

COMPUTER INTEGRATED SURGERY I

Programming Assignment 4 Report

Iou-Sheng (Danny) Chang

`ichang9@jhu.edu`

Ching-Yang (Austin) Huang

`chuan120@jhu.edu`

Prerequisites

For a thorough understanding of the formulation, mathematical, and algorithmic approaches pertaining to the tasks in this programming assignment, please consult our submissions for *Programming Assignment 1 and 3* [1, 2]. These submissions provide a comprehensive explanation of topics such as “*Cartesian 3D Points, Rotations, and Frame Transformations*” and “*Iterative Closest Point Matching Algorithm*” respectively, which are also leveraged in this assignment.

1 Introduction

In this programming assignment, our focus is on the problem scenario depicted in Fig. 1. The 3D surface of the bone is represented as a mesh of triangles, with coordinates of the vertices specified in CT coordinates. The B rigid body’s tip is securely attached to the bone in an unknown orientation, while the A rigid body serves as a pointer, making contact with multiple points on the surface of the bone [12].

The main objective is to implement the full *Iterative Closest Point (ICP) Algorithm*. This implementation builds upon the ICP matching component we developed in *Programming Assignment 3* [2] and extends it by adding the iterative component, thereby completing the ICP algorithm.

As detailed in *Programming Assignment 3* [2], we have developed two methods for performing the matching/nearest neighbor search: a linear Brute Force search, implemented in *NNS_brute_force.py*, and an efficient Covariance Tree search, implemented in *NNS_covariance_tree.py*.

Furthermore, we leverage the mathematical package *transform.py*, which was introduced in *Programming Assignment 1* [1]. In this programming assignment, we specifically make use of its point transformation function, `point_transformation`, and the rigid registration function, `rigid_registration`.

Throughout the remainder of the report, we will refer to the methods introduced in *Programming Assignment 1 and 3* as [1] and [2], respectively, for clarity.

2 Formulation and Mathematical Approach

2.1 ICP Algorithm

The formulation approaches in this subsection closely adhere to the methods detailed in the assignment instruction file titled “*Programming assignments 3 and 4*” [12].

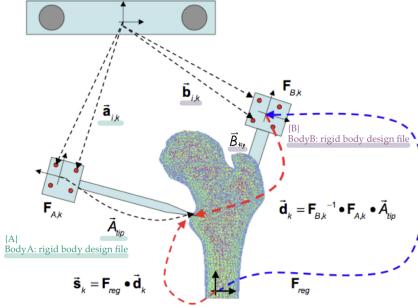


Figure 1. Problem Scenario. Figure adapted from [12].

We initiate the process by retrieving the necessary data, including:

- BodyA: Rigid Body A Design File Data.
 - \vec{A}_i : LED markers coordinates in A body coordinates.
 - \vec{A}_{tip} : Tip coordinates in A body coordinates.
- BodyB: Rigid Body B Design File Data.
 - \vec{B}_i : LED markers coordinates in B body coordinates.
 - \vec{B}_{tip} : Tip coordinates in B body coordinates.
- Mesh: Body Surface Definition File Data.
 - \vec{V} : Vertices coordinates in CT coordinates.
 - \vec{I} : Vertex indices for mesh triangles.
- SampleReadingsTest: Sample Readings Data.
 - $\vec{a}_{i,k}$: A body LED markers coordinates in tracker coordinates.
 - $\vec{b}_{i,k}$: B body LED markers coordinates in tracker coordinates.

Afterwards, for each sample frame k , we:

- Compute the rigid registration $F_{A,k}$ and $F_{B,k}$ for the respective rigid bodies with respect to the tracker using the *RigidRegistration* method in the following manner:

$$\begin{aligned} F_{A,k} &= \text{RigidRegistration}(\vec{A}_i, \vec{a}_{i,k}) \\ F_{B,k} &= \text{RigidRegistration}(\vec{B}_i, \vec{b}_{i,k}) \end{aligned} \quad (1)$$

- Determine the pointer tip position $\vec{d}_k = F_{B,k}^{-1} F_{A,k} \cdot \vec{A}_{tip}$ of the pointer tip with respect to rigid body B using the *PointTransformation* method as follows:

$$\vec{d}_k = \text{PointTransformation}(\vec{A}_{tip}, F_{B,k}^{-1} F_{A,k}) \quad (2)$$

Following this, beginning with an initial estimation of the transformation matrix $F_{reg} = \mathbb{I}_4$, we iteratively perform ICP matching to determine the closest points \vec{c} on the surface mesh to the sample points \vec{s} , utilizing the matching methods elucidated in *Programming Assignment 3* [2]. These identified points are utilized to iteratively refine and update the estimates for F_{reg} until the convergence criteria are satisfied, either all points satisfy our predefined distance threshold or until distances stabilize, indicating proximity to a local minimum and a satisfactory result. These processes unfold through the following detailed steps:

- For each sample frame k , compute the sample point $\vec{s}_k = F_{reg} \cdot \vec{d}_k$ using the *PointTransformation* method. Next, find the closest point \vec{c}_k on the surface mesh to this sample point and determine their L2 norm distance using either the *BruteForceSearch* or *CovarianceTreeSearch* methods detailed in *Programming Assignment 3* [2] as follows:

$$\begin{aligned}\vec{s}_k &= \text{PointTransformation}(\vec{d}_k, F_{reg}) \\ \vec{c}_k, dist_k &= \begin{cases} \text{BruteForceSearch}(\vec{s}_k) \\ \text{CovarianceTreeSearch}(\vec{s}_k) \end{cases} \quad (3)\end{aligned}$$

- Compute the rigid registration between \vec{s} and \vec{c} , denoted as F_{update} , using the *RigidRegistration* method. Subsequently, utilize this registration to refine and update the estimates for the transformation matrix F_{reg} in the following manner:

$$\begin{aligned}F_{update} &= \text{RigidRegistration}(\vec{s}, \vec{c}) \\ F_{reg} &\leftarrow F_{update} \cdot F_{reg} \quad (4)\end{aligned}$$

- The iteration persists until either all points meet our predefined distance threshold $dist_{threshold}$, set at $1e-2$ mm for its indication of satisfactory accuracy in surgical scenarios, *viz.*

$$dist < dist_{threshold} \quad (5)$$

Alternatively, the iteration halts when distances stabilize, implying proximity to a local minimum and an acceptable outcome. This assessment involves comparing the current distance $dist$ with the previous distance $dist_{prev}$ using NumPy's *allclose* function [4], checking for element-wise equivalence within a specified tolerance. The chosen relative *rtol* and absolute *atol* tolerances, set at $5e-2$ and $1e-4$ respectively, determine stabilization while considering the predefined distance threshold, *viz.*

$$\text{allclose}(dist, dist_{threshold}, \text{rtol} = 5e-2, \text{atol} = 1e-4) \quad (6)$$

To complete the process, we store and output the desired result, comprising the sample points \vec{s} , their corresponding closest points \vec{c} , and the L2 norm distance (magnitude of difference) between them.

3 Algorithmic Approach

3.1 ICP Algorithm

The algorithmic approaches in this subsection closely follow the formulation approaches outlined in Sec. 2.1, and adhere to the

methods detailed in the assignment instruction file titled “Programming assignments 3 and 4” [12].

The pseudocodes that encapsulate the approach detailed in Sec. 2.1, denoted as `task_ICP_brute_force` and `task_ICP_cov_tree`, are presented in Algorithm 1 and Algorithm 2, respectively.

Algorithm 1 `task_ICP_brute_force`

```

Require: RetrieveNecessaryData()
for  $k = 1$  to  $N_{samps}$  do
     $F_A \leftarrow \text{rigid\_registration}(\vec{A}_i, \vec{a}_{i,k})$ 
     $F_B \leftarrow \text{rigid\_registration}(\vec{B}_i, \vec{b}_{i,k})$ 
     $\vec{d}_k \leftarrow \text{point\_transformation}(\vec{A}_{tip}, F_B^{-1} F_A)$ 
end for
     $nnsBF \leftarrow \text{NNsBruteForce}()$ 
     $F_{reg} \leftarrow \mathbb{I}_4$ 
     $dist \leftarrow [\dots \infty \dots]^T_{N_{samps}}, dist_{threshold} \leftarrow 0.01$ 
while true do
     $dist_{prev} \leftarrow dist$ 
    for  $k = 1$  to  $N_{samps}$  do
         $\vec{s}_k \leftarrow \text{point\_transformation}(\vec{d}_k, F_{reg})$ 
         $\vec{c}_k, dist_k \leftarrow nnsBF.\text{brute\_force\_search}(\vec{s}_k, \vec{V}, \vec{I})$ 
    end for
     $N_{points\ passed} \leftarrow \sum(dist < dist_{threshold})$ 
    if  $N_{points\ passed} == N_{samps}$  or allclose(dist, dist_{prev}) then
        break ▷ Convergence criteria
    end if
     $F_{update} \leftarrow \text{rigid\_registration}(\vec{s}, \vec{c})$ 
     $F_{reg} \leftarrow F_{update} \cdot F_{reg}$  ▷ Refine and update  $F_{reg}$ 
end while
     $MoD \leftarrow dist$  ▷ Magnitude of difference
Return:  $\vec{s}, \vec{c}, MoD$ 

```

Algorithm 2 `task_ICP_cov_tree`

```

Require: RetrieveNecessaryData()
for  $k = 1$  to  $N_{samps}$  do
     $F_A \leftarrow \text{rigid\_registration}(\vec{A}_i, \vec{a}_{i,k})$ 
     $F_B \leftarrow \text{rigid\_registration}(\vec{B}_i, \vec{b}_{i,k})$ 
     $\vec{d}_k \leftarrow \text{point\_transformation}(\vec{A}_{tip}, F_B^{-1} F_A)$ 
end for
     $min\_count \leftarrow 15, min\_diag \leftarrow 0.35$ 
     $nnsCT \leftarrow \text{NNsCovTree}(\vec{V}, \vec{I}, \text{indices\_local}, min\_count, min\_diag)$ 
     $F_{reg} \leftarrow \mathbb{I}_4$ 
     $dist \leftarrow [\dots \infty \dots]^T_{N_{samps}}, dist_{threshold} \leftarrow 0.01$ 
while true do
     $dist_{prev} \leftarrow dist$ 
    for  $k = 1$  to  $N_{samps}$  do
         $\vec{s}_k \leftarrow \text{point\_transformation}(\vec{d}_k, F_{reg})$ 
         $\vec{c}_k, dist_k \leftarrow nnsCT.\text{cov\_tree\_search}(\vec{s}_k, \vec{V}, \vec{I}, \text{None}, \infty)$ 
    end for
     $N_{points\ passed} \leftarrow \sum(dist < dist_{threshold})$ 
    if  $N_{points\ passed} == N_{samps}$  or allclose(dist, dist_{prev}) then
        break ▷ Convergence criteria
    end if
     $F_{update} \leftarrow \text{rigid\_registration}(\vec{s}, \vec{c})$ 
     $F_{reg} \leftarrow F_{update} \cdot F_{reg}$  ▷ Refine and update  $F_{reg}$ 
end while
     $MoD \leftarrow dist$  ▷ Magnitude of difference
Return:  $\vec{s}, \vec{c}, MoD$ 

```

4 Overview of Program

This section offers a concise overview of the program, covering the high-level code structures, and the descriptions of the functions, including their intended purposes (Desc), input arguments (Args), and outputs (Returns).

4.1 PA4_main.py

PA4_main.py serves as the main driver file responsible for executing the primary tasks of the assignment (ICP algorithm), conducting validation procedures, examining the output results, and generating visual plots.

This program is implemented in *Python*, utilizing built-in modules such as *time*, *pathlib*, *functools*, *collections* [9]. Additionally, it incorporates a selection of external libraries, including *NumPy*, *SciPy*, *Pandas*, *Plotly*, *tqdm*, and *Rich API* [3–7, 13]. Fig. 4 shows the high-level program structure, along with descriptions of the functions, including their intended purposes, inputs, and outputs.

The main driver file can be executed via a command-line interface that we designed using the *Click* library [8]. For detailed information about the positional and optional arguments available through the command-line interface, please refer to Fig. 2.

```
> python PROGRAMS/PA4_main.py --help
Usage: PA4_main.py [OPTIONS] [PA_ROOT_DIR]

Options:
  -d, --data-root-dir PATH      Path to data root directory.
  -a, --process-all-data        Process all the data.
  -p, --data-fn-prefix [A-Debug|B-Debug|C-Debug|D-Debug|E-Debug|F-Debug|G-Unknown|H-Unknown|J-Unknown|K-Unknown]
                                Prefix of the data filename.
  -o, --generate-output-result Generate and export output results.
  -m, --icp-method [brute_force|cov_tree]    Run ICP with desired method.
  -v, --run-validations [all|ICP_matching_methods|output_result|box_plot]    Run ICP validations.
  --help                         Show this message and exit.
```

Figure 2. Command-Line Interface for *PA4_main.py*.

4.2 load_data.py

load_data.py serves as the data loader responsible for loading and formatting the provided *PA345 Student Data* files. This loader leverages the *Pandas* library for efficient handling of data from the provided *.txt* files, and relies on *Python*'s built-in module *pathlib* for efficient filesystem path handling [7, 9]. Fig. 5 shows the high-level program structure, along with descriptions of the functions, including their intended purposes, inputs, and outputs.

The data loader can be executed via a command-line interface that we designed using the *Click* library [8]. For detailed information about the positional and optional arguments available through the command-line interface, please refer to Fig. 3.

```
> python PROGRAMS/load_data.py --help
Usage: load_data.py [OPTIONS] [DATA_ROOT_DIR]

Options:
  -a, --process-all-data      Process all the data.
  -n, --data-fn-pa-num [PA4]   PA number of the data filename.
  -p, --data-fn-prefix [A-Debug|B-Debug|C-Debug|D-Debug|E-Debug|F-Debug|G-Unknown|H-Unknown|J-Unknown|K-Unknown]
                                Prefix of the data filename.
  -s, --skip [A-Debug|B-Debug|C-Debug|D-Debug|E-Debug|F-Debug|G-Unknown|H-Unknown|J-Unknown|K-Unknown]
                                Skip specific data.
  -e, --export-result          Export loaded data and show in console.
  --help                       Show this message and exit.
```

Figure 3. Command-Line Interface for *load_data.py*.

4.3 NNS_brute_force.py

The brute force nearest neighbor search package *NNS_brute_force.py* is implemented in *Python*, utilizing the

NumPy library [4, 9]. Fig. 6 shows the high-level program structure, along with descriptions of the functions, including their intended purposes, inputs, and outputs.

4.4 NNS_covariance_tree.py

The covariance tree nearest neighbor search package *NNS_covariance_tree.py* is implemented in *Python*, utilizing the *NumPy* library [4, 9]. Additionally, it incorporates our developed packages *transform.py* and *NNS_brute_force.py*. Fig. 7 shows the high-level program structure, along with descriptions of the functions, including their intended purposes, inputs, and outputs.

4.5 Other Source Code Files

For an overview of the mathematical package, *transform.py*, which is also utilized in this programming assignment, please refer to our submission for *Programming Assignment 1* [1] for comprehensive information about the program.

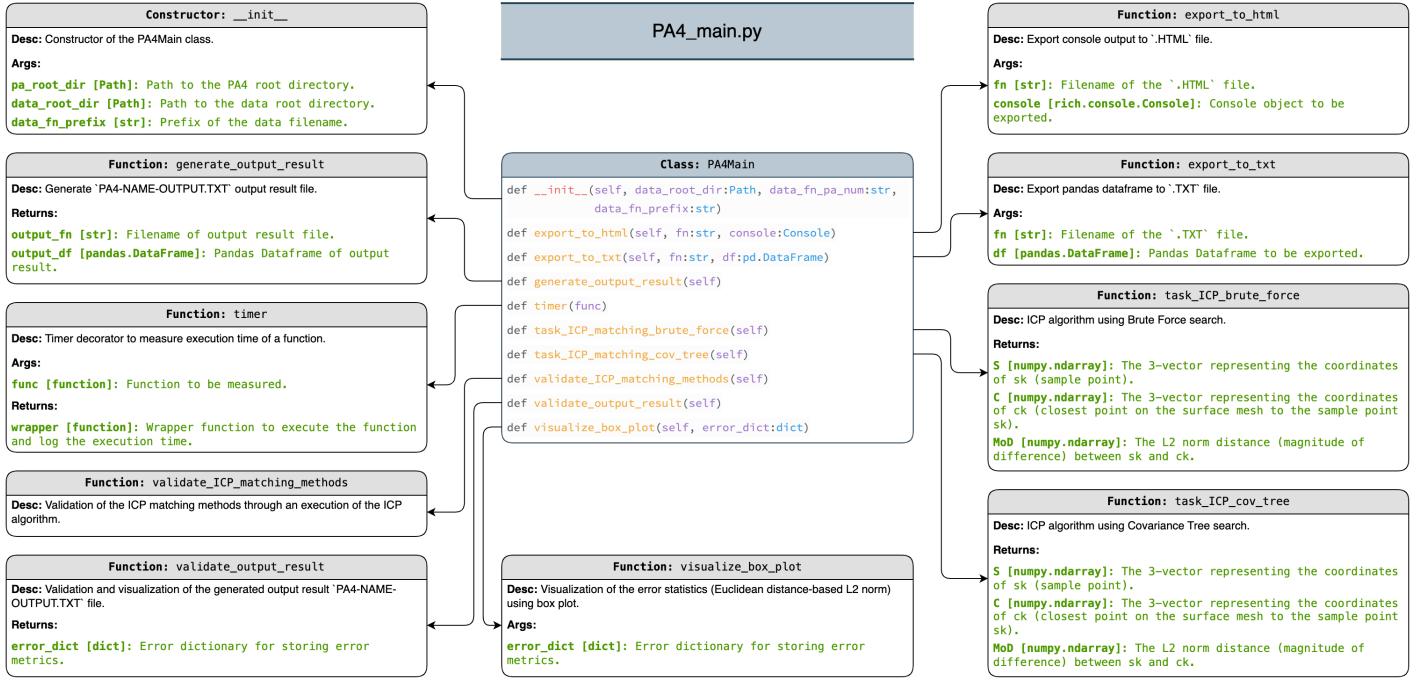


Figure 4. High-level *PA4_main.py* class overview with descriptions of functions, including input arguments, outputs, and intended purpose.

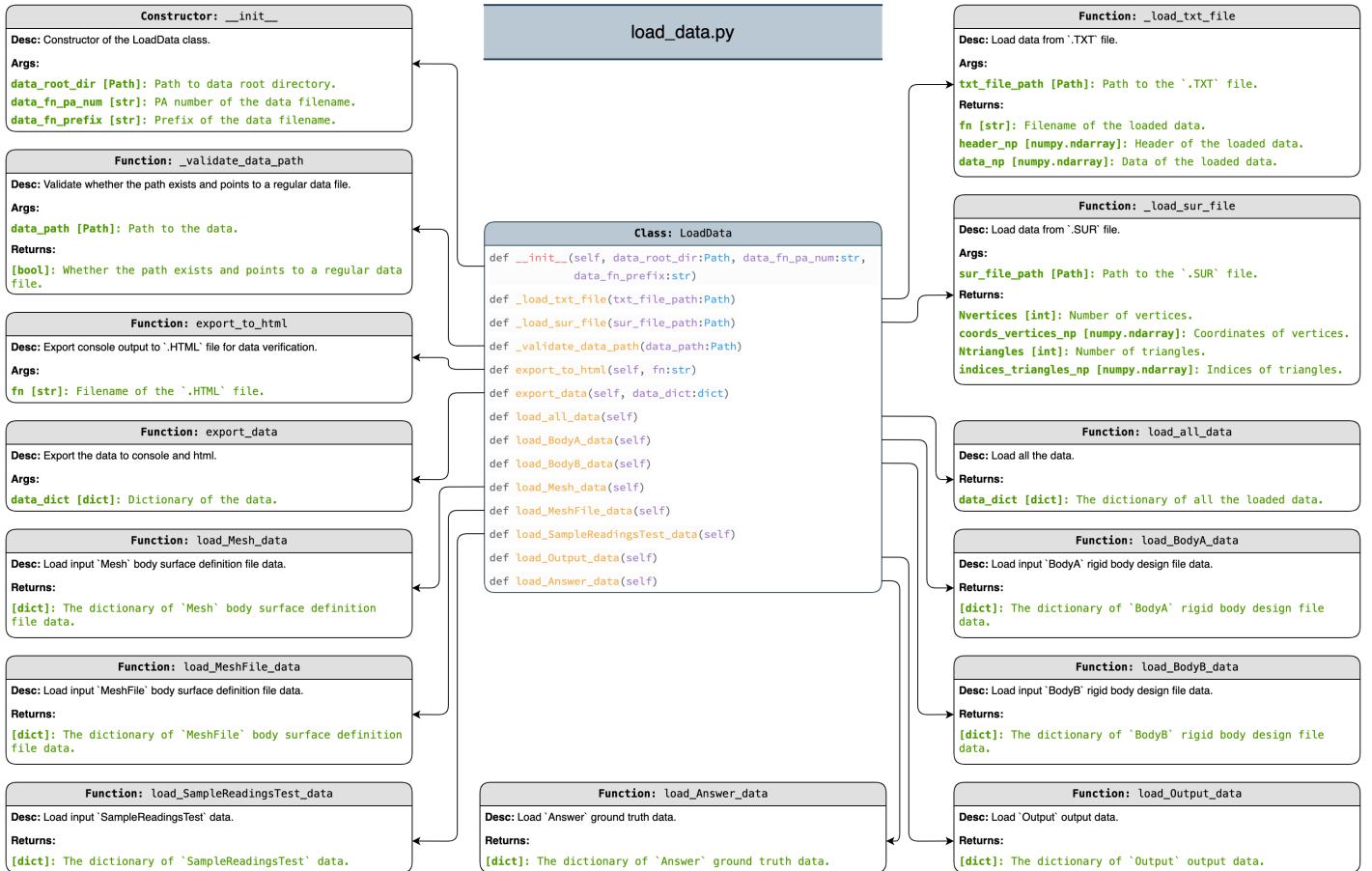


Figure 5. High-level *load_data.py* class overview with descriptions of functions, including input arguments, outputs, and intended purpose.

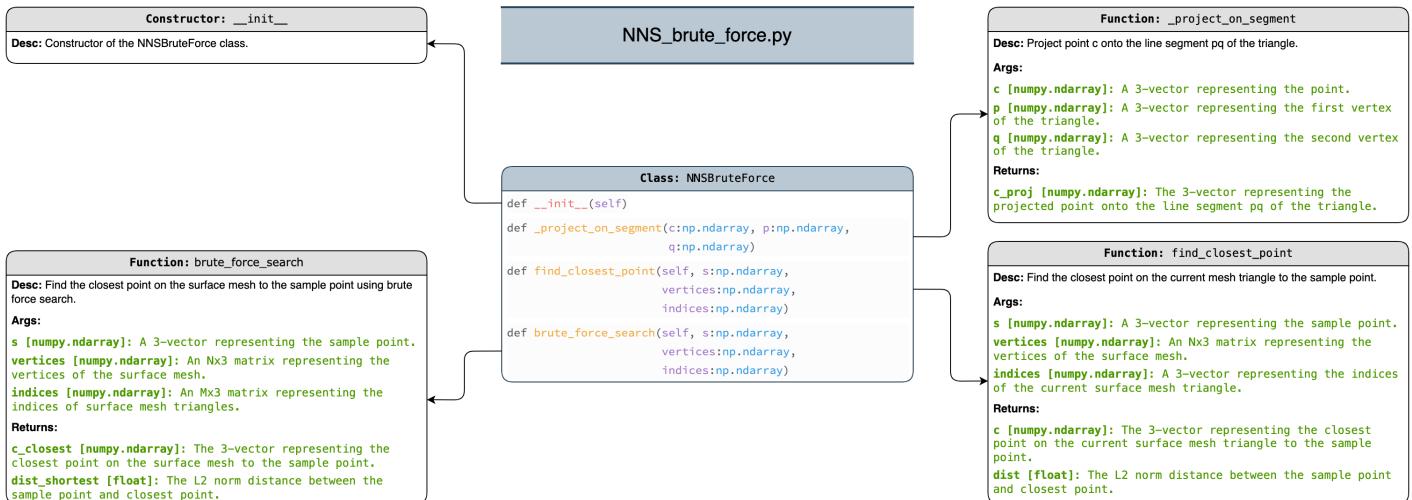


Figure 6. High-level `NNS_brute_force.py` class overview with descriptions of functions, including input arguments, outputs, and intended purpose.

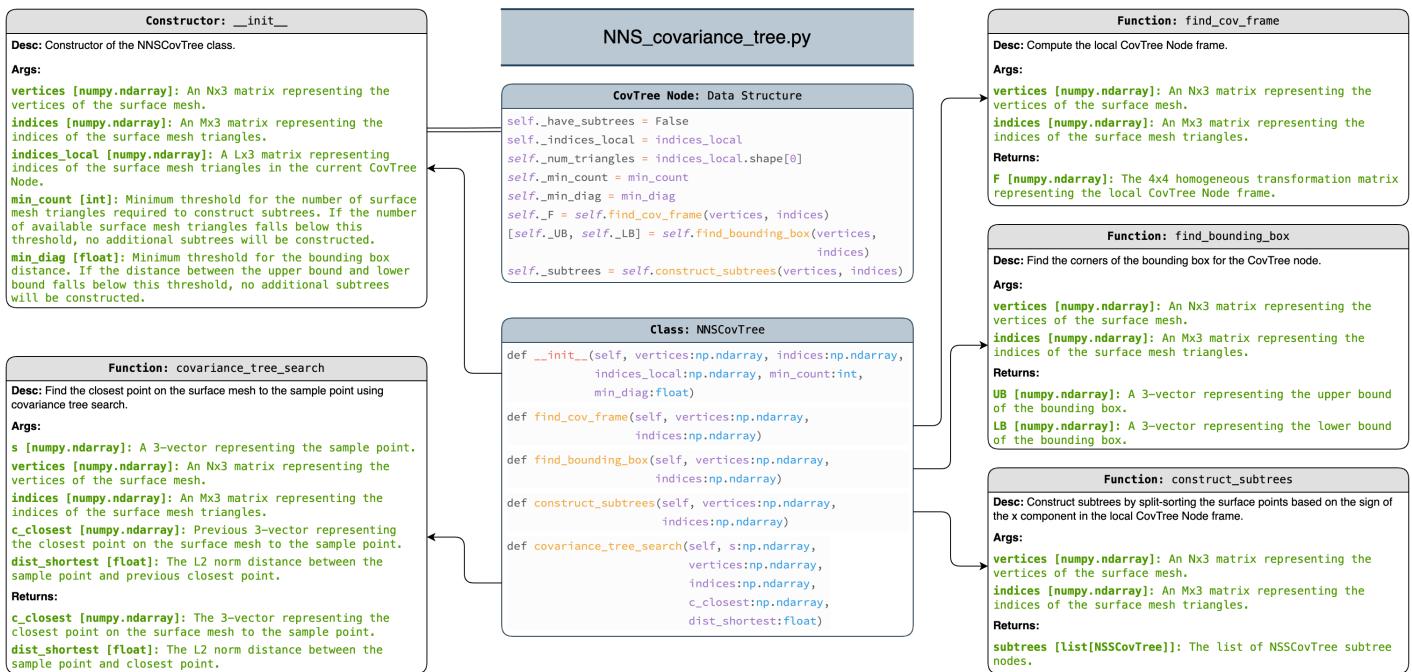


Figure 7. High-level `NNS_covariance_tree.py` class overview with descriptions of functions, including input arguments, outputs, and intended purpose.

5 Discussion

5.1 Discussion of Validation Approaches

5.1.1 Validation of ICP Matching Methods

The validation approach for the developed ICP matching packages, *NNS_brute_force.py* and *NNS_covariance_tree.py*, is demonstrated through the implementation of the *validate_ICP_matching_methods* function in *PA4_main.py* utilizing the *NumPy*, *SciPy*, and *tqdm* libraries [3, 4, 13].

For more in-depth details, please consult our submission for *Programming Assignment 3* [2].

5.1.2 Validation and Visualization of the Output Results

The generation of the output result file, named *NAME-OUTPUT.TXT*, adheres to the prescribed file format outlined in the programming assignment instructions titled *Programming Assignment 3 and 4* [12]. This file generation process is executed by the *generate_output_result* function in *PA4_main.py*, making use of the *NumPy* and *Pandas* libraries [4, 7].

The validation approach for the output result file is demonstrated through the implementation of the *validate_output_result* function in *PA4_main.py* utilizing the *NumPy* and *Plotly* library [4, 5]. The procedure commences with the retrieval of computed *NAME (DEBUG) -OUTPUT* data and provided ground truth *NAME (DEBUG) -ANSWER* data from their respective paths, namely *OUTPUT* and 2023 PA345 Student Data, using the data loader *load_data.py*. Subsequently, we compute the L2 norm (Euclidean distance-based) error metrics between the computed values and the given ground truth values. Following this, we construct error metrics for \vec{s}_{error} and \vec{c}_{error} , including measures such as the mean, standard deviation, median, upper and lower quartiles, maximum, and minimum. These error measurements and statistics are then stored in a dictionary. For visualization, we generate 3D visualization plots that depict the computed data alongside the provided ground truth data.

5.1.3 Validation and Visualization of Error Statistics

Having compiled and stored the error statistics for \vec{s}_{error} and \vec{c}_{error} , we take the next step and visualize these statistics using a box plot. This visualization is carried out by the *visualize_box_plot* function in *PA4_main.py*, utilizing the *Plotly* library [5].

5.2 Discussion of Results

5.2.1 Tabular Summary of the Output Results

Listings 1 to 6 and Listings 7 to 10 in the Appendix Section provide the tabular summaries of the output results contained in *NAME (DEBUG) -OUTPUT.TXT* and *NAME (UNKNOWN) -OUTPUT.TXT*, respectively. These output tabular listings adhere to the format specified in

Tab. 1, which includes the coordinates of sample points $\vec{s}_k = [s_{k,x}, s_{k,y}, s_{k,z}]^\top$, as well as their corresponding coordinates of closest points $\vec{c}_k = [c_{k,x}, c_{k,y}, c_{k,z}]^\top$. Additionally, the last column includes the L2 norm distance (magnitude of difference) $MoD = \|\vec{s}_k - \vec{c}_k\|_2$ between these points.

PA345	DATASET NAME							
	k	$s_{k,x}$	$s_{k,y}$	$s_{k,z}$	$c_{k,x}$	$c_{k,y}$	$c_{k,z}$	$\ \vec{s}_k - \vec{c}_k\ _2$
:	:	:	:	:	:	:	:	:

Table 1. File Format of Output Results in the Appendix Section

5.2.2 Time Efficiency Analysis of ICP Algorithm

Figures 8 and 9 illustrates the computational efficiency of the ICP algorithm. The execution time is influenced by various factors, including the number of iterations, the quantity of sample points, and the noise level present in the dataset. In cases with lower noise levels (e.g., A-Debug), fewer iterations are needed to meet the ICP convergence criteria, and vice versa.

Our analysis reveals that the execution time of the ICP algorithm using the Covariance Tree search method is approximately **one-fourth to one-fifth** that of using the Brute Force search approach. Our observation not only confirms the successful implementation of the Covariance Tree algorithm, but also highlights its significant improvement in efficiency, aligning with our earlier findings from *Programming Assignment 3* [2]. This enhancement is attributed to its hierarchical data structure and its ability to align shape and direction of the trees efficiently.

It is important to note that the program is implemented in *Python* [9]; hence, the execution time is longer compared to what could be achieved with C-based languages. However, our time comparison and analysis still clearly demonstrates that the Covariance Tree method is much more efficient than Brute Force.

5.2.3 Analysis of Output Results

Following the approach described in Sec. 5.1.2, we have compiled all the error measurements and statistics for the DEBUG datasets into a tabular summary, shown in Tab. 2.

Similarly, we have created 3D visualization plots that present the computed data alongside the provided ground truth data, as depicted in Fig. 10. Within this visual representation, solid circles represent the given values, while open circles correspond to the computed values. Notably, the resemblance between the solid and open shapes among the data points serves as a visual indicator of the accuracy and reliability of our implementation in comparison to the provided ground truth.

Upon meticulous evaluation of Tab. 2 and Fig. 10 pertaining to the DEBUG datasets, it becomes apparent that the errors $\|\vec{s}_{computed} - \vec{s}_{given}\|_2$ and $\|\vec{c}_{computed} - \vec{c}_{given}\|_2$ consistently remain below 0.05 [mm]. As a result, we can confidently assert the correctness of our obtained output result.

Cov Tree ICP A-Debug Iteration 1: 100%	100/100 [00:10<00:00, 9.42s/it, Passed/Total[Points]=75 / 75]
[PA4-A-Debug] task_ICP_brute_force executed in 10.648 seconds	
Cov Tree ICP B-Debug Iteration 30: 100%	100/100 [14:15<00:00, 8.55s/it, Passed/Total[Points]=200/200]
[PA4-B-Debug] task_ICP_brute_force executed in 855.361 seconds	
Cov Tree ICP C-Debug Iteration 42: 100%	100/100 [20:30<00:00, 12.30s/it, Passed/Total[Points]=200/200]
[PA4-C-Debug] task_ICP_brute_force executed in 1230.208 seconds	
Cov Tree ICP D-Debug Iteration 49: 100%	100/100 [23:37<00:00, 14.17s/it, Passed/Total[Points]=197/200]
[PA4-D-Debug] task_ICP_brute_force executed in 1417.230 seconds	
Cov Tree ICP E-Debug Iteration 42: 100%	100/100 [20:12<00:00, 12.13s/it, Passed/Total[Points]=21 / 200]
[PA4-E-Debug] task_ICP_brute_force executed in 1213.063 seconds	
Cov Tree ICP F-Debug Iteration 44: 100%	100/100 [20:22<00:00, 12.22s/it, Passed/Total[Points]=23 / 200]
[PA4-F-Debug] task_ICP_brute_force executed in 1222.092 seconds	
Cov Tree ICP G-Unknown Iteration 41: 100%	100/100 [17:19<00:00, 10.39s/it, Passed/Total[Points]=195/200]
[PA4-G-Unknown] task_ICP_brute_force executed in 1039.046 seconds	
Cov Tree ICP H-Unknown Iteration 43: 100%	100/100 [18:04<00:00, 10.84s/it, Passed/Total[Points]=195/200]
[PA4-H-Unknown] task_ICP_brute_force executed in 1084.361 seconds	
Cov Tree ICP J-Unknown Iteration 27: 100%	100/100 [11:24<00:00, 6.85s/it, Passed/Total[Points]=27 / 200]
[PA4-J-Unknown] task_ICP_brute_force executed in 684.980 seconds	
Cov Tree ICP K-Unknown Iteration 39: 100%	100/100 [16:18<00:00, 9.78s/it, Passed/Total[Points]=18 / 200]
[PA4-K-Unknown] task_ICP_brute_force executed in 978.312 seconds	

Figure 8. Execution Time of ICP Algorithm Using Brute Force Search

Cov Tree ICP A-Debug Iteration 1: 100%	100/100 [00:02<00:00, 1.58s/it, Passed/Total[Points]=75 / 75]
[PA4-A-Debug] task_ICP_cov_tree executed in 2.430 seconds	
Cov Tree ICP B-Debug Iteration 30: 100%	100/100 [02:45<00:00, 1.66s/it, Passed/Total[Points]=200/200]
[PA4-B-Debug] task_ICP_cov_tree executed in 165.936 seconds	
Cov Tree ICP C-Debug Iteration 42: 100%	100/100 [04:03<00:00, 2.43s/it, Passed/Total[Points]=200/200]
[PA4-C-Debug] task_ICP_cov_tree executed in 243.069 seconds	
Cov Tree ICP D-Debug Iteration 49: 100%	100/100 [04:43<00:00, 2.83s/it, Passed/Total[Points]=197/200]
[PA4-D-Debug] task_ICP_cov_tree executed in 283.148 seconds	
Cov Tree ICP E-Debug Iteration 42: 100%	100/100 [04:14<00:00, 2.54s/it, Passed/Total[Points]=21 / 200]
[PA4-E-Debug] task_ICP_cov_tree executed in 254.159 seconds	
Cov Tree ICP F-Debug Iteration 44: 100%	100/100 [04:18<00:00, 2.59s/it, Passed/Total[Points]=23 / 200]
[PA4-F-Debug] task_ICP_cov_tree executed in 259.009 seconds	
Cov Tree ICP G-Unknown Iteration 41: 100%	100/100 [04:27<00:00, 2.67s/it, Passed/Total[Points]=195/200]
[PA4-G-Unknown] task_ICP_cov_tree executed in 267.218 seconds	
Cov Tree ICP H-Unknown Iteration 43: 100%	100/100 [04:14<00:00, 2.55s/it, Passed/Total[Points]=195/200]
[PA4-H-Unknown] task_ICP_cov_tree executed in 254.960 seconds	
Cov Tree ICP J-Unknown Iteration 27: 100%	100/100 [02:54<00:00, 1.75s/it, Passed/Total[Points]=27 / 200]
[PA4-J-Unknown] task_ICP_cov_tree executed in 175.033 seconds	
Cov Tree ICP K-Unknown Iteration 39: 100%	100/100 [03:55<00:00, 2.36s/it, Passed/Total[Points]=18 / 200]
[PA4-K-Unknown] task_ICP_cov_tree executed in 235.650 seconds	

Figure 9. Execution Time of ICP Algorithm Using Covariance Tree Search

PA345	debug-a	debug-b	debug-c	debug-d	debug-e	debug-f
mean	0.0066	0.0075	0.0078	0.0076	0.0180	0.0127
std	0.0054	0.0056	0.0059	0.0062	0.0088	0.0062
Q1	0.0000	0.0000	0.0000	0.0000	0.0100	0.0100
Q2	0.0100	0.0100	0.0100	0.0100	0.0173	0.0141
Q3	0.0100	0.0100	0.0100	0.0100	0.0224	0.0149
max	0.0141	0.0173	0.0224	0.0245	0.0424	0.0300
min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PA345	debug-a	debug-b	debug-c	debug-d	debug-e	debug-f
mean	0.0048	0.0067	0.0069	0.0057	0.0158	0.0083
std	0.0056	0.0057	0.0060	0.0061	0.0077	0.0063
Q1	0.0000	0.0000	0.0000	0.0000	0.0100	0.0000
Q2	0.0000	0.0100	0.0100	0.0100	0.0000	0.0100
Q3	0.0100	0.0100	0.0100	0.0100	0.0200	0.0100
max	0.0141	0.0173	0.0173	0.0224	0.0424	0.0300
min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 2. Errors Statistics of (left) $\|\vec{s}_{\text{computed}} - \vec{s}_{\text{given}}\|_2$ (right) $\|\vec{c}_{\text{computed}} - \vec{c}_{\text{given}}\|_2$ [mm].



Figure 10. 3D visualization of the given and computed \vec{s} , and \vec{c} .

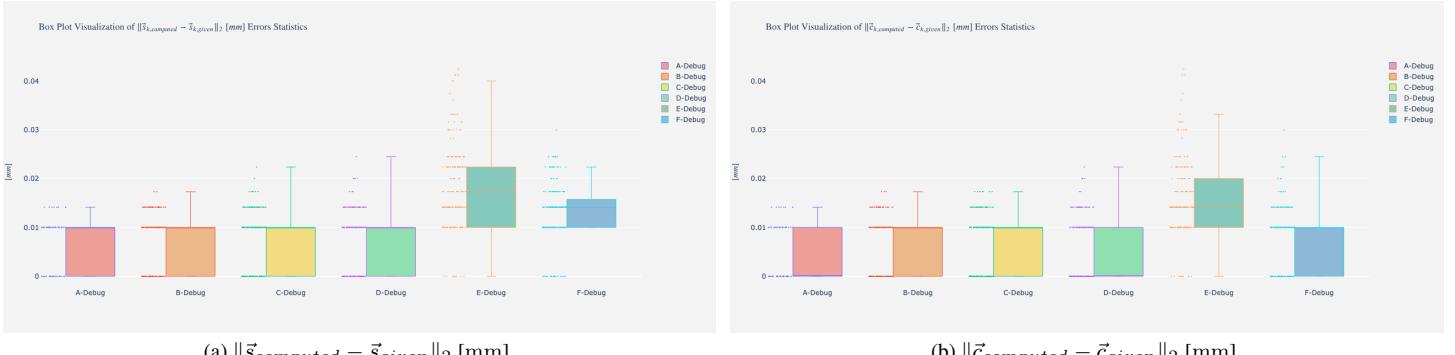


Figure 11. Box Plot Visualization of Error Statistics.

On top of this, the comparison presented in Listings 1 to 10 of the output results highlights a consistent range of magnitude of difference $\|\vec{s}_k - \vec{c}_k\|_2$, between the UNKNOWN and DEBUG datasets. This uniformity underscores the reliability and consistency of our implementation across the datasets.

5.2.4 Analysis of Error statistics

Following the approach described in Sec. 5.1.3, we can now visualize and analyze the error statistics using the box plot of \vec{s}_{error} and \vec{c}_{error} , as illustrated in Figs. 11a and 11b, respectively.

The box plot visualizations complement our evaluation in Sec. 5.2.3, affirming that the errors $\|\vec{s}_{computed} - \vec{s}_{given}\|_2$ and $\|\vec{c}_{computed} - \vec{c}_{given}\|_2$ consistently maintain values below 0.05 mm. These visualizations further underscore the uniformity and reliability of our implementation across the datasets.

Overall, we can confidently affirm that the implementation of the assignment tasks have been a success.

6 Statement

6.1 Contribution

Iou-Sheng (Danny) Chang was responsible for drafting the data loader named *load_data.py*, creating the structure of *PA4_main.py* and the command-line interfaces. Ching-Yang (Austin) Huang, on the other hand, worked on drafting the packages *NNS_brute_force.py* and *NNS_covariance_tree.py*.

During the debugging and finalization phases of the program, the authors collaborated closely through pair programming. Additionally, the report was a joint effort, with both authors contributing equally to its completion.

6.2 Alignment with Course Materials

The formulation and algorithmic approaches of the assignment are in close alignment with the methods presented in several key course materials, including lecture notes such as *Cartesian Coordinates, Points, and Transformations*, and *Finding Point Pairs for Iterative Closest Point Algorithms*. [10, 11]. Additionally, the methods outlined in the programming assignment instructions *Programming Assignment 3 and 4* [12] have also played a significant role in shaping our approach.

6.3 External Libraries Utilized

The program submitted for this assignment is implemented in *Python*, utilizing built-in modules such as *time*, *pathlib*, *functools*, and *collections* [9]. Additionally, it incorporates a selection of external libraries, including *Click*, *NumPy*, *SciPy*, *Pandas*, *Plotly*, *tqdm*, and *Rich API* [3–8, 13].

References

- [1] Iou-Sheng Chang and Ching-Yang Huang. Programming assignments 1 submission. <https://www.gradescope.com/courses/564928/assignments/3504688/submissions/201788395>, 2023. Submitted as part of the programming assignments for Computer Integrated Surgery I, Johns Hopkins University. 1, 3
- [2] Iou-Sheng Chang and Ching-Yang Huang. Programming assignments 3 submission. <https://www.gradescope.com/courses/564928/assignments/3504688/submissions/201788395>, 2023. Submitted as part of the programming assignments for Computer Integrated Surgery I, Johns Hopkins University. 1, 2, 6
- [3] Casper da Costa-Luis, Stephen Karl Larroque, Kyle Altendorf, Hadrien Mary, richardsheridan, Mikhail Korobov, Noam Yorav-Raphael, Ivan Ivanov, Marcel Bargull, Nishant Rodrigues, Guangshuo Chen, Antony Lee, Charles Newey, CrazyPython, JC, Martin Zugnoni, Matthew D. Pagel, mjstevens777, Mikhail Dektarev, Alex Rothberg, Alexander Plavin, Fabian Dill, Fichtefoll, Gregor Sturm, HeoHeo, Hugo van Kemenade, Jack McCracken, MapleCCC, Max Nordlund, and Mike Boyle. *tqdm: A fast, Extensible Progress Bar for Python and CLI*. doi=10.5281/zenodo.595120. 3, 6, 8
- [4] Charles R Harris, K Jarrod Millman, Stéfan J van der Walt, Ralf Gommers, Pauli Virtanen, David Cournapeau, Eric Wieser, Julian Taylor, Sebastian Berg, Nathaniel J Smith, Robert Kern, Matti Picus, Stephan Hoyer, Marten H van Kerkwijk, Matthew Brett, Allan Haldane, Jaime Fernández del Río, Mark Wiebe, Pearu Peterson, Pierre Gérard-Marchant, Kevin Sheppard, Tyler Reddy, Warren Weckesser, Hameer Abbasi, Christoph Gohlke, and Travis E Oliphant. Array programming with NumPy. *Nature*, 585(7825):357–362, 2020. 2, 3, 6, 8
- [5] Plotly Technologies Inc. *Collaborative Data Science*. Montreal, QC, 2015. 3, 6, 8
- [6] Will McGugan. *Rich API*, 2020. 3, 8
- [7] Wes McKinney et al. Data structures for statistical computing in python. In Stéfan van der Walt and Jarrod Millman, editors, *Pro-*

- ceedings of the 9th Python in Science Conference*, volume 445, pages 51 – 56. Austin, TX, 2010. [3](#), [6](#), [8](#)
- [8] Pallets. *Click*, 2014. [3](#), [8](#)
- [9] Python Core Team. *Python: A dynamic, open source programming language*. Python Software Foundation, 2019. [3](#), [6](#), [8](#)
- [10] Russell H. Taylor. Cartesian coordinates, points, and transformations. <https://ciis.lcsr.jhu.edu/lib/exe/fetch.php?media=courses:455-655:lectures:frames.pdf>, 2023. Supplied as lecture notes in Computer Integrated Surgery I, Johns Hopkins University. [8](#)
- [11] Russell H. Taylor. Finding point pairs for iterative closest point algorithms. https://ciis.lcsr.jhu.edu/lib/exe/fetch.php?media=courses:455-655:lectures:finding_point-pairs.pdf, 2023. Supplied as course notes in Computer Integrated Surgery I, Johns Hopkins University. [8](#)
- [12] Russell H. Taylor. Programming assignments 3 and 4. https://ciis.lcsr.jhu.edu/lib/exe/fetch.php?media=courses:455-655:2023:programming_3_and_4_600-445-2023.pdf, 2023. Supplied as course assignment instructions in Computer Integrated Surgery I, Johns Hopkins University. [1](#), [2](#), [6](#), [8](#)
- [13] Pauli Virtanen, Ralf Gommers, Travis E. Oliphant, Matt Haberland, Tyler Reddy, David Cournapeau, Evgeni Burovski, Pearu Peterson, Warren Weckesser, Jonathan Bright, Stéfan J. van der Walt, Matthew Brett, Joshua Wilson, K. Jarrod Millman, Nikolay Mayorov, Andrew R. J. Nelson, Eric Jones, Robert Kern, Eric Larson, CJ Carey, İlhan Polat, Yu Feng, Eric W. Moore, Jake VanderPlas, Denis Laxalde, Josef Perktold, Robert Cimrman, Ian Henriksen, E. A. Quintero, Charles R Harris, Anne M. Archibald, Antônio H. Ribeiro, Fabian Pedregosa, Paul van Mulbregt, and SciPy 1.0 Contributors. SciPy 1.0: Fundamental Algorithms for Scientific Computing in Python. *Nature Methods*, 17:261–272, 2020. [3](#), [6](#), [8](#)

Appendix

Listing 1. PA4-A-Debug-Output.txt

75	PA4-A-Debug-Output.txt						
-5.39	11.99	53.54	-5.38	11.99	53.54	0.01	15.89
20.22	25.78	-11.33	20.22	25.78	-11.33	0.00	9.74
5.44	24.28	6.77	5.44	24.27	6.77	0.00	4.00
3.76	-3.67	-24.38	3.76	-3.67	-24.38	0.00	7.64
-5.62	11.42	58.63	-5.62	11.42	58.63	0.00	12.15
13.45	27.52	1.99	13.45	27.51	1.99	0.01	-1.67
17.84	-15.09	-16.22	17.83	-15.10	-16.22	0.01	29.98
-21.87	3.97	-43.25	-21.87	3.97	-43.25	0.00	14.27
36.70	-1.39	9.01	36.70	-1.39	9.01	0.00	12.15
-4.32	-8.35	21.74	-4.33	-8.36	21.74	0.01	18.17
36.96	2.04	-15.45	36.96	2.04	-15.45	0.00	-18.18
-19.24	-18.22	-47.54	-19.24	-18.22	-47.53	0.00	12.15
-21.16	-23.59	-8.68	-21.16	-23.59	-8.69	0.00	-1.67
11.52	26.76	4.67	11.52	26.76	4.67	0.00	29.98
11.36	-6.34	34.05	11.37	-6.35	34.05	0.00	14.69
-44.03	-9.47	-26.15	-44.03	-9.47	-26.15	0.00	14.76
15.34	-5.38	44.41	15.34	-5.39	44.42	0.00	29.98
4.06	3.43	63.48	4.06	3.43	63.48	0.00	14.69
-6.69	3.47	46.95	-6.69	3.47	46.95	0.00	14.76
32.65	-6.74	-4.55	32.65	-6.74	-4.55	0.00	0.00
-9.23	-28.31	-33.12	-9.23	-28.31	-33.12	0.00	0.00
2.02	0.32	-23.60	2.02	0.32	-23.60	0.00	0.00
18.73	-4.51	34.50	18.73	-4.51	34.50	0.00	0.00
7.22	17.44	-6.80	7.22	17.44	-6.80	0.00	0.00
1.26	-6.93	62.45	1.26	-6.94	62.45	0.01	0.00
-9.81	-0.84	17.91	-9.81	-0.84	17.91	0.00	0.00
12.26	-16.96	-7.93	12.26	-16.97	-7.93	0.00	0.00
-42.59	-4.02	-30.58	-42.59	-4.02	-30.58	0.00	0.00
-16.37	17.90	24.50	-16.38	17.90	24.50	0.00	0.00
-8.57	1.38	-40.43	-8.57	1.38	-40.43	0.00	0.00
-12.53	2.41	10.90	-12.53	2.41	10.90	0.00	0.00
-6.94	-8.18	13.50	-6.95	-8.18	13.50	0.00	0.00
-12.37	-23.39	-10.89	-12.36	-23.39	-10.89	0.00	0.00
-32.22	-13.13	-46.49	-32.23	-13.13	-46.49	0.00	0.00
-10.90	2.66	17.78	-10.90	2.66	17.78	0.00	0.00
-30.91	5.54	-38.91	-30.91	5.55	-38.91	0.00	0.00
31.08	19.99	0.63	31.08	19.99	0.63	0.00	0.00
-8.15	5.72	31.10	-8.15	5.72	31.10	0.01	0.00
-14.30	20.63	31.15	-14.29	20.62	31.15	0.00	0.00
-0.45	21.64	35.92	-0.45	21.64	35.92	0.00	0.00
6.48	-14.97	-18.84	6.48	-14.97	-18.84	0.00	0.00
-4.31	8.02	-17.60	-4.31	8.02	-17.60	0.00	0.00
11.01	24.25	-7.08	11.02	24.25	-7.08	0.00	0.00
13.53	-2.22	63.09	13.53	-2.22	63.09	0.00	0.00
5.40	18.33	-3.17	5.40	18.33	-3.17	0.00	0.00
20.63	13.24	56.08	20.63	13.23	56.08	0.00	0.00
11.90	12.50	63.12	11.90	12.50	63.12	0.00	0.00
30.49	-6.13	-24.27	30.49	-6.13	-24.27	0.00	0.00
-0.26	-0.13	-25.20	-0.26	-0.13	-25.20	0.00	0.00
1.87	-18.32	-20.46	1.87	-18.31	-20.46	0.00	0.00
6.25	-7.05	33.50	6.26	-7.06	33.50	0.01	0.00
38.50	3.35	-12.27	38.50	3.35	-12.27	0.00	0.00
18.62	18.06	45.50	18.62	18.06	45.50	0.00	0.00
-27.27	-20.38	-46.18	-27.27	-20.38	-46.18	0.00	0.00
33.35	-5.62	-2.25	33.35	-5.62	-2.25	0.00	0.00
2.96	-5.83	-25.49	2.96	-5.83	-25.49	0.00	0.00
-13.80	-7.55	3.38	-13.80	-7.55	3.38	0.01	0.00
-39.83	1.92	-29.21	-39.84	1.93	-29.21	0.00	0.00
34.77	15.80	-10.97	34.76	15.79	-10.97	0.00	0.00
23.89	14.05	32.87	23.88	14.05	32.87	0.01	0.00
2.24	20.45	41.77	2.24	20.44	41.77	0.01	0.00
-3.95	16.07	8.89	-3.95	16.07	8.89	0.00	0.00
25.86	-0.05	-28.78	25.86	-0.06	-28.78	0.00	0.00
-16.13	10.76	-33.30	-16.14	10.76	-33.30	0.00	0.00
1.44	19.50	45.78	1.44	19.51	45.78	0.00	0.00
1.73	-16.69	-25.09	1.73	-16.69	-25.09	0.00	0.00
17.13	25.01	-22.77	17.13	25.00	-22.77	0.01	0.00

15.89	21.62	38.83	15.89	21.62	38.83	0.00
9.74	21.71	39.47	9.74	21.70	39.47	0.01
4.00	-17.11	-10.05	4.00	-17.12	-10.05	0.00
7.64	-7.14	53.02	7.64	-7.14	53.02	0.00
12.15	18.17	-18.18	12.15	18.17	-18.18	0.00
-1.67	-5.36	49.01	-1.67	-5.37	49.01	0.01
29.98	14.69	14.76	29.98	14.69	14.76	0.00
14.27	-8.24	14.24	14.27	-8.25	14.24	0.01

Listing 2. PA4-B-Debug-Output.txt

200	PA4-B-Debug-Output.txt						
-14.19	5.60	-9.93	-14.19	5.60	-9.93	0.00	0.00
-19.03	-32.45	-30.71	-19.03	-32.45	-30.71	0.00	0.00
-31.34	-23.41	-11.04	-31.34	-23.41	-11.04	0.00	0.00
-23.21	-32.51	-31.27	-23.21	-32.51	-31.27	0.00	0.00
26.99	-0.75	23.42	26.99	-0.75	23.42	0.00	0.00
4.41	-16.98	-10.11	4.41	-16.98	-10.11	0.00	0.00
26.52	0.78	-29.42	26.52	0.79	-29.41	0.01	0.01
-6.74	7.90	55.65	-6.74	7.90	55.65	0.00	0.00
-1.52	-22.36	-26.30	-1.52	-22.37	-26.30	0.00	0.00
36.66	3.64	10.34	36.67	3.64	10.35	0.00	0.00
30.87	-9.79	-16.64	30.87	-9.79	-16.64	0.00	0.00
-0.77	-16.19	-35.46	-0.77	-16.19	-35.46	0.00	0.00
20.08	-0.22	-24.19	20.08	-0.22	-24.19	0.00	0.00
5.32	19.77	52.16	5.33	19.77	52.16	0.00	0.00
-39.80	-15.69	-14.67	-39.80	-15.69	-14.68	0.01	0.01
22.55	-7.82	8.95	22.55	-7.82	8.95	0.01	0.01
-0.78	-11.36	-34.42	-0.78	-11.37	-34.42	0.00	0.00
4.50	-5.22	-24.25	4.50	-5.22	-24.25	0.00	0.00
-32.20	-18.49	-8.69	-32.20	-18.49	-8.69	0.00	0.00
23.70	9.86	41.88	23.71	9.86	41.88	0.00	0.00
20.33	-10.95	2.20	20.33	-10.95	2.20	0.00	0.00
-5.11	-11.51	4.56	-5.11	-11.50	4.56	0.00	0.00
35.72	11.38	-14.45	35.72	11.38	-14.45	0.00	0.00
17.83	16.52	59.29	17.82	16.52	59.29	0.01	0.01
8.07	-3.09	-22.44	8.07	-3.09	-22.43	0.00	0.00
-15.95	15.60	20.62	-15.95	15.60	20.62	0.00	0.00
-35.37	-15.68	-43.87	-35.37	-15.68	-43.87	0.00	0.00
10.32	-13.19	4.51	10.32	-13.19	4.51	0.00	0.00
28.97	9.12	-29.61	28.97	9.12	-29.61	0.00	0.00
31.93	-5.35	10.19	31.93	-5.35	10.18	0.01	0.01
-15.54	-12.52	-48.49	-15.54	-12.52	-48.49	0.00	0.00
-9.22	-11.19	2.64	-9.22	-11.19	2.63	0.00	0.00
10.32	-13.19	4.51	10.32	-13.19	4.51	0.00	0.00
15.20	25.36	-11.12	15.19	25.36	-11.12	0.00	0.00
2.92	-11.77	10.09	2.92	-11.77	10.09	0.00	0.00
-37.19	5.16	-28.10	-37.19	5.15	-28.10	0.00	0.00
1.38	11.46	-7.37	1.38	11.46	-7.37	0.00	0.00
-8.95	-14.41	-45.21	-8.95	-14.41	-45.21	0.00	0.00
-40.34	-18.52	-17.76	-40.34	-18.52	-17.76	0.00	0.00
-26.67	-19.03	-7.06	-26.67	-19.03	-7.06	0.00	0.00
33.43	-2.24	-23.20	33.43	-2.24	-23.20	0.00	0.00
1.38	11.46	-7.37	1.38	11.46	-7.37	0.00	0.00
24.89	-12.95	-4.63	24.89	-12.94	-4.63	0.00	0.00
-40.42	1.33	-25.20	-40.41	1.33	-25.20	0.00	0.00
18.78	16.91	50.84	18.78	16.90	50.84	0.01	0.01
25.71	17.26	-26.62	25.71	17.26	-26.62	0.00	0.00
-16.14	-17.99	-6.11	-16.14	-17.99	-6.11	0.00	0.00
16.74	19.64	46.94	16.73	19.64	46.93	0.00	0.00
-0.24	-10.88	12.71	-0.24	-10.88	12.71	0.00	0.00
21.12	-8.22	8.85	21.12	-8.22	8.85	0.00	0.00
19.04	20.43	-28.64	19.03	20.43	-28.64	0.00	0.00
15.28	-5.09	49.74	15.28	-5.09	49.74	0.00	0.00

-6.60	-2.96	31.94	-6.60	-2.96	31.94	0.00	-35.87	2.72	-15.30	-35.87	2.72	-15.30	0.00
-1.97	-22.04	-19.01	-1.98	-22.04	-19.01	0.00	-15.43	-18.61	-6.64	-15.43	-18.62	-6.64	0.00
33.29	11.79	12.33	33.30	11.79	12.33	0.00	-7.93	-3.44	24.03	-7.93	-3.44	24.03	0.00
-35.24	-25.87	-34.26	-35.23	-25.87	-34.26	0.00	-4.58	11.00	-0.24	-4.58	11.00	-0.24	0.00
-18.19	11.05	-33.91	-18.19	11.06	-33.91	0.00	6.74	19.36	-5.38	6.74	19.36	-5.38	0.00
18.91	19.44	39.22	18.91	19.44	39.21	0.00	12.60	-9.54	11.79	12.60	-9.54	11.79	0.00
-33.03	-3.13	-9.80	-33.03	-3.13	-9.80	0.00	1.21	18.62	51.29	1.22	18.61	51.29	0.00
-24.03	10.30	-34.78	-24.03	10.29	-34.77	0.01	-32.45	-17.19	-8.50	-32.45	-17.19	-8.50	0.00
-13.57	9.14	-34.61	-13.57	9.14	-34.61	0.00	-9.26	-20.96	-43.06	-9.26	-20.96	-43.07	0.01
-37.23	2.20	-16.98	-37.23	2.20	-16.98	0.00	-21.55	-10.76	-4.14	-21.55	-10.76	-4.14	0.00
-1.14	21.52	36.74	-1.14	21.51	36.74	0.00	-9.65	15.21	38.00	-9.65	15.21	38.00	0.00
-28.61	-7.64	-7.75	-28.61	-7.64	-7.75	0.00	-30.11	-30.30	-21.76	-30.11	-30.29	-21.76	0.00
30.01	-6.20	10.16	30.01	-6.20	10.16	0.00	-4.11	-11.54	5.20	-4.11	-11.54	5.20	0.00
-27.49	-29.94	-35.34	-27.48	-29.94	-35.34	0.01	-15.97	15.50	30.32	-15.98	15.50	30.32	0.01
-5.37	-21.91	-13.38	-5.36	-21.91	-13.38	0.00	37.38	-0.94	8.11	37.38	-0.94	8.11	0.00
-0.55	10.38	-8.02	-0.55	10.38	-8.02	0.00	20.32	-12.01	0.37	20.32	-12.01	0.37	0.00
13.12	-6.01	54.92	13.12	-6.00	54.92	0.00	-1.69	18.68	8.72	-1.69	18.68	8.72	0.00
10.67	23.14	26.68	10.67	23.14	26.68	0.00	14.68	-8.52	-21.76	14.68	-8.52	-21.76	0.00
-28.18	-25.16	-10.77	-28.18	-25.16	-10.77	0.00	-10.13	-3.87	13.41	-10.14	-3.88	13.41	0.00
-38.25	-21.05	-16.38	-38.25	-21.05	-16.38	0.00	-8.84	-29.14	-25.92	-8.84	-29.14	-25.93	0.00
-11.67	-15.46	-4.13	-11.67	-15.46	-4.13	0.00	10.51	24.27	19.52	10.51	24.27	19.52	0.00
12.31	-6.27	45.23	12.31	-6.27	45.23	0.00	31.16	0.76	16.62	31.16	0.76	16.62	0.00
-6.76	3.09	53.74	-6.76	3.09	53.74	0.00	1.77	-11.25	-26.91	1.77	-11.25	-26.92	0.00
-7.10	6.22	57.31	-7.10	6.22	57.31	0.00	18.33	26.62	-4.34	18.34	26.63	-4.34	0.01
28.34	-7.09	-24.38	28.34	-7.08	-24.37	0.01	-5.10	8.78	-11.66	-5.10	8.78	-11.66	0.00
-11.73	9.00	-18.28	-11.73	9.01	-18.28	0.00	25.02	23.40	7.28	25.02	23.40	7.28	0.00
24.11	24.41	-12.01	24.11	24.41	-12.01	0.00	20.30	18.32	36.87	20.30	18.32	36.87	0.00
-6.97	6.93	44.88	-6.97	6.93	44.88	0.00	22.48	10.22	49.47	22.48	10.22	49.47	0.00
-12.28	8.53	-34.60	-12.28	8.53	-34.60	0.00	0.82	18.18	53.85	0.82	18.18	53.85	0.00
14.49	21.17	-29.50	14.49	21.17	-29.50	0.00	-2.83	11.19	-2.90	-2.83	11.19	-2.90	0.00
-34.44	-13.25	-45.69	-34.44	-13.24	-45.69	0.00	8.37	-15.31	-2.00	8.37	-15.30	-2.01	0.00
-22.49	1.98	-11.37	-22.49	1.97	-11.37	0.00	30.37	20.65	-2.19	30.37	20.65	-2.19	0.00
-6.37	-17.28	-6.24	-6.37	-17.28	-6.24	0.00	-41.60	-6.41	-33.27	-41.60	-6.41	-33.27	0.00
25.53	-2.61	23.27	25.53	-2.61	23.27	0.00	22.07	0.96	45.04	22.07	0.96	45.04	0.00
0.20	6.10	-19.81	0.20	6.10	-19.81	0.00	23.30	23.86	8.15	23.30	23.86	8.15	0.00
-6.57	-6.91	12.86	-8.57	-6.90	12.86	0.01	-3.27	22.92	33.14	-3.27	22.92	33.14	0.00
29.39	6.76	-28.96	29.39	6.76	-28.95	0.00	-14.05	-25.38	-11.54	-14.05	-25.38	-11.54	0.00
-8.06	-16.89	-5.88	-8.06	-16.89	-5.88	0.00	22.15	-5.72	18.13	22.15	-5.72	18.13	0.00
-3.06	18.87	42.98	-3.06	18.87	42.98	0.00	-22.64	-8.63	-4.65	-22.64	-8.63	-4.65	0.00
-36.29	-0.05	-39.98	-36.29	-0.05	-39.97	0.00	2.65	20.49	41.68	2.65	20.49	41.68	0.00
-15.75	-30.81	-19.67	-15.75	-30.81	-19.67	0.00	7.82	20.66	45.18	7.82	20.66	45.18	0.00
8.65	18.60	61.53	8.65	18.60	61.53	0.00	32.62	-5.01	-22.79	32.62	-5.00	-22.79	0.01
24.68	10.44	35.47	24.68	10.44	35.47	0.00	-35.29	-24.12	-15.86	-35.29	-24.12	-15.86	0.00
12.61	16.47	-27.98	12.62	16.47	-27.98	0.01	29.22	-1.61	-27.20	29.22	-1.61	-27.20	0.00
9.55	21.70	40.07	9.55	21.69	40.07	0.00	21.33	8.10	59.90	21.33	8.10	59.90	0.00
21.31	-11.68	-0.09	21.31	-11.68	-0.08	0.00	-14.21	-31.58	-26.08	-14.21	-31.58	-26.08	0.00
-4.36	-18.35	-39.41	-4.36	-18.35	-39.41	0.00	-0.98	-20.35	-15.95	-0.98	-20.34	-15.95	0.00
-9.20	-22.73	-11.51	-9.20	-22.73	-11.51	0.00	-9.97	21.01	17.08	-9.97	21.01	17.08	0.00
10.95	-6.32	34.89	10.95	-6.32	34.89	0.00	32.44	-5.91	8.08	32.43	-5.91	8.08	0.01
12.27	-16.45	-10.91	12.27	-16.44	-10.91	0.00	21.96	24.73	-19.10	21.96	24.73	-19.10	0.01
-37.48	-1.58	-39.65	-37.48	-1.58	-39.65	0.00	-27.92	-28.95	-37.06	-27.92	-28.94	-37.06	0.00
-12.64	5.23	0.54	-12.63	5.23	0.54	0.00	-3.63	-14.56	-39.97	-3.63	-14.56	-39.97	0.00
36.72	1.40	10.25	36.72	1.40	10.25	0.00	-9.53	-28.76	-31.46	-9.54	-28.76	-31.46	0.00
6.02	-16.26	-9.56	6.02	-16.26	-9.56	0.00	23.84	9.48	41.31	23.85	9.48	41.31	0.00
11.88	21.98	36.10	11.88	21.99	36.10	0.00	-9.70	12.26	36.36	-9.70	12.26	36.36	0.00
28.41	0.11	20.87	28.41	0.11	20.87	0.00	-1.00	-16.08	-35.90	-1.00	-16.08	-35.91	0.00
-7.95	-7.48	-44.93	-7.95	-7.48	-44.94	0.00	-33.81	-6.66	-9.00	-33.81	-6.66	-9.00	0.00
11.84	20.82	54.37	11.84	20.82	54.37	0.00	32.59	0.03	14.55	32.59	0.03	14.55	0.00
25.46	24.11	0.06	25.46	24.11	0.07	0.01	16.52	-4.25	52.60	16.52	-4.26	52.60	0.00
-39.87	1.87	-29.46	-39.87	1.87	-29.46	0.00	-19.18	-20.93	-46.64	-19.18	-20.93	-46.64	0.00
-8.89	-0.46	22.82	-8.89	-0.46	22.82	0.00	28.87	-9.08	1.83	28.87	-9.07	1.83	0.00
-22.20	-2.40	-47.39	-22.20	-2.40	-47.39	0.00	-29.11	-31.23	-24.52	-29.11	-31.24	-24.52	0.00
0.13	-19.96	-25.24	0.14	-19.96	-25.24	0.01	-26.97	2.41	-43.68	-26.97	2.41	-43.68	0.00
9.77	22.20	-8.20	9.76	22.21	-8.20	0.00	-23.03	-28.36	-13.41	-23.03	-28.37	-13.41	0.00
-28.99	-28.18	-37.67	-28.98	-28.17	-37.67	0.00	15.61	-9.42	-21.12	15.61	-9.42	-21.12	0.00
-14.03	-0.89	6.78	-14.04	-0.89	6.78	0.00	-3.37	12.52	1.69	-3.37	12.53	1.69	0.01
-0.75	0.34	-25.42	-0.75	0.34	-25.42	0.00	7.25	-7.31	60.00	7.25	-7.32	60.00	0.00
-32.82	-2.63	-43.95	-32.81	-2.64	-43.95	0.00	-29.76	-13.07	-6.09	-29.76	-13.07	-6.09	0.00
-11.32	-26.01	-14.20	-11.32	-26.01	-14.20	0.00	200	PA4-C-Debug-Output.txt		200	PA4-C-Debug-Output.txt		
-38.56	-23.40	-21.05	-38.56	-23.40	-21.05	0.00							
7.98	23.57	23.80	7.98	23.57	23.80	0.00							
-25.06	1.20	-45.27	-25.06	1.20	-45.27	0.00							

Listing 3. PA4-C-Debug-Output.txt

-5.71	11.00	57.09	-5.71	11.00	57.09	0.00	-6.99	4.74	-33.32	-6.99	4.74	-33.32	0.00
-13.63	-28.74	-17.00	-13.63	-28.75	-17.00	0.00	-10.05	12.92	13.83	-10.05	12.92	13.83	0.00
-12.35	-1.14	-45.17	-12.35	-1.14	-45.17	0.00	36.58	13.96	5.53	36.58	13.96	5.53	0.00
20.23	13.98	54.21	20.23	13.97	54.21	0.00	12.35	16.66	-22.14	12.35	16.66	-22.14	0.00
-6.50	-12.62	1.24	-6.50	-12.62	1.24	0.00	-25.33	-32.49	-23.47	-25.33	-32.49	-23.47	0.00
7.89	22.49	30.60	7.89	22.49	30.60	0.00	-14.75	-16.80	-47.25	-14.75	-16.80	-47.25	0.00
11.33	-2.37	63.22	11.33	-2.37	63.22	0.00	-16.19	17.65	23.58	-16.19	17.65	23.58	0.00
6.72	19.82	59.01	6.72	19.82	59.01	0.00	-8.39	-26.12	-36.63	-8.39	-26.12	-36.63	0.00
28.19	9.88	-29.68	28.19	9.88	-29.68	0.00	-29.09	4.99	-40.36	-29.09	4.99	-40.36	0.00
-12.51	14.74	17.16	-12.51	14.74	17.16	0.00	13.60	18.55	62.43	13.60	18.55	62.43	0.00
24.83	23.03	-21.20	24.83	23.03	-21.21	0.00	21.65	25.49	-6.79	21.65	25.49	-6.79	0.00
-40.85	-19.15	-30.19	-40.85	-19.15	-30.19	0.00	-27.39	11.00	-22.96	-27.39	11.01	-22.96	0.00
-8.45	-22.59	-11.81	-8.45	-22.59	-11.81	0.00	3.67	24.42	15.72	3.67	24.42	15.72	0.00
-25.92	-26.56	-11.29	-25.92	-26.56	-11.29	0.00	18.92	20.53	-28.65	18.91	20.52	-28.65	0.00
-13.10	-11.60	-0.47	-13.10	-11.61	-0.47	0.00	27.87	-11.59	-10.73	27.86	-11.59	-10.73	0.01
-27.82	9.81	-32.30	-27.82	9.81	-32.30	0.00	-20.99	-21.41	-7.41	-20.99	-21.41	-7.41	0.00
14.17	21.80	44.17	14.17	21.80	44.17	0.00	-0.62	-6.28	40.68	-0.62	-6.28	40.68	0.00
-8.69	7.01	30.64	-8.69	7.00	30.64	0.01	7.03	-12.51	6.12	7.03	-12.51	6.12	0.00
15.76	21.19	41.87	15.76	21.19	41.87	0.00	17.47	21.27	-28.89	17.47	21.27	-28.89	0.00
0.43	20.39	7.93	0.43	20.40	7.93	0.00	16.43	-4.79	46.45	16.44	-4.79	46.45	0.00
-10.78	-30.16	-27.73	-10.78	-30.16	-27.73	0.00	21.02	-13.35	-18.37	21.02	-13.35	-18.37	0.01
20.46	0.06	52.56	20.46	0.06	52.56	0.00	17.86	-7.14	16.21	17.86	-7.14	16.20	0.00
14.54	25.70	-8.28	14.53	25.71	-8.28	0.01	22.01	21.05	21.34	22.02	21.05	21.34	0.00
7.27	-16.31	-13.33	7.27	-16.31	-13.33	0.01	-40.25	-16.71	-16.01	-40.26	-16.71	-16.01	0.00
-27.25	-30.70	-18.52	-27.25	-30.70	-18.52	0.00	-0.34	-10.41	-31.60	-0.34	-10.41	-31.60	0.00
-1.09	-20.12	-32.47	-1.10	-20.12	-32.47	0.00	-26.14	-32.34	-23.06	-26.14	-32.34	-23.06	0.00
-35.48	-16.44	-9.66	-35.48	-16.44	-9.66	0.00	-1.78	0.48	63.43	-1.78	0.48	63.43	0.00
-13.52	21.76	20.66	-13.52	21.76	20.66	0.00	-25.93	-13.29	-48.20	-25.93	-13.29	-48.20	0.00
-18.15	4.48	-11.28	-18.15	4.48	-11.28	0.00	3.96	-5.92	-24.74	3.96	-5.92	-24.74	0.00
24.64	17.29	23.81	24.64	17.29	23.81	0.00	13.29	-5.75	57.26	13.29	-5.75	57.26	0.00
-11.67	-13.60	-47.02	-11.67	-13.60	-47.02	0.00	-2.04	-21.46	-33.33	-2.04	-21.46	-33.33	0.00
-25.87	10.01	-18.84	-25.86	10.01	-18.84	0.00	1.46	-5.40	63.49	1.46	-5.40	63.49	0.00
-14.21	2.30	3.63	-14.21	2.29	3.63	0.00	33.33	13.44	-20.11	33.34	13.44	-20.11	0.00
-39.02	-17.91	-37.64	-39.02	-17.91	-37.64	0.00	-11.78	-27.85	-16.30	-11.78	-27.85	-16.30	0.00
-26.02	3.99	-42.54	-26.02	3.99	-42.54	0.00	15.41	-8.63	12.12	15.41	-8.63	12.12	0.00
-5.17	-1.87	54.20	-5.17	-1.87	54.20	0.00	-21.99	-31.31	-34.97	-21.99	-31.31	-34.97	0.00
2.82	-6.86	45.07	2.82	-6.86	45.07	0.00	23.89	7.38	41.74	23.89	7.38	41.74	0.00
-10.29	22.16	18.33	-10.29	22.16	18.33	0.00	-30.59	0.80	-42.92	-30.59	0.80	-42.92	0.00
11.82	24.71	16.05	11.82	24.71	16.05	0.00	34.94	15.23	6.57	34.95	15.23	6.57	0.01
4.36	19.12	56.31	4.36	19.12	56.31	0.01	6.11	20.15	-3.46	6.11	20.15	-3.46	0.00
23.90	6.78	-30.36	23.90	6.78	-30.36	0.00	15.82	0.01	-21.74	15.83	0.01	-21.74	0.00
-18.04	5.58	-13.10	-18.04	5.58	-13.10	0.00	18.58	-8.65	9.75	18.58	-8.64	9.75	0.00
0.99	23.11	29.69	0.99	23.10	29.69	0.00	17.06	22.24	29.18	17.06	22.24	29.18	0.00
-32.07	8.99	-24.69	-32.06	8.99	-24.69	0.00	25.41	-6.72	11.15	25.41	-6.72	11.15	0.00
20.89	0.10	-25.33	20.89	0.10	-25.33	0.00	-27.92	10.17	-20.46	-27.92	10.17	-20.46	0.00
-5.01	20.25	13.38	-5.01	20.25	13.38	0.00	-31.86	8.91	-29.23	-31.86	8.91	-29.23	0.00
-28.72	7.88	-36.18	-28.73	7.89	-36.18	0.00	-8.28	7.89	-24.79	-8.28	7.89	-24.79	0.00
-34.29	7.56	-28.33	-34.29	7.56	-28.33	0.00	-2.35	-20.43	-13.77	-2.35	-20.43	-13.77	0.00
22.82	3.05	44.87	22.82	3.05	44.87	0.00	22.51	13.69	41.26	22.52	13.69	41.26	0.00
2.69	-18.30	-14.52	2.69	-18.30	-14.52	0.00	-9.44	-28.63	-31.89	-9.44	-28.63	-31.89	0.00
-0.46	-12.62	2.30	-0.46	-12.62	2.30	0.00	-12.95	10.83	20.43	-12.95	10.83	20.43	0.01
-18.07	-15.83	-48.09	-18.07	-15.83	-48.09	0.00	13.07	27.31	0.43	13.07	27.31	0.43	0.00
21.95	0.97	45.62	21.94	0.97	45.62	0.00	9.68	-11.22	9.29	9.68	-11.22	9.29	0.01
21.47	-13.20	-18.62	21.47	-13.20	-18.62	0.01	-11.22	7.31	10.48	-11.21	7.31	10.48	0.00
11.93	11.95	63.12	11.93	11.95	63.12	0.00	-42.07	-14.22	-18.69	-42.07	-14.21	-18.69	0.00
38.19	11.00	5.01	38.19	11.00	5.01	0.00	-6.19	0.22	41.69	-6.19	0.22	41.69	0.00
8.11	-6.70	37.17	8.11	-6.70	37.17	0.00	-25.24	8.13	-37.96	-25.24	8.13	-37.96	0.00
-24.83	11.30	-21.30	-24.83	11.30	-21.30	0.00	0.06	-8.19	27.12	0.06	-8.18	27.12	0.00
5.85	-14.51	-20.87	5.85	-14.51	-20.87	0.00	-24.70	-21.49	-7.31	-24.70	-21.49	-7.31	0.00
24.58	12.59	32.56	24.58	12.59	32.56	0.00	37.25	12.56	-4.29	37.25	12.57	-4.29	0.01
-36.27	-25.06	-33.79	-36.27	-25.06	-33.79	0.00	17.63	26.28	6.66	17.63	26.28	6.66	0.00
-22.34	8.79	-37.68	-22.34	8.79	-37.68	0.01	-43.34	-12.50	-26.24	-43.34	-12.50	-26.23	0.00
35.98	13.57	-10.60	35.97	13.57	-10.60	0.00	-9.42	-3.51	16.96	-9.43	-3.51	16.96	0.00
6.38	-14.37	-20.30	6.38	-14.37	-20.30	0.00	29.67	20.81	6.51	29.68	20.81	6.51	0.01
-7.13	8.54	41.54	-7.13	8.54	41.54	0.00	-29.77	4.81	-40.22	-29.77	4.81	-40.22	0.00
-21.31	4.15	-42.99	-21.31	4.15	-42.99	0.00	19.54	22.77	-26.47	19.54	22.77	-26.47	0.00
21.22	14.07	-30.58	21.22	14.07	-30.58	0.00	21.61	10.24	56.20	21.61	10.24	56.20	0.00
15.09	-7.55	-22.07	15.09	-7.55	-22.06	0.01	-3.72	18.51	10.80	-3.71	18.51	10.80	0.00
7.85	-14.60	-0.43	7.85	-14.60	-0.43	0.00	-5.10	0.22	-35.83	-5.10	0.22	-35.83	0.00
-4.95	-0.67	-37.30	-4.95	-0.67	-37.30	0.00	22.81	13.49	39.84	22.81	13.49	39.84	0.00
3.00	-6.94	40.54	3.00	-6.94	40.54	0.01	-6.24	-27.04	-22.98	-6.24	-27.04	-22.98	0.00
22.44	-16.05	-12.14	22.43	-16.04	-12.14	0.00	13.01	7.37	62.98	13.01	7.37	62.99	0.00

-8.66	-20.73	-42.78	-8.67	-20.73	-42.78	0.00	12.79	-8.28	-21.62	12.79	-8.28	-21.62	0.00
10.57	-6.70	52.95	10.57	-6.70	52.95	0.00	-2.20	-4.07	-30.42	-2.20	-4.07	-30.43	0.01
29.51	-1.87	17.36	29.51	-1.87	17.36	0.00	1.24	-11.67	8.27	1.24	-11.68	8.27	0.01
3.38	-5.57	63.46	3.38	-5.57	63.46	0.00	-11.59	18.03	36.45	-11.59	18.03	36.45	0.00
-14.15	-15.06	-47.82	-14.15	-15.06	-47.82	0.00	24.49	-3.85	21.96	24.49	-3.85	21.96	0.00
-12.04	9.38	19.30	-12.05	9.38	19.30	0.00	-13.21	-31.18	-24.62	-13.21	-31.17	-24.62	0.01
12.39	17.03	-20.91	12.38	17.03	-20.91	0.00	24.36	10.01	37.92	24.36	10.02	37.92	0.01
20.66	25.95	2.27	20.66	25.95	2.27	0.00	37.16	13.02	3.64	37.15	13.02	3.64	0.00
21.54	22.45	-25.41	21.54	22.45	-25.41	0.00	-2.04	9.62	-9.47	-2.04	9.61	-9.47	0.00
-3.76	-16.02	-4.73	-3.76	-16.02	-4.73	0.00	-15.45	-24.76	-10.86	-15.45	-24.77	-10.85	0.01
-4.37	13.62	57.09	-4.37	13.62	57.09	0.00	-4.31	-3.08	54.64	-4.31	-3.08	54.64	0.00
-30.33	6.50	-37.74	-30.34	6.50	-37.74	0.00	-6.31	-1.45	35.75	-6.31	-1.45	35.75	0.00
38.93	2.03	6.95	38.93	2.03	6.95	0.00	-5.93	15.90	11.12	-5.93	15.90	11.12	0.00
-6.49	17.14	12.64	-6.49	17.14	12.64	0.00	-7.03	9.02	-1.76	-7.03	9.02	-1.76	0.01
-16.06	19.15	24.30	-16.06	19.15	24.30	0.00	8.33	-5.80	63.42	8.33	-5.80	63.42	0.00
14.34	-16.89	-10.44	14.34	-16.88	-10.43	0.01	28.40	9.90	-29.58	28.40	9.90	-29.58	0.00
3.98	-7.37	59.40	3.98	-7.37	59.40	0.00	-13.17	-1.39	8.81	-13.17	-1.39	8.81	0.00
31.62	-7.61	-0.41	31.61	-7.61	-0.41	0.01	27.97	-6.79	10.31	27.97	-6.79	10.31	0.00
-4.67	16.87	10.41	-4.67	16.87	10.41	0.00	29.50	4.41	-28.84	29.50	4.41	-28.84	0.00
33.82	-5.46	6.92	33.82	-5.45	6.92	0.00	-35.30	0.60	-40.33	-35.31	0.61	-40.34	0.01
-33.02	5.83	-16.37	-33.02	5.82	-16.37	0.00	-7.07	-20.38	-41.52	-7.07	-20.38	-41.53	0.00
-36.67	5.65	-28.04	-36.68	5.66	-28.04	0.00	-8.01	2.74	28.94	-8.01	2.74	28.94	0.00
6.74	-1.06	-22.27	6.74	-1.06	-22.26	0.00	30.98	20.15	-11.57	30.99	20.15	-11.57	0.00
1.51	-0.24	-24.21	1.51	-0.24	-24.20	0.00	12.56	22.75	-15.00	12.56	22.74	-15.00	0.00
7.49	3.73	63.16	7.49	3.73	63.17	0.00	4.55	4.87	63.40	4.55	4.87	63.40	0.00
22.83	-12.06	-2.00	22.83	-12.06	-2.00	0.00	-13.83	22.90	25.17	-13.84	22.91	25.17	0.01
-11.63	-29.91	-31.74	-11.63	-29.91	-31.74	0.00	-26.30	-22.44	-8.01	-26.30	-22.44	-8.01	0.00
30.88	16.36	-21.73	30.89	16.37	-21.74	0.00	29.43	10.45	19.30	29.43	10.45	19.30	0.00
-0.15	-20.33	-25.51	-0.15	-20.33	-25.51	0.00	-29.16	-26.60	-12.98	-29.16	-26.59	-12.99	0.01
18.65	-17.21	-8.12	18.65	-17.20	-8.12	0.00	22.65	10.05	48.75	22.66	10.05	48.75	0.01
-7.42	21.22	36.85	-7.42	21.22	36.85	0.00	-3.76	16.74	9.37	-3.77	16.74	9.36	0.01
-9.64	-24.06	-12.69	-9.64	-24.06	-12.69	0.00	24.59	6.09	37.95	24.59	6.09	37.95	0.00
-3.26	-5.80	34.53	-3.27	-5.81	34.53	0.01	-14.85	2.53	1.56	-14.85	2.53	1.56	0.00
14.60	15.24	63.11	14.60	15.24	63.12	0.01	-12.65	-26.89	-14.51	-12.65	-26.89	-14.51	0.00
-1.75	12.20	-2.10	-1.75	12.20	-2.11	0.00	18.58	26.56	-4.63	18.57	26.56	-4.63	0.00
-6.43	-25.35	-18.11	-6.43	-25.35	-18.11	0.00	8.75	-11.79	-20.92	8.75	-11.79	-20.92	0.00
-20.83	-32.67	-30.45	-20.83	-32.67	-30.45	0.00	-34.99	-10.76	-45.36	-34.99	-10.76	-45.36	0.00
-40.82	-18.79	-19.18	-40.82	-18.79	-19.18	0.00	-39.20	2.06	-31.36	-39.20	2.06	-31.36	0.00
15.41	22.72	27.66	15.41	22.71	27.66	0.00	-30.47	-3.88	-9.54	-30.47	-3.88	-9.54	0.00
20.68	17.98	36.41	20.68	17.98	36.41	0.00	4.65	-14.61	-21.99	4.65	-14.61	-21.99	0.00
-13.69	-1.28	7.50	-13.70	-1.28	7.50	0.00	20.27	-6.72	-23.95	20.27	-6.72	-23.95	0.00
-0.04	4.49	-22.16	-0.04	4.49	-22.16	0.00	33.39	-7.16	-13.08	33.39	-7.16	-13.08	0.00
-30.81	-5.82	-46.50	-30.81	-5.82	-46.50	0.00	2.19	-11.83	8.62	2.19	-11.83	8.62	0.01
7.58	23.41	24.67	7.58	23.40	24.66	0.00	17.17	22.33	28.56	17.16	22.33	28.56	0.01
-8.29	6.10	30.81	-8.30	6.10	30.81	0.00	-14.24	3.93	-0.76	-14.24	3.93	-0.76	0.00
21.24	-7.72	10.63	21.24	-7.72	10.63	0.00	6.37	-12.68	-21.92	6.37	-12.68	-21.93	0.00
20.00	22.11	21.92	20.00	22.11	21.92	0.00	-6.73	3.39	59.22	-6.74	3.39	59.22	0.01
25.05	-5.20	16.54	25.04	-5.19	16.54	0.01	-16.15	18.80	25.78	-16.16	18.80	25.78	0.01
-31.40	-29.33	-20.41	-31.40	-29.33	-20.41	0.00	36.15	4.51	-17.83	36.14	4.51	-17.83	0.01
8.00	21.39	39.50	8.00	21.39	39.50	0.00	-40.03	-13.90	-34.82	-40.02	-13.90	-34.82	0.00
37.46	12.53	-0.17	37.47	12.53	-0.17	0.01	29.47	0.20	-28.13	29.47	0.20	-28.13	0.00
38.16	2.38	8.56	38.16	2.38	8.56	0.00	-17.04	-20.84	-46.04	-17.04	-20.83	-46.03	0.00
17.09	-12.54	2.74	17.09	-12.54	2.74	0.00	-29.80	7.24	-36.65	-29.80	7.24	-36.65	0.00
-15.07	12.52	23.52	-15.08	12.52	23.51	0.01	14.25	22.57	32.10	14.25	22.57	32.10	0.01
-0.34	-12.60	-34.01	-0.34	-12.60	-34.01	0.00	-40.25	-19.91	-31.96	-40.25	-19.91	-31.96	0.00
32.24	17.06	-16.88	32.24	17.06	-16.88	0.00	21.45	8.79	58.68	21.45	8.79	58.68	0.00
							-39.55	-18.20	-35.17	-39.55	-18.20	-35.17	0.00
							28.24	-2.55	-27.17	28.23	-2.55	-27.16	0.00
							-36.82	-17.41	-41.36	-36.82	-17.42	-41.36	0.00
							2.97	-16.47	-22.52	2.97	-16.47	-22.52	0.00
							-6.93	4.29	38.71	-6.93	4.29	38.71	0.00
							-30.91	-4.32	-9.34	-30.91	-4.32	-9.35	0.00
							-0.17	-14.36	-33.75	-0.17	-14.36	-33.75	0.00
							7.03	-9.38	16.07	7.03	-9.38	16.07	0.00
							-11.84	-29.93	-32.13	-11.84	-29.93	-32.13	0.00
							11.44	18.30	-13.51	11.44	18.30	-13.51	0.00
							26.04	7.79	-30.33	26.04	7.79	-30.32	0.00
							9.97	-6.51	42.52	9.97	-6.50	42.52	0.01
							-14.23	7.01	-13.92	-14.23	7.00	-13.92	0.00
							-26.30	-25.64	-10.48	-26.30	-25.64	-10.49	0.00
							-17.02	-4.84	0.63	-17.02	-4.85	0.63	0.00
							5.80	-12.38	7.36	5.80	-12.37	7.36	0.01

Listing 4. PA4-D-Debug-Output.txt

200	PA4-D-Debug-Output.txt												
-7.74	11.90	9.08	-7.74	11.90	9.08	0.00	-6.93	4.29	38.71	-6.93	4.29	38.71	0.00
-39.01	-7.91	-12.27	-39.02	-7.91	-12.27	0.00	-30.91	-4.32	-9.34	-30.91	-4.32	-9.35	0.00
-0.22	17.50	5.16	-0.22	17.51	5.16	0.01	-0.17	-14.36	-33.75	-0.17	-14.36	-33.75	0.00
-5.87	-19.72	-40.74	-5.87	-19.72	-40.74	0.00	7.03	-9.38	16.07	7.03	-9.38	16.07	0.00
-0.53	-19.74	-14.69	-0.53	-19.74	-14.69	0.00	-11.84	-29.93	-32.13	-11.84	-29.93	-32.13	0.00
-7.37	12.53	41.82	-7.37	12.53	41.82	0.00	11.44	18.30	-13.51	11.44	18.30	-13.51	0.00
-32.14	-21.52	-42.76	-32.14	-21.52	-42.76	0.00	26.04	7.79	-30.33	26.04	7.79	-30.32	0.00
-36.85	-25.62	-29.60	-36.85	-25.61	-29.60	0.00	9.97	-6.51	42.52	9.97	-6.50	42.52	0.01
0.49	18.66	5.55	0.50	18.66	5.56	0.00	-14.23	7.01	-13.92	-14.23	7.00	-13.92	0.00
20.50	8.08	-28.94	20.50	8.08	-28								

13.13	-6.05	49.03	13.13	-6.05	49.03	0.00	22.26	9.68	51.62	22.26	9.68	51.62	0.00
35.25	14.61	7.11	35.25	14.61	7.11	0.00	-37.55	4.89	-27.32	-37.55	4.89	-27.32	0.00
10.54	-6.07	62.95	10.55	-6.08	62.96	0.01	-41.15	-0.94	-31.53	-41.16	-0.94	-31.53	0.00
11.25	24.12	20.29	11.25	24.12	20.29	0.00	7.99	25.73	6.49	7.99	25.73	6.49	0.01
19.82	-7.21	14.13	19.82	-7.20	14.13	0.00	-3.15	-4.48	50.73	-3.14	-4.47	50.73	0.01
-40.71	0.84	-24.30	-40.71	0.84	-24.30	0.00	6.95	20.54	49.56	6.95	20.53	49.56	0.01
-17.66	-13.69	-48.69	-17.66	-13.69	-48.69	0.00	-10.27	9.43	-22.98	-10.27	9.42	-22.98	0.00
14.23	22.03	35.57	14.23	22.02	35.57	0.01	19.04	16.18	52.46	19.04	16.18	52.46	0.00
39.62	8.03	-0.45	39.62	8.03	-0.45	0.00	-33.20	-14.19	-7.83	-33.20	-14.19	-7.83	0.00
-29.34	10.42	-25.51	-29.34	10.41	-25.51	0.01	12.49	23.47	-12.00	12.48	23.47	-12.00	0.00
-21.11	-31.59	-34.61	-21.11	-31.59	-34.61	0.00	6.09	19.18	-4.28	6.09	19.18	-4.28	0.00
-6.30	-12.40	1.97	-6.30	-12.40	1.97	0.00	-39.91	-10.91	-33.87	-39.91	-10.91	-33.87	0.00
-15.09	-30.15	-18.56	-15.09	-30.15	-18.56	0.00	-4.61	13.57	52.91	-4.61	13.57	52.91	0.00
33.96	16.64	-11.03	33.96	16.65	-11.04	0.00	37.36	2.23	9.59	37.36	2.23	9.59	0.00
35.02	15.25	6.40	35.02	15.25	6.40	0.00	18.79	25.47	-20.07	18.79	25.47	-20.07	0.00
15.26	24.85	-12.85	15.26	24.85	-12.85	0.00	-11.54	7.63	17.12	-11.54	7.63	17.12	0.00
-5.59	-3.91	33.22	-5.59	-3.91	33.22	0.01	2.77	-17.82	-11.34	2.76	-17.81	-11.34	0.00
31.13	-6.42	-23.25	31.13	-6.42	-23.25	0.00	10.29	-6.65	51.11	10.29	-6.64	51.11	0.00
-0.62	-17.67	-34.07	-0.63	-17.67	-34.07	0.00	19.49	-7.59	-23.53	19.49	-7.59	-23.52	0.00
35.28	-3.96	-8.60	35.28	-3.95	-8.60	0.00	20.46	22.40	19.07	20.46	22.40	19.07	0.00
19.09	-10.16	-21.27	19.09	-10.16	-21.27	0.00	30.95	16.21	-21.79	30.95	16.21	-21.79	0.00
13.78	21.51	-29.17	13.78	21.51	-29.17	0.00	10.09	-6.79	52.84	10.09	-6.80	52.84	0.01
-1.83	-22.05	-30.94	-1.83	-22.06	-30.94	0.01	10.34	20.57	-10.91	10.35	20.57	-10.91	0.00
-8.15	25.07	25.26	-8.15	25.06	25.26	0.00	-5.83	-2.53	37.69	-5.82	-2.52	37.69	0.01
1.30	-16.54	-26.23	1.30	-16.54	-26.23	0.00	-12.49	-25.28	-41.29	-12.50	-25.28	-41.29	0.00
35.34	4.00	-19.94	35.34	4.00	-19.94	0.00	31.00	11.92	15.22	31.00	11.92	15.22	0.00
22.22	-3.08	30.29	22.22	-3.08	30.29	0.00	23.53	7.62	43.77	23.53	7.62	43.77	0.00
0.81	-17.19	-8.21	0.81	-17.19	-8.20	0.00	22.70	-11.91	-1.69	22.70	-11.91	-1.69	0.00
37.17	12.51	-5.12	37.17	12.51	-5.12	0.01	-6.14	-12.61	1.57	-6.14	-12.61	1.57	0.00
-1.82	4.08	63.38	-1.82	4.08	63.39	0.00	6.81	22.79	28.97	6.81	22.79	28.97	0.00
-16.31	17.04	22.82	-16.31	17.04	22.82	0.00	24.64	2.17	35.14	24.63	2.17	35.13	0.00
-19.18	-1.17	-4.43	-19.18	-1.17	-4.43	0.00	2.83	23.67	23.81	2.83	23.68	23.81	0.01
21.87	6.98	55.73	21.87	6.98	55.73	0.00	13.75	-7.96	15.62	13.76	-7.96	15.62	0.01
7.21	-8.38	19.27	7.21	-8.38	19.27	0.00	-3.49	-21.99	-15.95	-3.50	-21.99	-15.95	0.00
-11.27	-6.97	6.91	-11.27	-6.97	6.91	0.00	9.75	20.80	-9.73	9.76	20.80	-9.73	0.00
-10.84	0.17	15.71	-10.84	0.17	15.71	0.00	-19.04	-30.54	-16.58	-19.04	-30.54	-16.58	0.00
-8.28	24.52	29.31	-8.28	24.52	29.31	0.00	-11.79	8.89	-32.22	-11.79	8.89	-32.22	0.00
-36.89	-19.81	-13.14	-36.90	-19.81	-13.14	0.00	16.20	19.63	-30.55	16.20	19.63	-30.56	0.00
-26.72	-31.85	-30.86	-26.72	-31.84	-30.85	0.00	11.27	19.80	-13.94	11.28	19.79	-13.94	0.01
-4.03	-11.85	-40.96	-4.03	-11.85	-40.96	0.00	-35.02	-5.38	-43.67	-35.02	-5.38	-43.67	0.00
3.42	-6.97	47.11	3.42	-6.97	47.11	0.00	-11.47	-13.93	-46.94	-11.47	-13.93	-46.93	0.00
10.71	-9.97	11.84	10.71	-9.97	11.84	0.00	24.30	19.92	-25.45	24.30	19.92	-25.45	0.00
-4.30	-24.26	-19.52	-4.31	-24.25	-19.52	0.00	16.18	-10.85	6.60	16.18	-10.85	6.59	0.00
-15.29	-3.68	-47.25	-15.29	-3.68	-47.24	0.00	4.04	4.73	63.46	4.04	4.73	63.45	0.00
34.95	15.58	-8.61	34.96	15.58	-8.61	0.01							
37.37	-1.51	-5.44	37.37	-1.51	-5.44	0.00							
-25.14	11.02	-20.15	-25.14	11.02	-20.15	0.00							
3.77	24.45	15.25	3.77	24.45	15.25	0.00							
-34.58	6.71	-21.92	-34.59	6.72	-21.92	0.00							
35.17	15.32	-0.79	35.17	15.32	-0.79	0.00							
6.76	-3.04	63.40	6.76	-3.04	63.39	0.00							
3.44	-16.63	-7.97	3.44	-16.63	-7.97	0.00							
1.37	23.64	26.46	1.37	23.63	26.46	0.01							
24.69	24.38	1.22	24.69	24.38	1.22	0.00							
-32.52	-12.56	-46.56	-32.52	-12.56	-46.55	0.00							
2.94	24.12	18.50	2.94	24.11	18.50	0.01							
-9.02	12.50	11.71	-9.02	12.50	11.71	0.00							
-6.84	-0.32	33.45	-6.83	-0.32	33.45	0.00							
-8.45	6.42	-32.06	-8.45	6.42	-32.06	0.00							
7.85	-6.72	42.22	7.85	-6.71	42.22	0.01							
22.11	18.32	29.82	22.11	18.32	29.82	0.00							
17.53	-10.48	-20.31	17.53	-10.48	-20.32	0.00							
-11.17	-9.18	-47.25	-11.17	-9.18	-47.25	0.00							
-24.50	-32.53	-29.33	-24.50	-32.52	-29.33	0.00							
1.80	17.60	2.83	1.80	17.60	2.83	0.00							
-12.67	10.44	-22.44	-12.67	10.43	-22.44	0.01							
24.66	16.41	-27.85	24.66	16.41	-27.84	0.00							
29.18	-2.83	16.06	29.18	-2.83	16.06	0.01							
10.21	-15.12	0.21	10.21	-15.12	0.20	0.01							
17.32	22.91	22.95	17.32	22.91	22.95	0.00							
27.10	-9.00	-23.55	27.10	-8.99	-23.55	0.01							
20.49	-8.26	9.32	20.49	-8.26	9.32	0.00							

Listing 5. PA4-E-Debug-Output.txt

14.76	17.69	-30.79	14.76	17.68	-30.80	0.01	15.88	21.20	-29.72	15.87	21.21	-29.75	0.04
-37.47	-11.44	-10.43	-37.47	-11.44	-10.42	0.00	24.55	6.46	-30.42	24.55	6.47	-30.35	0.07
30.24	19.45	-18.64	30.29	19.49	-18.66	0.06	-0.06	12.39	-3.38	-0.12	12.55	-3.44	0.18
-29.75	4.96	-40.19	-29.73	4.93	-40.15	0.05	12.83	20.50	57.44	12.83	20.50	57.44	0.01
-7.56	5.57	-31.21	-7.60	5.54	-31.21	0.06	-7.77	7.67	38.18	-7.56	7.71	38.18	0.22
40.36	2.70	-4.41	40.33	2.72	-4.42	0.03	10.56	7.28	63.00	10.56	7.28	62.93	0.07
-3.89	-6.14	32.59	-3.83	-6.07	32.57	0.09	20.62	10.70	61.89	20.54	10.68	61.87	0.09
16.09	19.07	53.46	16.07	19.04	53.45	0.03	-27.90	-4.56	-47.58	-27.88	-4.59	-47.53	0.07
-38.58	-3.64	-13.81	-38.52	-3.67	-13.85	0.08	17.83	-2.98	52.03	17.87	-3.01	52.04	0.04
25.66	-14.08	-14.84	25.59	-13.99	-14.84	0.11	-39.85	-16.80	-34.57	-39.82	-16.81	-34.57	0.03
13.91	-5.36	60.02	13.85	-5.28	60.02	0.11	-15.62	-21.01	-8.43	-15.59	-21.07	-8.34	0.11
13.29	-10.81	7.98	13.28	-10.81	7.98	0.00	-7.50	3.38	32.22	-7.44	3.39	32.21	0.06
-9.37	5.91	26.56	-9.46	5.87	26.58	0.10	31.61	19.38	-10.23	31.65	19.42	-10.23	0.05
-40.23	-16.98	-16.28	-40.27	-16.99	-16.26	0.05	29.21	16.73	14.14	29.20	16.72	14.14	0.01
-8.26	-19.41	-43.39	-8.30	-19.40	-43.34	0.07	-25.59	-27.48	-12.37	-25.59	-27.44	-12.40	0.05
-4.15	-4.78	34.50	-4.18	-4.82	34.50	0.05	-26.43	-13.77	-6.22	-26.43	-13.76	-6.25	0.02
-1.45	-13.67	-36.58	-1.39	-13.67	-36.61	0.06	19.58	-8.39	-23.04	19.58	-8.40	-23.05	0.02
30.92	-9.75	-14.44	30.93	-9.76	-14.44	0.02	-39.96	1.98	-27.71	-39.90	1.93	-27.71	0.08
-24.78	8.21	-16.83	-24.78	8.16	-16.88	0.07	-10.51	-23.44	-41.76	-10.47	-23.50	-41.82	0.09
29.22	-11.07	-12.69	29.18	-11.03	-12.70	0.05	12.05	17.24	-22.25	12.08	17.25	-22.26	0.02
-37.06	2.14	-36.92	-36.95	2.03	-36.88	0.16	-25.89	-27.57	-12.42	-25.89	-27.49	-12.48	0.10
3.71	-7.04	42.23	3.72	-6.96	42.23	0.08	-25.99	7.86	-37.98	-26.00	7.90	-38.00	0.04
-21.43	-12.64	-49.02	-21.43	-12.63	-49.01	0.01	-24.50	9.72	-35.57	-24.54	9.80	-35.60	0.10
-6.39	1.09	41.51	-6.40	1.09	41.51	0.01	0.51	-18.91	-12.73	0.51	-18.92	-12.73	0.01
15.00	25.29	12.71	14.99	25.25	12.70	0.04	28.76	18.07	-22.76	28.74	18.06	-22.74	0.03
-28.67	-31.46	-26.79	-28.66	-31.44	-26.79	0.02	-5.72	-19.84	-10.36	-5.70	-19.88	-10.31	0.06
-4.09	17.54	10.11	-4.00	17.48	10.19	0.14	-9.31	8.05	-12.56	-9.31	8.07	-12.56	0.02
22.05	-5.56	19.48	22.07	-5.60	19.49	0.05	20.53	-6.69	-23.98	20.53	-6.68	-23.97	0.02
-14.25	22.33	25.08	-14.35	22.44	25.08	0.16	-16.96	-32.35	-26.84	-16.96	-32.34	-26.84	0.01
-26.02	0.07	-45.78	-26.02	0.06	-45.77	0.02	22.35	10.82	48.30	22.47	10.86	48.32	0.13
-5.39	8.17	62.60	-5.38	8.16	62.56	0.04	-6.20	3.33	-32.30	-6.37	3.26	-32.30	0.18
23.44	6.75	45.72	23.27	6.75	45.69	0.18	-6.32	10.33	2.23	-6.33	10.35	2.23	0.02
6.56	24.97	8.40	6.52	25.11	8.40	0.14	-38.01	-17.01	-39.93	-38.10	-17.06	-40.01	0.13
-15.04	3.42	-4.76	-15.07	3.45	-4.75	0.04	1.70	18.62	51.87	1.69	18.65	51.87	0.03
-10.42	6.05	-36.90	-10.38	6.11	-36.94	0.08	21.43	1.78	50.87	21.48	1.76	50.88	0.05
5.96	23.69	21.93	5.96	23.76	21.94	0.07	11.85	26.20	10.48	11.85	26.19	10.48	0.02
-6.61	4.18	59.83	-6.74	4.13	59.84	0.14	6.92	-6.78	40.81	6.92	-6.79	40.81	0.01
-10.47	-26.02	-39.08	-10.50	-25.97	-39.05	0.07	11.53	26.93	1.34	11.53	26.92	1.34	0.01
-0.54	0.23	-25.20	-0.51	0.25	-25.23	0.05	-39.15	-0.54	-36.11	-39.12	-0.56	-36.09	0.04
-19.36	10.11	-36.07	-19.36	10.14	-36.09	0.03	36.74	7.26	-15.16	36.72	7.25	-15.16	0.03
36.98	10.41	8.13	36.95	10.40	8.10	0.04	17.35	21.52	35.57	17.34	21.50	35.57	0.02
-7.18	10.81	42.90	-7.00	10.82	42.84	0.19	38.87	2.64	7.71	38.83	2.65	7.70	0.04
8.29	23.52	23.67	8.29	23.59	23.69	0.07	-24.50	-18.46	-6.49	-24.50	-18.46	-6.48	0.01
-22.34	0.99	-45.66	-22.34	1.00	-45.68	0.03	11.25	21.49	45.18	11.25	21.48	45.18	0.01
-15.75	7.61	-39.44	-15.75	7.62	-39.45	0.02	-27.52	10.72	-21.30	-27.46	10.58	-21.33	0.16
23.12	16.24	31.34	23.05	16.20	31.33	0.08	-20.13	-14.68	-47.96	-20.16	-14.69	-47.95	0.04
-28.32	7.11	-38.04	-28.32	7.10	-38.04	0.00	14.33	-6.44	25.10	14.34	-6.56	25.11	0.12
-25.13	-22.04	-7.56	-25.13	-22.04	-7.56	0.00	31.55	1.65	-26.19	31.58	1.64	-26.21	0.04
0.90	10.43	-8.89	0.86	10.53	-8.93	0.11	-10.54	-7.21	8.04	-10.47	-7.14	8.01	0.10
22.30	20.51	22.72	22.24	20.45	22.70	0.09	-12.03	-17.89	-6.99	-12.03	-17.91	-6.98	0.02
25.92	-9.37	2.95	25.92	-9.33	2.94	0.04	29.68	-9.16	-1.02	29.74	-9.26	-1.01	0.11
-42.46	-13.82	-19.43	-42.40	-13.80	-19.45	0.06	-15.50	20.32	24.58	-15.70	20.43	24.54	0.24
-9.61	-18.56	-44.48	-9.62	-18.56	-44.46	0.02	-1.72	1.19	-26.11	-1.72	1.19	-26.11	0.00
3.92	-12.47	4.93	3.92	-12.45	4.92	0.02	15.84	11.88	-27.67	15.86	11.90	-27.66	0.03
25.74	-1.18	26.06	25.76	-1.20	26.06	0.03	-7.14	4.90	58.34	-7.09	4.90	58.33	0.06
21.15	16.38	39.63	21.16	16.39	39.63	0.02	-20.72	-13.04	-4.91	-20.72	-13.05	-4.90	0.01
-30.01	-30.17	-21.20	-30.04	-30.24	-21.19	0.08	23.61	20.33	18.64	23.70	20.42	18.68	0.13
7.42	-3.89	63.38	7.42	-3.89	63.41	0.02	31.11	15.69	12.39	31.17	15.74	12.43	0.09
-35.14	-13.92	-8.64	-35.15	-13.92	-8.63	0.01	30.75	7.00	18.32	30.65	6.99	18.27	0.12
28.40	-8.51	3.54	28.45	-8.64	3.58	0.14	-25.28	-30.51	-35.53	-25.27	-30.49	-35.52	0.02
-29.43	-30.94	-30.32	-29.39	-30.84	-30.30	0.11	-16.28	11.06	-32.82	-16.31	10.97	-32.79	0.10
-32.24	3.92	-39.35	-32.22	3.89	-39.32	0.05	-7.27	-21.99	-11.86	-7.29	-21.95	-11.89	0.05
26.26	17.81	18.02	26.27	17.82	18.03	0.02	36.75	-2.38	2.91	36.75	-2.37	2.91	0.01
29.79	14.98	14.92	29.74	14.95	14.88	0.07	-22.92	-0.62	-9.37	-22.94	-0.60	-9.34	0.05
23.10	11.70	43.54	23.03	11.68	43.53	0.07	-9.52	-28.74	-32.90	-9.61	-28.60	-32.88	0.17
-0.44	17.57	53.86	-0.40	17.52	53.86	0.06	11.35	12.35	63.09	11.35	12.35	63.13	0.04
-4.36	-26.27	-26.21	-4.45	-26.15	-26.19	0.16	-13.69	22.29	21.50	-13.65	22.27	21.52	0.05
-19.92	-15.04	-48.67	-19.92	-15.03	-48.61	0.06	-26.86	9.19	-35.28	-26.87	9.20	-35.29	0.01
38.86	9.98	2.57	38.95	10.03	2.58	0.11	14.02	9.79	63.14	14.02	9.79	63.15	0.01
0.97	-5.44	-27.21	0.91	-5.48	-27.16	0.09	-27.18	11.22	-24.72	-27.20	11.29	-24.71	0.07
-6.29	9.25	59.48	-6.49	9.31	59.48	0.21	-29.59	-24.39	-42.11	-29.58	-24.37	-42.09	0.03
-11.91	8.20	-35.26	-11.93	8.16	-35.25	0.05	-30.46	-23.88	-42.07	-30.47	-23.88	-42.08	0.01

-10.80	18.46	37.07	-10.77	18.45	37.04	0.04	-15.02	19.26	20.81	-15.00	19.24	20.83	0.03
-13.70	-31.18	-29.12	-13.68	-31.26	-29.13	0.09	24.64	24.50	-4.42	24.64	24.48	-4.42	0.02
14.65	-14.00	-16.63	14.65	-13.98	-16.61	0.04	21.28	-12.29	-0.99	21.26	-12.26	-1.01	0.04
-9.88	-18.61	-44.69	-9.90	-18.60	-44.66	0.05	27.01	0.58	25.30	26.94	0.61	25.27	0.09
28.61	20.56	-20.51	28.58	20.52	-20.48	0.06	15.53	-5.42	38.27	15.54	-5.50	38.27	0.08
36.41	4.33	-16.48	36.44	4.33	-16.49	0.03	-8.60	7.91	32.07	-8.70	7.84	32.10	0.12
-6.73	2.51	57.62	-6.72	2.51	57.62	0.01	24.15	-5.72	15.64	24.16	-5.75	15.65	0.04
-24.07	-15.41	-6.09	-24.07	-15.41	-6.10	0.01	4.83	7.31	63.32	4.84	7.31	63.35	0.03
-22.67	-11.55	-49.33	-22.67	-11.56	-49.36	0.03	18.73	-5.81	-23.34	18.74	-5.81	-23.32	0.02
37.57	11.98	3.88	37.68	12.04	3.88	0.13	-5.45	-1.96	57.68	-5.28	-1.84	57.68	0.21
7.34	23.90	21.38	7.34	23.90	21.38	0.01	-0.17	-11.82	-32.64	-0.21	-11.84	-32.63	0.05
30.72	1.03	-27.51	30.76	1.03	-27.54	0.05	-5.12	-5.51	28.07	-5.19	-5.58	28.07	0.09
-7.31	24.28	30.81	-7.30	24.22	30.80	0.06	6.49	-5.91	-23.29	6.49	-5.91	-23.28	0.01
27.84	22.49	1.55	27.86	22.51	1.56	0.03	-26.69	8.97	-17.09	-26.63	8.79	-17.19	0.22
21.57	24.04	-23.13	21.62	24.11	-23.17	0.09	-10.61	9.99	31.45	-10.74	9.85	31.50	0.19
-6.89	18.58	13.22	-6.85	18.55	13.28	0.07	-36.96	-2.28	-13.10	-37.01	-2.25	-13.06	0.07
16.29	-5.17	42.12	16.31	-5.22	42.13	0.05	-7.58	20.75	15.62	-7.63	20.83	15.53	0.13
-7.49	21.36	36.44	-7.51	21.44	36.49	0.09	-0.43	17.73	53.22	-0.36	17.61	53.21	0.14
-6.96	6.86	-25.16	-6.98	6.84	-25.14	0.03	7.13	21.94	-3.19	7.11	21.95	-3.19	0.02
-2.88	23.97	18.86	-2.88	23.81	18.89	0.16	14.96	-7.49	16.81	14.96	-7.50	16.81	0.00
-8.48	24.28	22.07	-8.48	24.47	22.02	0.19	-28.30	-25.74	-11.21	-28.29	-25.73	-11.23	0.02
0.41	20.20	42.62	0.43	20.14	42.61	0.06	-17.74	8.99	-18.19	-17.74	9.00	-18.19	0.01
35.32	-3.50	0.57	35.39	-3.56	0.57	0.09	-6.88	6.70	52.22	-7.00	6.73	52.22	0.12
18.86	26.08	-10.12	18.86	25.98	-10.10	0.10	-25.79	10.50	-19.67	-25.79	10.51	-19.66	0.01
-14.88	15.13	31.71	-14.97	15.09	31.77	0.11	-15.22	-25.80	-41.86	-15.23	-25.77	-41.82	0.05
-5.68	-24.59	-34.73	-5.68	-24.59	-34.73	0.01	11.71	-8.92	14.00	11.71	-8.90	13.99	0.02
-6.33	-27.26	-25.03	-6.31	-27.29	-25.03	0.04	-7.53	-18.04	-7.20	-7.54	-18.09	-7.16	0.06
25.55	23.73	-16.28	25.54	23.71	-16.28	0.03	-32.96	-11.02	-7.52	-33.00	-11.01	-7.44	0.09
-18.71	-17.90	-6.28	-18.71	-17.88	-6.31	0.04	-10.34	15.34	37.18	-10.37	15.33	37.23	0.07
-15.96	7.54	-39.81	-15.97	7.47	-39.77	0.09	-1.49	-19.48	-34.84	-1.49	-19.47	-34.84	0.00
-9.33	-29.18	-24.66	-9.28	-29.25	-24.65	0.08	-0.99	-10.92	-35.33	-1.05	-10.93	-35.32	0.06
-25.69	-23.09	-44.31	-25.68	-23.06	-44.27	0.05	-27.99	-28.75	-37.51	-27.99	-28.73	-37.50	0.02
							-28.97	-4.83	-47.25	-28.91	-4.89	-47.14	0.14
							-6.31	-21.06	-11.11	-6.34	-21.00	-11.15	0.07
							-36.12	-13.11	-44.66	-35.98	-13.06	-44.54	0.19
							22.20	4.20	50.07	22.32	4.18	50.10	0.13

Listing 6. PA4-F-Debug-Output.txt

200	PA4-F-Debug-Output.txt												
33.14	17.42	-12.24	33.14	17.42	-12.24	0.00	-15.22	-24.95	-11.03	-15.22	-24.94	-11.03	0.01
-7.04	4.60	48.91	-6.89	4.63	48.92	0.16	-5.57	10.99	2.59	-5.63	11.05	2.57	0.09
-16.29	16.20	22.32	-16.43	16.17	22.31	0.15	-22.64	2.66	-44.30	-22.64	2.69	-44.34	0.05
22.53	7.37	51.47	22.42	7.37	51.45	0.11	-6.71	24.71	22.04	-6.70	24.52	22.08	0.19
27.83	21.36	-19.35	27.92	21.49	-19.39	0.16	34.83	-3.84	8.30	34.98	-3.99	8.35	0.22
16.04	25.74	-10.78	16.05	25.68	-10.78	0.05	-2.91	-20.46	-35.91	-2.95	-20.44	-35.89	0.05
-1.61	-20.45	-33.78	-1.63	-20.43	-33.77	0.02	31.14	-7.89	-7.85	31.13	-7.87	-7.85	0.02
-0.23	-18.03	-31.64	-0.23	-18.03	-31.64	0.01	-18.55	-15.18	-5.20	-18.54	-15.16	-5.24	0.05
1.98	8.88	-14.80	1.99	8.74	-14.74	0.16	-5.01	-2.05	56.57	-5.10	-2.11	56.57	0.10
-39.80	-16.41	-33.95	-39.79	-16.41	-33.95	0.00	22.18	3.95	49.83	22.30	3.93	49.84	0.13
-2.80	-5.77	-37.78	-2.82	-5.77	-37.77	0.02	35.89	0.50	10.96	35.94	0.49	11.00	0.06
-14.14	-26.62	-13.37	-14.10	-26.76	-13.31	0.15	26.90	0.45	-29.36	26.89	0.44	-29.37	0.01
36.08	14.46	2.74	36.13	14.50	2.74	0.06	12.70	17.19	-29.35	12.70	17.19	-29.35	0.01
21.56	-0.22	44.56	21.58	-0.24	44.57	0.03	12.71	-17.10	-7.81	12.70	-17.13	-7.81	0.03
13.72	23.48	-15.77	13.72	23.48	-15.77	0.00	23.07	20.49	19.44	23.16	20.57	19.48	0.13
-7.17	-24.26	-37.79	-7.22	-24.21	-37.75	0.08	-2.39	0.77	-27.12	-2.35	0.79	-27.15	0.06
-24.81	9.63	-35.37	-24.86	9.74	-35.41	0.13	12.10	-13.21	4.03	12.11	-13.27	4.08	0.08
19.38	22.68	19.48	19.38	22.67	19.48	0.02	-3.51	-25.25	-24.95	-3.47	-25.30	-24.94	0.07
2.12	20.17	43.20	2.12	20.05	43.15	0.13	-42.91	-3.37	-25.28	-42.95	-3.35	-25.28	0.05
24.11	18.30	23.75	24.01	18.22	23.72	0.13	-12.51	-25.30	-41.54	-12.58	-25.19	-41.42	0.17
27.71	-6.06	-25.04	27.73	-6.11	-25.11	0.09	-41.69	-12.94	-17.07	-41.70	-12.94	-17.07	0.01
-31.12	-30.34	-24.63	-31.07	-30.25	-24.64	0.10	-27.87	9.68	-32.96	-27.85	9.64	-32.95	0.05
0.15	-13.53	-0.54	0.15	-13.53	-0.55	0.01	0.26	-18.32	-10.82	0.30	-18.49	-10.76	0.18
39.77	5.11	-6.52	39.96	5.15	-6.57	0.19	-14.02	-26.78	-13.38	-14.02	-26.77	-13.39	0.01
-34.52	-11.31	-45.71	-34.55	-11.31	-45.76	0.05	27.37	6.84	26.34	27.49	6.85	26.37	0.12
-25.88	-31.51	-32.95	-25.89	-31.55	-32.97	0.05	-8.25	-19.44	-8.71	-8.24	-19.49	-8.69	0.05
-29.82	-30.26	-31.78	-29.86	-30.34	-31.79	0.10	29.32	8.19	20.56	29.36	8.20	20.57	0.04
-6.68	7.44	51.79	-6.84	7.48	51.79	0.16	27.45	-3.35	18.20	27.44	-3.35	18.20	0.00
-5.76	16.21	11.24	-5.80	16.24	11.21	0.05	6.10	21.44	36.78	6.10	21.44	36.78	0.00
-24.37	11.89	-28.08	-24.38	11.92	-28.08	0.04	-9.83	13.49	13.66	-9.89	13.49	13.62	0.07
-39.74	-18.07	-34.56	-39.77	-18.08	-34.57	0.03	-26.30	2.52	-43.82	-26.30	2.52	-43.82	0.00
35.75	14.25	6.82	35.73	14.24	6.81	0.03	-32.56	-6.27	-45.57	-32.59	-6.24	-45.63	0.07
30.31	13.66	-25.15	30.27	13.63	-25.12	0.06	6.96	-15.37	-3.50	6.99	-15.25	-3.55	0.13
-16.90	-25.27	-42.50	-16.88	-25.33	-42.58	0.10	28.17	18.92	-22.58	28.19	18.93	-22.60	0.03
6.49	11.24	63.25	6.49	11.24	63.25	0.01	18.24	23.67	18.02	18.18	23.46	17.96	0.22
24.25	2.83	38.03	24.12	2.85	38.01	0.13	-38.27	-7.81	-41.42	-38.27	-7.81	-41.41	0.00

-33.03	8.32	-23.31	-33.05	8.35	-23.30	0.04	-17.53	-8.99	-48.57	-17.53	-8.98	-48.59	0.02
26.89	-8.76	4.73	26.89	-8.69	4.70	0.07	-41.94	-14.15	-18.30	-41.96	-14.16	-18.30	0.02
-27.23	10.28	-31.72	-27.22	10.25	-31.71	0.03	-26.44	8.44	-36.82	-26.46	8.50	-36.84	0.07
0.91	18.96	47.81	0.91	19.11	47.85	0.16	-15.23	19.84	21.79	-15.17	19.81	21.82	0.07
32.81	17.65	6.65	32.80	17.64	6.65	0.02	23.36	20.05	20.49	23.30	20.00	20.47	0.08
27.60	1.03	23.98	27.57	1.04	23.97	0.03	-22.17	8.58	-38.06	-22.17	8.55	-38.05	0.02
20.11	15.54	47.83	20.13	15.55	47.84	0.02	20.80	5.05	61.84	20.79	5.06	61.83	0.02
-0.09	21.23	37.02	-0.08	21.36	37.04	0.13	28.76	-10.74	-10.40	28.75	-10.72	-10.41	0.02
9.03	20.41	-8.92	9.10	20.39	-8.87	0.09	30.89	7.44	17.76	30.88	7.44	17.76	0.02
-7.38	22.52	17.57	-7.38	22.51	17.57	0.01	24.20	-13.21	-4.63	24.23	-13.27	-4.62	0.08
31.74	0.49	15.54	31.80	0.47	15.59	0.09	-37.58	-4.11	-12.12	-37.48	-4.17	-12.22	0.16
12.11	21.70	45.10	12.09	21.73	45.11	0.04	9.96	3.51	62.97	9.96	3.51	63.01	0.04
30.30	-8.98	-6.11	30.37	-9.05	-6.12	0.10	-32.84	-1.12	-43.31	-32.82	-1.14	-43.27	0.05
-25.06	8.57	-17.15	-25.06	8.55	-17.17	0.03	18.24	-4.12	40.39	18.18	-4.04	40.39	0.11
10.58	22.22	33.07	10.58	22.30	33.09	0.08	-2.25	2.31	63.33	-2.25	2.30	63.35	0.02
-6.89	7.98	52.09	-6.72	7.94	52.08	0.18	20.68	12.59	56.62	20.81	12.63	56.63	0.14
-22.77	-21.89	-7.53	-22.77	-21.86	-7.58	0.06	-7.86	4.04	30.57	-7.88	4.04	30.57	0.01
-32.62	5.42	-37.74	-32.55	5.28	-37.69	0.16	-14.03	-31.51	-28.88	-14.06	-31.42	-28.87	0.09
-4.50	-9.36	16.20	-4.45	-9.24	16.19	0.13	11.38	-15.72	-13.25	11.38	-15.48	-13.15	0.26
-24.01	12.08	-28.30	-23.99	11.98	-28.28	0.11	22.08	-15.64	-14.76	22.08	-15.66	-14.77	0.02
-6.44	1.51	51.30	-6.48	1.50	51.30	0.03							
-5.15	0.04	-35.84	-5.04	0.10	-35.87	0.12							
-4.45	-9.66	-41.75	-4.42	-9.66	-41.77	0.03							
26.83	10.91	25.68	26.91	10.94	25.70	0.09							
8.59	-13.59	3.10	8.59	-13.61	3.10	0.01							
-22.10	-32.53	-24.58	-22.09	-32.67	-24.58	0.14							
2.07	-17.72	-23.02	2.03	-17.70	-23.00	0.04							
40.19	4.69	-0.90	40.07	4.71	-0.91	0.12							
-21.81	-29.65	-14.99	-21.81	-29.62	-15.01	0.03							
26.31	-6.58	11.60	26.30	-6.54	11.59	0.04							
-39.43	2.04	-30.56	-39.47	2.07	-30.58	0.04							
-43.14	-6.10	-29.68	-43.19	-6.10	-29.69	0.05							
3.57	24.26	15.44	3.53	24.40	15.41	0.15							
-3.11	-7.98	-39.82	-3.12	-7.98	-39.81	0.01							
-29.11	5.67	-39.62	-29.12	5.71	-39.64	0.05							
-30.38	-29.04	-34.50	-30.44	-29.13	-34.54	0.12							
-43.24	-5.84	-29.65	-43.20	-5.84	-29.63	0.04							
1.39	-18.95	-15.74	1.36	-18.91	-15.76	0.05							
-41.51	-15.23	-17.66	-41.44	-15.21	-17.70	0.08							
-41.12	-1.05	-20.81	-41.21	-1.00	-20.81	0.10							
11.78	-6.37	57.32	11.77	-6.35	57.32	0.02							
35.95	-0.07	11.01	35.90	-0.06	10.96	0.07							
-3.93	-16.98	-39.74	-3.91	-17.00	-39.77	0.04							
-11.53	-23.43	-42.53	-11.54	-23.42	-42.52	0.02							
32.34	-6.78	1.09	32.35	-6.79	1.09	0.01							
-17.47	10.42	-35.68	-17.47	10.43	-35.68	0.01							
-40.08	-16.86	-32.63	-40.12	-16.85	-32.65	0.04							
-6.98	-9.61	8.66	-6.97	-9.60	8.65	0.02							
-14.33	-23.00	-43.79	-14.32	-23.03	-43.89	0.10							
-41.21	-18.99	-21.18	-41.21	-18.99	-21.18	0.00							
-42.19	-2.56	-22.65	-42.21	-2.55	-22.64	0.02							
19.95	-16.75	-6.75	19.94	-16.74	-6.75	0.01							
6.01	22.25	31.04	6.00	22.37	31.07	0.12							
-11.38	6.60	18.07	-11.50	6.58	18.05	0.12							
33.31	-3.36	-22.83	33.35	-3.37	-22.86	0.06							
-22.65	5.81	-41.38	-22.64	5.88	-41.46	0.11							
-33.91	7.69	-29.17	-33.90	7.68	-29.16	0.01							
-42.85	-14.37	-21.23	-42.80	-14.36	-21.24	0.05							
-19.16	-32.58	-25.67	-19.17	-32.52	-25.68	0.06							
7.04	-14.42	-19.55	6.92	-14.30	-19.50	0.17							
2.00	-7.27	-26.48	2.03	-7.26	-26.52	0.05							
-40.39	-17.72	-32.03	-40.45	-17.72	-32.05	0.06							
-13.51	-31.06	-29.45	-13.48	-31.15	-29.46	0.09							
3.43	-15.20	-4.74	3.44	-15.39	-4.67	0.20							
-23.43	-11.32	-5.13	-23.42	-11.32	-5.16	0.03							
-3.18	10.71	-3.55	-3.20	10.76	-3.57	0.06							
-10.03	7.17	-6.65	-10.03	7.17	-6.65	0.00							
21.42	14.22	45.43	21.44	14.23	45.43	0.02							
-24.59	11.19	-21.99	-24.66	11.40	-21.97	0.22							
-8.69	-27.78	-34.01	-8.72	-27.73	-33.98	0.06							
-31.30	5.55	-38.58	-31.30	5.54	-38.58	0.01							
30.60	20.38	-6.08	30.61	20.40	-6.08	0.03							

Listing 7. PA4-G-Unknown-Output.txt

-0.06	-12.53	-33.19	-0.05	-12.53	-33.19	0.00	27.95	22.01	7.05	27.96	22.01	7.05	0.00
-23.13	9.23	-17.92	-23.13	9.23	-17.92	0.00	-28.64	3.36	-41.97	-28.64	3.36	-41.97	0.00
1.24	8.60	-14.95	1.24	8.61	-14.95	0.01	39.85	7.15	-0.13	39.86	7.15	-0.13	0.01
-11.50	-4.32	9.95	-11.50	-4.31	9.95	0.00	-2.09	-7.26	-36.50	-2.09	-7.26	-36.50	0.00
6.66	-8.39	19.73	6.66	-8.40	19.74	0.01	22.15	25.18	-10.96	22.15	25.18	-10.96	0.00
-3.70	9.06	-10.90	-3.70	9.05	-10.90	0.01	-40.97	0.29	-24.05	-40.96	0.29	-24.05	0.00
-41.49	-7.69	-16.33	-41.49	-7.69	-16.34	0.00	32.48	-4.85	10.76	32.48	-4.85	10.76	0.00
-42.12	-17.80	-23.92	-42.12	-17.80	-23.92	0.00	-18.76	-31.78	-19.85	-18.76	-31.78	-19.85	0.00
32.88	17.65	-4.44	32.88	17.65	-4.44	0.00	-6.39	-25.08	-35.18	-6.39	-25.08	-35.18	0.00
18.47	16.14	56.18	18.46	16.14	56.18	0.01	3.72	-12.17	7.91	3.72	-12.17	7.91	0.01
-19.27	-4.10	-47.89	-19.27	-4.10	-47.89	0.00	16.36	17.97	57.82	16.36	17.98	57.82	0.01
16.51	-6.58	21.81	16.51	-6.57	21.81	0.01	-5.51	11.65	59.12	-5.51	11.65	59.12	0.01
18.20	-5.94	25.15	18.20	-5.94	25.15	0.00	-6.86	9.39	44.55	-6.87	9.39	44.55	0.00
9.22	26.15	4.26	9.22	26.16	4.26	0.01	-14.64	3.63	-1.96	-14.64	3.63	-1.96	0.00
-39.03	-18.10	-37.37	-39.03	-18.10	-37.37	0.00	-31.43	-19.20	-8.42	-31.43	-19.20	-8.42	0.00
-36.05	-26.82	-26.61	-36.05	-26.83	-26.62	0.00	17.70	22.55	-27.47	17.70	22.55	-27.47	0.00
-21.28	-18.04	-47.66	-21.28	-18.04	-47.65	0.00	6.25	-11.92	-22.29	6.25	-11.92	-22.28	0.00
-16.83	12.04	-26.90	-16.83	12.04	-26.90	0.00	-40.22	-21.68	-28.37	-40.22	-21.68	-28.37	0.00
-5.93	-2.63	36.51	-5.93	-2.64	36.52	0.00	-27.14	6.83	-15.57	-27.14	6.83	-15.57	0.00
5.24	-16.93	-12.17	5.23	-16.92	-12.17	0.01	3.90	22.18	4.17	3.90	22.18	4.16	0.00
5.72	-7.01	49.82	5.72	-7.02	49.82	0.01	21.39	-11.01	-21.56	21.39	-11.01	-21.56	0.01
16.25	25.00	-15.33	16.25	25.00	-15.33	0.00	-3.64	18.55	10.75	-3.64	18.55	10.75	0.00
-6.19	-1.53	36.54	-6.19	-1.53	36.54	0.00	33.40	-4.97	-21.44	33.40	-4.98	-21.44	0.00
-8.42	8.26	-23.30	-8.42	8.26	-23.30	0.00	-4.97	-5.77	28.98	-4.98	-5.77	28.98	0.01
29.52	16.46	13.99	29.52	16.45	13.98	0.01	31.72	8.45	-26.58	31.72	8.45	-26.58	0.00
0.90	-19.03	-19.25	0.90	-19.03	-19.25	0.00	-2.85	-11.92	4.50	-2.86	-11.93	4.50	0.01
7.30	15.84	63.20	7.30	15.84	63.20	0.00	6.96	24.40	3.40	6.96	24.40	3.40	0.00
20.76	0.69	-25.46	20.76	0.69	-25.46	0.00	31.18	-9.43	-14.26	31.17	-9.43	-14.26	0.00
-39.79	-15.72	-35.81	-39.79	-15.72	-35.81	0.00	28.21	20.91	9.86	28.21	20.92	9.86	0.01
-25.23	-31.44	-19.18	-25.23	-31.44	-19.18	0.00	-9.04	-18.35	-44.10	-9.04	-18.35	-44.09	0.00
-25.80	-5.90	-7.42	-25.80	-5.90	-7.42	0.00	-34.88	3.15	-15.06	-34.88	3.15	-15.06	0.00
-30.84	-15.31	-46.36	-30.84	-15.31	-46.36	0.00	15.88	-7.94	14.29	15.88	-7.94	14.30	0.00
-0.37	-7.36	31.78	-0.37	-7.36	31.78	0.00	-17.53	-32.29	-29.77	-17.53	-32.28	-29.76	0.01
-30.72	-27.26	-15.50	-30.71	-27.26	-15.50	0.01	33.30	-4.98	-21.83	33.29	-4.98	-21.83	0.01
26.51	13.36	24.40	26.51	13.36	24.41	0.00	-34.75	-17.15	-43.65	-34.75	-17.15	-43.64	0.00
20.30	20.90	-27.72	20.30	20.90	-27.72	0.00	-9.99	23.32	19.75	-9.99	23.32	19.75	0.01
11.78	20.56	58.12	11.78	20.55	58.12	0.01	-43.47	-10.58	-22.01	-43.47	-10.58	-22.02	0.01
32.46	-2.27	13.34	32.46	-2.27	13.34	0.00	26.10	23.42	-16.64	26.10	23.42	-16.64	0.00
-0.26	-7.37	32.30	-0.26	-7.37	32.30	0.00	-5.46	-10.92	6.31	-5.46	-10.92	6.31	0.00
11.51	24.22	-8.14	11.51	24.22	-8.14	0.00	18.87	20.49	36.05	18.87	20.49	36.05	0.00
35.39	12.17	-14.99	35.39	12.17	-14.99	0.00	12.47	18.89	-29.70	12.47	18.89	-29.69	0.00
14.62	-13.39	-17.30	14.62	-13.39	-17.31	0.00	21.44	14.22	45.57	21.43	14.22	45.57	0.01
-11.28	8.01	12.12	-11.29	8.02	12.12	0.01	-14.57	-31.60	-24.50	-14.57	-31.60	-24.50	0.00
6.81	11.23	-10.69	6.81	11.24	-10.69	0.00	-36.08	-26.08	-31.40	-36.08	-26.08	-31.40	0.00
-13.34	5.20	-41.16	-13.34	5.21	-41.16	0.00	-2.17	15.76	57.11	-2.17	15.75	57.11	0.00
-23.09	2.84	-44.24	-23.09	2.84	-44.25	0.00	-0.92	21.42	37.13	-0.92	21.41	37.13	0.00
1.52	-5.98	-26.77	1.52	-5.98	-26.77	0.00	15.65	-10.98	6.49	15.65	-10.98	6.49	0.00
-15.56	-11.24	-1.99	-15.56	-11.25	-1.99	0.00	-13.39	-31.07	-29.79	-13.39	-31.07	-29.79	0.00
9.36	22.92	-6.39	9.36	22.92	-6.39	0.00	9.21	25.53	1.28	9.21	25.54	1.28	0.00
-7.73	-22.94	-39.77	-7.72	-22.94	-39.78	0.01	20.17	-1.17	49.67	20.17	-1.18	49.67	0.00
-6.71	8.39	47.63	-6.71	8.39	47.63	0.00	-14.89	-19.94	-7.87	-14.89	-19.94	-7.87	0.00
-35.21	6.67	-29.33	-35.21	6.67	-29.33	0.01	35.74	8.08	-18.37	35.75	8.08	-18.37	0.00
11.86	-6.22	-21.94	11.86	-6.22	-21.94	0.00	13.12	-5.74	59.70	13.13	-5.75	59.70	0.00
14.60	25.80	-7.97	14.60	25.80	-7.97	0.00	-15.21	-7.75	1.37	-15.21	-7.75	1.37	0.00
-35.24	-19.43	-41.52	-35.24	-19.43	-41.53	0.00	-32.55	7.81	-20.46	-32.55	7.81	-20.46	0.00
35.29	15.72	2.66	35.29	15.71	2.66	0.01	-18.65	-10.25	-49.13	-18.65	-10.25	-49.13	0.00
-24.43	11.98	-26.17	-24.43	11.99	-26.17	0.00	-6.88	3.77	56.83	-6.87	3.77	56.83	0.01
14.69	18.70	-30.98	14.69	18.70	-30.98	0.00	-36.62	-24.77	-33.61	-36.61	-24.77	-33.61	0.00
-6.57	11.36	44.95	-6.56	11.36	44.95	0.01	-7.40	8.21	39.67	-7.41	8.21	39.67	0.01
8.06	20.38	56.17	8.06	20.38	56.17	0.00	-30.18	6.37	-38.09	-30.18	6.37	-38.09	0.00
9.83	-14.29	-17.09	9.83	-14.29	-17.09	0.00	-17.74	6.03	-13.42	-17.74	6.03	-13.42	0.00
-38.67	2.62	-31.65	-38.66	2.61	-31.65	0.01	20.51	-9.76	4.49	20.51	-9.76	4.49	0.00
-28.35	-1.86	-11.06	-28.35	-1.86	-11.05	0.00	27.88	22.39	-15.66	27.88	22.38	-15.66	0.00
28.56	-7.33	-24.15	28.57	-7.34	-24.16	0.01	7.78	-9.21	-23.01	7.78	-9.21	-23.01	0.00
-9.47	6.90	28.22	-9.48	6.90	28.22	0.00	-6.88	4.26	53.47	-6.88	4.26	53.47	0.00
27.06	23.23	-5.66	27.06	23.22	-5.66	0.00	14.11	-3.98	62.61	14.11	-3.98	62.61	0.01
18.41	0.63	62.38	18.41	0.63	62.38	0.00	6.36	19.50	60.90	6.36	19.51	60.90	0.00
21.61	-13.44	-19.71	21.61	-13.44	-19.71	0.00	-11.92	-28.24	-16.93	-11.92	-28.24	-16.94	0.00
-36.95	-2.60	-40.96	-36.95	-2.60	-40.96	0.00	-22.51	12.22	-26.21	-22.51	12.22	-26.21	0.01
34.55	-2.32	-20.58	34.55	-2.32	-20.58	0.00	39.81	7.44	-0.75	39.80	7.44	-0.75	0.01
-28.34	-3.51	-9.98	-28.34	-3.51	-9.98	0.00	34.19	-0.82	12.67	34.19	-0.82	12.66	0.00
15.39	8.53	63.16	15.39	8.53	63.17	0.00	-21.16	-12.74	-47.73	-21.16	-12.75	-47.73	0.01

-0.24	-6.26	44.70	-0.24	-6.26	44.70	0.00	-30.04	-26.96	-14.27	-30.04	-26.96	-14.27	0.00
28.92	-5.28	12.85	28.92	-5.28	12.85	0.00	36.01	10.05	-15.07	36.01	10.05	-15.07	0.00
24.29	3.41	37.56	24.28	3.41	37.55	0.01	-7.07	9.04	-1.36	-7.07	9.04	-1.36	0.00
22.48	10.37	49.31	22.47	10.37	49.31	0.00	-5.76	2.95	62.86	-5.76	2.95	62.86	0.00
-23.84	-31.79	-19.79	-23.84	-31.79	-19.79	0.00	7.06	21.19	39.29	7.06	21.18	39.29	0.00
-6.93	19.93	14.27	-6.92	19.93	14.27	0.01	-12.97	-27.66	-38.74	-12.97	-27.65	-38.74	0.00
34.49	-4.48	8.29	34.49	-4.48	8.29	0.00	33.11	-5.99	-0.88	33.11	-5.99	-0.88	0.00
-4.02	24.07	29.51	-4.02	24.07	29.51	0.00	-30.18	-18.20	-46.18	-30.18	-18.20	-46.18	0.00
							-24.83	-22.93	-8.19	-24.83	-22.93	-8.19	0.00
							27.67	8.10	25.24	27.67	8.10	25.24	0.00
							-0.28	2.55	-24.17	-0.28	2.55	-24.17	0.00
							-6.99	7.85	43.36	-6.99	7.85	43.36	0.00

Listing 8. PA4-H-Unknown-Output.txt

200	PA4-H-Unknown-Output.txt												
-34.67	2.55	-38.68	-34.67	2.56	-38.68	0.00	-15.66	2.10	-0.20	-15.66	2.10	-0.20	0.00
14.96	22.70	28.09	14.96	22.70	28.10	0.00	3.20	2.51	-21.58	3.20	2.51	-21.58	0.00
23.86	14.35	32.33	23.85	14.35	32.32	0.01	-39.63	-21.01	-32.53	-39.63	-21.01	-32.53	0.00
-8.05	-3.18	24.05	-8.05	-3.18	24.05	0.00	-13.52	-26.69	-13.53	-13.52	-26.69	-13.52	0.00
13.50	20.25	-29.90	13.50	20.24	-29.90	0.01	32.56	12.64	12.70	32.56	12.64	12.70	0.00
-36.29	-20.09	-12.41	-36.29	-20.09	-12.41	0.00	-28.51	-0.89	-45.20	-28.52	-0.89	-45.20	0.00
2.34	6.05	-18.67	2.34	6.06	-18.67	0.00	-17.68	-26.73	-11.80	-17.68	-26.72	-11.81	0.01
-39.41	0.33	-34.12	-39.41	0.33	-34.12	0.00	6.17	-7.61	25.98	6.17	-7.61	25.98	0.00
22.55	1.86	44.49	22.55	1.86	44.49	0.00	-20.94	4.11	-42.96	-20.94	4.11	-42.96	0.00
-35.46	-9.68	-44.70	-35.46	-9.68	-44.70	0.00	-40.88	0.42	-23.98	-40.88	0.42	-23.98	0.00
-42.93	-3.69	-23.83	-42.93	-3.69	-23.83	0.00	3.32	21.07	3.83	3.33	21.06	3.84	0.01
-23.91	-29.45	-15.16	-23.91	-29.46	-15.16	0.00	16.19	27.09	0.77	16.19	27.09	0.77	0.00
29.94	16.94	12.91	29.93	16.93	12.90	0.01	13.34	-6.36	28.20	13.34	-6.36	28.20	0.00
-41.46	-16.07	-30.38	-41.46	-16.07	-30.38	0.00	-41.96	-16.66	-20.64	-41.97	-16.66	-20.64	0.00
-4.06	-10.98	7.19	-4.06	-10.97	7.19	0.00	30.86	19.04	-17.62	30.86	19.04	-17.62	0.00
-4.47	-18.80	-39.26	-4.47	-18.80	-39.26	0.00	19.60	26.10	-8.25	19.61	26.10	-8.25	0.00
-6.05	0.31	51.00	-6.04	0.32	51.00	0.01	37.48	3.65	-13.98	37.48	3.65	-13.98	0.00
35.11	15.34	-0.91	35.11	15.35	-0.91	0.01	-6.75	2.45	58.53	-6.75	2.45	58.53	0.00
22.17	-16.09	-9.22	22.17	-16.09	-9.22	0.00	25.35	-10.69	-0.52	25.35	-10.68	-0.53	0.01
-2.29	9.02	-12.03	-2.29	9.02	-12.03	0.00	-25.79	-15.84	-6.59	-25.79	-15.84	-6.59	0.00
5.08	-6.04	-24.03	5.08	-6.04	-24.03	0.00	27.78	-12.35	-13.73	27.78	-12.35	-13.73	0.00
32.92	7.26	14.31	32.92	7.26	14.30	0.00	25.58	9.03	32.34	25.58	9.03	32.34	0.00
11.45	-6.63	27.78	11.44	-6.62	27.78	0.01	22.76	-7.18	11.05	22.76	-7.18	11.05	0.00
-26.15	-27.81	-39.51	-26.15	-27.81	-39.51	0.01	-15.65	-12.33	-48.48	-15.65	-12.33	-48.49	0.00
-5.34	24.06	20.11	-5.34	24.06	20.11	0.01	16.22	27.13	1.90	16.22	27.13	1.90	0.01
18.92	-16.31	-4.79	18.92	-16.31	-4.79	0.00	-28.98	-22.84	-43.73	-28.98	-22.83	-43.73	0.00
-40.20	-20.58	-19.54	-40.21	-20.58	-19.54	0.00	19.49	-6.52	-23.76	19.50	-6.52	-23.76	0.00
25.98	20.75	-23.04	25.98	20.75	-23.04	0.00	12.53	15.91	-23.17	12.52	15.91	-23.17	0.00
3.74	16.49	-2.06	3.74	16.49	-2.06	0.00	-4.76	13.72	7.14	-4.76	13.72	7.14	0.00
17.42	-15.88	-14.83	17.42	-15.88	-14.83	0.00	-7.76	-26.71	-34.65	-7.76	-26.71	-34.65	0.00
-4.16	13.81	57.58	-4.16	13.81	57.59	0.01	10.08	24.38	-5.31	10.09	24.38	-5.31	0.01
-37.32	-8.87	-9.67	-37.32	-8.87	-9.67	0.00	7.29	10.88	-11.34	7.29	10.89	-11.34	0.01
-4.55	-15.52	-3.80	-4.55	-15.53	-3.80	0.00	14.65	-5.68	38.93	14.66	-5.68	38.93	0.00
3.35	3.33	-20.81	3.36	3.34	-20.81	0.01	-22.37	11.25	-32.90	-22.37	11.25	-32.90	0.00
11.52	18.03	-23.68	11.52	18.03	-23.68	0.00	21.44	10.31	57.48	21.44	10.31	57.48	0.00
25.94	15.06	-27.95	25.94	15.06	-27.95	0.00	26.99	10.64	25.75	26.99	10.64	25.75	0.00
4.27	-0.52	-22.80	4.27	-0.52	-22.80	0.00	9.39	6.41	-15.85	9.39	6.41	-15.84	0.00
-2.73	24.09	20.27	-2.73	24.09	20.28	0.01	0.78	10.64	-8.58	0.78	10.63	-8.58	0.01
28.23	7.48	23.66	28.23	7.49	23.66	0.00	-10.49	9.65	31.56	-10.49	9.65	31.56	0.00
7.65	21.94	-4.70	7.65	21.93	-4.70	0.00	27.51	22.97	-2.25	27.51	22.97	-2.25	0.00
-35.14	-21.24	-12.37	-35.14	-21.24	-12.37	0.00	-26.97	-31.11	-19.81	-26.97	-31.11	-19.81	0.00
-12.90	-4.46	7.19	-12.90	-4.46	7.19	0.00	0.24	-16.76	-7.15	0.24	-16.76	-7.15	0.01
4.11	-2.78	-23.85	4.11	-2.78	-23.84	0.00	-39.75	-11.30	-38.34	-39.75	-11.30	-38.34	0.00
19.78	0.16	-24.03	19.77	0.16	-24.03	0.00	-8.72	-5.60	-44.88	-8.71	-5.60	-44.88	0.00
-6.80	22.27	17.00	-6.81	22.27	17.00	0.01	29.88	14.14	15.31	29.88	14.14	15.31	0.00
34.91	4.63	-21.24	34.91	4.63	-21.24	0.00	-27.53	-26.52	-40.64	-27.53	-26.52	-40.64	0.00
39.44	8.75	-0.96	39.43	8.75	-0.96	0.01	18.24	-13.79	-1.06	18.24	-13.79	-1.06	0.00
-12.20	23.53	21.57	-12.20	23.52	21.57	0.01	8.29	4.36	63.05	8.29	4.36	63.04	0.00
-6.17	-0.06	39.57	-6.16	-0.06	39.57	0.01	-14.69	10.13	-33.10	-14.69	10.12	-33.09	0.00
18.69	9.32	-28.12	18.70	9.33	-28.12	0.00	-6.70	-23.80	-15.07	-6.70	-23.80	-15.06	0.01
-32.36	-5.93	-45.63	-32.36	-5.93	-45.64	0.01	-34.88	1.44	-13.29	-34.88	1.44	-13.29	0.00
-39.58	2.28	-29.36	-39.58	2.28	-29.36	0.00	-42.87	-16.64	-26.64	-42.87	-16.64	-26.64	0.00
-33.29	5.98	-17.12	-33.29	5.98	-17.12	0.00	20.60	-8.76	-23.05	20.60	-8.76	-23.05	0.00
-3.92	-0.75	-30.65	-3.92	-0.75	-30.65	0.00	17.95	14.46	62.37	17.95	14.47	62.37	0.00
10.96	-16.58	-6.17	10.96	-16.58	-6.17	0.01	-27.99	-26.42	-40.58	-27.99	-26.42	-40.57	0.00
-33.19	-2.72	-9.69	-33.19	-2.72	-9.68	0.00	-35.54	5.27	-20.26	-35.54	5.26	-20.26	0.00
28.54	20.55	10.18	28.54	20.56	10.19	0.01	7.99	20.28	-6.89	7.99	20.29	-6.89	0.00
19.42	-11.86	1.32	19.42	-11.86	1.32	0.00	-23.79	-11.07	-49.29	-23.79	-11.07	-49.29	0.00
-11.12	-3.50	11.87	-11.12	-3.50	11.87	0.00	-4.87	2.04	-29.48	-4.86	2.04	-29.48	0.00
6.20	-7.33	57.55	6.20	-7.34	57.55	0.01	-34.20	3.72	-15.19	-34.20	3.72	-15.19	0.00

-18.96	-28.14	-13.03	-18.96	-28.13	-13.04	0.00	11.07	22.24	33.34	11.06	22.29	33.35	0.05
-31.20	-21.06	-9.00	-31.20	-21.06	-9.00	0.00	7.19	13.64	-8.91	7.18	13.65	-8.94	0.04
13.62	22.18	38.80	13.62	22.18	38.80	0.00	-11.43	6.96	-36.88	-11.43	6.96	-36.88	0.01
-22.70	-10.76	-49.69	-22.70	-10.77	-49.70	0.01	-22.30	10.77	-34.75	-22.28	10.68	-34.73	0.10
-15.03	10.44	-32.47	-15.03	10.43	-32.47	0.00	-3.65	-20.06	-11.82	-3.63	-20.13	-11.78	0.08
-6.25	-18.36	-8.20	-6.25	-18.36	-8.20	0.00	-3.08	4.14	-24.33	-3.07	4.15	-24.34	0.02
-1.16	-9.25	-31.97	-1.15	-9.24	-31.97	0.00	31.80	19.16	-8.96	31.84	19.20	-8.96	0.05
-38.22	-22.34	-17.89	-38.22	-22.34	-17.89	0.00	-22.67	-14.83	-6.11	-22.67	-14.83	-6.07	0.04
5.82	0.16	-21.87	5.82	0.16	-21.87	0.00	0.49	-6.37	50.92	0.47	-6.43	50.92	0.06
-16.58	7.53	-15.05	-16.58	7.53	-15.06	0.01	-17.01	1.26	-2.34	-17.05	1.29	-2.33	0.05
-39.17	1.97	-21.01	-39.17	1.97	-21.01	0.00	16.37	-4.48	51.46	16.38	-4.50	51.46	0.02
32.80	-0.01	-24.39	32.80	-0.01	-24.39	0.00	23.72	-13.27	-4.27	23.73	-13.28	-4.26	0.01
30.53	5.67	18.66	30.53	5.67	18.66	0.00	-27.93	-28.37	-14.45	-27.92	-28.33	-14.47	0.05
33.17	-7.57	-14.03	33.17	-7.57	-14.03	0.00	-14.46	-16.23	-47.50	-14.46	-16.21	-47.44	0.06
7.57	22.14	-4.11	7.57	22.15	-4.11	0.01	24.98	16.38	24.59	24.89	16.33	24.56	0.11
31.53	10.93	15.00	31.54	10.93	15.00	0.00	-16.93	-1.00	-46.97	-16.93	-1.01	-46.96	0.01
-8.43	-6.54	14.13	-8.43	-6.54	14.13	0.00	-41.32	-17.05	-18.91	-41.34	-17.06	-18.91	0.03
40.05	6.90	-1.69	40.05	6.89	-1.69	0.00	18.36	23.29	18.05	18.38	23.37	18.07	0.09
-20.23	12.09	-30.40	-20.23	12.09	-30.40	0.00	4.76	24.48	16.04	4.76	24.45	16.03	0.04
36.23	13.61	-9.75	36.23	13.61	-9.75	0.00	34.05	8.18	-21.95	34.13	8.18	-21.99	0.09
2.25	-18.02	-20.89	2.25	-18.02	-20.89	0.00	-39.57	-21.95	-30.54	-39.59	-21.96	-30.54	0.01
-15.57	20.68	26.06	-15.57	20.68	26.06	0.00	19.49	6.49	-26.80	19.47	6.49	-26.81	0.02
-38.23	-19.15	-14.67	-38.23	-19.15	-14.68	0.00	14.27	22.36	32.69	14.26	22.54	32.70	0.18
37.08	13.13	4.33	37.09	13.14	4.33	0.00	31.09	16.78	11.36	31.11	16.80	11.39	0.04
-15.57	-31.88	-24.50	-15.57	-31.88	-24.50	0.01	-10.95	7.02	3.91	-10.77	6.82	3.94	0.27
-8.93	8.15	-14.23	-8.93	8.14	-14.23	0.01	-4.38	-24.64	-19.97	-4.43	-24.60	-19.99	0.07
3.95	23.69	22.76	3.95	23.69	22.76	0.00	39.39	8.92	0.27	39.37	8.91	0.27	0.03
-28.56	1.00	-12.67	-28.56	1.00	-12.67	0.00	0.99	18.84	51.24	1.06	18.59	51.20	0.26
-10.68	-28.85	-34.19	-10.68	-28.84	-34.19	0.01	-31.25	6.97	-16.67	-31.28	7.01	-16.65	0.06
-4.38	-11.95	3.62	-4.38	-11.95	3.62	0.00	-24.44	10.52	-33.53	-24.44	10.55	-33.54	0.03
-42.29	-13.35	-18.74	-42.29	-13.34	-18.74	0.00	-23.87	-18.18	-6.34	-23.87	-18.18	-6.35	0.02
35.96	13.77	7.22	35.96	13.77	7.22	0.00	21.37	-8.20	8.26	21.40	-8.30	8.28	0.10
-16.51	16.53	23.01	-16.51	16.53	23.01	0.00	-6.32	-17.99	-7.12	-6.38	-17.89	-7.19	0.13
22.18	-2.02	34.63	22.18	-2.02	34.63	0.01	12.61	14.73	63.13	12.61	14.73	63.09	0.05
-34.49	3.41	-15.12	-34.49	3.42	-15.12	0.00	9.22	25.88	8.53	9.19	25.95	8.54	0.07
36.81	6.19	-15.52	36.81	6.19	-15.52	0.00	-33.07	2.08	-40.67	-33.06	2.06	-40.66	0.02
-4.20	2.69	-27.80	-4.20	2.68	-27.79	0.00	9.61	-10.08	-21.78	9.62	-10.09	-21.80	0.03
-15.80	8.82	-37.87	-15.80	8.82	-37.87	0.00	12.18	-8.59	14.94	12.15	-8.48	14.91	0.12
-0.01	-10.65	-30.27	-0.01	-10.65	-30.27	0.00	-9.12	15.17	38.55	-9.22	15.15	38.62	0.12
-11.81	-18.18	-7.25	-11.81	-18.18	-7.25	0.00	11.33	-11.44	7.55	11.33	-11.44	7.55	0.01
-39.72	-16.06	-14.66	-39.72	-16.06	-14.66	0.00	1.98	-4.60	-25.88	1.96	-4.60	-25.86	0.02
22.39	3.66	48.10	22.39	3.66	48.10	0.00	14.71	-1.88	63.10	14.71	-1.88	63.05	0.05
19.03	-6.43	18.90	19.03	-6.43	18.91	0.01	0.30	-9.18	-29.19	0.31	-9.17	-29.20	0.01
-2.76	23.71	18.54	-2.76	23.72	18.54	0.01	22.07	4.72	52.69	21.99	4.74	52.68	0.08
21.00	13.36	52.11	20.98	13.35	52.11	0.01	-0.62	-1.72	-26.78	-0.63	-1.73	-26.77	0.01
-34.47	4.99	-35.62	-34.47	4.99	-35.62	0.00	-29.15	-30.56	-31.74	-29.19	-30.65	-31.76	0.10
14.78	23.26	23.24	14.79	23.27	23.24	0.01	-21.29	-18.71	-47.41	-21.29	-18.73	-47.46	0.06
-37.83	-10.47	-10.66	-37.83	-10.47	-10.66	0.00	-0.76	17.23	53.38	-0.81	17.31	53.39	0.10
-7.38	5.70	-29.52	-7.38	5.70	-29.52	0.00	40.06	4.94	-0.51	40.05	4.94	-0.51	0.01
-7.06	16.80	40.98	-7.06	16.80	40.98	0.00	-8.57	9.14	4.59	-8.57	9.15	4.59	0.01
-26.37	-26.09	-10.86	-26.37	-26.09	-10.86	0.00	-16.87	1.10	-45.65	-16.87	1.13	-45.68	0.04
-22.64	-32.71	-25.00	-22.64	-32.72	-25.00	0.01	1.07	19.05	48.17	1.07	19.04	48.17	0.02
-3.03	15.19	6.28	-3.03	15.19	6.28	0.00	-26.18	9.56	-34.96	-26.18	9.53	-34.95	0.03
4.01	-7.04	50.03	4.01	-7.04	50.03	0.00	1.54	-7.05	54.27	1.56	-7.00	54.27	0.05
25.55	8.70	32.54	25.56	8.70	32.54	0.00	-16.57	16.79	22.60	-16.44	16.73	22.61	0.14
-30.32	3.63	-40.84	-30.32	3.63	-40.84	0.00	-9.11	-2.60	20.28	-9.02	-2.58	20.26	0.10
16.98	-3.36	56.68	16.98	-3.36	56.68	0.00	-5.15	-24.22	-34.35	-5.13	-24.24	-34.35	0.02
38.02	-0.15	-12.80	38.02	-0.15	-12.80	0.00	-4.58	-5.89	30.32	-4.66	-5.99	30.34	0.13
0.05	-15.65	-5.00	0.05	-15.65	-5.00	0.00	16.94	22.92	-27.28	16.94	22.94	-27.29	0.02
21.77	-10.78	-21.68	21.77	-10.78	-21.68	0.00	-39.71	-1.85	-35.65	-39.86	-1.81	-35.71	0.16
-5.92	-23.42	-15.26	-5.92	-23.42	-15.26	0.00	12.58	-17.15	-7.71	12.59	-17.11	-7.71	0.04
0.57	-8.37	-28.55	0.57	-8.37	-28.56	0.00	-22.34	8.40	-38.10	-22.34	8.49	-38.15	0.10
-36.04	4.96	-20.64	-36.04	4.97	-20.64	0.00	14.84	-5.67	42.48	14.85	-5.69	42.48	0.02
-20.90	5.54	-41.66	-20.90	5.54	-41.67	0.00	10.61	-14.02	2.68	10.60	-13.92	2.64	0.10
6.78	-12.57	5.48	6.78	-12.57	5.48	0.00	-6.93	4.36	50.54	-6.90	4.37	50.54	0.03
13.25	11.74	-13.67	13.25	11.74	-13.67	0.00	-25.99	-22.12	-7.53	-25.98	-22.09	-7.56	0.05
9.86	3.21	-18.59	9.86	3.21	-18.59	0.00	-27.10	-11.14	-6.66	-27.10	-11.12	-6.62	0.04
7.98	16.14	63.21	7.98	16.14	63.21	0.01	-10.87	23.61	21.08	-10.91	23.73	21.04	0.14
							-3.76	-4.95	36.65	-3.87	-5.07	36.66	0.17
							23.74	18.15	24.64	23.73	18.15	24.63	0.01
							9.12	-13.00	-19.24	9.16	-13.07	-19.29	0.09
200	PA4-J-Unknown-Output.txt												0.05

Listing 9. PA4-J-Unknown-Output.txt

19.90	0.93	-24.50	19.91	0.93	-24.49	0.02	25.59	-13.47	-9.80	25.55	-13.42	-9.81	0.06
-42.11	-14.07	-28.38	-42.18	-14.05	-28.43	0.09	-5.35	11.82	53.58	-5.44	11.86	53.60	0.09
33.77	14.91	-16.39	33.69	14.88	-16.36	0.09	-1.78	-7.90	-35.94	-1.81	-7.91	-35.95	0.04
28.67	-11.84	-14.74	28.70	-11.88	-14.74	0.06	4.25	-8.50	22.73	4.24	-8.49	22.72	0.01
17.60	-15.37	-15.82	17.61	-15.36	-15.80	0.02	10.43	24.37	19.30	10.43	24.31	19.29	0.06
37.97	4.17	8.65	38.02	4.17	8.69	0.06	7.46	25.31	4.55	7.54	25.21	4.58	0.13
-27.55	6.78	-38.78	-27.55	6.78	-38.78	0.01	9.08	-7.19	62.71	9.04	-7.04	62.67	0.17
27.56	9.31	24.71	27.67	9.32	24.74	0.12	33.37	14.71	-17.82	33.29	14.67	-17.80	0.09
-38.45	-18.73	-38.23	-38.34	-18.67	-38.18	0.14	20.68	23.29	15.29	20.67	23.26	15.29	0.03
-16.07	10.82	-21.83	-16.07	10.79	-21.85	0.03	-31.19	-29.44	-20.78	-31.23	-29.51	-20.76	0.09
30.47	-2.67	-26.08	30.46	-2.67	-26.14	0.05	-41.74	-0.87	-28.71	-41.74	-0.87	-28.71	0.00
-26.09	-27.31	-12.05	-26.08	-27.22	-12.12	0.12	-18.43	-27.21	-41.17	-18.43	-27.21	-41.17	0.00
-3.72	-23.26	-17.99	-3.73	-23.23	-18.00	0.03	-0.80	-8.68	-31.25	-0.97	-8.72	-31.16	0.20
-1.15	-5.79	56.49	-1.21	-5.91	56.49	0.13	29.28	8.94	20.68	29.24	8.93	20.67	0.03
30.22	-4.75	-26.04	30.21	-4.74	-26.03	0.02	-28.12	-22.09	-44.66	-28.13	-22.12	-44.69	0.04
14.87	22.94	-27.61	14.86	22.95	-27.61	0.01	8.85	20.73	-8.44	8.94	20.70	-8.40	0.11
-31.94	-18.69	-8.58	-31.93	-18.69	-8.59	0.01	-8.83	-25.18	-15.09	-8.81	-25.20	-15.08	0.04
35.97	-2.75	8.56	36.00	-2.78	8.57	0.04	10.93	5.73	62.93	10.93	5.73	62.91	0.03
17.94	-16.73	-12.94	17.93	-16.79	-12.96	0.06	-0.60	-8.90	23.54	-0.61	-8.99	23.56	0.09
-31.40	-29.29	-32.84	-31.40	-29.29	-32.84	0.00	38.12	2.27	8.44	38.19	2.26	8.50	0.09
14.75	22.01	34.80	14.75	22.16	34.85	0.15	-6.55	-24.90	-17.20	-6.55	-24.90	-17.20	0.00
-5.85	17.23	11.87	-5.85	17.23	11.87	0.00	-37.01	-20.62	-14.06	-37.03	-20.63	-14.05	0.02
5.12	7.25	-16.17	5.08	7.17	-16.09	0.12	-32.99	-17.65	-8.87	-32.99	-17.65	-8.88	0.00
33.76	16.56	-3.79	33.75	16.55	-3.79	0.02	9.49	-8.91	15.74	9.48	-8.87	15.72	0.04
6.38	-8.07	22.34	6.37	-8.05	22.34	0.02	-13.35	5.39	-7.45	-13.36	5.41	-7.45	0.02
-29.02	-21.78	-8.21	-29.01	-21.77	-8.22	0.02	-12.92	-29.55	-34.98	-12.90	-29.60	-35.01	0.07
8.65	24.37	18.08	8.64	24.49	18.10	0.12	-16.24	15.43	29.81	-16.13	15.44	29.78	0.11
-24.27	7.37	-16.09	-24.27	7.37	-16.09	0.00	-32.94	2.58	-40.13	-32.96	2.60	-40.15	0.04
24.06	6.89	-30.36	24.05	6.89	-30.40	0.05	-5.79	11.08	58.63	-5.79	11.08	58.63	0.00
-38.08	-20.28	-37.11	-38.04	-20.26	-37.09	0.05	4.86	-7.03	49.26	4.87	-7.12	49.26	0.08
0.03	24.07	22.99	0.03	24.03	22.98	0.03	-5.89	11.60	4.64	-5.91	11.63	4.63	0.04
27.08	-8.85	3.99	27.08	-8.92	4.02	0.07	-23.87	-29.45	-37.90	-23.87	-29.39	-37.86	0.07
-35.25	0.91	-13.24	-35.22	0.89	-13.27	0.04	-24.87	-20.81	-6.89	-24.87	-20.78	-6.95	0.07
-7.00	25.10	28.07	-7.02	24.87	28.01	0.25	30.11	-0.18	-27.43	30.12	-0.19	-27.45	0.02
29.03	6.90	21.68	29.05	6.90	21.69	0.02	4.79	19.17	57.19	4.78	19.20	57.20	0.03
16.11	20.76	42.04	16.21	20.97	42.05	0.24	-15.49	-19.42	-7.30	-15.48	-19.42	-7.29	0.01
-14.94	16.48	32.66	-14.98	16.46	32.69	0.05	-11.65	6.15	-0.88	-11.65	6.15	-0.88	0.00
3.11	-15.63	-23.63	3.03	-15.59	-23.59	0.10	-4.33	-14.14	-40.85	-4.30	-14.14	-40.88	0.04
-5.24	-2.08	56.48	-5.15	-2.02	56.48	0.11	32.88	12.64	-22.03	32.91	12.66	-22.05	0.04
-2.08	-18.02	-36.48	-2.01	-18.05	-36.52	0.09	-0.99	-19.96	-31.75	-0.91	-20.00	-31.77	0.10
28.05	-10.93	-3.30	28.01	-10.87	-3.31	0.07	17.49	-16.70	-13.06	17.50	-16.68	-13.05	0.02
17.91	25.27	-18.50	17.90	25.31	-18.49	0.04	26.59	-9.00	3.44	26.59	-9.12	3.48	0.13
15.03	-12.58	-18.24	15.03	-12.58	-18.24	0.01	-30.81	-3.65	-45.41	-30.85	-3.62	-45.47	0.08
-2.90	23.85	29.56	-2.90	23.87	29.57	0.02	14.75	0.07	62.94	14.75	0.07	62.99	0.05
32.58	-5.35	-22.64	32.54	-5.32	-22.60	0.06	-12.99	4.05	7.45	-12.90	4.01	7.44	0.10
-0.57	-18.61	-33.46	-0.62	-18.60	-33.46	0.05	-39.41	2.62	-27.27	-39.44	2.64	-27.27	0.03
20.91	2.99	55.82	21.15	2.94	55.86	0.25	-32.10	-28.95	-21.42	-32.17	-29.06	-21.40	0.13
-12.18	9.64	-28.04	-12.19	9.63	-28.04	0.01	29.42	-9.55	-2.30	29.47	-9.63	-2.29	0.09
-13.21	8.16	-37.03	-13.22	8.14	-37.02	0.02	27.64	-11.59	-10.15	27.64	-11.60	-10.14	0.01
21.00	25.23	-17.52	21.00	25.23	-17.52	0.01	24.77	8.80	35.92	24.80	8.80	35.93	0.03
-2.26	4.42	-23.52	-2.28	4.37	-23.48	0.06	31.34	0.94	16.29	31.40	0.93	16.33	0.07
10.63	7.61	62.95	10.63	7.61	62.95	0.00	-5.04	-1.94	60.59	-5.20	-2.05	60.58	0.20
-4.73	17.18	10.81	-4.76	17.20	10.77	0.05	-1.63	1.18	-26.09	-1.67	1.16	-26.06	0.06
-5.58	-20.37	-39.61	-5.55	-20.39	-39.63	0.04	28.35	20.72	-20.43	28.37	20.73	-20.44	0.03
21.07	0.74	50.78	21.03	0.76	50.77	0.04	-6.62	10.44	46.85	-6.52	10.42	46.85	0.10
2.50	21.34	36.41	2.50	21.34	36.41	0.01	-12.43	-28.71	-17.62	-12.43	-28.69	-17.64	0.03
4.66	4.63	63.40	4.66	4.63	63.40	0.00							
-1.53	23.81	28.50	-1.52	23.86	28.52	0.06							
-29.41	-21.57	-8.32	-29.40	-21.57	-8.33	0.00							
31.18	20.01	-12.07	31.14	19.98	-12.07	0.05	200						
-26.71	-5.25	-8.47	-26.73	-5.22	-8.43	0.05	16.16	21.31	38.30	16.21	21.51	38.29	0.20
-2.39	-7.51	-37.48	-2.33	-7.49	-37.50	0.07	-32.19	7.38	-18.59	-32.17	7.35	-18.60	0.04
13.10	14.84	-22.48	13.16	14.87	-22.49	0.07	-22.51	2.61	-44.32	-22.51	2.64	-44.37	0.06
9.46	19.51	-9.76	9.38	19.54	-9.81	0.09	20.02	15.54	49.01	20.01	15.54	49.00	0.01
16.93	20.86	40.37	16.94	20.90	40.38	0.04	-2.40	-6.66	-34.97	-2.45	-6.68	-34.98	0.06
32.33	-6.90	1.25	32.28	-6.84	1.25	0.07	-37.07	-0.43	-39.12	-37.13	-0.39	-39.17	0.08
14.87	-16.83	-11.66	14.92	-16.65	-11.59	0.20	-19.92	-31.81	-34.20	-19.93	-31.76	-34.18	0.05
6.97	-6.92	42.32	6.96	-6.79	42.33	0.13	-35.04	1.59	-13.35	-34.97	1.55	-13.43	0.12
-41.65	-8.61	-16.20	-41.64	-8.61	-16.21	0.01	29.95	-7.87	5.53	29.96	-7.93	5.54	0.07
-41.16	-16.05	-30.91	-41.11	-16.06	-30.87	0.07	37.60	11.58	-6.22	37.53	11.55	-6.21	0.08
-8.48	6.61	-30.83	-8.51	6.59	-30.83	0.04	11.35	20.44	58.81	11.36	20.52	58.82	0.08
-5.92	-0.60	42.31	-5.93	-0.60	42.31	0.01	21.89	-15.71	-14.19	21.89	-15.74	-14.19	0.03

Listing 10. PA4-K-Unknown-Output.txt

24.13	23.01	-22.11	24.14	23.04	-22.13	0.03	14.73	-14.21	0.93	14.73	-14.22	0.94	0.01
-5.88	-13.46	-42.83	-5.83	-13.48	-42.89	0.08	2.96	-7.00	48.99	2.96	-6.94	48.99	0.06
27.09	19.07	14.31	27.13	19.10	14.34	0.06	-23.09	-11.12	-49.33	-23.09	-11.10	-49.30	0.04
0.74	-18.56	-11.20	0.73	-18.54	-11.21	0.03	40.48	3.53	-4.20	40.55	3.53	-4.19	0.07
3.29	-7.34	61.00	3.29	-7.35	61.00	0.01	9.76	25.70	11.59	9.75	25.65	11.58	0.05
4.75	20.53	43.25	4.77	20.39	43.22	0.15	35.67	-1.41	-18.62	35.66	-1.41	-18.62	0.00
0.86	-18.69	-24.26	0.92	-18.71	-24.28	0.07	33.02	17.18	6.88	33.05	17.20	6.88	0.03
-9.62	7.35	-6.02	-9.63	7.38	-6.02	0.03	19.19	25.54	7.42	19.22	25.61	7.44	0.07
10.44	5.89	62.89	10.44	5.89	62.89	0.00	-26.38	-14.28	-47.92	-26.38	-14.27	-47.89	0.02
24.13	24.61	-5.46	24.12	24.59	-5.46	0.02	-3.45	-4.30	51.09	-3.40	-4.25	51.08	0.07
-26.81	9.23	-35.19	-26.82	9.26	-35.20	0.03	29.14	-10.14	-4.69	29.15	-10.15	-4.69	0.01
-6.91	6.68	59.46	-7.03	6.69	59.45	0.13	12.04	18.00	-20.96	12.01	17.99	-20.96	0.03
1.80	-18.83	-22.10	1.74	-18.79	-22.08	0.07	6.88	20.27	-5.35	6.98	20.23	-5.30	0.12
-4.21	-17.26	-7.10	-4.20	-17.30	-7.08	0.04	-1.00	-7.78	28.20	-1.01	-7.88	28.22	0.10
-28.41	-22.99	-43.74	-28.41	-23.00	-43.75	0.02	-3.91	-5.39	34.96	-3.76	-5.26	34.96	0.19
-5.29	-24.11	-35.01	-5.30	-24.10	-35.01	0.01	0.91	-11.46	9.11	0.89	-11.53	9.12	0.06
11.12	20.72	55.76	11.12	20.69	55.76	0.03	-39.53	-3.28	-37.64	-39.45	-3.31	-37.60	0.09
-16.42	-8.86	-0.54	-16.43	-8.87	-0.52	0.03	20.76	-13.33	-2.36	20.79	-13.38	-2.33	0.07
-6.72	8.35	55.61	-6.66	8.33	55.61	0.06	-14.59	-9.94	-48.24	-14.58	-9.94	-48.27	0.03
5.96	-12.29	6.81	5.95	-12.39	6.81	0.10	4.48	18.49	62.08	4.45	18.57	62.15	0.11
12.20	-10.84	8.80	12.19	-10.80	8.79	0.04	-37.27	5.32	-25.89	-37.20	5.25	-25.89	0.10
-30.97	-20.42	-8.57	-30.96	-20.41	-8.58	0.02	20.26	2.98	-25.76	20.23	2.97	-25.78	0.04
34.53	-4.62	8.09	34.47	-4.56	8.07	0.09	-35.64	6.50	-25.40	-35.67	6.54	-25.40	0.05
15.91	11.36	-26.89	15.94	11.38	-26.88	0.03	-6.92	-23.62	-14.51	-6.95	-23.56	-14.55	0.07
-3.04	-9.52	18.56	-3.04	-9.51	18.55	0.02	-4.74	13.81	54.17	-4.49	13.66	54.16	0.29
-13.90	-6.19	-47.73	-13.90	-6.19	-47.72	0.00	-3.54	-20.39	-36.80	-3.52	-20.41	-36.81	0.03
-7.71	24.22	30.56	-7.70	24.17	30.56	0.05	36.69	13.07	-5.17	36.69	13.07	-5.17	0.00
-3.84	-11.14	-40.87	-3.84	-11.14	-40.87	0.00	0.12	-17.47	-29.18	0.18	-17.48	-29.21	0.07
-32.47	-17.61	-8.54	-32.44	-17.60	-8.59	0.06	-6.77	7.05	50.71	-6.94	7.09	50.70	0.18
-24.76	6.54	-40.59	-24.75	6.52	-40.58	0.03	-7.72	23.80	32.77	-7.71	23.72	32.73	0.09
1.14	-10.34	16.19	1.14	-10.37	16.20	0.04	-15.82	8.91	-37.85	-15.83	8.87	-37.82	0.06
-5.21	16.98	10.91	-5.16	16.94	10.96	0.08	-16.53	11.50	-31.57	-16.58	11.41	-31.54	0.11
22.17	24.92	-14.92	22.20	25.07	-14.93	0.15	14.48	-5.78	32.75	14.51	-5.90	32.75	0.13
-2.04	-22.40	-31.31	-2.07	-22.38	-31.31	0.04	-4.12	-17.94	-8.24	-4.12	-17.88	-8.27	0.06
15.34	21.70	37.13	15.34	21.69	37.13	0.01	-8.63	-19.16	-43.61	-8.62	-19.16	-43.62	0.01
-6.81	-27.39	-24.14	-6.75	-27.49	-24.13	0.12	-38.76	-0.96	-36.95	-38.87	-0.89	-37.01	0.15
7.20	-5.74	-23.04	7.18	-5.75	-22.99	0.05	-16.97	10.36	-20.61	-16.97	10.34	-20.62	0.02
27.89	-3.19	18.20	27.78	-3.07	18.14	0.17	-11.33	0.04	13.73	-11.47	-0.01	13.78	0.16
27.80	11.62	22.12	27.82	11.63	22.13	0.03	-6.55	0.31	34.32	-6.86	0.25	34.36	0.32
-14.04	-26.63	-12.83	-14.06	-26.55	-12.87	0.09	13.08	27.32	0.88	13.09	27.38	0.87	0.06
27.45	22.22	-18.46	27.41	22.17	-18.44	0.06	-32.86	1.55	-12.97	-32.86	1.52	-13.07	0.10
-36.47	-6.35	-42.70	-36.49	-6.35	-42.72	0.02	27.41	8.25	26.10	27.40	8.25	26.10	0.01
-11.81	-30.37	-23.16	-11.84	-30.29	-23.17	0.09	20.70	-12.08	0.24	20.62	-11.95	0.16	0.17
22.60	25.06	-13.77	22.59	25.03	-13.77	0.03	36.53	7.28	-16.43	36.52	7.28	-16.43	0.01
20.46	-12.43	-20.79	20.51	-12.39	-20.75	0.07	-26.51	-20.96	-45.95	-26.51	-20.98	-45.99	0.05
18.94	-17.15	-8.37	18.94	-17.16	-8.37	0.01	-25.48	-28.25	-13.61	-25.48	-28.28	-13.59	0.04
25.69	-4.84	17.18	25.64	-4.73	17.14	0.13	-6.68	-2.49	32.44	-6.61	-2.48	32.43	0.06
-6.02	-24.70	-17.56	-6.01	-24.71	-17.55	0.03	1.35	-6.71	53.84	1.29	-6.87	53.82	0.17
-34.78	4.57	-36.18	-34.73	4.51	-36.15	0.08	16.62	-10.72	-19.95	16.64	-10.66	-19.88	0.10
4.14	-13.66	-0.18	4.15	-13.62	-0.19	0.05	-13.12	15.50	17.47	-13.11	15.50	17.47	0.00
-21.33	-11.13	-49.63	-21.33	-11.13	-49.59	0.03	-27.95	-26.65	-40.40	-27.94	-26.60	-40.36	0.07
-15.57	-17.08	-5.69	-15.57	-17.07	-5.71	0.02	38.38	10.86	-3.49	38.39	10.87	-3.49	0.01
15.56	21.39	41.43	15.53	21.31	41.43	0.08	-20.73	-24.31	-9.06	-20.74	-24.30	-9.08	0.02
8.36	-6.59	35.01	8.37	-6.69	35.01	0.10	18.41	21.87	29.65	18.35	21.76	29.64	0.13
-35.69	-12.81	-45.00	-35.67	-12.79	-44.97	0.04	-0.48	-6.40	38.85	-0.49	-6.41	38.85	0.01
11.69	21.57	35.45	11.63	21.99	35.47	0.42	13.92	22.76	-27.72	13.96	22.71	-27.72	0.07
7.59	18.84	61.61	7.58	18.77	61.55	0.09	-7.74	6.40	35.27	-7.69	6.42	35.26	0.06
-30.52	-14.35	-6.60	-30.50	-14.30	-6.70	0.11	-6.28	5.73	-26.36	-6.28	5.72	-26.36	0.01
-22.34	-11.38	-4.62	-22.32	-11.38	-4.66	0.04	29.67	17.01	13.15	29.68	17.02	13.16	0.02
-24.66	-31.12	-34.47	-24.66	-31.11	-34.47	0.01	34.25	-6.03	-13.64	34.34	-6.09	-13.64	0.10
-4.28	18.52	42.14	-4.27	18.52	42.14	0.00	-5.56	8.99	-4.75	-5.63	9.12	-4.78	0.15
-35.48	-25.12	-35.02	-35.52	-25.16	-35.04	0.06	-11.33	10.01	30.34	-11.34	10.00	30.34	0.01
-8.40	-24.69	-38.53	-8.41	-24.69	-38.53	0.01	-39.09	-20.37	-34.81	-39.08	-20.37	-34.81	0.02
33.84	-5.32	0.50	33.83	-5.31	0.50	0.01	11.17	-6.38	-21.93	11.17	-6.35	-21.87	0.06
-0.89	-18.36	-34.55	-0.96	-18.35	-34.51	0.08	20.57	-7.21	-23.69	20.55	-7.23	-23.73	0.05
-27.87	2.97	-13.41	-27.87	2.96	-13.43	0.02	13.97	22.59	-24.49	13.98	22.59	-24.48	0.01
0.29	-6.22	-28.25	0.30	-6.22	-28.25	0.00	-5.08	2.19	-29.57	-5.03	2.22	-29.60	0.05
23.47	8.77	44.52	23.38	8.76	44.51	0.10	13.41	24.10	19.83	13.40	24.06	19.83	0.04
0.59	-6.72	56.10	0.59	-6.74	56.10	0.01	11.93	-6.36	60.95	11.91	-6.31	60.95	0.05
-18.93	-4.22	-47.88	-18.94	-4.23	-47.84	0.04	-35.88	1.81	-38.46	-35.90	1.84	-38.48	0.04
5.35	-10.50	-23.74	5.32	-10.49	-23.71	0.04	39.28	9.18	-0.36	39.30	9.19	-0.36	0.02
-3.83	-4.67	-39.13	-3.83	-4.67	-39.13	0.00	-28.81	9.81	-20.46	-28.82	9.82	-20.46	0.01

-35.52	1.38	-39.33	-35.54	1.41	-39.35	0.04
-24.72	-8.93	-49.22	-24.71	-8.94	-49.19	0.03
-19.08	3.66	-10.68	-19.05	3.61	-10.72	0.07
-4.64	2.98	-27.96	-4.63	2.99	-27.97	0.02
6.57	-9.07	17.69	6.57	-9.06	17.68	0.01
0.34	-6.37	46.66	0.32	-6.43	46.66	0.07
-19.79	-0.24	-6.37	-19.86	-0.20	-6.32	0.09
26.49	23.28	-10.75	26.51	23.32	-10.75	0.05
-6.25	0.32	46.49	-6.13	0.36	46.49	0.12
-6.99	3.11	-36.04	-6.98	3.12	-36.05	0.02
23.95	16.08	27.57	24.04	16.12	27.59	0.10
16.66	9.22	-24.27	16.73	9.24	-24.26	0.07
-8.13	-20.61	-9.90	-8.11	-20.64	-9.85	0.06
8.24	-6.89	47.96	8.23	-6.79	47.96	0.10
20.36	18.29	35.63	20.57	18.42	35.68	0.25
14.10	23.43	-20.11	14.07	23.47	-20.12	0.04
32.94	-2.42	12.35	33.04	-2.50	12.43	0.15
-22.25	-4.07	-47.57	-22.23	-4.09	-47.52	0.06
22.94	16.13	32.14	22.92	16.11	32.14	0.03
-18.24	-16.45	-47.90	-18.25	-16.43	-47.86	0.04
-11.64	2.70	14.86	-11.82	2.68	14.89	0.19
-38.53	-16.30	-13.25	-38.61	-16.34	-13.20	0.10
-17.53	-28.53	-14.27	-17.52	-28.55	-14.26	0.03
21.18	-5.63	20.97	21.21	-5.73	20.98	0.10
4.30	-0.16	-22.64	4.30	-0.16	-22.64	0.00
19.71	6.33	-27.25	19.72	6.33	-27.24	0.02
-14.91	-11.98	-48.51	-14.91	-11.98	-48.50	0.02
-12.44	9.10	-33.26	-12.47	9.02	-33.24	0.09
-4.76	13.06	55.11	-4.69	13.02	55.10	0.08
-6.88	6.63	53.98	-7.01	6.66	53.98	0.14
13.98	-16.17	-1.98	13.99	-16.21	-1.97	0.04
-24.12	0.38	-11.23	-24.10	0.37	-11.24	0.02
-19.58	0.21	-6.18	-19.53	0.18	-6.22	0.06
34.91	11.40	-17.63	34.88	11.39	-17.62	0.04
-21.34	7.05	-40.01	-21.34	7.07	-40.03	0.02
-14.98	14.81	31.66	-14.95	14.82	31.64	0.03
-31.61	4.77	-39.12	-31.61	4.77	-39.12	0.00
-14.37	13.72	32.04	-14.31	13.74	32.00	0.08
-8.31	13.75	11.53	-8.26	13.73	11.56	0.06
-39.47	-21.88	-21.53	-39.61	-21.98	-21.51	0.17
21.84	7.92	53.46	22.10	7.92	53.50	0.26
-36.27	-3.24	-41.86	-36.31	-3.22	-41.91	0.07
30.72	20.52	0.88	30.69	20.48	0.88	0.05
-31.69	8.14	-19.76	-31.71	8.18	-19.75	0.05