MECE 4606 DIGITAL MANUFACTURING

Laser Cut Box
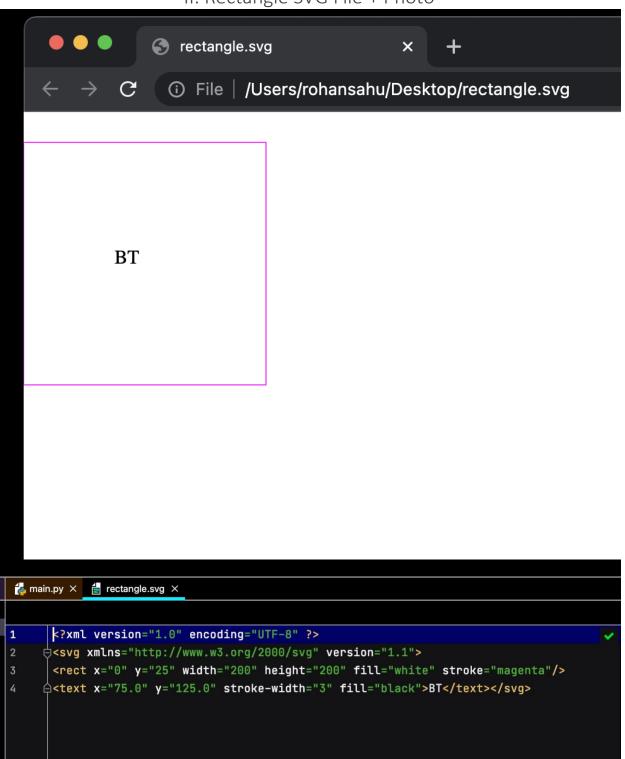
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February 12th: 11:59 PM

96 Grace Hours Before Submission, +24 Hours Gained, 120 Hours After Submission

```
1  <?xml version="1.0" encoding="UTF-8" ?>
2  <svg xmlns="http://www.w3.org/2000/svg" version="1.1">
3  <rect x="0" y="25" width="200" height="200" fill="white" stroke="magenta"/>
4  <text x="75.0" y="125.0" stroke-width="3" fill="black">BT</text></svg>
```

III. Description of Software

The software starts by requesting input for all information about the box from the user (length, width, height, material thickness, top text, front text, and the number of dovetails). It then loops from 0 to 5 to create each side of the cube, saving the current position as x, y for each step and updating as necessary.

The squares themselves for the sides are made through a method called make_square() which takes input parameters regarding which type of square it is. make_square() differentiates between type 1 (front and sides) and type 2 (top and bottom) squares. The way our dovetails work, the front and sides have identical orientation of dovetails (3 in and 1 out). For the top and

bottom, all dovetails face out. Additionally, the top is a special case, as it functions as a lid by removing the holes for the fasteners. The program accounts for this by an additional parameter called top.

The program splits the process of making the dovetails of each square into x and y with directional inputs through a parameter called sign (valued 1 or -1). Additionally, by including make_dovetails_x and make_dovetails_y, it allows us to call make_dovetail_x or make_dovetail_y multiple times for smaller lengths depending on the number of dovetails requested by the user.

For making the dovetails themselves, it takes the current position as an input, and writes <line> in xml to construct a dovetail which splits the input width into 3 sections. On the first step of making the dovetail, if the dovetail is on the bottom (sign = -1), then it makes rectangles for fasteners using the following parameters:

X = x - (1 / 2) * wid - screw_rad / 2 - 2
Y = y - screw_len, screw_rad + 4
Width = screw_rad + 4
Height = screw_len - material_thickness
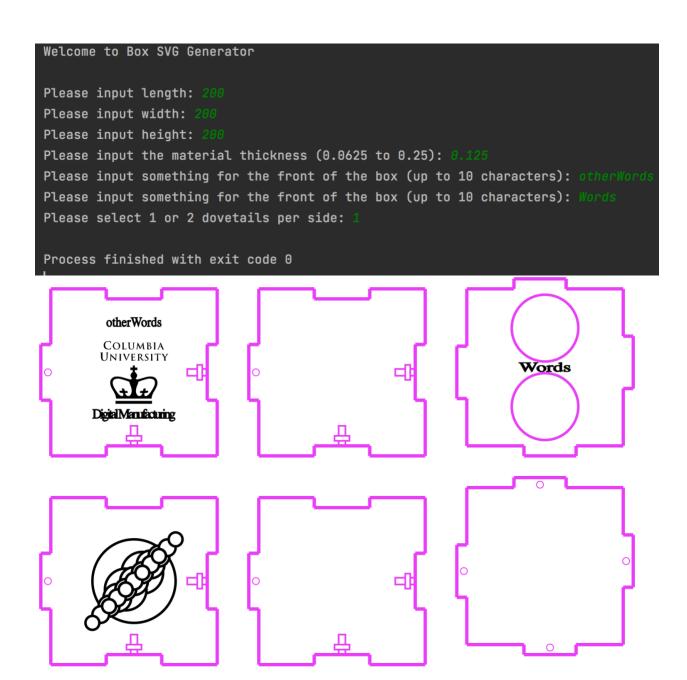
In which x, y are the current position saved by the program; screw_rad and screw_len are global constants for the dimensions of the screw; -2 and +4 are included as tolerances. The other fastener cuts have similar calculations.

The program includes the Columbia Logo by reading a .svg file of the logo from the same file directory, saving the file as a string, outputting that string into the .svg output file for the program, and adding a <g transform> script to move the logo and scale it. Some formatting changes needed to be made to the logo file in order for this to work.

Further description can be found in the in-line comments/documentation included in the code.
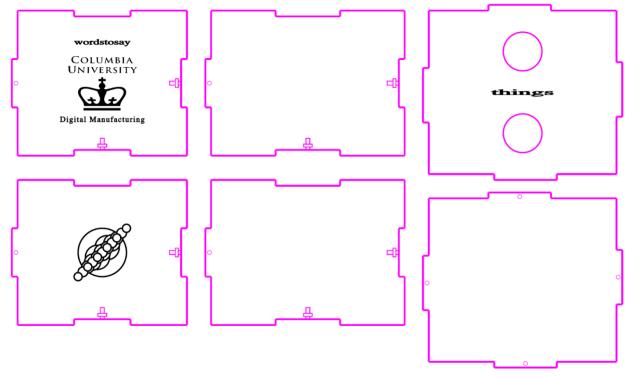
IV. Examples of input and output

```
Welcome to Box SVG Generator

Please input length: 300
Please input width: 200
Please input height: 200
Please input the material thickness (0.0625 to 0.25): 0.0625
Please input something for the front of the box (up to 10 characters): stuff
Please input something for the front of the box (up to 10 characters): things
Please select 1 or 2 dovetails per side: 2

Process finished with exit code 0
```

```
Welcome to Box SVG Generator

Please input length: 200
Please input width: 200
Please input height: 200
Please input the material thickness (0.0625 to 0.25): 0.125
Please input something for the front of the box (up to 10 characters): otherWords
Please input something for the front of the box (up to 10 characters): Words
Please select 1 or 2 dovetails per side: 1

Process finished with exit code 0
```

```
Please input length: 4
You entered an invalid length. Please input between 200 and 400: 400
Please input width: 350
Please input height: 300
Please input the material thickness (0.0625 to 0.25): 0.125
Please input something for the front of the box (up to 10 characters): wordstosay
Please input something for the front of the box (up to 10 characters): things
Please select 1 or 2 dovetails per side: 1

Process finished with exit code 0
```

```
Welcome to Box SVG Generator

Please input length: 200
Please input width: 300
Please input height: 250
Please input the material thickness (0.0625 to 0.25): 0.125
Please input something for the front of the box (up to 10 characters): Roar
Please input something for the front of the box (up to 10 characters): Columbia
Please select 1 or 2 dovetails per side: 1

Process finished with exit code 0
```
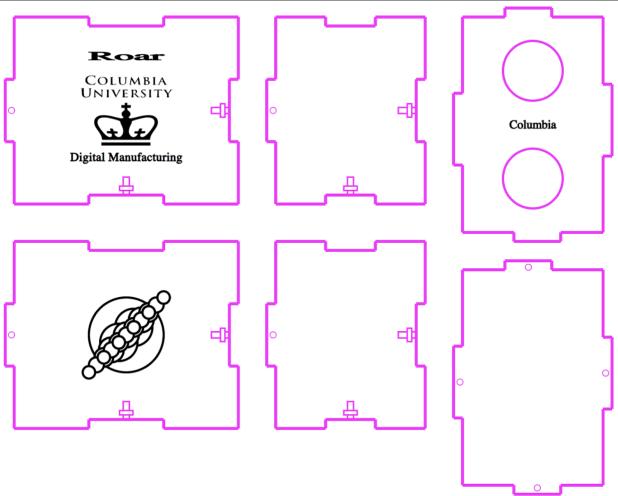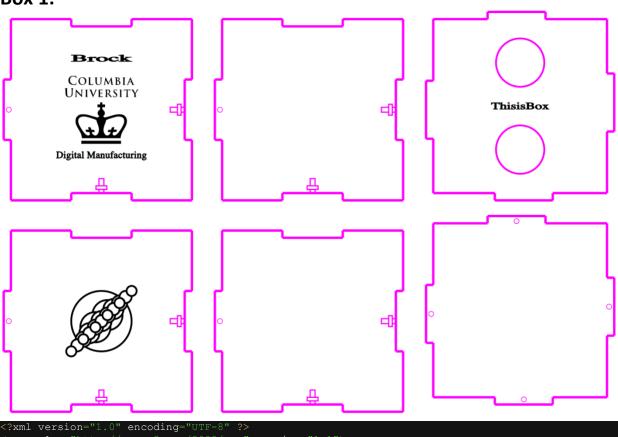
V. Print-out of SVGs and Boxes

Box 1:


```xml
<?xml version="1.0" encoding="UTF-8" ?>
<svg xmlns="http://www.w3.org/2000/svg" version="1.1">
<line x1="25" y1="25" x2="125.0" y2="25" stroke="magenta" stroke-width="4" />
<line x1="125.0" y1="25" x2="125.0" y2="37.0" stroke="magenta" stroke-width="4" />
<line x1="125.0" y1="37.0" x2="225.0" y2="37.0" stroke="magenta" stroke-width="4" />
<line x1="225.0" y1="37.0" x2="225.0" y2="25.0" stroke="magenta" stroke-width="4" />
<line x1="225.0" y1="25.0" x2="325.0" y2="25.0" stroke="magenta" stroke-width="4" />
<line x1="325" y1="25" x2="325" y2="125.0" stroke="magenta" stroke-width="4" />
<rect x="289" y="170.936" width="24.0" height="8.128" fill="White" stroke="magenta" stroke-
width="2" />
<rect x="301.0" y="166.0" width="6" height="18" fill="White" stroke="magenta" stroke-width="2" />
<line x1="325" y1="125.0" x2="313.0" y2="125.0" stroke="magenta" stroke-width="4" />
<line x1="313.0" y1="125.0" x2="313.0" y2="225.0" stroke="magenta" stroke-width="4" />
<line x1="313.0" y1="225.0" x2="325.0" y2="225.0" stroke="magenta" stroke-width="4" />
<line x1="325.0" y1="225.0" x2="325.0" y2="325.0" stroke="magenta" stroke-width="4" />
<line x1="325" y1="325" x2="225.0" y2="325" stroke="magenta" stroke-width="4" />
<rect x="170.936" y="289" width="8.128" height="24.0" fill="White" stroke="magenta" stroke-
width="2" />
<rect x="166.0" y="301.0" width="18" height="6" fill="White" stroke="magenta" stroke-width="2" />
<line x1="225.0" y1="325" x2="225.0" y2="313.0" stroke="magenta" stroke-width="4" />
<line x1="225.0" y1="313.0" x2="125.0" y2="313.0" stroke="magenta" stroke-width="4" />
<line x1="125.0" y1="313.0" x2="125.0" y2="325.0" stroke="magenta" stroke-width="4" />
<line x1="125.0" y1="325.0" x2="25.0" y2="325.0" stroke="magenta" stroke-width="4" />
<line x1="25" y1="325" x2="25" y2="225.0" stroke="magenta" stroke-width="4" />
<circle cx="21.5" cy="175.0" r="4.128" stroke="magenta" fill="white" stroke-width="1"/>
<line x1="25" y1="225.0" x2="13.0" y2="225.0" stroke="magenta" stroke-width="4" />
<line x1="13.0" y1="225.0" x2="13.0" y2="125.0" stroke="magenta" stroke-width="4" />
<line x1="13.0" y1="125.0" x2="25.0" y2="125.0" stroke="magenta" stroke-width="4" />
<line x1="25.0" y1="125.0" x2="25.0" y2="25.0" stroke="magenta" stroke-width="4" />
<g transform="translate(100.0,250.0) scale(0.03,-0.03)" fill="#000000" stroke="none">
<path d="M850 4361 c-112 -34 -174 -119 -175 -236 0 -91 30 -154 92 -199 65
-46 97 -54 209 -55 120 -1 132 5 139 74 l6 50 -17 -32 c-46 -87 -194 -83 -282
8 -95 97 -75 302 34 354 33 15 108 20 163 9 40 -8 81 -50 81 -82 0 -18 3 -23
```

11 -15 5 5 9 34 7 64 -3 51 -5 54 -33 60 -42 9 -205 9 -235 0z"/>
<path d="M1350 4274 c-160 -69 -166 -304 -9 -384 50 -26 149 -27 205 -1 122
55 162 230 77 332 -15 18 -45 40 -68 50 -50 23 -156 24 -205 3z m150 -27 c61
-32 90 -89 90 -176 -1 -88 -27 -146 -74 -166 -47 -20 -72 -19 -122 6 -115 55
-130 289 -22 342 45 23 77 21 128 -6z"/>
<path d="M1770 4278 c0 -5 9 -8 20 -8 19 0 20 -7 20 -188 0 -184 -1 -189 -22
-199 -15 -6 17 -10 111 -11 99 -2 132 1 135 10 3 7 7 27 10 43 16 30 -21 -27
c-18 -24 -28 -28 -74 -28 -43 0 -56 4 -65 19 -6 11 -10 88 -10 179 0 150 1
160 21 173 18 13 12 14 -55 14 -42 0 -76 -3 -76 -7z"/>
<path d="M2130 4279 c0 -4 9 -9 19 -12 18 -4 20 -17 23 -148 3 -161 12 -189
67 -226 48 -32 144 -32 192 0 59 39 69 73 69 230 0 130 1 139 20 144 39 10 19
18 -45 18 -63 0 -89 -10 -42 -17 21 -3 22 -7 25 -134 3 -164 -7 -201 -62 -228
-36 -17 -43 -18 -80 -5 -65 22 -76 55 -76 222 0 113 3 139 15 143 32 13 12 19
-55 19 -38 0 -70 -3 -70 -6z"/>
<path d="M2715 4258 c-3 -18 -17 -107 -31 -198 -14 -90 -26 -165 -27 -166 -1
0 -11 -6 -22 -12 -16 -9 -7 -11 45 -10 52 1 61 3 43 11 -27 12 -26 3 -9 135
13 94 20 123 29 111 2 -2 30 -59 62 -126 32 -68 63 -123 67 -123 5 0 37 59 70
130 34 72 64 130 68 130 9 0 42 -239 35 -251 -4 -5 0 -9 7 -9 7 0 38 -2 68 -5
49 -4 52 -3 28 7 -16 7 -30 19 -33 27 -4 15 -55 357 -55 374 0 30 -27 -14 -91
-148 -40 -85 -76 -155 -79 -155 -3 0 -38 70 -79 155 -41 85 -77 155 -82 155
-4 0 -11 -15 -14 -32z"/>
<path d="M3250 4282 c0 -6 10 -12 23 -14 22 -3 22 -5 25 -183 2 -166 1 -181
-16 -195 -17 -15 -12 -16 70 -18 49 0 101 3 116 9 85 32 109 117 51 184 -17
19 -37 35 -45 35 -20 0 -18 8 11 42 32 38 32 81 0 113 -22 23 -32 25 -114 25
-49 0 -96 3 -105 6 -9 3 -16 1 -16 -4z m186 -43 c22 -25 25 -89 5 -113 -9 -11
-26 -16 -45 -14 l-31 3 -3 73 -3 72 29 0 c17 0 37 -9 48 -21z m12 -172 c39
-32 54 -118 25 -149 -19 -21 -82 -25 -101 -6 -13 13 -17 160 -5 172 10 10 62
-1 81 -17z"/>
<path d="M3670 4279 c0 -4 9 -9 20 -12 19 -5 20 -14 20 -190 0 -181 0 -184
-22 -194 -18 -9 -4 -11 62 -10 70 0 80 2 58 10 l-28 11 0 183 c0 154 2 185 15
189 32 13 12 19 -55 19 -38 0 -70 -3 -70 -6z"/>
<path d="M4022 4111 c-40 -98 -72 -184 -72 -190 0 -6 -14 -20 -30 -30 l-30
-18 60 0 c48 0 57 2 44 12 -15 10 -14 17 6 74 l23 62 64 -3 65 -3 23 -58 c13
-32 22 -64 19 -71 -4 -11 10 -14 61 -15 41 0 64 3 60 9 -3 6 -12 10 -20 10
-21 0 -40 39 -115 225 -36 93 -71 170 -76 172 -6 2 -43 -77 -82 -176z m97 -3
c11 -31 17 -59 14 -62 -12 -11 -93 -6 -93 5 0 26 44 129 51 122 5 -5 17 -34
28 -65z"/>
<path d="M476 3679 l31 -9 5 -168 c4 -154 6 -173 29 -218 29 -58 68 -83 141
-91 106 -11 194 39 217 122 6 22 11 106 11 186 0 152 5 173 45 182 11 3 -20 5
-70 4 -49 0 -80 -2 -67 -4 39 -8 44 -35 40 -207 -4 -189 -13 -215 -86 -243
-39 -15 -49 -15 -85 -2 -76 27 -82 44 -82 257 l0 186 25 7 c14 4 -22 7 -80 7
-79 0 -97 -2 -74 -9z"/>
<path d="M1080 3441 c0 -186 -6 -226 -37 -234 -10 -3 16 -5 57 -4 41 0 65 2
53 4 -14 3 -25 13 -27 26 -9 42 -15 257 -8 257 4 0 72 -65 151 -145 78 -80
147 -145 152 -145 5 0 9 53 9 118 0 66 3 154 7 196 5 66 9 79 27 86 14 6 -3 9
-54 8 -45 0 -65 -3 -50 -7 14 -4 27 -17 31 -31 10 -34 11 -260 2 -259 -5 1
-73 70 -153 154 -80 84 -148 153 -152 154 -5 0 -8 -80 -8 -178z"/>
<path d="M3233 3609 c-17 -5 -41 -22 -52 -38 -41 -57 -23 -104 70 -191 74 -70
83 -95 53 -138 -12 -17 -25 -22 -58 -22 -46 0 -61 11 -83 59 -11 24 -11 23
-12 -22 -1 -43 2 -49 27 -58 36 -15 121 -4 152 19 14 11 30 35 37 55 20 59 2
98 -78 169 -77 69 -91 98 -64 128 35 39 123 18 126 -31 1 -8 5 2 9 21 5 19 5
38 1 42 -12 13 -94 18 -128 7z"/>
<path d="M3745 3610 c-1 -3 -6 -21 -10 -40 l-7 -35 21 23 c18 18 33 22 81 22
l60 0 0 -142 c0 -177 -6 -217 -34 -228 -14 -6 10 -9 69 -8 50 0 81 3 70 5 -43
11 -45 18 -45 199 l0 174 55 0 c43 0 58 -5 75 -22 l20 -22 0 37 0 36 -176 3
c-97 2 -177 1 -179 -2z"/>
<path d="M1618 3600 c22 -9 22 -12 22 -195 0 -183 0 -186 -22 -195 -16 -6 4
-9 67 -8 52 0 77 3 60 7 l-30 6 -3 188 c-2 187 -2 188 20 197 17 6 1 9 -57 9
-58 0 -74 -3 -57 -9z"/>
<path d="M1826 3603 c35 -7 48 -29 129 -226 43 -103 82 -184 86 -180 4 4 46
94 92 198 62 140 91 193 108 202 21 11 16 13 -41 12 -36 -1 -57 -3 -47 -6 9
-2 17 -9 17 -14 0 -13 -101 -272 -110 -282 -7 -8 -110 255 -110 280 0 6 8 14
18 16 9 3 -23 5 -73 4 -49 0 -80 -2 -69 -4z"/>
<path d="M2320 3601 l25 -7 3 -187 c2 -187 2 -188 -20 -197 -16 -6 17 -9 103
-9 136 -1 139 0 139 52 0 21 0 21 -16 -1 -14 -20 -23 -23 -72 -20 l-57 3 0 85
c0 94 3 98 71 85 26 -4 34 -11 34 -27 0 -30 6 -19 13 22 15 36 -64 -4 -64 -4
0 76 0 76 55 0 c48 0 57 -3 65 -22 5 -14 9 -17 10 -8 0 8 3 25 6 38 l6 22
-133 -1 c-74 -1 -123 -4 -109 -8z"/>
<path d="M2713 3603 c29 -8 37 -46 37 -172 0 -162 -8 -211 -34 -221 -14 -6 8
-9 64 -8 50 0 75 3 60 7 -24 6 -25 11 -28 84 l-3 77 30 0 c25 0 36 -10 74 -62
65 -91 78 -101 145 -105 47 -3 53 -1 32 7 -33 15 -62 42 -122 118 l-51 63 25

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27 c57 60 62 106 19 154 l-29 33 -119 2 c-65 1 -110 -1 -100 -4z m161 -27 c91
-38 56 -206 -38 -182 -25 6 -26 8 -26 95 0 110 2 113 64 87z"/>
<path d="M3508 3600 c22 -9 22 -12 22 -195 0 -183 0 -186 -22 -195 -16 -6 2
-9 62 -8 50 0 75 3 60 7 l-25 7 -3 187 c-2 187 -2 188 20 197 17 6 1 9 -57 9
-58 0 -74 -3 -57 -9z"/>
<path d="M4165 3598 c25 -14 37 -31 103 -136 51 -84 52 -87 52 -164 0 -72 -2
-79 -22 -88 -16 -6 2 -9 62 -8 50 0 75 3 60 7 -24 7 -25 11 -28 94 l-3 87 58
96 c41 70 65 100 88 110 29 13 28 13 -34 14 -54 0 -62 -2 -51 -14 9 -12 3 -31
-32 -95 -24 -45 -47 -79 -53 -78 -17 6 -96 151 -91 170 4 15 -4 17 -62 17 -55
-1 -64 -3 -47 -12z"/>
<path d="M2430 2850 l0 -60 -75 0 -75 0 0 -75 0 -74 73 -3 72 -3 3 -54 c3 -54
3 -54 -49 -100 -108 -94 -118 -214 -26 -309 132 -33 -37 -34 -34 c-32 -29 -42 -34
-70 -29 -66 12 -196 47 -354 94 -217 66 -326 84 -473 78 -100 -4 -124 -8 -173
-32 -81 -39 -134 -89 -170 -160 -28 -53 -32 -74 -36 -156 -7 -154 23 -240 162
-475 123 -208 158 -290 178 -421 112 -74 1068 0 1068 0 0 33 c0 51 37 184 71
257 17 36 61 117 99 180 135 226 180 345 180 475 0 129 -46 227 -137 297 -75
57 -152 78 -284 78 -133 0 -243 -21 -454 -85 -219 -67 -351 -98 -372 -86 -10
5 -29 21 -42 35 l-25 26 32 33 c89 92 82 200 -19 299 -58 56 -59 59 -59 113
l0 55 75 0 75 0 0 75 0 75 -75 0 -75 0 0 60 0 60 -60 0 -60 0 0 -60z m-754
-741 c199 -47 470 -136 530 -174 15 -9 23 -27 26 -57 3 -24 24 -87 47 -140
105 -247 112 -428 21 -572 -68 -107 -178 -116 -272 -21 -38 38 -65 96 -53 115
3 5 38 10 77 10 171 0 -5 45 c-8 67 -19 75 -100 75 l-69 0 -15 35 c-7 19 -14
43 -14 53 0 37 -24 53 -88 59 -71 7 -75 1 -47 -77 8 -23 15 -46 15 -51 0 -5
-38 -9 -84 -9 -47 0 -87 -4 -90 -8 -3 -5 0 -31 7 -58 14 -55 25 -61 122 -63
69 -1 80 -6 94 -44 30 -80 -4 -147 -75 -147 -56 0 -114 33 -189 108 -122 122
-324 455 -353 580 -54 236 65 370 314 357 44 -2 102 -9 130 -16z m1935 -8
c128 -49 176 -168 133 -335 -34 -135 -211 -428 -341 -566 -107 -114 -195 -148
-257 -99 -31 24 -35 78 -12 134 14 32 18 35 59 35 24 0 65 3 90 6 40 6 47 11
56 37 6 16 11 43 11 58 l0 29 -85 0 c-95 0 -95 0 -70 70 23 65 21 70 -27 69
-76 -2 -92 -10 -106 -59 -28 -94 -23 -90 -106 -90 l-75 0 -16 -52 c-8 -28 -15
-55 -15 -60 0 -4 34 -8 75 -8 56 0 77 -4 81 -14 14 -36 -73 -144 -133 -167
-66 -25 -139 -1 -185 63 -108 147 -98 333 36 643 14 33 26 76 26 96 0 36 1 37
83 72 115 50 428 142 542 160 61 10 180 -1 236 -22z"/>
<path d="M1390 705 l0 -85 1095 0 1095 0 0 85 0 85 -1095 0 -1095 0 0 -85z"/>
</g><text x="100.0" y="255.0" stroke="Black" stroke-width="1" textLength="150.0">Digital
Manufacturing</text><text x="125.0" y="95.0" lengthAdjust="spacingAndGlyphs" stroke="Black"
stroke-width="1" textLength="100.0">Brock</text><circle cx="175.0" cy="525.0" r="50.0"
fill="white" stroke="black" stroke-width="3"/>
<circle cx="185.0" cy="515.0" r="25.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="195.0" cy="505.0" r="16.666666666666668" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="205.0" cy="495.0" r="12.5" fill="white" stroke="black" stroke-width="3"/>
<circle cx="215.0" cy="485.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="225.0" cy="475.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="205.0" cy="495.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="195.0" cy="505.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="205.0" cy="495.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="185.0" cy="515.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="185.0" cy="515.0" r="12.5" fill="white" stroke="black" stroke-width="3"/>
<circle cx="195.0" cy="505.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="205.0" cy="495.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="185.0" cy="515.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="175.0" cy="525.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="185.0" cy="515.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="165.0" cy="535.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="175.0" cy="525.0" r="16.666666666666668" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="185.0" cy="515.0" r="12.5" fill="white" stroke="black" stroke-width="3"/>
<circle cx="195.0" cy="505.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="205.0" cy="495.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
<circle cx="185.0" cy="515.0" r="8.333333333333334" fill="white" stroke="black" stroke-
width="3"/>
```

```
<circle cx="175.0" cy="525.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="185.0" cy="515.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="165.0" cy="535.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="165.0" cy="535.0" r="12.5" fill="white" stroke="black" stroke-width="3"/>
<circle cx="175.0" cy="525.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="185.0" cy="515.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="165.0" cy="535.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="155.0" cy="545.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="165.0" cy="535.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="145.0" cy="555.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="165.0" cy="535.0" r="25.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="175.0" cy="525.0" r="16.666666666666668" fill="white" stroke="black" stroke-width="3"/>
<circle cx="185.0" cy="515.0" r="12.5" fill="white" stroke="black" stroke-width="3"/>
<circle cx="195.0" cy="505.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
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<circle cx="185.0" cy="515.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="175.0" cy="525.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
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<circle cx="165.0" cy="535.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="165.0" cy="535.0" r="12.5" fill="white" stroke="black" stroke-width="3"/>
<circle cx="175.0" cy="525.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
<circle cx="185.0" cy="515.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="165.0" cy="535.0" r="8.333333333333334" fill="white" stroke="black" stroke-width="3"/>
<circle cx="155.0" cy="545.0" r="10.0" fill="white" stroke="black" stroke-width="3"/>
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```xml
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</svg>
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Box 2:

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<line x1="291.6666666666667" y1="25.0" x2="425.0" y2="25.0" stroke="magenta" stroke-width="4" />
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<rect x="389" y="170.936" width="24.0" height="8.128" fill="White" stroke="magenta" stroke-width="2" />
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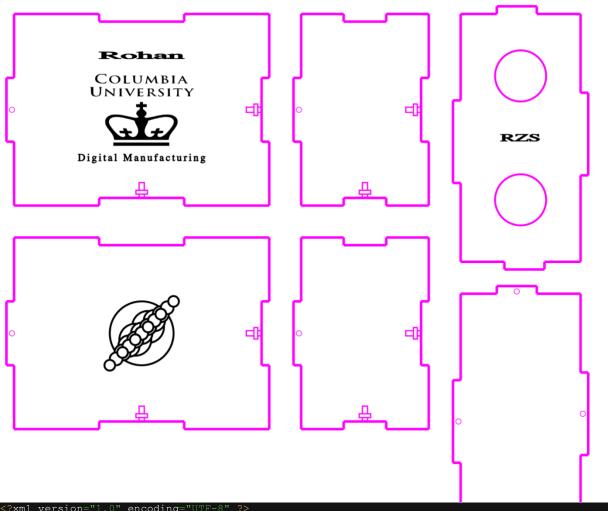
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stroke-width="4" />
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stroke="none">
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-46 97 -54 209 -55 120 -1 132 5 139 74 16 50 -17 -32 c-46 -87 -194 -83 -282
8 -95 97 -75 302 34 354 33 15 108 20 163 9 40 -8 81 -50 81 -82 0 -18 3 -23
11 -15 5 5 9 34 7 64 -3 51 -5 54 -33 60 -42 9 -205 9 -235 0z"/>
<path d="M1350 4274 c-160 -69 -166 -304 -9 -384 50 -26 149 -27 205 -1 122
55 162 230 77 332 -15 18 -45 40 -68 50 -50 23 -156 24 -205 3z m150 -27 c61
-32 90 -89 90 -176 -1 -88 -27 -146 -74 -166 -47 -20 -72 -19 -122 6 -115 55
-130 289 -22 342 45 23 77 21 128 -6z"/>
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-199 -15 -6 17 -10 111 -11 99 -2 132 1 135 10 3 7 7 27 10 43 16 30 -21 -27
c-18 -24 -28 -28 -74 -28 -43 0 -56 4 -65 19 -6 11 -10 88 -10 179 0 150 1
160 21 173 18 13 12 14 -55 14 -42 0 -76 -3 -76 -7z"/>
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67 -226 48 -32 144 -32 192 0 59 39 69 73 69 230 0 130 1 139 20 144 39 10 19
18 -45 18 -63 0 -89 -10 -42 -17 21 -3 22 -7 25 -134 3 -164 -7 -201 -62 -228
-36 -17 -43 -18 -80 -5 -65 22 -76 55 -76 222 0 113 3 139 15 143 32 13 12 19
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13 94 20 123 29 111 2 -2 30 -59 62 -126 32 -68 63 -123 67 -123 5 0 37 59 70
130 34 72 64 130 68 130 9 0 42 -239 35 -251 -4 -5 0 -9 7 -9 7 0 38 -2 68 -5
49 -4 52 -3 28 7 -16 7 -30 19 -33 27 -4 15 -55 357 -55 374 0 30 -27 -14 -91
-148 -40 -85 -76 -155 -79 -155 -3 0 -38 70 -79 155 -41 85 -77 155 -82 155
-4 0 -11 -15 -14 -32z"/>
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19 -37 35 -45 35 -20 0 -18 8 11 42 32 38 32 81 0 113 -22 23 -32 25 -114 25
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stroke-width="4" />
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stroke-width="4" />
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stroke-width="4" />
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width="4" />
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width="4" />
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width="4" />
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width="4" />
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stroke-width="4" />
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stroke-width="4" />
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stroke-width="4" />
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stroke-width="4" />
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/>
```

```
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stroke-width="4" />
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width="1" textLength="62.666666666666664">RZS</text><circle cx="819.0" cy="122.0" r="40"
fill="white" stroke="magenta" stroke-width="3"/>
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stroke-width="4" />
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stroke-width="4" />
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/>
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stroke-width="4" />
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stroke-width="4" />
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stroke-width="4" />
</svg>
```

VI. References and Bibliography

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https://admissions.ucr.edu/image/ucr-education-logo-columbia-university.png.

VII. Code Appendix

Main Code:

```python
screw_len = 36
screw_rad = 4.128
nut_wid = 18
nut_hei = 6
global material_thickness


def make_dovetail_x(pos_x, pos_y, wid, sign, ):
    x = pos_x
    y = pos_y
    x_del = sign * wid
    y_del = 0

    for i in range(0, 5):
        f.write("<line x1=\"{}\" y1=\"{}\" x2=\"{}\" y2=\"{}\" stroke=\"magenta\" stroke-
width=\"4\" />\n".format(x, y, x + x_del, y + y_del))

        x += x_del
        y += y_del

        if(i == 0):
            if(sign == -1):
                f.write(
                    "<rect x=\"{}\" y=\"{}\" width=\"{}\" height=\"{}\" fill=\"White\"
stroke=\"magenta\" stroke-width=\"2\" />\n"
                    .format(x - (1 / 2) * wid - screw_rad / 2 - 2, y - screw_len, screw_rad + 4,
screw_len - material_thickness))
                f.write(
                    "<rect x=\"{}\" y=\"{}\" width=\"{}\" height=\"{}\" fill=\"White\"
stroke=\"magenta\" stroke-width=\"2\" />\n"
                        .format(x - (1 / 2) * wid - nut_wid / 2, y - screw_len +
material_thickness, nut_wid, nut_hei))
            #else:
                # f.write(
                #     "<rect x=\"{}\" y=\"{}\" width=\"{}\" height=\"{}\" fill=\"White\"
stroke=\"magenta\" stroke-width=\"2\" />\n"
                #     .format(x + (1/2) * wid - 5, y + 20, 10, 20))
                # f.write(
                #     "<rect x=\"{}\" y=\"{}\" width=\"{}\" height=\"{}\" fill=\"White\"
stroke=\"magenta\" stroke-width=\"2\" />\n"
                #         .format(x + (1 / 2) * wid - 10, y + 27.5, 20, 5))
                #     #need to change width and height for fasteners

            x_del = 0
            y_del = sign * material_thickness
        if(i == 1):
            x_del = sign * wid
            y_del = 0
        if(i == 2):
            x_del = 0
            y_del = sign * (-material_thickness)
        if(i == 3):
            x_del = sign * wid
            y_del = 0
def make_dovetails_x(pos_x, pos_y, wid, num, sign, version, top):
    # make a full side of horizontal dovetails.
    # sign = +/- 1. determines if it goes + or - x
    # version: make a 1 or 2 square. Determines layout of dovetails
    # a version 1 will have one side with protruding dovetails with the remainder going inwards
    # a version 2 will have all sides protruding outwards (for the top and bottom)
    x = pos_x
    y = pos_y
    for i in range(0, num):
        if(version == 1):
```

```python
            make_dovetail_x(x, y, wid / (3 * num), sign)
        else:
            make_dovetail_x_2(x, y, wid / (3 * num), sign, top)
        x += sign * (wid / num)
def make_dovetail_y(pos_x, pos_y, hei, sign):
    x = pos_x
    y = pos_y
    x_del = 0
    y_del = sign * hei

    for i in range(0, 5):
        f.write("<line x1=\"{}\" y1=\"{}\" x2=\"{}\" y2=\"{}\" stroke=\"magenta\" stroke-
width=\"4\" />\n".format(x, y,

x + x_del,

y + y_del))

        x += x_del
        y += y_del

        if (i == 0):
            if(sign == -1):
                # add fastener
                f.write(
                    "<circle cx=\"{}\" cy=\"{}\" r=\"{}\" stroke=\"magenta\" fill=\"white\"
stroke-width=\"1\"/>\n".format(
                        x + sign * (material_thickness / 2 - 2.5), y + sign * (1 / 2) * hei,
screw_rad))
            else:
                f.write(
                    "<rect x=\"{}\" y=\"{}\" width=\"{}\" height=\"{}\" fill=\"White\"
stroke=\"magenta\" stroke-width=\"2\" />\n"
                        .format(x - screw_len, y + (1 / 2) * hei - screw_rad / 2 - 2, screw_len -
material_thickness, screw_rad + 4))
                f.write(
                    "<rect x=\"{}\" y=\"{}\" width=\"{}\" height=\"{}\" fill=\"White\"
stroke=\"magenta\" stroke-width=\"2\" />\n"
                        .format(x - screw_len + material_thickness, y  + (1 / 2) * hei - nut_wid
/ 2, nut_hei, nut_wid))
                # need to change width and height for fasteners
            x_del = -material_thickness
            y_del = 0
        if (i == 1):
            x_del = 0
            y_del = sign * hei
        if (i == 2):
            x_del = material_thickness
            y_del = 0
        if(i == 3):
            x_del = 0
            y_del = sign * hei
def make_dovetails_y(pos_x, pos_y, hei, num, sign, version, top):
    # make a full side of vertical dovetails.
    # sign = +/- 1. determines if it goes + or - x
    # version: make a 1 or 2 square. Determines layout of dovetails
    # a version 1 will have one side with protruding dovetails with the remainder going inwards
    # a version 2 will have all sides protruding outwards (for the top and bottom)

    x = pos_x
    y = pos_y
    for i in range(0, num):
        if(version == 1):
            make_dovetail_y(x, y, hei / (3 * num), sign)
        else:
            make_dovetail_y_2(x, y, hei / (3 * num), sign, top)
        y += sign * (hei / num)

def make_dovetail_x_2(pos_x, pos_y, wid, sign, top):
    x = pos_x
    y = pos_y
```

```python
        x_del = sign * (wid - material_thickness / 2)
        y_del = 0

        for i in range(0, 5):
            f.write("<line x1=\"{}\" y1=\"{}\" x2=\"{}\" y2=\"{}\" stroke=\"magenta\" stroke-
width=\"4\" />\n".format(x, y,

x + x_del,

y + y_del))

            x += x_del
            y += y_del

            if (i == 0):
                # add fastener
                if(top != 1):
                    f.write(
                        "<circle cx=\"{}\" cy=\"{}\" r=\"{}\" stroke=\"magenta\" fill=\"white\"
stroke-width=\"1\"/>\n".format(
                            x + sign * (1 / 2) * wid, y - sign * (material_thickness / 2 - 2.5),
screw_rad))

                x_del = 0
                y_del = sign * (-material_thickness)
            if (i == 1):
                x_del = sign * wid
                y_del = 0
            if (i == 2):
                x_del = 0
                y_del = sign * (material_thickness)
            if (i == 3):
                x_del = sign * (wid + material_thickness / 2)
                y_del = 0
def make_dovetail_y_2(pos_x, pos_y, hei, sign, top):
    x = pos_x
    y = pos_y
    x_del = 0
    y_del = sign * (hei - material_thickness / 2)

    for i in range(0, 5):
        f.write("<line x1=\"{}\" y1=\"{}\" x2=\"{}\" y2=\"{}\" stroke=\"magenta\" stroke-
width=\"4\" />\n".format(x, y,

x + x_del,

y + y_del))

        x += x_del
        y += y_del

        if (i == 0):
            # add fastener
            if(top != 1):
                f.write(
                    "<circle cx=\"{}\" cy=\"{}\" r=\"{}\" stroke=\"magenta\" fill=\"white\"
stroke-width=\"1\"/>\n".format(
                        x + sign * (material_thickness / 2 - 2.5), y + sign * (1 / 2) * hei,
screw_rad))

            x_del = sign * material_thickness
            y_del = 0
        if (i == 1):
            x_del = 0
            y_del = sign * hei
        if (i == 2):
            x_del = sign * (-material_thickness)
            y_del = 0
        if (i == 3):
            x_del = 0
            y_del = sign * (hei + material_thickness / 2)
```

```python
def make_square(pos_x, pos_y, wid, hei, num_dovetails, version, top):
    #make a full square with dovetails
    x = pos_x
    y = pos_y
    if(version == 1):
        make_dovetails_x(x, y, wid, num_dovetails, 1, 1, top)
        x += wid

        make_dovetails_y(x, y, hei, num_dovetails, 1, 1, top)
        y += hei

        make_dovetails_x(x, y, wid, num_dovetails, -1, 1, top)
        x -= wid

        make_dovetails_y(x, y, hei, num_dovetails, -1, 1, top)
        y -= hei
    else:
        make_dovetails_x(x, y, wid, num_dovetails, 1, 2, top)
        x += wid

        make_dovetails_y(x, y, hei, num_dovetails, 1, 2, top)
        y += hei

        make_dovetails_x(x, y, wid, num_dovetails, -1, 2, top)
        x -= wid

        make_dovetails_y(x, y, hei, num_dovetails, -1, 2, top)
        y -= hei

def make_fractal(f, pos_x, pos_y, wid, hei, depth):
    x = pos_x + (wid / 2)
    y = pos_y + (hei / 2)
    #move to center of square

    if(depth <= 6):
        f.write("<circle cx=\"{}\" cy=\"{}\" r=\"{}\" fill=\"white\" stroke=\"black\" stroke-
width=\"3\"/>\n"
            .format(x, y, 50 / depth))
        #draw circle, then recursively call this function
        make_fractal(f, x + 10, y - 10, 0, 0, depth + 1)
        make_fractal(f, x - 10, y + 10, 0, 0, depth + 1)

if __name__ == '__main__':

    #fastener dimensions. Nut: 3/16 in width 1/16 in height
    #screw: 3/8 in length 18 / 96 in. 0.086 in diameter. 4.128/96 in radius
    #1 pixel = 1/96 in

    # taking user input for dimensions and text detail
    print("Welcome to Box SVG Generator\n")

    #length
    length = int(input("Please input length: "))
    while (length < 200 or length > 400):
        length = int(input("You entered an invalid length. Please input between 200 and 400: "))

    #width
    width = int(input("Please input width: "))
    while (width < 200 or width > 400):
        width = int(input("You entered an invalid width. Please input between 200 and 400: "))

    #height
    height = int(input("Please input height: "))
    while (height < 200 or height > 400):
        height = int(input("You entered an invalid height. Please input between 200 and 400: "))

    #material thickness
    material_thickness = float(input("Please input the material thickness (0.0625 to 0.25): "))
    while (material_thickness < 0.0625 or material_thickness > 0.25):
        material_thickness = float(input("You entered an invalid thickness. Please input between
```

```python
0.0625 and 0.25 "))
    material_thickness *= 96

    # text input for front of box
    front_text = input("Please input something for the front of the box (up to 10 characters): ")
    while (len(front_text) > 10 or len(front_text) == 0):
        front_text = input("Invalid length. Please input 1 to 10 characters: ")

    # text input for the top of the box
    top_text = input("Please input something for the front of the box (up to 10 characters): ")
    while (len(top_text) > 10 or len(top_text) == 0):
        top_text = input("Invalid length. Please input 1 to 10 characters: ")

    # additional parameter accommodated by software: pick how many dovetails you want
    # 3 or more dovetails is possible with a large enough box, but we are limiting to two for
scalability
    num_dovetails = int(input("Please select 1 or 2 dovetails per side: "))
    while(num_dovetails < 1 or num_dovetails > 2):
        num_dovetails = int(input("Invalid number. Please select 1 or 2 dovetails per side: "))


    f = open("Box.svg", "w")
    f.write("<?xml version=\"1.0\" encoding=\"UTF-8\" ?>\n")
    f.write("<svg xmlns=\"http://www.w3.org/2000/svg\" version=\"1.1\">\n")

    # start positions for our SVG
    x, y = 25, 25
    for i in range(0, 6):
        w, h = width, height
        # creating front face
        if(i == 0):
            make_square(x, y, w, h, num_dovetails, 1, 0)
            # front face Columbia Logo
            logo_f = open("Columbia_Logo_Simple.svg", "r")
            # we are writing the details from a converted svg file of the Columbia logo directly
into the file
            logo = logo_f.read()
            logo_f.close()
            # altering the scale to position the logo within the SVG to the front face
            f.write("<g transform=\"translate({},{}) scale({},{})\" ".format(x + w / 4, y + (3/4)
* h, (0.03 / 300) * w, -(0.03 / 300) * h))
            f.write(logo)
            #f.write("<image x=\"{}\" y=\"{}\" width=\"{}\" height=\"{}\"
href=\"Columbia_Logo_Simple.svg\"/>"
                    #.format(x + w / 4, y + h / 4, w / 2, h / 2))

            # adding the text 'Digital Manufacturing' to front face
            f.write("<text x=\"{}\" y=\"{}\" stroke=\"Black\" stroke-width=\"1\"
textLength=\"{}\">Digital Manufacturing</text>"
                    .format(x + w / 4, y + (3/4) * h + 5, w / 2))

            # adding the user-specified text to the front face
            f.write(
                "<text x=\"{}\" y=\"{}\" lengthAdjust=\"spacingAndGlyphs\" stroke=\"Black\"
stroke-width=\"1\" textLength=\"{}\">{}</text>"
                .format(x + w / 3, y + h / 4 - 5, w / 3, front_text))

        if(i == 1):
            make_fractal(f, x, y, w, h, 1)
            make_square(x, y, w, h, num_dovetails, 1, 0)
        # adjusting input dimensions for a side face
        if(i == 2 or i == 3):
            w, h = length, height #side face
            make_square(x, y, w, h, num_dovetails, 1, 0)

        # adjusting input dimensions for the top/bottom faces
        if(i >= 4):
            w, h = length - material_thickness, width - material_thickness #top face


        # top and bottom plates need to be type 2 squares
```

```
        if(i == 4):
            make_square(x, y, w, h, num_dovetails, 2, 1)
            # adding the user specified text to the top face
            f.write(
                "<text x=\"{}\" y=\"{}\" lengthAdjust=\"spacingAndGlyphs\" stroke=\"Black\"
stroke-width=\"1\" textLength=\"{}\">{}</text>"
                .format(x + w / 3, y + h / 2 + 5, w / 3, top_text))

            #adding circles for lid
            f.write("<circle cx=\"{}\" cy=\"{}\" r=\"{}\" fill=\"white\" stroke=\"magenta\"
stroke-width=\"3\"/>\n"
                .format(x + w / 2, y + h / 4, 40))
            f.write("<circle cx=\"{}\" cy=\"{}\" r=\"{}\" fill=\"white\" stroke=\"magenta\"
stroke-width=\"3\"/>\n"
                    .format(x + w / 2, y + (3/4) * h, 40))
        if(i == 5):
            make_square(x, y, w, h, num_dovetails, 2, 0)


        # adjust the start position after creating each face
        if(i % 2 == 0):
            y += 50 + h
        else:
            x += 50 + w
            y = 25
    f.write("</svg>")
    f.close()
```

For the Square:

```
if __name__ == '__main__':
    print("Welcome to Rectangle SVG Generator\n")
    #maximum 2x2 square. 100 pixels per inch
    width = int(input("Please input width: "))
    height = int(input("Please input height: "))
    while(height < 75 or height > 200):
        height = int(input("You entered an invalid height. Please input between 75 and 200: "))
    while (width < 75 or width > 200):
        width = int(input("You entered an invalid width. Please input between 75 and 200: "))

    name = input("Please input your initials (up to 4 characters): ")
    while(len(name) > 4 or len(name) == 0):
        name = input("Invalid initials. Please input 1 to 4 characters: ")

    f = open("rectangle.svg", "w")
    f.write("<?xml version=\"1.0\" encoding=\"UTF-8\" ?>\n")
    f.write("<svg xmlns=\"http://www.w3.org/2000/svg\" version=\"1.1\">\n")
    f.write("<rect x=\"0\" y=\"25\" width=\"{}\" height=\"{}\" fill=\"white\"
stroke=\"magenta\"/>\n".format(width, height))
    f.write("<text x=\"{}\" y=\"{}\" stroke-width=\"3\" fill=\"black\">{}</text>".format(width /
2 - 25, height / 2 + 25, name))
    #center. 25 pixel offset to adjust for up to 4 characters (initials)
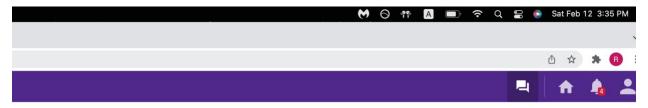    f.write("</svg>")
     f.close()
```

VIII. Rubrics Completed

1. 10pt Cover page correct and complete
2. 10pt small rectangle cut correctly (SVG+Photo) submitted a week before deadline
3. 10pt Software inputs length, width and height of box and detects errors (show input dialog)

```
Welcome to Box SVG Generator

Please input length: 100
You entered an invalid length. Please input between 200 and 400: 500
You entered an invalid length. Please input between 200 and 400: 400
Please input width: 500
You entered an invalid width. Please input between 200 and 400: 400
Please input height: 200
Please input the material thickness (0.0625 to 0.25): 0
You entered an invalid thickness. Please input between 0.0625 and 0.25 0.3
You entered an invalid thickness. Please input between 0.0625 and 0.25 0.25
Please input something for the front of the box (up to 10 characters):
Invalid length. Please input 1 to 10 characters: a
Please input something for the front of the box (up to 10 characters): asdfjkl;asdfjkl;
Invalid length. Please input 1 to 10 characters: asdf
Please select 1 or 2 dovetails per side: 3
Invalid number. Please select 1 or 2 dovetails per side: 0
Invalid number. Please select 1 or 2 dovetails per side: 1

Process finished with exit code 0
```

4. 10pt A description of the software you wrote – calculation steps, formulas, conditions.
5. 20pt Four examples showing input parameters and output flat pattern.
6. 20pt Printout of the two SVG files and photo of boxes they produced
7. 10pt User-specified text engraved on the top of the box
8. 10pt User-specified text engraved on the front of the box
9. 10pt Columbia logo and "Digital Manufacturing" engraved on the front of the box
10. 10pt A fractal engraving generated by the program embedded on one side of the box
11. 10pt a lid to cover the box
12. 10pt Any additional parameter accommodated by software:

    Software allows for specification of number of dovetails desired

13. 10pt box image posted on Ed at least 24h day before the deadline (show screenshot)

Box images Rohan Sahu & Brock Taylor #99

Rohan Sahu
less than a minute ago in General

★
STAR

👁
WATCHING

1
VIEW

Hi everyone,

We've attached some pictures of our boxes below: