，可以看出每个工位点的需求时间是不一样的，因此就会产生时间上的偏差，从而导致停线现象的发生。为了更好地衡量和表达总停线时间以及流水线的停线时间，我们给出工位点停线时间的定量化的计算方式和判别依据，如下：

其中表示拖车的到达该工位点的所需要的时间，表示该工位点的需求时间。判断的依据便是到达时间与需求时间的差值。

当结果大于0，则会流水线会产生停线的现象，停线时间为；反之，流水线正常工作运行，停线时间为0。

就工位点的停线实际情况而言，我们对其停线时间的计算和流水线的工作过程做了一个现实的分析说明。



图5 拖车承包区结果示意图

如图 所示，图中4点位为发生停线的工位点，因为拖车没有及时输送零件而导致该现象的发生。在4到8点位方向上，会继续进行，直到零件加工完毕。在1到4点位方向上会发生停滞现象，因为B点是停线状态，上半部分无法继续进行零件加工的工作。所以在计算该B工位点的停线时间，我们可以通过上述的公式进行计算和分析。

最终我们通过模型的三部分可以得到使总流水线停线时间最小情况，即尽量减小停线风险前提下的拖车派送方案。

**4.2.3模型的解答与分析**

我们通过应用数学模型，明确目标函数，结合题目所给的拖车数量与配送工位点需求时间的数据对模型进行求解。

**4.2.3.1 模型的求解**

在模型的求解过程中，因为仓库区域取货时间与装配区域工位点需求时间都和停线时间有很大的关联，因此我们主要将模型分为两部分运用贪心算法和局部最优化排列进行求解，第一部分是仓库区域最优化的取货时间求解，第二部分是装配区域各拖车最优化的总停线时间求解。这两步求解不断循环，直至所有工位点在满足拖车容量的情况下，全部安排给所有拖车后，结束循环。最后通过前面的结果计算总的流水线停线时间。具体步骤如下和示意图：

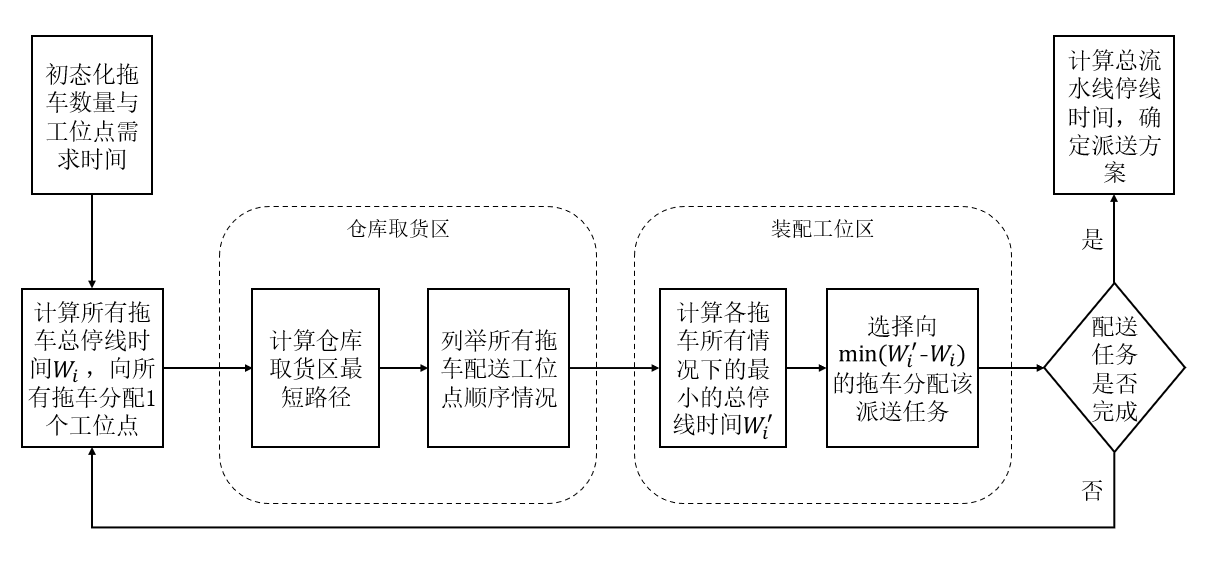


图6 求解模型示意图

**初始步骤：**

*Step1*.在循环开始前，初始化拖车的数量以及需要配送的工位点的数量和各工位点的需求时间信息；

*Step2*.向每个拖车分配1个相同的派送工位点零件的任务.

**1)仓库区最优取货时间求解**

*Step1*.确定每个拖车各自的派送工位点任务，寻找并计算每个拖车在仓库区域内存货点的汉密尔顿通路；

*Step2*.确定每辆拖车在仓库内的最短汉密尔顿通路，根据此通路的原理，所有存货点有且经过一次。因此所有拖车在仓库区内的经过存货点的最短汉密尔顿通路即为它们在仓库区内的路径最优解。此方式保证了拖车取货过程能够实现最优解的目标，尽可能降低取货所花费的时间成本；

*Step3*.对每辆拖车的派送工位点任务而言，计算所有的配送顺序可能性，为下一步各拖车的最优总停线时间求解做铺垫。

**2)各拖车最优总停线时间求解**

*Step1*.针对于每一辆拖车而言，对其派送任务的工位点按照所有配送可能的顺序进行，计算所有配送顺序可能性过程中的每个工位点的停线时间，最后得到所有配送顺序情况下的拖车的总停线时间；

*Step2*.通过步骤一的结果，得到每一辆拖车的最短总停线时间，计算每一辆拖车的，其表达式为：

为上一个循环阶段中对应的每一辆车的最短总停线时间。计算所有拖车的总停线时间差值；

*Step3*.当总停线时间差值最小的拖车容量在限制因素范围内，即该拖车目前的配送工位点个数小于4个，则可以分配该派送任务给这个总停线时间差值最小的拖车，反之，选取其次小的拖车进行分配，直至选中为止。若所有拖车都满足分配工位点的容量限制，且每辆拖车的总停线时间差值大小一样，则随机任意选择一个拖车分配该派送任务。

**循环判定与结果计算：**

*Step1*.在进行下一轮分配之前，需要对剩余为配送的工位点进行判别，当仍有剩余待分配的工位点，则继续循环步骤，向所有容量仍然没有达到4个派送零件，可以继续派送的拖车分配下一个派送任务，返回初始步骤中的第二步，通过两个最优值的求解方法确定下一个工位点任务的配送归属权；如果没有剩余的工位点任务待配送，则退出循环步骤；

*Step2*.通过上述步骤计算得到的所有拖车的总停线时间，求解出总的流水线停线时间。带入附件2中的数据，求出在给定的已知数据条件下的工位点任务派送方案，该结果即为尽可能减小停线风险下的最优解。

**4.2.3.2 模型的结果与分析**

1).结果展示

根据题目要求，通过附件2中的给出的拖车数量、工位点需求时间和前文模型中的公式，用Dev C++软件计算出此结果条件下的拖车最优工位点派送方案，以验证模型的正确性。

我们以附件2中的任务一为例，我们通过模型计算出各工位点的停线时间和最小的总流水线停线时间。各工位停线时间展示如下：

表4 拖车各工位停线时间

|  |  |  |  |
| --- | --- | --- | --- |
| 需求编号 | 需求工位 | 拖车编号 | 停线时间(*s*) |
| 1 | I-3 | 1 | 0 |
| 2 | I-4 | 1 | 0 |
| 3 | I-8 | 1 | 13 |
| 4 | I-7 | 1 | 3 |
| 5 | I-11 | 2 | 0 |
| 6 | I-12 | 2 | 0 |
| 7 | I-15 | 2 | 27.6 |
| 8 | I-16 | 2 | 21.6 |

我们通过模型计算出确定的总流水线最小停线时间后，求解该情况下，各编号拖车的取货和配送顺序，此结果即为考虑尽可能减少停线风险情形下的拖车派送分配方案。结果呈现如下：

表5 拖车取件和配送顺序

|  |  |  |
| --- | --- | --- |
| 任务一 | | |
| 拖车编号 | 取件顺序 | 配送顺序 |
| 1 | 4-3-2-1 | 1-2-3-4 |
| 2 | 5-6-7-8 | 5-6-7-8 |
| 任务二 | | |
| 拖车编号 | 取件顺序 | 配送顺序 |
| 1 | 12-10-15-4 | 10-4-12-15 |
| 2 | 6-11-16-17 | 11-6-16-17 |
| 3 | 1-9-3-7 | 1-3-7-9 |
| 4 | 第一趟 2-5-8 | 第一趟 2-5-8 |
| 第二趟 18-19-13-14 | 第二趟 18-19-13-14 |
| 任务三 | | |
| 拖车编号 | 取件顺序 | 配送顺序 |
| 1 | 15-20-19-16 | 20-15-16-19 |
| 2 | 9-3-4-1 | 9-3-4-1 |
| 3 | 7-13-12 | 7-12-13 |
| 4 | 17-8-21-11 | 17-21-11-8 |
| 5 | 2-6-18-22 | 6-2-18-22 |
| 6 | 14-5-23-10 | 14-5-23-10 |

2).结果分析

经过计算，在题给条件的情况下，流水下一定会发生停线。停线现象在任务三中的数据条件中尤为明显，每条流水线的平均停线时常超过了400秒。物料的运输效率极大的限制了流水线的工作效率。我们应该对此进行改进。因此，在第三问中我们将对生产线的运行条件进行适当调整以期提高生产效率。

为了更好地验证我们算法技术方案的实用与可行性，我们设计了计算量更加庞大的数据集合任务四，以检验我们的的技术方案设计出来的派送方案能够实现尽可能减少停线风险。

表6 新设计任务单的任务示例

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 可用拖车 | 1 | 2 | 3 | | 4 | 5 |
| 需求编号 | 需求工位 | | | 需求时间(*s*) | | |
| 1 | I-13 | | | 60 | | |
| 2 | I-7 | | | 62 | | |
| 3 | I-21 | | | 65 | | |
| 4 | I-12 | | | 72 | | |
| 5 | I-16 | | | 80 | | |
| 6 | I-9 | | | 82 | | |
| 7 | I-22 | | | 85 | | |
| 8 | I-18 | | | 110 | | |
| 9 | I-16 | | | 110 | | |
| 10 | II-5 | | | 55 | | |
| 11 | II-15 | | | 58 | | |
| 12 | II-3 | | | 94 | | |
| 13 | II-17 | | | 96 | | |
| 14 | II-19 | | | 100 | | |
| 15 | II-8 | | | 120 | | |
| 16 | II-22 | | | 121 | | |
| 17 | II-24 | | | 123 | | |
| 18 | II-5 | | | 140 | | |
| 19 | II-11 | | | 150 | | |

通过我们的模型可以计算出五辆拖车各自的总停线时间以及它们的取货顺序和配送顺序，结果呈现表如下所示：

表7 拖车取件和配送顺序

|  |  |  |  |
| --- | --- | --- | --- |
| 任务四 | | | |
| 拖车编号 | 取件顺序 | 配送顺序 | 停线时间(*s*) |
| 1 | 1 9-14-15-17 | 14-15-17-19 | 41.4 |
| 2 | 12-13-16-18 | 12-13-16-18 | 23.2 |
| 3 | 2-5-6 | 2-5-6 | 36.9 |
| 4 | 9-1-10-11 | 9-1-10-11 | 41.5 |
| 5 | 4-3-8-7 | 3-4-7-8 | 45.2 |

通过验证可以看出我们的拖车派送方案求解算法，适应能力和计算能力强，能够满足较大计算量情况下的任务分配。

**4.3问题三的模型建立与求解**

**4.3.1 问题三的分析**

根据问题三的要求，在第二题中我们发现，在题给的条件下，流水线总会发生停线。其原因有二：其一，由于工位存储空间有限，拖车必须在零件消耗完的时刻补充零件，故即使拖车提前到达工位，它开始卸载零件的时刻亦为该任务的需求时间。即使拖车提早到达目标工位，也必须等到需求时间才能卸货，这可能耽误拖车完成下一个任务；二、一些工位的需求时间较小，拖车按照当前速率行进，即使立刻赶往目标点，也已经赶不上需求时间。

因此我们提出如下改进：对于问题一来说，我们希望扩大流水线上每个工位的物料存储空间，以便在拖车数量紧张的时候有足够的物料进行缓冲，而拖车也无需等待需求时间，在接到送货任务后可以随时在目标工位卸货而无需等待；对于问题二而言，我们希望提高拖车的运行速度，降低交通耗时以减少停线时间。

**4.3.2 问题三的解答**

**4.3.2.1机制的改进与转化**

我们通过问题二的求解结果可以知道，在问题二中是不能杜绝停线情况的。因此为了防止停线现象的发生，我们需要通过改进拖车的运行机制来实现。

1).针对任务一而言，我们通过问题二的模型可以得到结论，拖车能够在某些工位点的需求时间到达之前很久便抵达工位点。但由于拖车必须等到工位点的需求时间到达后，方可出发前往下一个工位点，而按照拖车的行进速度和前后顺序相邻的两个工位点之间的距离，难以实现在下一个工位点需求时间抵达之前达到下一个工位点。因此就会导致停线情况的出现。但这一现象是非常没有必要的，拖车在上一个工位点浪费了很久的时间去等待该工位点需求时间，这段时间完全可以放在行进路径中以降低停线时间。因此我们针对任务一提出扩大工位的存储空间的举措，拖车无需等待需求时间，可以直接前往下一个工位点；

2).针对任务三而言，我们通过问题二的可以看出，存在着拖车还没抵达装配区第一个工位点时，该工位点的需求时间已经抵达的情况，并且还存在着，两个工位点之间距离过大，距离与速度的比值远大于两者的需求时间差，导致拖车无论如何也不可能避免停线现象的情况。因此，我们针对任务三，提出了加快拖车的行进速度，使拖车能够在工位点的需求时间到来之前抵达该需求点，并能够满足公式：

其中指的是按配送顺序相邻的两个工位点的最短路径，表示这两个工位点的需求时间差值。

我们改进的拖车行进速度必须大于两点距离与需求时间差值的比值的最大值，才能够杜绝停线情况的发生；

3).针对我们自己设计的任务四数据而言，我们通过对问题二结果的分析，可以看出任务四的数据中存在着任务一和任务二两种问题情况，因此我们不仅需要对任务四进行扩张工位存储空间方式，还需要加快拖车的行进速度。这样不仅可以解决问题三所带来的杜绝停线情形，而且还能提高整个流水线的工作效率，减小拖车执行派送任务时的工作时间。

**4.3.2.2求解过程**

本问题中的模型求解部分与问题二的模型求解步骤和原理完全相同。唯一存在不同地方在于已知参数数据的变化。

1).扩大工位的存储空间

扩大工位的存储空间，其本质就是消除拖车在工位上等待需求时间抵达的那部分原本浪费的时间，而导致的停线情况。因此在模型求解和算法编程过程中，无需考虑拖车等待时间参数影响。在计算总的停线时间时，可以直接运用拖车总的路径和拖车行进速度进行计算。在模型中和程序中抹除等待时间的干扰。

2).提高拖车的行进速度

提高拖车的行进速度，其本质在于消除因工位点之间距离过于远，而导致拖车无法在指定的需求时间之前抵达，而导致的停线情况。所以在模型的求解过程和算法编程中，只需要改变拖车行进速度的参数，对总的停线时间进行计算，消除因速度导致停线的影响。

3).同时提高速度与存储空间

同时改变这两个参数对停线情况的影响时，只需要同时改变算法和模型中这两个参数即可。因为在模型和算法中，拖车运行速度和工位存储空间之间没有直接的数学关系关联，所以可以直接对这两个参数进行修改，以更好地实现对停线情况的制约，完成拖车的派送方案。

**4.3.2.3结果分析**

1)结果呈现

**针对任务一**，我们通过提高它的工位存储容量，使拖车放完零件可以直接前往下一个工位点，无需等待，来减小停线情况的发生，具体的比较参数如下表所示：

表8 任务一拖车取件和配送顺序及停线时间

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 型号参数 | | | 原停线时间(*s*) | 扩大存储空间后停线时间(*s*) |
| 拖车编号 | 取件顺序 | 配送顺序 |
| 1 | 4-3-2-1 | 1-2-3-4 | 26 | 0 |
| 2 | 5-6-7-8 | 5-6-7-8 | 49.2 | 0 |

**针对任务三**，我们通过提高它的拖车行进速度，来减少停线情况的发生。将行进速度由5*m/s*逐步提升到光速。由图7可以观察到随着拖车速度的增长，停线时间呈现明显下降趋势。

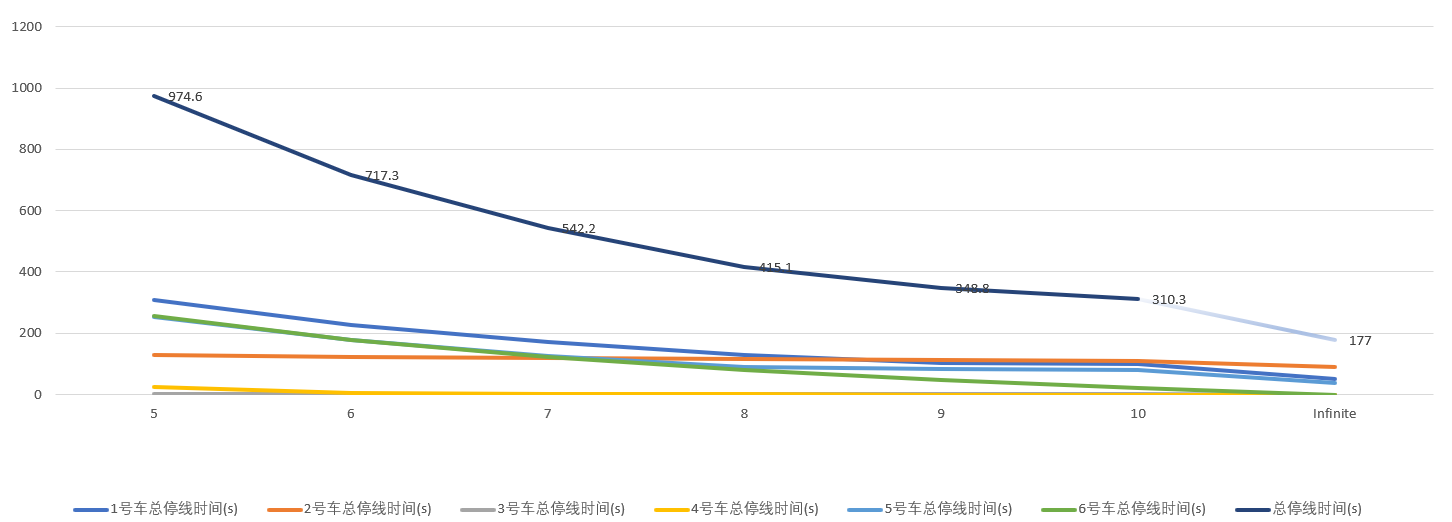


图7 任务三拖车停线时间趋势图

图表中最后一个属性值表示的数据是拖车行进速度接近无限大时的各拖车和总的停线时间。最后的趋势图呈现出来的是一个收敛的趋势。

**针对任务四**，我们使用三种改进方案，即提高拖车行进速度至6m/s，扩大工位存储空间和同时增大速度到6*m/s*、扩大空间存储的方式，来减少停线情况的发生，具体的比较参数表格如下所示：

表10 任务四拖车取件和配送顺序及停线时间

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 型号参数 | | | 原停线时间(*s*) | 提升速度后停线时间(*s*) |
| 拖车编号 | 取件顺序 | 配送顺序 |
| 1 | 15-20-19-16 | 20-15-16-19 | 41.4 | 27.7 |
| 2 | 9-3-4-1 | 9-3-4-1 | 23.2 | 8.5 |
| 3 | 7-13-12 | 7-12-13 | 36.9 | 14.3 |
| 4 | 17-8-21-11 | 17-21-11-8 | 41.5 | 20.8 |
| 5 | 2-6-18-22 | 6-2-18-22 | 45.2 | 12.7 |
|  |  |  |  |  |
| 拖车编号 | 取件顺序 | 配送顺序 | 扩大存储空间后停线时间(*s*) | 两种改进方式的停线时间(*s*) |
| 1 | 15-20-19-16 | 20-15-16-19 | 40.2 | 0 |
| 2 | 9-3-4-1 | 9-3-4-1 | 17.4 | 0 |
| 3 | 7-13-12 | 7-12-13 | 26.8 | 0 |
| 4 | 17-8-21-11 | 17-21-11-8 | 41.5 | 3.2 |
| 5 | 2-6-18-22 | 6-2-18-22 | 45.2 | 0 |

2)结果分析

从图七的结果中可以看出，在一定范围内，提高拖车的运行速度可以大大减少整条流水线的停线时间。但是，当拖车的运行速度已经较快时，继续提高拖车的运行速度，对流水线的停线时间影响较小。极限状态下，当速度趋向于光速，停线时间趋向于一个定值。

由此可以得出，拖车的运行速度并不是唯一制约流水线运行效率的因素，过分地提高拖车速度既无法实现，也存在着安全隐患。因此，我们改变了流水线的布局，使得工位旁有足够的存储空间，即拖车可以在需求时间前进行卸货。从任务四的停线时间可以看出，单独提升速度与单独扩大存储空间都能够减少一部分停线时间，二同时提升速度和扩大存储空间可以将停线时间几乎降至零。

五、模型的综合评价和推广

**5.1 模型的综合评价**

**5.1.1 模型的优点**

1).问题二与问题三的目标函数(func)符合实际情况，对反映方案的好坏能够发挥指导性作用；

2).问题三对工厂的构造和布局没有太大改变，具有现实指导意义；

3).选用的算法较为先进和复杂，时间复杂度较低。

**5.1.2 模型的缺点分析**

1).模型的假设太过于理想化，没有考虑车辆之间相互干扰造成的运输效率的下降；

2).模型没有考虑拖车负重对运输速率的影响，和实际情况有一定差距；

3).拖车的运动学模型较为粗糙，没有考虑车辆的变速。

**5.2模型的推广**

该题目所探讨、研究的问题与模型具有较强的普适性。在实际的流水线中，能够以此为基础计算生产线的物流效率，将现实物流系统中的效率短板暴露出来。

问题二的模型与现实情况较为贴合，需求任务在拖车运行过程中动态变化，拖车的运行路线也以此为基础动态变化，更符合现代化工业生产的要求。

整个数学模型和代码计算过程体系完整、严密，逻辑性强，对于物流运输的研究具有重要的作用和参考价值，满足当今社会的发展趋势，能够为工业生产的高效发展和进步贡献一定的力量。

六、参考文献

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附录

运行环境：  
C++ 版本：TDM-GCC 4.9.2 64-bit Release  
操作系统: Microsoft Windows 10 家庭中文版 Version 10.0 (Build 17134)   
Bit Server VM mixed mode

附录1：distance.cpp

该程序用于计算两点间的最短路径，优化计算。

#include<bits/stdc++.h>

using namespace std;

typedef long long ll;

const int INF=0x3f3f3f3f;

const long long mod=100000007;

const double e=2.718281828459045;

const double pi=3.1415926535;

#define CK cout<<"OK\n";

struct Point{

string name;

int rank;

Point(string s="\_",int x=0):name(s),rank(x){}

}p[100];

double dis[100][100];

int cnt;

void init(){

cnt=0;

for(int i=0;i<100;i++){

p[i].name="\_";

p[i].rank=-1;

}

for(int i=0;i<100;i++){

for(int j=0;j<100;j++)dis[i][j]=1000000;

}

}

int search\_point(string tar){

int r=-1;

for(int i=0;i<cnt;i++){

if(tar==p[i].name){

r=i;

break;

}

}

return r;

}

int main(){

freopen("distance\_in.txt","r",stdin);

freopen("distance\_out.txt","w",stdout);

int N;

init();

scanf("%d",&N);

for(int i=0;i<N;i++){

string s1,s2;

double tmp;

cin>>s1>>s2>>tmp;

int r1,r2;

r1=search\_point(s1);

if(r1==-1){

p[cnt].rank=cnt;

p[cnt].name=s1;

r1=cnt;

cnt++;

}

r2=search\_point(s2);

if(r2==-1){

p[cnt].rank=cnt;

p[cnt].name=s2;

r2=cnt;

cnt++;

}

dis[r1][r2]=tmp;

dis[r2][r1]=tmp;

}

for(int i=0;i<cnt;i++)for(int j=0;j<cnt;j++)for(int k=0;k<cnt;k++)

if(dis[j][k]>dis[j][i]+dis[i][k]){

dis[j][k]=dis[j][i]+dis[i][k];

dis[k][j]=dis[j][i]+dis[i][k];

}

printf("%d\n",cnt);

for(int i=0;i<cnt;i++){

cout<<p[i].name<<"\t";

}

printf("\n");

for(int i=0;i<cnt;i++){

for(int j=0;j<cnt;j++)printf("%.1lf\t",dis[i][j]);

printf("\n");

}

return 0;

}

附录2：integrated1.cpp

#include<bits/stdc++.h>

using namespace std;

typedef long long ll;

const int INF=0x3f3f3f3f;

const long long mod=100000007;

const double e=2.718281828459045;

const double pi=3.1415926535;

#define CK cout<<"OK\n";

struct Point{

string name;

int rank;

Point(string s="\_",int x=0):name(s),rank(x){}

}p[87];

double dis[87][87]={

40.0,20.0,40.0,60.0,80.0,100.0,100.0,120.0,140.0,160.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,120.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,150.0,221.5,201.5,181.5,161.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,281.5,291.5,311.5,331.5,351.5,291.5,200.0,271.5,160.0,180.0,200.0,220.0,251.5,263.0,283.0,303.0,323.0,291.5,311.5,331.5,351.5,160.0,170.0,180.0,190.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,190.0,210.0,230.0,250.0,210.0,230.0,250.0,270.0,220.0,240.0,260.0,280.0,

20.0,40.0,20.0,40.0,60.0,80.0,80.0,100.0,120.0,140.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,271.5,180.0,251.5,140.0,160.0,180.0,200.0,231.5,243.0,263.0,283.0,303.0,271.5,291.5,311.5,331.5,140.0,150.0,160.0,170.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,200.0,220.0,240.0,260.0,

40.0,20.0,40.0,20.0,40.0,60.0,60.0,80.0,100.0,120.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,80.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,251.5,160.0,231.5,120.0,140.0,160.0,180.0,211.5,223.0,243.0,263.0,283.0,251.5,271.5,291.5,311.5,120.0,130.0,140.0,150.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,180.0,200.0,220.0,240.0,

60.0,40.0,20.0,40.0,20.0,40.0,40.0,60.0,80.0,100.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,60.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,231.5,140.0,211.5,100.0,120.0,140.0,160.0,191.5,203.0,223.0,243.0,263.0,231.5,251.5,271.5,291.5,100.0,110.0,120.0,130.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,160.0,180.0,200.0,220.0,

80.0,60.0,40.0,20.0,40.0,20.0,20.0,40.0,60.0,80.0,100.0,80.0,60.0,40.0,40.0,60.0,80.0,100.0,40.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,70.0,141.5,121.5,101.5,81.5,161.5,171.5,191.5,211.5,231.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,211.5,120.0,191.5,80.0,100.0,120.0,140.0,171.5,183.0,203.0,223.0,243.0,211.5,231.5,251.5,271.5,80.0,90.0,100.0,110.0,90.0,110.0,130.0,150.0,110.0,130.0,150.0,170.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,140.0,160.0,180.0,200.0,

100.0,80.0,60.0,40.0,20.0,40.0,40.0,20.0,40.0,60.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,60.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,231.5,140.0,211.5,100.0,120.0,140.0,160.0,191.5,203.0,223.0,243.0,263.0,231.5,251.5,271.5,291.5,100.0,110.0,120.0,130.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,160.0,180.0,200.0,220.0,

100.0,80.0,60.0,40.0,20.0,40.0,40.0,60.0,80.0,100.0,80.0,60.0,40.0,20.0,20.0,40.0,60.0,80.0,20.0,100.0,80.0,60.0,40.0,40.0,60.0,80.0,100.0,50.0,121.5,101.5,81.5,61.5,141.5,151.5,171.5,191.5,211.5,161.5,171.5,191.5,211.5,231.5,181.5,191.5,211.5,231.5,251.5,191.5,100.0,171.5,60.0,80.0,100.0,120.0,151.5,163.0,183.0,203.0,223.0,191.5,211.5,231.5,251.5,60.0,70.0,80.0,90.0,70.0,90.0,110.0,130.0,90.0,110.0,130.0,150.0,90.0,110.0,130.0,150.0,110.0,130.0,150.0,170.0,120.0,140.0,160.0,180.0,

120.0,100.0,80.0,60.0,40.0,20.0,60.0,40.0,20.0,40.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,80.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,251.5,160.0,231.5,120.0,140.0,160.0,180.0,211.5,223.0,243.0,263.0,283.0,251.5,271.5,291.5,311.5,120.0,130.0,140.0,150.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,180.0,200.0,220.0,240.0,

140.0,120.0,100.0,80.0,60.0,40.0,80.0,20.0,40.0,20.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,271.5,180.0,251.5,140.0,160.0,180.0,200.0,231.5,243.0,263.0,283.0,303.0,271.5,291.5,311.5,331.5,140.0,150.0,160.0,170.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,200.0,220.0,240.0,260.0,

160.0,140.0,120.0,100.0,80.0,60.0,100.0,40.0,20.0,40.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,120.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,150.0,221.5,201.5,181.5,161.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,281.5,291.5,311.5,331.5,351.5,291.5,200.0,271.5,160.0,180.0,200.0,220.0,251.5,263.0,283.0,303.0,323.0,291.5,311.5,331.5,351.5,160.0,170.0,180.0,190.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,190.0,210.0,230.0,250.0,210.0,230.0,250.0,270.0,220.0,240.0,260.0,280.0,

180.0,160.0,140.0,120.0,100.0,120.0,80.0,140.0,160.0,180.0,40.0,20.0,40.0,60.0,100.0,120.0,140.0,160.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,271.5,180.0,251.5,140.0,160.0,180.0,200.0,231.5,243.0,263.0,283.0,303.0,271.5,291.5,311.5,331.5,140.0,150.0,160.0,170.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,200.0,220.0,240.0,260.0,

160.0,140.0,120.0,100.0,80.0,100.0,60.0,120.0,140.0,160.0,20.0,40.0,20.0,40.0,80.0,100.0,120.0,140.0,80.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,251.5,160.0,231.5,120.0,140.0,160.0,180.0,211.5,223.0,243.0,263.0,283.0,251.5,271.5,291.5,311.5,120.0,130.0,140.0,150.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,180.0,200.0,220.0,240.0,

140.0,120.0,100.0,80.0,60.0,80.0,40.0,100.0,120.0,140.0,40.0,20.0,40.0,20.0,60.0,80.0,100.0,120.0,60.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,231.5,140.0,211.5,100.0,120.0,140.0,160.0,191.5,203.0,223.0,243.0,263.0,231.5,251.5,271.5,291.5,100.0,110.0,120.0,130.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,160.0,180.0,200.0,220.0,

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190.0,170.0,150.0,130.0,110.0,130.0,90.0,150.0,170.0,190.0,170.0,150.0,130.0,110.0,110.0,130.0,150.0,170.0,70.0,150.0,130.0,110.0,90.0,90.0,110.0,130.0,150.0,40.0,111.5,91.5,71.5,51.5,131.5,141.5,161.5,181.5,201.5,151.5,161.5,181.5,201.5,221.5,131.5,141.5,161.5,181.5,201.5,121.5,30.0,141.5,50.0,70.0,90.0,110.0,141.5,153.0,173.0,193.0,213.0,161.5,181.5,201.5,221.5,30.0,20.0,10.0,20.0,40.0,60.0,80.0,100.0,40.0,60.0,80.0,100.0,20.0,20.0,40.0,60.0,40.0,60.0,80.0,100.0,50.0,70.0,90.0,110.0,

210.0,190.0,170.0,150.0,130.0,150.0,110.0,170.0,190.0,210.0,190.0,170.0,150.0,130.0,130.0,150.0,170.0,190.0,90.0,170.0,150.0,130.0,110.0,110.0,130.0,150.0,170.0,60.0,131.5,111.5,91.5,71.5,151.5,161.5,181.5,201.5,221.5,171.5,181.5,201.5,221.5,241.5,151.5,161.5,181.5,201.5,221.5,141.5,50.0,161.5,70.0,90.0,110.0,130.0,161.5,173.0,193.0,213.0,233.0,181.5,201.5,221.5,241.5,50.0,40.0,30.0,40.0,60.0,80.0,100.0,120.0,60.0,80.0,100.0,120.0,20.0,40.0,20.0,40.0,60.0,80.0,100.0,120.0,70.0,90.0,110.0,130.0,

230.0,210.0,190.0,170.0,150.0,170.0,130.0,190.0,210.0,230.0,210.0,190.0,170.0,150.0,150.0,170.0,190.0,210.0,110.0,190.0,170.0,150.0,130.0,130.0,150.0,170.0,190.0,80.0,151.5,131.5,111.5,91.5,171.5,181.5,201.5,221.5,241.5,191.5,201.5,221.5,241.5,261.5,171.5,181.5,201.5,221.5,241.5,161.5,70.0,181.5,90.0,110.0,130.0,150.0,181.5,193.0,213.0,233.0,253.0,201.5,221.5,241.5,261.5,70.0,60.0,50.0,60.0,80.0,100.0,120.0,140.0,80.0,100.0,120.0,140.0,40.0,20.0,40.0,20.0,80.0,100.0,120.0,140.0,90.0,110.0,130.0,150.0,

250.0,230.0,210.0,190.0,170.0,190.0,150.0,210.0,230.0,250.0,230.0,210.0,190.0,170.0,170.0,190.0,210.0,230.0,130.0,210.0,190.0,170.0,150.0,150.0,170.0,190.0,210.0,100.0,171.5,151.5,131.5,111.5,191.5,201.5,221.5,241.5,261.5,211.5,221.5,241.5,261.5,281.5,191.5,201.5,221.5,241.5,261.5,181.5,90.0,201.5,110.0,130.0,150.0,170.0,201.5,213.0,233.0,253.0,273.0,221.5,241.5,261.5,281.5,90.0,80.0,70.0,80.0,100.0,120.0,140.0,160.0,100.0,120.0,140.0,160.0,60.0,40.0,20.0,40.0,100.0,120.0,140.0,160.0,110.0,130.0,150.0,170.0,

210.0,190.0,170.0,150.0,130.0,150.0,110.0,170.0,190.0,210.0,190.0,170.0,150.0,130.0,130.0,150.0,170.0,190.0,90.0,170.0,150.0,130.0,110.0,110.0,130.0,150.0,170.0,60.0,131.5,111.5,91.5,71.5,151.5,161.5,181.5,201.5,221.5,151.5,161.5,181.5,201.5,221.5,131.5,141.5,161.5,181.5,201.5,121.5,30.0,141.5,70.0,90.0,110.0,130.0,161.5,173.0,193.0,213.0,233.0,161.5,181.5,201.5,221.5,50.0,40.0,30.0,20.0,60.0,80.0,100.0,120.0,60.0,80.0,100.0,120.0,40.0,60.0,80.0,100.0,40.0,20.0,40.0,60.0,50.0,70.0,90.0,110.0,

230.0,210.0,190.0,170.0,150.0,170.0,130.0,190.0,210.0,230.0,210.0,190.0,170.0,150.0,150.0,170.0,190.0,210.0,110.0,190.0,170.0,150.0,130.0,130.0,150.0,170.0,190.0,80.0,151.5,131.5,111.5,91.5,171.5,181.5,201.5,221.5,241.5,171.5,181.5,201.5,221.5,241.5,151.5,161.5,181.5,201.5,221.5,141.5,50.0,161.5,90.0,110.0,130.0,150.0,181.5,193.0,213.0,233.0,253.0,181.5,201.5,221.5,241.5,70.0,60.0,50.0,40.0,80.0,100.0,120.0,140.0,80.0,100.0,120.0,140.0,60.0,80.0,100.0,120.0,20.0,40.0,20.0,40.0,70.0,90.0,110.0,130.0,

250.0,230.0,210.0,190.0,170.0,190.0,150.0,210.0,230.0,250.0,230.0,210.0,190.0,170.0,170.0,190.0,210.0,230.0,130.0,210.0,190.0,170.0,150.0,150.0,170.0,190.0,210.0,100.0,171.5,151.5,131.5,111.5,191.5,201.5,221.5,241.5,261.5,191.5,201.5,221.5,241.5,261.5,171.5,181.5,201.5,221.5,241.5,161.5,70.0,181.5,110.0,130.0,150.0,170.0,201.5,213.0,233.0,253.0,273.0,201.5,221.5,241.5,261.5,90.0,80.0,70.0,60.0,100.0,120.0,140.0,160.0,100.0,120.0,140.0,160.0,80.0,100.0,120.0,140.0,40.0,20.0,40.0,20.0,90.0,110.0,130.0,150.0,

270.0,250.0,230.0,210.0,190.0,210.0,170.0,230.0,250.0,270.0,250.0,230.0,210.0,190.0,190.0,210.0,230.0,250.0,150.0,230.0,210.0,190.0,170.0,170.0,190.0,210.0,230.0,120.0,191.5,171.5,151.5,131.5,211.5,221.5,241.5,261.5,281.5,211.5,221.5,241.5,261.5,281.5,191.5,201.5,221.5,241.5,261.5,181.5,90.0,201.5,130.0,150.0,170.0,190.0,221.5,233.0,253.0,273.0,293.0,221.5,241.5,261.5,281.5,110.0,100.0,90.0,80.0,120.0,140.0,160.0,180.0,120.0,140.0,160.0,180.0,100.0,120.0,140.0,160.0,60.0,40.0,20.0,40.0,110.0,130.0,150.0,170.0,

220.0,200.0,180.0,160.0,140.0,160.0,120.0,180.0,200.0,220.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,70.0,141.5,121.5,101.5,81.5,161.5,171.5,191.5,211.5,231.5,141.5,151.5,171.5,191.5,211.5,121.5,131.5,151.5,171.5,191.5,111.5,20.0,131.5,80.0,100.0,120.0,140.0,151.5,163.0,183.0,203.0,223.0,151.5,171.5,191.5,211.5,60.0,50.0,40.0,30.0,70.0,90.0,110.0,130.0,70.0,90.0,110.0,130.0,50.0,70.0,90.0,110.0,50.0,70.0,90.0,110.0,40.0,20.0,40.0,60.0,

240.0,220.0,200.0,180.0,160.0,180.0,140.0,200.0,220.0,240.0,220.0,200.0,180.0,160.0,160.0,180.0,200.0,220.0,120.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,161.5,171.5,191.5,211.5,231.5,141.5,151.5,171.5,191.5,211.5,131.5,40.0,151.5,100.0,120.0,140.0,160.0,171.5,183.0,203.0,223.0,243.0,171.5,191.5,211.5,231.5,80.0,70.0,60.0,50.0,90.0,110.0,130.0,150.0,90.0,110.0,130.0,150.0,70.0,90.0,110.0,130.0,70.0,90.0,110.0,130.0,20.0,40.0,20.0,40.0,

260.0,240.0,220.0,200.0,180.0,200.0,160.0,220.0,240.0,260.0,240.0,220.0,200.0,180.0,180.0,200.0,220.0,240.0,140.0,220.0,200.0,180.0,160.0,160.0,180.0,200.0,220.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,181.5,191.5,211.5,231.5,251.5,161.5,171.5,191.5,211.5,231.5,151.5,60.0,171.5,120.0,140.0,160.0,180.0,191.5,203.0,223.0,243.0,263.0,191.5,211.5,231.5,251.5,100.0,90.0,80.0,70.0,110.0,130.0,150.0,170.0,110.0,130.0,150.0,170.0,90.0,110.0,130.0,150.0,90.0,110.0,130.0,150.0,40.0,20.0,40.0,20.0,

280.0,260.0,240.0,220.0,200.0,220.0,180.0,240.0,260.0,280.0,260.0,240.0,220.0,200.0,200.0,220.0,240.0,260.0,160.0,240.0,220.0,200.0,180.0,180.0,200.0,220.0,240.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,201.5,211.5,231.5,251.5,271.5,181.5,191.5,211.5,231.5,251.5,171.5,80.0,191.5,140.0,160.0,180.0,200.0,211.5,223.0,243.0,263.0,283.0,211.5,231.5,251.5,271.5,120.0,110.0,100.0,90.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,110.0,130.0,150.0,170.0,110.0,130.0,150.0,170.0,60.0,40.0,20.0,40.0

};

int N;

void init1(){

p[0].name="III-1";

p[0].rank=0;

p[1].name="III-2";

p[1].rank=1;

p[2].name="III-3";

p[2].rank=2;

p[3].name="III-4";

p[3].rank=3;

p[4].name="A";

p[4].rank=4;

p[5].name="III-5";

p[5].rank=5;

p[6].name="B";

p[6].rank=6;

p[7].name="III-6";

p[7].rank=7;

p[8].name="III-7";

p[8].rank=8;

p[9].name="III-8";

p[9].rank=9;

p[10].name="III-9";

p[10].rank=10;

p[11].name="III-10";

p[11].rank=11;

p[12].name="III-11";

p[12].rank=12;

p[13].name="III-12";

p[13].rank=13;

p[14].name="III-13";

p[14].rank=14;

p[15].name="III-14";

p[15].rank=15;

p[16].name="III-15";

p[16].rank=16;

p[17].name="III-16";

p[17].rank=17;

p[18].name="C";

p[18].rank=18;

p[19].name="III-17";

p[19].rank=19;

p[20].name="III-18";

p[20].rank=20;

p[21].name="III-19";

p[21].rank=21;

p[22].name="III-20";

p[22].rank=22;

p[23].name="III-21";

p[23].rank=23;

p[24].name="III-22";

p[24].rank=24;

p[25].name="III-23";

p[25].rank=25;

p[26].name="III-24";

p[26].rank=26;

p[27].name="D";

p[27].rank=27;

p[28].name="I-1";

p[28].rank=28;

p[29].name="I-2";

p[29].rank=29;

p[30].name="I-3";

p[30].rank=30;

p[31].name="I-4";

p[31].rank=31;

p[32].name="E";

p[32].rank=32;

p[33].name="I-5";

p[33].rank=33;

p[34].name="I-6";

p[34].rank=34;

p[35].name="I-7";

p[35].rank=35;

p[36].name="I-8";

p[36].rank=36;

p[37].name="I";

p[37].rank=37;

p[38].name="I-13";

p[38].rank=38;

p[39].name="I-14";

p[39].rank=39;

p[40].name="I-15";

p[40].rank=40;

p[41].name="I-16";

p[41].rank=41;

p[42].name="M";

p[42].rank=42;

p[43].name="I-21";

p[43].rank=43;

p[44].name="I-22";

p[44].rank=44;

p[45].name="I-23";

p[45].rank=45;

p[46].name="I-24";

p[46].rank=46;

p[47].name="O";

p[47].rank=47;

p[48].name="N";

p[48].rank=48;

p[49].name="L";

p[49].rank=49;

p[50].name="II-1";

p[50].rank=50;

p[51].name="II-2";

p[51].rank=51;

p[52].name="II-3";

p[52].rank=52;

p[53].name="II-4";

p[53].rank=53;

p[54].name="H";

p[54].rank=54;

p[55].name="II-12";

p[55].rank=55;

p[56].name="II-11";

p[56].rank=56;

p[57].name="II-10";

p[57].rank=57;

p[58].name="II-9";

p[58].rank=58;

p[59].name="II-20";

p[59].rank=59;

p[60].name="II-19";

p[60].rank=60;

p[61].name="II-18";

p[61].rank=61;

p[62].name="II-17";

p[62].rank=62;

p[63].name="F";

p[63].rank=63;

p[64].name="G";

p[64].rank=64;

p[65].name="J";

p[65].rank=65;

p[66].name="K";

p[66].rank=66;

p[67].name="II-5";

p[67].rank=67;

p[68].name="II-6";

p[68].rank=68;

p[69].name="II-7";

p[69].rank=69;

p[70].name="II-8";

p[70].rank=70;

p[71].name="I-12";

p[71].rank=71;

p[72].name="I-11";

p[72].rank=72;

p[73].name="I-10";

p[73].rank=73;

p[74].name="I-9";

p[74].rank=74;

p[75].name="II-13";

p[75].rank=75;

p[76].name="II-14";

p[76].rank=76;

p[77].name="II-15";

p[77].rank=77;

p[78].name="II-16";

p[78].rank=78;

p[79].name="I-20";

p[79].rank=79;

p[80].name="I-19";

p[80].rank=80;

p[81].name="I-18";

p[81].rank=81;

p[82].name="I-17";

p[82].rank=82;

p[83].name="II-21";

p[83].rank=83;

p[84].name="II-22";

p[84].rank=84;

p[85].name="II-23";

p[85].rank=85;

p[86].name="II-24";

p[86].rank=86;

N=87;

}

int search\_point(string tar){

int r=-1;

for(int i=0;i<N;i++){

if(tar==p[i].name){

r=i;

break;

}

}

return r;

}

struct Task{

string name;

double time;

friend bool operator<(const Task &x,const Task &y){

return x.time<y.time;

}

int rank;

}t[100];

int numT;

struct Car{

vector<int> task;

}c[10];

int numC;

void init(){

numT=0;

numC=0;

for(int i=0;i<9;i++){

c[i].task.clear();

}

}

int main(){

init1();

init();

freopen("task1\_in.txt","r",stdin);

freopen("task1\_out.txt","w",stdout);

cin>>numC>>numT;

for(int i=0;i<numT;i++){

cin>>t[i].rank>>t[i].name>>t[i].time;

}

sort(t,t+numT);

return 0;

}

附录3：t3.cpp

该程序用于第三题改变速度的计算。

#include<bits/stdc++.h>

using namespace std;

typedef long long ll;

const int INF=0x3f3f3f3f;

const long long mod=100000007;

const double e=2.718281828459045;

const double pi=3.1415926535;

#define CK cout<<"OK\n";

struct Point{

string name;

int rank;

Point(string s="\_",int x=0):name(s),rank(x){}

}p[87];

double dis[87][87]={

40.0,20.0,40.0,60.0,80.0,100.0,100.0,120.0,140.0,160.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,120.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,150.0,221.5,201.5,181.5,161.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,281.5,291.5,311.5,331.5,351.5,291.5,200.0,271.5,160.0,180.0,200.0,220.0,251.5,263.0,283.0,303.0,323.0,291.5,311.5,331.5,351.5,160.0,170.0,180.0,190.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,190.0,210.0,230.0,250.0,210.0,230.0,250.0,270.0,220.0,240.0,260.0,280.0,

20.0,40.0,20.0,40.0,60.0,80.0,80.0,100.0,120.0,140.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,271.5,180.0,251.5,140.0,160.0,180.0,200.0,231.5,243.0,263.0,283.0,303.0,271.5,291.5,311.5,331.5,140.0,150.0,160.0,170.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,200.0,220.0,240.0,260.0,

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};

int N;

void init1(){

p[0].name="III-1";

p[0].rank=0;

p[1].name="III-2";

p[1].rank=1;

p[2].name="III-3";

p[2].rank=2;

p[3].name="III-4";

p[3].rank=3;

p[4].name="A";

p[4].rank=4;

p[5].name="III-5";

p[5].rank=5;

p[6].name="B";

p[6].rank=6;

p[7].name="III-6";

p[7].rank=7;

p[8].name="III-7";

p[8].rank=8;

p[9].name="III-8";

p[9].rank=9;

p[10].name="III-9";

p[10].rank=10;

p[11].name="III-10";

p[11].rank=11;

p[12].name="III-11";

p[12].rank=12;

p[13].name="III-12";

p[13].rank=13;

p[14].name="III-13";

p[14].rank=14;

p[15].name="III-14";

p[15].rank=15;

p[16].name="III-15";

p[16].rank=16;

p[17].name="III-16";

p[17].rank=17;

p[18].name="C";

p[18].rank=18;

p[19].name="III-17";

p[19].rank=19;

p[20].name="III-18";

p[20].rank=20;

p[21].name="III-19";

p[21].rank=21;

p[22].name="III-20";

p[22].rank=22;

p[23].name="III-21";

p[23].rank=23;

p[24].name="III-22";

p[24].rank=24;

p[25].name="III-23";

p[25].rank=25;

p[26].name="III-24";

p[26].rank=26;

p[27].name="D";

p[27].rank=27;

p[28].name="I-1";

p[28].rank=28;

p[29].name="I-2";

p[29].rank=29;

p[30].name="I-3";

p[30].rank=30;

p[31].name="I-4";

p[31].rank=31;

p[32].name="E";

p[32].rank=32;

p[33].name="I-5";

p[33].rank=33;

p[34].name="I-6";

p[34].rank=34;

p[35].name="I-7";

p[35].rank=35;

p[36].name="I-8";

p[36].rank=36;

p[37].name="I";

p[37].rank=37;

p[38].name="I-13";

p[38].rank=38;

p[39].name="I-14";

p[39].rank=39;

p[40].name="I-15";

p[40].rank=40;

p[41].name="I-16";

p[41].rank=41;

p[42].name="M";

p[42].rank=42;

p[43].name="I-21";

p[43].rank=43;

p[44].name="I-22";

p[44].rank=44;

p[45].name="I-23";

p[45].rank=45;

p[46].name="I-24";

p[46].rank=46;

p[47].name="O";

p[47].rank=47;

p[48].name="N";

p[48].rank=48;

p[49].name="L";

p[49].rank=49;

p[50].name="II-1";

p[50].rank=50;

p[51].name="II-2";

p[51].rank=51;

p[52].name="II-3";

p[52].rank=52;

p[53].name="II-4";

p[53].rank=53;

p[54].name="H";

p[54].rank=54;

p[55].name="II-12";

p[55].rank=55;

p[56].name="II-11";

p[56].rank=56;

p[57].name="II-10";

p[57].rank=57;

p[58].name="II-9";

p[58].rank=58;

p[59].name="II-20";

p[59].rank=59;

p[60].name="II-19";

p[60].rank=60;

p[61].name="II-18";

p[61].rank=61;

p[62].name="II-17";

p[62].rank=62;

p[63].name="F";

p[63].rank=63;

p[64].name="G";

p[64].rank=64;

p[65].name="J";

p[65].rank=65;

p[66].name="K";

p[66].rank=66;

p[67].name="II-5";

p[67].rank=67;

p[68].name="II-6";

p[68].rank=68;

p[69].name="II-7";

p[69].rank=69;

p[70].name="II-8";

p[70].rank=70;

p[71].name="I-12";

p[71].rank=71;

p[72].name="I-11";

p[72].rank=72;

p[73].name="I-10";

p[73].rank=73;

p[74].name="I-9";

p[74].rank=74;

p[75].name="II-13";

p[75].rank=75;

p[76].name="II-14";

p[76].rank=76;

p[77].name="II-15";

p[77].rank=77;

p[78].name="II-16";

p[78].rank=78;

p[79].name="I-20";

p[79].rank=79;

p[80].name="I-19";

p[80].rank=80;

p[81].name="I-18";

p[81].rank=81;

p[82].name="I-17";

p[82].rank=82;

p[83].name="II-21";

p[83].rank=83;

p[84].name="II-22";

p[84].rank=84;

p[85].name="II-23";

p[85].rank=85;

p[86].name="II-24";

p[86].rank=86;

N=87;

}

int search\_point(string tar){

int r=-1;

for(int i=0;i<N;i++){

if(tar==p[i].name){

r=i;

break;

}

}

return r;

}

int main(){

init1();

double v=5;

freopen("t3\_in.txt","r",stdin);

freopen("t3\_out.txt","w",stdout);

for(;v<=10;v+=0.1){

for(int I=0;I<6;I++){

int num;

cin>>num;

int r[10];

r[0]=search\_point("D");

for(int i=1;i<=num;i++){

string tar;

cin>>tar;

r[i]=search\_point(tar);

}

double pre=0,real\_pre; //real pre表示实际上倒达d的时间（由于速度改变，到达d的时间也会改变）

double W=0;

double b[10];

cin>>pre;

real\_pre=(pre-3\*num)\*5/v+3\*num;

pre=real\_pre;

double a[10];

for(int i=1;i<=num;i++){

cin>>a[i];

}

b[0]=pre-3;

for(int i=1;i<=num;i++){

b[i]=b[i-1]+3+dis[ r[i] ][ r[i-1] ]/v;

if(b[i]<a[i])b[i]=a[i]; //无法贮存

W+=b[i]-a[i];

}

for(int i=1;i<=num;i++){

printf("%.1lf\t",b[i]);

}

cout<<"\n";

printf("%.1lf\n\n\n",W);

}

printf("-------------------------------\n");

}

return 0;

}

附录4：task1.cpp

该程序用于第三题计算任务一。

#include<bits/stdc++.h>

using namespace std;

typedef long long ll;

const int INF=0x3f3f3f3f;

const long long mod=100000007;

const double e=2.718281828459045;

const double pi=3.1415926535;

#define CK cout<<"OK\n";

struct Point{

string name;

int rank;

Point(string s="\_",int x=0):name(s),rank(x){}

}p[87];

double dis[87][87]={

40.0,20.0,40.0,60.0,80.0,100.0,100.0,120.0,140.0,160.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,120.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,150.0,221.5,201.5,181.5,161.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,281.5,291.5,311.5,331.5,351.5,291.5,200.0,271.5,160.0,180.0,200.0,220.0,251.5,263.0,283.0,303.0,323.0,291.5,311.5,331.5,351.5,160.0,170.0,180.0,190.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,190.0,210.0,230.0,250.0,210.0,230.0,250.0,270.0,220.0,240.0,260.0,280.0,

20.0,40.0,20.0,40.0,60.0,80.0,80.0,100.0,120.0,140.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,271.5,180.0,251.5,140.0,160.0,180.0,200.0,231.5,243.0,263.0,283.0,303.0,271.5,291.5,311.5,331.5,140.0,150.0,160.0,170.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,200.0,220.0,240.0,260.0,

40.0,20.0,40.0,20.0,40.0,60.0,60.0,80.0,100.0,120.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,80.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,251.5,160.0,231.5,120.0,140.0,160.0,180.0,211.5,223.0,243.0,263.0,283.0,251.5,271.5,291.5,311.5,120.0,130.0,140.0,150.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,180.0,200.0,220.0,240.0,

60.0,40.0,20.0,40.0,20.0,40.0,40.0,60.0,80.0,100.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,60.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,231.5,140.0,211.5,100.0,120.0,140.0,160.0,191.5,203.0,223.0,243.0,263.0,231.5,251.5,271.5,291.5,100.0,110.0,120.0,130.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,160.0,180.0,200.0,220.0,

80.0,60.0,40.0,20.0,40.0,20.0,20.0,40.0,60.0,80.0,100.0,80.0,60.0,40.0,40.0,60.0,80.0,100.0,40.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,70.0,141.5,121.5,101.5,81.5,161.5,171.5,191.5,211.5,231.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,211.5,120.0,191.5,80.0,100.0,120.0,140.0,171.5,183.0,203.0,223.0,243.0,211.5,231.5,251.5,271.5,80.0,90.0,100.0,110.0,90.0,110.0,130.0,150.0,110.0,130.0,150.0,170.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,140.0,160.0,180.0,200.0,

100.0,80.0,60.0,40.0,20.0,40.0,40.0,20.0,40.0,60.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,60.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,231.5,140.0,211.5,100.0,120.0,140.0,160.0,191.5,203.0,223.0,243.0,263.0,231.5,251.5,271.5,291.5,100.0,110.0,120.0,130.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,160.0,180.0,200.0,220.0,

100.0,80.0,60.0,40.0,20.0,40.0,40.0,60.0,80.0,100.0,80.0,60.0,40.0,20.0,20.0,40.0,60.0,80.0,20.0,100.0,80.0,60.0,40.0,40.0,60.0,80.0,100.0,50.0,121.5,101.5,81.5,61.5,141.5,151.5,171.5,191.5,211.5,161.5,171.5,191.5,211.5,231.5,181.5,191.5,211.5,231.5,251.5,191.5,100.0,171.5,60.0,80.0,100.0,120.0,151.5,163.0,183.0,203.0,223.0,191.5,211.5,231.5,251.5,60.0,70.0,80.0,90.0,70.0,90.0,110.0,130.0,90.0,110.0,130.0,150.0,90.0,110.0,130.0,150.0,110.0,130.0,150.0,170.0,120.0,140.0,160.0,180.0,

120.0,100.0,80.0,60.0,40.0,20.0,60.0,40.0,20.0,40.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,80.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,251.5,160.0,231.5,120.0,140.0,160.0,180.0,211.5,223.0,243.0,263.0,283.0,251.5,271.5,291.5,311.5,120.0,130.0,140.0,150.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,180.0,200.0,220.0,240.0,

140.0,120.0,100.0,80.0,60.0,40.0,80.0,20.0,40.0,20.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,271.5,180.0,251.5,140.0,160.0,180.0,200.0,231.5,243.0,263.0,283.0,303.0,271.5,291.5,311.5,331.5,140.0,150.0,160.0,170.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,200.0,220.0,240.0,260.0,

160.0,140.0,120.0,100.0,80.0,60.0,100.0,40.0,20.0,40.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,120.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,150.0,221.5,201.5,181.5,161.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,281.5,291.5,311.5,331.5,351.5,291.5,200.0,271.5,160.0,180.0,200.0,220.0,251.5,263.0,283.0,303.0,323.0,291.5,311.5,331.5,351.5,160.0,170.0,180.0,190.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,190.0,210.0,230.0,250.0,210.0,230.0,250.0,270.0,220.0,240.0,260.0,280.0,

180.0,160.0,140.0,120.0,100.0,120.0,80.0,140.0,160.0,180.0,40.0,20.0,40.0,60.0,100.0,120.0,140.0,160.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,271.5,180.0,251.5,140.0,160.0,180.0,200.0,231.5,243.0,263.0,283.0,303.0,271.5,291.5,311.5,331.5,140.0,150.0,160.0,170.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,200.0,220.0,240.0,260.0,

160.0,140.0,120.0,100.0,80.0,100.0,60.0,120.0,140.0,160.0,20.0,40.0,20.0,40.0,80.0,100.0,120.0,140.0,80.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,251.5,160.0,231.5,120.0,140.0,160.0,180.0,211.5,223.0,243.0,263.0,283.0,251.5,271.5,291.5,311.5,120.0,130.0,140.0,150.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,180.0,200.0,220.0,240.0,

140.0,120.0,100.0,80.0,60.0,80.0,40.0,100.0,120.0,140.0,40.0,20.0,40.0,20.0,60.0,80.0,100.0,120.0,60.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,231.5,140.0,211.5,100.0,120.0,140.0,160.0,191.5,203.0,223.0,243.0,263.0,231.5,251.5,271.5,291.5,100.0,110.0,120.0,130.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,160.0,180.0,200.0,220.0,

120.0,100.0,80.0,60.0,40.0,60.0,20.0,80.0,100.0,120.0,60.0,40.0,20.0,40.0,40.0,60.0,80.0,100.0,40.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,70.0,141.5,121.5,101.5,81.5,161.5,171.5,191.5,211.5,231.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,211.5,120.0,191.5,80.0,100.0,120.0,140.0,171.5,183.0,203.0,223.0,243.0,211.5,231.5,251.5,271.5,80.0,90.0,100.0,110.0,90.0,110.0,130.0,150.0,110.0,130.0,150.0,170.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,140.0,160.0,180.0,200.0,

120.0,100.0,80.0,60.0,40.0,60.0,20.0,80.0,100.0,120.0,100.0,80.0,60.0,40.0,40.0,20.0,40.0,60.0,40.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,70.0,141.5,121.5,101.5,81.5,161.5,171.5,191.5,211.5,231.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,211.5,120.0,191.5,80.0,100.0,120.0,140.0,171.5,183.0,203.0,223.0,243.0,211.5,231.5,251.5,271.5,80.0,90.0,100.0,110.0,90.0,110.0,130.0,150.0,110.0,130.0,150.0,170.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,140.0,160.0,180.0,200.0,

140.0,120.0,100.0,80.0,60.0,80.0,40.0,100.0,120.0,140.0,120.0,100.0,80.0,60.0,20.0,40.0,20.0,40.0,60.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,231.5,140.0,211.5,100.0,120.0,140.0,160.0,191.5,203.0,223.0,243.0,263.0,231.5,251.5,271.5,291.5,100.0,110.0,120.0,130.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,160.0,180.0,200.0,220.0,

160.0,140.0,120.0,100.0,80.0,100.0,60.0,120.0,140.0,160.0,140.0,120.0,100.0,80.0,40.0,20.0,40.0,20.0,80.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,251.5,160.0,231.5,120.0,140.0,160.0,180.0,211.5,223.0,243.0,263.0,283.0,251.5,271.5,291.5,311.5,120.0,130.0,140.0,150.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,180.0,200.0,220.0,240.0,

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250.0,230.0,210.0,190.0,170.0,190.0,150.0,210.0,230.0,250.0,230.0,210.0,190.0,170.0,170.0,190.0,210.0,230.0,130.0,210.0,190.0,170.0,150.0,150.0,170.0,190.0,210.0,100.0,171.5,151.5,131.5,111.5,191.5,201.5,221.5,241.5,261.5,211.5,221.5,241.5,261.5,281.5,191.5,201.5,221.5,241.5,261.5,181.5,90.0,201.5,110.0,130.0,150.0,170.0,201.5,213.0,233.0,253.0,273.0,221.5,241.5,261.5,281.5,90.0,80.0,70.0,80.0,100.0,120.0,140.0,160.0,100.0,120.0,140.0,160.0,60.0,40.0,20.0,40.0,100.0,120.0,140.0,160.0,110.0,130.0,150.0,170.0,

210.0,190.0,170.0,150.0,130.0,150.0,110.0,170.0,190.0,210.0,190.0,170.0,150.0,130.0,130.0,150.0,170.0,190.0,90.0,170.0,150.0,130.0,110.0,110.0,130.0,150.0,170.0,60.0,131.5,111.5,91.5,71.5,151.5,161.5,181.5,201.5,221.5,151.5,161.5,181.5,201.5,221.5,131.5,141.5,161.5,181.5,201.5,121.5,30.0,141.5,70.0,90.0,110.0,130.0,161.5,173.0,193.0,213.0,233.0,161.5,181.5,201.5,221.5,50.0,40.0,30.0,20.0,60.0,80.0,100.0,120.0,60.0,80.0,100.0,120.0,40.0,60.0,80.0,100.0,40.0,20.0,40.0,60.0,50.0,70.0,90.0,110.0,

230.0,210.0,190.0,170.0,150.0,170.0,130.0,190.0,210.0,230.0,210.0,190.0,170.0,150.0,150.0,170.0,190.0,210.0,110.0,190.0,170.0,150.0,130.0,130.0,150.0,170.0,190.0,80.0,151.5,131.5,111.5,91.5,171.5,181.5,201.5,221.5,241.5,171.5,181.5,201.5,221.5,241.5,151.5,161.5,181.5,201.5,221.5,141.5,50.0,161.5,90.0,110.0,130.0,150.0,181.5,193.0,213.0,233.0,253.0,181.5,201.5,221.5,241.5,70.0,60.0,50.0,40.0,80.0,100.0,120.0,140.0,80.0,100.0,120.0,140.0,60.0,80.0,100.0,120.0,20.0,40.0,20.0,40.0,70.0,90.0,110.0,130.0,

250.0,230.0,210.0,190.0,170.0,190.0,150.0,210.0,230.0,250.0,230.0,210.0,190.0,170.0,170.0,190.0,210.0,230.0,130.0,210.0,190.0,170.0,150.0,150.0,170.0,190.0,210.0,100.0,171.5,151.5,131.5,111.5,191.5,201.5,221.5,241.5,261.5,191.5,201.5,221.5,241.5,261.5,171.5,181.5,201.5,221.5,241.5,161.5,70.0,181.5,110.0,130.0,150.0,170.0,201.5,213.0,233.0,253.0,273.0,201.5,221.5,241.5,261.5,90.0,80.0,70.0,60.0,100.0,120.0,140.0,160.0,100.0,120.0,140.0,160.0,80.0,100.0,120.0,140.0,40.0,20.0,40.0,20.0,90.0,110.0,130.0,150.0,

270.0,250.0,230.0,210.0,190.0,210.0,170.0,230.0,250.0,270.0,250.0,230.0,210.0,190.0,190.0,210.0,230.0,250.0,150.0,230.0,210.0,190.0,170.0,170.0,190.0,210.0,230.0,120.0,191.5,171.5,151.5,131.5,211.5,221.5,241.5,261.5,281.5,211.5,221.5,241.5,261.5,281.5,191.5,201.5,221.5,241.5,261.5,181.5,90.0,201.5,130.0,150.0,170.0,190.0,221.5,233.0,253.0,273.0,293.0,221.5,241.5,261.5,281.5,110.0,100.0,90.0,80.0,120.0,140.0,160.0,180.0,120.0,140.0,160.0,180.0,100.0,120.0,140.0,160.0,60.0,40.0,20.0,40.0,110.0,130.0,150.0,170.0,

220.0,200.0,180.0,160.0,140.0,160.0,120.0,180.0,200.0,220.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,70.0,141.5,121.5,101.5,81.5,161.5,171.5,191.5,211.5,231.5,141.5,151.5,171.5,191.5,211.5,121.5,131.5,151.5,171.5,191.5,111.5,20.0,131.5,80.0,100.0,120.0,140.0,151.5,163.0,183.0,203.0,223.0,151.5,171.5,191.5,211.5,60.0,50.0,40.0,30.0,70.0,90.0,110.0,130.0,70.0,90.0,110.0,130.0,50.0,70.0,90.0,110.0,50.0,70.0,90.0,110.0,40.0,20.0,40.0,60.0,

240.0,220.0,200.0,180.0,160.0,180.0,140.0,200.0,220.0,240.0,220.0,200.0,180.0,160.0,160.0,180.0,200.0,220.0,120.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,161.5,171.5,191.5,211.5,231.5,141.5,151.5,171.5,191.5,211.5,131.5,40.0,151.5,100.0,120.0,140.0,160.0,171.5,183.0,203.0,223.0,243.0,171.5,191.5,211.5,231.5,80.0,70.0,60.0,50.0,90.0,110.0,130.0,150.0,90.0,110.0,130.0,150.0,70.0,90.0,110.0,130.0,70.0,90.0,110.0,130.0,20.0,40.0,20.0,40.0,

260.0,240.0,220.0,200.0,180.0,200.0,160.0,220.0,240.0,260.0,240.0,220.0,200.0,180.0,180.0,200.0,220.0,240.0,140.0,220.0,200.0,180.0,160.0,160.0,180.0,200.0,220.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,181.5,191.5,211.5,231.5,251.5,161.5,171.5,191.5,211.5,231.5,151.5,60.0,171.5,120.0,140.0,160.0,180.0,191.5,203.0,223.0,243.0,263.0,191.5,211.5,231.5,251.5,100.0,90.0,80.0,70.0,110.0,130.0,150.0,170.0,110.0,130.0,150.0,170.0,90.0,110.0,130.0,150.0,90.0,110.0,130.0,150.0,40.0,20.0,40.0,20.0,

280.0,260.0,240.0,220.0,200.0,220.0,180.0,240.0,260.0,280.0,260.0,240.0,220.0,200.0,200.0,220.0,240.0,260.0,160.0,240.0,220.0,200.0,180.0,180.0,200.0,220.0,240.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,201.5,211.5,231.5,251.5,271.5,181.5,191.5,211.5,231.5,251.5,171.5,80.0,191.5,140.0,160.0,180.0,200.0,211.5,223.0,243.0,263.0,283.0,211.5,231.5,251.5,271.5,120.0,110.0,100.0,90.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,110.0,130.0,150.0,170.0,110.0,130.0,150.0,170.0,60.0,40.0,20.0,40.0

};

int N;

void init1(){

p[0].name="III-1";

p[0].rank=0;

p[1].name="III-2";

p[1].rank=1;

p[2].name="III-3";

p[2].rank=2;

p[3].name="III-4";

p[3].rank=3;

p[4].name="A";

p[4].rank=4;

p[5].name="III-5";

p[5].rank=5;

p[6].name="B";

p[6].rank=6;

p[7].name="III-6";

p[7].rank=7;

p[8].name="III-7";

p[8].rank=8;

p[9].name="III-8";

p[9].rank=9;

p[10].name="III-9";

p[10].rank=10;

p[11].name="III-10";

p[11].rank=11;

p[12].name="III-11";

p[12].rank=12;

p[13].name="III-12";

p[13].rank=13;

p[14].name="III-13";

p[14].rank=14;

p[15].name="III-14";

p[15].rank=15;

p[16].name="III-15";

p[16].rank=16;

p[17].name="III-16";

p[17].rank=17;

p[18].name="C";

p[18].rank=18;

p[19].name="III-17";

p[19].rank=19;

p[20].name="III-18";

p[20].rank=20;

p[21].name="III-19";

p[21].rank=21;

p[22].name="III-20";

p[22].rank=22;

p[23].name="III-21";

p[23].rank=23;

p[24].name="III-22";

p[24].rank=24;

p[25].name="III-23";

p[25].rank=25;

p[26].name="III-24";

p[26].rank=26;

p[27].name="D";

p[27].rank=27;

p[28].name="I-1";

p[28].rank=28;

p[29].name="I-2";

p[29].rank=29;

p[30].name="I-3";

p[30].rank=30;

p[31].name="I-4";

p[31].rank=31;

p[32].name="E";

p[32].rank=32;

p[33].name="I-5";

p[33].rank=33;

p[34].name="I-6";

p[34].rank=34;

p[35].name="I-7";

p[35].rank=35;

p[36].name="I-8";

p[36].rank=36;

p[37].name="I";

p[37].rank=37;

p[38].name="I-13";

p[38].rank=38;

p[39].name="I-14";

p[39].rank=39;

p[40].name="I-15";

p[40].rank=40;

p[41].name="I-16";

p[41].rank=41;

p[42].name="M";

p[42].rank=42;

p[43].name="I-21";

p[43].rank=43;

p[44].name="I-22";

p[44].rank=44;

p[45].name="I-23";

p[45].rank=45;

p[46].name="I-24";

p[46].rank=46;

p[47].name="O";

p[47].rank=47;

p[48].name="N";

p[48].rank=48;

p[49].name="L";

p[49].rank=49;

p[50].name="II-1";

p[50].rank=50;

p[51].name="II-2";

p[51].rank=51;

p[52].name="II-3";

p[52].rank=52;

p[53].name="II-4";

p[53].rank=53;

p[54].name="H";

p[54].rank=54;

p[55].name="II-12";

p[55].rank=55;

p[56].name="II-11";

p[56].rank=56;

p[57].name="II-10";

p[57].rank=57;

p[58].name="II-9";

p[58].rank=58;

p[59].name="II-20";

p[59].rank=59;

p[60].name="II-19";

p[60].rank=60;

p[61].name="II-18";

p[61].rank=61;

p[62].name="II-17";

p[62].rank=62;

p[63].name="F";

p[63].rank=63;

p[64].name="G";

p[64].rank=64;

p[65].name="J";

p[65].rank=65;

p[66].name="K";

p[66].rank=66;

p[67].name="II-5";

p[67].rank=67;

p[68].name="II-6";

p[68].rank=68;

p[69].name="II-7";

p[69].rank=69;

p[70].name="II-8";

p[70].rank=70;

p[71].name="I-12";

p[71].rank=71;

p[72].name="I-11";

p[72].rank=72;

p[73].name="I-10";

p[73].rank=73;

p[74].name="I-9";

p[74].rank=74;

p[75].name="II-13";

p[75].rank=75;

p[76].name="II-14";

p[76].rank=76;

p[77].name="II-15";

p[77].rank=77;

p[78].name="II-16";

p[78].rank=78;

p[79].name="I-20";

p[79].rank=79;

p[80].name="I-19";

p[80].rank=80;

p[81].name="I-18";

p[81].rank=81;

p[82].name="I-17";

p[82].rank=82;

p[83].name="II-21";

p[83].rank=83;

p[84].name="II-22";

p[84].rank=84;

p[85].name="II-23";

p[85].rank=85;

p[86].name="II-24";

p[86].rank=86;

N=87;

}

//输入点的名字，找编号

int search\_point(string tar){

int r=-1;

for(int i=0;i<N;i++){

if(tar==p[i].name){

r=i;

break;

}

}

return r;

}

struct Task{

string name;

double time;

friend bool operator<(const Task &x,const Task &y){

return x.time<y.time;

}

//按时间排序

int rank;

}t[100];

int numT;

struct Car{

vector<int> task;

//表示其任务编号

double w;

//表示其已经浪费的时间

Car(vector<int> TASK,double W):task(TASK),w(W){}

}c[10];

int numC;

//车的数量

//初始化

void init(){

numT=0;

numC=0;

for(int i=0;i<9;i++){

c[i].task.clear();

w=0;

}

}

//测试某一辆车将要造成的停线时间

double test\_time(Car C){

}

int main(){

init1();

init();

freopen("task1\_in.txt","r",stdin);

// freopen("task1\_out.txt","w",stdout);

cin>>numC>>numT;

for(int i=0;i<numT;i++){

cin>>t[i].rank>>t[i].name>>t[i].time;

}

sort(t,t+numT);

return 0;

}

附录5：第三题.cpp

该程序用于计算第三题改变存储情况下的数据改变量。

#include<bits/stdc++.h>

using namespace std;

typedef long long ll;

const int INF=0x3f3f3f3f;

const long long mod=100000007;

const double e=2.718281828459045;

const double pi=3.1415926535;

#define CK cout<<"OK\n";

struct Point{

string name;

int rank;

Point(string s="\_",int x=0):name(s),rank(x){}

}p[87];

double dis[87][87]={

40.0,20.0,40.0,60.0,80.0,100.0,100.0,120.0,140.0,160.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,120.0,200.0,180.0,160.0,140.0,140.0,160.0,180.0,200.0,150.0,221.5,201.5,181.5,161.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,281.5,291.5,311.5,331.5,351.5,291.5,200.0,271.5,160.0,180.0,200.0,220.0,251.5,263.0,283.0,303.0,323.0,291.5,311.5,331.5,351.5,160.0,170.0,180.0,190.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,190.0,210.0,230.0,250.0,210.0,230.0,250.0,270.0,220.0,240.0,260.0,280.0,

20.0,40.0,20.0,40.0,60.0,80.0,80.0,100.0,120.0,140.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,100.0,180.0,160.0,140.0,120.0,120.0,140.0,160.0,180.0,130.0,201.5,181.5,161.5,141.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,261.5,271.5,291.5,311.5,331.5,271.5,180.0,251.5,140.0,160.0,180.0,200.0,231.5,243.0,263.0,283.0,303.0,271.5,291.5,311.5,331.5,140.0,150.0,160.0,170.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,170.0,190.0,210.0,230.0,190.0,210.0,230.0,250.0,200.0,220.0,240.0,260.0,

40.0,20.0,40.0,20.0,40.0,60.0,60.0,80.0,100.0,120.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,80.0,160.0,140.0,120.0,100.0,100.0,120.0,140.0,160.0,110.0,181.5,161.5,141.5,121.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,241.5,251.5,271.5,291.5,311.5,251.5,160.0,231.5,120.0,140.0,160.0,180.0,211.5,223.0,243.0,263.0,283.0,251.5,271.5,291.5,311.5,120.0,130.0,140.0,150.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,150.0,170.0,190.0,210.0,170.0,190.0,210.0,230.0,180.0,200.0,220.0,240.0,

60.0,40.0,20.0,40.0,20.0,40.0,40.0,60.0,80.0,100.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,60.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,231.5,140.0,211.5,100.0,120.0,140.0,160.0,191.5,203.0,223.0,243.0,263.0,231.5,251.5,271.5,291.5,100.0,110.0,120.0,130.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,160.0,180.0,200.0,220.0,

80.0,60.0,40.0,20.0,40.0,20.0,20.0,40.0,60.0,80.0,100.0,80.0,60.0,40.0,40.0,60.0,80.0,100.0,40.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,70.0,141.5,121.5,101.5,81.5,161.5,171.5,191.5,211.5,231.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,211.5,120.0,191.5,80.0,100.0,120.0,140.0,171.5,183.0,203.0,223.0,243.0,211.5,231.5,251.5,271.5,80.0,90.0,100.0,110.0,90.0,110.0,130.0,150.0,110.0,130.0,150.0,170.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,140.0,160.0,180.0,200.0,

100.0,80.0,60.0,40.0,20.0,40.0,40.0,20.0,40.0,60.0,120.0,100.0,80.0,60.0,60.0,80.0,100.0,120.0,60.0,140.0,120.0,100.0,80.0,80.0,100.0,120.0,140.0,90.0,161.5,141.5,121.5,101.5,181.5,191.5,211.5,231.5,251.5,201.5,211.5,231.5,251.5,271.5,221.5,231.5,251.5,271.5,291.5,231.5,140.0,211.5,100.0,120.0,140.0,160.0,191.5,203.0,223.0,243.0,263.0,231.5,251.5,271.5,291.5,100.0,110.0,120.0,130.0,110.0,130.0,150.0,170.0,130.0,150.0,170.0,190.0,130.0,150.0,170.0,190.0,150.0,170.0,190.0,210.0,160.0,180.0,200.0,220.0,

100.0,80.0,60.0,40.0,20.0,40.0,40.0,60.0,80.0,100.0,80.0,60.0,40.0,20.0,20.0,40.0,60.0,80.0,20.0,100.0,80.0,60.0,40.0,40.0,60.0,80.0,100.0,50.0,121.5,101.5,81.5,61.5,141.5,151.5,171.5,191.5,211.5,161.5,171.5,191.5,211.5,231.5,181.5,191.5,211.5,231.5,251.5,191.5,100.0,171.5,60.0,80.0,100.0,120.0,151.5,163.0,183.0,203.0,223.0,191.5,211.5,231.5,251.5,60.0,70.0,80.0,90.0,70.0,90.0,110.0,130.0,90.0,110.0,130.0,150.0,90.0,110.0,130.0,150.0,110.0,130.0,150.0,170.0,120.0,140.0,160.0,180.0,

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};

int N;

void init1(){

p[0].name="III-1";

p[0].rank=0;

p[1].name="III-2";

p[1].rank=1;

p[2].name="III-3";

p[2].rank=2;

p[3].name="III-4";

p[3].rank=3;

p[4].name="A";

p[4].rank=4;

p[5].name="III-5";

p[5].rank=5;

p[6].name="B";

p[6].rank=6;

p[7].name="III-6";

p[7].rank=7;

p[8].name="III-7";

p[8].rank=8;

p[9].name="III-8";

p[9].rank=9;

p[10].name="III-9";

p[10].rank=10;

p[11].name="III-10";

p[11].rank=11;

p[12].name="III-11";

p[12].rank=12;

p[13].name="III-12";

p[13].rank=13;

p[14].name="III-13";

p[14].rank=14;

p[15].name="III-14";

p[15].rank=15;

p[16].name="III-15";

p[16].rank=16;

p[17].name="III-16";

p[17].rank=17;

p[18].name="C";

p[18].rank=18;

p[19].name="III-17";

p[19].rank=19;

p[20].name="III-18";

p[20].rank=20;

p[21].name="III-19";

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p[23].name="III-21";

p[23].rank=23;

p[24].name="III-22";

p[24].rank=24;

p[25].name="III-23";

p[25].rank=25;

p[26].name="III-24";

p[26].rank=26;

p[27].name="D";

p[27].rank=27;

p[28].name="I-1";

p[28].rank=28;

p[29].name="I-2";

p[29].rank=29;

p[30].name="I-3";

p[30].rank=30;

p[31].name="I-4";

p[31].rank=31;

p[32].name="E";

p[32].rank=32;

p[33].name="I-5";

p[33].rank=33;

p[34].name="I-6";

p[34].rank=34;

p[35].name="I-7";

p[35].rank=35;

p[36].name="I-8";

p[36].rank=36;

p[37].name="I";

p[37].rank=37;

p[38].name="I-13";

p[38].rank=38;

p[39].name="I-14";

p[39].rank=39;

p[40].name="I-15";

p[40].rank=40;

p[41].name="I-16";

p[41].rank=41;

p[42].name="M";

p[42].rank=42;

p[43].name="I-21";

p[43].rank=43;

p[44].name="I-22";

p[44].rank=44;

p[45].name="I-23";

p[45].rank=45;

p[46].name="I-24";

p[46].rank=46;

p[47].name="O";

p[47].rank=47;

p[48].name="N";

p[48].rank=48;

p[49].name="L";

p[49].rank=49;

p[50].name="II-1";

p[50].rank=50;

p[51].name="II-2";

p[51].rank=51;

p[52].name="II-3";

p[52].rank=52;

p[53].name="II-4";

p[53].rank=53;

p[54].name="H";

p[54].rank=54;

p[55].name="II-12";

p[55].rank=55;

p[56].name="II-11";

p[56].rank=56;

p[57].name="II-10";

p[57].rank=57;

p[58].name="II-9";

p[58].rank=58;

p[59].name="II-20";

p[59].rank=59;

p[60].name="II-19";

p[60].rank=60;

p[61].name="II-18";

p[61].rank=61;

p[62].name="II-17";

p[62].rank=62;

p[63].name="F";

p[63].rank=63;

p[64].name="G";

p[64].rank=64;

p[65].name="J";

p[65].rank=65;

p[66].name="K";

p[66].rank=66;

p[67].name="II-5";

p[67].rank=67;

p[68].name="II-6";

p[68].rank=68;

p[69].name="II-7";

p[69].rank=69;

p[70].name="II-8";

p[70].rank=70;

p[71].name="I-12";

p[71].rank=71;

p[72].name="I-11";

p[72].rank=72;

p[73].name="I-10";

p[73].rank=73;

p[74].name="I-9";

p[74].rank=74;

p[75].name="II-13";

p[75].rank=75;

p[76].name="II-14";

p[76].rank=76;

p[77].name="II-15";

p[77].rank=77;

p[78].name="II-16";

p[78].rank=78;

p[79].name="I-20";

p[79].rank=79;

p[80].name="I-19";

p[80].rank=80;

p[81].name="I-18";

p[81].rank=81;

p[82].name="I-17";

p[82].rank=82;

p[83].name="II-21";

p[83].rank=83;

p[84].name="II-22";

p[84].rank=84;

p[85].name="II-23";

p[85].rank=85;

p[86].name="II-24";

p[86].rank=86;

N=87;

}

int search\_point(string tar){

int r=-1;

for(int i=0;i<N;i++){

if(tar==p[i].name){

r=i;

break;

}

}

return r;

}

int main(){

init1();

freopen("t3\_1\_out.txt","w",stdout);

double v=300000000; //速度

cout<<" 先输入点的个数，再输入点的名称，再输出发时间（从D），最后输每个点的需求时间\n";

int num;

cin>>num;

int r[10];

r[0]=search\_point("D");

for(int i=1;i<=num;i++){

string tar;

cin>>tar;

r[i]=search\_point(tar);

}

double pre=0,real\_pre; //real pre表示实际上倒达d的时间（由于速度改变，到达d的时间也会改变）

double W=0;

double b[10];

cin>>pre;

real\_pre=(pre-3\*num)\*5/v+3\*num;

pre=real\_pre;

double a[10];

for(int i=1;i<=num;i++){

cin>>a[i];

}

b[0]=pre-3;

for(int i=1;i<=num;i++){

b[i]=b[i-1]+3+dis[ r[i] ][ r[i-1] ]/v;

if(b[i]<a[i])b[i]=a[i]; //无法贮存

W+=b[i]-a[i];

}

CK

cout<<"\n到达时间\n";

for(int i=1;i<=num;i++){

printf("%.1lf\t",b[i]);

}

printf("\n%.1lf\n",W);

return 0;

}

附录6：距离查询.cpp

该程序用于查询两点间的距离，方便手头计算。

#include<bits/stdc++.h>

using namespace std;

typedef long long ll;

const int INF=0x3f3f3f3f;

const long long mod=100000007;

const double e=2.718281828459045;

const double pi=3.1415926535;

#define CK cout<<"OK\n";

struct Point{

string name;

int rank;

Point(string s="\_",int x=0):name(s),rank(x){}

}p[100];

double dis[100][100];

int N;

int search\_point(string tar){

int r=-1;

for(int i=0;i<N;i++){

if(tar==p[i].name){

r=i;

break;

}

}

return r;

}

int main(){

freopen("distance\_out.txt","r",stdin);

scanf("%d",&N);

for(int i=0;i<N;i++){

cin>>p[i].name;

p[i].rank=i;

}

for(int i=0;i<N;i++){

for(int j=0;j<N;j++)scanf("%lf",&dis[i][j]);

}

freopen("CON","r",stdin); //切换到从控制台输入

string s1,s2;

while(1){

cin>>s1;

if(s1=="end")break;

cin>>s2;

int r1,r2;

r1=search\_point(s1);

r2=search\_point(s2);

if(r1==-1 || r2==-1)printf("输入有误\n");

else{

printf("%.1lf\n",dis[r1][r2]/5);

}

}

return 0;

}

附录7：头部1.cpp

该程序用于搜索找货路径。

#include<bits/stdc++.h>

using namespace std;

typedef long long ll;

const int INF=0x3f3f3f3f;

const long long mod=100000007;

const double e=2.718281828459045;

const double pi=3.1415926535;

#define CK cout<<"OK\n";

struct Point{

string name;

int rank;

Point(string s="\_",int x=0):name(s),rank(x){}

}p[100];

double dis[100][100];

int cnt;

void init(){

cnt=0;

for(int i=0;i<100;i++){

p[i].name="\_";

p[i].rank=-1;

}

for(int i=0;i<100;i++){

for(int j=0;j<100;j++)dis[i][j]=1000000;

}

}

int search\_point(string tar){

int r=-1;

for(int i=0;i<cnt;i++){

if(tar==p[i].name){

r=i;

break;

}

}

return r;

}

int main(){

freopen("distance\_in.txt","r",stdin);

freopen("头部1.txt","w",stdout);

int N;

init();

scanf("%d",&N);

for(int i=0;i<N;i++){

string s1,s2;

double tmp;

cin>>s1>>s2>>tmp;

int r1,r2;

r1=search\_point(s1);

if(r1==-1){

p[cnt].rank=cnt;

p[cnt].name=s1;

r1=cnt;

cnt++;

}

r2=search\_point(s2);

if(r2==-1){

p[cnt].rank=cnt;

p[cnt].name=s2;

r2=cnt;

cnt++;

}

dis[r1][r2]=tmp;

dis[r2][r1]=tmp;

}

for(int i=0;i<cnt;i++)for(int j=0;j<cnt;j++)for(int k=0;k<cnt;k++)

if(dis[j][k]>dis[j][i]+dis[i][k]){

dis[j][k]=dis[j][i]+dis[i][k];

dis[k][j]=dis[j][i]+dis[i][k];

}

printf("\n");

for(int i=0;i<cnt;i++){

for(int j=0;j<cnt;j++)printf("%.1lf,",dis[i][j]);

printf("\n");

}

return 0;

}

附录8：承包区结果表

|  |  |  |
| --- | --- | --- |
| 拖车编号 | 拖车行进路径长度() | 拖车运行周期() |
| 1 | 703 |  |
| 2 | 703 |  |
| 3 | 546 |  |
| 4 | 623 |  |
| 5 | 686 |  |
| 6 | 560 |  |
| 7 | 640 |  |
| 8 | 606 |  |
| 9 | 503 |  |
| 10 | 768 |  |