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Final Year Project Report (Term 2)

Bin Packing Problem

Author:
TANG Tsz Tsun, HO Kwok Chi

Supervisor:
Dr. Ng Chi-Kong Kevin

Faculty of Engineering

Department of System Engineering and Engineering Management

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The Chinese University of Hong Kong

Abstract

Faculty of Engineering

Department of System Engineering and Engineering Management

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Bin Packing Problem

by TANG Tsz Tsun, HO Kwok Chi

The Bin Packing Problem is an optimization problem. The problem is to pack all the given items with different sizes into a finite number of containers or bins with a fixed capacity. The aim is to minimize the number of containers or bins used.Two dimensional bin packing and Three dimensional bin packing are one of the variations of the Bin Packing Problem. This problem is related to various aspects. For example sheet cutting for industrial use and box packing in logistic use. There is much previous research about algorithms to solve the Bin Packing Problem. In this research, we decided to design and enhance our Offline Two Dimensional Bin Packing Algorithm and compare it with the Maximal Rectangles Algorithms, Besides, designing a new Online Two Dimensional Bin Packing Algorithm and compare it with the Online Shelf Heuristics Algorithms. We would compare their results and find out the best algorithm by comparing the Number of Bins Used. Also,we would look into the weakness of our own algorithm and decide the future development.

Acknowledgement

We would like to express our gratitude to our supervisor Doctor NG Chi-Kong Kevin who provided us suggestions and guidance for the project.

Besides, we would like to express our special thanks to the previous project studying the bin packing problem that strengthened our background knowledge and provided a good reference to our project.

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Chapter 1 - Introduction

1.1. Overview

The topic of this final year project is trying to develop a New Algorithm, which is an improved version of our Old Algorithm. Our aim is to lower the number of bin used. We would also compare our New Algorithm to other existing algorithms to see whether our New Algorithm is better or not. Moreover, we would develop our own Online Algorithm and compare it to other existing online algorithms. Throughout this report, we will demonstrate the work we have done in the second semester. This chapter will provide a brief overview of the New Algorithm project and the Online Algorithm project. Besides, the other online algorithm for the problem will be discussed in the report. Finally, difficulties and problems faced will be discussed

1.2. Motivation

The two dimensional bin packing problem can be applied to different scenarios in real life such as sheet cutting, box packing, parking lot designing, etc. Environmental protection is one of the main issues due to the overexploitation of natural resources. By studying two dimensional bin packing problems, we could apply them to industrial use like sheet cutting to make the most of the material. Therefore, help reduce the waste of resources and protect the environment. There are different algorithms that work with the two dimensional bin packing problem, but still we would like to find our own way to solve the problem. Furthermore, an online algorithm could be a back-up plan for 2d bin packing if sorting is impracticable. Thus we would also like to develop our own method to answer the online 2d bin packing problem.

1.3. Background

1.3.1. Bin Packing Problem

The classic bin packing problem is one dimensional and offline for the packing mode. It is defined as the following: Given a positive integer bin with size C and a set of items $L = \{i_1, i_2, i_3, \ldots, i_n\}$, each item i_k having an integer size $s(i_k)\ s.t.\ 0 < s(i_k) \leq C$. Find the minimum integer m such that there is a partition

$L = B_1 \cup B_2 \cup B_3 \cup \ldots \cup B_m\ s.t.\ \sum_{i_k \in B_j} s(i_k) \leq C,\ 1 \leq j \leq m.$ (Coffman Jr. et al., 2014, 49)

The problem contains different attributes such as the dimension, packing mode and we are focusing on two dimensional and offline for the packing mode.
For dimension, it defines the dimension of the bins and items, all bins and items are supposed to be in the same dimension.
For online packing mode, all the size of the item is unknown until the moment that the item is being packed while offline packing mode means all the size of the item is given.

1.3.2. Two Dimensional Offline Bin Packing Problem

The two dimensional offline bin packing problem is defined as the following: Given a positive integer bin with size $h(C) \times w(C)$ and a set of items $L = \{i_1, i_2, i_3, \ldots, i_n\}$, each item i_k having two integer $h(i_k)$, $w(i_k)$ $s.t.$ $0 < h(i_k) \leq h(C)$, $0 < w(i_k) \leq w(C)$. Find the minimum integer m such that there is a partition

$$L = B_1 \cup B_2 \cup B_3 \cup \ldots \cup B_m \; s.t. \sum_{i_k \in B_j} h(i_k) \leq h(C),\; w(i_k) \leq w(C),\; 1 \leq j \leq m.$$

1.3.3. Two Dimensional Online Bin Packing Problem

The difference between offline and online is that the algorithm only knows the incoming item instead of all items in the set. Therefore, no sorting for the item set is allowed.

1.4. Objective

In this project, our objective is to design an enhanced version offline algorithm and online algorithm for the two dimensional bin packing problem and compare it to other existing algorithms. We need to build a simulation for our own algorithm in order to see the result.

Chapter 2 - Preparation

2.1. Data Defination

For the two dimensional bin packing problem, we have to define the dimension of bins and items with height and width. We define a height $h(C)$ and width $w(C)$ as a constant for every bin B. Then, we using random function to generate a set of items $L = \{i_1, i_2, i_3, ..., i_n\}$, $\forall i_k \in L \; s.t. \; 0 < h(i_k) \leq h(C), \; 0 < w(i_k) \leq w(C), \; 0 < k \leq n$. In the simulation, we define $h(C) = 220, \; w(C) = 170$ and $n = 20$.

2.2. Simulation for Our Algorithm

As we design our own algorithm, we build a simulation for our own algorithm in Java which is an Object-Oriented Programming Language. This helps us to build the simulation by using the features of Object-Oriented. We used JOptionPane to show the result of each item packed using our algorithm.

2.3. Simulation for Other Algorithms

In order to understand the weakness of our own Offline algorithm, we choose Maximal Rectangles Algorithms with different placement rules as the comparison. The rules are Bottom-Left, Best Short Side Fit, Best Long Side Fit, and Best Area Fit respectively. We add the new placement rule, Greedy Best Long Side Fit, for a deeper comparison in this report. All of the above algorithm simulations are carried out in an online calculator for 2D Offline Bin Packing Problem Solver provided by PlanetCalc (Timur from PLANETCALC, 2019).

For the online algorithm, we choose the Online Shelf Heuristics with different placement rules for the comparison. The rules are Shelf First Fit, Shelf Best Width Fit, Shelf Worst Width Fit, and Shelf Best Area Fit respectively. All of the above algorithm simulations are carried out in an online bin packing heuristic website for 2D Online Bin Packing website provided by Veronika Černohorská. (Veronika Černohorská, 2015).

2.4. Placement rules for the Maximal Rectangles Algorithms

Bottom-Left : Each rectangle is placed to the position where the top side of the rectangle y-coordinate is the smallest. If there are more than 1 position with the same y-coordinate, the one with the smallest x-coordinate will be picked. (Jylänki, 2010, 20)

Best Short Side Fit : Each rectangle is placed to the position where the length of the shorter leftover side of the remaining space area is minimal. (Jylänki, 2010, 20)

Best Long Side Fit : Each rectangle is placed to the position where the length of the longer leftover side of the remaining space area is minimal. (Jylänki, 2010, 20)

Best Area Fit : Each rectangle is placed to the position where the remaining empty space area is the smallest to place the next rectangle. If there is a tie, the Best Short Side Fit rule is used. (Jylänki, 2010, 20)

Greedy Best Long Side Fit : Similar to the Best Long Side Fit, but the item that fits perfectly along any side of free space will be placed first. (Jylänki, 2010, 20) (Paul E. Black, 2005)

2.5. Placement rules for the Online Shelf Heuristics Algorithms

Online Algorithms : Every item must be put in the bin immediately after receiving it. Withholding the item is not applicable. Therefore, the whole item sequence to pack is unknown, and sorting is not applicable also. (Jylänki, 2010, 4)

Shelf First Fit : Each rectangle with the lowest index is placed to the first shelf of the bin where it fits.(Jylänki, 2010, 7)

Shelf Best Width Fit : Each rectangle is placed to the shelf where it fits and the remaining width of the shelf space is minimized. (Jylänki, 2010, 8)

Shelf Worst Width Fit : Each rectangle is placed to the shelf where it fits and the remaining width of the shelf space is maximized. (Jylänki, 2010, 9)

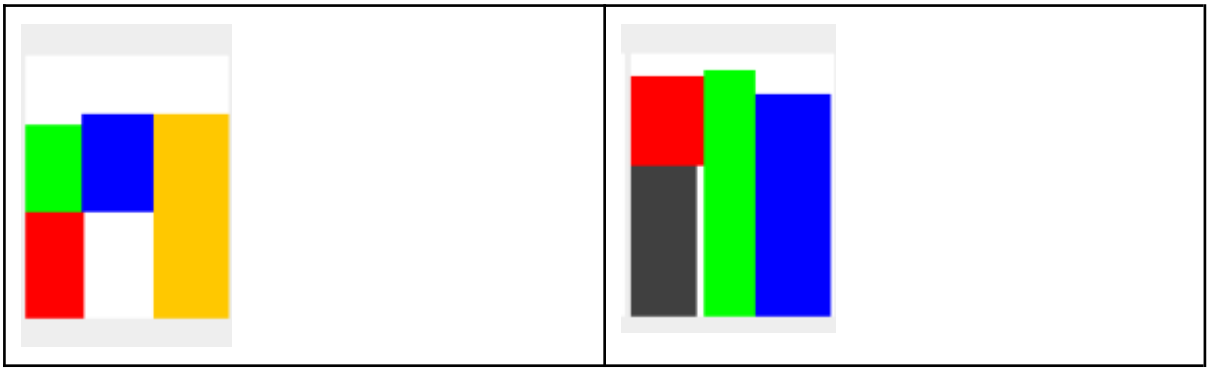
Shelf Best Area Fit : Each rectangle is placed to the shelf where it fits and the total unused shelf area is minimized. (Jylänki, 2010, 8)

Chapter 3 - Algorithm Design

3.1. Algorithm Introduction

Our strategy for our new offline algorithm is first rotate all items to vertical and sort by height in descending order. Next, pack the first item to the bottom-left corner, then keep packing the items next to the first item. After that, we place an item on top of the items packed previously if possible. Finally create a new bin and repeat the step until all items are packed.

For our online algorithm, we first rotate each incoming item to vertical. Then, we pack the item to the bottom-left corner and try to pack on top of the item packed previously if possible. If not, we pack it right next to the item packed after checking the possibility. Also, we check if the item at the upper part has a greater width than the one at the lower part, if so, the next item to be packed at the lower part will be packed to the right of the upper item at the lower part. Here are the examples for the case:



3.2. Algorithm Pseudo Code

The time complexity of our offline algorithm is $O(n^2)$

1.	Rotate all items i_k in list L such that $h(i_k) > w(i_k),\ 0 \leq k < n$	$O(n)$
2.	Sort the list L in descending order	$O(nlogn)$
3.	Do until size of list $n = 0$	$O(n^2)$
3.1.	Do if bin B_j has no item i	$O(n)$
3.1.1.	Pack item i_0 to bin B_j	$O(1)$
3.1.2.	Calculate remaining height, width $rh(C),\ rw(C)$	$O(1)$
3.1.3.	Calculate upper remaining width $urw(C, i_0)$	$O(1)$
3.1.4.	Remove item i_0 from the list L, $n \leftarrow n - 1$	$O(n)$
3.2.	Otherwise do if $rh(C) \geq h(i_k)$	$O(n)$
3.2.1.	Do if $urw(B_j) \geq w(i_k)$	$O(1)$
3.2.1.1.	Pack item i_k to bin B_j	$O(1)$
3.2.1.1.	Calculate upper remaining width $urw(B_j, i_k)$	$O(1)$

3.2.1.2.	Remove item i_k from the list L, $n \leftarrow n - 1$	$O(n)$
3.2.2.	Otherwise do	$O(1)$
3.2.2.1.	Do if $k + 2 > n$	$O(1)$
3.2.2.1.1.	Set the upper bin B_j is full and $k = 0$	$O(1)$
3.2.2.2.	Otherwise set $k = k + 1$	$O(1)$
3.3.	Otherwise do	$O(n)$
3.3.1.	Do if $rw(C) \geq w(i_k)$	$O(1)$
3.3.1.1.	Pack item i_k to bin B_j	$O(1)$
3.3.1.2.	Do if $i_k > (C - rh(B_j))$	$O(n)$
3.3.1.2.1.	Calculate upper remaining height $rh(C, i_k)$	$O(1)$
3.3.1.3.	Calculate upper remaining width $urw(B_j, i_k)$	$O(1)$
3.3.1.4.	Remove item i_k from the list L, $n \leftarrow n - 1$	$O(n)$
3.3.2.	Otherwise do	$O(1)$
3.3.2.1.	Set $k \leftarrow k + 1$ if $k + 2 < n$	$O(1)$
3.3.2.2.	Otherwise set the bin B_j is full and create a new bin B_{j+1}	$O(1)$
4.	Return j as the number of bin used	$O(1)$

The time complexity of our online algorithm is $O(n^2)$

1.	Rotate all items i_k in list L such that $h(i_k) > w(i_k)$, $0 \leq k < n$	$O(n)$
2.	Do until size of list $n = 0$	$O(n^2)$
2.1.	Do if bin B_j has no item i	$O(n)$
2.1.1.	Pack item i_0 to bin B_j	$O(1)$
2.1.2.	Calculate remaining height, width $rh(C)$, $rw(C)$	$O(1)$
2.1.3.	Calculate upper remaining width $urw(C, i_0)$	$O(1)$
2.1.4.	Remove item i_0 from the list L, $n \leftarrow n - 1$	$O(n)$
2.2.	Otherwise do if $rh(C) \geq h(i_k)$	$O(n)$
2.2.1.	Do if $urw(B_j) \geq w(i_k)$	$O(1)$
2.2.1.1.	Pack item i_k to bin B_j	$O(1)$
2.2.1.2.	Calculate upper remaining width $urw(B_j, i_k)$	$O(1)$
2.2.1.3.	Remove item i_k from the list L, $n \leftarrow n - 1$	$O(n)$
2.2.2.	Otherwise set the bin B_j is full and create a new bin B_{j+1}	$O(1)$
2.3.	Otherwise do	$O(n)$
2.3.1.	Do if $rw(C) \geq w(i_k)$	$O(1)$
2.3.1.1.	Pack item i_k to bin B_j	$O(1)$
2.3.1.2.	Do if $rw(B_j) > urw(B_j))$	$O(n)$
2.3.1.2.1.	Calculate remaining height $rw(urw(B_j))$	$O(1)$
2.3.1.3.	Calculate upper remaining width $urw(B_j, i_k)$	$O(1)$

2.3.1.4.	Remove item i_k from the list L, $n \leftarrow n - 1$	$O(n)$
2.3.2.	Otherwise set the bin B_j is full and create a new bin B_{j+1}	$O(1)$
3.	Return j as the number of bin used	$O(1)$

Sorting a collection in java takes $O(nlogn)$ time (Mendoza, 2014) and removing an element from an arraylist takes $O(n)$ time (Baeldung, 2022).

3.3. Algorithm Implementation

The algorithm is implemented in Java and the required program (partially captured) is the following:

Offline Algorithm:

```
public int placeItemOffline(Bin bin, Item item) {
    // CASE 1: Bin is empty
    // Always put the first item at the left-bottom corner
    if (bin.countItems() == 0) {
        // Set the location of the item and update the remaining dimension of the bin
        // i = # of item placed, used for generating color of the item
        // X = left, Y = bottom
        item.setLoc(i++, bin.getXLoc(), y: bin.getYLoc() + (bin.getHeight() - item.getHeight()));

        // Set remaining height & width of bin
        bin.setRemainingHeight(bin.getHeight() - item.getHeight());
        bin.setRemainingWidth(bin.getWidth() - item.getWidth());

        // Upper Width = Bin Width at the beginning
        bin.setUpperRemainingWidth(bin.getWidth());
        // Add the item to bin
        bin.addItem(item);
        return 1;
    }

    // If the item can be packed on top of the first item packed
    if (item.getHeight() <= bin.getRemainingHeight()) {
        // No space for upper width
        if (item.getWidth() > bin.getUpperRemainingWidth()) {
            return -2;
        }
        println("PLACING NEXT UPPER");
        // Placing the item at the upper part
        item.setLoc(i++, x: bin.getXLoc() + bin.getUpperNextLoc(),
                y: bin.getYLoc() + bin.getRemainingHeight() - item.getHeight());
        bin.setUpperRemainingWidth(bin.getUpperRemainingWidth() - item.getWidth());
        bin.addItem(item);
        return 1;
    }


    // Put the item next to the first item packed
    // Check if there is enough space for the next item
    if (item.getWidth() > bin.getRemainingWidth())
        return -1;

    println("PLACING NEXT LOWER");
    // Set the location of the item and add the item to the bin
    item.setLoc(i++, bin.getRemainingXLoc(), y: bin.getYLoc() + (bin.getHeight() - item.getHeight()));
    // If new item has a greater height than old item, update the remaining height of the bin.
    int oldHeight = bin.getHeight() - bin.getRemainingHeight();
    if (item.getHeight() > oldHeight)
        bin.setRemainingHeight(bin.getHeight() - item.getHeight());
    bin.setRemainingWidth(bin.getRemainingWidth() - item.getWidth());
    bin.addItem(item);
    return 1;
}
```

```
public void putItemOffline() {
    // Do whenever there is an item that not yet packed
    if (items.size() <= 0) {
        return;
    }

    // Prevent out of bound
    if (k2 >= items.size()) {
        println("Out of bound, k2 = 0");
        k2 = 0;
    }

    int flag = placeItemOffline(bins.get(k1), items.get(k2));
    println("flag, k1, k2: " + flag + " " + k1 + " " + k2 + "/" + (items.size()-1));
    // When an item is packed (flag == 1)
    // Remove the item from the arraylist
    if (flag == 1)
        items.remove(k2);
    else if (flag == -1) { // Can't place at lower part
        if (k2 + 2 > items.size()) {
            println("SET LOWER FULL");
            bins.get(k1).setLowerFul();
            bins.get(k1).setUpperFull();
            k2 = 0;
        } else {
            k2++;
            return;
        }
    } else if (flag == -2) {
        if (k2 + 2 > items.size()) {
            println("SET UPPER FULL");
            bins.get(k1).setUpperFull();
            k2 = 0;
        } else {
            k2++;
            return;
        }
    }

    if (bins.get(k1).isLowerFul() && bins.get(k1).isUpperFull())
        bins.get(k1).setFull();

    // If the bin is full, add a new one
    if (bins.get(k1).isFull()) {
        println("bin full, add new bin");
        println(bins.get(k1).toString());
        bins.add(new Bin(pen,BIN_HEIGHT, BIN_WIDTH));
        k1++;
    }
}
```

Online Algorithm:

```java
public int placeItemOnline(Bin bin, Item item) {
    // CASE 1: Bin is empty
    // Always put the first item at the left-bottom corner
    if (bin.countItems() == 0) {
        // Set the location of the item and update the remaining dimension of the bin
        // i = # of item placed, used for generating color of the item
        // X = left, Y = bottom
        item.setLoc(i++, bin.getXLoc(), y: bin.getYLoc() + (bin.getHeight() - item.getHeight()));

        // Set remaining height & width of bin
        bin.setRemainingHeight(bin.getHeight() - item.getHeight());
        bin.setRemainingWidth(bin.getWidth() - item.getWidth());

        // Upper Width = Bin Width at the beginning
        bin.setUpperRemainingWidth(bin.getWidth());
        // Add the item to bin
        bin.addItem(item);
        return 1;
    }

    // If the item can be packed on top of the first item packed
    if (item.getHeight() <= bin.getRemainingHeight()) {
        // No space for upper width
        if (item.getWidth() > bin.getUpperRemainingWidth()) {
            return -2;
        }
        println("PLACING NEXT UPPER");
        item.setLoc(i++, x: bin.getXLoc() + bin.getUpperNextLoc(),
                y: bin.getYLoc() + bin.getRemainingHeight() - item.getHeight());
        bin.setUpperRemainingWidth(bin.getUpperRemainingWidth() - item.getWidth());
        // If upper item width > lower item width
        // Change the remaining width of bin to prevent overlap since the item are not sorted
        if (bin.getRemainingWidth() > bin.getUpperRemainingWidth()) {
            println("Upper > Lower");
            bin.setRemainingWidth(bin.getUpperRemainingWidth());
        }
        bin.addItem(item);
        return 1;
    }

    // Put the item next to the first item packed
    // Check if there is enough space for the next item
    if (item.getWidth() > bin.getRemainingWidth())
        return -1;

    println("PLACING NEXT LOWER");
    // Set the location of the item and add the item to the bin
    item.setLoc(i++, bin.getRemainingXLoc(), y: bin.getYLoc() + (bin.getHeight() - item.getHeight()));
    // If new item has a greater height than old item, update the remaining height of the bin.
    int oldHeight = bin.getHeight() - bin.getRemainingHeight();
    if (item.getHeight() > oldHeight)
        bin.setRemainingHeight(bin.getHeight() - item.getHeight());
    bin.setRemainingWidth(bin.getRemainingWidth() - item.getWidth());
    bin.addItem(item);
    return 1;

}
```

```java
public void putItemOnline() {
    // Do whenever there is an item that not yet packed
    if (items.size() <= 0) {
        return;
    }

    // Prevent out of bound
    if (k2 >= items.size()) {
        println("Out of bound; End of algorithm");
        return;
    }

    // Just place the item
    int flag = placeItemOnline(bins.get(k1), items.get(k2));
    if (flag == 1) {
        items.remove(k2);
        return;
    }

    // If we can't place item, start a new bin
    bins.get(k1).setFull();
    println("bin full, add new bin");
    println(bins.get(k1).toString());
    bins.add(new Bin(pen,BIN_HEIGHT, BIN_WIDTH));
    k1++;

}
```

3.4. Algorithm Analysis

3.4.1. Time Complexity

The time complexity of our offline algorithm is $O(n^2)$ by comparing steps 1-4 while our online algorithm is $O(n^2)$ by comparing steps 1-3 as shown in section 3.2. Algorithm Pseudo Code,

3.4.2. Space Complexity

The space complexity of our offline and online algorithm is $O(n)$ as we store all items in an arraylist.

Chapter 4 - Offline Algorithm Comparison

In the following chapter, we will compare our offline algorithm and other algorithms.
For the complexity, $F = \{F_1, F_2, F_3, \dots, F_n\}$ is defined as the set of maximal free rectangles that represents the free area left in the bin after some items are packed by applying the Maximal Rectangles algorithms. Then, for all rectangles $R \subseteq \bigcup_{i=1}^{n} F_i$, $\exists F_i \in F \; s.t. \; R \subseteq F_i$.
(Jylänki, 2010, 17)

4.1. Bottom-Left

4.1.1. Number of Bins Used (m)

Dataset ID (k)	**Our Old Algorithm ($A(L_k)$)**	**Our New Algorithm ($A'(L_k)$)**	**Bottom-Left ($BL(L_k)$)**
1	10	9	15
2	11	9	17
3	10	8	15
4	10	7	18
5	10	7	15
6	10	8	12
7	13	10	15
8	12	9	14
9	11	10	16
10	11	7	14
11	10	9	16
12	10	7	15
13	11	8	13
14	10	6	14
15	11	6	13
16	11	8	17
17	11	7	15
18	11	8	11

19	11	7	17
20	9	7	10
21	7	4	11
22	10	8	14
23	10	5	6
24	10	7	16
25	9	7	14
26	11	6	9
27	9	8	11
28	9	6	11
29	9	8	17
30	10	6	17

4.1.2. Statistic for Number of Bins Used

	Our Old Algorithm	**Our New Algorithm**	**Bottom-Left**
$\overline{m}$	10.2333	7.4	13.9333
$\sigma(m)$	1.0858	1.3565	2.7439

4.1.3. Time Complexity

Our Old Algorithm	**Our New Algorithm**	**Bottom-Left**
$O(n^2)$	$O(n^2)$	$O(\|F\|^2 n)$

4.1.4. Space Complexity

Our Old Algorithm	**Our New Algorithm**	**Bottom-Left**
$O(n)$	$O(n)$	$O(\|F\|)$

4.2. Best Short Side Fit

4.2.1. Number of Bins Used (m)

Dataset ID (k)	**Our Old Algorithm ($A(L_k)$)**	**Our New Algorithm ($A'(L_k)$)**	**Best Short Side Fit ($BSSF(L_k)$)**
1	10	9	8
2	11	9	9
3	10	8	8
4	10	7	7
5	10	7	7
6	10	8	9
7	13	10	8
8	12	9	7
9	11	10	10
10	11	7	6
11	10	9	9
12	10	7	5
13	11	8	7
14	10	6	5
15	11	6	5
16	11	8	8
17	11	7	6
18	11	8	6
19	11	7	7
20	9	7	7
21	7	4	4
22	10	8	7
23	10	5	4
24	10	7	6

25	9	7	5
26	11	6	5
27	9	8	6
28	9	6	6
29	9	8	7
30	10	6	6

4.2.2. Statistic for Number of Bins Used

	Our Old Algorithm	**Our New Algorithm**	**Best Short Side Fit**
$\overline{m}$	10.2333	7.4	6.6667
$\sigma(m)$	1.0858	1.3565	1.4907

4.2.3. Time Complexity

Our Old Algorithm	**Our New Algorithm**	**Best Short Side Fit**
$O(n^2)$	$O(n^2)$	$O(\|F\|^2 n)$

4.2.4. Space Complexity

Our Old Algorithm	**Our New Algorithm**	**Best Short Side Fit**
$O(n)$	$O(n)$	$O(\|F\|)$

4.3. Best Long Side Fit

4.3.1. Number of Bins Used (m)

Dataset ID (k)	**Our Old Algorithm ($A(L_k)$)**	**Our New Algorithm ($A'(L_k)$)**	**Best Long Side Fit ($BLSF(L_k)$)**
1	10	9	8
2	11	9	9
3	10	8	8

4	10	7	6
5	10	7	6
6	10	8	8
7	13	10	9
8	12	9	8
9	11	10	10
10	11	7	7
11	10	9	8
12	10	7	6
13	11	8	8
14	10	6	5
15	11	6	5
16	11	8	7
17	11	7	6
18	11	8	6
19	11	7	6
20	9	7	6
21	7	4	4
22	10	8	7
23	10	5	4
24	10	7	6
25	9	7	5
26	11	6	5
27	9	8	7
28	9	6	5
29	9	8	6
30	10	6	6

4.3.2. Statistic for Number of Bins Used

	Our Old Algorithm	Our New Algorithm	Best Long Side Fit
$\overline{m}$	10.2333	7.4	6.5667
$\sigma(m)$	1.0858	1.3565	1.4761

4.3.3. Time Complexity

Our Old Algorithm	Our New Algorithm	Best Long Side Fit
$O(n^2)$	$O(n^2)$	$O(\|F\|^2 n)$

4.3.4. Space Complexity

Our Old Algorithm	Our New Algorithm	Best Long Side Fit
$O(n)$	$O(n)$	$O(\|F\|)$

4.4. Best Area Fit

4.4.1. Number of Bins Used (m)

Dataset ID (k)	Our Old Algorithm ($A(L_k)$)	Our New Algorithm ($A'(L_k)$)	Best Area Fit($BAF(L_k)$)
1	10	9	8
2	11	9	8
3	10	8	7
4	10	7	6
5	10	7	6
6	10	8	7
7	13	10	8
8	12	9	7
9	11	10	9
10	11	7	6

11	10	9	7
12	10	7	6
13	11	8	7
14	10	6	5
15	11	6	5
16	11	8	7
17	11	7	6
18	11	8	6
19	11	7	6
20	9	7	6
21	7	4	4
22	10	8	6
23	10	5	4
24	10	7	6
25	9	7	5
26	11	6	5
27	9	8	6
28	9	6	5
29	9	8	6
30	10	6	6

4.4.2. Statistic for Number of Bins Used

	Our Old Algorithm	**Our New Algorithm**	**Best Area Fit**
$\overline{m}$	10.2333	7.4	6.2
$\sigma(m)$	1.0858	1.3565	1.1372

4.3.3. Time Complexity

Our Old Algorithm	Our New Algorithm	Best Area Fit
$O(n^2)$	$O(n^2)$	$O(\|F\|^2 n)$

4.3.4. Space Complexity

Our Old Algorithm	Our New Algorithm	Best Area Fit
$O(n)$	$O(n)$	$O(\|F\|)$

4.5. Greedy Best Long Side Fit

4.5.1. Number of Bins Used (m)

Dataset ID (k)	Our Old Algorithm ($A(L_k)$)	Our New Algorithm ($A'(L_k)$)	Greedy Best Long Side Fit($GBLSF(L_k)$)
1	10	9	8
2	11	9	9
3	10	8	8
4	10	7	6
5	10	7	6
6	10	8	8
7	13	10	9
8	12	9	8
9	11	10	10
10	11	7	7
11	10	9	7
12	10	7	6
13	11	8	8
14	10	6	5
15	11	6	5
16	11	8	7

17	11	7	6
18	11	8	7
19	11	7	6
20	9	7	6
21	7	4	4
22	10	8	7
23	10	5	4
24	10	7	6
25	9	7	6
26	11	6	5
27	9	8	6
28	9	6	6
29	9	8	6
30	10	6	6

4.5.2. Statistic for Number of Bins Used

	Our Old Algorithm	**Our New Algorithm**	**Greedy Best Long Side Fit**
$\overline{m}$	10.2333	7.4	6.6
$\sigma(m)$	1.0858	1.3565	1.4048

4.5.3. Time Complexity

Our Old Algorithm	**Our New Algorithm**	**Greedy Best Long Side Fit**
$O(n^2)$	$O(n^2)$	$O(\|F\|^2 n)$

4.5.4. Space Complexity

Our Old Algorithm	**Our New Algorithm**	**Greedy Best Long Side Fit**
$O(n)$	$O(n)$	$O(\|F\|)$

Chapter 5 - Online Algorithm Comparison

In the following chapter, we will compare our online algorithm and other algorithms.

5.1. Shelf First Fit

5.1.1. Number of Bins Used (m)

Dataset ID (k)	**Our Online Algorithm ($OA(L_k)$)**	**Shelf First Fit ($SFF(L_k)$)**
1	7	5
2	11	9
3	7	6
4	8	6
5	12	9
6	9	8
7	9	7
8	10	8
9	14	10
10	9	8

5.1.2. Statistic for Number of Bins Used

	Our Online Algorithm	**Shelf First Fit**
$\overline{m}$	9.6	7.6
$\sigma(m)$	2.1071	1.4967

5.1.3. Time Complexity

Our Online Algorithm	**Shelf First Fit**
$O(n^2)$	$O(nlogn)$

5.1.4. Space Complexity

Our Online Algorithm	Shelf First Fit
$O(n)$	$O(n)$

5.2. Shelf Best Width Fit

5.2.1. Number of Bins Used (m)

Dataset ID (k)	Our Online Algorithm ($OA(L_k)$)	Shelf Best Width Fit ($SBWF(L_k)$)
1	7	5
2	11	9
3	7	6
4	8	6
5	12	9
6	9	8
7	9	7
8	10	8
9	14	10
10	9	8

5.2.2. Statistic for Number of Bins Used

	Our Online Algorithm	Shelf Best Width Fit
$\overline{m}$	9.6	7.6
$\sigma(m)$	2.1071	1.4967

5.2.3. Time Complexity

Our Online Algorithm	Shelf Best Width Fit
$O(n^2)$	$O(n^2)$

5.2.4. Space Complexity

Our Online Algorithm	Shelf Best Width Fit
$O(n)$	$O(n)$

5.3. Shelf Worst Width Fit

5.3.1. Number of Bins Used (m)

Dataset ID (k)	Our Online Algorithm ($OA(L_k)$)	Shelf Worst Width Fit ($SWWF(L_k)$)
1	7	5
2	11	9
3	7	6
4	8	6
5	12	9
6	9	8
7	9	7
8	10	8
9	14	10
10	9	8

5.3.2. Statistic for Number of Bins Used

	Our Online Algorithm	Shelf Worst Width Fit
$\overline{m}$	9.6	7.6
$\sigma(m)$	2.1071	1.4967

5.3.3. Time Complexity

Our Online Algorithm	Shelf Worst Width Fit
$O(n^2)$	$O(n^2)$

5.3.4. Space Complexity

Our Online Algorithm	Shelf Worst Width Fit
$O(n)$	$O(n)$

5.4. Shelf Best Area Fit

5.4.1. Number of Bins Used (m)

Dataset ID (k)	Our Online Algorithm ($OA(L_k)$)	Shelf Best Area Fit ($SBAF(L_k)$)
1	7	5
2	11	9
3	7	6
4	8	6
5	12	9
6	9	8
7	9	7
8	10	8
9	14	10
10	9	8

5.4.2. Statistic for Number of Bins Used

	Our Online Algorithm	Shelf Best Area Fit
$\overline{m}$	9.6	7.6
$\sigma(m)$	2.1071	1.4967

5.4.3. Time Complexity

Our Online Algorithm	Shelf Best Area Fit
$O(n^2)$	$O(n^2)$

5.4.4. Space Complexity

Our Online Algorithm	Shelf Best Area Fit
$O(n)$	$O(n)$

Chapter 6 - Conclusion

6.1. Comparison Result

6.1.1. Statistics Comparison

6.1.1.1 New Algorithm

From the statistics shown above, our New Algorithm has a lower number of bins used in average ($\overline{m}$) when compared to our old algorithm. An average 2.8333 number of bins used is reduced. Still, the number of bins used in average ($\overline{m}$) is higher than the Maximal Rectangles Algorithms. In terms of the steadiness ($\sigma(m)$), our New Algorithm is mostly steady among all algorithms.

6.1.1.2 Online Algorithm

From the statistics shown above, our Online Algorithm has a higher number of bins used in average ($\overline{m}$). Also with a less stable performance as the standard deviation of the number of bins used ($\sigma(m)$) is higher than the one from other algorithms.

6.1.2. Time Complexity Comparison

6.1.2.1 New Algorithm

The time complexity of our New Algorithm is same as the Old Algorithm $O(n^2)$ while the time complexity of Bottom-Left Algorithm, Best Short Side Fit Algorithm, Best Long Side Fit Algorithm, Best Area Algorithm, and Greedy Best Long Side Fit Algorithm are all $O(|F|^2 n)$ (Jylänki, 2010, 21). As the range of number of maximal free rectangles is $1 \leq |F| \leq n$, the time complexity for those algorithm might grow faster or slower than $O(n^2)$.

6.1.2.2 Online Algorithm

The time complexity of our Online Algorithm is $O(n^2)$ while the time complexity of Shelf First Fit Algorithm, Shelf Best Width Fit Algorithm, Shelf Worst Width Fit Algorithm, and Shelf Best Area Fit Algorithm are all $O(n^2)$(Jylänki, 2010, 8-9).

6.1.3. Space Complexity Comparison

6.1.3.1 New Algorithm

The space complexity of our New Algorithm is same as the Old Algorithm $O(n)$ while the space complexity of Bottom-Left Algorithm, Best Short Side Fit Algorithm, Best Long Side Fit Algorithm, Best Area Algorithm and Greedy Best Long Side Fit Algorithm are all $O(|F|)$ (Jylänki, 2010, 37) which can grow no faster than $O(n)$.

6.1.3.2 Online Algorithm

The space Complexity of our Online Algorithm is $O(n)$ while the space complexity of Shelf First Fit Algorithm, Shelf Best Width Fit Algorithm, Shelf Worst Width Fit Algorithm, and Shelf Best Area Fit Algorithm are all $O(n)$ (Jylänki, 2010, 8-9).

6.1.4. Conclusion

6.1.4.1 New Algorithm

Our New Algorithm is not the best by comparing with Best Short Side Fit Algorithm, Best Long Side Fit Algorithm, Best Area Algorithm and Greedy Best Long Side Fit Algorithm. However, it is better than the Bottom-Left Algorithm and our Old Algorithm. Thus, the Best Area Algorithm is the best among the 5 algorithms and we made an improvement in our own algorithm.

6.1.4.2 Online Algorithm

Our Online Algorithm is not the best by comparing with Shelf First Fit Algorithm, Shelf Best Width Fit Algorithm, Shelf Worst Width Fit Algorithm, and Shelf Best Area Fit Algorithm. All of the Online Shelf Heuristics Algorithms performances are similar.

6.2. Problem Encountered

There are several problems that we have encountered during the project studying and development.

6.2.1. Algorithm Implementing

During the simulation development, we found that it is much more difficult to implement an algorithm in the simulation in order to show every step the algorithm has taken. Compared to the website that we used for other algorithms, they only showed the result of the uses of bins but not the detailed step for both in Offline and Online Algorithms . Besides, the graphics are built in different coordinates which makes the calculation for positioning the items much more complicated.

6.2.2. Algorithm Disadvantage

By comparing our own algorithm to Bottom-Left Algorithm, Best Short Side Fit Algorithm, Best Long Side Fit Algorithm, Best Area Algorithm and Greedy Best Long Side Fit Algorithm, It shows that our algorithm still have a room of improvement for utilizing the space of the bin wisely. We could see that from the number of bins used and the statistics of our algorithm, there is still some empty space in each bin.

7.3. Future Development

5.3.1. Performance of Our Algorithm

As the performance of our offline and online algorithm is still not good enough. In terms of the number of bins used, time complexity, there is room for improvement. We plan to enhance more for our algorithm to reach a better number of bin used, time complexity.

7.3.2. Comparison to Other Algorithms

By only comparing the Shelf First Fit Algorithm, Shelf Best Width Fit Algorithm, Shelf Worst Width Fit Algorithm, and Shelf Best Area Fit Algorithm, there are not enough statistics. We plan to study more other online algorithms and compare them to our enhanced online algorithm.

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Appendix

There are 600 items in 30 testing set for offline algorithms:

The result of our own algorithm:

ID	Number of Bin Used (Our Old Algorithm)	Number of Bin Used (Our New Algorithm)	Dataset
1	10	9	[217x13] [202x136] [196x86] [195x117] [189x15] [188x19] [175x95] [156x154] [150x20] [147x50] [146x140] [139x132] [127x95] [120x58] [120x82] [115x19] [92x74] [51x26] [31x3] [25x3]
2	11	9	[219x137] [218x136] [215x89] [196x107] [194x6] [178x17] [177x121] [156x132] [153x55] [139x138] [138x92] [131x70] [123x90] [109x51] [100x72] [94x82] [68x9] [54x6] [49x23] [17x9]
3	10	8	[211x34] [204x98] [191x80] [190x158] [181x127] [164x75] [162x8] [160x97] [156x18] [153x100] [151x42] [142x95] [129x12] [119x37] [113x55] [109x87] [105x95] [84x41] [65x3] [48x42]
4	10	7	[206x127] [195x134] [186x107] [167x145] [166x3] [160x64] [150x66] [147x45] [143x78] [138x83] [131x42] [115x40] [111x32] [109x71] [96x38] [93x5] [86x19] [82x42] [60x23] [46x27]
5	10	7	[212x91] [200x58] [188x100] [186x46] [180x33] [172x48] [170x54] [168x76] [159x42] [152x120] [148x108] [147x34] [131x6] [128x98] [125x15] [123x48] [114x26] [92x18] [87x57] [76x9]
6	10	8	[205x3] [199x74] [195x99] [186x114] [176x8] [175x155] [175x115] [174x0] [171x63] [170x2] [154x68] [153x51] [143x141] [140x80] [122x87] [116x6] [114x70] [112x94] [93x0] [69x27]
7	13	10	[204x109] [194x108] [181x32] [160x107] [159x8] [158x78] [149x70] [148x128] [148x117] [146x131] [145x2] [141x117] [137x111] [134x102] [131x58] [120x51] [119x15] [110x65] [56x6] [48x33]
8	12	9	[182x107] [175x142] [170x142] [169x70] [159x108] [151x100] [143x100] [142x52] [137x72] [137x8] [132x26] [125x38] [118x73]

			[117x110] [108x71] [105x81] [88x66] [66x30] [43x34] [23x13]
9	11	10	[209x16] [197x118] [194x133] [191x151] [190x80] [184x23] [170x168] [161x92] [155x152] [140x121] [139x8] [124x79] [122x94] [110x94] [109x108] [102x28] [98x75] [79x4] [74x31] [55x16]
10	11	7	[219x82] [208x164] [177x18] [166x98] [163x124] [153x137] [138x7] [123x98] [122x26] [116x38] [116x66] [114x113] [105x72] [99x65] [70x9] [67x49] [67x53] [40x34] [33x6] [11x6]
11	10	9	[215x103] [204x125] [192x74] [178x167] [170x72] [169x23] [166x142] [156x98] [156x102] [151x64] [146x69] [141x38] [133x70] [131x66] [115x15] [91x66] [65x1] [49x15] [44x27] [9x8]
12	10	7	[197x125] [184x24] [174x50] [166x119] [166x53] [165x34] [159x130] [155x125] [154x21] [132x17] [131x1] [124x94] [115x52] [114x11] [112x58] [112x85] [109x77] [92x26] [71x18] [42x17]
13	11	8	[214x21] [213x13] [190x68] [172x119] [170x166] [166x9] [165x103] [162x95] [154x58] [149x62] [146x74] [141x54] [123x106] [122x110] [120x39] [110x101] [103x35] [80x67] [79x33] [67x50]
14	10	6	[198x109] [195x54] [158x2] [153x81] [141x59] [141x138] [140x24] [136x59] [136x65] [133x87] [132x14] [116x91] [111x17] [107x33] [97x30] [95x13] [92x34] [91x82] [34x7] [33x29]
15	11	6	[190x129] [190x17] [189x10] [170x22] [166x80] [164x163] [161x52] [155x113] [153x28] [147x87] [139x46] [137x18] [137x26] [131x52] [103x13] [86x57] [67x62] [61x41] [19x4] [15x3]
16	11	8	[215x73] [209x127] [191x98] [172x25] [168x44] [161x124] [148x63] [139x84] [138x4] [132x34] [132x126] [127x18] [125x45] [125x82] [125x85] [125x81] [117x73] [102x101] [52x25] [45x28]
17	11	7	[202x55] [196x92] [193x121] [184x33] [165x36] [164x42] [163x17] [160x83] [155x28] [147x59] [137x1] [129x63] [126x11] [125x104] [124x104] [122x83] [118x45] [97x24] [93x57]

			[92x38]
18	11	8	[208x44] [189x22] [173x29] [170x79] [164x45] [158x145] [157x14] [148x43] [147x67] [146x101] [140x140] [136x57] [129x123] [102x31] [100x80] [100x37] [97x71] [96x85] [74x38] [53x46]
19	11	7	[213x133] [212x156] [206x12] [185x69] [172x48] [172x6] [167x57] [162x150] [153x103] [146x79] [142x56] [123x44] [114x84] [108x27] [96x14] [93x29] [65x44] [53x30] [42x30] [12x10]
20	9	7	[208x12] [195x31] [194x14] [193x64] [192x86] [190x158] [183x44] [182x59] [180x146] [161x88] [157x106] [149x39] [118x52] [104x93] [84x15] [82x55] [67x5] [64x15] [58x6] [27x2]
21	7	4	[194x112] [190x111] [166x57] [165x2] [165x66] [155x39] [142x36] [126x38] [120x6] [120x57] [118x11] [113x90] [107x23] [70x3] [70x51] [68x7] [55x4] [29x13] [10x5] [7x3]
22	10	8	[200x51] [187x74] [173x140] [168x20] [164x29] [162x124] [159x116] [146x66] [125x104] [123x109] [122x93] [119x67] [110x87] [110x96] [91x45] [87x77] [80x46] [57x56] [49x14] [32x21]
23	10	5	[203x7] [166x83] [163x67] [158x16] [156x7] [150x56] [142x69] [133x116] [133x88] [120x83] [113x68] [94x30] [92x52] [87x57] [78x31] [74x62] [61x6] [46x11] [40x34] [38x37]
24	10	7	[211x66] [208x19] [206x120] [187x101] [155x83] [153x139] [149x93] [146x63] [145x73] [140x25] [140x90] [134x31] [129x59] [115x32] [114x32] [99x31] [98x18] [46x31] [40x31] [27x9]
25	9	7	[192x18] [192x44] [187x116] [174x3] [164x88] [160x42] [156x48] [153x80] [151x29] [150x60] [146x112] [146x107] [139x64] [138x4] [130x61] [105x47] [103x63] [57x48] [57x16] [38x11]
26	11	6	[220x1] [214x51] [202x33] [189x19] [170x169] [161x112] [158x14] [156x104] [154x127] [148x26] [147x49] [133x13] [123x90] [121x3] [104x32] [97x31] [92x61] [78x45] [66x23] [60x26]

27	9	8	[208x107] [202x54] [201x3] [170x124] [168x59] [166x18] [162x96] [160x143] [158x105] [135x11] [119x118] [118x80] [117x69] [107x92] [61x30] [44x11] [42x1] [31x5] [24x16] [18x15]
28	9	6	[212x39] [211x30] [201x22] [198x51] [194x166] [159x25] [158x116] [157x44] [146x108] [142x85] [141x61] [136x30] [127x93] [107x68] [103x1] [103x15] [74x48] [64x8] [45x16] [45x7]
29	9	8	[202x151] [181x120] [173x165] [162x41] [158x60] [147x56] [140x52] [138x39] [136x48] [132x9] [131x40] [126x48] [117x116] [113x80] [109x95] [88x78] [87x67] [65x3] [53x4] [36x10]
30	10	6	[220x83] [217x87] [208x115] [201x119] [188x128] [161x17] [157x13] [147x76] [145x18] [141x31] [140x17] [136x79] [136x14] [126x71] [89x65] [60x41] [56x56] [49x33] [47x36] [41x28]

ID	Bin Information with Item Packed (Old Algorithm)	Bin Information with Item Packed (New Algorithm)
1	[Items count: 2 | Items packed: [[217x13], [202x136]]] [Items count: 2 | Items packed: [[196x86], [189x15]]] [Items count: 2 | Items packed: [[188x19], [175x95]]] [Items count: 4 | Items packed: [[156x154], [51x26], [31x3], [25x3]]] [Items count: 2 | Items packed: [[92x74], [150x20]]] [Items count: 2 | Items packed: [[92x74], [150x20]]] [Items count: 2 | Items packed: [[120x58], [120x82]]] [Items count: 2 | Items packed: [[115x19], [195x117]]] [Items count: 1 | Items packed: [[146x140]]] [Items count: 1 | Items packed: [[139x132]]]	[Items count: 5 | Items packed: [[217x13], [202x136], [189x15], [31x3], [25x3]]] [Items count: 5 | Items packed: [[196x86], [188x19], [150x20], [115x19], [51x26]]] [Items count: 2 | Items packed: [[195x117], [147x50]]] [Items count: 2 | Items packed: [[175x95], [120x58]]] [Items count: 1 | Items packed: [[156x154]]] [Items count: 1 | Items packed: [[146x140]]] [Items count: 1 | Items packed: [[139x132]]] [Items count: 2 | Items packed: [[127x95], [92x74]]] [Items count: 1 | Items packed: [[120x82]]]
2	[Items count: 2 | Items packed: [[219x137], [194x6]]] [Items count: 2 | Items packed: [[178x17], [177x121]]]	[Items count: 4 | Items packed: [[219x137], [194x6], [178x17], [68x9]]] [Items count: 3 | Items packed: [[218x136], [54x6], [49x23]]]

	[Items count: 2 | Items packed: [[156x132], [68x9]]] [Items count: 1 | Items packed: [[54x6]]] [Items count: 2 | Items packed: [[218x136], [49x23]]] [Items count: 2 | Items packed: [[17x9], [215x89]]] [Items count: 2 | Items packed: [[196x107], [153x55]]] [Items count: 1 | Items packed: [[139x138]]] [Items count: 2 | Items packed: [[94x82], [131x70]]] [Items count: 2 | Items packed: [[123x90], [109x51]]] [Items count: 2 | Items packed: [[100x72], [138x92]]]	[Items count: 3 | Items packed: [[215x89], [153x55], [17x9]]] [Items count: 2 | Items packed: [[196x107], [109x51]]] [Items count: 1 | Items packed: [[177x121]]] [Items count: 1 | Items packed: [[156x132]]] [Items count: 1 | Items packed: [[139x138]]] [Items count: 2 | Items packed: [[138x92], [131x70]]] [Items count: 3 | Items packed: [[123x90], [100x72], [94x82]]]
3	[Items count: 2 | Items packed: [[211x34], [204x98]]] [Items count: 2 | Items packed: [[191x80], [164x75]]] [Items count: 2 | Items packed: [[162x8], [160x97]]] [Items count: 2 | Items packed: [[156x18], [153x100]]] [Items count: 2 | Items packed: [[151x42], [142x95]]] [Items count: 2 | Items packed: [[129x12], [119x37]]] [Items count: 2 | Items packed: [[113x55], [109x87]]] [Items count: 4 | Items packed: [[105x95], [84x41], [65x3], [48x42]]] [Items count: 1 | Items packed: [[181x127]]] [Items count: 1 | Items packed: [[204x98]]]	[Items count: 5 | Items packed: [[211x34], [204x98], [162x8], [156x18], [129x12]]] [Items count: 3 | Items packed: [[191x80], [164x75], [65x3]]] [Items count: 1 | Items packed: [[190x158]]] [Items count: 2 | Items packed: [[181x127], [151x42]]] [Items count: 3 | Items packed: [[160x97], [119x37], [48x42]]] [Items count: 2 | Items packed: [[153x100], [113x55]]] [Items count: 2 | Items packed: [[142x95], [84x41]]] [Items count: 2 | Items packed: [[109x87], [105x95]]]
4	[Items count: 2 | Items packed: [[206x127], [166x3]]] [Items count: 2 | Items packed: [[160x64], [150x66]]] [Items count: 2 | Items packed: [[147x45], [143x78]]] [Items count: 2 | Items packed: [[138x83], [131x42]]] [Items count: 2 | Items packed: [[115x40], [111x32]]] [Items count: 4 | Items packed: [[109x71], [96x38], [93x5], [86x19]]] [Items count: 2 | Items packed: [[195x134], [60x23]]] [Items count: 2 | Items packed: [[46x27],	[Items count: 3 | Items packed: [[206x127], [166x3], [115x40]]] [Items count: 2 | Items packed: [[195x134], [111x32]]] [Items count: 3 | Items packed: [[186x107], [147x45], [93x5]]] [Items count: 3 | Items packed: [[167x145], [86x19], [46x27]]] [Items count: 4 | Items packed: [[160x64], [150x66], [96x38], [60x23]]] [Items count: 2 | Items packed: [[143x78], [138x83]]] [Items count: 3 | Items packed: [[131x42], [109x71], [82x42]]]

	[186x107]]] [Items count: 1 | Items packed: [[167x145]]] [Items count: 1 | Items packed: [[82x42]]]	
5	[Items count: 2 | Items packed: [[212x91], [200x58]]] [Items count: 2 | Items packed: [[188x100], [186x46]]] [Items count: 2 | Items packed: [[180x33], [172x48]]] [Items count: 2 | Items packed: [[170x54], [168x76]]] [Items count: 2 | Items packed: [[159x42], [152x120]]] [Items count: 2 | Items packed: [[148x108], [147x34]]] [Items count: 2 | Items packed: [[131x6], [128x98]]] [Items count: 2 | Items packed: [[125x15], [123x48]]] [Items count: 2 | Items packed: [[114x26], [92x18]]] [Items count: 2 | Items packed: [[87x57], [76x9]]]	[Items count: 4 | Items packed: [[212x91], [200x58], [131x6], [125x15]]] [Items count: 3 | Items packed: [[188x100], [186x46], [92x18]]] [Items count: 4 | Items packed: [[180x33], [172x48], [170x54], [147x34]]] [Items count: 3 | Items packed: [[168x76], [159x42], [123x48]]] [Items count: 3 | Items packed: [[152x120], [114x26], [76x9]]] [Items count: 2 | Items packed: [[148x108], [87x57]]] [Items count: 1 | Items packed: [[128x98]]]
6	[Items count: 2 | Items packed: [[205x3], [199x74]]] [Items count: 2 | Items packed: [[195x99], [176x8]]] [Items count: 2 | Items packed: [[175x155], [174x0]]] [Items count: 2 | Items packed: [[171x63], [170x2]]] [Items count: 2 | Items packed: [[154x68], [153x51]]] [Items count: 2 | Items packed: [[143x141], [116x6]]] [Items count: 2 | Items packed: [[114x70], [112x94]]] [Items count: 2 | Items packed: [[93x0], [186x114]]] [Items count: 2 | Items packed: [[175x115], [69x27]]] [Items count: 2 | Items packed: [[140x80], [122x87]]]	[Items count: 8 | Items packed: [[205x3], [199x74], [176x8], [174x0], [171x63], [170x2], [116x6], [93x0]]] [Items count: 2 | Items packed: [[195x99], [154x68]]] [Items count: 2 | Items packed: [[186x114], [153x51]]] [Items count: 1 | Items packed: [[175x155]]] [Items count: 2 | Items packed: [[175x115], [69x27]]] [Items count: 1 | Items packed: [[143x141]]] [Items count: 2 | Items packed: [[140x80], [122x87]]] [Items count: 2 | Items packed: [[114x70], [112x94]]]
7	[Items count: 2 | Items packed: [[204x109], [181x32]]] [Items count: 2 | Items packed: [[160x107], [159x8]]] [Items count: 2 | Items packed: [[158x78], [149x70]]]	[Items count: 5 | Items packed: [[204x109], [181x32], [159x8], [145x2], [119x15]]] [Items count: 2 | Items packed: [[194x108], [131x58]]] [Items count: 4 | Items packed:

	[Items count: 2 | Items packed: [[148x128], [145x2]]] [Items count: 2 | Items packed: [[141x117], [120x51]]] [Items count: 2 | Items packed: [[119x15], [110x65]]] [Items count: 1 | Items packed: [[56x6]]] [Items count: 2 | Items packed: [[194x108], [131x58]]] [Items count: 1 | Items packed: [[48x33]]] [Items count: 1 | Items packed: [[148x117]]] [Items count: 1 | Items packed: [[134x102]]] [Items count: 1 | Items packed: [[137x111]]] [Items count: 1 | Items packed: [[146x131]]]	[[160x107], [120x51], [56x6], [48x33]]] [Items count: 2 | Items packed: [[158x78], [149x70]]] [Items count: 1 | Items packed: [[148x128]]] [Items count: 1 | Items packed: [[148x117]]] [Items count: 1 | Items packed: [[146x131]]] [Items count: 1 | Items packed: [[141x117]]] [Items count: 1 | Items packed: [[137x111]]] [Items count: 2 | Items packed: [[134x102], [110x65]]]
8	[Items count: 2 | Items packed: [[182x107], [142x52]]] [Items count: 2 | Items packed: [[137x72], [137x8]]] [Items count: 2 | Items packed: [[132x26], [125x38]]] [Items count: 2 | Items packed: [[118x73], [108x71]]] [Items count: 3 | Items packed: [[105x81], [88x66], [169x70]]] [Items count: 2 | Items packed: [[159x108], [66x30]]] [Items count: 2 | Items packed: [[43x34], [23x13]]] [Items count: 1 | Items packed: [[175x142]]] [Items count: 1 | Items packed: [[117x110]]] [Items count: 1 | Items packed: [[143x100]]] [Items count: 1 | Items packed: [[151x100]]] [Items count: 1 | Items packed: [[170x142]]]	[Items count: 4 | Items packed: [[182x107], [142x52], [137x8], [23x13]]] [Items count: 3 | Items packed: [[175x142], [132x26], [43x34]]] [Items count: 1 | Items packed: [[170x142]]] [Items count: 2 | Items packed: [[169x70], [151x100]]] [Items count: 2 | Items packed: [[159x108], [125x38]]] [Items count: 3 | Items packed: [[143x100], [88x66], [66x30]]] [Items count: 2 | Items packed: [[137x72], [118x73]]] [Items count: 1 | Items packed: [[117x110]]] [Items count: 2 | Items packed: [[108x71], [105x81]]]
9	[Items count: 2 | Items packed: [[209x16], [197x118]]] [Items count: 2 | Items packed: [[194x133], [184x23]]] [Items count: 1 | Items packed: [[170x168]]] [Items count: 2 | Items packed: [[55x16], [191x151]]] [Items count: 2 | Items packed:	[Items count: 5 | Items packed: [[209x16], [197x118], [184x23], [139x8], [79x4]]] [Items count: 2 | Items packed: [[194x133], [102x28]]] [Items count: 2 | Items packed: [[191x151], [55x16]]] [Items count: 2 | Items packed: [[190x80], [124x79]]]

	[[190x80], [139x8]]] [Items count: 2 | Items packed: [[124x79], [102x28]]] [Items count: 4 | Items packed: [[98x75], [79x4], [74x31], [161x92]]] [Items count: 1 | Items packed: [[155x152]]] [Items count: 2 | Items packed: [[109x108], [110x94]]] [Items count: 1 | Items packed: [[122x94]]] [Items count: 1 | Items packed: [[140x121]]]	[Items count: 1 | Items packed: [[170x168]]] [Items count: 2 | Items packed: [[161x92], [98x75]]] [Items count: 1 | Items packed: [[155x152]]] [Items count: 2 | Items packed: [[140x121], [74x31]]] [Items count: 1 | Items packed: [[122x94]]] [Items count: 2 | Items packed: [[110x94], [109x108]]]
10	[Items count: 2 | Items packed: [[219x82], [177x18]]] [Items count: 2 | Items packed: [[166x98], [138x7]]] [Items count: 2 | Items packed: [[123x98], [122x26]]] [Items count: 2 | Items packed: [[116x38], [116x66]]] [Items count: 4 | Items packed: [[114x113], [105x72], [11x6], [33x6]]] [Items count: 1 | Items packed: [[208x164]]] [Items count: 1 | Items packed: [[40x34]]] [Items count: 2 | Items packed: [[163x124], [70x9]]] [Items count: 1 | Items packed: [[67x49]]] [Items count: 2 | Items packed: [[153x137], [67x53]]] [Items count: 1 | Items packed: [[99x65]]]	[Items count: 7 | Items packed: [[219x82], [177x18], [138x7], [122x26], [70x9], [33x6], [11x6]]] [Items count: 1 | Items packed: [[208x164]]] [Items count: 3 | Items packed: [[166x98], [116x38], [40x34]]] [Items count: 1 | Items packed: [[163x124]]] [Items count: 3 | Items packed: [[153x137], [67x49], [67x53]]] [Items count: 2 | Items packed: [[123x98], [116x66]]] [Items count: 3 | Items packed: [[114x113], [105x72], [99x65]]]
11	[Items count: 2 | Items packed: [[215x103], [169x23]]] [Items count: 2 | Items packed: [[166x142], [115x15]]] [Items count: 6 | Items packed: [[91x66], [65x1], [49x15], [44x27], [9x8], [192x74]]] [Items count: 1 | Items packed: [[178x167]]] [Items count: 2 | Items packed: [[131x66], [170x72]]] [Items count: 2 | Items packed: [[156x98], [151x64]]] [Items count: 2 | Items packed: [[146x69], [141x38]]] [Items count: 1 | Items packed: [[133x70]]]	[Items count: 4 | Items packed: [[215x103], [169x23], [141x38], [65x1]]] [Items count: 4 | Items packed: [[204x125], [115x15], [49x15], [9x8]]] [Items count: 2 | Items packed: [[192x74], [170x72]]] [Items count: 1 | Items packed: [[178x167]]] [Items count: 2 | Items packed: [[166x142], [44x27]]] [Items count: 2 | Items packed: [[156x98], [151x64]]] [Items count: 2 | Items packed: [[156x102], [131x66]]] [Items count: 2 | Items packed: [[146x69], [133x70]]] [Items count: 1 | Items packed:

	[Items count: 1 | Items packed: [[156x102]]] [Items count: 1 | Items packed: [[204x125]]]	[[91x66]]]
12	[Items count: 2 | Items packed: [[197x125], [184x24]]] [Items count: 2 | Items packed: [[174x50], [166x119]]] [Items count: 2 | Items packed: [[166x53], [165x34]]] [Items count: 2 | Items packed: [[159x130], [154x21]]] [Items count: 2 | Items packed: [[132x17], [131x1]]] [Items count: 2 | Items packed: [[124x94], [115x52]]] [Items count: 2 | Items packed: [[114x11], [112x58]]] [Items count: 2 | Items packed: [[112x85], [109x77]]] [Items count: 2 | Items packed: [[92x26], [71x18]]] [Items count: 2 | Items packed: [[155x125], [42x17]]]	[Items count: 3 | Items packed: [[197x125], [184x24], [154x21]]] [Items count: 4 | Items packed: [[174x50], [166x119], [131x1], [42x17]]] [Items count: 5 | Items packed: [[166x53], [165x34], [132x17], [115x52], [114x11]]] [Items count: 2 | Items packed: [[159x130], [92x26]]] [Items count: 2 | Items packed: [[155x125], [71x18]]] [Items count: 2 | Items packed: [[124x94], [112x58]]] [Items count: 2 | Items packed: [[112x85], [109x77]]]
13	[Items count: 2 | Items packed: [[214x21], [213x13]]] [Items count: 2 | Items packed: [[190x68], [166x9]]] [Items count: 2 | Items packed: [[165x103], [154x58]]] [Items count: 2 | Items packed: [[149x62], [146x74]]] [Items count: 2 | Items packed: [[141x54], [123x106]]] [Items count: 2 | Items packed: [[122x110], [120x39]]] [Items count: 2 | Items packed: [[110x101], [103x35]]] [Items count: 2 | Items packed: [[172x119], [79x33]]] [Items count: 2 | Items packed: [[67x50], [162x95]]] [Items count: 1 | Items packed: [[80x67]]] [Items count: 1 | Items packed: [[170x166]]]	[Items count: 5 | Items packed: [[214x21], [213x13], [190x68], [166x9], [154x58]]] [Items count: 2 | Items packed: [[172x119], [120x39]]] [Items count: 1 | Items packed: [[170x166]]] [Items count: 2 | Items packed: [[165x103], [149x62]]] [Items count: 2 | Items packed: [[162x95], [146x74]]] [Items count: 4 | Items packed: [[141x54], [123x106], [79x33], [67x50]]] [Items count: 3 | Items packed: [[122x110], [103x35], [80x67]]] [Items count: 1 | Items packed: [[110x101]]]
14	[Items count: 2 | Items packed: [[198x109], [195x54]]] [Items count: 2 | Items packed: [[158x2], [153x81]]] [Items count: 2 | Items packed:	[Items count: 3 | Items packed: [[198x109], [195x54], [158x2]]] [Items count: 5 | Items packed: [[153x81], [141x59], [140x24], [34x7], [33x29]]]

	[[141x59], [140x24]]] [Items count: 2 | Items packed: [[136x59], [136x65]]] [Items count: 2 | Items packed: [[133x87], [132x14]]] [Items count: 2 | Items packed: [[116x91], [111x17]]] [Items count: 2 | Items packed: [[107x33], [97x30]]] [Items count: 2 | Items packed: [[141x138], [95x13]]] [Items count: 2 | Items packed: [[92x34], [33x29]]] [Items count: 2 | Items packed: [[91x82], [34x7]]]	[Items count: 3 | Items packed: [[141x138], [132x14], [111x17]]] [Items count: 4 | Items packed: [[136x59], [136x65], [107x33], [95x13]]] [Items count: 3 | Items packed: [[133x87], [97x30], [92x34]]] [Items count: 2 | Items packed: [[116x91], [91x82]]]
15	[Items count: 2 | Items packed: [[190x129], [190x17]]] [Items count: 2 | Items packed: [[189x10], [170x22]]] [Items count: 2 | Items packed: [[166x80], [161x52]]] [Items count: 2 | Items packed: [[155x113], [153x28]]] [Items count: 2 | Items packed: [[147x87], [139x46]]] [Items count: 2 | Items packed: [[137x18], [137x26]]] [Items count: 2 | Items packed: [[131x52], [103x13]]] [Items count: 1 | Items packed: [[86x57]]] [Items count: 3 | Items packed: [[164x163], [19x4], [15x3]]] [Items count: 1 | Items packed: [[61x41]]] [Items count: 1 | Items packed: [[67x62]]]	[Items count: 6 | Items packed: [[190x129], [190x17], [189x10], [103x13], [19x4], [15x3]]] [Items count: 3 | Items packed: [[170x22], [166x80], [161x52]]] [Items count: 1 | Items packed: [[164x163]]] [Items count: 4 | Items packed: [[155x113], [153x28], [137x18], [61x41]]] [Items count: 4 | Items packed: [[147x87], [139x46], [137x26], [67x62]]] [Items count: 2 | Items packed: [[131x52], [86x57]]]
16	[Items count: 2 | Items packed: [[215x73], [172x25]]] [Items count: 2 | Items packed: [[168x44], [161x124]]] [Items count: 2 | Items packed: [[148x63], [139x84]]] [Items count: 2 | Items packed: [[138x4], [132x34]]] [Items count: 2 | Items packed: [[132x126], [127x18]]] [Items count: 2 | Items packed: [[125x45], [125x82]]] [Items count: 2 | Items packed: [[125x85], [125x81]]] [Items count: 1 | Items packed:	[Items count: 5 | Items packed: [[215x73], [172x25], [168x44], [138x4], [127x18]]] [Items count: 2 | Items packed: [[209x127], [132x34]]] [Items count: 2 | Items packed: [[191x98], [148x63]]] [Items count: 4 | Items packed: [[161x124], [125x45], [52x25], [45x28]]] [Items count: 2 | Items packed: [[139x84], [125x82]]] [Items count: 1 | Items packed: [[132x126]]] [Items count: 2 | Items packed: [[125x85], [125x81]]]

	[[117x73]]] [Items count: 2 | Items packed: [[209x127], [52x25]]] [Items count: 2 | Items packed: [[45x28], [191x98]]] [Items count: 1 | Items packed: [[102x101]]]	[Items count: 2 | Items packed: [[117x73], [102x101]]]
17	[Items count: 2 | Items packed: [[202x55], [196x92]]] [Items count: 2 | Items packed: [[193x121], [184x33]]] [Items count: 2 | Items packed: [[165x36], [164x42]]] [Items count: 2 | Items packed: [[163x17], [160x83]]] [Items count: 2 | Items packed: [[155x28], [147x59]]] [Items count: 2 | Items packed: [[137x1], [129x63]]] [Items count: 2 | Items packed: [[126x11], [125x104]]] [Items count: 2 | Items packed: [[124x104], [118x45]]] [Items count: 1 | Items packed: [[97x24]]] [Items count: 2 | Items packed: [[122x83], [93x57]]] [Items count: 1 | Items packed: [[92x38]]]	[Items count: 4 | Items packed: [[202x55], [196x92], [163x17], [137x1]]] [Items count: 3 | Items packed: [[193x121], [184x33], [126x11]]] [Items count: 3 | Items packed: [[165x36], [164x42], [160x83]]] [Items count: 3 | Items packed: [[155x28], [147x59], [129x63]]] [Items count: 4 | Items packed: [[125x104], [118x45], [93x57], [92x38]]] [Items count: 2 | Items packed: [[124x104], [97x24]]] [Items count: 1 | Items packed: [[122x83]]]
18	[Items count: 2 | Items packed: [[208x44], [189x22]]] [Items count: 2 | Items packed: [[173x29], [170x79]]] [Items count: 2 | Items packed: [[164x45], [157x14]]] [Items count: 2 | Items packed: [[148x43], [147x67]]] [Items count: 2 | Items packed: [[146x101], [136x57]]] [Items count: 2 | Items packed: [[129x123], [102x31]]] [Items count: 2 | Items packed: [[100x80], [100x37]]] [Items count: 2 | Items packed: [[158x145], [53x46]]] [Items count: 1 | Items packed: [[74x38]]] [Items count: 1 | Items packed: [[140x140]]] [Items count: 2 | Items packed: [[96x85], [97x71]]]	[Items count: 5 | Items packed: [[208x44], [189x22], [173x29], [164x45], [157x14]]] [Items count: 3 | Items packed: [[170x79], [148x43], [102x31]]] [Items count: 2 | Items packed: [[158x145], [53x46]]] [Items count: 2 | Items packed: [[147x67], [146x101]]] [Items count: 2 | Items packed: [[140x140], [74x38]]] [Items count: 2 | Items packed: [[136x57], [100x80]]] [Items count: 2 | Items packed: [[129x123], [100x37]]] [Items count: 2 | Items packed: [[97x71], [96x85]]]

19	[Items count: 2 | Items packed: [[213x133], [206x12]]] [Items count: 2 | Items packed: [[185x69], [172x48]]] [Items count: 2 | Items packed: [[172x6], [167x57]]] [Items count: 2 | Items packed: [[162x150], [96x14]]] [Items count: 1 | Items packed: [[93x29]]] [Items count: 2 | Items packed: [[212x156], [12x10]]] [Items count: 2 | Items packed: [[153x103], [142x56]]] [Items count: 2 | Items packed: [[123x44], [114x84]]] [Items count: 1 | Items packed: [[108x27]]] [Items count: 3 | Items packed: [[146x79], [65x44], [53x30]]] [Items count: 1 | Items packed: [[42x30]]]	[Items count: 4 | Items packed: [[213x133], [206x12], [172x6], [96x14]]] [Items count: 2 | Items packed: [[212x156], [12x10]]] [Items count: 3 | Items packed: [[185x69], [172x48], [123x44]]] [Items count: 4 | Items packed: [[167x57], [153x103], [53x30], [42x30]]] [Items count: 1 | Items packed: [[162x150]]] [Items count: 4 | Items packed: [[146x79], [142x56], [108x27], [65x44]]] [Items count: 2 | Items packed: [[114x84], [93x29]]]
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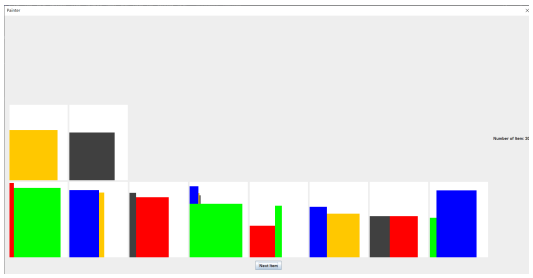
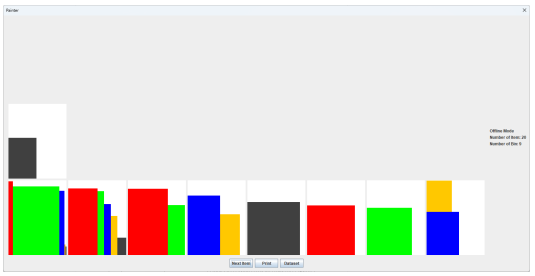
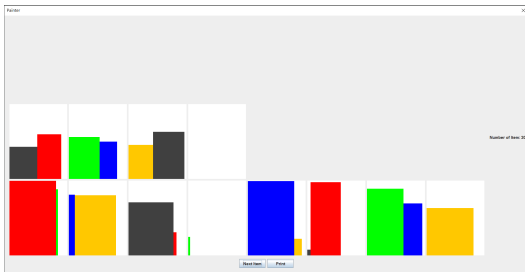
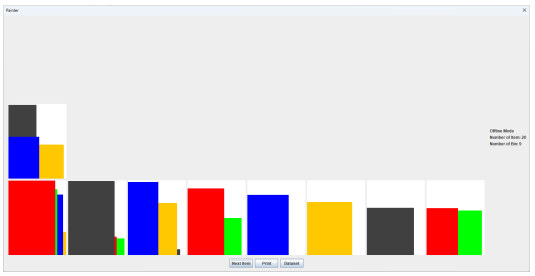
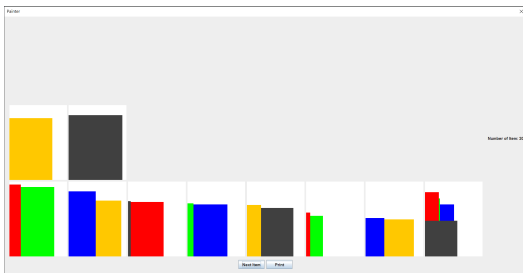
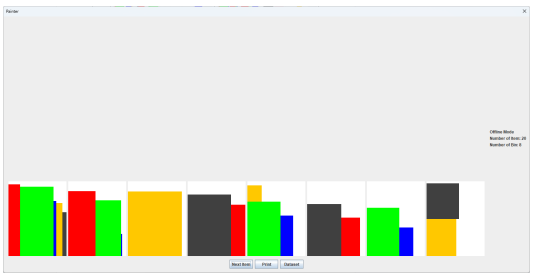
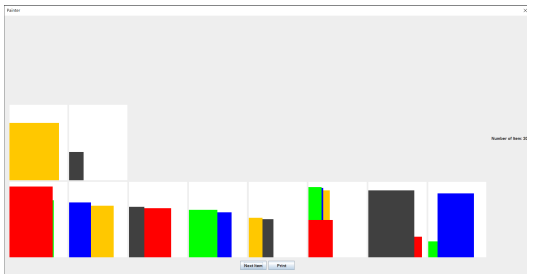
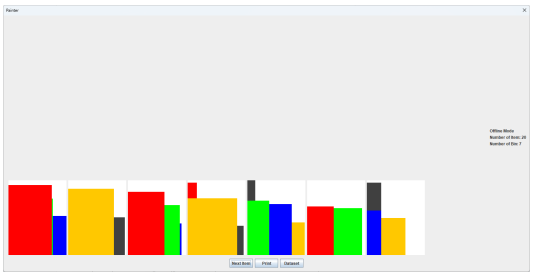
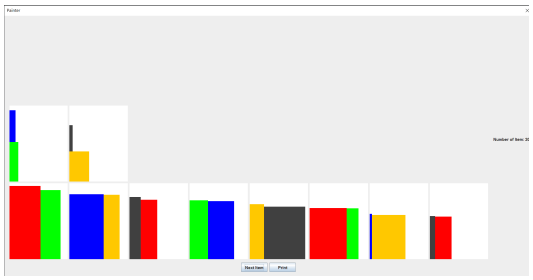
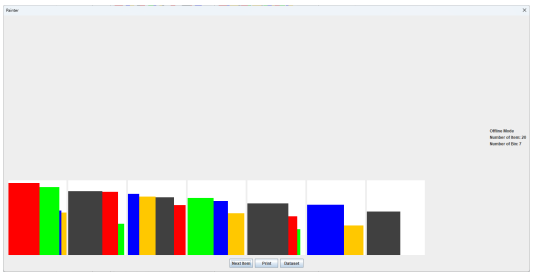
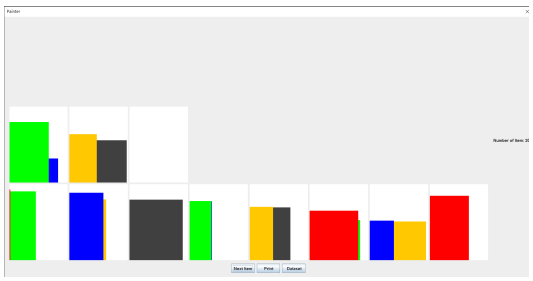
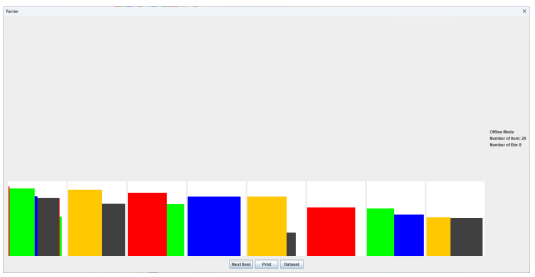
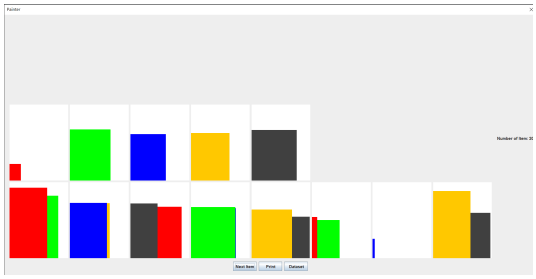
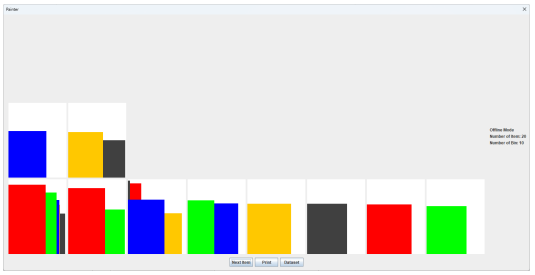
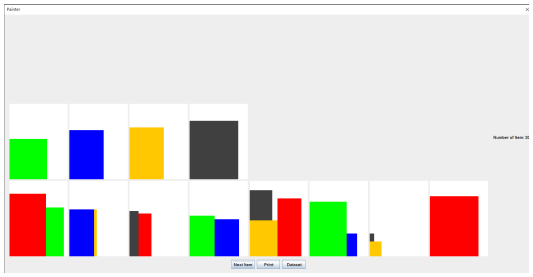
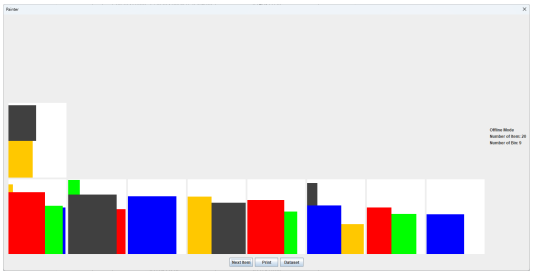
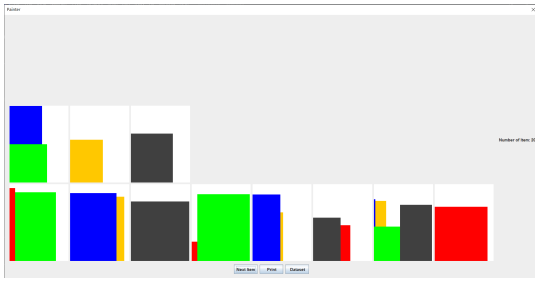
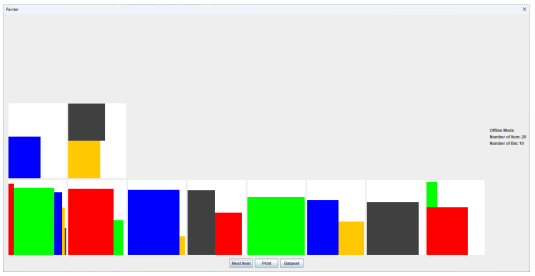
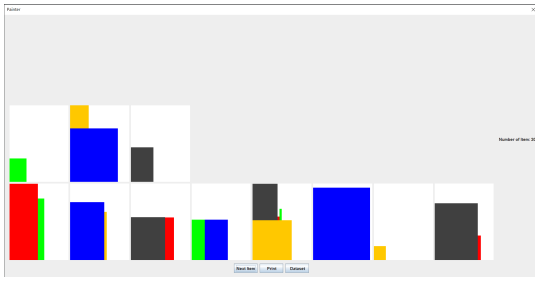
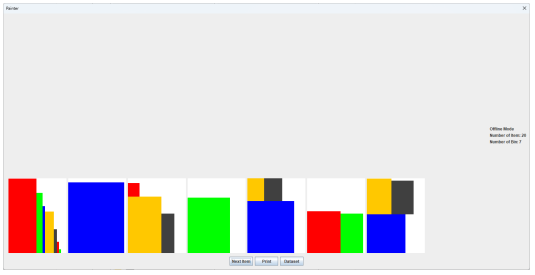
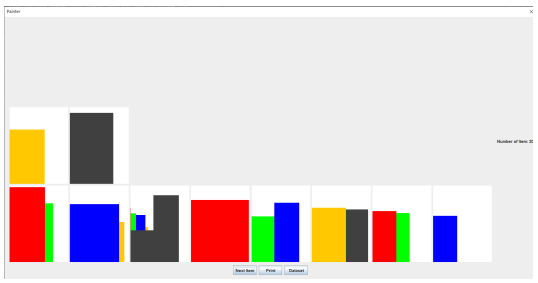
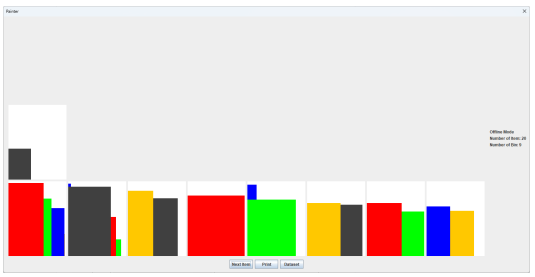
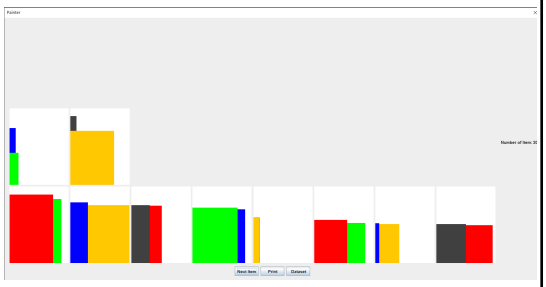
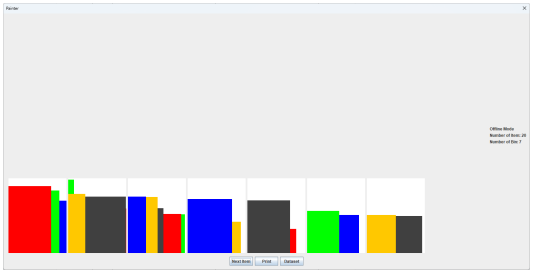
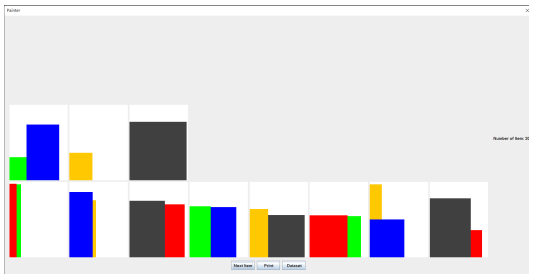
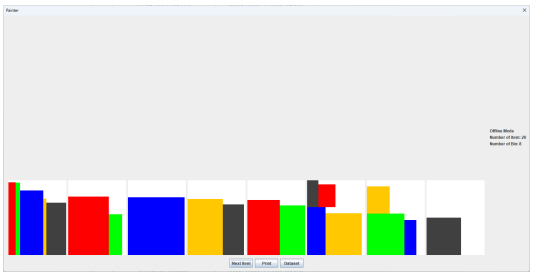
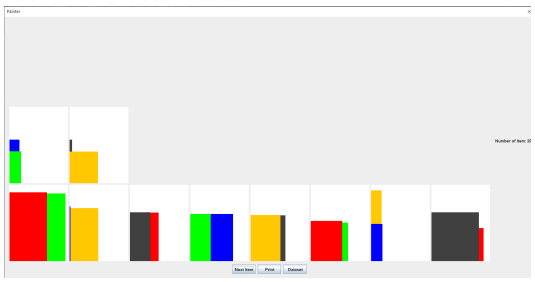
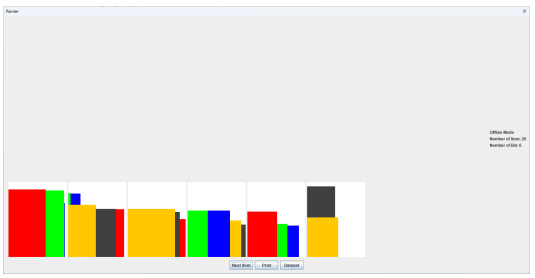
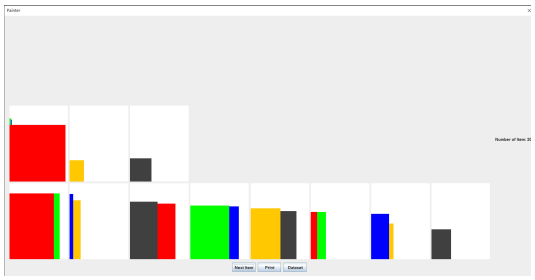
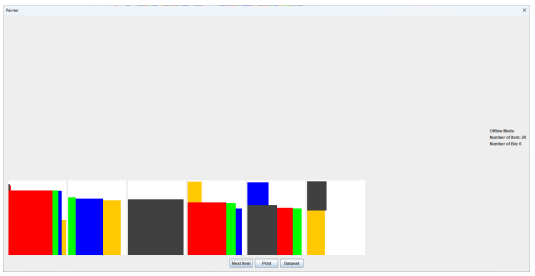
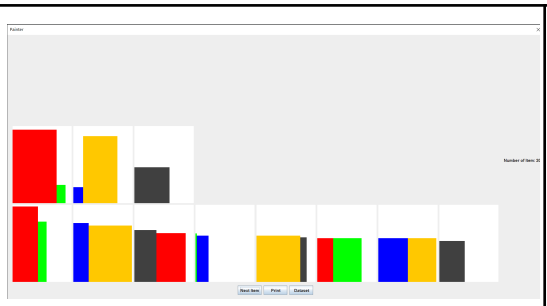
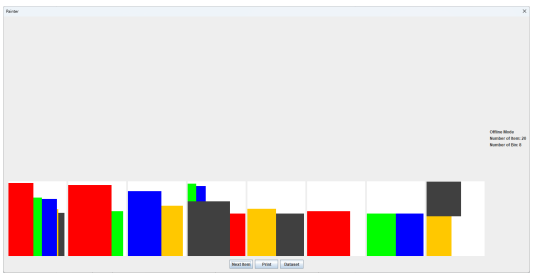
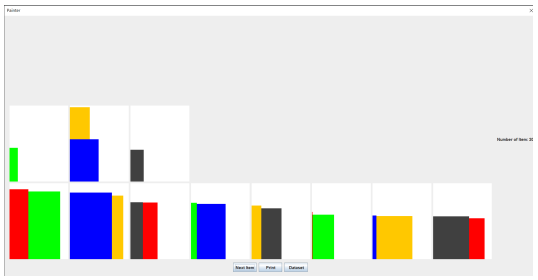
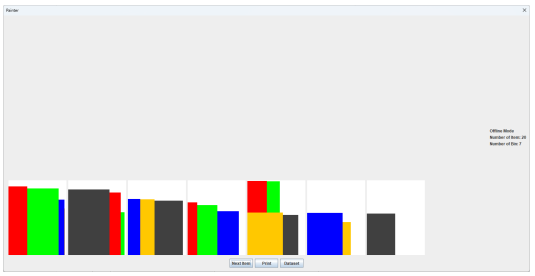
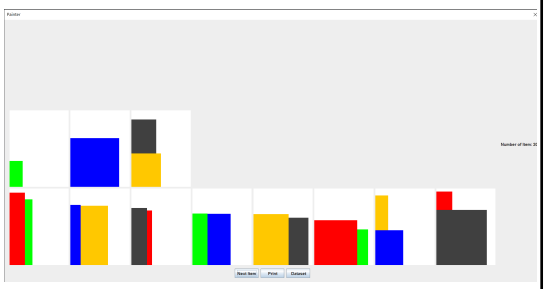
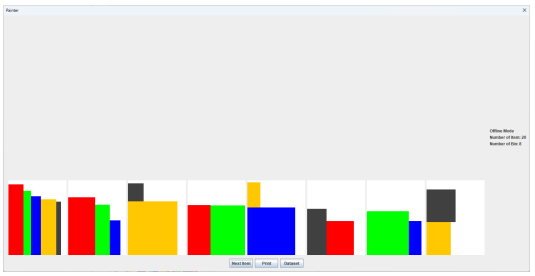
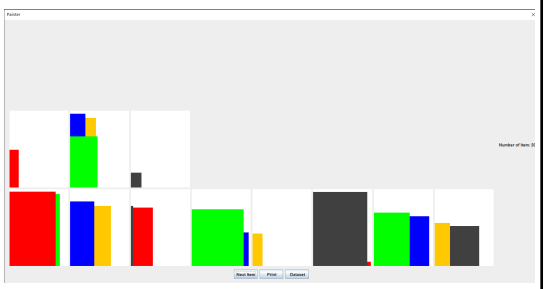
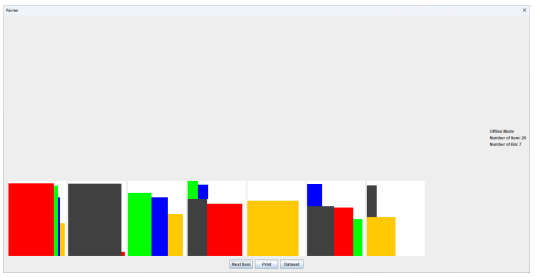
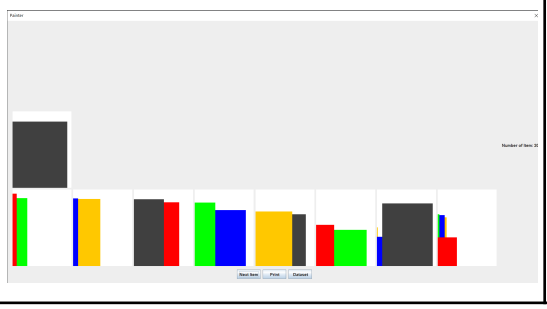
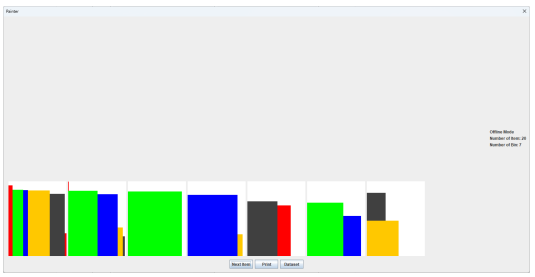
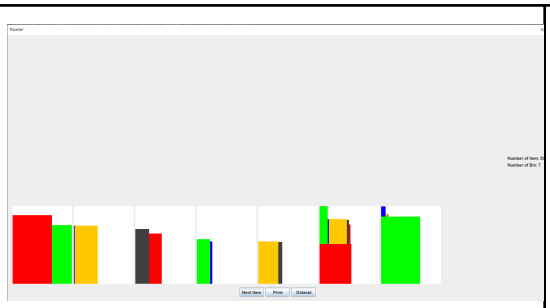
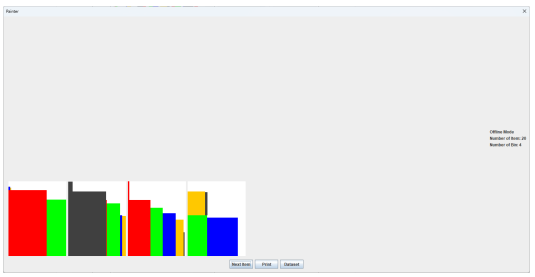
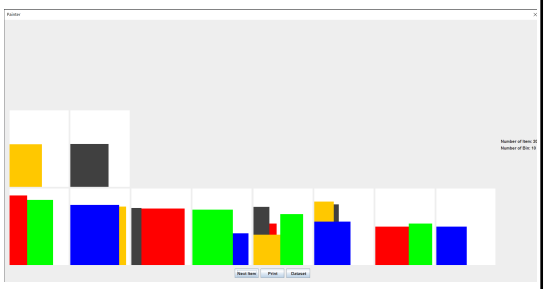
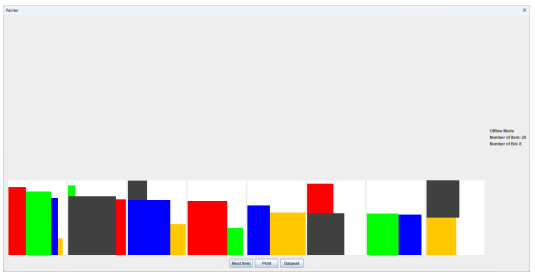
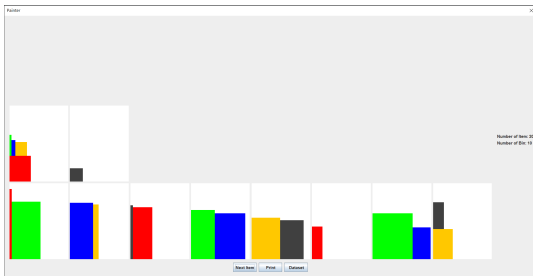
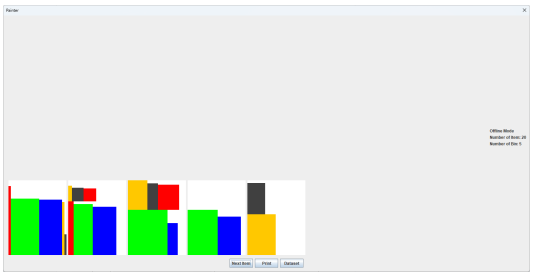
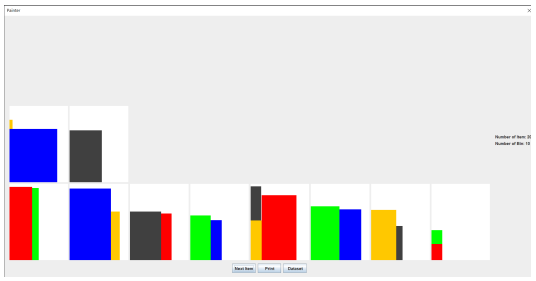
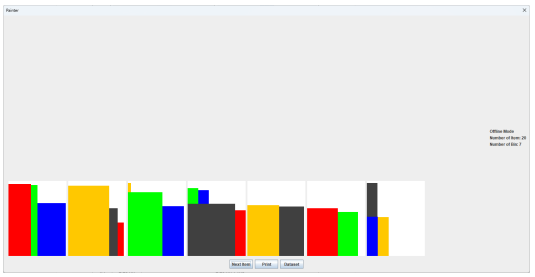
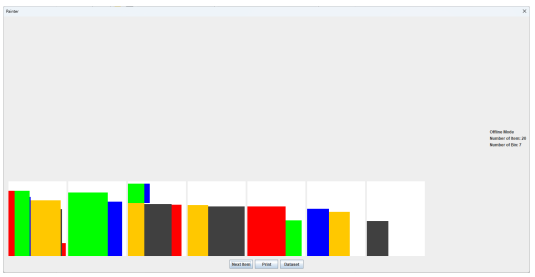
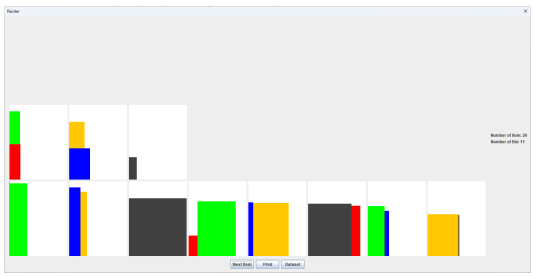
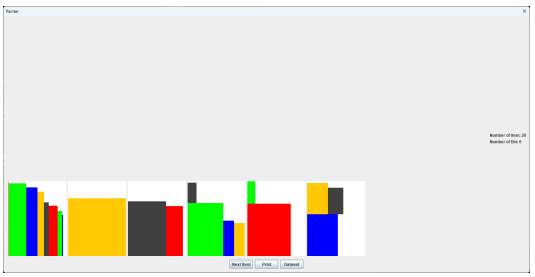
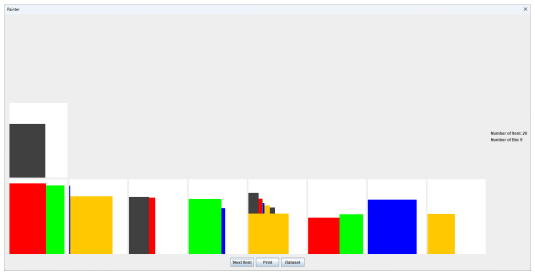
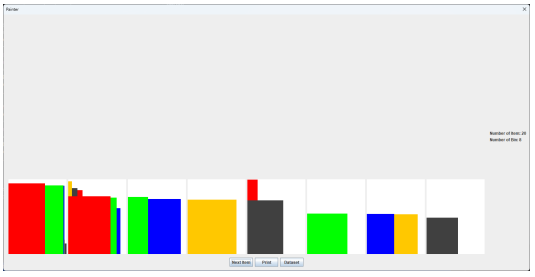
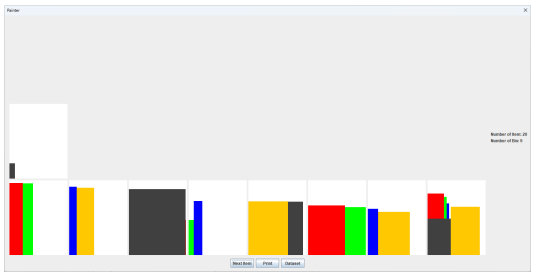
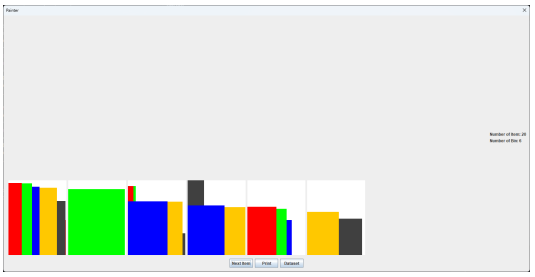
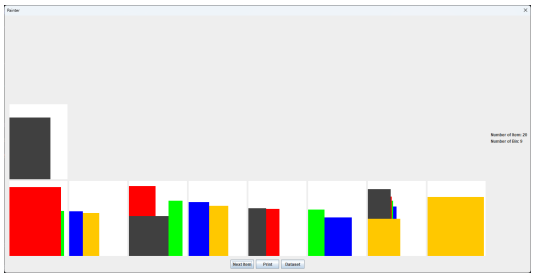
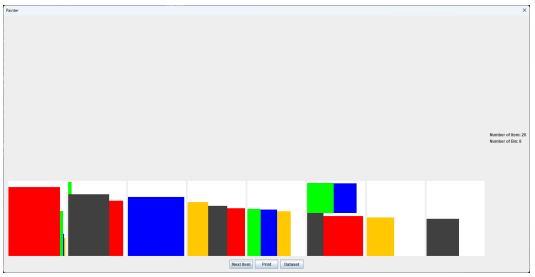
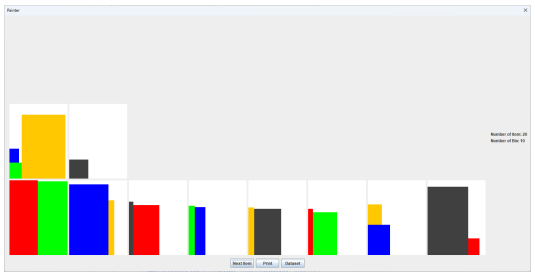
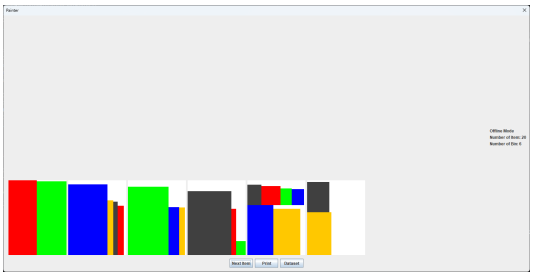
1		
2		
3		
4		
5		

6		
7		
8		
9		
10		

11		
12		
13		
14		
15		

16		
17		
18		
19		
20		

21		
22		
23		
24		
25		

26		
27		
28		
29		
30		

The result of the Bottom-Left algorithm:

ID	Result	Result Link
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		146x140x1%0A139x132x1%0A127x95x1%0A120x58x1%0A120x82x1%0A115x19x1%0A92x74x1%0A51x26x1%0A31x3x1%0A25x3x1&heuristic=bl
2	17	https://planetcalc.com/8634/?master=220x170&rectangles=219x137x1%0A218x136x1%0A215x89x1%0A196x107x1%0A194x6x1%0A178x17x1%0A177x121x1%0A156x132x1%0A153x55x1%0A139x138x1%0A138x92x1%0A131x70x1%0A123x90x1%0A109x51x1%0A100x72x1%0A94x82x1%0A68x9x1%0A54x6x1%0A49x23x1%0A17x9x1&heuristic=bl
3	15	https://planetcalc.com/8634/?master=220x170&rectangles=211x34x1%0A204x98x1%0A191x80x1%0A190x158x1%0A181x127x1%0A164x75x1%0A162x8x1%0A160x97x1%0A156x18x1%0A153x100x1%0A151x42x1%0A142x95x1%0A129x12x1%0A119x37x1%0A113x55x1%0A109x87x1%0A105x95x1%0A84x41x1%0A65x3x1%0A48x42x1&heuristic=bl
4	18	https://planetcalc.com/8634/?master=220x170&rectangles=206x127x1%0A195x134x1%0A186x107x1%0A167x145x1%0A166x3x1%0A160x64x1%0A150x66x1%0A147x45x1%0A143x78x1%0A138x83x1%0A131x42x1%0A115x40x1%0A111x32x1%0A109x71x1%0A96x38x1%0A93x5x1%0A86x19x1%0A82x42x1%0A60x23x1%0A46x27x1&heuristic=bl
5	15	https://planetcalc.com/8634/?master=220x170&rectangles=212x91x1%0A200x58x1%0A188x100x1%0A186x46x1%0A180x33x1%0A172x48x1%0A170x54x1%0A168x76x1%0A159x42x1%0A152x120x1%0A148x108x1%0A147x34x1%0A131x6x1%0A128x98x1%0A125x15x1%0A123x48x1%0A114x26x1%0A92x18x1%0A87x57x1%0A76x9x1&heuristic=bl
6	12	https://planetcalc.com/8634/?master=220x170&rectangles=205x3x1%0A199x74x1%0A195x99x1%0A186x114x1%0A176x8x1%0A175x155x1%0A175x115x1%0A174x0x1%0A171x63x1%0A170x2x1%0A154x68x1%0A153x51x1%0A143x141x1%0A140x80x1%0A122x87x1%0A116x6x1%0A114x70x1%0A112x94x1%0A93x0x1%0A69x27x1&heuristic=bl
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11	16	https://planetcalc.com/8634/?master=220x170&rectangles=215x103x1%0A204x125x1%0A192x74x1%0A178x167x1%0A170x72x1%0A169x23x1%0A166x142x1%0A156x98x1%0A156x102x1%0A151x64x1%0A146x69x1%0A141x38x1%0A133x70x1%0A131x66x1%0A115x15x1%0A91x66x1%0A65x1x1%0A49x15x1%0A44x27x1%0A9x8x1&heuristic=bl
12	15	https://planetcalc.com/8634/?master=220x170&rectangles=197x125x1%0A184x24x1%0A174x50x1%0A166x119x1%0A166x53x1%0A165x34x1%0A159x130x1%0A155x125x1%0A154x21x1%0A132x17x1%0A131x1x1%0A124x94x1%0A115x52x1%0A114x11x1%0A112x58x1%0A112x85x1%0A109x77x1%0A92x26x1%0A71x18x1%0A42x17x1&heuristic=bl
13	13	https://planetcalc.com/8634/?master=220x170&rectangles=214x21x1%0A213x13x1%0A190x68x1%0A172x119x1%0A170x166x1%0A166x9x1%0A165x103x1%0A162x95x1%0A154x58x1%0A149x62x1%0A146x74x1%0A141x54x1%0A123x106x1%0A122x110x1%0A120x39x1%0A110x101x1%0A103x35x1%0A80x67x1%0A79x33x1%0A67x50x1&heuristic=bl
14	14	https://planetcalc.com/8634/?master=220x170&rectangles=198x109x1%0A195x54x1%0A158x2x1%0A153x81x1%0A141x59x1%0A141x138x1%0A140x24x1%0A136x59x1%0A136x65x1%0A133x87x1%0A132x14x1%0A116x91x1%0A111x17x1%0A107x33x1%0A97x30x1%0A95x13x1%0A92x34x1%0A91x82x1%0A34x7x1%0A33x29x1&heuristic=bl
15	13	https://planetcalc.com/8634/?master=220x170&rectangles=190x129x1%0A190x17x1%0A189x10x1%0A170x22x1%0A166x80x1%0A164x163x1%0A161x52x1%0A155x113x1%0A153x28x1%0A147x87x1%0A139x46x1%0A137x18x1%0A137x26x1%0A131x52x1%0A103x13x1%0A86x57x1%0A67x62x1%0A61x41x1%0A19x4x1%0A15x3x1&heuristic=bl
16	17	https://planetcalc.com/8634/?master=220x170&rectangles=215x73x1%0A209x127x1%0A191x98x1%0A172x25x1%0A168x44x1%0A161x124x1%0A148x63x1%0A139x84x1%0A138x4x1%0A132x34x1%0A132x126x1%0A127x18x1%0A125x45x1%0A125x82x1%0A125x85x1%0A125x81x1%0A117x73x1%0A102x101x1%0A52x25x1%0A45x28x1&heuristic=bl
17	15	https://planetcalc.com/8634/?master=220x170&rectangles=202x55x1

		%0A196x92x1%0A193x121x1%0A184x33x1%0A165x36x1%0A164x42x1%0A163x17x1%0A160x83x1%0A155x28x1%0A147x59x1%0A137x1x1%0A129x63x1%0A126x11x1%0A125x104x1%0A124x104x1%0A122x83x1%0A118x45x1%0A97x24x1%0A93x57x1%0A92x38x1&heuristic=bl
18	11	https://planetcalc.com/8634/?master=220x170&rectangles=208x44x1%0A189x22x1%0A173x29x1%0A170x79x1%0A164x45x1%0A158x145x1%0A157x14x1%0A148x43x1%0A147x67x1%0A146x101x1%0A140x140x1%0A136x57x1%0A129x123x1%0A102x31x1%0A100x80x1%0A100x37x1%0A97x71x1%0A96x85x1%0A74x38x1%0A53x46x1&heuristic=bl
19	17	https://planetcalc.com/8634/?master=220x170&rectangles=213x133x1%0A212x156x1%0A206x12x1%0A185x69x1%0A172x48x1%0A172x6x1%0A167x57x1%0A162x150x1%0A153x103x1%0A146x79x1%0A142x56x1%0A123x44x1%0A114x84x1%0A108x27x1%0A96x14x1%0A93x29x1%0A65x44x1%0A53x30x1%0A42x30x1%0A12x10x1&heuristic=bl
20	10	https://planetcalc.com/8634/?master=220x170&rectangles=208x12x1%0A195x31x1%0A194x14x1%0A193x64x1%0A192x86x1%0A190x158x1%0A183x44x1%0A182x59x1%0A180x146x1%0A161x88x1%0A157x106x1%0A149x39x1%0A118x52x1%0A104x93x1%0A84x15x1%0A82x55x1%0A67x5x1%0A64x15x1%0A58x6x1%0A27x2x1&heuristic=bl
21	11	https://planetcalc.com/8634/?master=220x170&rectangles=194x112x1%0A190x111x1%0A166x57x1%0A165x2x1%0A165x66x1%0A155x39x1%0A142x36x1%0A126x38x1%0A120x6x1%0A120x57x1%0A118x11x1%0A113x90x1%0A107x23x1%0A70x3x1%0A70x51x1%0A68x7x1%0A55x4x1%0A29x13x1%0A10x5x1%0A7x3x1&heuristic=bl
22	14	https://planetcalc.com/8634/?master=220x170&rectangles=200x51x1%0A187x74x1%0A173x140x1%0A168x20x1%0A164x29x1%0A162x124x1%0A159x116x1%0A146x66x1%0A125x104x1%0A123x109x1%0A122x93x1%0A119x67x1%0A110x87x1%0A110x96x1%0A91x45x1%0A87x77x1%0A80x46x1%0A57x56x1%0A49x14x1%0A32x21x1&heuristic=bl
23	6	https://planetcalc.com/8634/?master=220x170&rectangles=203x7x1%0A166x83x1%0A163x67x1%0A158x16x1%0A156x7x1%0A150x56x1%0A142x69x1%0A133x116x1%0A133x88x1%0A120x83x1%0A113x68x1%0A94x30x1%0A92x52x1%0A87x57x1%0A78x31x1%0A74x62x1%0A61x6x1%0A46x11x1%0A40x34x1%0A38x37x1&heuristic=bl
24	16	https://planetcalc.com/8634/?master=220x170&rectangles=211x66x1%0A208x19x1%0A206x120x1%0A187x101x1%0A155x83x1%0A153x139x1%0A149x93x1%0A146x63x1%0A145x73x1%0A140x25x1%0A140x90x1%0A134x31x1%0A129x59x1%0A115x32x1%0A114x32x1%0A99x31x1%0A98x18x1%0A46x31x1%0A40x31x1%0A27x9x1&heuristic=bl
25	14	https://planetcalc.com/8634/?master=220x170&rectangles=192x18x1%0A192x44x1%0A187x116x1%0A174x3x1%0A164x88x1%0A160x42

		x1%0A156x48x1%0A153x80x1%0A151x29x1%0A150x60x1%0A146x112x1%0A146x107x1%0A139x64x1%0A138x4x1%0A130x61x1%0A105x47x1%0A103x63x1%0A57x48x1%0A57x16x1%0A38x11x1&heuristic=bl
26	9	https://planetcalc.com/8634/?master=220x170&rectangles=220x1x1%0A214x51x1%0A202x33x1%0A189x19x1%0A170x169x1%0A161x112x1%0A158x14x1%0A156x104x1%0A154x127x1%0A148x26x1%0A147x49x1%0A133x13x1%0A123x90x1%0A121x3x1%0A104x32x1%0A97x31x1%0A92x61x1%0A78x45x1%0A66x23x1%0A60x26x1&heuristic=bl
27	11	https://planetcalc.com/8634/?master=220x170&rectangles=208x107x1%0A202x54x1%0A201x3x1%0A170x124x1%0A168x59x1%0A166x18x1%0A162x96x1%0A160x143x1%0A158x105x1%0A135x11x1%0A119x118x1%0A118x80x1%0A117x69x1%0A107x92x1%0A61x30x1%0A44x11x1%0A42x1x1%0A31x5x1%0A24x16x1%0A18x15x1&heuristic=bl
28	11	https://planetcalc.com/8634/?master=220x170&rectangles=212x39x1%0A211x30x1%0A201x22x1%0A198x51x1%0A194x166x1%0A159x25x1%0A158x116x1%0A157x44x1%0A146x108x1%0A142x85x1%0A141x61x1%0A136x30x1%0A127x93x1%0A107x68x1%0A103x1x1%0A103x15x1%0A74x48x1%0A64x8x1%0A45x16x1%0A45x7x1&heuristic=bl
29	17	https://planetcalc.com/8634/?master=220x170&rectangles=202x151x1%0A181x120x1%0A173x165x1%0A162x41x1%0A158x60x1%0A147x56x1%0A140x52x1%0A138x39x1%0A136x48x1%0A132x9x1%0A131x40x1%0A126x48x1%0A117x116x1%0A113x80x1%0A109x95x1%0A88x78x1%0A87x67x1%0A65x3x1%0A53x4x1%0A36x10x1&heuristic=bl
30	17	https://planetcalc.com/8634/?master=220x170&rectangles=220x83x1%0A217x87x1%0A208x115x1%0A201x119x1%0A188x128x1%0A161x17x1%0A157x13x1%0A147x76x1%0A145x18x1%0A141x31x1%0A140x17x1%0A136x79x1%0A136x14x1%0A126x71x1%0A89x65x1%0A60x41x1%0A56x56x1%0A49x33x1%0A47x36x1%0A41x28x1&heuristic=bl

The result of the Best Short Side Fit algorithm:

ID	Result	Result Link
1	8	https://planetcalc.com/8634/?master=220x170&rectangles=217x13x1%0A202x136x1%0A196x86x1%0A195x117x1%0A189x15x1%0A188x19x1%0A175x95x1%0A156x154x1%0A150x20x1%0A147x50x1%0A146x140x1%0A139x132x1%0A127x95x1%0A120x58x1%0A120x82x1%0A115x19x1%0A92x74x1%0A51x26x1%0A31x3x1%0A25x3x1&heuristic=bssf
2	9	https://planetcalc.com/8634/?master=220x170&rectangles=219x137x1%0A218x136x1%0A215x89x1%0A196x107x1%0A194x6x1%0A178

		x17x1%0A177x121x1%0A156x132x1%0A153x55x1%0A139x138x1%0A138x92x1%0A131x70x1%0A123x90x1%0A109x51x1%0A100x72x1%0A94x82x1%0A68x9x1%0A54x6x1%0A49x23x1%0A17x9x1&heuristic=bssf
3	8	https://planetcalc.com/8634/?master=220x170&rectangles=211x34x1%0A204x98x1%0A191x80x1%0A190x158x1%0A181x127x1%0A164x75x1%0A162x8x1%0A160x97x1%0A156x18x1%0A153x100x1%0A151x42x1%0A142x95x1%0A129x12x1%0A119x37x1%0A113x55x1%0A109x87x1%0A105x95x1%0A84x41x1%0A65x3x1%0A48x42x1&heuristic=bssf
4	7	https://planetcalc.com/8634/?master=220x170&rectangles=206x127x1%0A195x134x1%0A186x107x1%0A167x145x1%0A166x3x1%0A160x64x1%0A150x66x1%0A147x45x1%0A143x78x1%0A138x83x1%0A131x42x1%0A115x40x1%0A111x32x1%0A109x71x1%0A96x38x1%0A93x5x1%0A86x19x1%0A82x42x1%0A60x23x1%0A46x27x1&heuristic=bssf
5	7	https://planetcalc.com/8634/?master=220x170&rectangles=212x91x1%0A200x58x1%0A188x100x1%0A186x46x1%0A180x33x1%0A172x48x1%0A170x54x1%0A168x76x1%0A159x42x1%0A152x120x1%0A148x108x1%0A147x34x1%0A131x6x1%0A128x98x1%0A125x15x1%0A123x48x1%0A114x26x1%0A92x18x1%0A87x57x1%0A76x9x1&heuristic=bssf
6	9	https://planetcalc.com/8634/?master=220x170&rectangles=205x3x1%0A199x74x1%0A195x99x1%0A186x114x1%0A176x8x1%0A175x155x1%0A175x115x1%0A174x0x1%0A171x63x1%0A170x2x1%0A154x68x1%0A153x51x1%0A143x141x1%0A140x80x1%0A122x87x1%0A116x6x1%0A114x70x1%0A112x94x1%0A93x0x1%0A69x27x1&heuristic=bssf
7	8	https://planetcalc.com/8634/?master=220x170&rectangles=204x109x1%0A194x108x1%0A181x32x1%0A160x107x1%0A159x8x1%0A158x78x1%0A149x70x1%0A148x128x1%0A148x117x1%0A146x131x1%0A145x2x1%0A141x117x1%0A137x111x1%0A134x102x1%0A131x58x1%0A120x51x1%0A119x15x1%0A110x65x1%0A56x6x1%0A48x33x1&heuristic=bssf
8	7	https://planetcalc.com/8634/?master=220x170&rectangles=182x107x1%0A175x142x1%0A170x142x1%0A169x70x1%0A159x108x1%0A151x100x1%0A143x100x1%0A142x52x1%0A137x72x1%0A137x8x1%0A132x26x1%0A125x38x1%0A118x73x1%0A117x110x1%0A108x71x1%0A105x81x1%0A88x66x1%0A66x30x1%0A43x34x1%0A23x13x1&heuristic=bssf
9	10	https://planetcalc.com/8634/?master=220x170&rectangles=209x16x1%0A197x118x1%0A194x133x1%0A191x151x1%0A190x80x1%0A184x23x1%0A170x168x1%0A161x92x1%0A155x152x1%0A140x121x1%0A139x8x1%0A124x79x1%0A122x94x1%0A110x94x1%0A109x108x1%0A102x28x1%0A98x75x1%0A79x4x1%0A74x31x1%0A55x16x1&heuristic=bssf
10	6	https://planetcalc.com/8634/?master=220x170&rectangles=219x82x1

		%0A208x164x1%0A177x18x1%0A166x98x1%0A163x124x1%0A153x137x1%0A138x7x1%0A123x98x1%0A122x26x1%0A116x38x1%0A116x66x1%0A114x113x1%0A105x72x1%0A99x65x1%0A70x9x1%0A67x49x1%0A67x53x1%0A40x34x1%0A33x6x1%0A11x6x1&heuristic=bssf
11	9	https://planetcalc.com/8634/?master=220x170&rectangles=215x103x1%0A204x125x1%0A192x74x1%0A178x167x1%0A170x72x1%0A169x23x1%0A166x142x1%0A156x98x1%0A156x102x1%0A151x64x1%0A146x69x1%0A141x38x1%0A133x70x1%0A131x66x1%0A115x15x1%0A91x66x1%0A65x1x1%0A49x15x1%0A44x27x1%0A9x8x1&heuristic=bssf
12	5	https://planetcalc.com/8634/?master=220x170&rectangles=197x125x1%0A184x24x1%0A174x50x1%0A166x119x1%0A166x53x1%0A165x34x1%0A159x130x1%0A155x125x1%0A154x21x1%0A132x17x1%0A131x1x1%0A124x94x1%0A115x52x1%0A114x11x1%0A112x58x1%0A112x85x1%0A109x77x1%0A92x26x1%0A71x18x1%0A42x17x1&heuristic=bssf
13	7	https://planetcalc.com/8634/?master=220x170&rectangles=214x21x1%0A213x13x1%0A190x68x1%0A172x119x1%0A170x166x1%0A166x9x1%0A165x103x1%0A162x95x1%0A154x58x1%0A149x62x1%0A146x74x1%0A141x54x1%0A123x106x1%0A122x110x1%0A120x39x1%0A110x101x1%0A103x35x1%0A80x67x1%0A79x33x1%0A67x50x1&heuristic=bssf
14	5	https://planetcalc.com/8634/?master=220x170&rectangles=198x109x1%0A195x54x1%0A158x2x1%0A153x81x1%0A141x59x1%0A141x138x1%0A140x24x1%0A136x59x1%0A136x65x1%0A133x87x1%0A132x14x1%0A116x91x1%0A111x17x1%0A107x33x1%0A97x30x1%0A95x13x1%0A92x34x1%0A91x82x1%0A34x7x1%0A33x29x1&heuristic=bssf
15	5	https://planetcalc.com/8634/?master=220x170&rectangles=190x129x1%0A190x17x1%0A189x10x1%0A170x22x1%0A166x80x1%0A164x163x1%0A161x52x1%0A155x113x1%0A153x28x1%0A147x87x1%0A139x46x1%0A137x18x1%0A137x26x1%0A131x52x1%0A103x13x1%0A86x57x1%0A67x62x1%0A61x41x1%0A19x4x1%0A15x3x1&heuristic=bssf
16	8	https://planetcalc.com/8634/?master=220x170&rectangles=215x73x1%0A209x127x1%0A191x98x1%0A172x25x1%0A168x44x1%0A161x124x1%0A148x63x1%0A139x84x1%0A138x4x1%0A132x34x1%0A132x126x1%0A127x18x1%0A125x45x1%0A125x82x1%0A125x85x1%0A125x81x1%0A117x73x1%0A102x101x1%0A52x25x1%0A45x28x1&heuristic=bssf
17	6	https://planetcalc.com/8634/?master=220x170&rectangles=202x55x1%0A196x92x1%0A193x121x1%0A184x33x1%0A165x36x1%0A164x42x1%0A163x17x1%0A160x83x1%0A155x28x1%0A147x59x1%0A137x1x1%0A129x63x1%0A126x11x1%0A125x104x1%0A124x104x1%0A122x83x1%0A118x45x1%0A97x24x1%0A93x57x1%0A92x38x1&heuristic=bssf

18	6	https://planetcalc.com/8634/?master=220x170&rectangles=208x44x1%0A189x22x1%0A173x29x1%0A170x79x1%0A164x45x1%0A158x145x1%0A157x14x1%0A148x43x1%0A147x67x1%0A146x101x1%0A140x140x1%0A136x57x1%0A129x123x1%0A102x31x1%0A100x80x1%0A100x37x1%0A97x71x1%0A96x85x1%0A74x38x1%0A53x46x1&heuristic=bssf
19	7	https://planetcalc.com/8634/?master=220x170&rectangles=213x133x1%0A212x156x1%0A206x12x1%0A185x69x1%0A172x48x1%0A172x6x1%0A167x57x1%0A162x150x1%0A153x103x1%0A146x79x1%0A142x56x1%0A123x44x1%0A114x84x1%0A108x27x1%0A96x14x1%0A93x29x1%0A65x44x1%0A53x30x1%0A42x30x1%0A12x10x1&heuristic=bssf
20	7	https://planetcalc.com/8634/?master=220x170&rectangles=208x12x1%0A195x31x1%0A194x14x1%0A193x64x1%0A192x86x1%0A190x158x1%0A183x44x1%0A182x59x1%0A180x146x1%0A161x88x1%0A157x106x1%0A149x39x1%0A118x52x1%0A104x93x1%0A84x15x1%0A82x55x1%0A67x5x1%0A64x15x1%0A58x6x1%0A27x2x1&heuristic=bssf
21	4	https://planetcalc.com/8634/?master=220x170&rectangles=194x112x1%0A190x111x1%0A166x57x1%0A165x2x1%0A165x66x1%0A155x39x1%0A142x36x1%0A126x38x1%0A120x6x1%0A120x57x1%0A118x11x1%0A113x90x1%0A107x23x1%0A70x3x1%0A70x51x1%0A68x7x1%0A55x4x1%0A29x13x1%0A10x5x1%0A7x3x1&heuristic=bssf
22	7	https://planetcalc.com/8634/?master=220x170&rectangles=200x51x1%0A187x74x1%0A173x140x1%0A168x20x1%0A164x29x1%0A162x124x1%0A159x116x1%0A146x66x1%0A125x104x1%0A123x109x1%0A122x93x1%0A119x67x1%0A110x87x1%0A110x96x1%0A91x45x1%0A87x77x1%0A80x46x1%0A57x56x1%0A49x14x1%0A32x21x1&heuristic=bssf
23	4	https://planetcalc.com/8634/?master=220x170&rectangles=203x7x1%0A166x83x1%0A163x67x1%0A158x16x1%0A156x7x1%0A150x56x1%0A142x69x1%0A133x116x1%0A133x88x1%0A120x83x1%0A113x68x1%0A94x30x1%0A92x52x1%0A87x57x1%0A78x31x1%0A74x62x1%0A61x6x1%0A46x11x1%0A40x34x1%0A38x37x1&heuristic=bssf
24	6	https://planetcalc.com/8634/?master=220x170&rectangles=211x66x1%0A208x19x1%0A206x120x1%0A187x101x1%0A155x83x1%0A153x139x1%0A149x93x1%0A146x63x1%0A145x73x1%0A140x25x1%0A140x90x1%0A134x31x1%0A129x59x1%0A115x32x1%0A114x32x1%0A99x31x1%0A98x18x1%0A46x31x1%0A40x31x1%0A27x9x1&heuristic=bssf
25	5	https://planetcalc.com/8634/?master=220x170&rectangles=192x18x1%0A192x44x1%0A187x116x1%0A174x3x1%0A164x88x1%0A160x42x1%0A156x48x1%0A153x80x1%0A151x29x1%0A150x60x1%0A146x112x1%0A146x107x1%0A139x64x1%0A138x4x1%0A130x61x1%0A105x47x1%0A103x63x1%0A57x48x1%0A57x16x1%0A38x11x1&heuristic=bssf
26	5	https://planetcalc.com/8634/?master=220x170&rectangles=220x1x1%

		0A214x51x1%0A202x33x1%0A189x19x1%0A170x169x1%0A161x112x1%0A158x14x1%0A156x104x1%0A154x127x1%0A148x26x1%0A147x49x1%0A133x13x1%0A123x90x1%0A121x3x1%0A104x32x1%0A97x31x1%0A92x61x1%0A78x45x1%0A66x23x1%0A60x26x1&heuristic=bssf
27	6	https://planetcalc.com/8634/?master=220x170&rectangles=208x107x1%0A202x54x1%0A201x3x1%0A170x124x1%0A168x59x1%0A166x18x1%0A162x96x1%0A160x143x1%0A158x105x1%0A135x11x1%0A119x118x1%0A118x80x1%0A117x69x1%0A107x92x1%0A61x30x1%0A44x11x1%0A42x1x1%0A31x5x1%0A24x16x1%0A18x15x1&heuristic=bssf
28	6	https://planetcalc.com/8634/?master=220x170&rectangles=212x39x1%0A211x30x1%0A201x22x1%0A198x51x1%0A194x166x1%0A159x25x1%0A158x116x1%0A157x44x1%0A146x108x1%0A142x85x1%0A141x61x1%0A136x30x1%0A127x93x1%0A107x68x1%0A103x1x1%0A103x15x1%0A74x48x1%0A64x8x1%0A45x16x1%0A45x7x1&heuristic=bssf
29	7	https://planetcalc.com/8634/?master=220x170&rectangles=202x151x1%0A181x120x1%0A173x165x1%0A162x41x1%0A158x60x1%0A147x56x1%0A140x52x1%0A138x39x1%0A136x48x1%0A132x9x1%0A131x40x1%0A126x48x1%0A117x116x1%0A113x80x1%0A109x95x1%0A88x78x1%0A87x67x1%0A65x3x1%0A53x4x1%0A36x10x1&heuristic=bssf
30	6	https://planetcalc.com/8634/?master=220x170&rectangles=220x83x1%0A217x87x1%0A208x115x1%0A201x119x1%0A188x128x1%0A161x17x1%0A157x13x1%0A147x76x1%0A145x18x1%0A141x31x1%0A140x17x1%0A136x79x1%0A136x14x1%0A126x71x1%0A89x65x1%0A60x41x1%0A56x56x1%0A49x33x1%0A47x36x1%0A41x28x1&heuristic=bssf

The result of the Best Long Side Fit algorithm:

ID	Result	Result Link
1	8	https://planetcalc.com/8634/?master=220x170&rectangles=217x13x1%0A202x136x1%0A196x86x1%0A195x117x1%0A189x15x1%0A188x19x1%0A175x95x1%0A156x154x1%0A150x20x1%0A147x50x1%0A146x140x1%0A139x132x1%0A127x95x1%0A120x58x1%0A120x82x1%0A115x19x1%0A92x74x1%0A51x26x1%0A31x3x1%0A25x3x1&heuristic=blsf
2	9	https://planetcalc.com/8634/?master=220x170&rectangles=219x137x1%0A218x136x1%0A215x89x1%0A196x107x1%0A194x6x1%0A178x17x1%0A177x121x1%0A156x132x1%0A153x55x1%0A139x138x1%0A138x92x1%0A131x70x1%0A123x90x1%0A109x51x1%0A100x72x1%0A94x82x1%0A68x9x1%0A54x6x1%0A49x23x1%0A17x9x1&heuristic=blsf
3	8	https://planetcalc.com/8634/?master=220x170&rectangles=211x34x1

		%0A204x98x1%0A191x80x1%0A190x158x1%0A181x127x1%0A164x75x1%0A162x8x1%0A160x97x1%0A156x18x1%0A153x100x1%0A151x42x1%0A142x95x1%0A129x12x1%0A119x37x1%0A113x55x1%0A109x87x1%0A105x95x1%0A84x41x1%0A65x3x1%0A48x42x1&heuristic=blsf
4	6	https://planetcalc.com/8634/?master=220x170&rectangles=206x127x1%0A195x134x1%0A186x107x1%0A167x145x1%0A166x3x1%0A160x64x1%0A150x66x1%0A147x45x1%0A143x78x1%0A138x83x1%0A131x42x1%0A115x40x1%0A111x32x1%0A109x71x1%0A96x38x1%0A93x5x1%0A86x19x1%0A82x42x1%0A60x23x1%0A46x27x1&heuristic=blsf
5	6	https://planetcalc.com/8634/?master=220x170&rectangles=212x91x1%0A200x58x1%0A188x100x1%0A186x46x1%0A180x33x1%0A172x48x1%0A170x54x1%0A168x76x1%0A159x42x1%0A152x120x1%0A148x108x1%0A147x34x1%0A131x6x1%0A128x98x1%0A125x15x1%0A123x48x1%0A114x26x1%0A92x18x1%0A87x57x1%0A76x9x1&heuristic=blsf
6	8	https://planetcalc.com/8634/?master=220x170&rectangles=205x3x1%0A199x74x1%0A195x99x1%0A186x114x1%0A176x8x1%0A175x155x1%0A175x115x1%0A174x0x1%0A171x63x1%0A170x2x1%0A154x68x1%0A153x51x1%0A143x141x1%0A140x80x1%0A122x87x1%0A116x6x1%0A114x70x1%0A112x94x1%0A93x0x1%0A69x27x1&heuristic=blsf
7	9	https://planetcalc.com/8634/?master=220x170&rectangles=204x109x1%0A194x108x1%0A181x32x1%0A160x107x1%0A159x8x1%0A158x78x1%0A149x70x1%0A148x128x1%0A148x117x1%0A146x131x1%0A145x2x1%0A141x117x1%0A137x111x1%0A134x102x1%0A131x58x1%0A120x51x1%0A119x15x1%0A110x65x1%0A56x6x1%0A48x33x1&heuristic=blsf
8	8	https://planetcalc.com/8634/?master=220x170&rectangles=182x107x1%0A175x142x1%0A170x142x1%0A169x70x1%0A159x108x1%0A151x100x1%0A143x100x1%0A142x52x1%0A137x72x1%0A137x8x1%0A132x26x1%0A125x38x1%0A118x73x1%0A117x110x1%0A108x71x1%0A105x81x1%0A88x66x1%0A66x30x1%0A43x34x1%0A23x13x1&heuristic=blsf
9	10	https://planetcalc.com/8634/?master=220x170&rectangles=209x16x1%0A197x118x1%0A194x133x1%0A191x151x1%0A190x80x1%0A184x23x1%0A170x168x1%0A161x92x1%0A155x152x1%0A140x121x1%0A139x8x1%0A124x79x1%0A122x94x1%0A110x94x1%0A109x108x1%0A102x28x1%0A98x75x1%0A79x4x1%0A74x31x1%0A55x16x1&heuristic=blsf
10	7	https://planetcalc.com/8634/?master=220x170&rectangles=219x82x1%0A208x164x1%0A177x18x1%0A166x98x1%0A163x124x1%0A153x137x1%0A138x7x1%0A123x98x1%0A122x26x1%0A116x38x1%0A116x66x1%0A114x113x1%0A105x72x1%0A99x65x1%0A70x9x1%0A67x49x1%0A67x53x1%0A40x34x1%0A33x6x1%0A11x6x1&heuristic=blsf

11	8	https://planetcalc.com/8634/?master=220x170&rectangles=215x103x1%0A204x125x1%0A192x74x1%0A178x167x1%0A170x72x1%0A169x23x1%0A166x142x1%0A156x98x1%0A156x102x1%0A151x64x1%0A146x69x1%0A141x38x1%0A133x70x1%0A131x66x1%0A115x15x1%0A91x66x1%0A65x1x1%0A49x15x1%0A44x27x1%0A9x8x1&heuristic=blsf
12	6	https://planetcalc.com/8634/?master=220x170&rectangles=197x125x1%0A184x24x1%0A174x50x1%0A166x119x1%0A166x53x1%0A165x34x1%0A159x130x1%0A155x125x1%0A154x21x1%0A132x17x1%0A131x1x1%0A124x94x1%0A115x52x1%0A114x11x1%0A112x58x1%0A112x85x1%0A109x77x1%0A92x26x1%0A71x18x1%0A42x17x1&heuristic=blsf
13	8	https://planetcalc.com/8634/?master=220x170&rectangles=214x21x1%0A213x13x1%0A190x68x1%0A172x119x1%0A170x166x1%0A166x9x1%0A165x103x1%0A162x95x1%0A154x58x1%0A149x62x1%0A146x74x1%0A141x54x1%0A123x106x1%0A122x110x1%0A120x39x1%0A110x101x1%0A103x35x1%0A80x67x1%0A79x33x1%0A67x50x1&heuristic=blsf
14	5	https://planetcalc.com/8634/?master=220x170&rectangles=198x109x1%0A195x54x1%0A158x2x1%0A153x81x1%0A141x59x1%0A141x138x1%0A140x24x1%0A136x59x1%0A136x65x1%0A133x87x1%0A132x14x1%0A116x91x1%0A111x17x1%0A107x33x1%0A97x30x1%0A95x13x1%0A92x34x1%0A91x82x1%0A34x7x1%0A33x29x1&heuristic=blsf
15	5	https://planetcalc.com/8634/?master=220x170&rectangles=190x129x1%0A190x17x1%0A189x10x1%0A170x22x1%0A166x80x1%0A164x163x1%0A161x52x1%0A155x113x1%0A153x28x1%0A147x87x1%0A139x46x1%0A137x18x1%0A137x26x1%0A131x52x1%0A103x13x1%0A86x57x1%0A67x62x1%0A61x41x1%0A19x4x1%0A15x3x1&heuristic=blsf
16	7	https://planetcalc.com/8634/?master=220x170&rectangles=215x73x1%0A209x127x1%0A191x98x1%0A172x25x1%0A168x44x1%0A161x124x1%0A148x63x1%0A139x84x1%0A138x4x1%0A132x34x1%0A132x126x1%0A127x18x1%0A125x45x1%0A125x82x1%0A125x85x1%0A125x81x1%0A117x73x1%0A102x101x1%0A52x25x1%0A45x28x1&heuristic=blsf
17	6	https://planetcalc.com/8634/?master=220x170&rectangles=202x55x1%0A196x92x1%0A193x121x1%0A184x33x1%0A165x36x1%0A164x42x1%0A163x17x1%0A160x83x1%0A155x28x1%0A147x59x1%0A137x1x1%0A129x63x1%0A126x11x1%0A125x104x1%0A124x104x1%0A122x83x1%0A118x45x1%0A97x24x1%0A93x57x1%0A92x38x1&heuristic=blsf
18	6	https://planetcalc.com/8634/?master=220x170&rectangles=208x44x1%0A189x22x1%0A173x29x1%0A170x79x1%0A164x45x1%0A158x145x1%0A157x14x1%0A148x43x1%0A147x67x1%0A146x101x1%0A140x140x1%0A136x57x1%0A129x123x1%0A102x31x1%0A100x80x1%0A100x37x1%0A97x71x1%0A96x85x1%0A74x38x1%0A53x46x1

		&heuristic=blsf
19	6	https://planetcalc.com/8634/?master=220x170&rectangles=213x133x1%0A212x156x1%0A206x12x1%0A185x69x1%0A172x48x1%0A172x6x1%0A167x57x1%0A162x150x1%0A153x103x1%0A146x79x1%0A142x56x1%0A123x44x1%0A114x84x1%0A108x27x1%0A96x14x1%0A93x29x1%0A65x44x1%0A53x30x1%0A42x30x1%0A12x10x1&heuristic=blsf
20	6	https://planetcalc.com/8634/?master=220x170&rectangles=208x12x1%0A195x31x1%0A194x14x1%0A193x64x1%0A192x86x1%0A190x158x1%0A183x44x1%0A182x59x1%0A180x146x1%0A161x88x1%0A157x106x1%0A149x39x1%0A118x52x1%0A104x93x1%0A84x15x1%0A82x55x1%0A67x5x1%0A64x15x1%0A58x6x1%0A27x2x1&heuristic=blsf
21	4	https://planetcalc.com/8634/?master=220x170&rectangles=194x112x1%0A190x111x1%0A166x57x1%0A165x2x1%0A165x66x1%0A155x39x1%0A142x36x1%0A126x38x1%0A120x6x1%0A120x57x1%0A118x11x1%0A113x90x1%0A107x23x1%0A70x3x1%0A70x51x1%0A68x7x1%0A55x4x1%0A29x13x1%0A10x5x1%0A7x3x1&heuristic=blsf
22	7	https://planetcalc.com/8634/?master=220x170&rectangles=200x51x1%0A187x74x1%0A173x140x1%0A168x20x1%0A164x29x1%0A162x124x1%0A159x116x1%0A146x66x1%0A125x104x1%0A123x109x1%0A122x93x1%0A119x67x1%0A110x87x1%0A110x96x1%0A91x45x1%0A87x77x1%0A80x46x1%0A57x56x1%0A49x14x1%0A32x21x1&heuristic=blsf
23	4	https://planetcalc.com/8634/?master=220x170&rectangles=203x7x1%0A166x83x1%0A163x67x1%0A158x16x1%0A156x7x1%0A150x56x1%0A142x69x1%0A133x116x1%0A133x88x1%0A120x83x1%0A113x68x1%0A94x30x1%0A92x52x1%0A87x57x1%0A78x31x1%0A74x62x1%0A61x6x1%0A46x11x1%0A40x34x1%0A38x37x1&heuristic=blsf
24	6	https://planetcalc.com/8634/?master=220x170&rectangles=211x66x1%0A208x19x1%0A206x120x1%0A187x101x1%0A155x83x1%0A153x139x1%0A149x93x1%0A146x63x1%0A145x73x1%0A140x25x1%0A140x90x1%0A134x31x1%0A129x59x1%0A115x32x1%0A114x32x1%0A99x31x1%0A98x18x1%0A46x31x1%0A40x31x1%0A27x9x1&heuristic=blsf
25	5	https://planetcalc.com/8634/?master=220x170&rectangles=192x18x1%0A192x44x1%0A187x116x1%0A174x3x1%0A164x88x1%0A160x42x1%0A156x48x1%0A153x80x1%0A151x29x1%0A150x60x1%0A146x112x1%0A146x107x1%0A139x64x1%0A138x4x1%0A130x61x1%0A105x47x1%0A103x63x1%0A57x48x1%0A57x16x1%0A38x11x1&heuristic=blsf
26	5	https://planetcalc.com/8634/?master=220x170&rectangles=220x1x1%0A214x51x1%0A202x33x1%0A189x19x1%0A170x169x1%0A161x112x1%0A158x14x1%0A156x104x1%0A154x127x1%0A148x26x1%0A147x49x1%0A133x13x1%0A123x90x1%0A121x3x1%0A104x32x1%0A97x31x1%0A92x61x1%0A78x45x1%0A66x23x1%0A60x26x1&heuristic=blsf

27	7	https://planetcalc.com/8634/?master=220x170&rectangles=208x107x1%0A202x54x1%0A201x3x1%0A170x124x1%0A168x59x1%0A166x18x1%0A162x96x1%0A160x143x1%0A158x105x1%0A135x11x1%0A119x118x1%0A118x80x1%0A117x69x1%0A107x92x1%0A61x30x1%0A44x11x1%0A42x1x1%0A31x5x1%0A24x16x1%0A18x15x1&heuristic=blsf
28	5	https://planetcalc.com/8634/?master=220x170&rectangles=212x39x1%0A211x30x1%0A201x22x1%0A198x51x1%0A194x166x1%0A159x25x1%0A158x116x1%0A157x44x1%0A146x108x1%0A142x85x1%0A141x61x1%0A136x30x1%0A127x93x1%0A107x68x1%0A103x1x1%0A103x15x1%0A74x48x1%0A64x8x1%0A45x16x1%0A45x7x1&heuristic=blsf
29	6	https://planetcalc.com/8634/?master=220x170&rectangles=202x151x1%0A181x120x1%0A173x165x1%0A162x41x1%0A158x60x1%0A147x56x1%0A140x52x1%0A138x39x1%0A136x48x1%0A132x9x1%0A131x40x1%0A126x48x1%0A117x116x1%0A113x80x1%0A109x95x1%0A88x78x1%0A87x67x1%0A65x3x1%0A53x4x1%0A36x10x1&heuristic=blsf
30	6	https://planetcalc.com/8634/?master=220x170&rectangles=220x83x1%0A217x87x1%0A208x115x1%0A201x119x1%0A188x128x1%0A161x17x1%0A157x13x1%0A147x76x1%0A145x18x1%0A141x31x1%0A140x17x1%0A136x79x1%0A136x14x1%0A126x71x1%0A89x65x1%0A60x41x1%0A56x56x1%0A49x33x1%0A47x36x1%0A41x28x1&heuristic=blsf

The result of the Best Area Fit algorithm:

ID	Result	Result Link
1	8	https://planetcalc.com/8634/?master=220x170&rectangles=217x13x1%0A202x136x1%0A196x86x1%0A195x117x1%0A189x15x1%0A188x19x1%0A175x95x1%0A156x154x1%0A150x20x1%0A147x50x1%0A146x140x1%0A139x132x1%0A127x95x1%0A120x58x1%0A120x82x1%0A115x19x1%0A92x74x1%0A51x26x1%0A31x3x1%0A25x3x1&heuristic=baf
2	8	https://planetcalc.com/8634/?master=220x170&rectangles=219x137x1%0A218x136x1%0A215x89x1%0A196x107x1%0A194x6x1%0A178x17x1%0A177x121x1%0A156x132x1%0A153x55x1%0A139x138x1%0A138x92x1%0A131x70x1%0A123x90x1%0A109x51x1%0A100x72x1%0A94x82x1%0A68x9x1%0A54x6x1%0A49x23x1%0A17x9x1&heuristic=baf
3	7	https://planetcalc.com/8634/?master=220x170&rectangles=211x34x1%0A204x98x1%0A191x80x1%0A190x158x1%0A181x127x1%0A164x75x1%0A162x8x1%0A160x97x1%0A156x18x1%0A153x100x1%0A151x42x1%0A142x95x1%0A129x12x1%0A119x37x1%0A113x55x1%0A109x87x1%0A105x95x1%0A84x41x1%0A65x3x1%0A48x42x1&heuristic=baf

4	6	https://planetcalc.com/8634/?master=220x170&rectangles=206x127x1%0A195x134x1%0A186x107x1%0A167x145x1%0A166x3x1%0A160x64x1%0A150x66x1%0A147x45x1%0A143x78x1%0A138x83x1%0A131x42x1%0A115x40x1%0A111x32x1%0A109x71x1%0A96x38x1%0A93x5x1%0A86x19x1%0A82x42x1%0A60x23x1%0A46x27x1&heuristic=baf
5	6	https://planetcalc.com/8634/?master=220x170&rectangles=212x91x1%0A200x58x1%0A188x100x1%0A186x46x1%0A180x33x1%0A172x48x1%0A170x54x1%0A168x76x1%0A159x42x1%0A152x120x1%0A148x108x1%0A147x34x1%0A131x6x1%0A128x98x1%0A125x15x1%0A123x48x1%0A114x26x1%0A92x18x1%0A87x57x1%0A76x9x1&heuristic=baf
6	7	https://planetcalc.com/8634/?master=220x170&rectangles=205x3x1%0A199x74x1%0A195x99x1%0A186x114x1%0A176x8x1%0A175x155x1%0A175x115x1%0A174x0x1%0A171x63x1%0A170x2x1%0A154x68x1%0A153x51x1%0A143x141x1%0A140x80x1%0A122x87x1%0A116x6x1%0A114x70x1%0A112x94x1%0A93x0x1%0A69x27x1&heuristic=baf
7	8	https://planetcalc.com/8634/?master=220x170&rectangles=204x109x1%0A194x108x1%0A181x32x1%0A160x107x1%0A159x8x1%0A158x78x1%0A149x70x1%0A148x128x1%0A148x117x1%0A146x131x1%0A145x2x1%0A141x117x1%0A137x111x1%0A134x102x1%0A131x58x1%0A120x51x1%0A119x15x1%0A110x65x1%0A56x6x1%0A48x33x1&heuristic=baf
8	7	https://planetcalc.com/8634/?master=220x170&rectangles=182x107x1%0A175x142x1%0A170x142x1%0A169x70x1%0A159x108x1%0A151x100x1%0A143x100x1%0A142x52x1%0A137x72x1%0A137x8x1%0A132x26x1%0A125x38x1%0A118x73x1%0A117x110x1%0A108x71x1%0A105x81x1%0A88x66x1%0A66x30x1%0A43x34x1%0A23x13x1&heuristic=baf
9	9	https://planetcalc.com/8634/?master=220x170&rectangles=209x16x1%0A197x118x1%0A194x133x1%0A191x151x1%0A190x80x1%0A184x23x1%0A170x168x1%0A161x92x1%0A155x152x1%0A140x121x1%0A139x8x1%0A124x79x1%0A122x94x1%0A110x94x1%0A109x108x1%0A102x28x1%0A98x75x1%0A79x4x1%0A74x31x1%0A55x16x1&heuristic=baf
10	6	https://planetcalc.com/8634/?master=220x170&rectangles=219x82x1%0A208x164x1%0A177x18x1%0A166x98x1%0A163x124x1%0A153x137x1%0A138x7x1%0A123x98x1%0A122x26x1%0A116x38x1%0A116x66x1%0A114x113x1%0A105x72x1%0A99x65x1%0A70x9x1%0A67x49x1%0A67x53x1%0A40x34x1%0A33x6x1%0A11x6x1&heuristic=baf
11	7	https://planetcalc.com/8634/?master=220x170&rectangles=215x103x1%0A204x125x1%0A192x74x1%0A178x167x1%0A170x72x1%0A169x23x1%0A166x142x1%0A156x98x1%0A156x102x1%0A151x64x1%0A146x69x1%0A141x38x1%0A133x70x1%0A131x66x1%0A115x15x1%0A91x66x1%0A65x1x1%0A49x15x1%0A44x27x1%0A9x8x1&heur

		istic=baf
12	6	https://planetcalc.com/8634/?master=220x170&rectangles=197x125x1%0A184x24x1%0A174x50x1%0A166x119x1%0A166x53x1%0A165x34x1%0A159x130x1%0A155x125x1%0A154x21x1%0A132x17x1%0A131x1x1%0A124x94x1%0A115x52x1%0A114x11x1%0A112x58x1%0A112x85x1%0A109x77x1%0A92x26x1%0A71x18x1%0A42x17x1&heuristic=baf
13	7	https://planetcalc.com/8634/?master=220x170&rectangles=214x21x1%0A213x13x1%0A190x68x1%0A172x119x1%0A170x166x1%0A166x9x1%0A165x103x1%0A162x95x1%0A154x58x1%0A149x62x1%0A146x74x1%0A141x54x1%0A123x106x1%0A122x110x1%0A120x39x1%0A110x101x1%0A103x35x1%0A80x67x1%0A79x33x1%0A67x50x1&heuristic=baf
14	5	https://planetcalc.com/8634/?master=220x170&rectangles=198x109x1%0A195x54x1%0A158x2x1%0A153x81x1%0A141x59x1%0A141x138x1%0A140x24x1%0A136x59x1%0A136x65x1%0A133x87x1%0A132x14x1%0A116x91x1%0A111x17x1%0A107x33x1%0A97x30x1%0A95x13x1%0A92x34x1%0A91x82x1%0A34x7x1%0A33x29x1&heuristic=baf
15	5	https://planetcalc.com/8634/?master=220x170&rectangles=190x129x1%0A190x17x1%0A189x10x1%0A170x22x1%0A166x80x1%0A164x163x1%0A161x52x1%0A155x113x1%0A153x28x1%0A147x87x1%0A139x46x1%0A137x18x1%0A137x26x1%0A131x52x1%0A103x13x1%0A86x57x1%0A67x62x1%0A61x41x1%0A19x4x1%0A15x3x1&heuristic=baf
16	7	https://planetcalc.com/8634/?master=220x170&rectangles=215x73x1%0A209x127x1%0A191x98x1%0A172x25x1%0A168x44x1%0A161x124x1%0A148x63x1%0A139x84x1%0A138x4x1%0A132x34x1%0A132x126x1%0A127x18x1%0A125x45x1%0A125x82x1%0A125x85x1%0A125x81x1%0A117x73x1%0A102x101x1%0A52x25x1%0A45x28x1&heuristic=baf
17	6	https://planetcalc.com/8634/?master=220x170&rectangles=202x55x1%0A196x92x1%0A193x121x1%0A184x33x1%0A165x36x1%0A164x42x1%0A163x17x1%0A160x83x1%0A155x28x1%0A147x59x1%0A137x1x1%0A129x63x1%0A126x11x1%0A125x104x1%0A124x104x1%0A122x83x1%0A118x45x1%0A97x24x1%0A93x57x1%0A92x38x1&heuristic=baf
18	6	https://planetcalc.com/8634/?master=220x170&rectangles=208x44x1%0A189x22x1%0A173x29x1%0A170x79x1%0A164x45x1%0A158x145x1%0A157x14x1%0A148x43x1%0A147x67x1%0A146x101x1%0A140x140x1%0A136x57x1%0A129x123x1%0A102x31x1%0A100x80x1%0A100x37x1%0A97x71x1%0A96x85x1%0A74x38x1%0A53x46x1&heuristic=baf
19	6	https://planetcalc.com/8634/?master=220x170&rectangles=213x133x1%0A212x156x1%0A206x12x1%0A185x69x1%0A172x48x1%0A172x6x1%0A167x57x1%0A162x150x1%0A153x103x1%0A146x79x1%0A142x56x1%0A123x44x1%0A114x84x1%0A108x27x1%0A96x14x1%

		0A93x29x1%0A65x44x1%0A53x30x1%0A42x30x1%0A12x10x1&heuristic=baf
20	6	https://planetcalc.com/8634/?master=220x170&rectangles=208x12x1%0A195x31x1%0A194x14x1%0A193x64x1%0A192x86x1%0A190x158x1%0A183x44x1%0A182x59x1%0A180x146x1%0A161x88x1%0A157x106x1%0A149x39x1%0A118x52x1%0A104x93x1%0A84x15x1%0A82x55x1%0A67x5x1%0A64x15x1%0A58x6x1%0A27x2x1&heuristic=baf
21	4	https://planetcalc.com/8634/?master=220x170&rectangles=194x112x1%0A190x111x1%0A166x57x1%0A165x2x1%0A165x66x1%0A155x39x1%0A142x36x1%0A126x38x1%0A120x6x1%0A120x57x1%0A118x11x1%0A113x90x1%0A107x23x1%0A70x3x1%0A70x51x1%0A68x7x1%0A55x4x1%0A29x13x1%0A10x5x1%0A7x3x1&heuristic=baf
22	6	https://planetcalc.com/8634/?master=220x170&rectangles=200x51x1%0A187x74x1%0A173x140x1%0A168x20x1%0A164x29x1%0A162x124x1%0A159x116x1%0A146x66x1%0A125x104x1%0A123x109x1%0A122x93x1%0A119x67x1%0A110x87x1%0A110x96x1%0A91x45x1%0A87x77x1%0A80x46x1%0A57x56x1%0A49x14x1%0A32x21x1&heuristic=baf
23	4	https://planetcalc.com/8634/?master=220x170&rectangles=203x7x1%0A166x83x1%0A163x67x1%0A158x16x1%0A156x7x1%0A150x56x1%0A142x69x1%0A133x116x1%0A133x88x1%0A120x83x1%0A113x68x1%0A94x30x1%0A92x52x1%0A87x57x1%0A78x31x1%0A74x62x1%0A61x6x1%0A46x11x1%0A40x34x1%0A38x37x1&heuristic=baf
24	6	https://planetcalc.com/8634/?master=220x170&rectangles=211x66x1%0A208x19x1%0A206x120x1%0A187x101x1%0A155x83x1%0A153x139x1%0A149x93x1%0A146x63x1%0A145x73x1%0A140x25x1%0A140x90x1%0A134x31x1%0A129x59x1%0A115x32x1%0A114x32x1%0A99x31x1%0A98x18x1%0A46x31x1%0A40x31x1%0A27x9x1&heuristic=baf
25	5	https://planetcalc.com/8634/?master=220x170&rectangles=192x18x1%0A192x44x1%0A187x116x1%0A174x3x1%0A164x88x1%0A160x42x1%0A156x48x1%0A153x80x1%0A151x29x1%0A150x60x1%0A146x112x1%0A146x107x1%0A139x64x1%0A138x4x1%0A130x61x1%0A105x47x1%0A103x63x1%0A57x48x1%0A57x16x1%0A38x11x1&heuristic=baf
26	5	https://planetcalc.com/8634/?master=220x170&rectangles=220x1x1%0A214x51x1%0A202x33x1%0A189x19x1%0A170x169x1%0A161x112x1%0A158x14x1%0A156x104x1%0A154x127x1%0A148x26x1%0A147x49x1%0A133x13x1%0A123x90x1%0A121x3x1%0A104x32x1%0A97x31x1%0A92x61x1%0A78x45x1%0A66x23x1%0A60x26x1&heuristic=baf
27	6	https://planetcalc.com/8634/?master=220x170&rectangles=208x107x1%0A202x54x1%0A201x3x1%0A170x124x1%0A168x59x1%0A166x18x1%0A162x96x1%0A160x143x1%0A158x105x1%0A135x11x1%0A119x118x1%0A118x80x1%0A117x69x1%0A107x92x1%0A61x30x1%0A44x11x1%0A42x1x1%0A31x5x1%0A24x16x1%0A18x15x1&heur

		istic=baf
28	5	https://planetcalc.com/8634/?master=220x170&rectangles=212x39x1%0A211x30x1%0A201x22x1%0A198x51x1%0A194x166x1%0A159x25x1%0A158x116x1%0A157x44x1%0A146x108x1%0A142x85x1%0A141x61x1%0A136x30x1%0A127x93x1%0A107x68x1%0A103x1x1%0A103x15x1%0A74x48x1%0A64x8x1%0A45x16x1%0A45x7x1&heuristic=baf
29	6	https://planetcalc.com/8634/?master=220x170&rectangles=202x151x1%0A181x120x1%0A173x165x1%0A162x41x1%0A158x60x1%0A147x56x1%0A140x52x1%0A138x39x1%0A136x48x1%0A132x9x1%0A131x40x1%0A126x48x1%0A117x116x1%0A113x80x1%0A109x95x1%0A88x78x1%0A87x67x1%0A65x3x1%0A53x4x1%0A36x10x1&heuristic=baf
30	6	https://planetcalc.com/8634/?master=220x170&rectangles=220x83x1%0A217x87x1%0A208x115x1%0A201x119x1%0A188x128x1%0A161x17x1%0A157x13x1%0A147x76x1%0A145x18x1%0A141x31x1%0A140x17x1%0A136x79x1%0A136x14x1%0A126x71x1%0A89x65x1%0A60x41x1%0A56x56x1%0A49x33x1%0A47x36x1%0A41x28x1&heuristic=baf

The result of the Greedy Best Long Side Fit algorithm:

ID	Result	Result Link
1	8	https://planetcalc.com/8634/?master=220x170&rectangles=217x13x1%0A202x136x1%0A196x86x1%0A195x117x1%0A189x15x1%0A188x19x1%0A175x95x1%0A156x154x1%0A150x20x1%0A147x50x1%0A146x140x1%0A139x132x1%0A127x95x1%0A120x58x1%0A120x82x1%0A115x19x1%0A92x74x1%0A51x26x1%0A31x3x1%0A25x3x1&heuristic=gblsf
2	9	https://planetcalc.com/8634/?master=220x170&rectangles=219x137x1%0A218x136x1%0A215x89x1%0A196x107x1%0A194x6x1%0A178x17x1%0A177x121x1%0A156x132x1%0A153x55x1%0A139x138x1%0A138x92x1%0A131x70x1%0A123x90x1%0A109x51x1%0A100x72x1%0A94x82x1%0A68x9x1%0A54x6x1%0A49x23x1%0A17x9x1&heuristic=gblsf
3	8	https://planetcalc.com/8634/?master=220x170&rectangles=211x34x1%0A204x98x1%0A191x80x1%0A190x158x1%0A181x127x1%0A164x75x1%0A162x8x1%0A160x97x1%0A156x18x1%0A153x100x1%0A151x42x1%0A142x95x1%0A129x12x1%0A119x37x1%0A113x55x1%0A109x87x1%0A105x95x1%0A84x41x1%0A65x3x1%0A48x42x1&heuristic=gblsf
4	6	https://planetcalc.com/8634/?master=220x170&rectangles=206x127x1%0A195x134x1%0A186x107x1%0A167x145x1%0A166x3x1%0A160x64x1%0A150x66x1%0A147x45x1%0A143x78x1%0A138x83x1%0A131x42x1%0A115x40x1%0A111x32x1%0A109x71x1%0A96x38x1%0A93x5x1%0A86x19x1%0A82x42x1%0A60x23x1%0A46x27x1&heuristic=gblsf

5	6	https://planetcalc.com/8634/?master=220x170&rectangles=212x91x1%0A200x58x1%0A188x100x1%0A186x46x1%0A180x33x1%0A172x48x1%0A170x54x1%0A168x76x1%0A159x42x1%0A152x120x1%0A148x108x1%0A147x34x1%0A131x6x1%0A128x98x1%0A125x15x1%0A123x48x1%0A114x26x1%0A92x18x1%0A87x57x1%0A76x9x1&heuristic=gblsf
6	8	https://planetcalc.com/8634/?master=220x170&rectangles=205x3x1%0A199x74x1%0A195x99x1%0A186x114x1%0A176x8x1%0A175x155x1%0A175x115x1%0A174x0x1%0A171x63x1%0A170x2x1%0A154x68x1%0A153x51x1%0A143x141x1%0A140x80x1%0A122x87x1%0A116x6x1%0A114x70x1%0A112x94x1%0A93x0x1%0A69x27x1&heuristic=gblsf
7	9	https://planetcalc.com/8634/?master=220x170&rectangles=204x109x1%0A194x108x1%0A181x32x1%0A160x107x1%0A159x8x1%0A158x78x1%0A149x70x1%0A148x128x1%0A148x117x1%0A146x131x1%0A145x2x1%0A141x117x1%0A137x111x1%0A134x102x1%0A131x58x1%0A120x51x1%0A119x15x1%0A110x65x1%0A56x6x1%0A48x33x1&heuristic=gblsf
8	8	https://planetcalc.com/8634/?master=220x170&rectangles=182x107x1%0A175x142x1%0A170x142x1%0A169x70x1%0A159x108x1%0A151x100x1%0A143x100x1%0A142x52x1%0A137x72x1%0A137x8x1%0A132x26x1%0A125x38x1%0A118x73x1%0A117x110x1%0A108x71x1%0A105x81x1%0A88x66x1%0A66x30x1%0A43x34x1%0A23x13x1&heuristic=gblsf
9	10	https://planetcalc.com/8634/?master=220x170&rectangles=209x16x1%0A197x118x1%0A194x133x1%0A191x151x1%0A190x80x1%0A184x23x1%0A170x168x1%0A161x92x1%0A155x152x1%0A140x121x1%0A139x8x1%0A124x79x1%0A122x94x1%0A110x94x1%0A109x108x1%0A102x28x1%0A98x75x1%0A79x4x1%0A74x31x1%0A55x16x1&heuristic=gblsf
10	7	https://planetcalc.com/8634/?master=220x170&rectangles=219x82x1%0A208x164x1%0A177x18x1%0A166x98x1%0A163x124x1%0A153x137x1%0A138x7x1%0A123x98x1%0A122x26x1%0A116x38x1%0A116x66x1%0A114x113x1%0A105x72x1%0A99x65x1%0A70x9x1%0A67x49x1%0A67x53x1%0A40x34x1%0A33x6x1%0A11x6x1&heuristic=gblsf
11	7	https://planetcalc.com/8634/?master=220x170&rectangles=215x103x1%0A204x125x1%0A192x74x1%0A178x167x1%0A170x72x1%0A169x23x1%0A166x142x1%0A156x98x1%0A156x102x1%0A151x64x1%0A146x69x1%0A141x38x1%0A133x70x1%0A131x66x1%0A115x15x1%0A91x66x1%0A65x1x1%0A49x15x1%0A44x27x1%0A9x8x1&heuristic=gblsf
12	6	https://planetcalc.com/8634/?master=220x170&rectangles=197x125x1%0A184x24x1%0A174x50x1%0A166x119x1%0A166x53x1%0A165x34x1%0A159x130x1%0A155x125x1%0A154x21x1%0A132x17x1%0A131x1x1%0A124x94x1%0A115x52x1%0A114x11x1%0A112x58x1%0A112x85x1%0A109x77x1%0A92x26x1%0A71x18x1%0A42x17x1&h

		euristic=gblsf
13	8	https://planetcalc.com/8634/?master=220x170&rectangles=214x21x1%0A213x13x1%0A190x68x1%0A172x119x1%0A170x166x1%0A166x9x1%0A165x103x1%0A162x95x1%0A154x58x1%0A149x62x1%0A146x74x1%0A141x54x1%0A123x106x1%0A122x110x1%0A120x39x1%0A110x101x1%0A103x35x1%0A80x67x1%0A79x33x1%0A67x50x1&heuristic=gblsf
14	5	https://planetcalc.com/8634/?master=220x170&rectangles=198x109x1%0A195x54x1%0A158x2x1%0A153x81x1%0A141x59x1%0A141x138x1%0A140x24x1%0A136x59x1%0A136x65x1%0A133x87x1%0A132x14x1%0A116x91x1%0A111x17x1%0A107x33x1%0A97x30x1%0A95x13x1%0A92x34x1%0A91x82x1%0A34x7x1%0A33x29x1&heuristic=gblsf
15	5	https://planetcalc.com/8634/?master=220x170&rectangles=190x129x1%0A190x17x1%0A189x10x1%0A170x22x1%0A166x80x1%0A164x163x1%0A161x52x1%0A155x113x1%0A153x28x1%0A147x87x1%0A139x46x1%0A137x18x1%0A137x26x1%0A131x52x1%0A103x13x1%0A86x57x1%0A67x62x1%0A61x41x1%0A19x4x1%0A15x3x1&heuristic=gblsf
16	7	https://planetcalc.com/8634/?master=220x170&rectangles=215x73x1%0A209x127x1%0A191x98x1%0A172x25x1%0A168x44x1%0A161x124x1%0A148x63x1%0A139x84x1%0A138x4x1%0A132x34x1%0A132x126x1%0A127x18x1%0A125x45x1%0A125x82x1%0A125x85x1%0A125x81x1%0A117x73x1%0A102x101x1%0A52x25x1%0A45x28x1&heuristic=gblsf
17	6	https://planetcalc.com/8634/?master=220x170&rectangles=202x55x1%0A196x92x1%0A193x121x1%0A184x33x1%0A165x36x1%0A164x42x1%0A163x17x1%0A160x83x1%0A155x28x1%0A147x59x1%0A137x1x1%0A129x63x1%0A126x11x1%0A125x104x1%0A124x104x1%0A122x83x1%0A118x45x1%0A97x24x1%0A93x57x1%0A92x38x1&heuristic=gblsf
18	7	https://planetcalc.com/8634/?master=220x170&rectangles=208x44x1%0A189x22x1%0A173x29x1%0A170x79x1%0A164x45x1%0A158x145x1%0A157x14x1%0A148x43x1%0A147x67x1%0A146x101x1%0A140x140x1%0A136x57x1%0A129x123x1%0A102x31x1%0A100x80x1%0A100x37x1%0A97x71x1%0A96x85x1%0A74x38x1%0A53x46x1&heuristic=gblsf
19	6	https://planetcalc.com/8634/?master=220x170&rectangles=213x133x1%0A212x156x1%0A206x12x1%0A185x69x1%0A172x48x1%0A172x6x1%0A167x57x1%0A162x150x1%0A153x103x1%0A146x79x1%0A142x56x1%0A123x44x1%0A114x84x1%0A108x27x1%0A96x14x1%0A93x29x1%0A65x44x1%0A53x30x1%0A42x30x1%0A12x10x1&heuristic=gblsf
20	6	https://planetcalc.com/8634/?master=220x170&rectangles=208x12x1%0A195x31x1%0A194x14x1%0A193x64x1%0A192x86x1%0A190x158x1%0A183x44x1%0A182x59x1%0A180x146x1%0A161x88x1%0A157x106x1%0A149x39x1%0A118x52x1%0A104x93x1%0A84x15x1%

		0A82x55x1%0A67x5x1%0A64x15x1%0A58x6x1%0A27x2x1&heuristic=gblsf
21	4	https://planetcalc.com/8634/?master=220x170&rectangles=194x112x1%0A190x111x1%0A166x57x1%0A165x2x1%0A165x66x1%0A155x39x1%0A142x36x1%0A126x38x1%0A120x6x1%0A120x57x1%0A118x11x1%0A113x90x1%0A107x23x1%0A70x3x1%0A70x51x1%0A68x7x1%0A55x4x1%0A29x13x1%0A10x5x1%0A7x3x1&heuristic=gblsf
22	7	https://planetcalc.com/8634/?master=220x170&rectangles=200x51x1%0A187x74x1%0A173x140x1%0A168x20x1%0A164x29x1%0A162x124x1%0A159x116x1%0A146x66x1%0A125x104x1%0A123x109x1%0A122x93x1%0A119x67x1%0A110x87x1%0A110x96x1%0A91x45x1%0A87x77x1%0A80x46x1%0A57x56x1%0A49x14x1%0A32x21x1&heuristic=gblsf
23	4	https://planetcalc.com/8634/?master=220x170&rectangles=203x7x1%0A166x83x1%0A163x67x1%0A158x16x1%0A156x7x1%0A150x56x1%0A142x69x1%0A133x116x1%0A133x88x1%0A120x83x1%0A113x68x1%0A94x30x1%0A92x52x1%0A87x57x1%0A78x31x1%0A74x62x1%0A61x6x1%0A46x11x1%0A40x34x1%0A38x37x1&heuristic=gblsf
24	6	https://planetcalc.com/8634/?master=220x170&rectangles=211x66x1%0A208x19x1%0A206x120x1%0A187x101x1%0A155x83x1%0A153x139x1%0A149x93x1%0A146x63x1%0A145x73x1%0A140x25x1%0A140x90x1%0A134x31x1%0A129x59x1%0A115x32x1%0A114x32x1%0A99x31x1%0A98x18x1%0A46x31x1%0A40x31x1%0A27x9x1&heuristic=gblsf
25	6	https://planetcalc.com/8634/?master=220x170&rectangles=192x18x1%0A192x44x1%0A187x116x1%0A174x3x1%0A164x88x1%0A160x42x1%0A156x48x1%0A153x80x1%0A151x29x1%0A150x60x1%0A146x112x1%0A146x107x1%0A139x64x1%0A138x4x1%0A130x61x1%0A105x47x1%0A103x63x1%0A57x48x1%0A57x16x1%0A38x11x1&heuristic=gblsf
26	5	https://planetcalc.com/8634/?master=220x170&rectangles=220x1x1%0A214x51x1%0A202x33x1%0A189x19x1%0A170x169x1%0A161x112x1%0A158x14x1%0A156x104x1%0A154x127x1%0A148x26x1%0A147x49x1%0A133x13x1%0A123x90x1%0A121x3x1%0A104x32x1%0A97x31x1%0A92x61x1%0A78x45x1%0A66x23x1%0A60x26x1&heuristic=gblsf
27	6	https://planetcalc.com/8634/?master=220x170&rectangles=208x107x1%0A202x54x1%0A201x3x1%0A170x124x1%0A168x59x1%0A166x18x1%0A162x96x1%0A160x143x1%0A158x105x1%0A135x11x1%0A119x118x1%0A118x80x1%0A117x69x1%0A107x92x1%0A61x30x1%0A44x11x1%0A42x1x1%0A31x5x1%0A24x16x1%0A18x15x1&heuristic=gblsf
28	6	https://planetcalc.com/8634/?master=220x170&rectangles=212x39x1%0A211x30x1%0A201x22x1%0A198x51x1%0A194x166x1%0A159x25x1%0A158x116x1%0A157x44x1%0A146x108x1%0A142x85x1%0A141x61x1%0A136x30x1%0A127x93x1%0A107x68x1%0A103x1x1%0A103x15x1%0A74x48x1%0A64x8x1%0A45x16x1%0A45x7x1&he

		uristic=gblsf
29	6	https://planetcalc.com/8634/?master=220x170&rectangles=202x151x1%0A181x120x1%0A173x165x1%0A162x41x1%0A158x60x1%0A147x56x1%0A140x52x1%0A138x39x1%0A136x48x1%0A132x9x1%0A131x40x1%0A126x48x1%0A117x116x1%0A113x80x1%0A109x95x1%0A88x78x1%0A87x67x1%0A65x3x1%0A53x4x1%0A36x10x1&heuristic=gblsf
30	6	https://planetcalc.com/8634/?master=220x170&rectangles=220x83x1%0A217x87x1%0A208x115x1%0A201x119x1%0A188x128x1%0A161x17x1%0A157x13x1%0A147x76x1%0A145x18x1%0A141x31x1%0A140x17x1%0A136x79x1%0A136x14x1%0A126x71x1%0A89x65x1%0A60x41x1%0A56x56x1%0A49x33x1%0A47x36x1%0A41x28x1&heuristic=gblsf

There are 200 items in 10 testing set for online algorithms:
The result of our online algorithm:

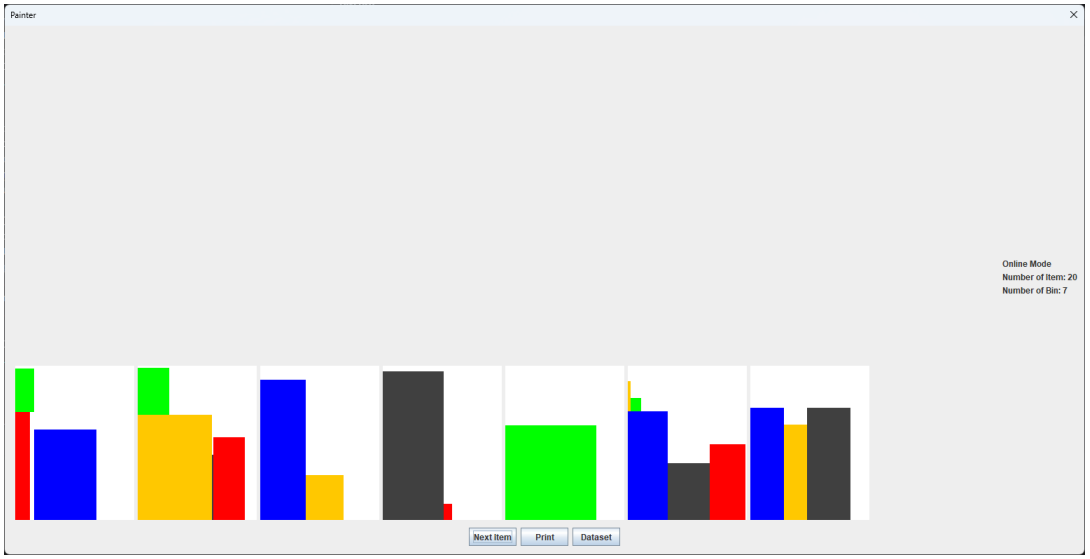
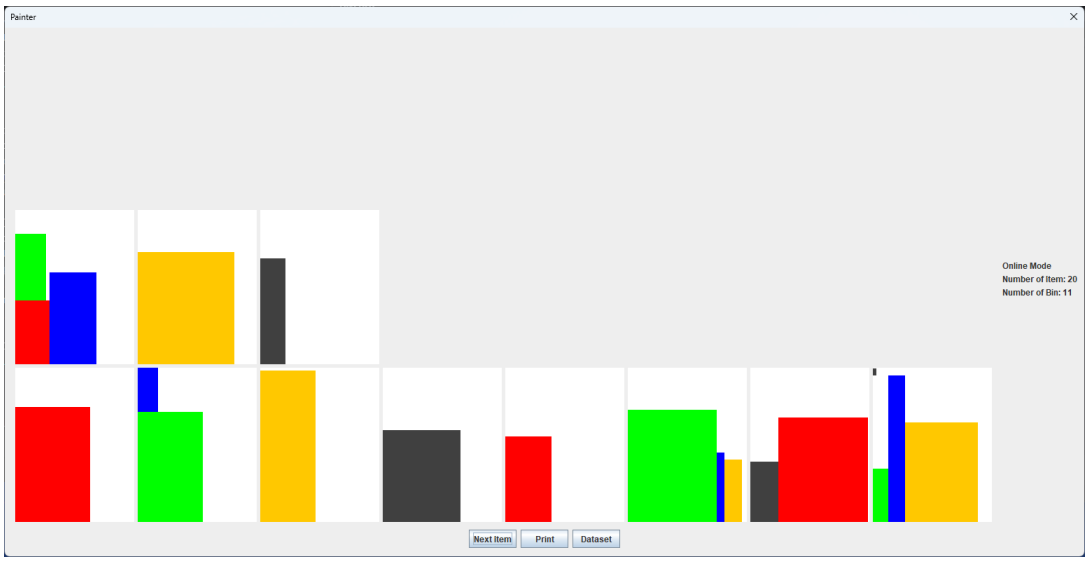
ID	Number of Bin Used	Dataset
1	7	[154x21] [62x27] [129x89] [150x106] [93x2] [118x45] [67x45] [200x65] [64x54] [212x87] [23x12] [135x130] [155x57] [43x4] [81x60] [108x51] [19x15] [160x48] [136x33] [160x62]
2	11	[164x107] [157x93] [63x29] [216x79] [131x111] [122x66] [160x127] [99x11] [89x25] [86x40] [149x128] [76x22] [209x24] [142x104] [10x5] [91x49] [95x44] [131x67] [160x138] [151x36]
3	7	[180x15] [119x33] [115x105] [148x57] [127x11] [194x83] [122x9] [127x120] [136x34] [141x48] [100x71] [149x20] [137x77] [122x73] [126x55] [75x61] [206x43] [186x63] [184x47] [183x19]
4	8	[79x61] [134x65] [91x26] [86x67] [74x28] [132x107] [216x99] [49x36] [92x37] [89x42] [127x125] [137x132] [122x25] [197x64] [60x16] [72x8] [197x110] [80x77] [126x22] [206x76]
5	12	[171x154] [190x32] [45x3] [179x84] [137x101] [137x95] [166x107] [186x26] [84x42] [182x162] [145x58] [87x51] [81x70] [98x37] [128x91] [132x64] [84x21] [190x113] [50x18] [91x66]
6	9	[141x34] [131x41] [150x124] [209x152] [148x13] [22x21] [52x4] [87x54] [70x1] [159x33] [122x52] [70x7] [123x58] [147x94] [146x79] [81x7] [56x50] [154x103] [129x101] [150x123]
7	9	[158x85] [112x4] [90x87] [113x112] [169x60] [206x132] [140x34] [75x54] [90x68] [136x15] [60x42] [123x33] [33x29] [133x118] [91x48] [147x29] [138x48] [175x100] [106x53] [164x65]
8	10	[132x38] [184x40] [200x86] [163x74] [100x98] [208x43] [156x147] [75x54] [127x118] [144x130] [89x49] [73x47] [82x60] [171x63] [144x10] [124x86] [19x11] [91x80] [34x2] [176x103]

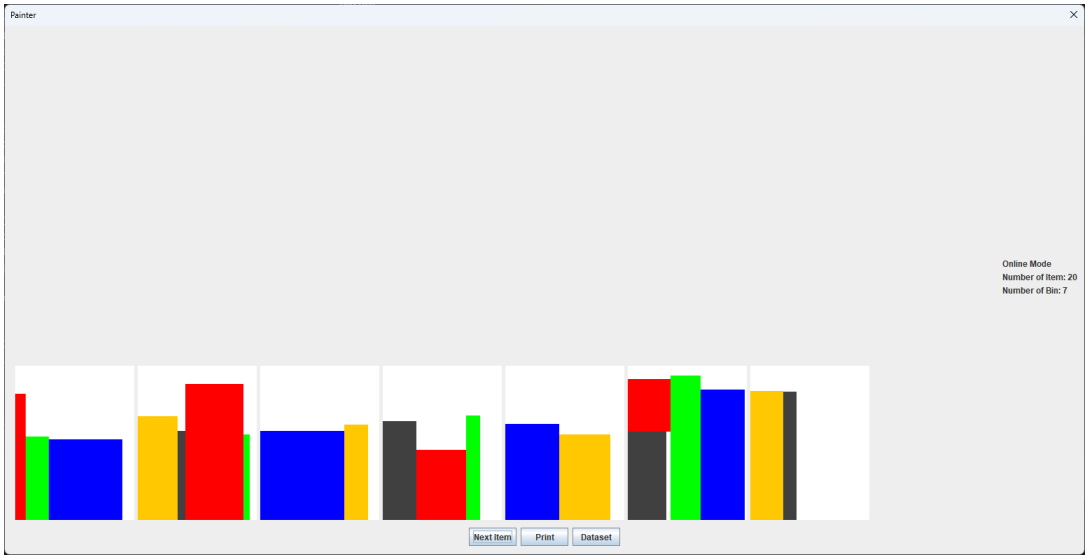
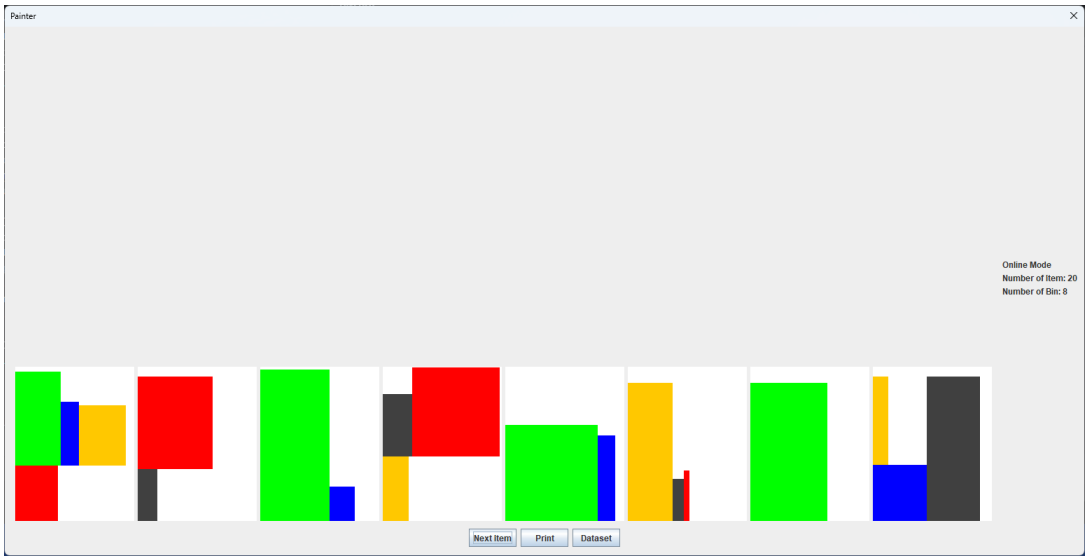
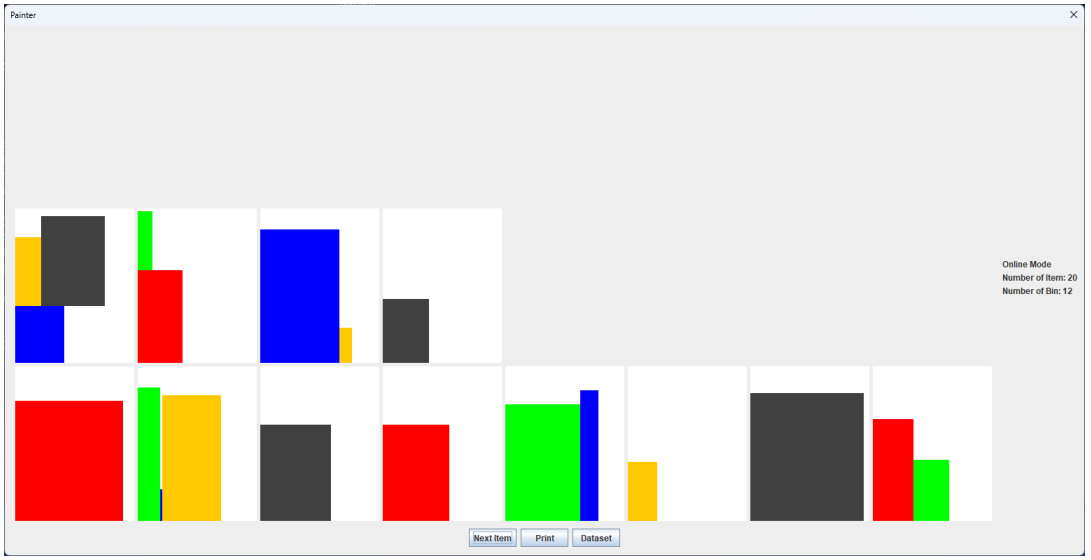
9	14	[142x78] [102x100] [71x11] [160x159] [84x75] [202x161] [176x113] [91x90] [143x101] [185x145] [123x21] [184x38] [43x6] [125x120] [79x70] [198x115] [56x52] [159x11] [149x135] [86x51]
10	9	[104x62] [57x1] [122x51] [188x48] [212x129] [161x74] [58x37] [132x30] [154x90] [78x53] [182x105] [39x21] [160x159] [84x28] [218x110] [127x117] [167x27] [169x18] [160x55] [214x101]

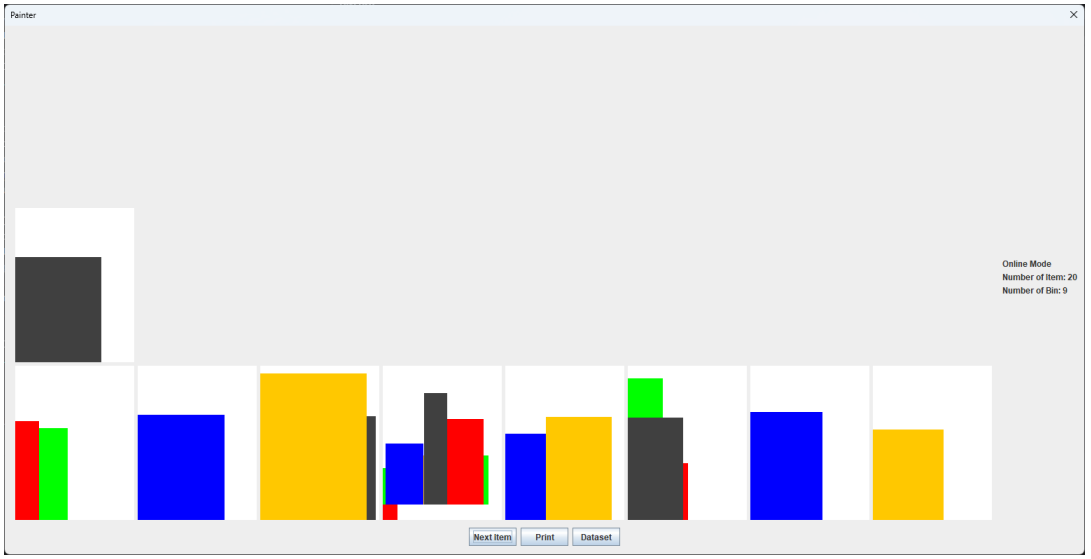
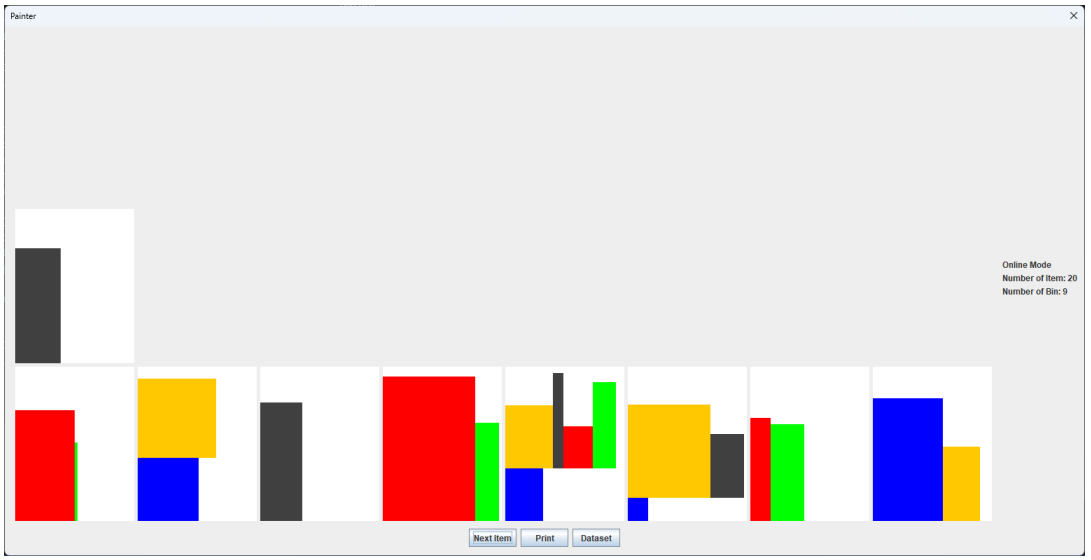
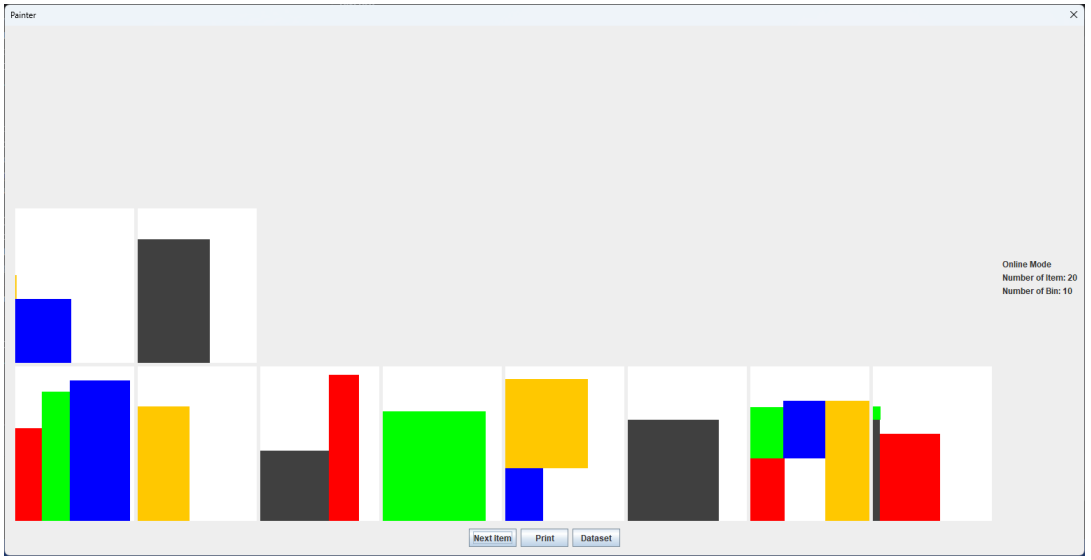
ID	Bin Information with Item Packed
1	[Items count: 3 | Items packed: [[154x21], [62x27], [129x89]]] [Items count: 4 | Items packed: [[150x106], [93x2], [118x45], [67x45]]] [Items count: 2 | Items packed: [[200x65], [64x54]]] [Items count: 2 | Items packed: [[212x87], [23x12]]] [Items count: 1 | Items packed: [[135x130]]] [Items count: 5 | Items packed: [[155x57], [43x4], [81x60], [108x51], [19x15]]] [Items count: 3 | Items packed: [[160x48], [136x33], [160x62]]]
2	[Items count: 1 | Items packed: [[164x107]]] [Items count: 2 | Items packed: [[157x93], [63x29]]] [Items count: 1 | Items packed: [[216x79]]] [Items count: 1 | Items packed: [[131x111]]] [Items count: 1 | Items packed: [[122x66]]] [Items count: 3 | Items packed: [[160x127], [99x11], [89x25]]] [Items count: 2 | Items packed: [[86x40], [149x128]]] [Items count: 4 | Items packed: [[76x22], [209x24], [142x104], [10x5]]] [Items count: 3 | Items packed: [[91x49], [95x44], [131x67]]] [Items count: 1 | Items packed: [[160x138]]] [Items count: 1 | Items packed: [[151x36]]]
3	[Items count: 3 | Items packed: [[180x15], [119x33], [115x105]]] [Items count: 4 | Items packed: [[148x57], [127x11], [194x83], [122x9]]] [Items count: 2 | Items packed: [[127x120], [136x34]]] [Items count: 3 | Items packed: [[141x48], [100x71], [149x20]]] [Items count: 2 | Items packed: [[137x77], [122x73]]] [Items count: 4 | Items packed: [[126x55], [75x61], [206x43], [186x63]]] [Items count: 2 | Items packed: [[184x47], [183x19]]]
4	[Items count: 4 | Items packed: [[79x61], [134x65], [91x26], [86x67]]] [Items count: 2 | Items packed: [[74x28], [132x107]]] [Items count: 2 | Items packed: [[216x99], [49x36]]] [Items count: 3 | Items packed: [[92x37], [89x42], [127x125]]] [Items count: 2 | Items packed: [[137x132], [122x25]]] [Items count: 3 | Items packed: [[197x64], [60x16], [72x8]]] [Items count: 1 | Items packed: [[197x110]]] [Items count: 3 | Items packed: [[80x77], [126x22], [206x76]]]
5	[Items count: 1 | Items packed: [[171x154]]] [Items count: 3 | Items packed: [[190x32], [45x3], [179x84]]] [Items count: 1 | Items packed: [[137x101]]] [Items count: 1 | Items packed: [[137x95]]] [Items count: 2 | Items packed: [[166x107], [186x26]]]

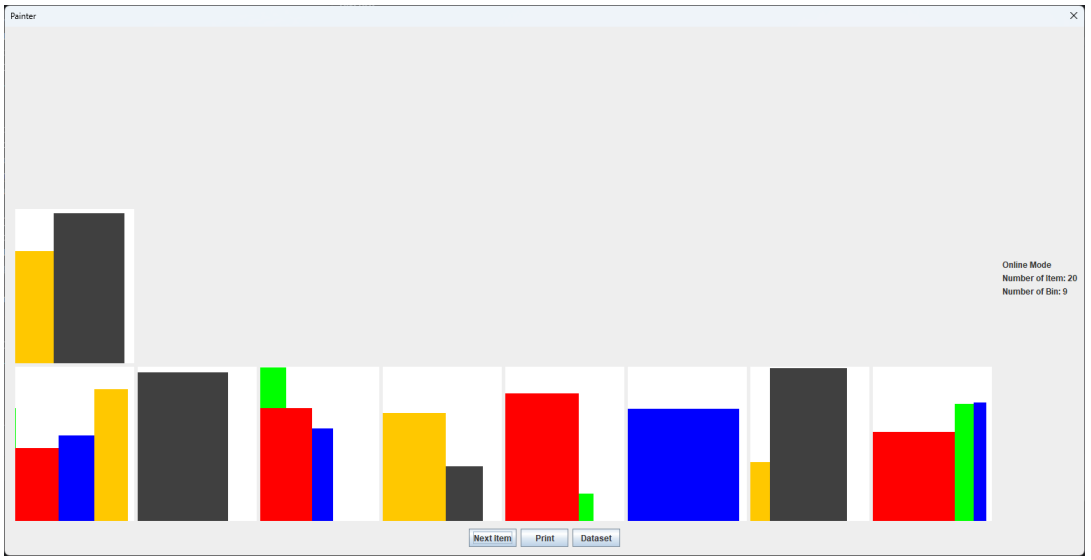
	[Items count: 1 | Items packed: [[84x42]]] [Items count: 1 | Items packed: [[182x162]]] [Items count: 2 | Items packed: [[145x58], [87x51]]] [Items count: 3 | Items packed: [[81x70], [98x37], [128x91]]] [Items count: 2 | Items packed: [[132x64], [84x21]]] [Items count: 2 | Items packed: [[190x113], [50x18]]] [Items count: 1 | Items packed: [[91x66]]]
6	[Items count: 2 | Items packed: [[141x34], [131x41]]] [Items count: 1 | Items packed: [[150x124]]] [Items count: 2 | Items packed: [[209x152], [148x13]]] [Items count: 7 | Items packed: [[22x21], [52x4], [87x54], [70x1], [159x33], [122x52], [70x7]]] [Items count: 2 | Items packed: [[123x58], [147x94]]] [Items count: 3 | Items packed: [[146x79], [81x7], [56x50]]] [Items count: 1 | Items packed: [[154x103]]] [Items count: 1 | Items packed: [[129x101]]] [Items count: 1 | Items packed: [[150x123]]]
7	[Items count: 2 | Items packed: [[158x85], [112x4]]] [Items count: 2 | Items packed: [[90x87], [113x112]]] [Items count: 1 | Items packed: [[169x60]]] [Items count: 2 | Items packed: [[206x132], [140x34]]] [Items count: 5 | Items packed: [[75x54], [90x68], [136x15], [60x42], [123x33]]] [Items count: 3 | Items packed: [[33x29], [133x118], [91x48]]] [Items count: 2 | Items packed: [[147x29], [138x48]]] [Items count: 2 | Items packed: [[175x100], [106x53]]] [Items count: 1 | Items packed: [[164x65]]]
8	[Items count: 3 | Items packed: [[132x38], [184x40], [200x86]]] [Items count: 1 | Items packed: [[163x74]]] [Items count: 2 | Items packed: [[100x98], [208x43]]] [Items count: 1 | Items packed: [[156x147]]] [Items count: 2 | Items packed: [[75x54], [127x118]]] [Items count: 1 | Items packed: [[144x130]]] [Items count: 4 | Items packed: [[89x49], [73x47], [82x60], [171x63]]] [Items count: 3 | Items packed: [[144x10], [124x86], [19x11]]] [Items count: 2 | Items packed: [[91x80], [34x2]]] [Items count: 1 | Items packed: [[176x103]]]
9	[Items count: 1 | Items packed: [[142x78]]] [Items count: 2 | Items packed: [[102x100], [71x11]]] [Items count: 1 | Items packed: [[160x159]]] [Items count: 1 | Items packed: [[84x75]]] [Items count: 1 | Items packed: [[202x161]]] [Items count: 1 | Items packed: [[176x113]]] [Items count: 1 | Items packed: [[91x90]]] [Items count: 1 | Items packed: [[143x101]]] [Items count: 2 | Items packed: [[185x145], [123x21]]] [Items count: 3 | Items packed: [[184x38], [43x6], [125x120]]] [Items count: 1 | Items packed: [[79x70]]] [Items count: 2 | Items packed: [[198x115], [56x52]]] [Items count: 2 | Items packed: [[159x11], [149x135]]] [Items count: 1 | Items packed: [[86x51]]]

10	[Items count: 4 | Items packed: [[104x62], [57x1], [122x51], [188x48]]] [Items count: 1 | Items packed: [[212x129]]] [Items count: 3 | Items packed: [[161x74], [58x37], [132x30]]] [Items count: 2 | Items packed: [[154x90], [78x53]]] [Items count: 2 | Items packed: [[182x105], [39x21]]] [Items count: 1 | Items packed: [[160x159]]] [Items count: 2 | Items packed: [[84x28], [218x110]]] [Items count: 3 | Items packed: [[127x117], [167x27], [169x18]]] [Items count: 2 | Items packed: [[160x55], [214x101]]]

ID	Result
1	
2	

3	 Painter Online Mode Number of Item: 20 Number of Bin: 7 Next Item Print Dataset
4	 Painter Online Mode Number of Item: 20 Number of Bin: 8 Next Item Print Dataset
5	 Painter Online Mode Number of Item: 20 Number of Bin: 12 Next Item Print Dataset

6	 Painter Online Mode Number of Item: 20 Number of Bin: 9 Next Item Print Dataset
7	 Painter Online Mode Number of Item: 20 Number of Bin: 9 Next Item Print Dataset
8	 Painter Online Mode Number of Item: 20 Number of Bin: 10 Next Item Print Dataset

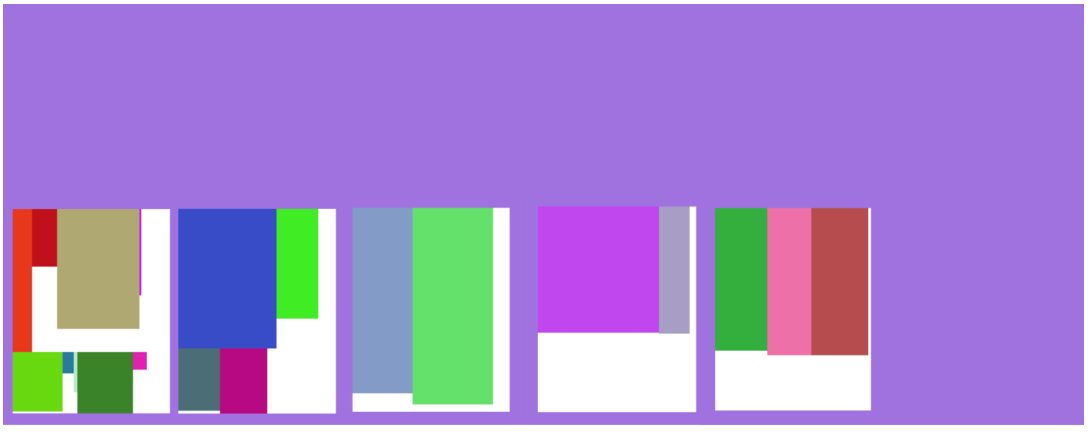
9	
10	

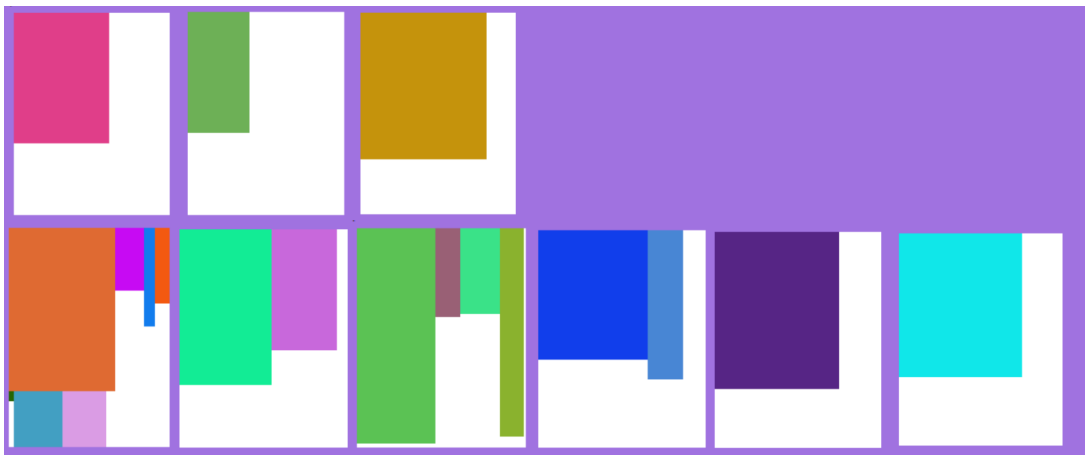
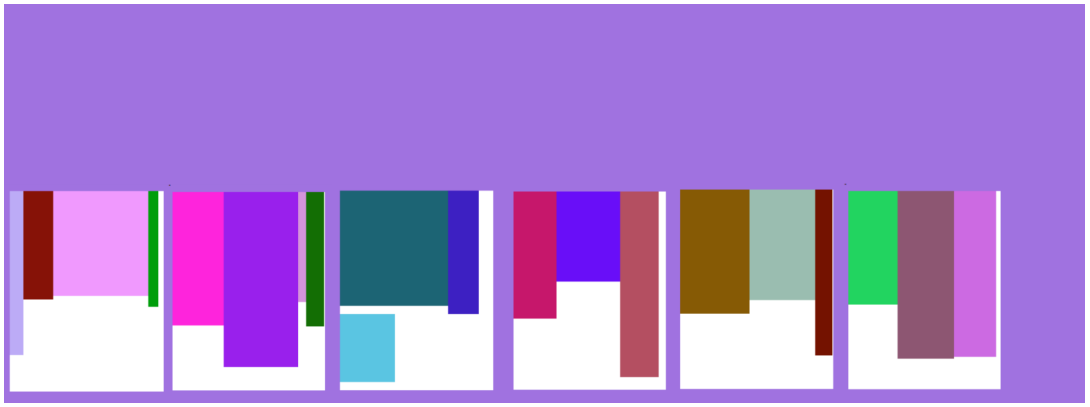
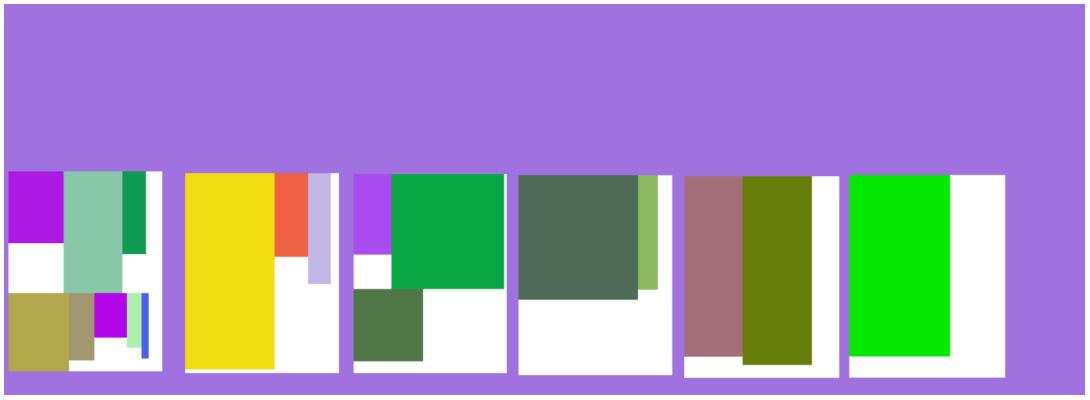
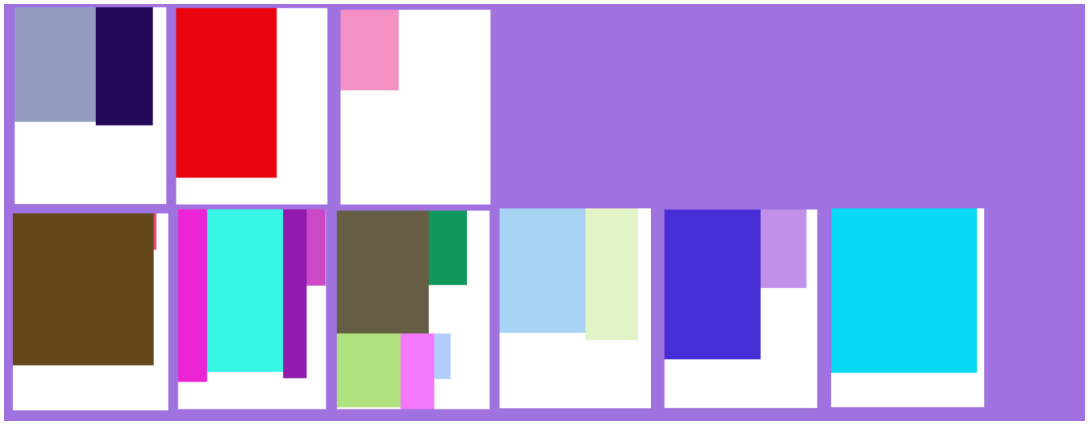
The result of the Shelf First Fit Algorithm:

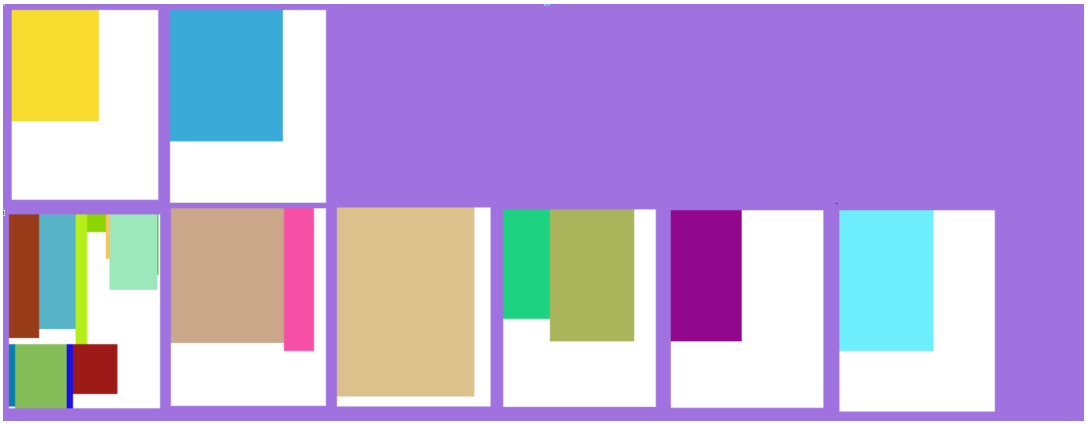
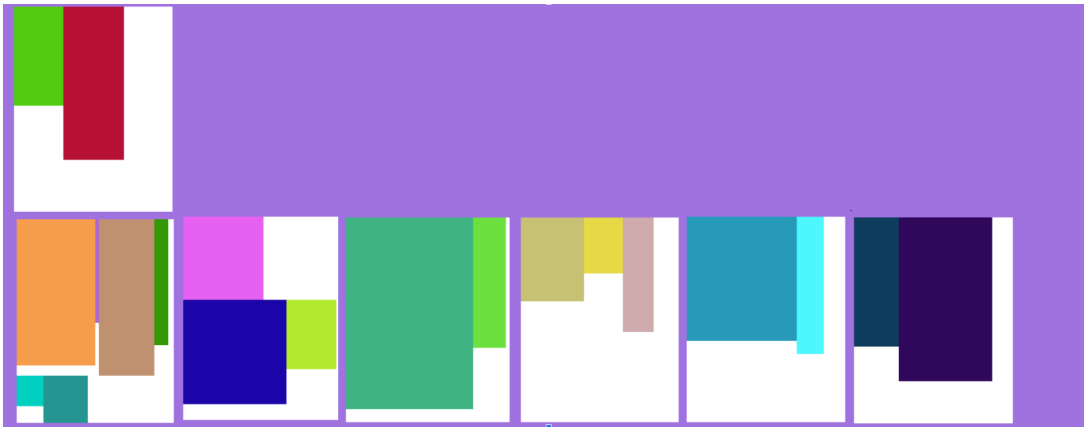
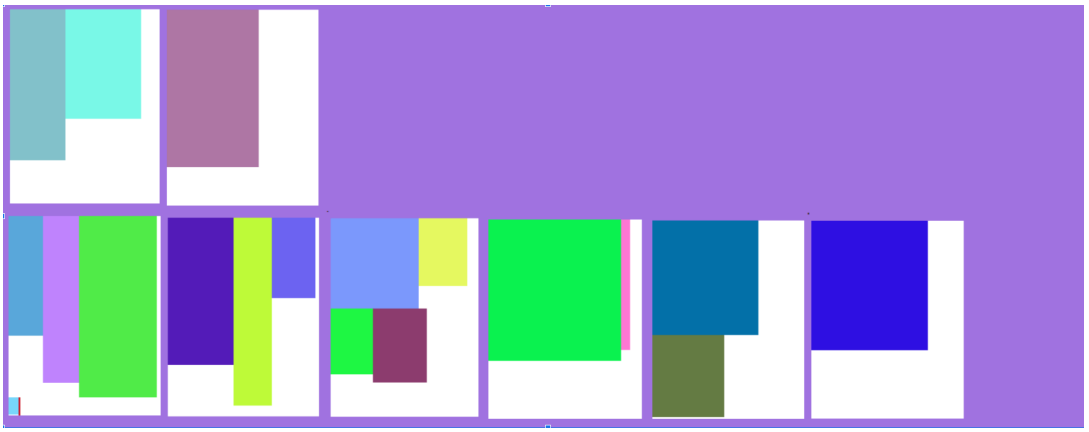
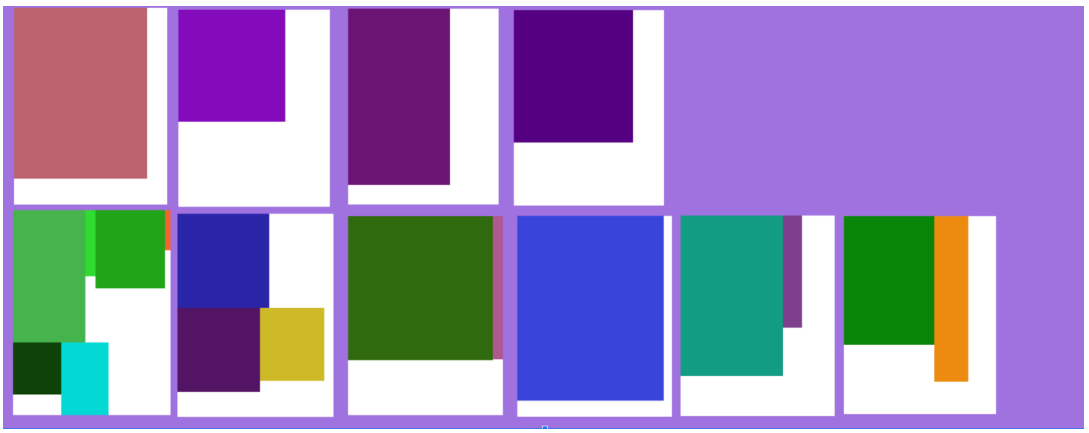
ID	Result	Bin Information with Item Packed
1	5	[Items count: 9 | Items packed: [[154x21], [62x27], [129x89], [93x2], [64x54], [23x12], [43x4], [81x60], [19x15]]] [Items count: 4 | Items packed: [[150x106], [118x45], [67x45], [108x51]]] [Items count: 2 | Items packed: [[200x65], [212x87]]] [Items count: 2 | Items packed: [[135x130], [136x33]]] [Items count: 3 | Items packed: [[155x57], [160x48], [160x62]]]
2	9	[Items count: 7 | Items packed: [[164x107], [63x29], [99x11], [76x22], [10x5], [91x49], [95x44]]] [Items count: 2 | Items packed: [[157x93], [122x66]]] [Items count: 4 | Items packed: [[216x79], [89x25], [86x40], [209x24]]] [Items count: 2 | Items packed: [[131x111], [151x36]]] [Items count: 1 | Items packed: [[160x127]]] [Items count: 1| Items packed: [[149x128]]]

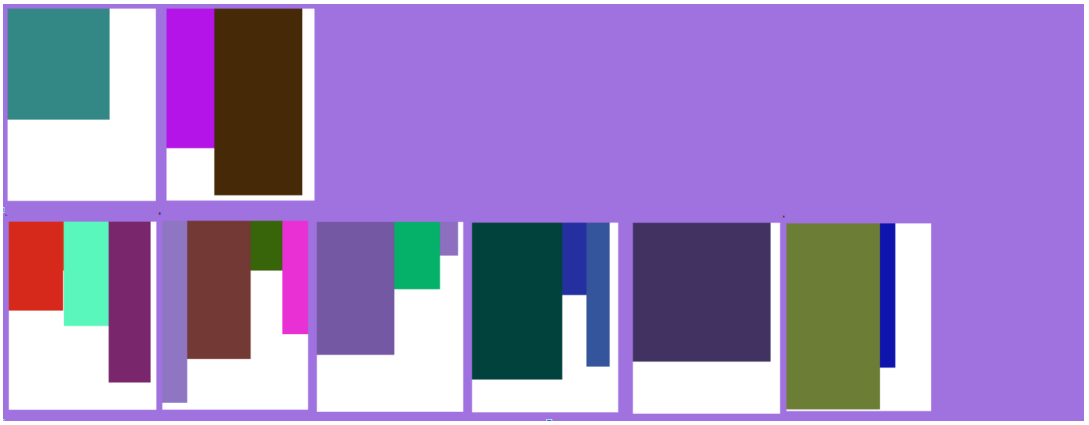
		[Items count: 1 | Items packed: [[142x104]]] [Items count: 1 | Items packed: [[131x67]]] [Items count: 1 | Items packed: [[160x138]]]
3	6	[Items count: 4 | Items packed: [[180x15], [119x33], [115x105], [127x11]]] [Items count: 4 | Items packed: [[148x57], [194x83], [122x9], [149x20]]] [Items count: 3 | Items packed: [[127x120], [136x34], [75x61]] [Items count: 3 | Items packed: [[141x48], [100x71], [206x43]]] [Items count: 3 | Items packed: [[137x77], [122x73], [183x19]]] [Items count: 3 | Items packed: [[126x55], [186x63], [184x47]]]
4	6	[Items count: 9 | Items packed: [[79x61], [134x65], [91x26], [86x67], [74x28], [132x107], [49x36], [60x16], [72x8]]] [Items count: 3 | Items packed: [[216x99], [92x37], [122x25]]] [Items count: 3 | Items packed: [[89x42], [127x125], [80x77]]] [Items count: 2 | Items packed: [[137x132], [126x22]]] [Items count: 2 | Items packed: [[197x64], [206x76]]] [Items count: 1 | Items packed: [[197x110]]]
5	9	[Items count: 2 | Items packed: [[171x154], [45x3]]] [Items count: 4 | Items packed: [[190x32], [179x84], [186x26], [84x21]]] [Items count: 5 | Items packed: [[137x101], [84x42], [81x70], [98x37], [50x18]]] [Items count: 2 | Items packed: [[137x95], [145x58]]] [Items count: 2 | Items packed: [[166x107], [87x51]]] [Items count: 1 | Items packed: [[182x162]]] [Items count: 3 | Items packed: [[128x91], [132x64]]] [Items count: 2 | Items packed: [[190x113]]] [Items count: 1 | Items packed: [[91x66]]]
6	8	[Items count: 11 | Items packed: [[141x34], [131x41], [148x13], [22x21], [52x4], [87x54], [70x1], [70x7], [123x58], [81x7], [56x50]]] [Items count: 2 | Items packed: [[150x124], [159x33]]] [Items count: 1 | Items packed: [[209x152]]] [Items count: 2 | Items packed: [[122x52], [147x94]]] [Items count: 1 | Items packed: [[146x79]]] [Items count: 1 | Items packed: [[154x103]]] [Items count: 1 | Items packed: [[129x101]]] [Items count: 1 | Items packed: [[150x123]]]
7	7	[Items count: 6 | Items packed: [[158x85], [112x4], [169x60], [136x15], [33x29], [91x48]]] [Items count: 3 | Items packed: [[90x87], [113x112], [75x54]]] [Items count: 2 | Items packed: [[206x132], [140x34]]] [Items count: 3 | Items packed: [[90x68], [60x42], [123x33]]] [Items count: 3 | Items packed: [[133x118], [147x29]]] [Items count: 2 | Items packed: [[138x48], [175x100]]] [Items count: 2 | Items packed: [[106x53], [164x65]]]
8	8	[Items count: 5 | Items packed: [[132x38], [184x40], [200x86], [19x11], [34x2]]] [Items count: 3 | Items packed: [[163x74]], [208x43], [89x49]]] [Items count: 4 | Items packed: [[100x98], [75x54], [73x47], [82x60]]] [Items count: 2 | Items packed: [[156x147], [144x10]]]

		[Items count: 2 | Items packed: [[127x118], [91x80]]] [Items count: 1 | Items packed: [[144x130]]] [Items count: 4 | Items packed: [[171x63], [124x86]]] [Items count: 1 | Items packed: [[176x103]]]
9	10	[Items count: 6 | Items packed: [[142x78], [71x11], [84x75], [43x6], [56x52], [86x51]]] [Items count: 3 | Items packed: [[102x100], [91x90], [79x70]]] [Items count: 2 | Items packed: [[160x159], [159x11]]] [Items count: 1 | Items packed: [[202x161]]] [Items count: 2 | Items packed: [[176x113], [123x21]]] [Items count: 2 | Items packed: [[143x101], [184x38]]] [Items count: 1 | Items packed: [[185x145]]] [Items count: 1 | Items packed: [[125x120]]] [Items count: 1 | Items packed: [[198x115]]] [Items count: 1 | Items packed: [[149x135]]]
10	8	[Items count: 4 | Items packed: [[104x62], [57x1], [122x51], [188x48]]] [Items count: 4 | Items packed: [[212x129], [161x74], [58x37], [132x30]]] [Items count: 3 | Items packed: [[154x90], [78x53], [39x21]]] [Items count: 3 | Items packed: [[182x105], [84x28], [167x27]]] [Items count: 1 | Items packed: [[160x159]]] [Items count: 2 | Items packed: [[218x110], [169x18]]] [Items count: 1 | Items packed: [[127x117]]] [Items count: 2 | Items packed: [[160x55], [214x101]]]

ID	Result
1	

2	
3	
4	
5	

6	
7	
8	
9	

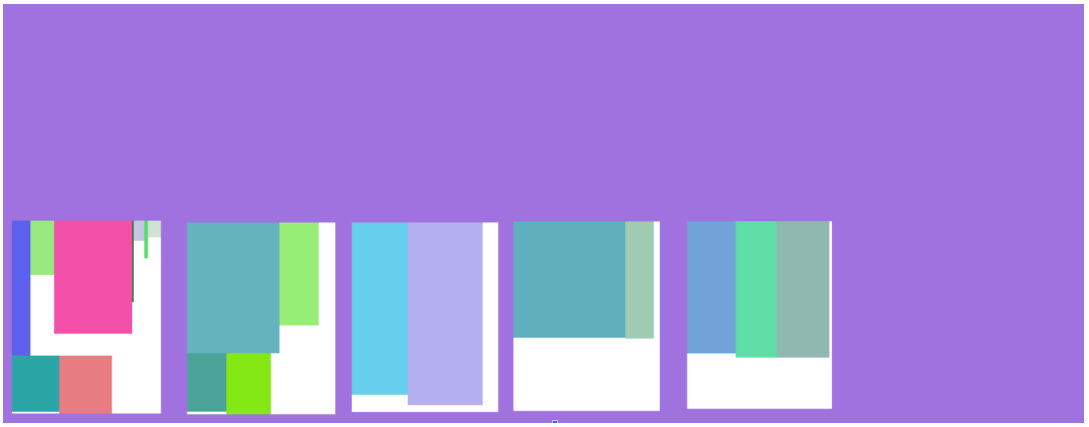
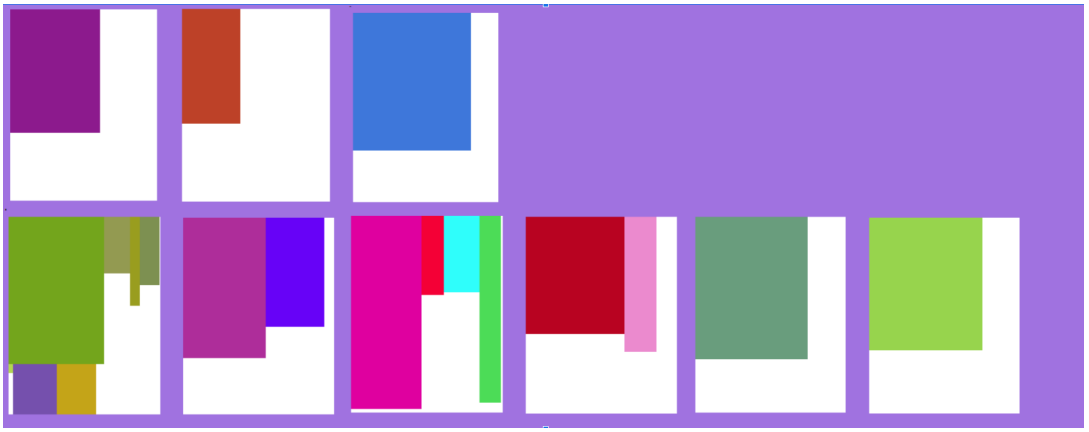
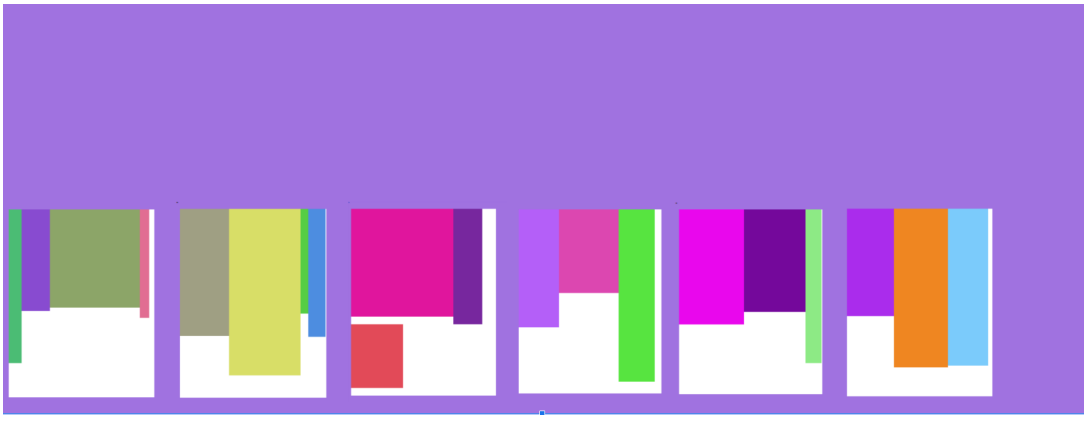
10	

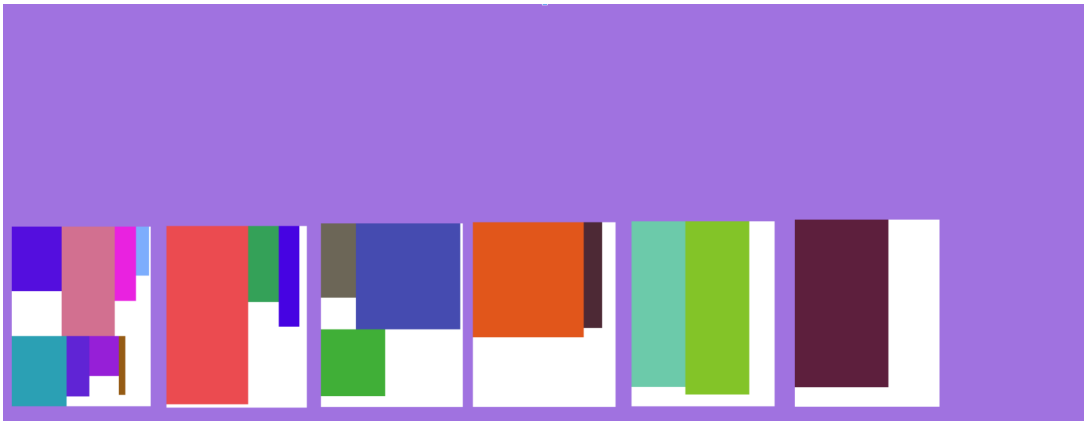
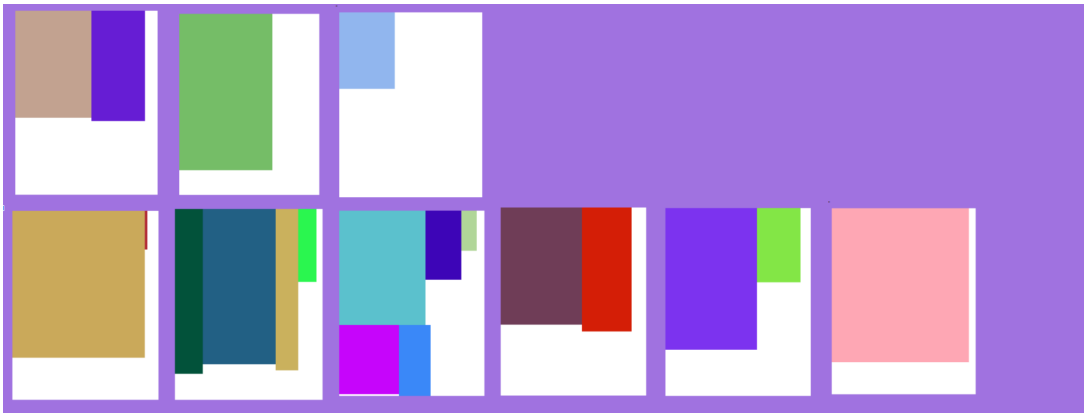
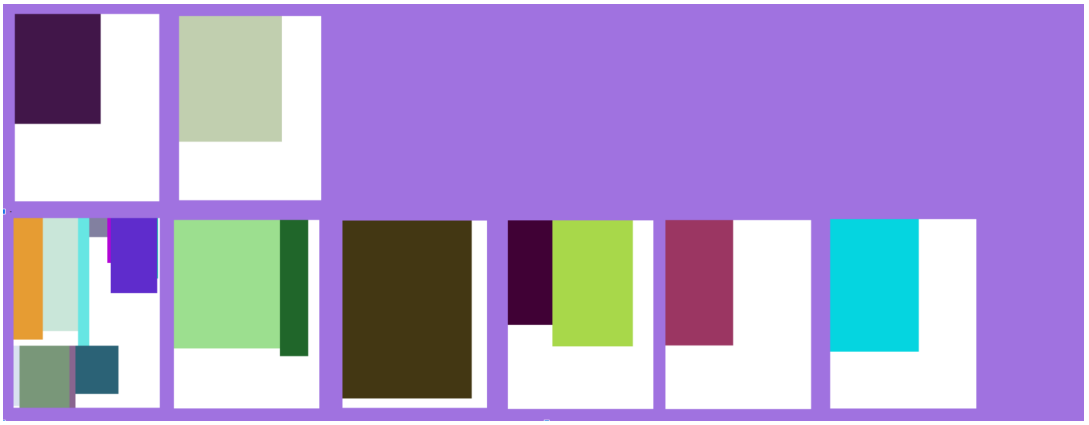
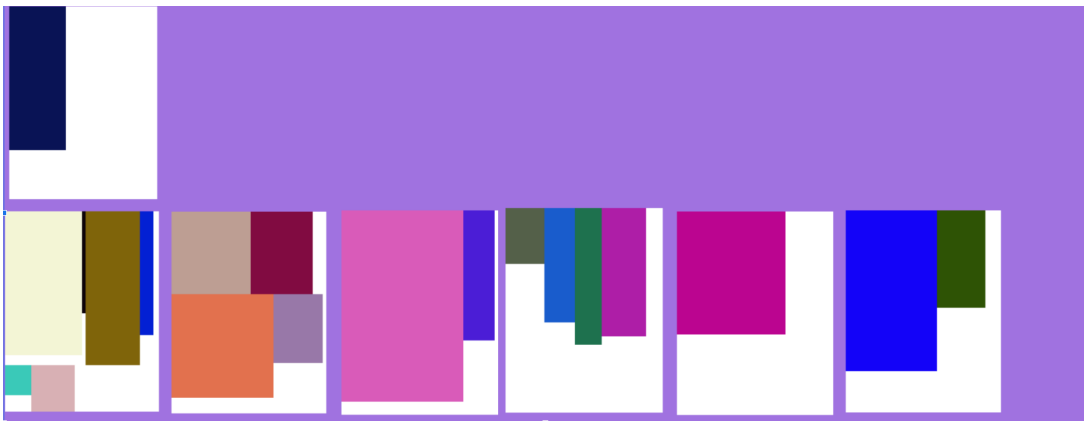
The result of the Shelf Best Width Fit Algorithm:

ID	Result	Bin Information with Item Packed
1	5	[Items count: 9 | Items packed: [[154x21], [62x27], [129x89], [93x2], [64x54], [23x12], [43x4], [81x60], [19x15]]] [Items count: 4 | Items packed: [[150x106], [118x45], [67x45], [108x51]]] [Items count: 2 | Items packed: [[200x65], [212x87]]] [Items count: 2 | Items packed: [[135x130], [136x33]]] [Items count: 3 | Items packed: [[155x57], [160x48], [160x62]]]
2	9	[Items count: 7 | Items packed: [[164x107], [63x29], [99x11], [76x22], [10x5], [91x49], [95x44]]] [Items count: 2 | Items packed: [[157x93], [122x66]]] [Items count: 4 | Items packed: [[216x79], [89x25], [86x40], [209x24]]] [Items count: 2 | Items packed: [[131x111], [151x36]]] [Items count: 1 | Items packed: [[160x127]]] [Items count: 1| Items packed: [[149x128]]] [Items count: 1 | Items packed: [[142x104],]] [Items count: 1 | Items packed: [[131x67]]] [Items count: 1 | Items packed: [[160x138]]]
3	6	[Items count: 4 | Items packed: [[180x15], [119x33], [115x105], [127x11]]] [Items count: 4 | Items packed: [[148x57], [194x83], [122x9], [149x20]]] [Items count: 3 | Items packed: [[127x120], [136x34], [75x61]] [Items count: 3 | Items packed: [[141x48], [100x71], [206x43]]] [Items count: 3 | Items packed: [[137x77], [122x73], [183x19]]] [Items count: 3 | Items packed: [[126x55], [186x63], [184x47]]]
4	6	[Items count: 9 | Items packed: [[79x61], [134x65], [91x26], [86x67], [74x28], [132x107], [49x36], [60x16], [72x8]]] [Items count: 3 | Items packed: [[216x99], [92x37], [122x25]]] [Items count: 3 | Items packed: [[89x42], [127x125], [80x77]]] [Items count: 2 | Items packed: [[137x132], [126x22]]] [Items count: 2 | Items packed: [[197x64], [206x76]]] [Items count: 1 | Items packed: [[197x110]]]

5	9	[Items count: 2 | Items packed: [[171x154], [45x3]]] [Items count: 4 | Items packed: [[190x32], [179x84], [186x26], [84x21]]] [Items count: 5 | Items packed: [[137x101], [84x42], [81x70], [98x37], [50x18]]] [Items count: 2 | Items packed: [[137x95], [145x58]]] [Items count: 2 | Items packed: [[166x107], [87x51]]] [Items count: 1 | Items packed: [[182x162]]] [Items count: 3 | Items packed: [[128x91], [132x64]]] [Items count: 2 | Items packed: [[190x113]]] [Items count: 1 | Items packed: [[91x66]]]
6	8	[Items count: 11 | Items packed: [[141x34], [131x41], [148x13], [22x21], [52x4], [87x54], [70x1], [70x7], [123x58], [81x7], [56x50]]] [Items count: 2 | Items packed: [[150x124], [159x33]]] [Items count: 1 | Items packed: [[209x152]]] [Items count: 2 | Items packed: [[122x52], [147x94]]] [Items count: 1 | Items packed: [[146x79]]] [Items count: 1 | Items packed: [[154x103]]] [Items count: 1 | Items packed: [[129x101]]] [Items count: 1 | Items packed: [[150x123]]]
7	7	[Items count: 6 | Items packed: [[158x85], [112x4], [169x60], [136x15], [33x29], [91x48]]] [Items count: 4 | Items packed: [[90x87], [113x112], [75x54], [90x68]]] [Items count: 2 | Items packed: [[206x132], [140x34]]] [Items count: 4 | Items packed: [[60x42], [123x33], [147x29], [138x48]]] [Items count: 1 | Items packed: [[133x118]]] [Items count: 2 | Items packed: [[175x100], [106x53]]] [Items count: 1 | Items packed: [[164x65]]]
8	8	[Items count: 5 | Items packed: [[132x38], [184x40], [200x86], [19x11], [34x2]]] [Items count: 3 | Items packed: [[163x74]], [208x43], [89x49]]] [Items count: 4 | Items packed: [[100x98], [75x54], [73x47], [82x60]]] [Items count: 2 | Items packed: [[156x147], [144x10]]] [Items count: 2 | Items packed: [[127x118], [91x80]]] [Items count: 1 | Items packed: [[144x130]]] [Items count: 4 | Items packed: [[171x63], [124x86]]] [Items count: 1 | Items packed: [[176x103]]]
9	10	[Items count: 6 | Items packed: [[142x78], [71x11], [84x75], [43x6], [56x52], [86x51]]] [Items count: 3 | Items packed: [[102x100], [91x90], [79x70]]] [Items count: 2 | Items packed: [[160x159], [159x11]]] [Items count: 1 | Items packed: [[202x161]]] [Items count: 2 | Items packed: [[176x113], [123x21]]] [Items count: 2 | Items packed: [[143x101], [184x38]]] [Items count: 1 | Items packed: [[185x145]]] [Items count: 1 | Items packed: [[125x120]]] [Items count: 1 | Items packed: [[198x115]]] [Items count: 1 | Items packed: [[149x135]]]
10	8	[Items count: 4 | Items packed: [[104x62], [57x1], [122x51], [188x48]]]

		[Items count: 4 | Items packed: [[212x129], [161x74], [58x37], [132x30]]] [Items count: 3 | Items packed: [[154x90], [78x53], [39x21]]] [Items count: 3 | Items packed: [[182x105], [84x28], [167x27]]] [Items count: 1 | Items packed: [[160x159]]] [Items count: 2 | Items packed: [[218x110], [169x18]]] [Items count: 1 | Items packed: [[127x117]]] [Items count: 2 | Items packed: [[160x55], [214x101]]]

ID	Result
1	
2	
3	

4	
5	
6	
7	

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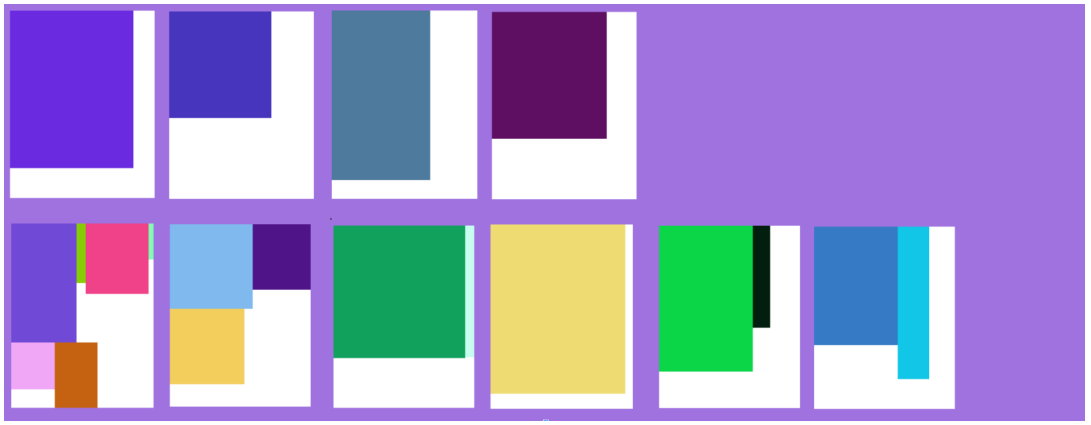
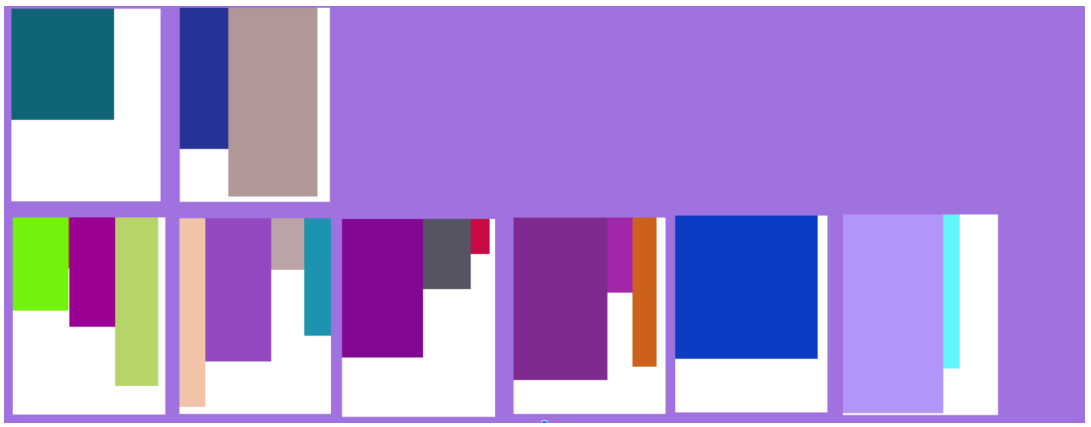
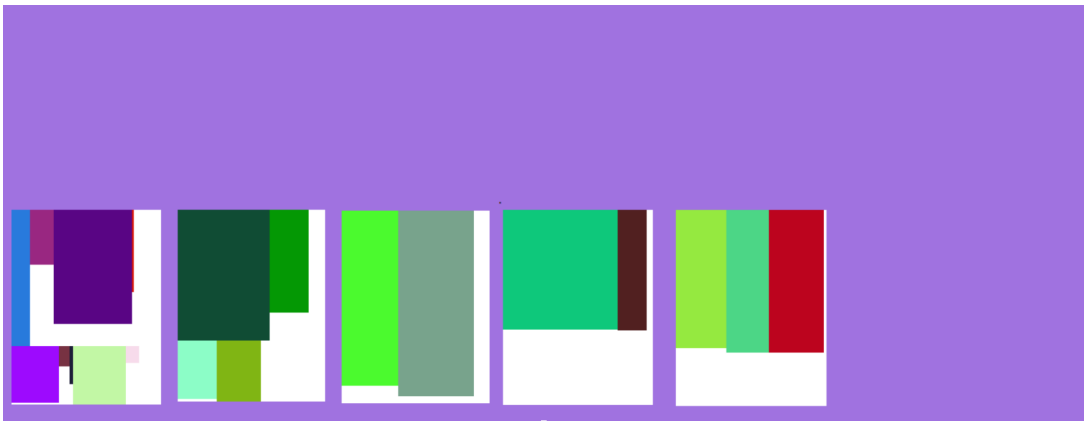
9	
10	

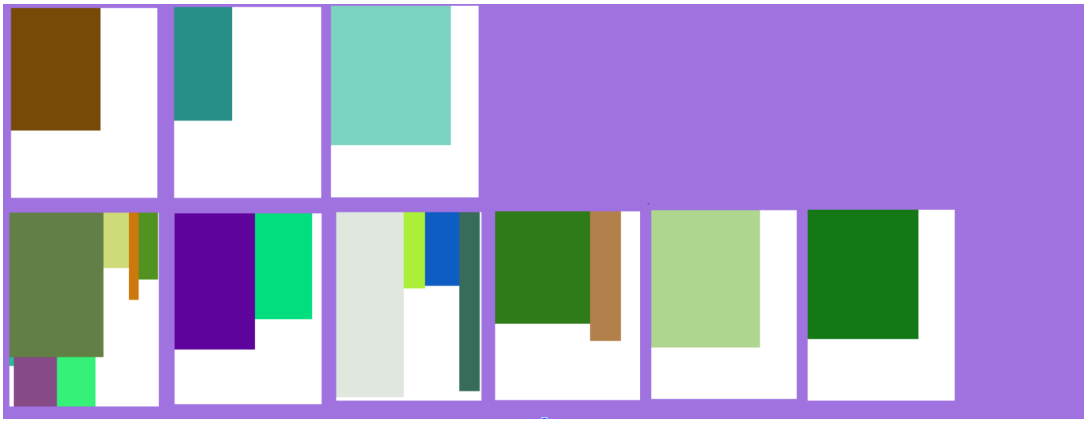
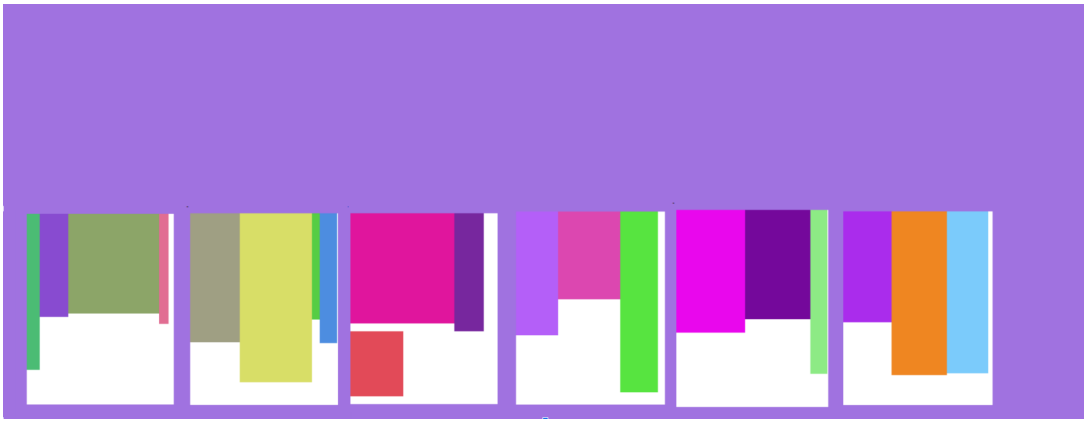
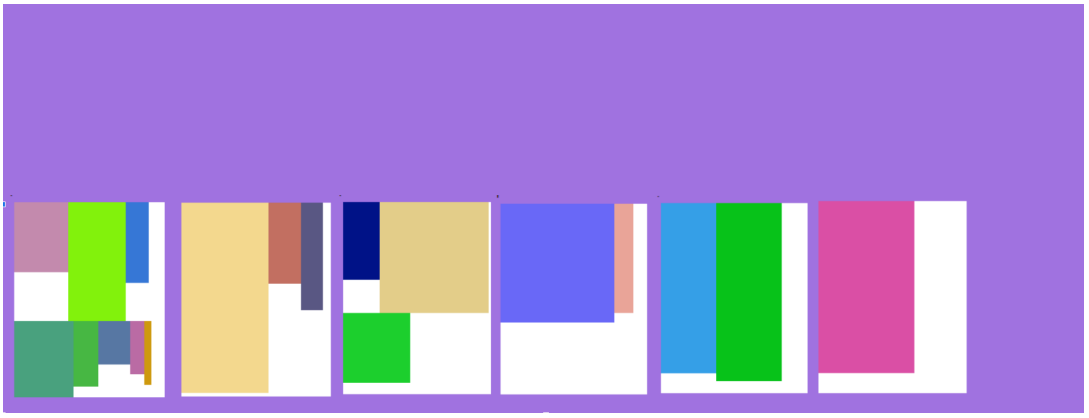
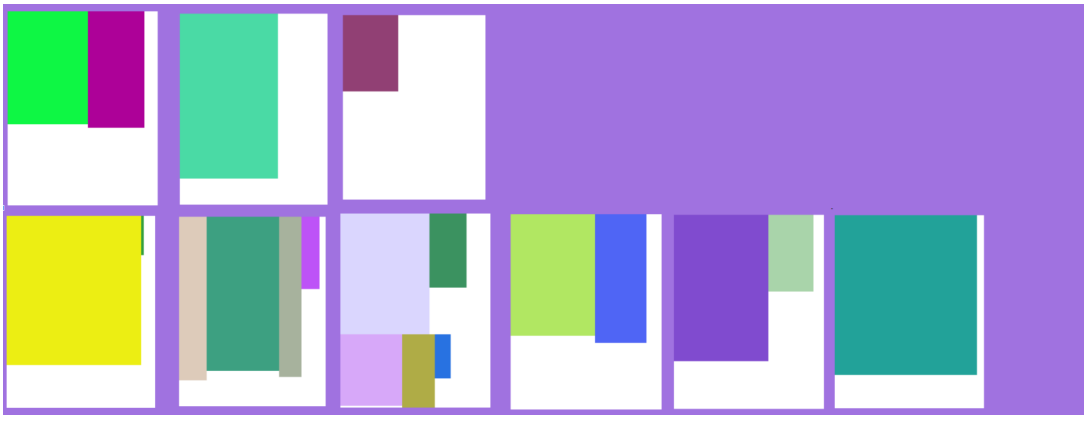
The result of the Shelf Worst Width Fit Algorithm:

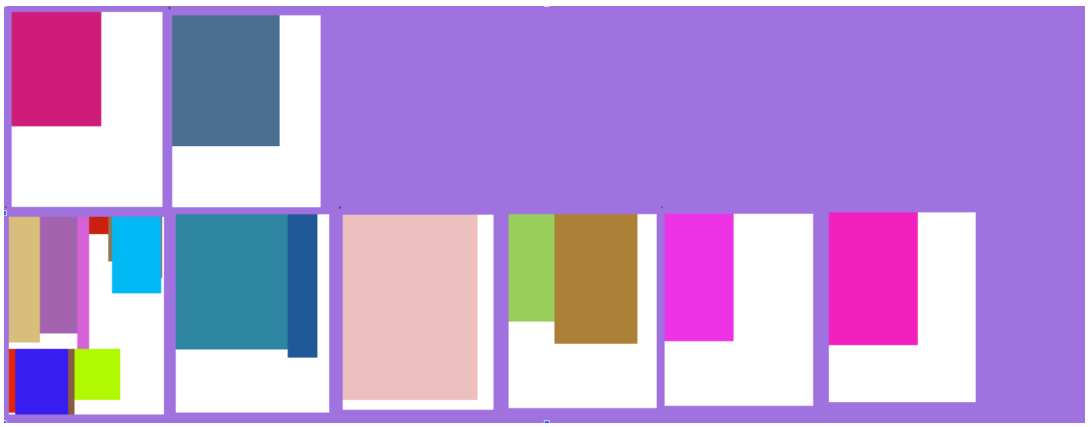
ID	Result	Bin Information with Item Packed
1	5	[Items count: 9 | Items packed: [[154x21], [62x27], [129x89], [93x2], [64x54], [23x12], [43x4], [81x60], [19x15]]] [Items count: 4 | Items packed: [[150x106], [118x45], [67x45], [108x51]]] [Items count: 2 | Items packed: [[200x65], [212x87]]] [Items count: 2 | Items packed: [[135x130], [136x33]]] [Items count: 3 | Items packed: [[155x57], [160x48], [160x62]]]

2	9	[Items count: 7 | Items packed: [[164x107], [63x29], [99x11], [76x22], [10x5], [91x49], [95x44]]] [Items count: 2 | Items packed: [[157x93], [122x66]]] [Items count: 4 | Items packed: [[216x79], [89x25], [86x40], [209x24]]] [Items count: 2 | Items packed: [[131x111], [151x36]]] [Items count: 1 | Items packed: [[160x127]]] [Items count: 1| Items packed: [[149x128]]] [Items count: 1 | Items packed: [[142x104]]] [Items count: 1 | Items packed: [[131x67]]] [Items count: 1 | Items packed: [[160x138]]]
3	6	[Items count: 4 | Items packed: [[180x15], [119x33], [115x105], [127x11]]] [Items count: 4 | Items packed: [[148x57], [194x83], [122x9], [149x20]]] [Items count: 3 | Items packed: [[127x120], [136x34], [75x61]] [Items count: 3 | Items packed: [[141x48], [100x71], [206x43]]] [Items count: 3 | Items packed: [[137x77], [122x73], [183x19]]] [Items count: 3 | Items packed: [[126x55], [186x63], [184x47]]]
4	6	[Items count: 9 | Items packed: [[79x61], [134x65], [91x26], [86x67], [74x28], [132x107], [49x36], [60x16], [72x8]]] [Items count: 3 | Items packed: [[216x99], [92x37], [122x25]]] [Items count: 3 | Items packed: [[89x42], [127x125], [80x77]]] [Items count: 2 | Items packed: [[137x132], [126x22]]] [Items count: 2 | Items packed: [[197x64], [206x76]]] [Items count: 1 | Items packed: [[197x110]]]
5	9	[Items count: 2 | Items packed: [[171x154], [45x3]]] [Items count: 4 | Items packed: [[190x32], [179x84], [186x26], [84x21]]] [Items count: 5 | Items packed: [[137x101], [84x42], [81x70], [98x37], [50x18]]] [Items count: 2 | Items packed: [[137x95], [145x58]]] [Items count: 2 | Items packed: [[166x107], [87x51]]] [Items count: 1 | Items packed: [[182x162]]] [Items count: 3 | Items packed: [[128x91], [132x64]]] [Items count: 2 | Items packed: [[190x113]]] [Items count: 1 | Items packed: [[91x66]]]
6	8	[Items count: 11 | Items packed: [[141x34], [131x41], [148x13], [22x21], [52x4], [87x54], [70x1], [70x7], [123x58], [81x7], [56x50]]] [Items count: 2 | Items packed: [[150x124], [159x33]]] [Items count: 1 | Items packed: [[209x152]]] [Items count: 2 | Items packed: [[122x52], [147x94]]] [Items count: 1 | Items packed: [[146x79]]] [Items count: 1 | Items packed: [[154x103]]] [Items count: 1 | Items packed: [[129x101]]] [Items count: 1 | Items packed: [[150x123]]]
7	7	[Items count: 6 | Items packed: [[158x85], [112x4], [169x60], [136x15], [33x29], [91x48]]] [Items count: 4 | Items packed: [[90x87], [113x112], [75x54], [90x68]]] [Items count: 2 | Items packed: [[206x132], [140x34]]] [Items count: 4 | Items packed: [[60x42], [123x33], [147x29], [138x48]]] [Items count: 1 | Items packed: [[133x118]]] [Items count: 2 | Items packed: [[175x100], [106x53]]]

		[Items count: 1 | Items packed: [[164x65]]]
8	8	[Items count: 5 | Items packed: [[132x38], [184x40], [200x86], [19x11], [34x2]]] [Items count: 3 | Items packed: [[163x74]], [208x43], [89x49]]] [Items count: 4 | Items packed: [[100x98], [75x54], [73x47], [82x60]]] [Items count: 2 | Items packed: [[156x147], [144x10]]] [Items count: 2 | Items packed: [[127x118], [91x80]]] [Items count: 1 | Items packed: [[144x130]]] [Items count: 4 | Items packed: [[171x63], [124x86]]] [Items count: 1 | Items packed: [[176x103]]]
9	10	[Items count: 6 | Items packed: [[142x78], [71x11], [84x75], [43x6], [56x52], [86x51]]] [Items count: 3 | Items packed: [[102x100], [91x90], [79x70]]] [Items count: 2 | Items packed: [[160x159], [159x11]]] [Items count: 1 | Items packed: [[202x161]]] [Items count: 2 | Items packed: [[176x113], [123x21]]] [Items count: 2 | Items packed: [[143x101], [184x38]]] [Items count: 1 | Items packed: [[185x145]]] [Items count: 1 | Items packed: [[125x120]]] [Items count: 1 | Items packed: [[198x115]]] [Items count: 1 | Items packed: [[149x135]]]
10	8	[Items count: 4 | Items packed: [[104x62], [57x1], [122x51], [188x48]]] [Items count: 4 | Items packed: [[212x129], [161x74], [58x37], [132x30]]] [Items count: 3 | Items packed: [[154x90], [78x53], [39x21]]] [Items count: 3 | Items packed: [[182x105], [84x28], [167x27]]] [Items count: 1 | Items packed: [[160x159]]] [Items count: 2 | Items packed: [[218x110], [169x18]]] [Items count: 1 | Items packed: [[127x117]]] [Items count: 2 | Items packed: [[160x55], [214x101]]]

ID	Result
1	

2	
3	
4	
5	

6	
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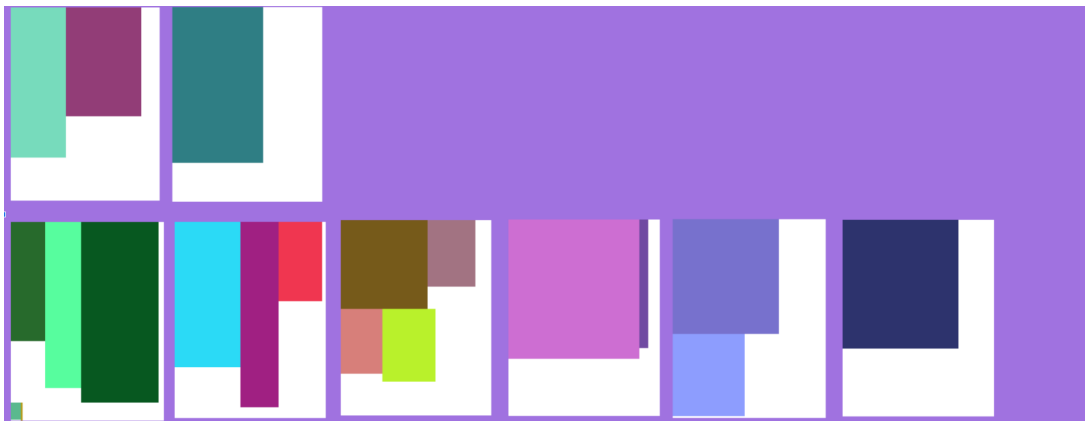
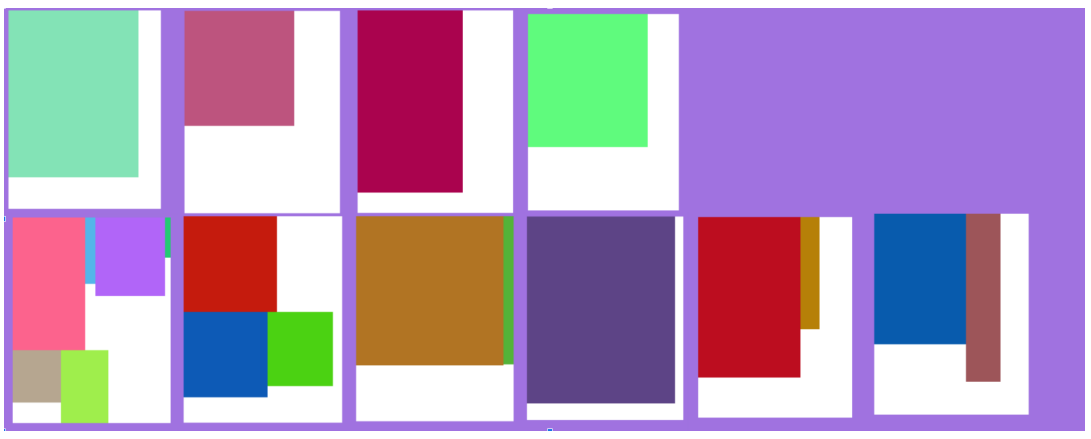
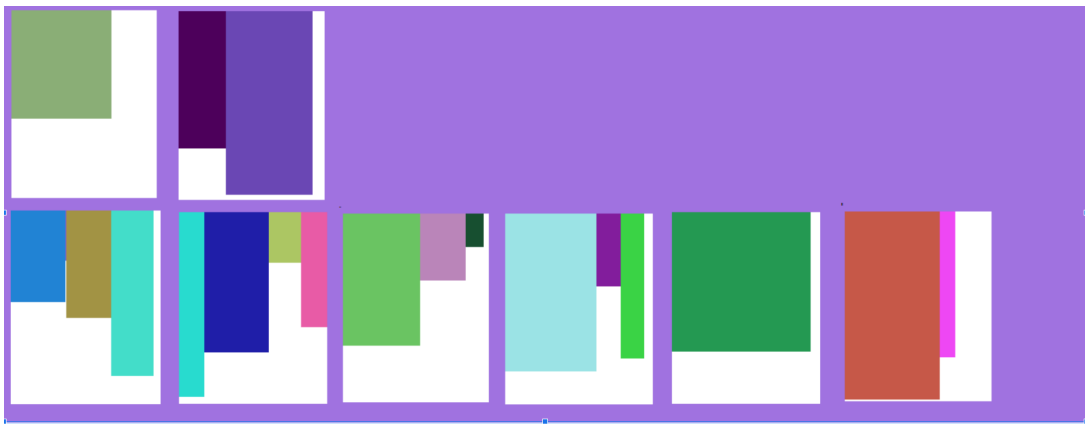
8	
9	

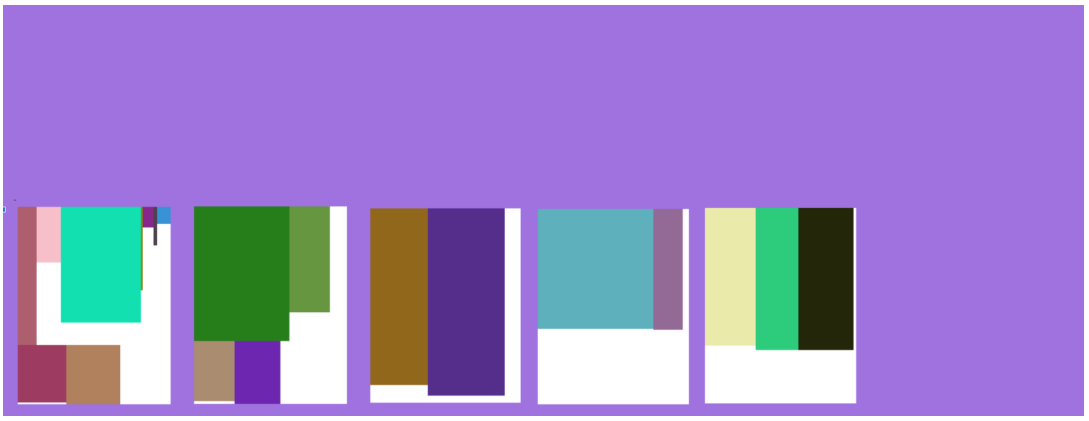
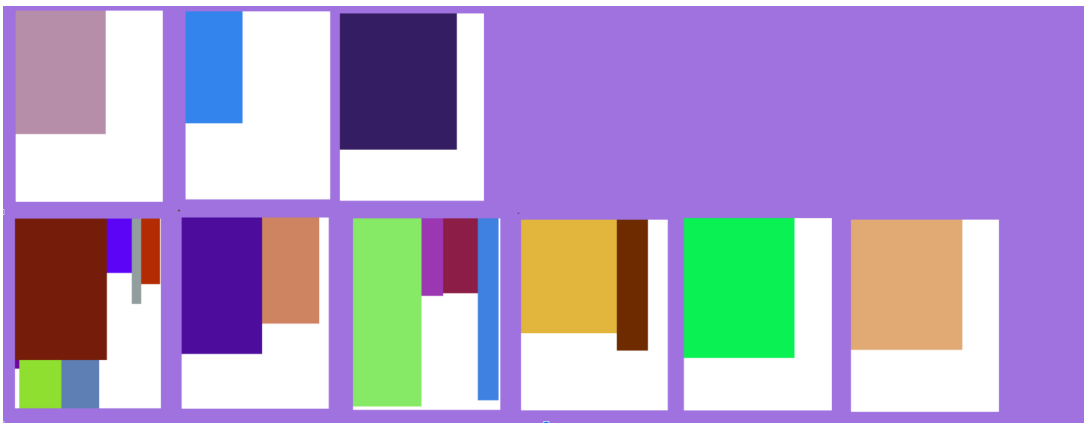
10	

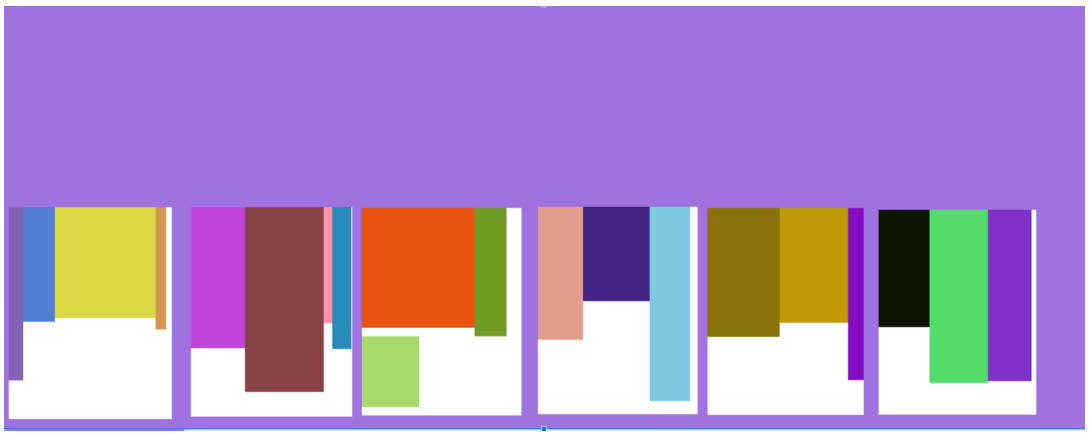
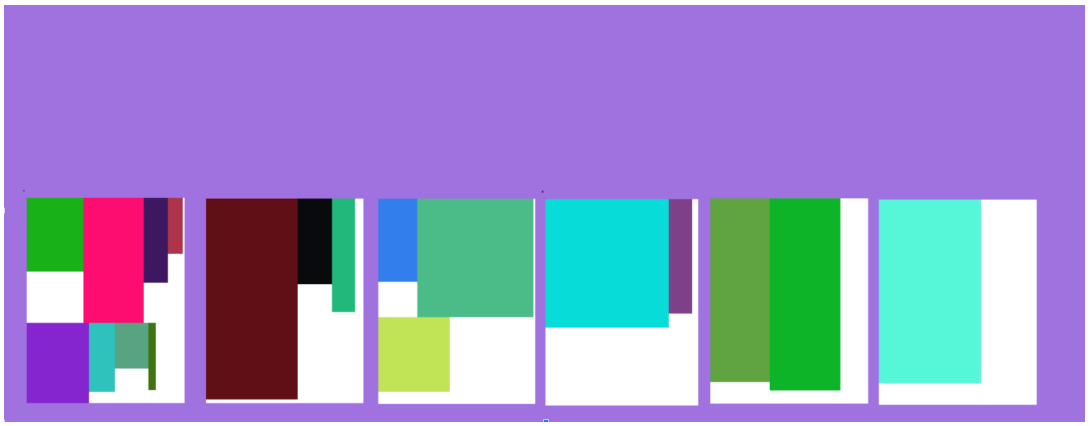
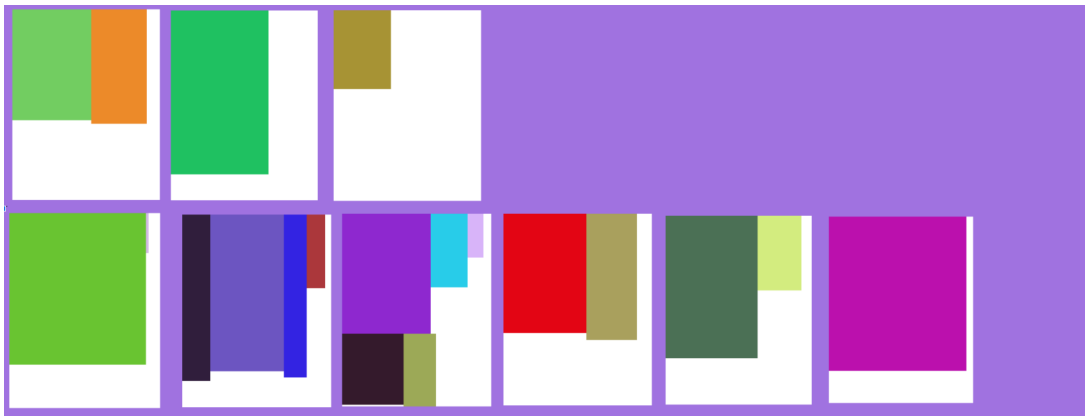
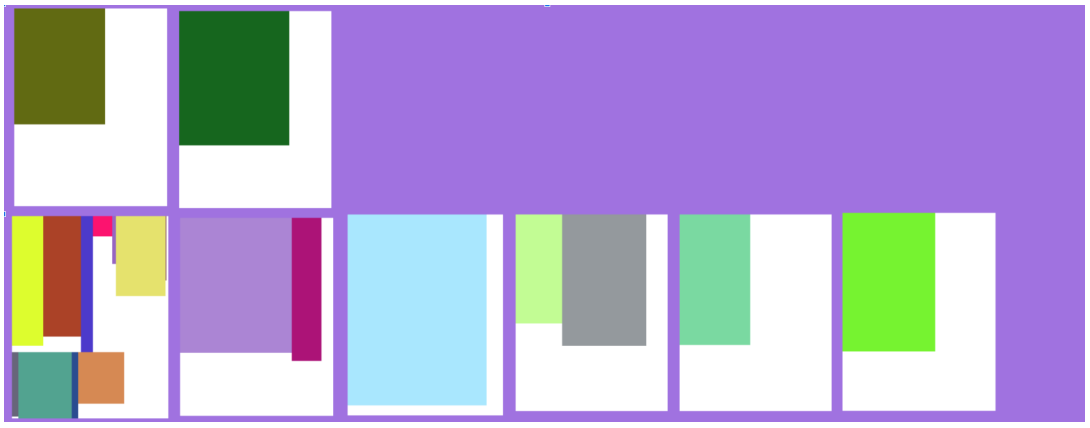
The result of the Shelf Best Area Fit Algorithm:

ID	Result	Bin Information with Item Packed
1	5	[Items count: 9 | Items packed: [[154x21], [62x27], [129x89], [93x2], [64x54], [23x12], [43x4], [81x60], [19x15]]] [Items count: 4 | Items packed: [[150x106], [118x45], [67x45], [108x51]]] [Items count: 2 | Items packed: [[200x65], [212x87]]] [Items count: 2 | Items packed: [[135x130], [136x33]]] [Items count: 3 | Items packed: [[155x57], [160x48], [160x62]]]
2	9	[Items count: 7 | Items packed: [[164x107], [63x29], [99x11], [76x22], [10x5], [91x49], [95x44]]] [Items count: 2 | Items packed: [[157x93], [122x66]]] [Items count: 4 | Items packed: [[216x79], [89x25], [86x40], [209x24]]] [Items count: 2 | Items packed: [[131x111], [151x36]]] [Items count: 1 | Items packed: [[160x127]]] [Items count: 1| Items packed: [[149x128]]] [Items count: 1 | Items packed: [[142x104]]] [Items count: 1 | Items packed: [[131x67]]] [Items count: 1 | Items packed: [[160x138]]]
3	6	[Items count: 4 | Items packed: [[180x15], [119x33], [115x105], [127x11]]] [Items count: 4 | Items packed: [[148x57], [194x83], [122x9], [149x20]]] [Items count: 3 | Items packed: [[127x120], [136x34], [75x61]] [Items count: 3 | Items packed: [[141x48], [100x71], [206x43]]] [Items count: 3 | Items packed: [[137x77], [122x73], [183x19]]] [Items count: 3 | Items packed: [[126x55], [186x63], [184x47]]]
4	6	[Items count: 9 | Items packed: [[79x61], [134x65], [91x26], [86x67], [74x28], [132x107], [49x36], [60x16], [72x8]]] [Items count: 3 | Items packed: [[216x99], [92x37], [122x25]]]

		[Items count: 3 | Items packed: [[89x42], [127x125], [80x77]]] [Items count: 2 | Items packed: [[137x132], [126x22]]] [Items count: 2 | Items packed: [[197x64], [206x76]]] [Items count: 1 | Items packed: [[197x110]]]
5	9	[Items count: 2 | Items packed: [[171x154], [45x3]]] [Items count: 4 | Items packed: [[190x32], [179x84], [186x26], [84x21]]] [Items count: 5 | Items packed: [[137x101], [84x42], [81x70], [98x37], [50x18]]] [Items count: 2 | Items packed: [[137x95], [145x58]]] [Items count: 2 | Items packed: [[166x107], [87x51]]] [Items count: 1 | Items packed: [[182x162]]] [Items count: 2 | Items packed: [[128x91], [132x64]]] [Items count: 1 | Items packed: [[190x113]]] [Items count: 1 | Items packed: [[91x66]]]
6	8	[Items count: 11 | Items packed: [[141x34], [131x41], [148x13], [22x21], [52x4], [87x54], [70x1], [70x7], [123x58], [81x7], [56x50]]] [Items count: 2 | Items packed: [[150x124], [159x33]]] [Items count: 1 | Items packed: [[209x152]]] [Items count: 2 | Items packed: [[122x52], [147x94]]] [Items count: 1 | Items packed: [[146x79]]] [Items count: 1 | Items packed: [[154x103]]] [Items count: 1 | Items packed: [[129x101]]] [Items count: 1 | Items packed: [[150x123]]]
7	7	[Items count: 6 | Items packed: [[158x85], [112x4], [169x60], [136x15], [33x29], [91x48]]] [Items count: 3 | Items packed: [[90x87], [113x112], [75x54]]] [Items count: 2 | Items packed: [[206x132], [140x34]]] [Items count: 3 | Items packed: [[90x68], [60x42], [123x33]]] [Items count: 3 | Items packed: [[133x118], [147x29]]] [Items count: 2 | Items packed: [[138x48], [175x100]]] [Items count: 2 | Items packed: [[106x53], [164x65]]]
8	8	[Items count: 5 | Items packed: [[132x38], [184x40], [200x86], [19x11], [34x2]]] [Items count: 3 | Items packed: [[163x74]], [208x43], [89x49]]] [Items count: 4 | Items packed: [[100x98], [75x54], [73x47], [82x60]]] [Items count: 2 | Items packed: [[156x147], [144x10]]] [Items count: 2 | Items packed: [[127x118], [91x80]]] [Items count: 1 | Items packed: [[144x130]]] [Items count: 2 | Items packed: [[171x63], [124x86]]] [Items count: 1 | Items packed: [[176x103]]]
9	10	[Items count: 6 | Items packed: [[142x78], [71x11], [84x75], [43x6], [56x52], [86x51]]] [Items count: 3 | Items packed: [[102x100], [91x90], [79x70]]] [Items count: 2 | Items packed: [[160x159], [159x11]]] [Items count: 1 | Items packed: [[202x161]]] [Items count: 2 | Items packed: [[176x113], [123x21]]] [Items count: 2 | Items packed: [[143x101], [184x38]]] [Items count: 1 | Items packed: [[185x145]]] [Items count: 1 | Items packed: [[125x120]]]

		[Items count: 1 | Items packed: [[198x115]]] [Items count: 1 | Items packed: [[149x135]]]
10	8	[Items count: 4 | Items packed: [[104x62], [57x1], [122x51], [188x48]]] [Items count: 4 | Items packed: [[212x129], [161x74], [58x37], [132x30]]] [Items count: 3 | Items packed: [[154x90], [78x53], [39x21]]] [Items count: 3 | Items packed: [[182x105], [84x28], [167x27]]] [Items count: 1 | Items packed: [[160x159]]] [Items count: 2 | Items packed: [[218x110], [169x18]]] [Items count: 1 | Items packed: [[127x117]]] [Items count: 2 | Items packed: [[160x55], [214x101]]]

ID	Result
1	
2	

3	
4	
5	
6	

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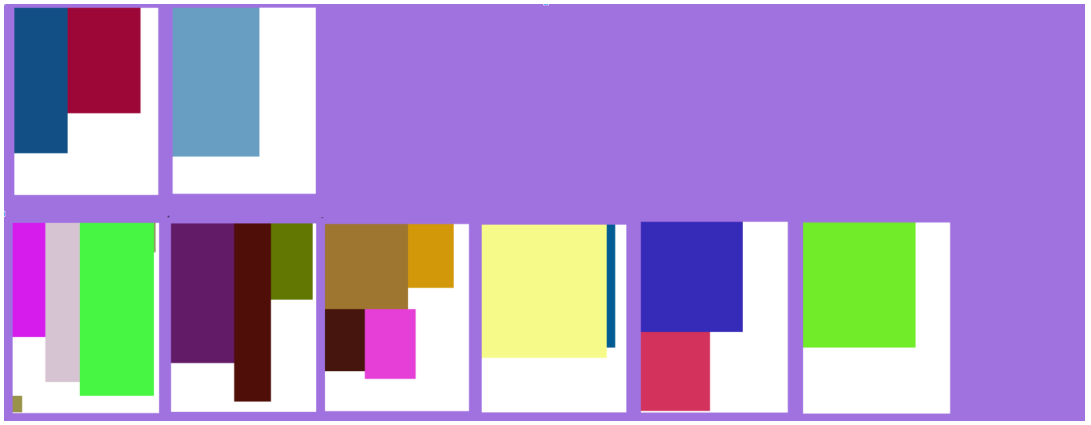
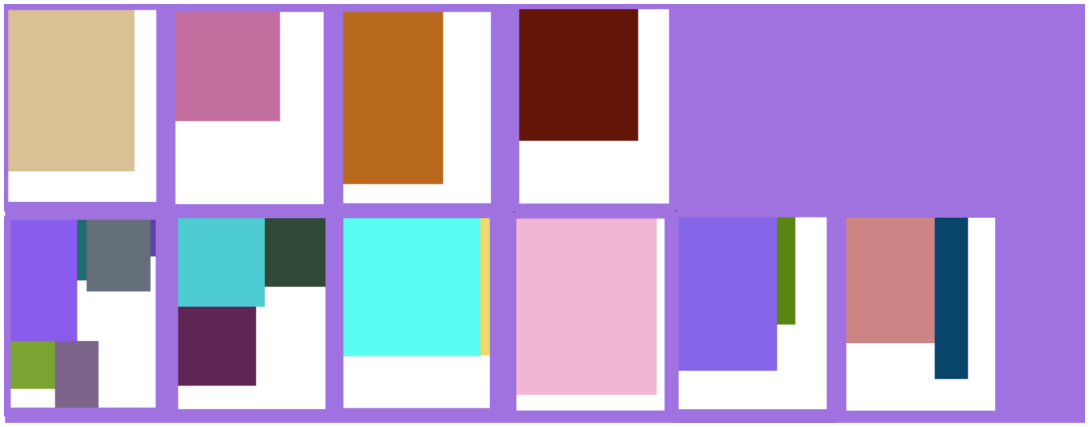
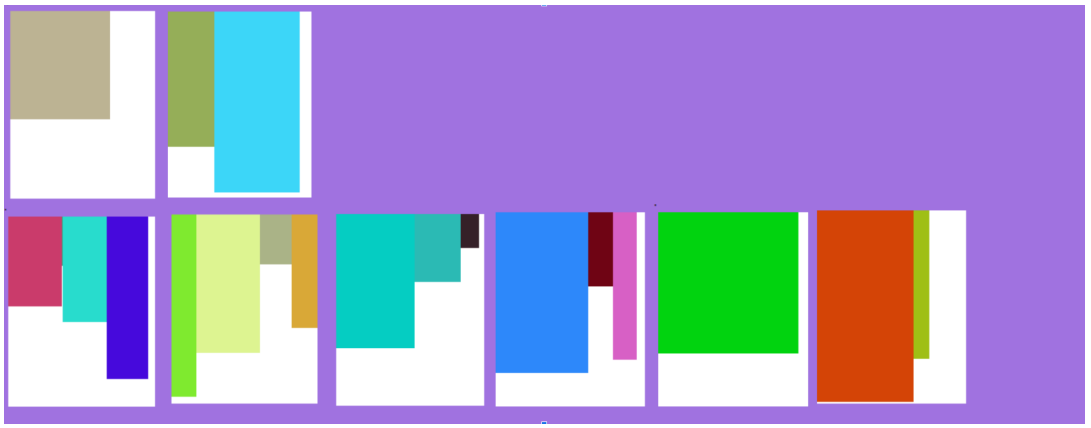
8	
9	
10	

Given a positive integer bin with size C and a set of items $L = \{i_1, i_2, i_3, ..., i_n\}$, each item i_k having an integer size $s(i_k)\ s.t.\ 0 < s(i_k) \leq C$.
Find the minimum integer m such that there is a partition

$$L = B_1 \cup B_2 \cup B_3 \cup ... \cup B_m\ s.t.\ \sum_{i_k \in B_j} s(i_k) \leq C,\ 1 \leq j \leq m.$$

Given a positive integer bin with size $h(C) \times w(C)$ and a set of items $L = \{i_1, i_2, i_3, ..., i_n\}$, each item i_k having two integer $h(i_k)$, $w(i_k)\ s.t.\ 0 < h(i_k) \leq h(C),\ 0 < w(i_k) \leq w(C)$.
Find the minimum integer m such that there is a partition

$$L = B_1 \cup B_2 \cup B_3 \cup ... \cup B_m\ s.t.\ \sum_{i_k \in B_j} h(i_k) \leq h(C),\ w(i_k) \leq w(C),\ 1 \leq j \leq m.$$

If A is an algorithm and $A(L)$ is the number of bins used by the algorithm for list L, define $R_A(L) \equiv A(L)/OPT(L)$.
The absolute performance ratio R_A for algorithm A is given by
$R_A \equiv inf\{r \geq 1: R_A(L) \leq r\ for\ all\ lists\ L\}$.
The asymptotic performance ratio
$R^{\infty}_A \equiv inf\{r \geq 1:\ for\ some\ N > 0,\ R_A(L) \leq r\ for\ all\ lists\ L\ with\ OPT(L) \geq N\}$