



INSTITUTO POLITÉCNICO NACIONAL

ESCUELA SUPERIOR DE CÓMPUTO

PROGRAMA 2: PROGRAMA PARA
CALCULAR ECAS Y ATRACTORES

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Capítulo 1

Introducción

En matemáticas y teoría de computabilidad, un autómata celular elemental es un autómata celular unidimensional donde hay dos estados posibles (0 y 1) y la regla para determinar el estado de una célula en la próxima generación depende solo del estado actual de la célula y sus dos vecinos inmediatos. Este es uno de los modelos posibles más sencillos de computación. No obstante, hay un autómata celular elemental (regla 110) capaz de computación universal.

ATRACTORES

Los atractores son un conjunto de valores numéricos hacia los cuales un sistema tiende a evolucionar, dada por una variedad de condiciones iniciales en el sistema, existen tres tipos de atractores que son los siguientes:

- **Atractor de punto fijo:** El sistema que tenga un atractor de punto fijo tenderá a estabilizarse en un único punto.
- **Atractor de ciclo límite o atractor periódico:** Este tipo de atractor tiende a mantenerse en un periodo o en un mismo ciclo.
- **Atractor caótico:** Aparece en sistemas no lineales que tienen una gran sensibilidad a las condiciones. Un famoso ejemplo de estos atractores es el atractor de Lorenz.

1.1. Checklist

Elaborar un programa que permita simular todas las reglas de los autómatas celulares elementales y los campos de atracción para realizar una clasificación de ellos. Y debe de tener las siguientes características.

- Poder seleccionar cualquiera de las 256 reglas permitidas.
- Evaluar espacios de 300x300
- Evaluar espacios de 500x500
- Evaluar espacios de 10000x10000 (podría pero se tardaría bastante). :c
- Poder cambiar los colores de los estados.
- Poder inicializar el espacio de evoluciones con diferentes densidades.

- Poder salvar y levantar archivos con configuraciones en específico.
- Graficar el número de unos de cada generación (densidad).
- Graficar el número de unos de cada generación (densidad logaritmo base 10).
- Graficar la curva acerca de la entropía.

Capítulo 2

Códigos

2.1. HTML

```
1 <!DOCTYPE html>
2 <html>
3     <head>
4         <meta charset="utf-8" />
5         <title>Elementary Cellular Automata</title>
6         <link rel="stylesheet" href="style.css" />
7         <script type="module" src="JS/gol-config.js"></script>
8         <!-- Grafica -->
9         <script src="https://cdn.anychart.com/releases/8.11.0/js/anychart-base.min.js"></script>
10    </head>
11
12    <body>
13        <div id="container">
14            <main id="canvas"></main>
15
16            <section id="parameters-section">
17                <fieldset id="parameters-values">
18                    <legend>Parámetros</legend>
19                    <div id="inputs">
20                        <div class="inputs">
21                            <label for="canvasSize">Número de células:</label>
22                            <input
23                                id="canvasSize"
24                                name="canvasSize"
25                                type="number"
26                                min="400"
27                                max="1500"
28                                />
29                        </div>
30                        <div class="inputs">
31                            <label for="cellSize">Tamaño de célula:</label>
32                            <input
33                                id="cellSize"
```

```
34         name="cellSize"
35             type="number"
36             min="0"
37             max="9"
38         />
39     </div>
40     <div class="inputs">
41         <label>Condición inicial: </label>
42         <select id="initialOption">
43             <option value="center" selected>Al centro</option>
44             <option value="random">Random</option>
45         </select>
46     </div>
47     <div class="inputs">
48         <label for="percent-life-reset">Probabilidad de vida:</label>
49         <input
50             id="percent-life-reset"
51             name="percent-life-reset"
52             type="number"
53             value="0"
54             min="0"
55             max="1"
56             step="0.01"
57         />
58     </div>
59 </div>
60     <div id="section-rules">
61         <div class="config">
62             <div>
63                 <label for="initialRule">Regla:</label>
64                 <input
65                     id="initialRule"
66                     name="initialRule"
67                     type="number"
68                     min="0"
69                     max="255"
70                     step="1"
71                 />
72             </div>
73             <div>
74                 <label for="n">Tamaño de la cadena (atractor):</label>
75                 <input
76                     id="n"
77                     name="n"
78                     type="number"
79                     min="2"
80                     max="15"
81                     step="1"
82                     value="2"
```

```
83         />
84     </div>
85 </div>
86 <div id="colors">
87     <div>
88         <label for="deathStyle">Célula muerta</label>
89         <input
90             type="color"
91             id="deathStyle"
92             name="head"
93             value="#000000"
94         />
95     </div>
96     <div>
97         <label for="lifeStyle">Célula viva</label>
98         <input
99             type="color"
100            id="lifeStyle"
101            name="head"
102            value="#ffffff"
103        />
104    </div>
105    </div>
106 </div>
107 </fieldset>
108
109 <fieldset>
110     <legend>Datos</legend>
111     <label class="labels">
112         Generaciones:
113         <div class="value" id="generations"></div>
114     </label>
115     <label class="labels">
116         Células vivas:
117         <div class="value" id="population"></div>
118     </label>
119 </fieldset>
120
121 <fieldset class="controls">
122     <legend>Controles</legend>
123     <button id="btnDownload">Descargar datos attractor</button>
124
125     <button id="pause-play-button">Pause/Play</button>
126     <button id="reset-life-button">Aplicar cambios</button>
127     <button id="next-generation">Next Generation</button>
128 </fieldset>
129
130 <fieldset>
131     <legend>Gráficas</legend>
```

```

132
133      <!-- Chart -->
134      <div id="chart">
135          <div id="graph"></div>
136      </div>
137  </fieldset>
138  </section>
139 </div>
140 </body>
141 </html>

```

2.2. JavaScript - Cell

```

1  export default class Cell {
2      constructor(alive, rule, lifeColor, deathColor) {
3          this.alive = alive;
4          this.lifeColor = lifeColor;
5          this.deathColor = deathColor;
6          this.rule = rule;
7          this.ruleFormatted = this.formatRule(rule);
8
9          this.neighbors = [];
10         this.nextState = null;
11         this.forceRepaint = true;
12     } // fin del constructor
13
14     formatRule(rule) {
15         const RuleAsBinary = ("0".repeat(8) + rule.toString(2))
16             .slice(-8)
17             .split("")
18             .map(Number);
19
20         return {
21             "000": RuleAsBinary[7],
22             "001": RuleAsBinary[6],
23             "010": RuleAsBinary[5],
24             "011": RuleAsBinary[4],
25             100: RuleAsBinary[3],
26             101: RuleAsBinary[2],
27             110: RuleAsBinary[1],
28             111: RuleAsBinary[0],
29         };
30     }
31
32     prepareUpdate() {
33         let Neighbourhood = "";
34

```

```

35     for (let n of this.neighbors) Neighbourhood += n.alive.toString();
36
37     this.nextState = this.ruleFormatted[Neighbourhood];
38     return this.ruleFormatted[Neighbourhood];
39   }
40
41   getLifeStyle() {
42     return this.lifeColor;
43   }
44
45   setLifeStyle(color) {
46     this.lifeColor = color;
47   }
48
49   getDeathStyle() {
50     return this.deathColor;
51   }
52
53   setDeathStyle(color) {
54     this.deathColor = color;
55   }
56
57   setPaintStyles(canvasCtx) {
58     canvasCtx.fillStyle = this.alive == 1 ? this.lifeColor : this.deathColor;
59   }
60 }

```

2.3. JavaScript - Interaction-DOM

```

1 import Attractor from "./attractor.js";
2 import GOL from "./gol.js";
3
4 let CURRENT_SIM = null;
5 let option = null;
6
7 document.addEventListener("DOMContentLoaded", function () {
8   const cellSize = 4;
9   const numberOfCells = 200;
10  const canvasSize = numberOfCells * cellSize;
11  const rule = 110;
12  const chanceOfLife = 0.5;
13  const initialOption = "center";
14
15  resetSimulation(canvasSize, cellSize, rule, chanceOfLife, initialOption);
16  setupEventListeners(numberOfCells, cellSize, rule, chanceOfLife);
17 });
18

```

```
19 function resetSimulation(
20   canvasSize,
21   cellSize,
22   rule,
23   initialChanceOfLife,
24   initialOption,
25   lifeColor = "#ffffff",
26   deathColor = "#000000"
27 ) {
28   const containerCanvas = document.getElementById("canvas");
29   const previousCanvas = containerCanvas.querySelector("#canvas");
30
31   const chart = document.querySelector("#chart");
32   const previousGraph = document.querySelector("#graph");
33
34   if (previousCanvas) containerCanvas.removeChild(previousCanvas);
35
36   if (previousGraph) {
37     chart.removeChild(previousGraph);
38     const newGraph = document.createElement("div");
39     newGraph.setAttribute("id", "graph");
40     newGraph.style.width = "100%";
41     newGraph.style.height = "50%";
42     chart.appendChild(newGraph);
43   }
44
45   let cols = canvasSize / cellSize;
46   let rows = canvasSize / cellSize;
47
48   CURRENT_SIM = new GOL(
49     rows,
50     cols,
51     cellSize,
52     initialChanceOfLife,
53     rule,
54     initialOption,
55     lifeColor,
56     deathColor
57   );
58
59   CURRENT_SIM.canvas.style.height = canvasSize + "px";
60   CURRENT_SIM.canvas.style.width = canvasSize + "px";
61   containerCanvas.appendChild(CURRENT_SIM.canvas);
62   CURRENT_SIM.repaint();
63   CURRENT_SIM.start();
64
65   window.CURRENT_SIM = CURRENT_SIM;
66 }
```

```
68 function setupEventListeners(
69   initialNumberOfCells,
70   initialCellSize,
71   initialRule,
72   initialChanceOfLife
73 ) {
74   const rulesForm = document.querySelector("#parameters-section");
75
76   rulesForm.querySelector("#canvasSize").value = initialNumberOfCells;
77   rulesForm.querySelector("#cellSize").value = initialCellSize;
78   rulesForm.querySelector("#initialRule").value = initialRule;
79   rulesForm.querySelector("#percent-life-reset").value = initialChanceOfLife;
80
81   rulesForm.addEventListener("submit", (e) => {
82     e.preventDefault();
83   });
84
85   let pause = () => {
86     if (CURRENT_SIM.paused) {
87       CURRENT_SIM.start();
88     } else {
89       CURRENT_SIM.stop();
90     }
91
92     CURRENT_SIM.paused = !CURRENT_SIM.paused;
93   };
94
95   window.addEventListener("keydown", (e) => {
96     if (e.which === 90) pause();
97     if (e.which === 88) {
98       CURRENT_SIM.advanceRound();
99       CURRENT_SIM.repaint(true);
100    }
101  });
102
103  document.querySelector("#initialOption").addEventListener("change", (e) => {
104    option = e.target.value;
105  });
106
107  document
108    .querySelector("#pause-play-button")
109    .addEventListener("click", (e) => {
110      pause();
111    });
112
113  document.querySelector("#next-generation").addEventListener("click", (e) => {
114    CURRENT_SIM.advanceRound();
115    CURRENT_SIM.repaint(true);
116  });
117
```

```
117
118 document
119   .querySelector("#reset-life-button")
120   .addEventListener("click", (e) => {
121     const chanceOfLife = rulesForm.querySelector("#percent-life-reset").value;
122     let canvasSize = rulesForm.querySelector("#canvasSize").value;
123     const cellSize = rulesForm.querySelector("#cellSize").value;
124     const rule = document.querySelector("#initialRule").value;
125     const option = document.querySelector("#initialOption").value;
126     const newLifeColor = document.querySelector("#lifeStyle").value;
127     const newDeathColor = document.querySelector("#deathStyle").value;
128
129     canvasSize = canvasSize * cellSize;
130
131     resetSimulation(
132       canvasSize,
133       cellSize,
134       +rule,
135       chanceOfLife,
136       option,
137       newLifeColor,
138       newDeathColor
139     );
140   });
141
142 document.querySelector("#btnDownload").addEventListener("click", () => {
143   const rule = document.querySelector("#initialRule").value;
144   const n = document.querySelector("#n").value;
145   const attractor = new Attractor(+rule, +n);
146   const element = document.createElement("a");
147   const filename = "from_" + rule + "_n" + n + ".txt";
148   const element2 = document.createElement("a");
149   const filename2 = "to_" + rule + "_n" + n + ".txt";
150   const { from, to } = attractor._getData();
151
152   element.setAttribute(
153     "href",
154     "data:text/plain;charset=utf-8," + encodeURIComponent(from)
155   );
156   element.setAttribute("download", filename);
157   element.click();
158
159   element2.setAttribute(
160     "href",
161     "data:text/plain;charset=utf-8," + encodeURIComponent(to)
162   );
163   element2.setAttribute("download", filename2);
164   element2.click();
165 });
```

166 }

2.4. JavaScript - Lógica

```
1 import Cell from "./Cell.js";
2 import { Chart } from "./chartConfig.js";
3
4 export default class GOL {
5     constructor(
6         rows,
7         cols,
8         pixelSize,
9         initialChanceOfLife,
10        initialRule,
11        initialOption,
12        lifeColor,
13        deathColor
14    ) {
15        this.rows = rows;
16        this.cols = cols;
17        this.pixelSize = pixelSize;
18        this.mouseIsDown = false;
19        this.paused = false;
20        this.intervalId = 1;
21        this.generations = 0;
22        this.population = 0;
23        this.rule = initialRule;
24        this.lifeColor = lifeColor;
25        this.deathColor = deathColor;
26
27        this.grid = [];
28        this.setup(initialChanceOfLife, initialRule, initialOption);
29
30        // Configuración del canvas
31        let width = this.pixelSize * this.cols;
32        let height = this.pixelSize * this.rows;
33        this.canvas = document.createElement("canvas");
34        this.canvas.width = width;
35        this.canvas.height = height;
36        this.canvasCtx = this.canvas.getContext("2d", { alpha: false });
37
38        // Para la gráfica
39        this.chart = new Chart("graph", "Gráfica de densidades");
40        this.chart2 = new Chart("graph", "Gráfica de densidades (log10)");
41    } // fin del constructor
42
43    setup(initialChanceOfLife, initialRule, initialOption) {
```

```
44     const generation1 = [];
45
46     if (initialOption === "center") {
47         for (let i = 0; i < this.rows; i++)
48             generation1.push(
49                 i === Math.floor(this.cols / 2)
50                     ? new Cell(1, initialRule, this.lifeColor, this.deathColor)
51                     : new Cell(0, initialRule, this.lifeColor, this.deathColor)
52             );
53     } else {
54         for (let i = 0; i < this.rows; i++) {
55             let alive = Math.random() < initialChanceOfLife;
56
57             generation1.push(
58                 alive
59                     ? new Cell(1, initialRule, this.lifeColor, this.deathColor)
60                     : new Cell(0, initialRule, this.lifeColor, this.deathColor)
61             );
62         }
63     }
64
65     this.grid.push(generation1);
66
67     for (let j = 0; j < generation1.length; j++) {
68         generation1[j].neighbors = this.getNeighbors(j);
69     }
70 }
71
72 start() {
73     if (this.intervalId) {
74         return;
75     }
76
77     this.intervalId = setInterval(() => {
78         if (this.generations < this.rows) {
79             this.advanceRound();
80             this.repaint();
81         }
82     }, 20);
83 }
84
85 stop() {
86     if (this.intervalId) {
87         clearInterval(this.intervalId);
88         this.intervalId = null;
89     }
90 }
91
92 getNeighbors(cell) {
```

```
93     const neighbors = [];
94     let index;
95
96     for (let i = cell - 1; i <= cell + 1; i++) {
97         index = i;
98
99         if (cell === 0) index = this.cols - 1;
100        else if (cell === this.cols - 1) index = 0;
101
102        neighbors.push(this.grid[this.generations][index]);
103    }
104
105    return neighbors;
106}
107
108 advanceRound() {
109     if (this.mouseIsDown) return;
110     let nextGen = [];
111     const index = this.generations;
112
113     for (let j = 0; j < this.cols; j++) {
114         const nextState = this.grid[index][j].prepareUpdate();
115         const newCell = new Cell(
116             nextState,
117             this.rule,
118             this.lifeColor,
119             this.deathColor
120         );
121         nextGen.push(newCell);
122     }
123
124     this.generations++;
125
126     this.grid.push(nextGen);
127
128     for (let j = 0; j < this.cols; j++) {
129         nextGen[j].neighbors = this.getNeighbors(j);
130     }
131
132     this.population = this.grid
133         .flat()
134         .filter((cell) => cell.alive === 1).length;
135
136     this.chart.updateChart(this.generations, this.population);
137     this.chart2.updateChart(this.generations, Math.log10(this.population));
138
139     document.querySelector("#generations").innerHTML = this.generations + "";
140     document.querySelector("#population").innerHTML = this.population + "";
141 }
```

```

142
143     repaint(force = false) {
144         if (this.mouseIsDown && !force) return;
145
146         for (let j = 0; j < this.grid.length; j++) {
147             const gen = this.grid[j];
148             for (let i = 0; i < gen.length; i++) {
149                 if (gen[i].alive === 1) {
150                     this.paintPixel(j, i);
151                 } else this.paintPixel(j, i);
152             }
153         }
154     }
155
156     paintPixel(row, col) {
157         this.grid[row][col].setPaintStyles(this.canvasCtx);
158         this.canvasCtx.fillRect(
159             col * this.pixelSize,
160             row * this.pixelSize,
161             this.pixelSize,
162             this.pixelSize
163         );
164     }
165 }
```

2.5. JavaScript - Attractor

```

1 export default class Attractor {
2     constructor(rule, n) {
3         this.rule = rule;
4         this.n = n;
5         this.ruleFormatted = this._formatRule(rule);
6         this.totalCombinations = Math.pow(2, n);
7         this.nodes = [];
8         this.edges = [];
9     }
10
11     _formatRule(rule) {
12         const RuleAsBinary = ("0".repeat(8) + rule.toString(2))
13             .slice(-8)
14             .split("")
15             .map(Number);
16
17         return {
18             "000": RuleAsBinary[7],
19             "001": RuleAsBinary[6],
20             "010": RuleAsBinary[5],
```

```
21     "011": RuleAsBinary[4] ,
22     100: RuleAsBinary[3] ,
23     101: RuleAsBinary[2] ,
24     110: RuleAsBinary[1] ,
25     111: RuleAsBinary[0] ,
26   };
27 }
28
29 _getCombinations(n) {
30   const combinations = [] ;
31
32   for (let i = 0; i < this.totalCombinations; i++) {
33     const combination = ("0".repeat(n) + i.toString(2))
34       .slice(-n)
35       .split("")
36       .map(Number);
37     combinations.push(combination);
38   }
39
40   return combinations;
41 }
42
43 _nextState(combination, ruleValues) {
44   let cadena = "";
45   let cadenota = "";
46   let index;
47
48   for (let i = 0; i < this.n; i++) {
49     for (let j = i - 1; j <= i + 1; j++) {
50       index = j;
51       if (j < 0) index = this.n - 1;
52       if (j >= this.n) index = 0;
53       cadena += combination[index];
54     }
55     cadenota += ruleValues[cadena];
56     cadena = "";
57   }
58
59   return cadenota;
60 }
61
62 _getData() {
63   const combinations = this._getCombinations(this.n);
64   const from = [];
65   const to = [];
66
67   for (const combination of combinations) {
68     const nextState = this._nextState(combination, this.ruleFormatted);
69     from.push(parseInt(combination.join(""), 2) + 1);
```

```

70     to.push(parseInt(nextState, 2) + 1);
71 }
72
73     return { from, to };
74 }
75 }
```

2.6. JavaScript - Configuración de gráfica

```

1  export class Chart {
2      constructor(container, title) {
3          this.dataset = anychart.data.set([]);
4
5          // set chart type
6          var chart = anychart.line();
7
8          chart.title({
9              text: title,
10             fontColor: "#333",
11             fontSize: 20,
12         });
13
14         // set data
15         chart.spline(this.dataset).markers(null);
16
17         // disable stagger mode. Only one line for x axis labels
18         chart.xAxis().staggerMode(false);
19
20         // set container and draw chart
21         chart.container(container).draw();
22     }
23
24     updateChart(generations, population) {
25         this.dataset.append({
26             x: generations,
27             value: population,
28         });
29     }
30 }
```

2.7. Matlab - Ploteo del atractor

```

1 clc;
2 close all;
3
```

```
4 from = csvread('~/72,237/from_72_n15.txt');
5 to = csvread('~/72,237/to_72_n15.txt');
6
7 G = digraph(from, to);
8
9 pt = plot(G, 'Layout','force');
10 pt.NodeLabel = {};
```

Capítulo 3

Atractores

3.1. Reglas 0,255

Se aprecia que entre más grande es el tamaño de la cadena (n) surgen más nodos que apuntan/convergen al nodo 0, creando una figura que asemeja a un círculo.

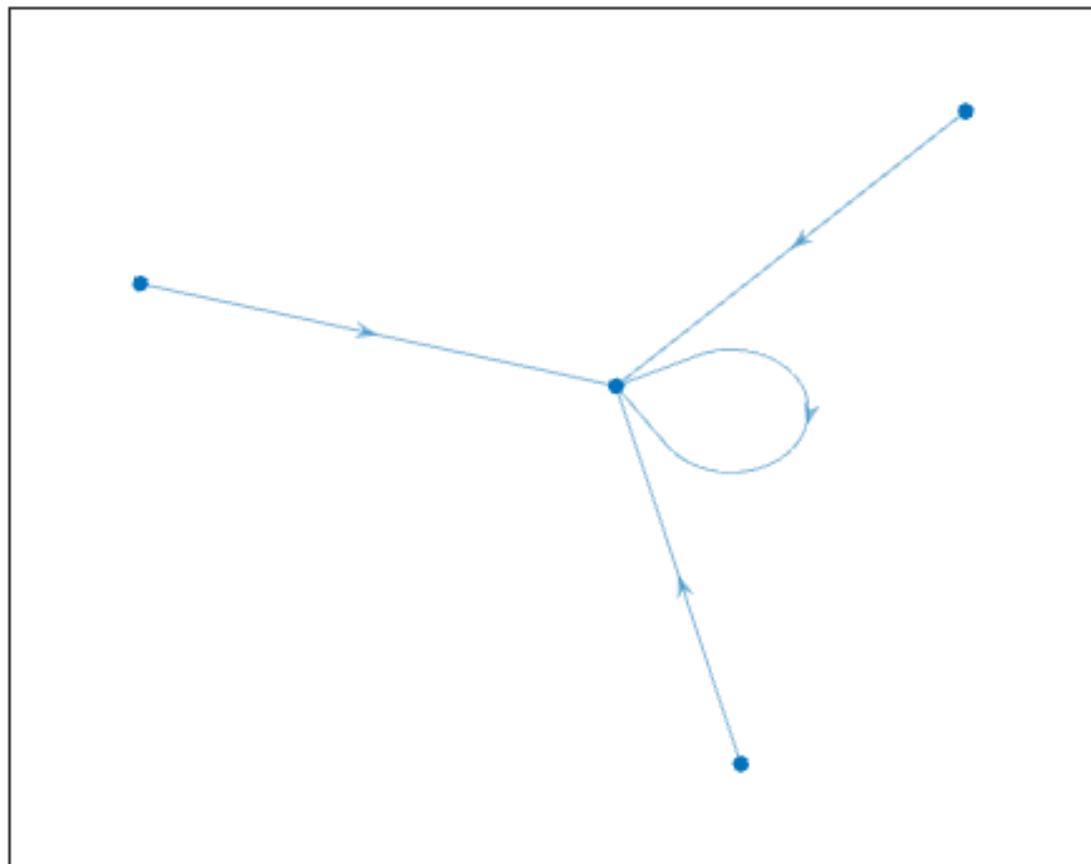
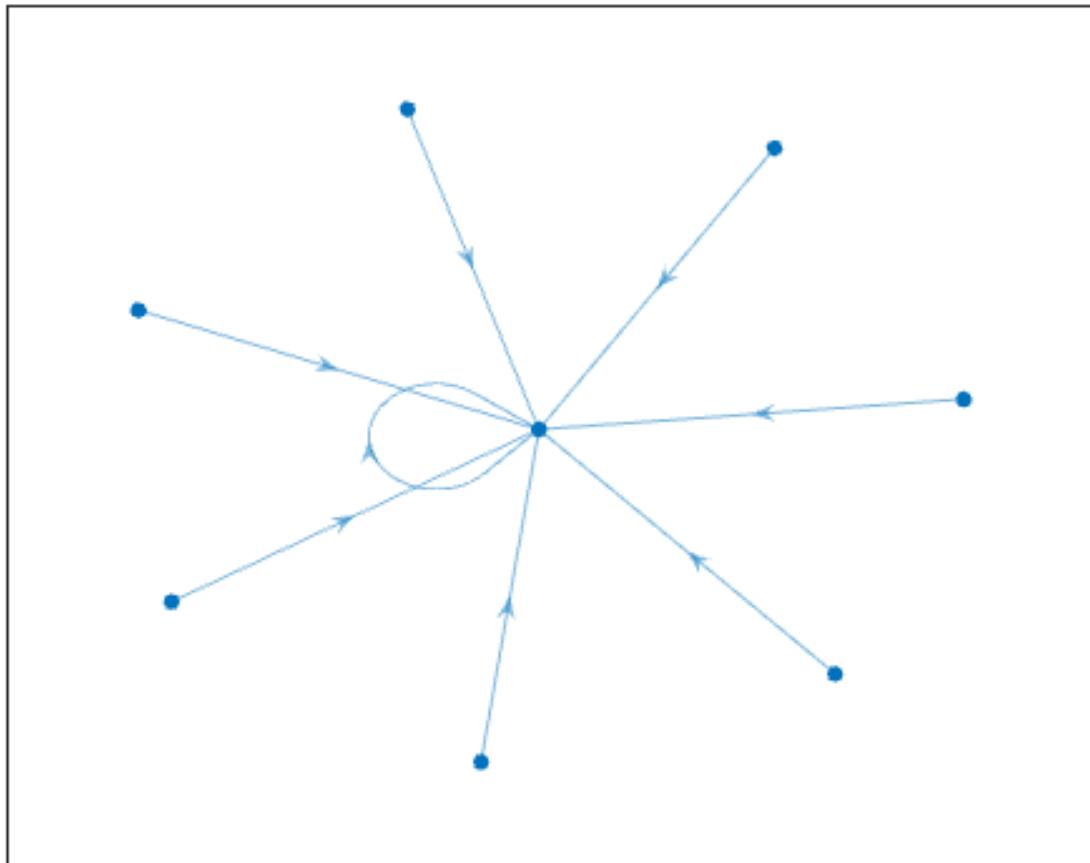
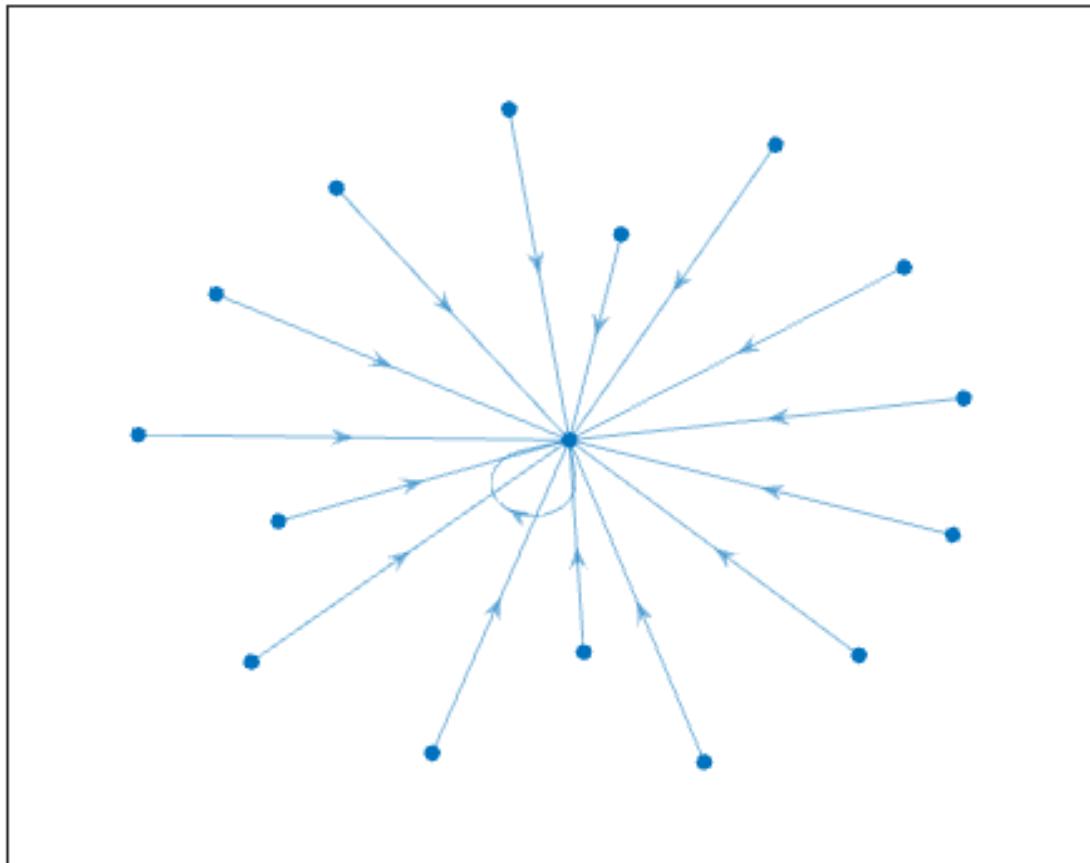


Figura 3.1: Atractor regla 0 $n=2$

Figura 3.2: Atractor regla 0 $n=3$

Figura 3.3: Atractor regla 0 $n=4$

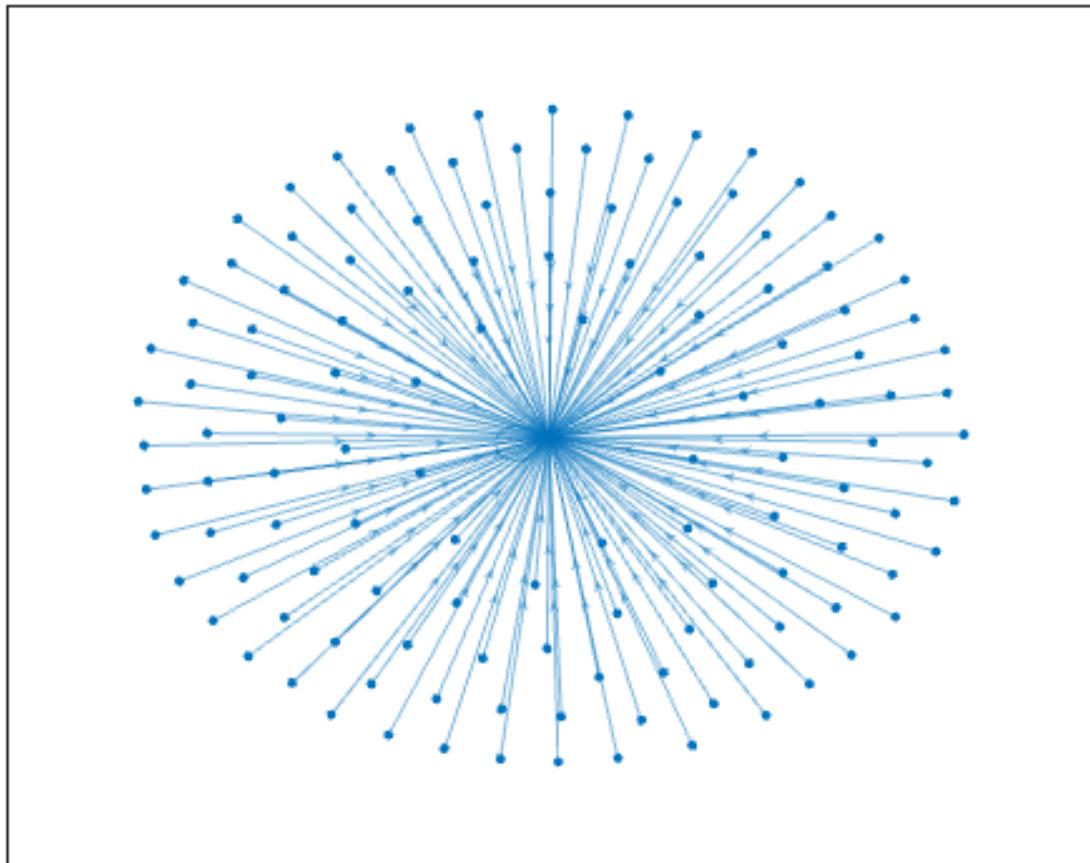


Figura 3.4: Atractor regla 0 n=7

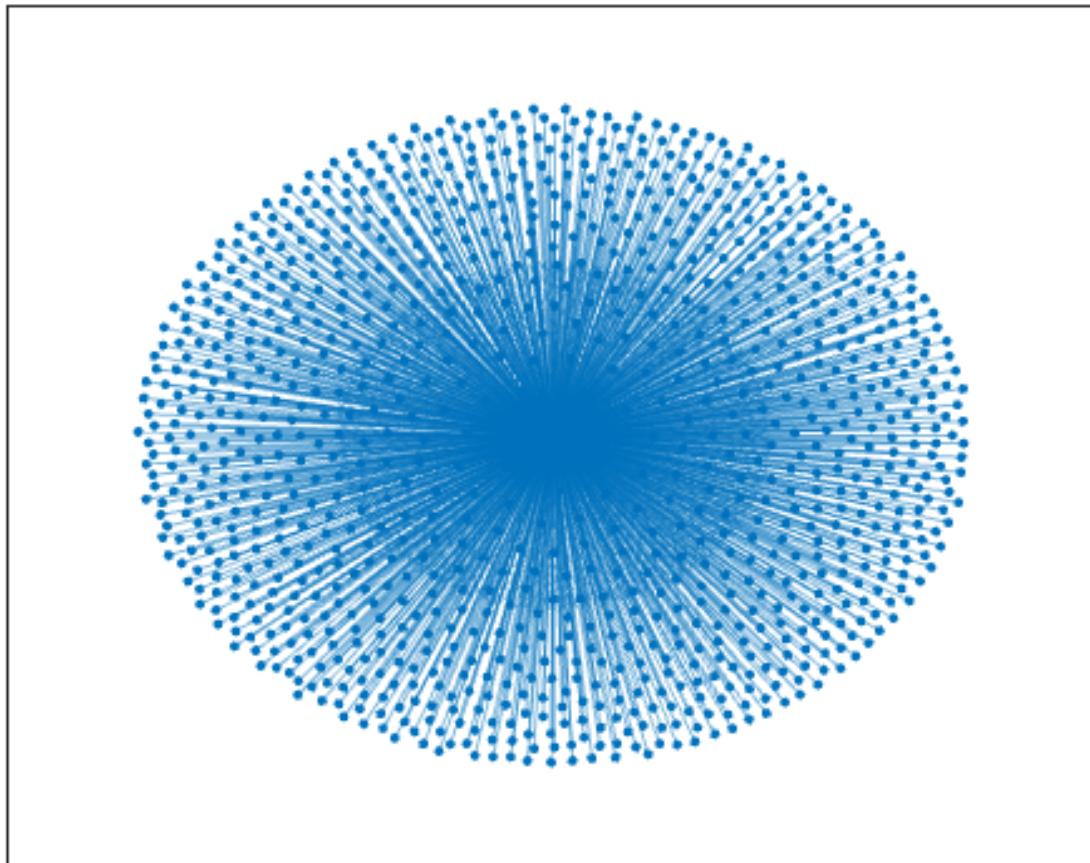


Figura 3.5: Atractor regla 0 n=10

3.2. Reglas 1,127

Respecto a la regla 1 se aprecia que mientras más grande es el tamaño de la cadena (n) van surgiendo nuevos atractores que mientras se incrementa el valor de n estos evolucionan y más nodos convergen a ellos dando lugar a atractores que asemejan círculos.

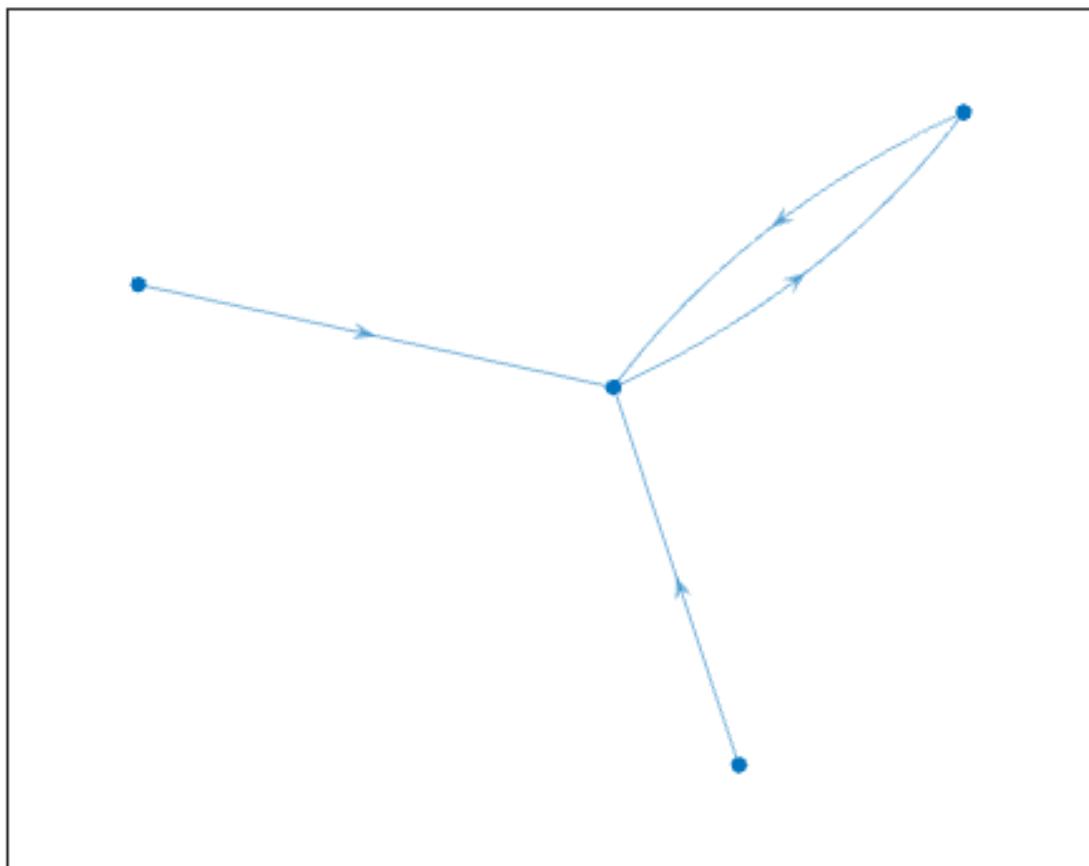


Figura 3.6: Atractor regla 1 $n=2$

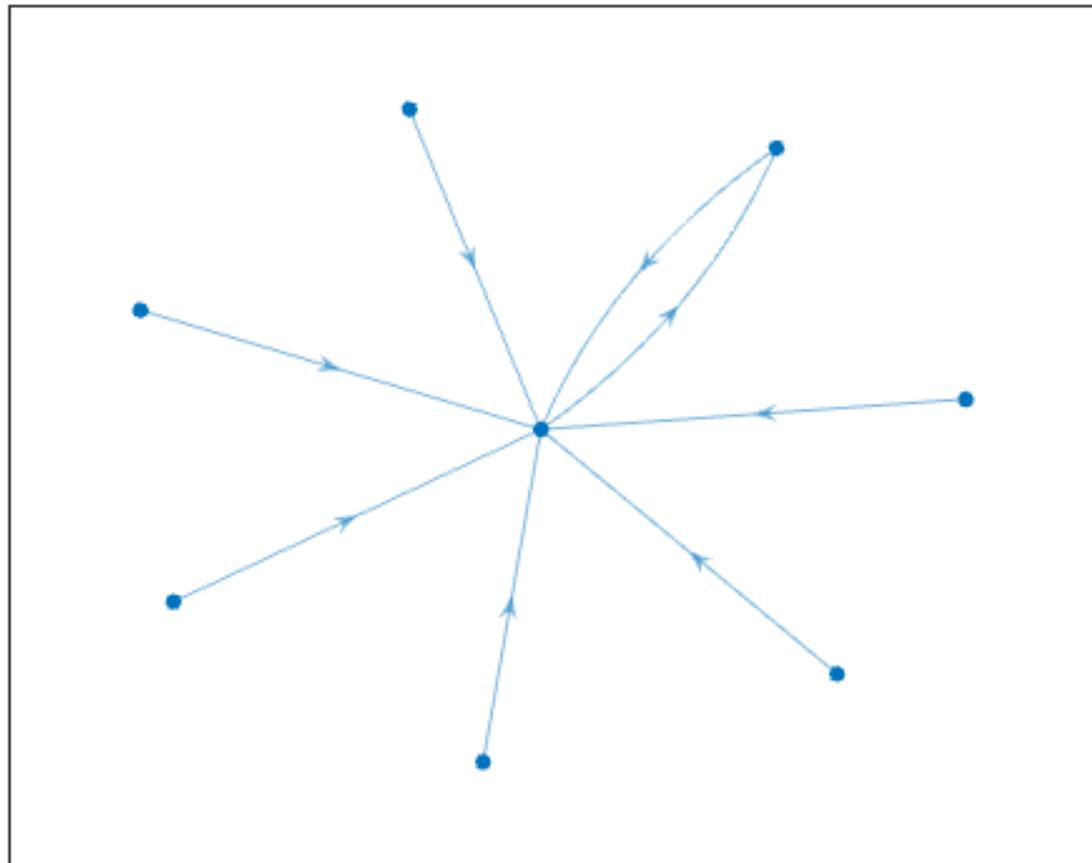


Figura 3.7: Atractor regla 1 n=3

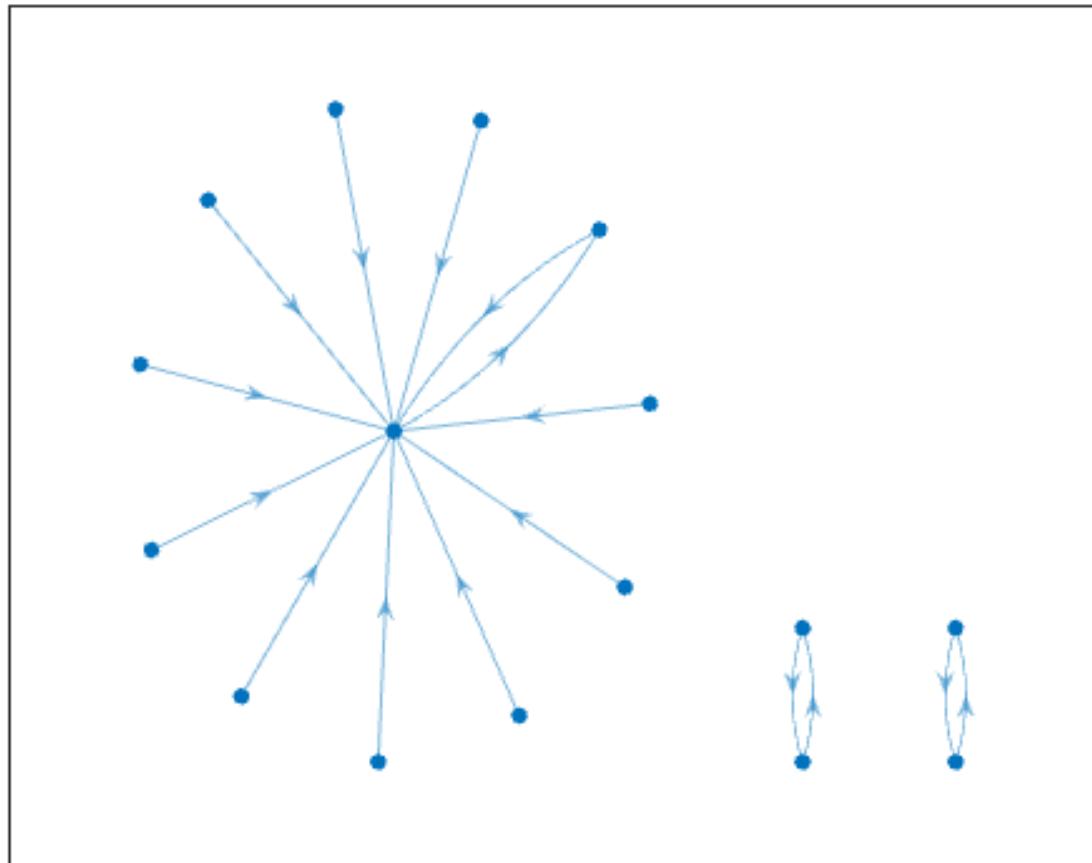


Figura 3.8: Atractor regla 1 n=4

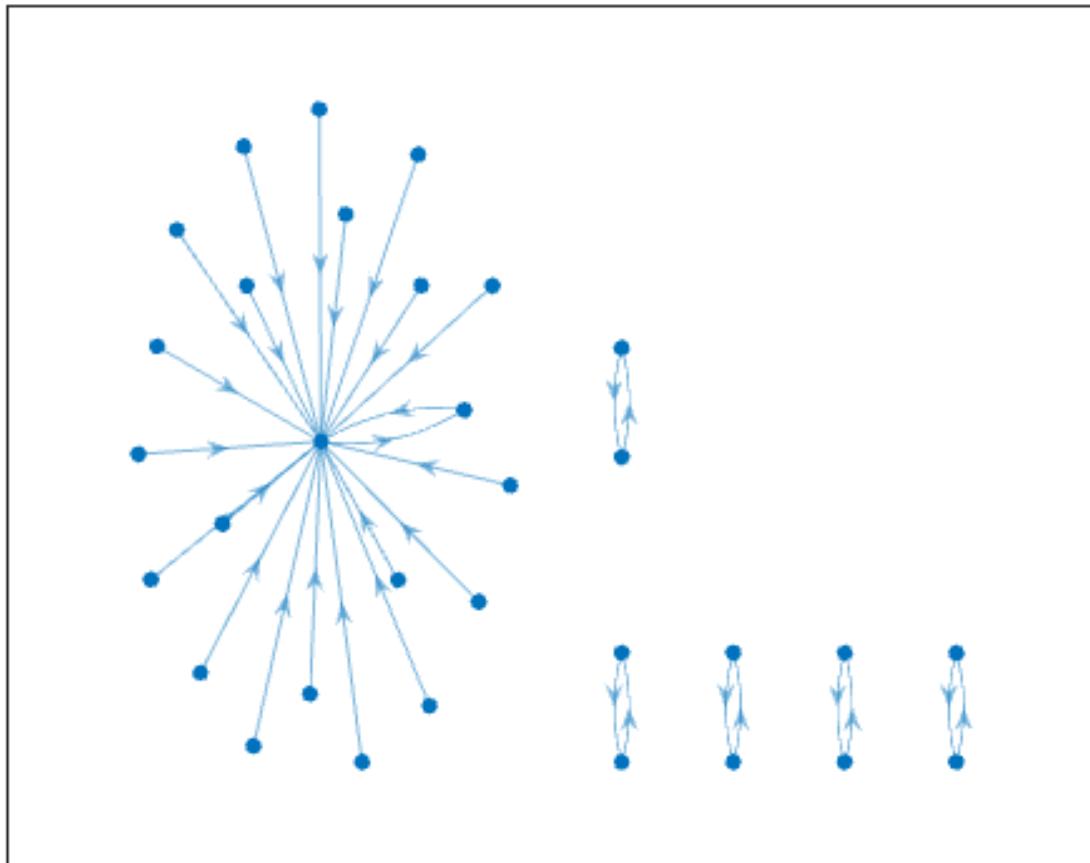
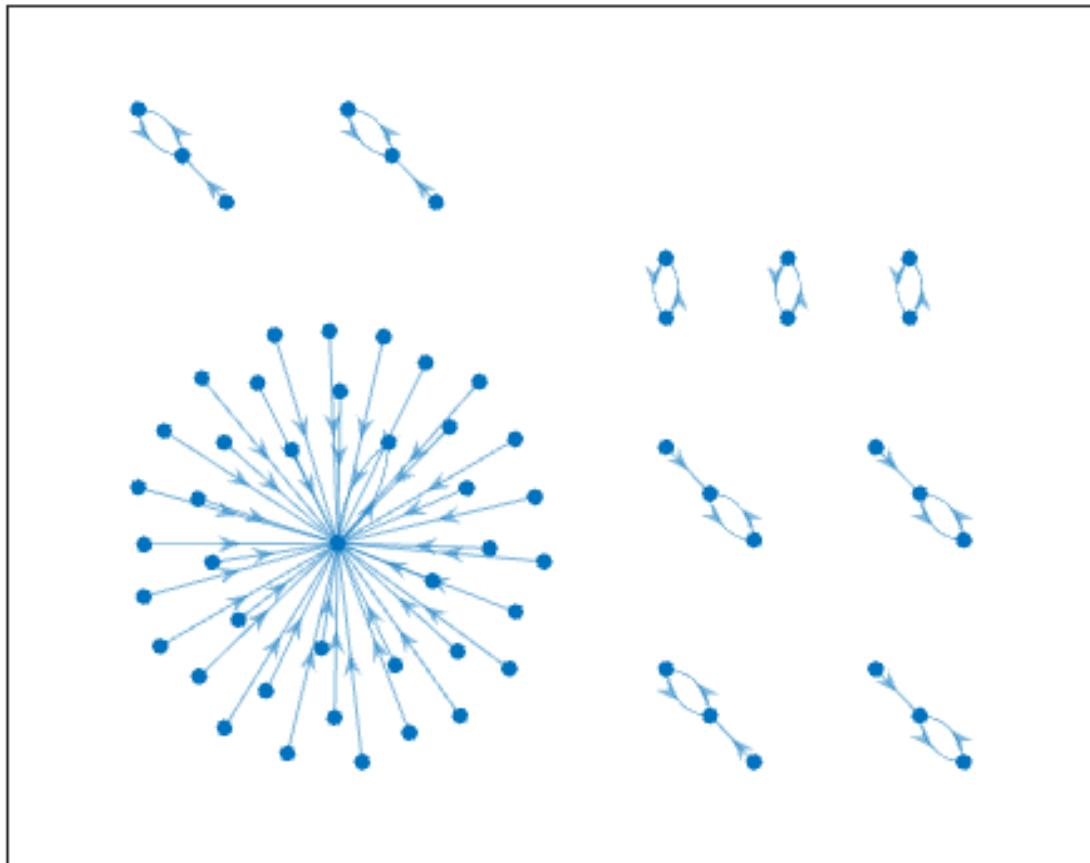
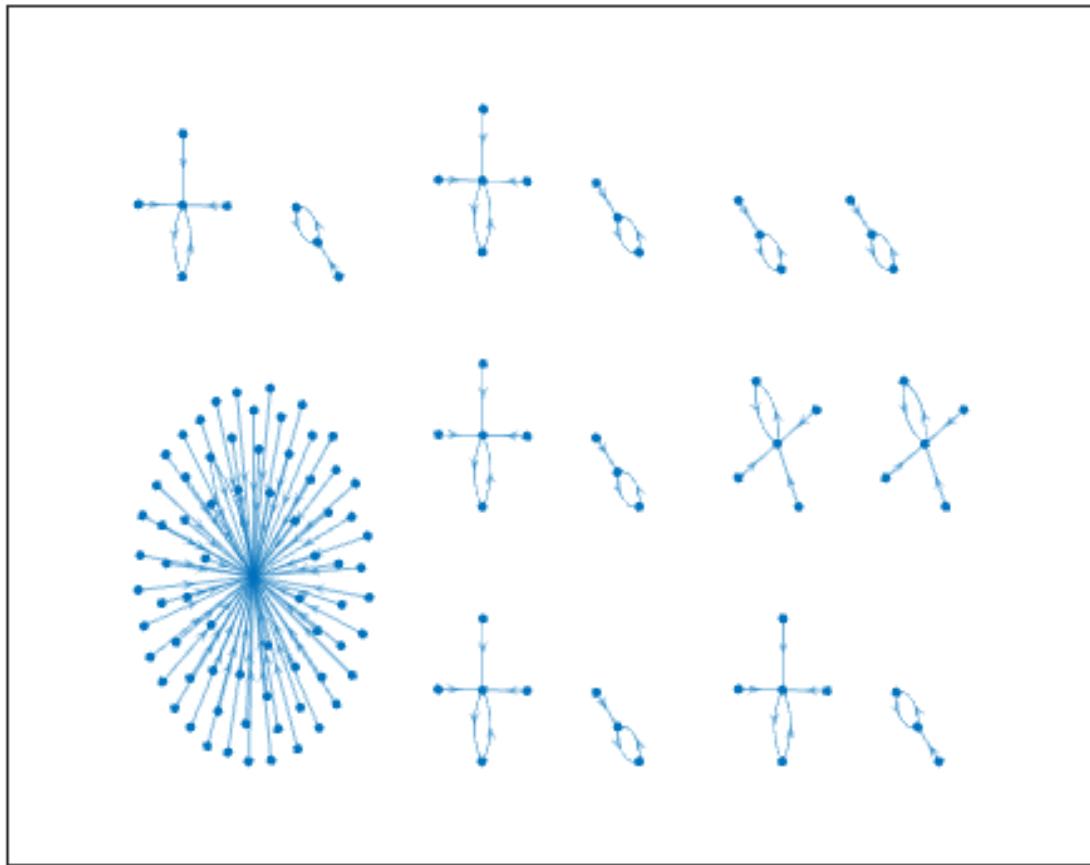
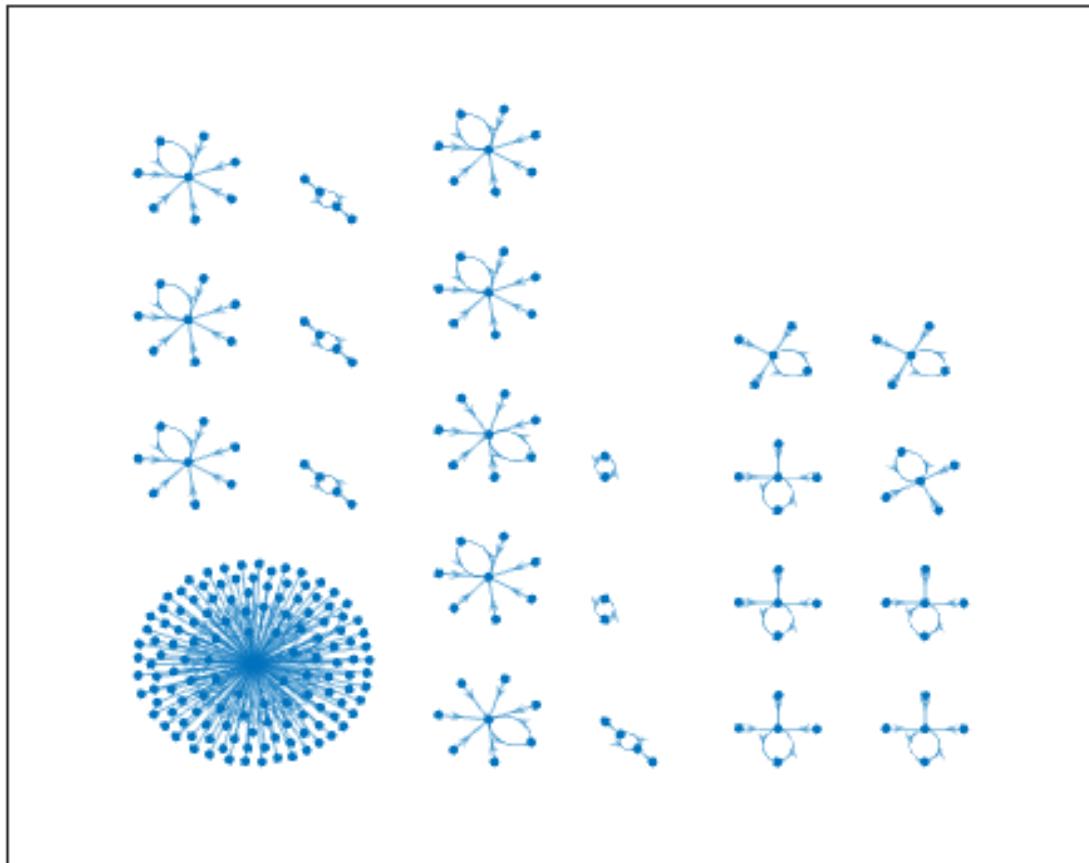
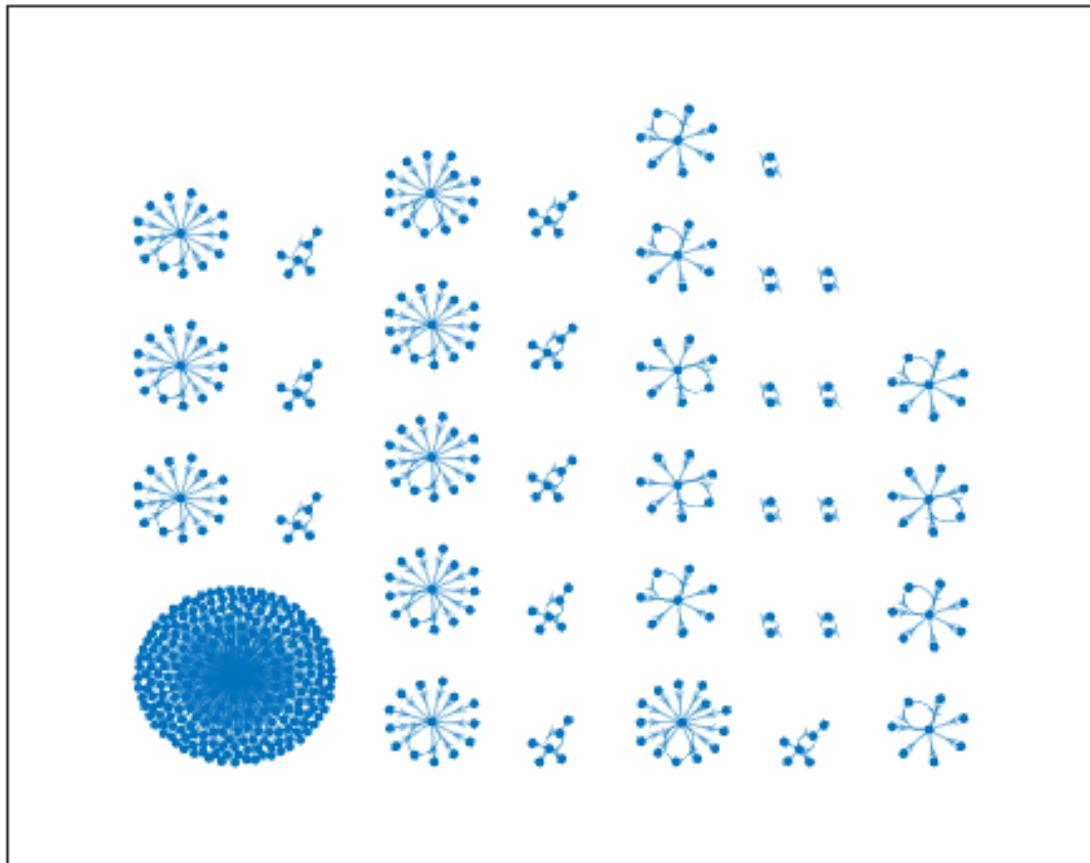


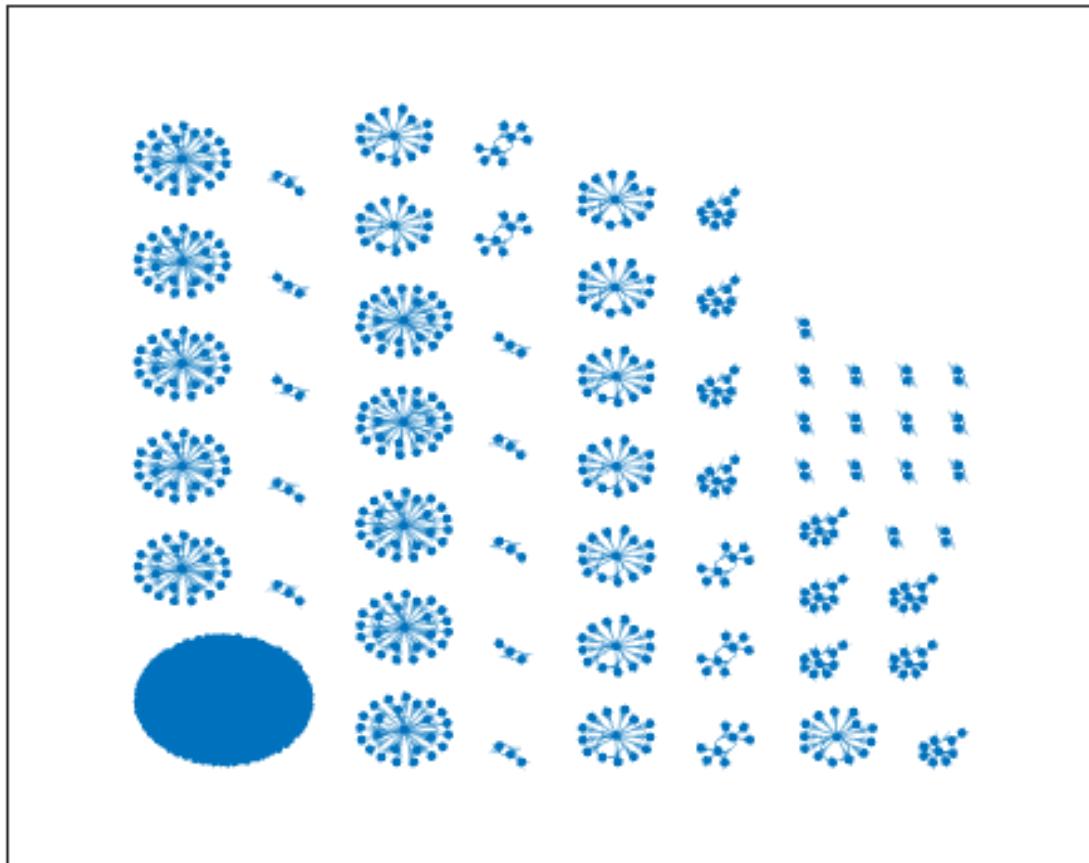
Figura 3.9: Atractor regla 1 n=5

Figura 3.10: Atractor regla 1 $n=6$

Figura 3.11: Atractor regla 1 $n=7$

Figura 3.12: Atractor regla 1 $n=8$

Figura 3.13: Atractor regla 1 $n=9$

Figura 3.14: Atractor regla 1 $n=10$

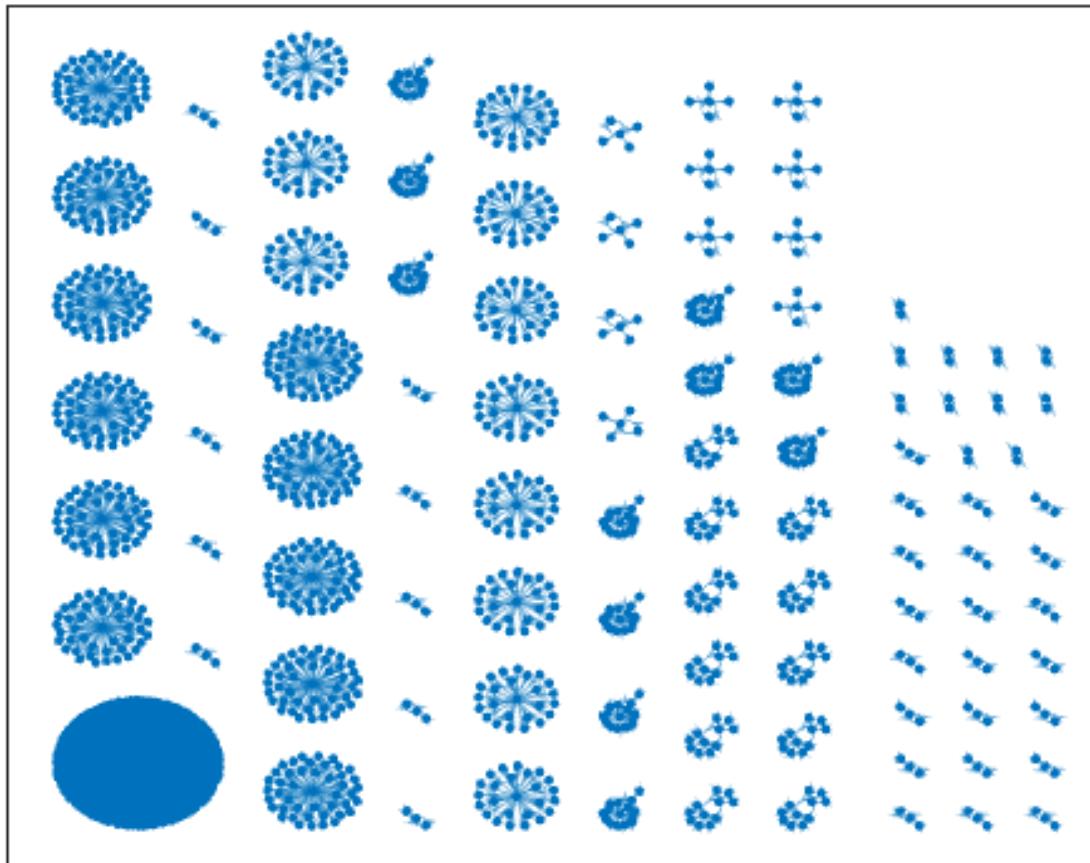


Figura 3.15: Atractor regla 1 n=11

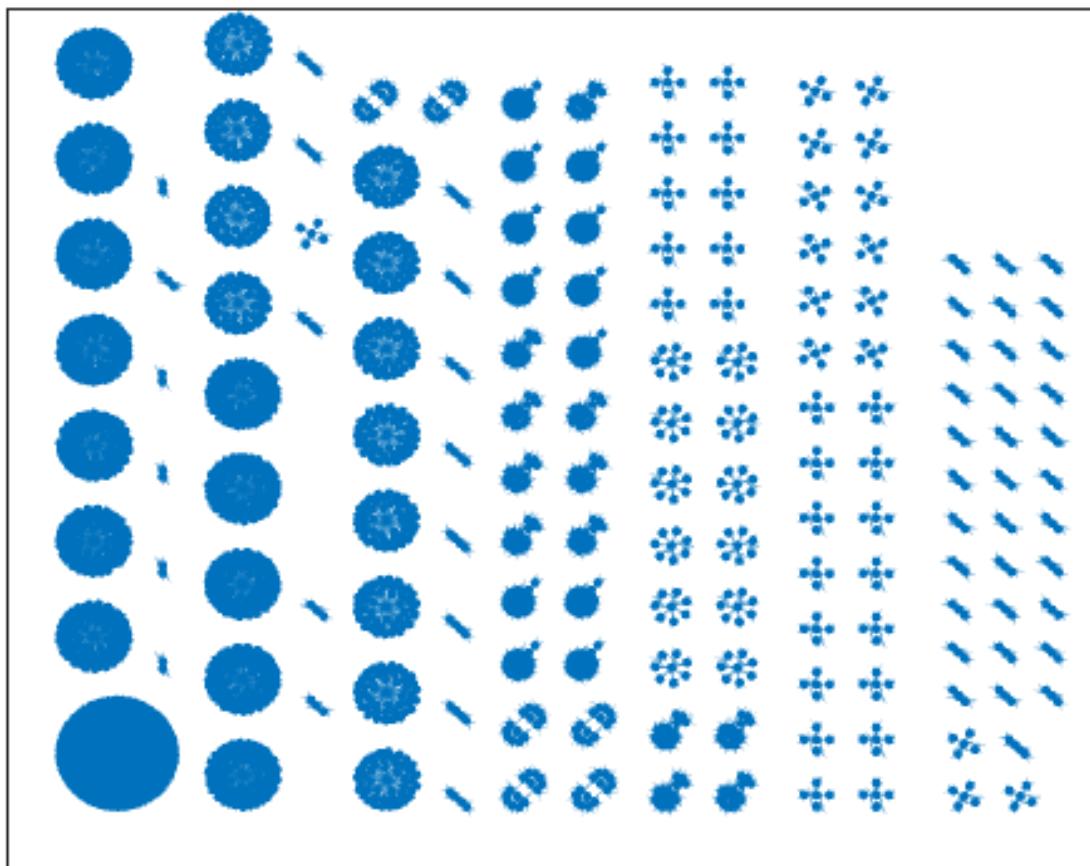
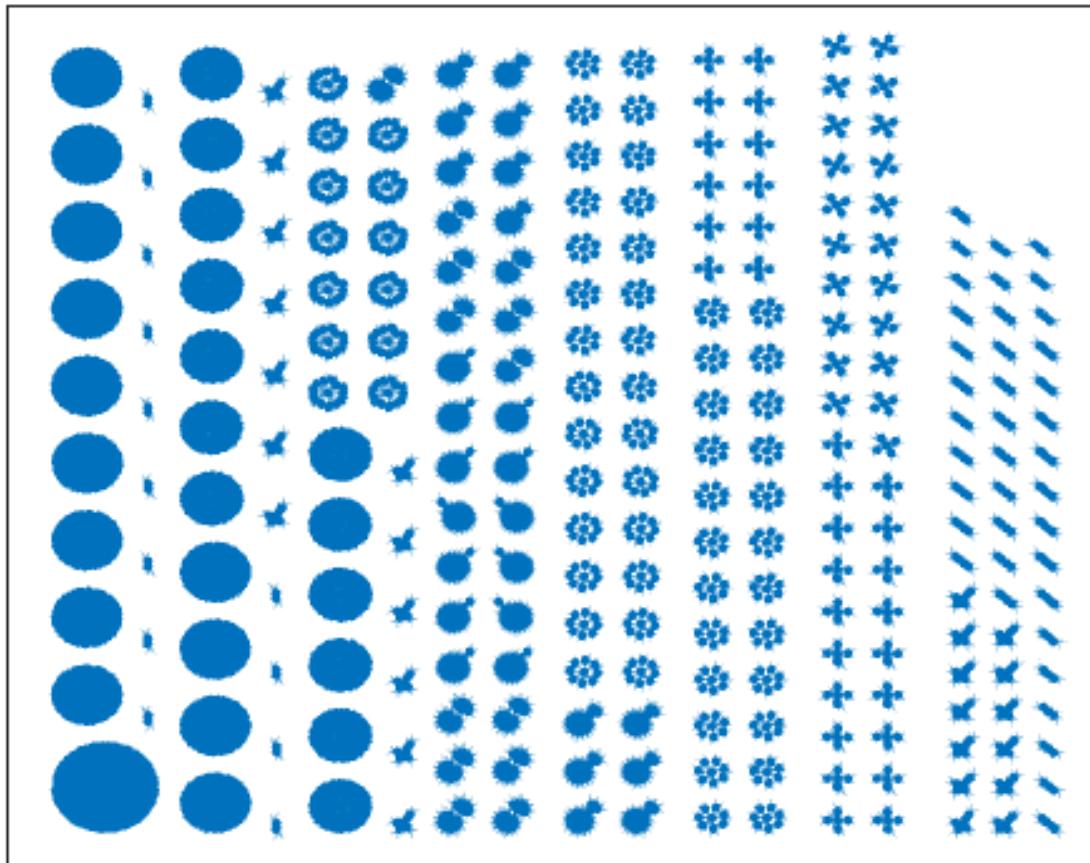


Figura 3.16: Atractor regla 1 n=12

Figura 3.17: Atractor regla 1 $n=13$

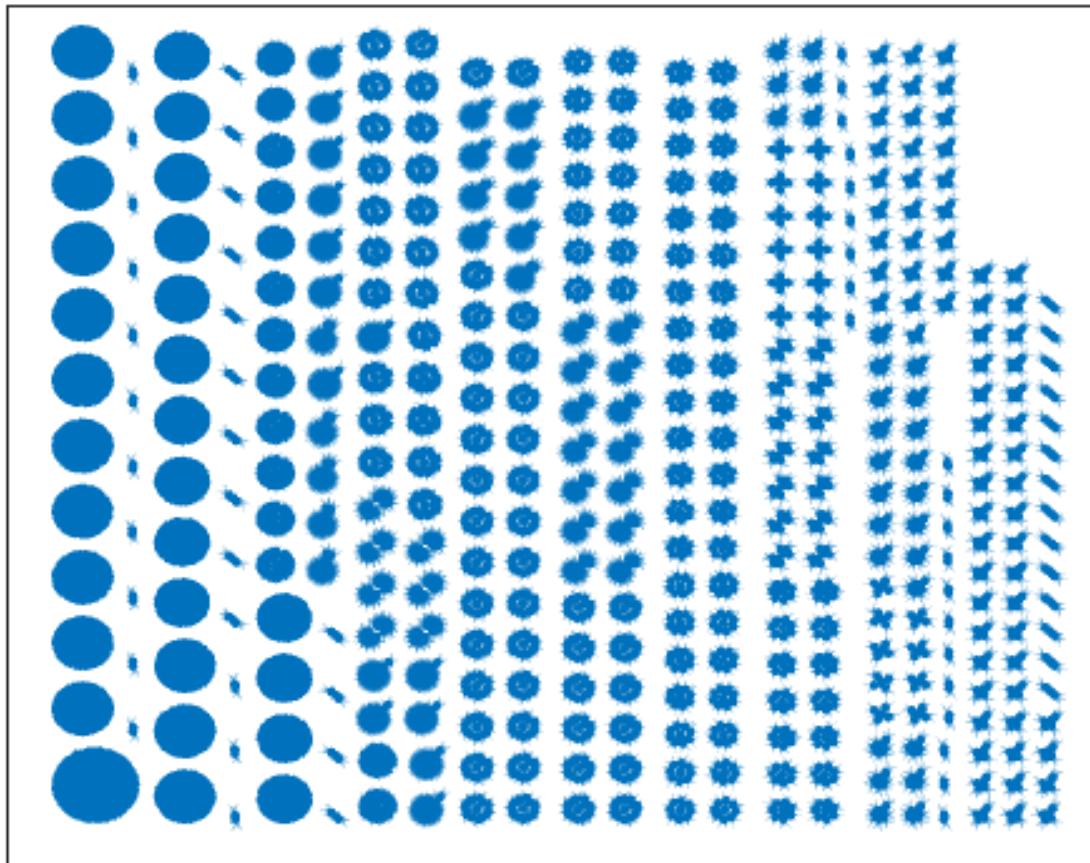


Figura 3.18: Atractor regla 1 n=14

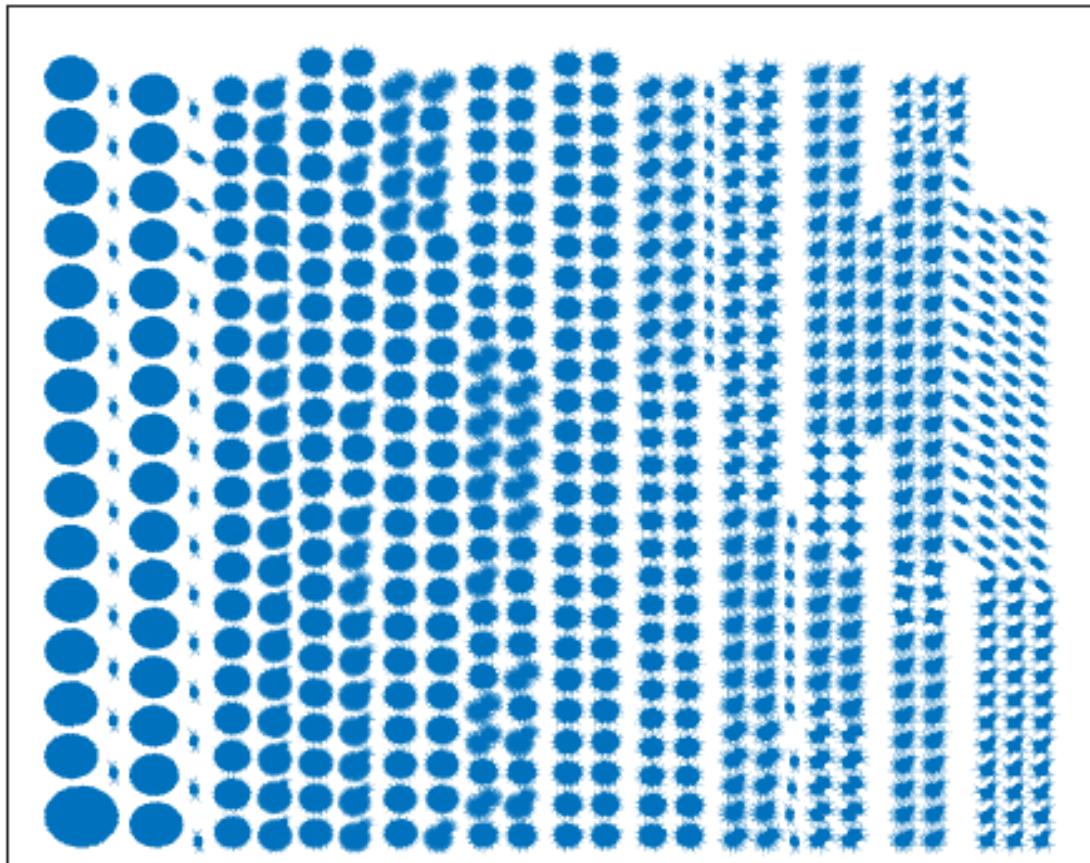


Figura 3.19: Atractor regla 1 $n=15$

3.3. Reglas 2,16,191,247

Respecto a la regla 2 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen atractores que según el algoritmo de ordenamiento que usa matlab crean polígonos tales como un triángulo, cuadrado, pentágono y conforme crece la n se forman los siguientes polígonos hexágono, heptágono, etc.

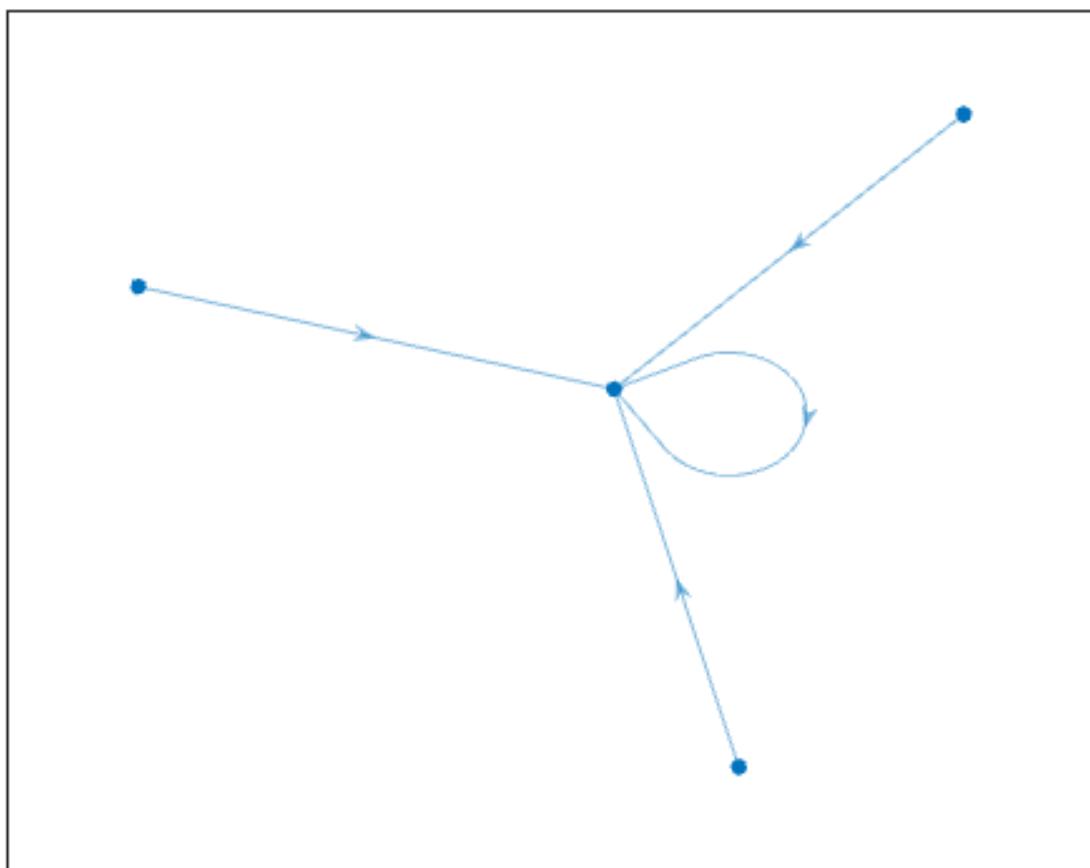
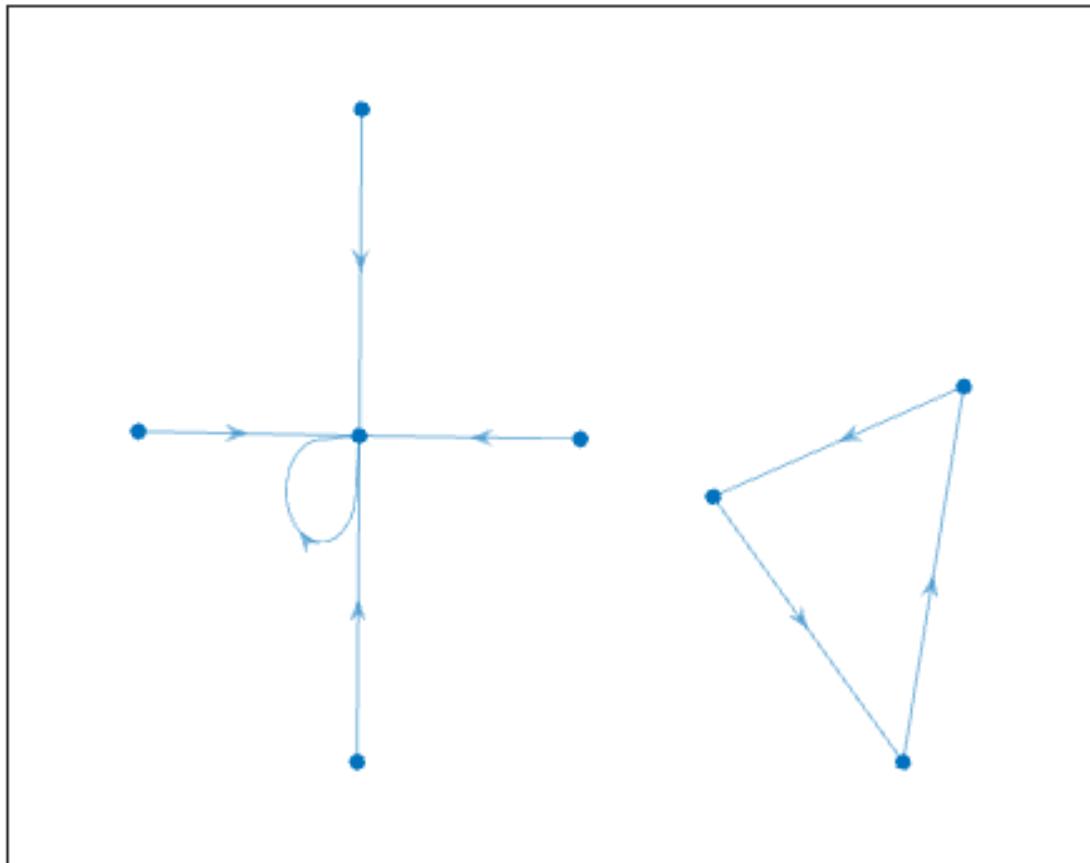
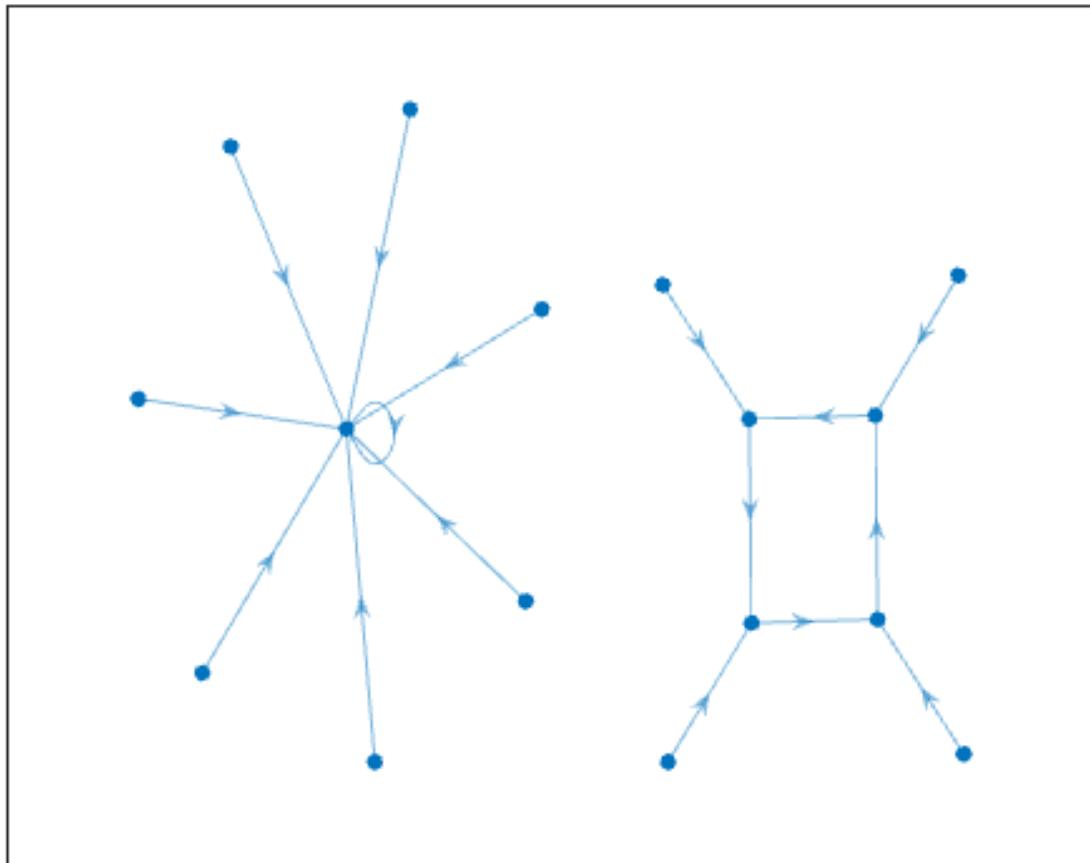
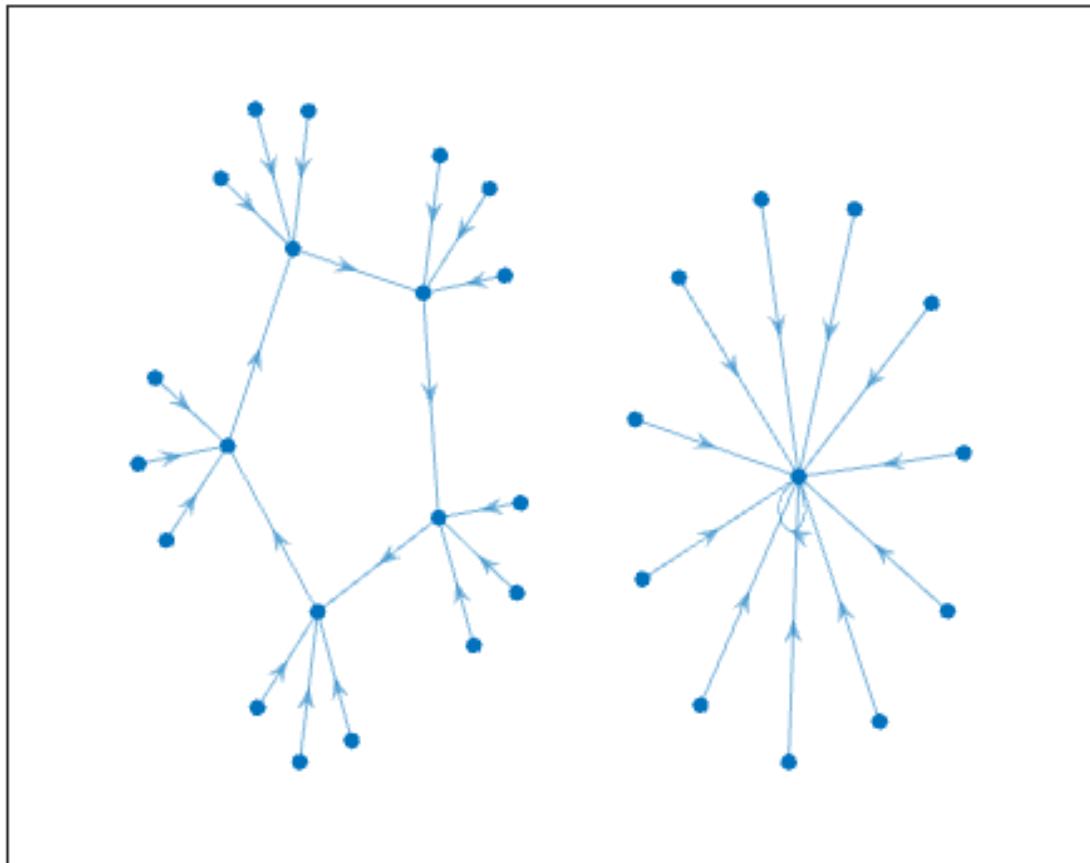
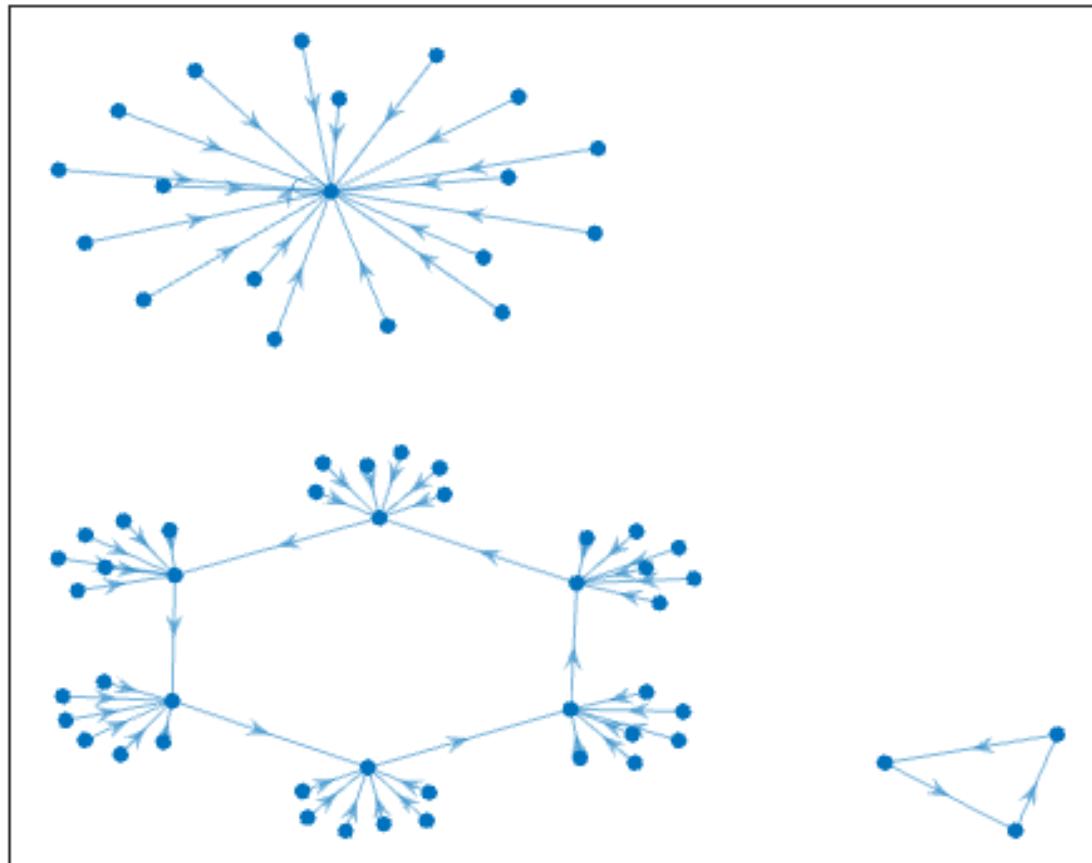


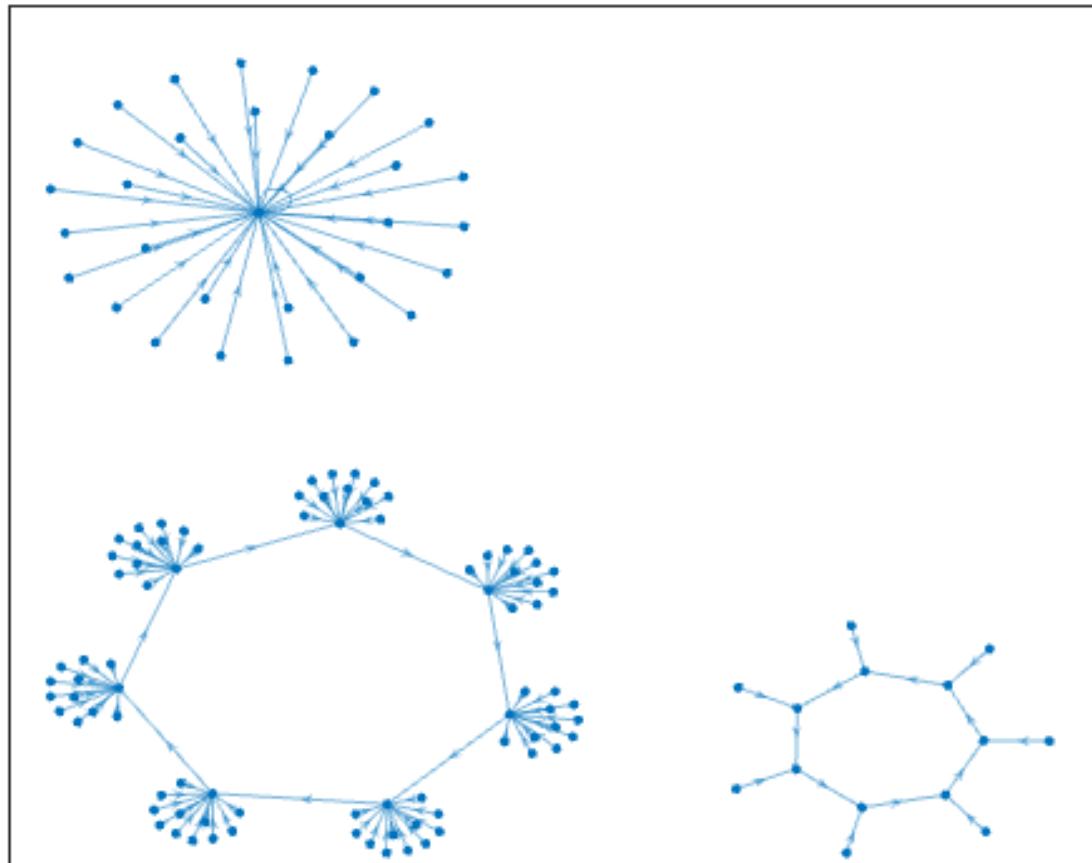
Figura 3.20: Atractor regla 2 $n=2$

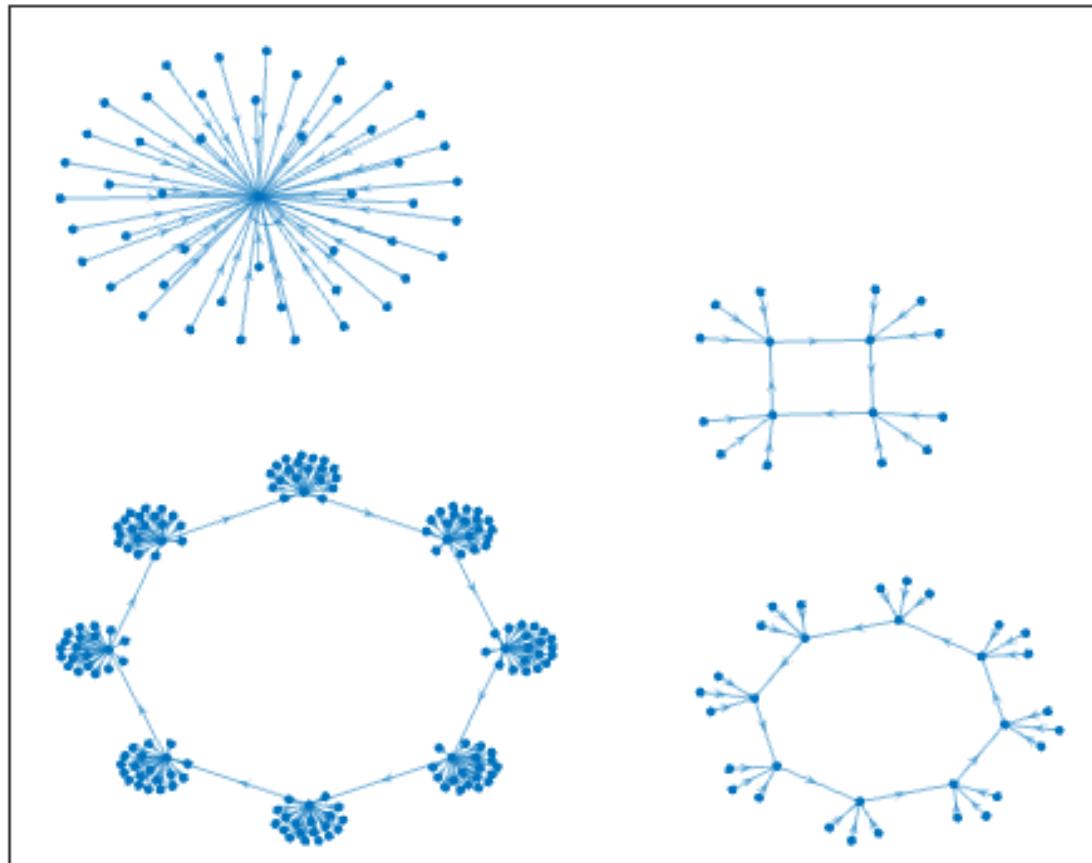
Figura 3.21: Atractor regla 2 $n=3$

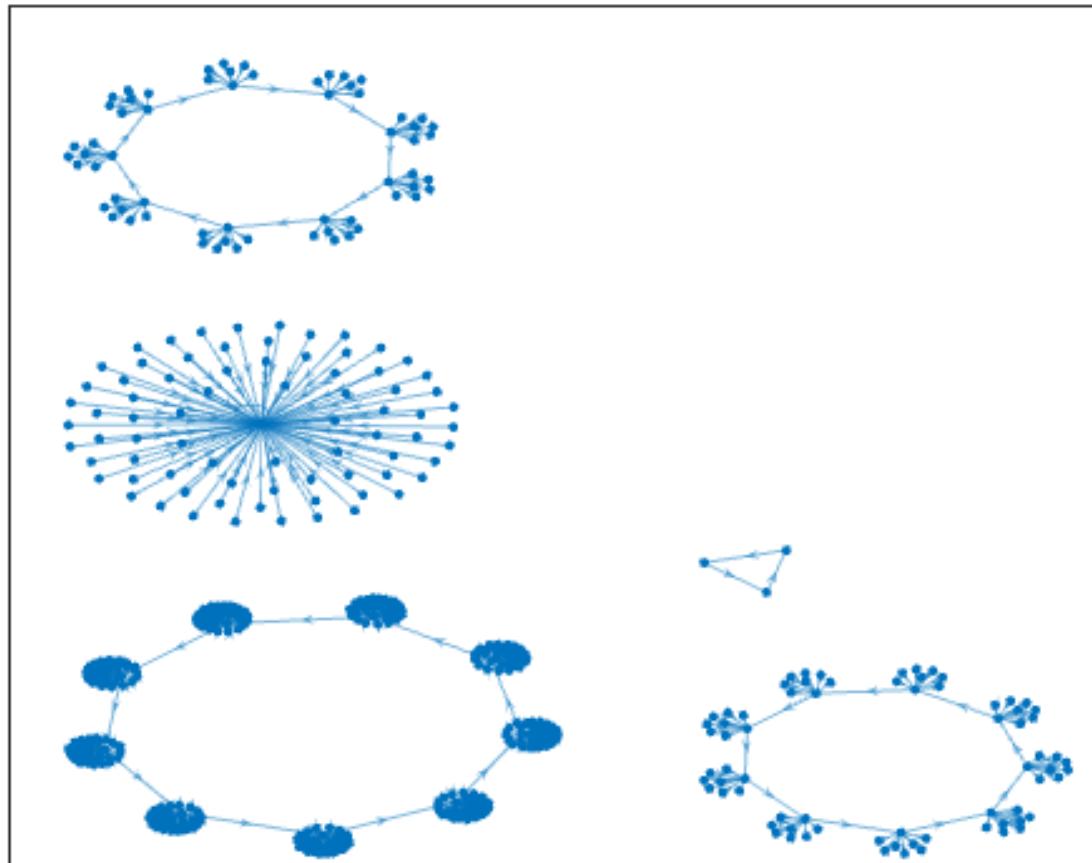
Figura 3.22: Atractor regla 2 $n=4$

Figura 3.23: Atractor regla 2 $n=5$

Figura 3.24: Atractor regla 2 $n=6$

Figura 3.25: Atractor regla 2 $n=7$

Figura 3.26: Atractor regla 2 $n=8$

Figura 3.27: Atractor regla 2 $n=9$

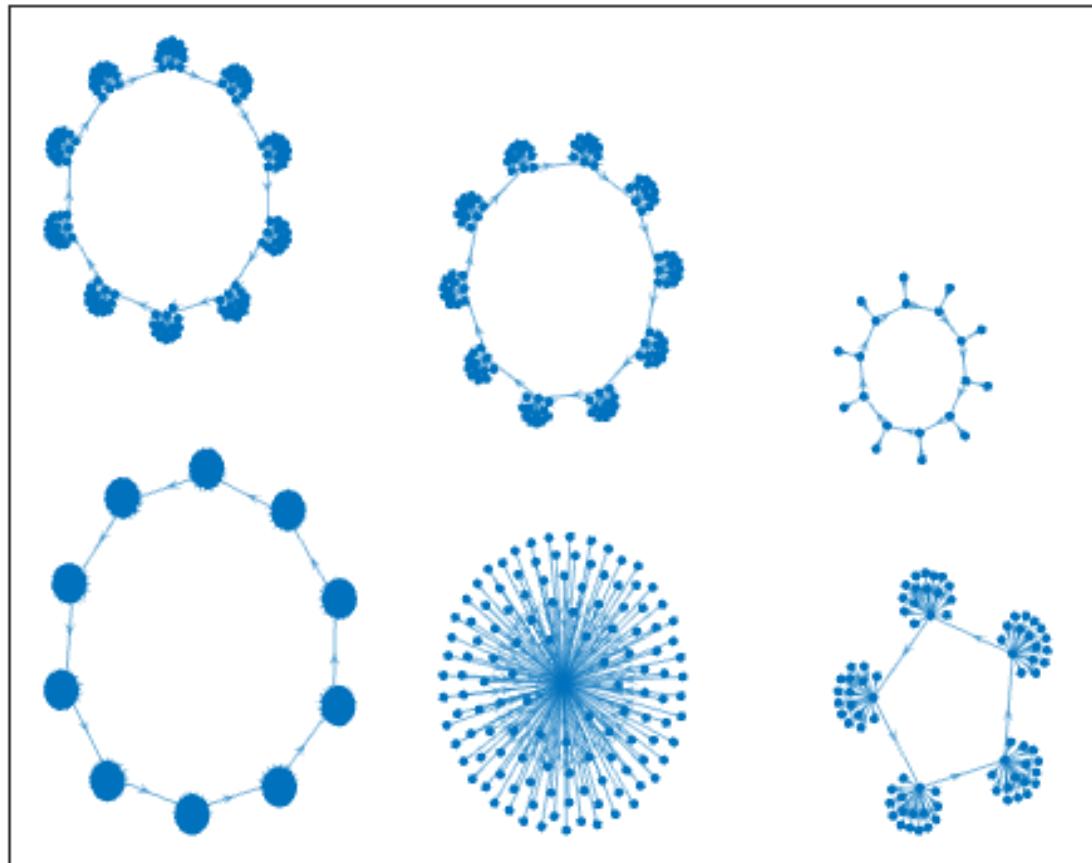
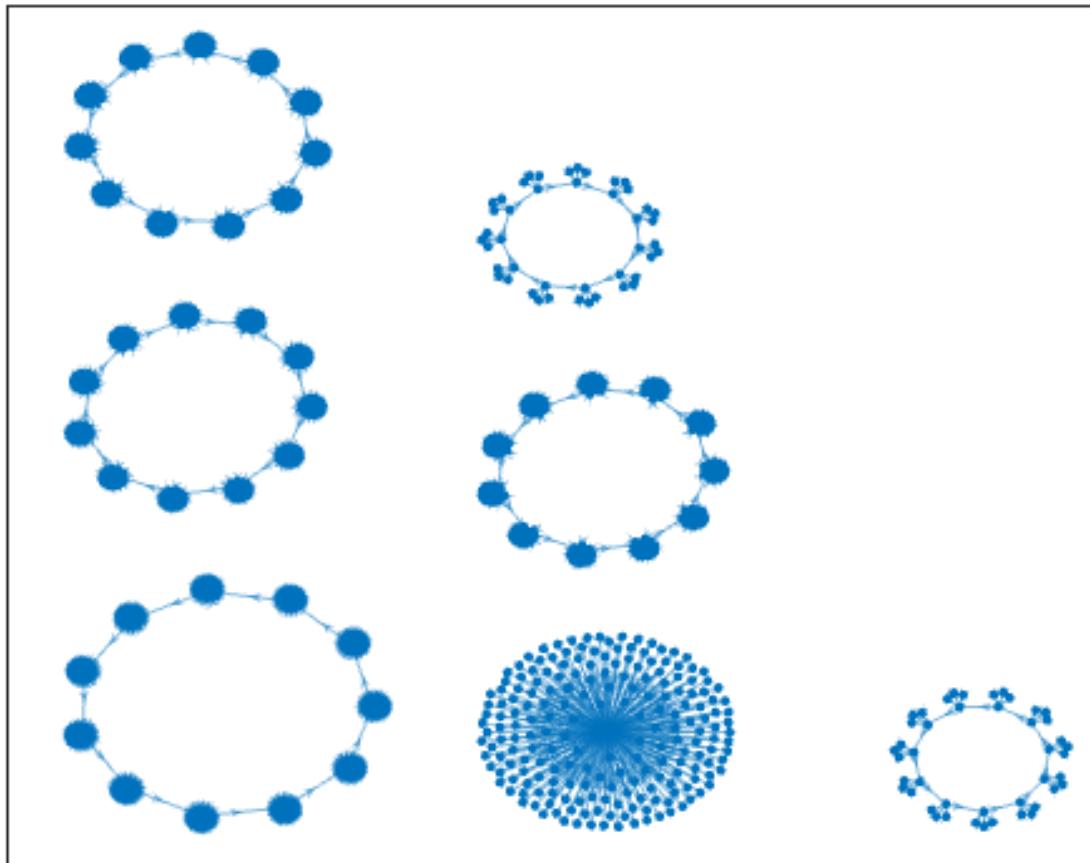
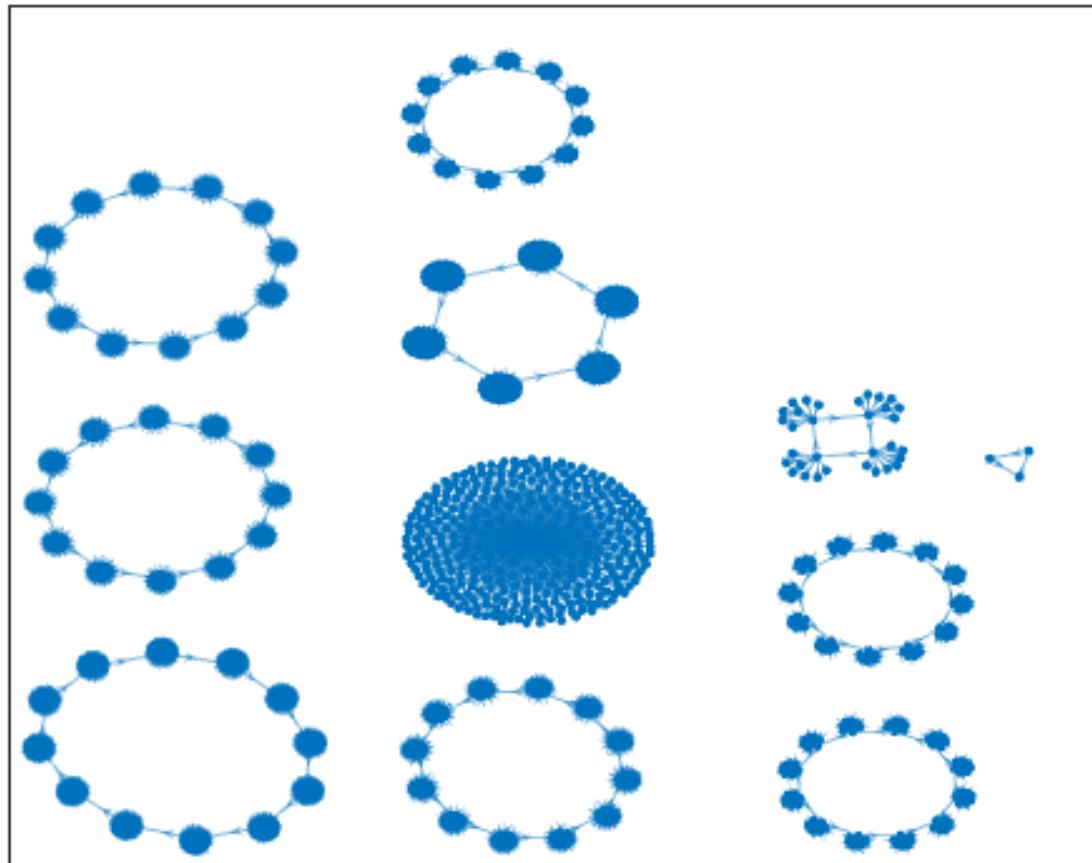


Figura 3.28: Atractor regla 2 n=10

Figura 3.29: Atractor regla 2 $n=11$

Figura 3.30: Atractor regla 2 $n=12$

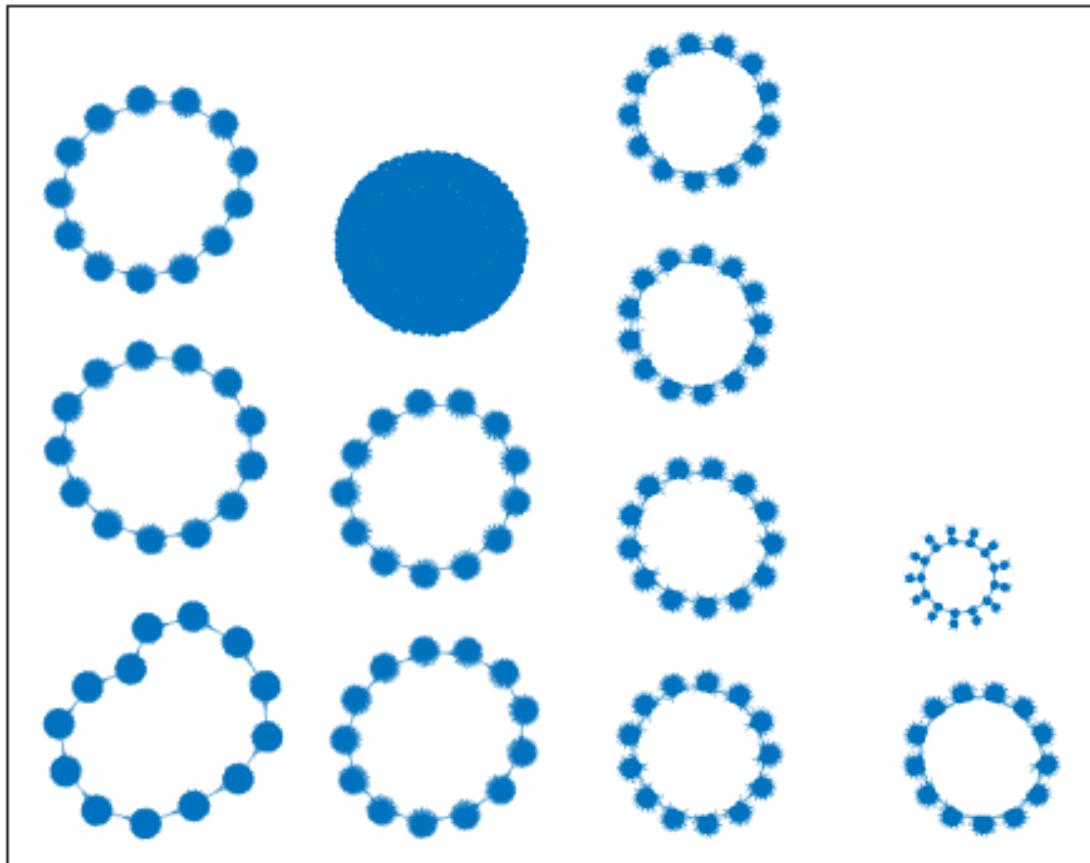
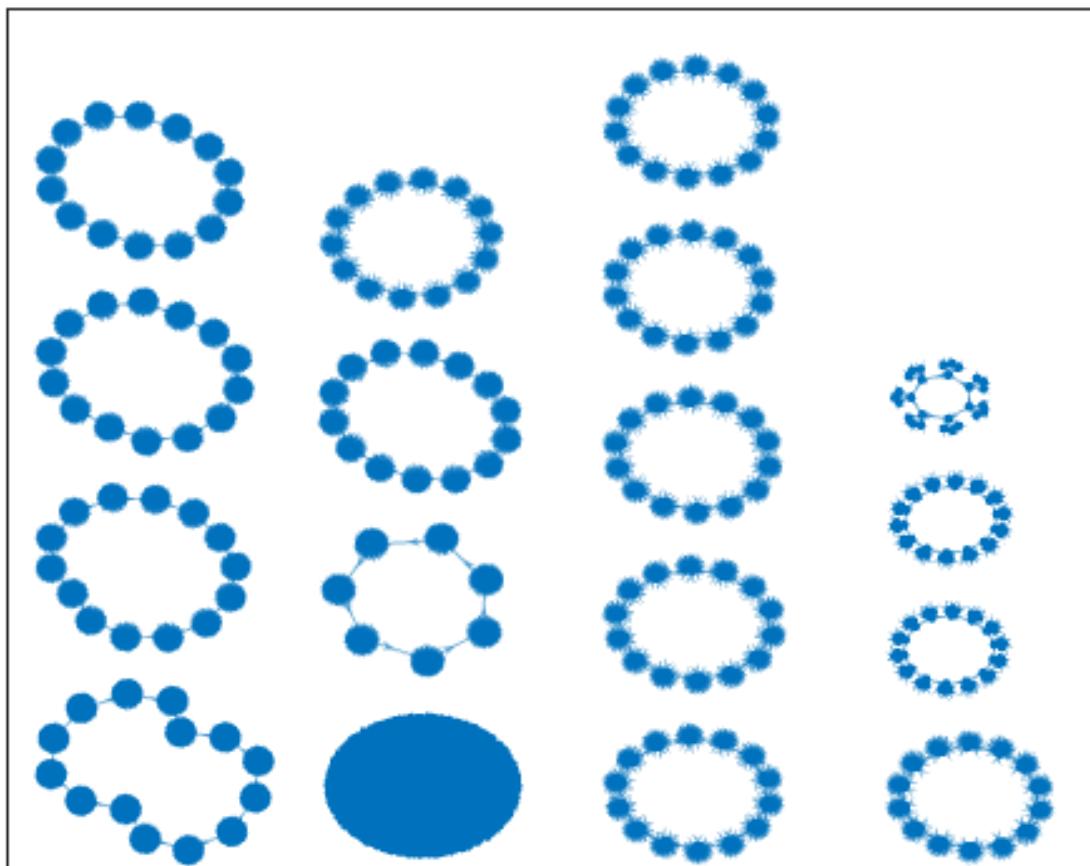


Figura 3.31: Atractor regla 2 n=13

Figura 3.32: Atractor regla 2 $n=14$

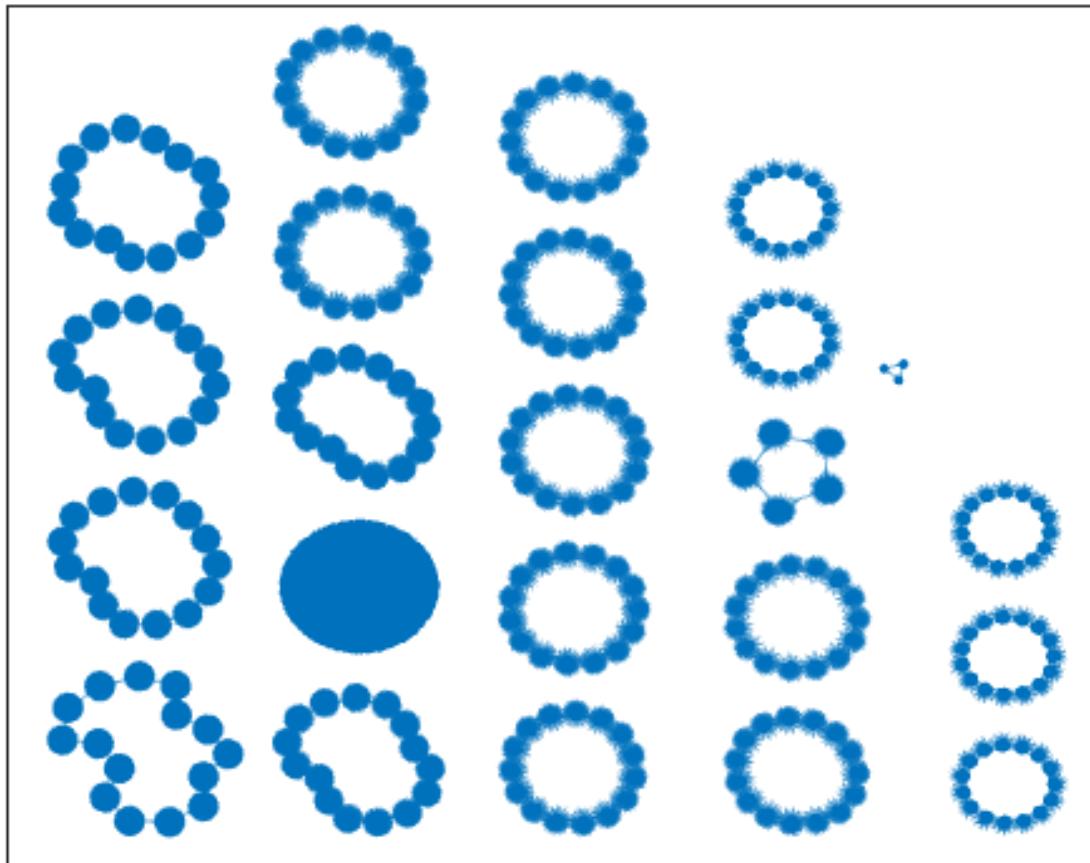


Figura 3.33: Atractor regla 2 n=15

3.4. Reglas 3,17,63,119

Respecto a la regla 3 se aprecia que mientras más grande es el tamaño de la cadena (n), sucede algo similar con la regla 2 con el cambio de que aquí los polígonos aumentan el número de sus lados más rápido creando múltiples polígonos en un solo tamaño de n y después de que son tantos nodos pareciera que se genera una "plasta" parecida a un círculo.

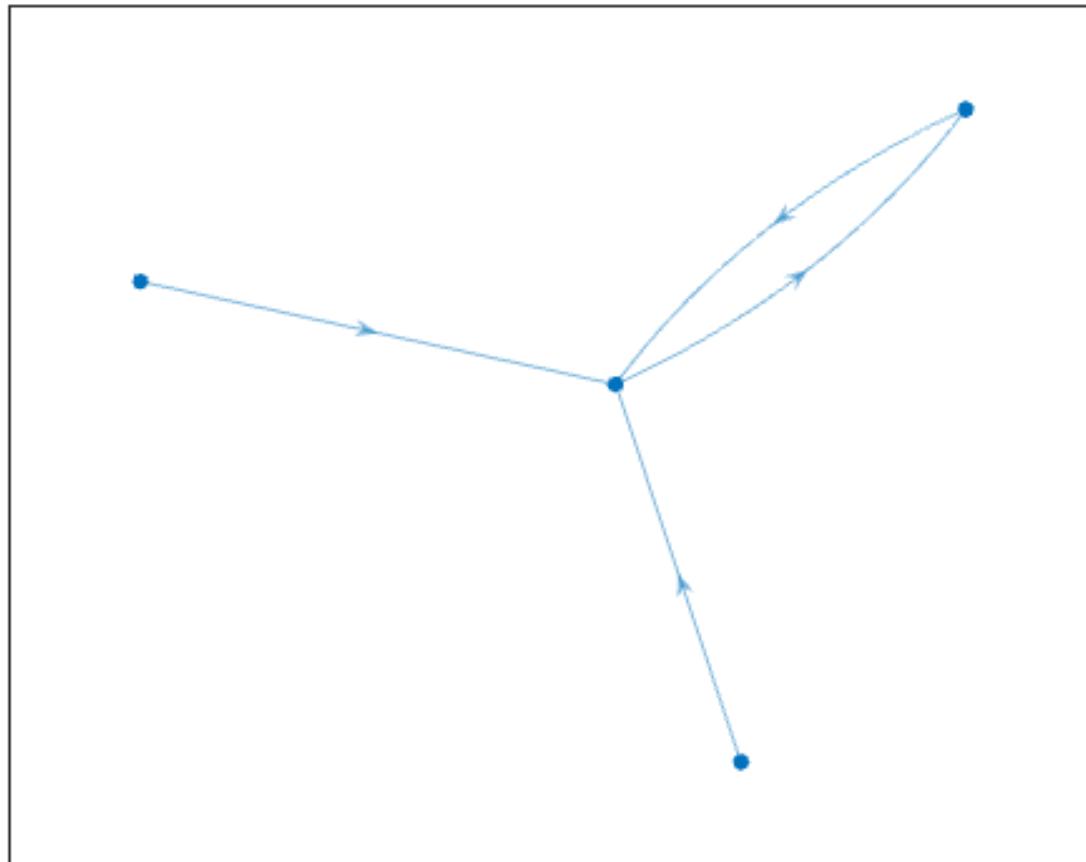
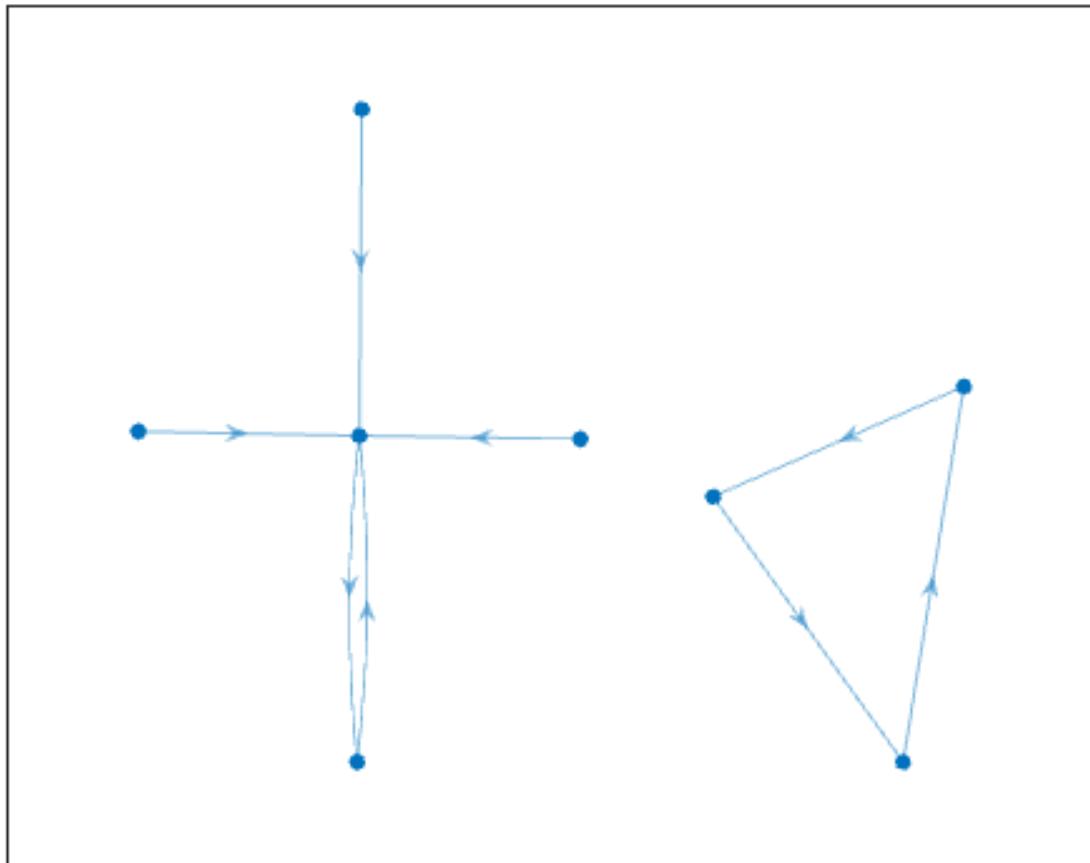


Figura 3.34: Atractor regla 3 $n=2$

Figura 3.35: Atractor regla 3 $n=3$

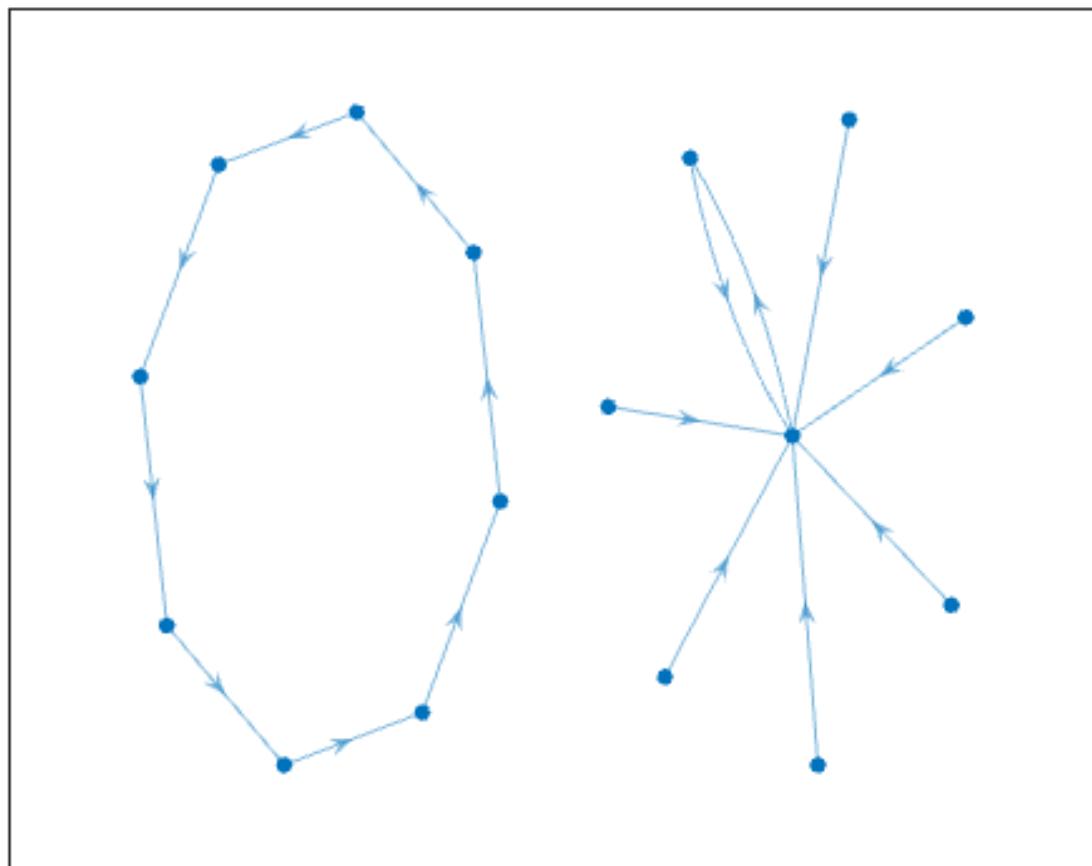


Figura 3.36: Atractor regla 3 n=4

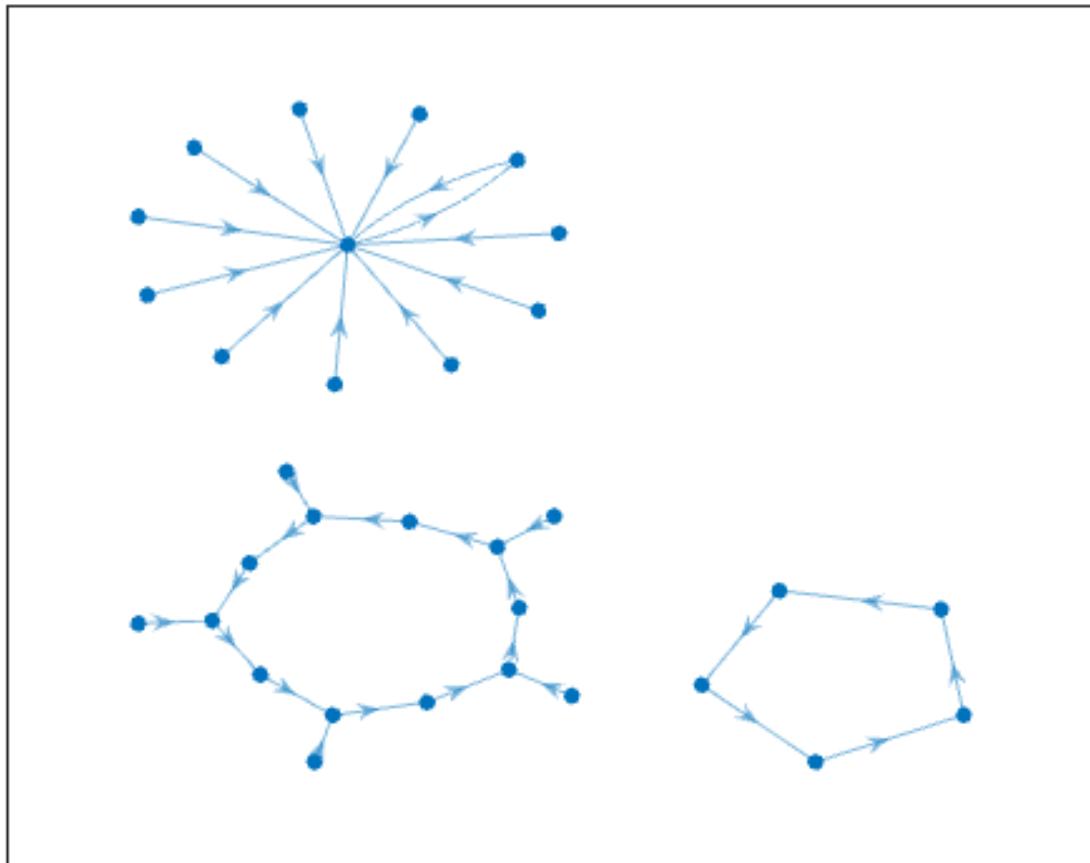
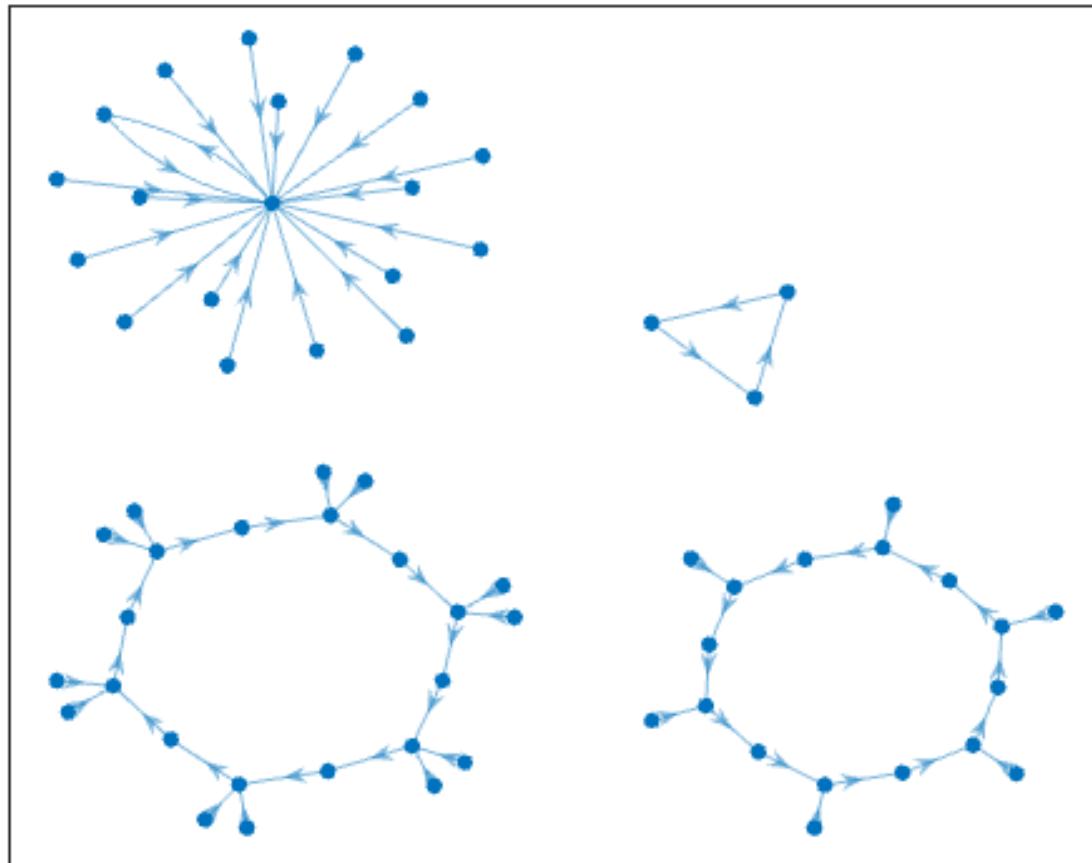
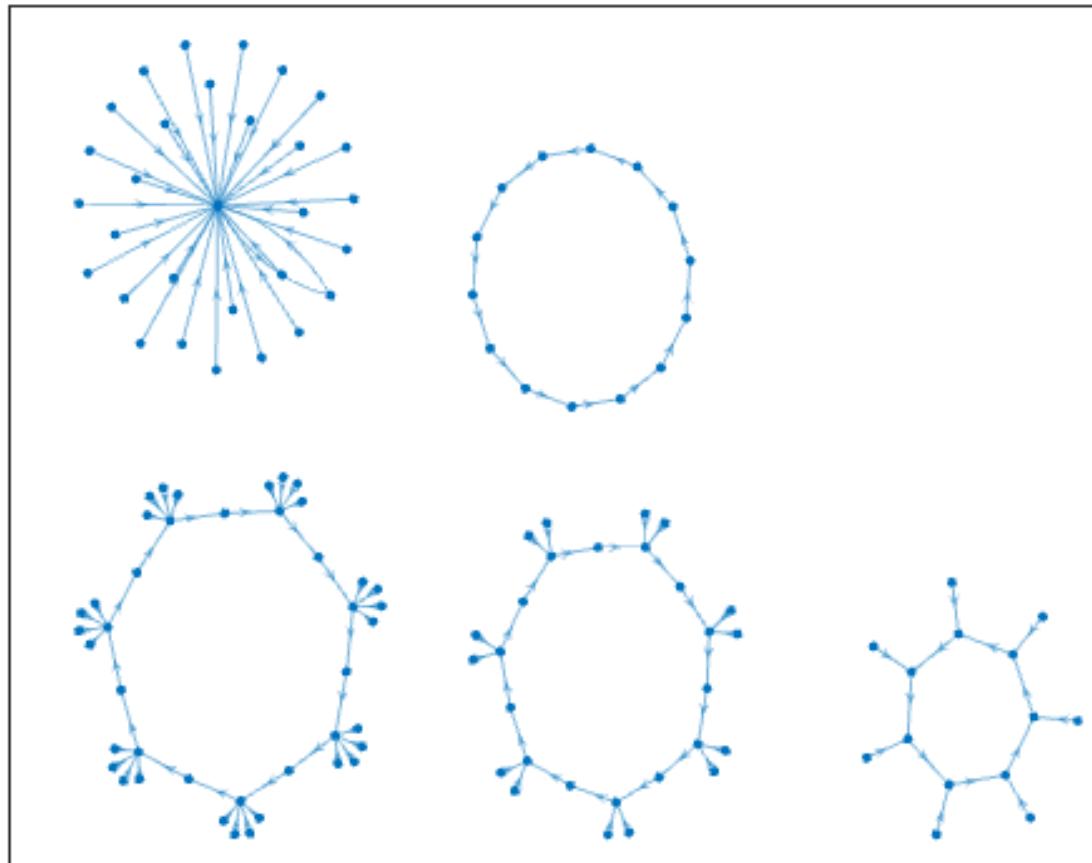
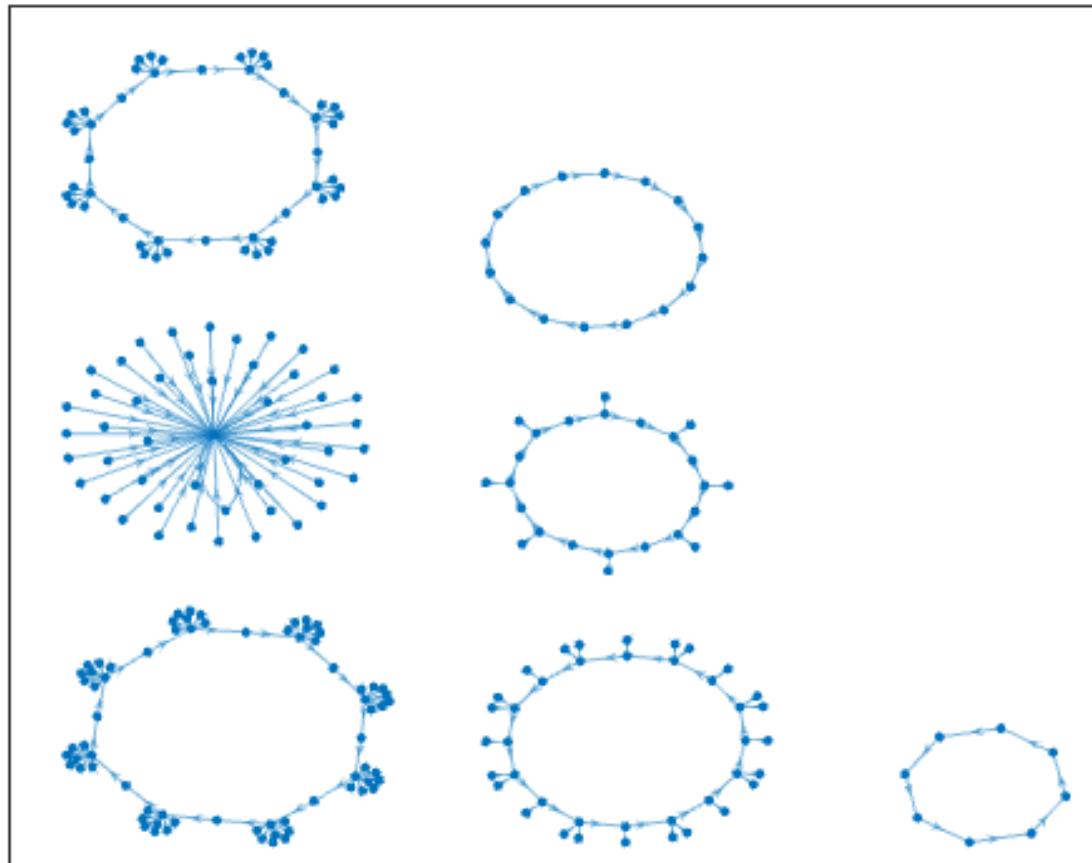


Figura 3.37: Atractor regla 3 n=5

Figura 3.38: Atractor regla 3 $n=6$

Figura 3.39: Atractor regla 3 $n=7$

Figura 3.40: Atractor regla 3 $n=8$

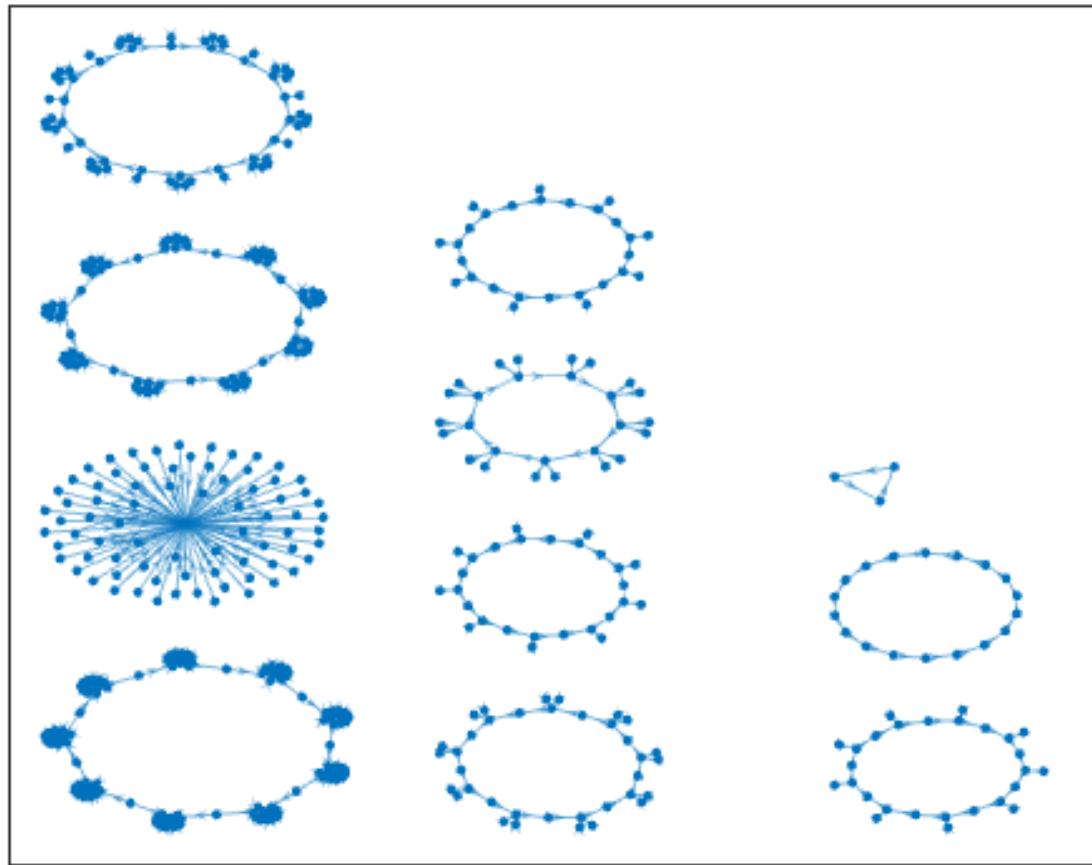


Figura 3.41: Atractor regla 3 n=9

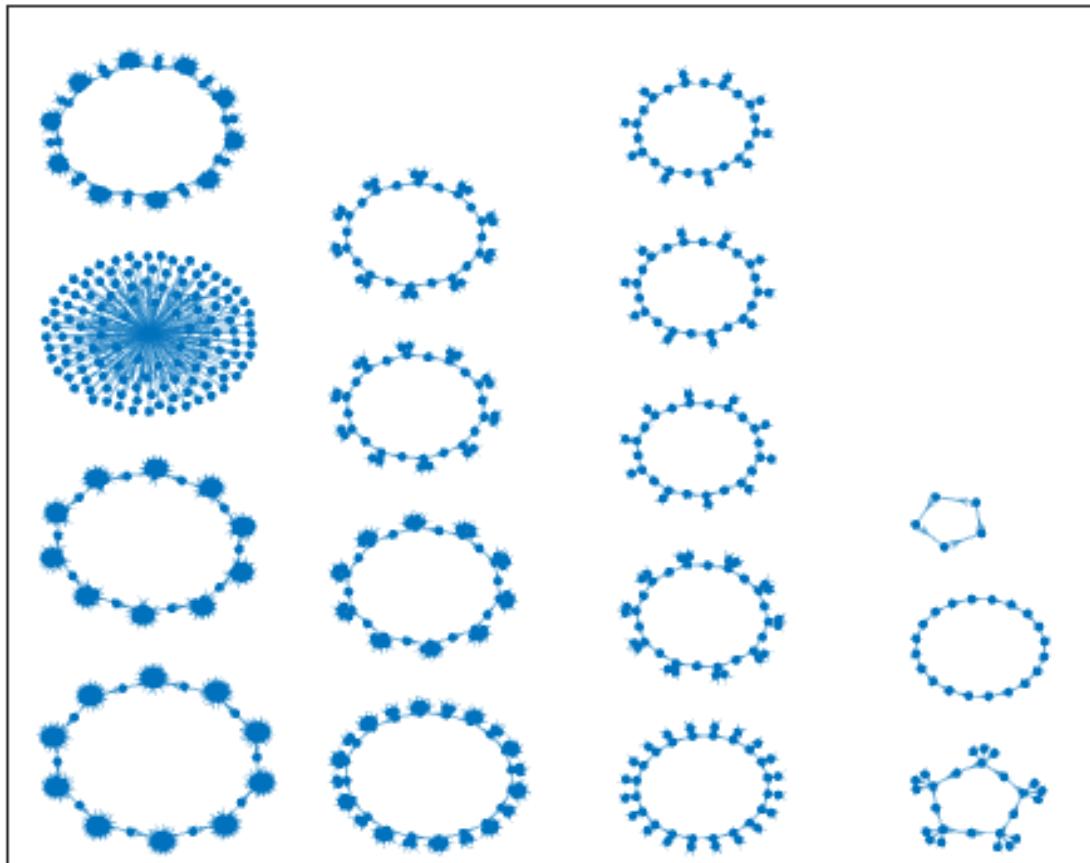


Figura 3.42: Atractor regla 3 n=10

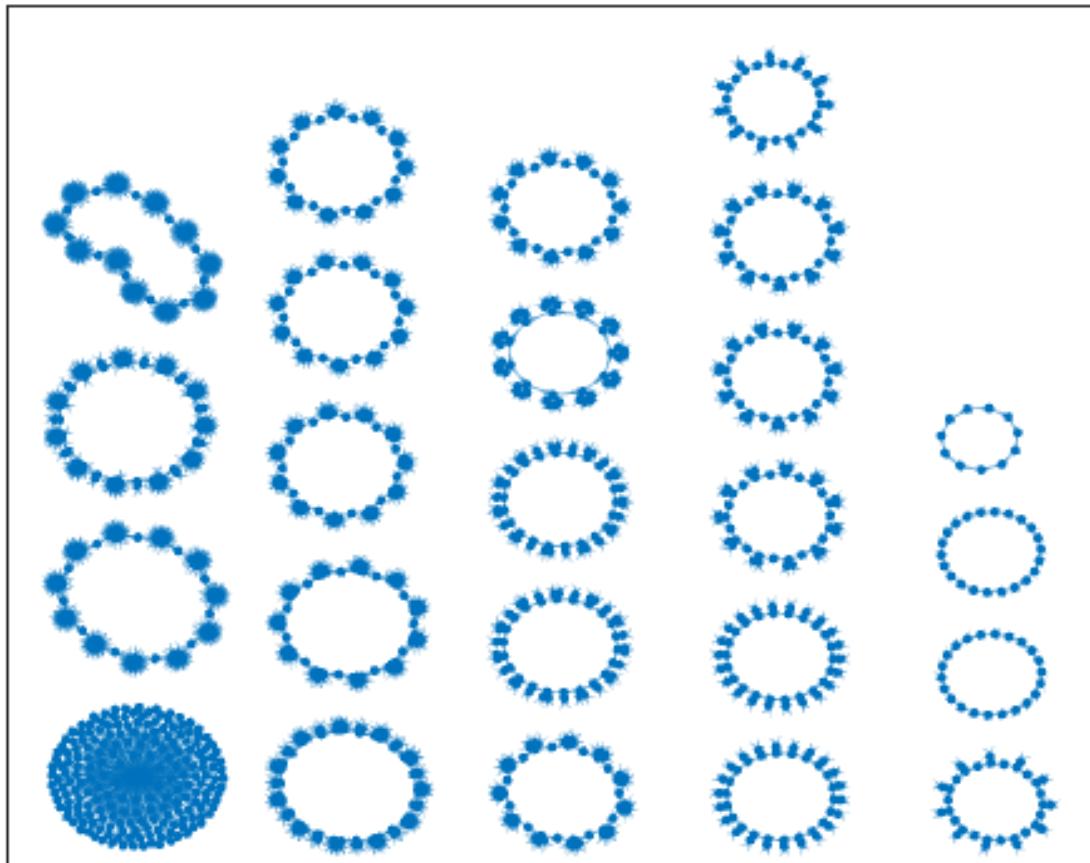


Figura 3.43: Atractor regla 3 n=11

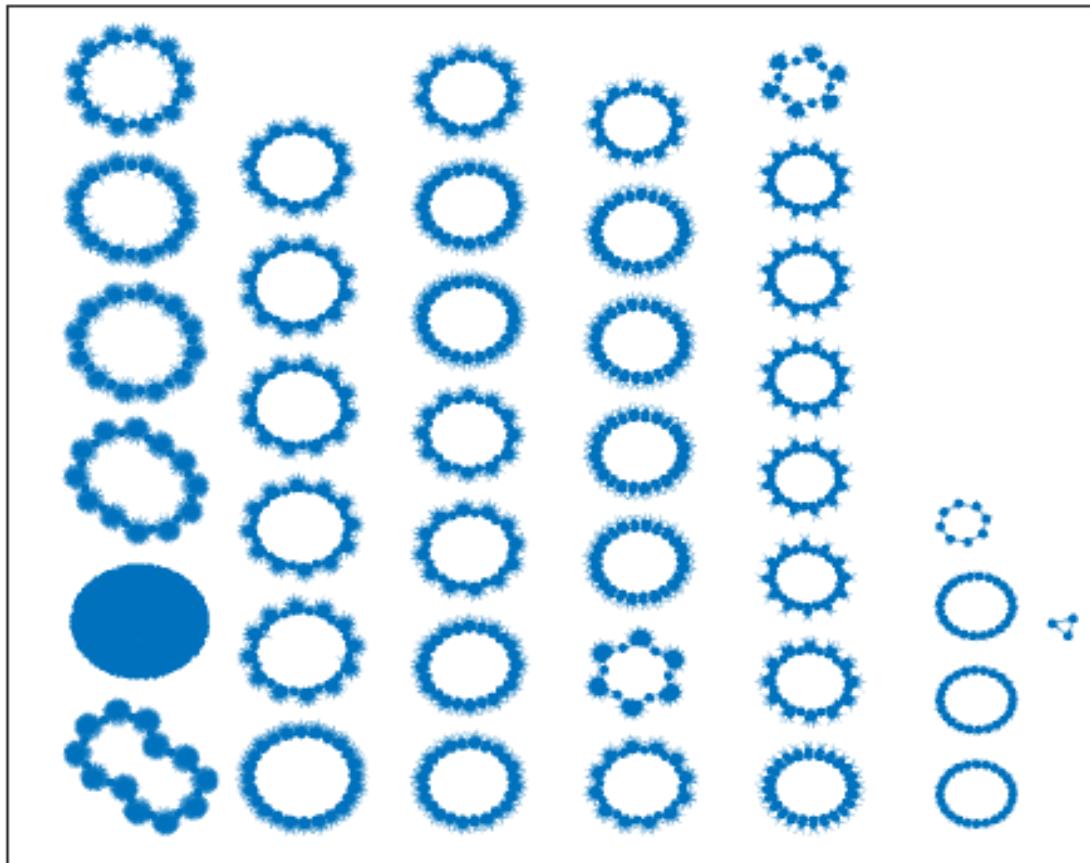
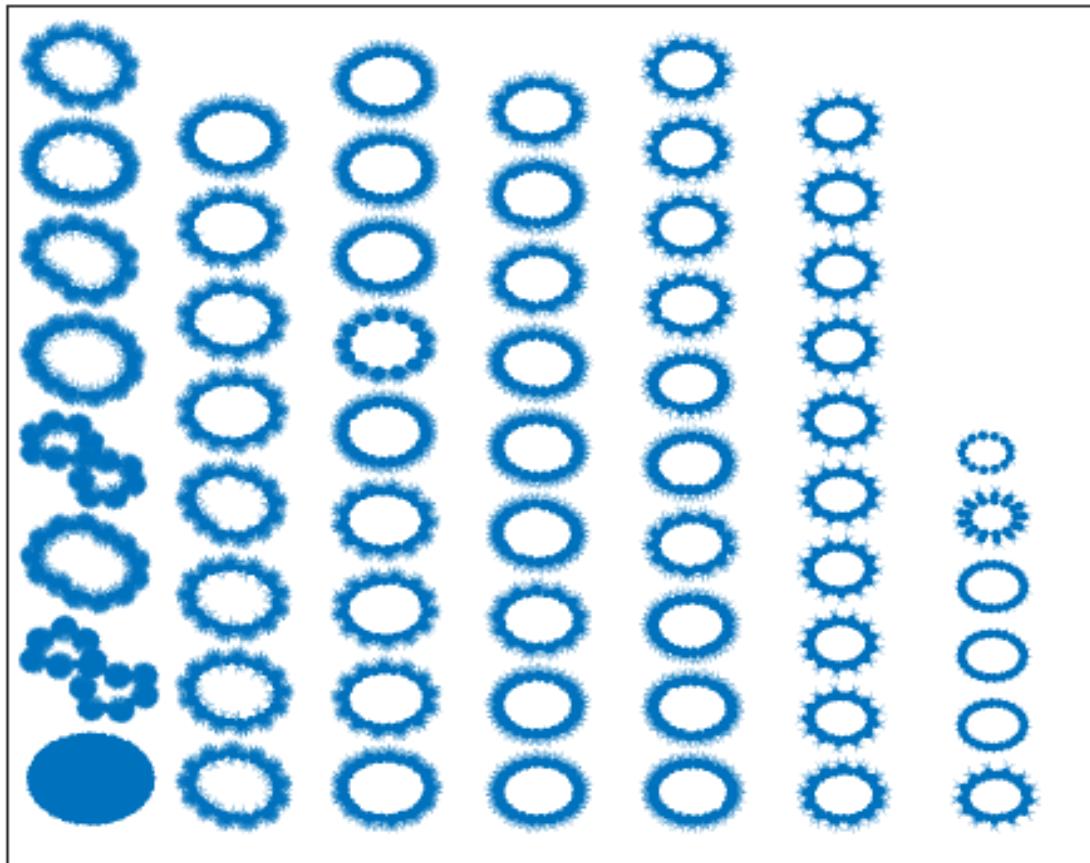


Figura 3.44: Atractor regla 3 n=12

Figura 3.45: Atractor regla 3 $n=13$

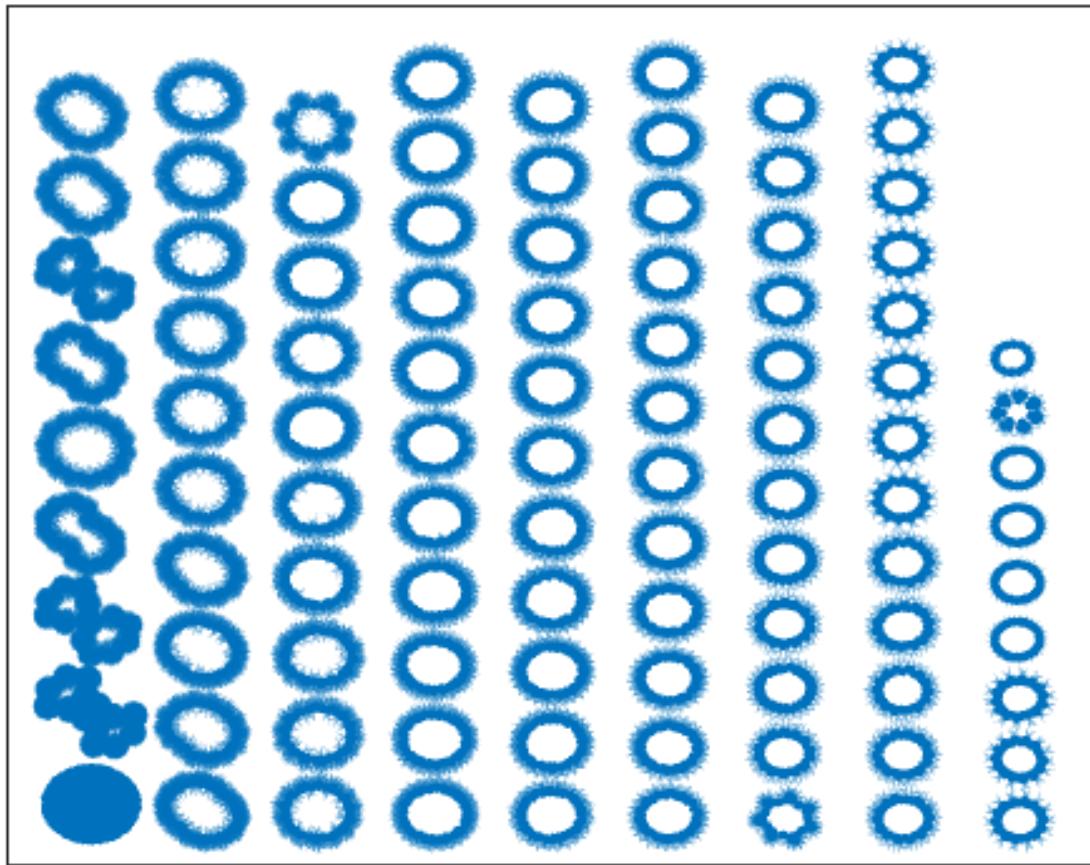


Figura 3.46: Atractor regla 3 n=14

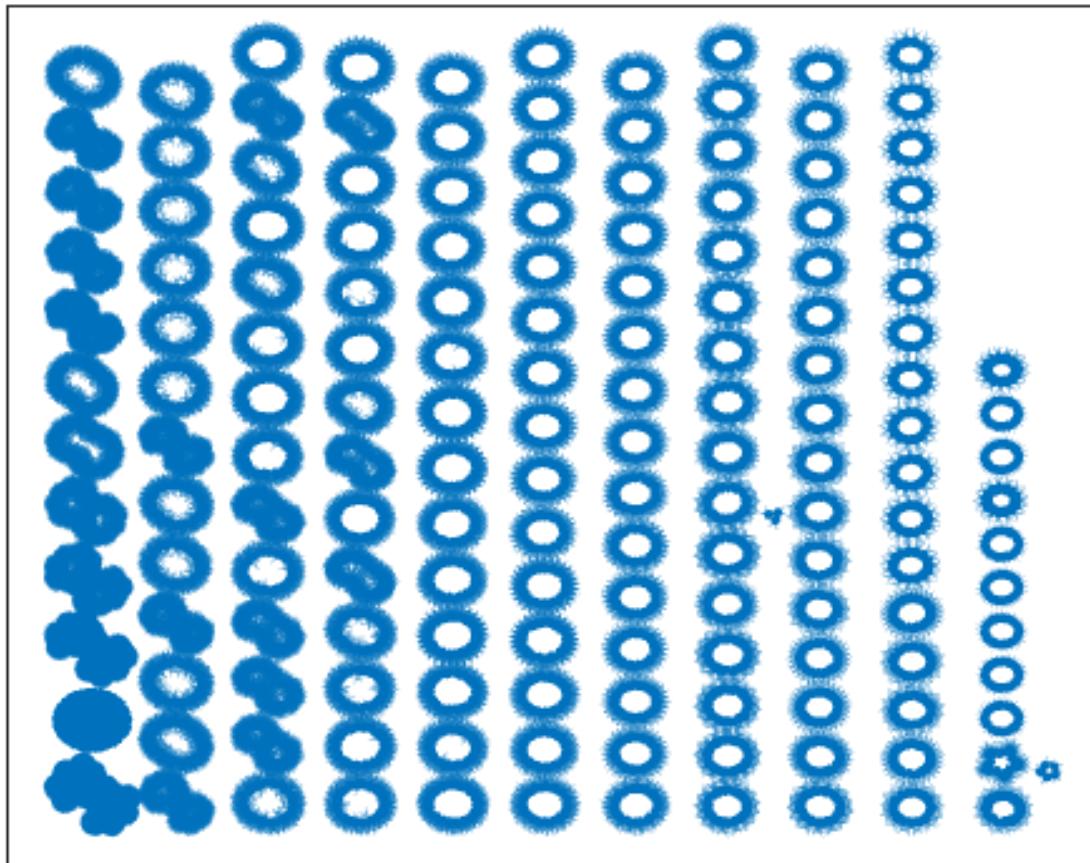


Figura 3.47: Atractor regla 3 n=15

3.5. Reglas 4,223

Respecto a la regla 4 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen nuevos atractores autoreferenciados que mientras más crece la n más nodos convergen a ellos y mientras sucede eso nuevos atractores autoreferenciados surgen.

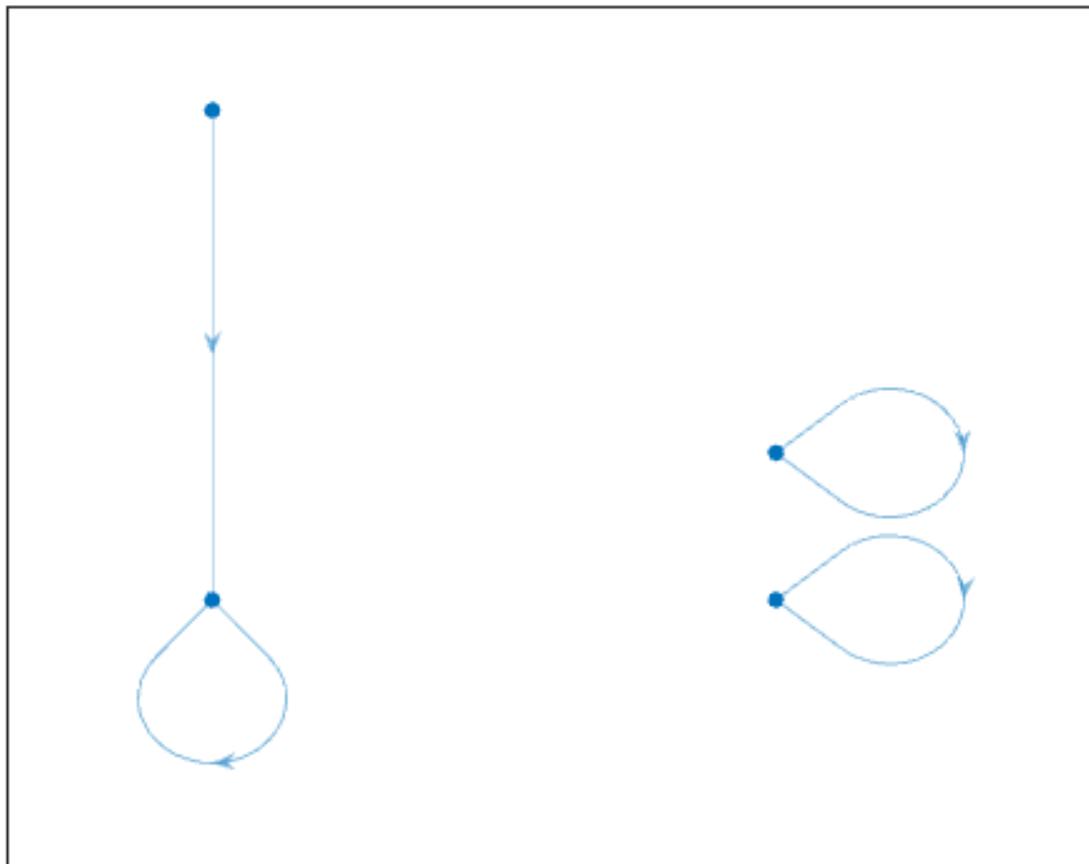


Figura 3.48: Atractor regla 4 $n=2$

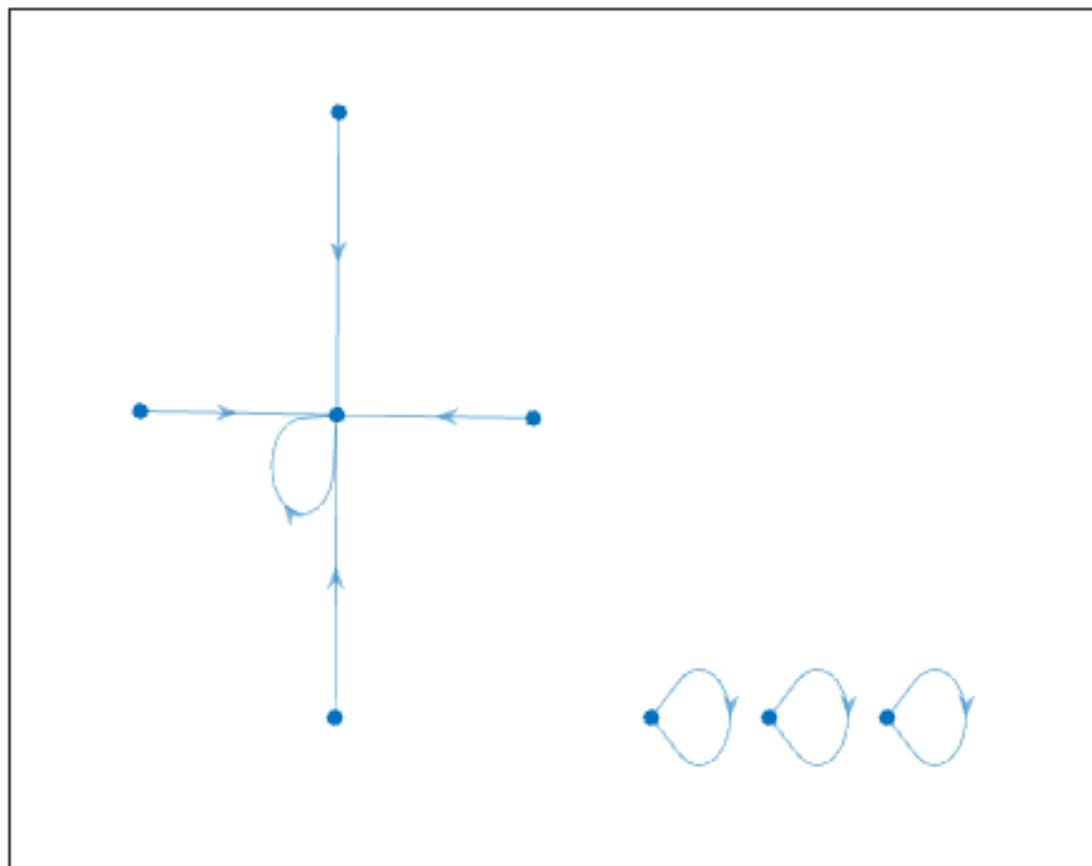


Figura 3.49: Atractor regla 4 n=3

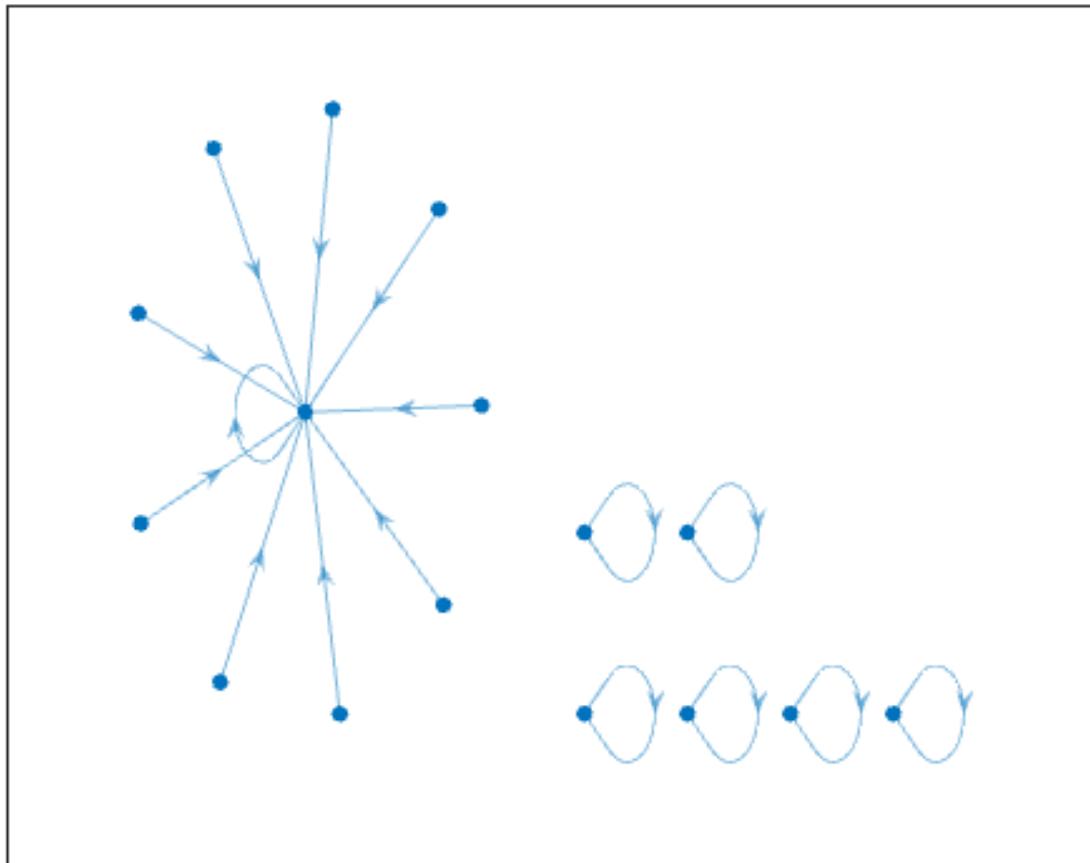


Figura 3.50: Atractor regla 4 n=4

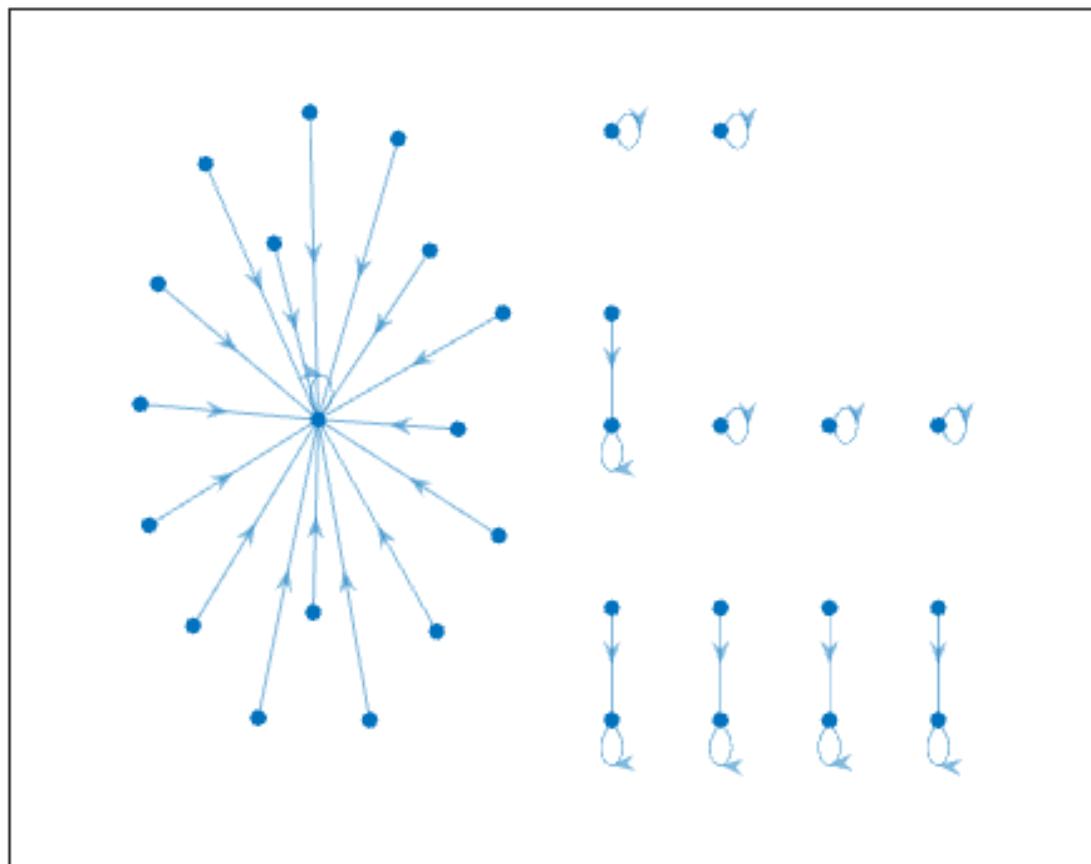


Figura 3.51: Atractor regla 4 n=5

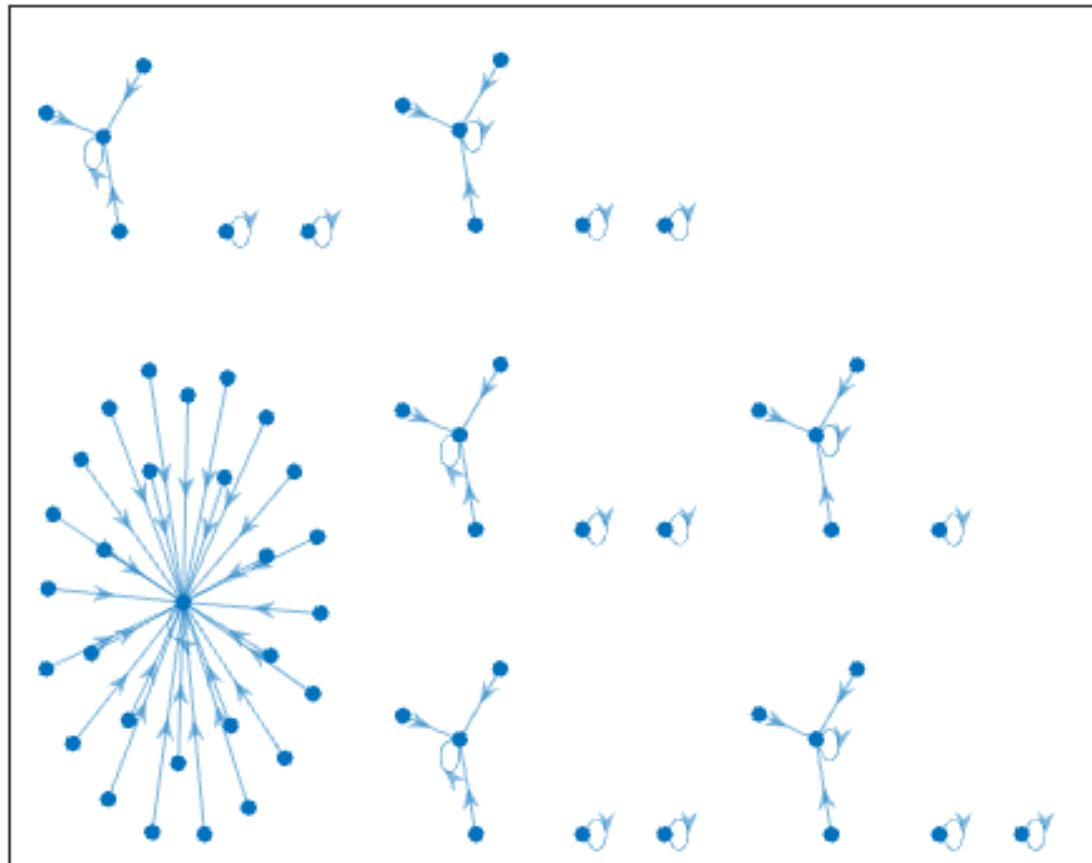
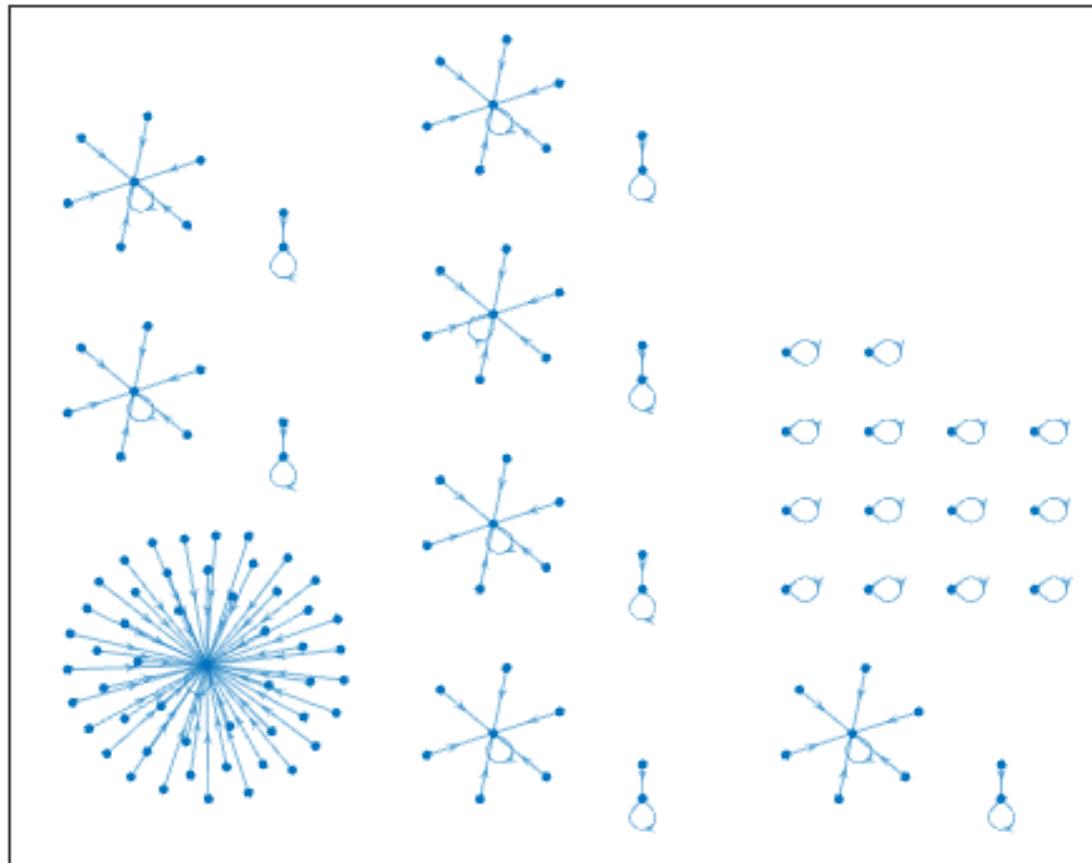


Figura 3.52: Atractor regla 4 n=6

Figura 3.53: Atractor regla 4 $n=7$

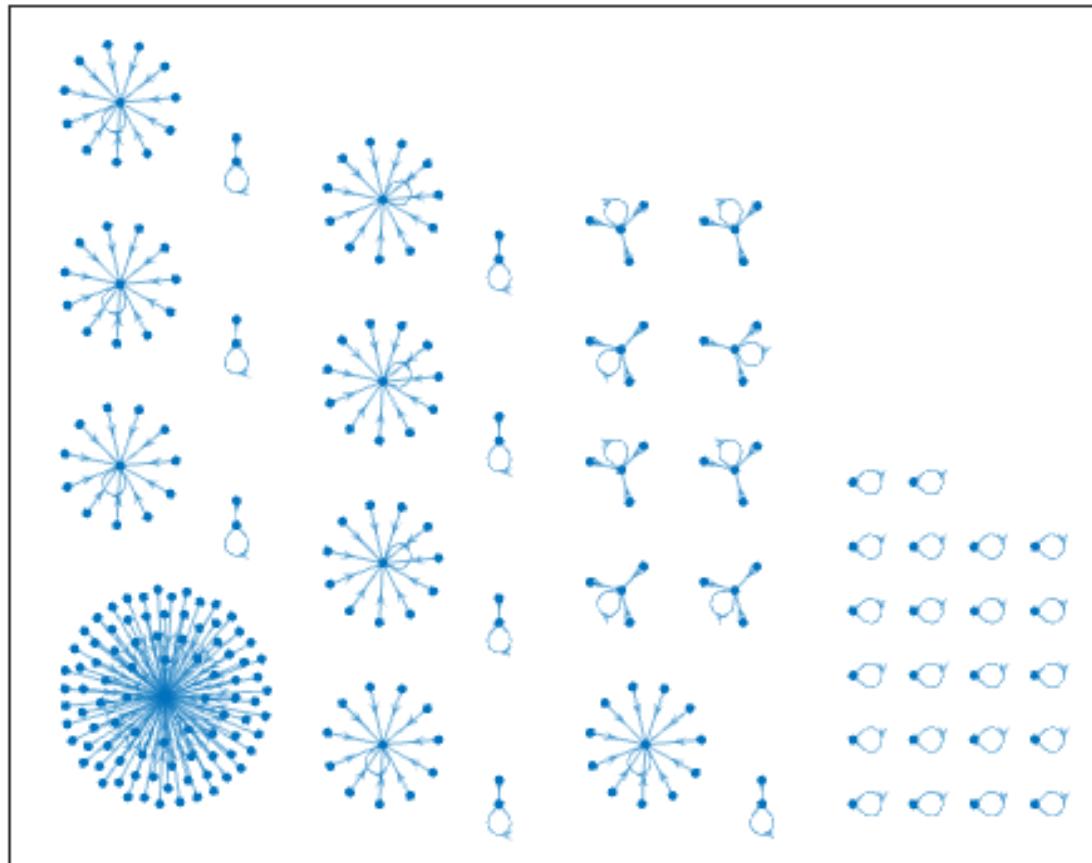


Figura 3.54: Atractor regla 4 n=8

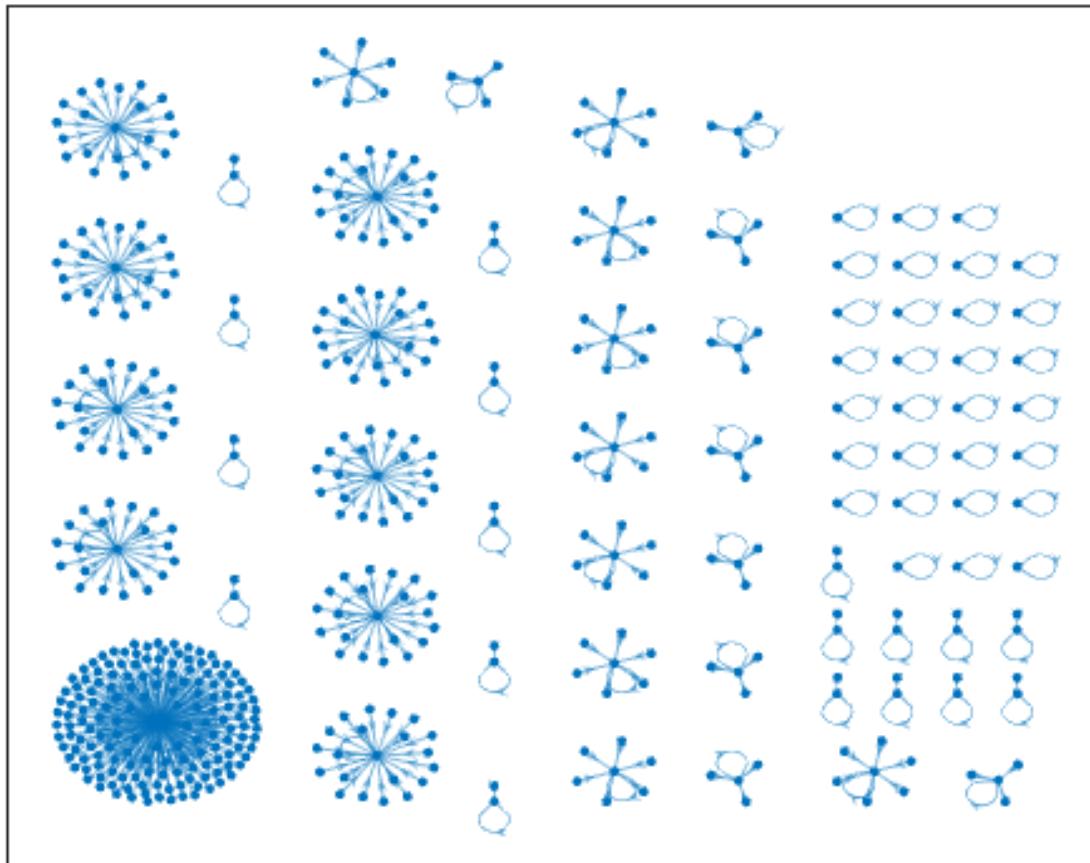
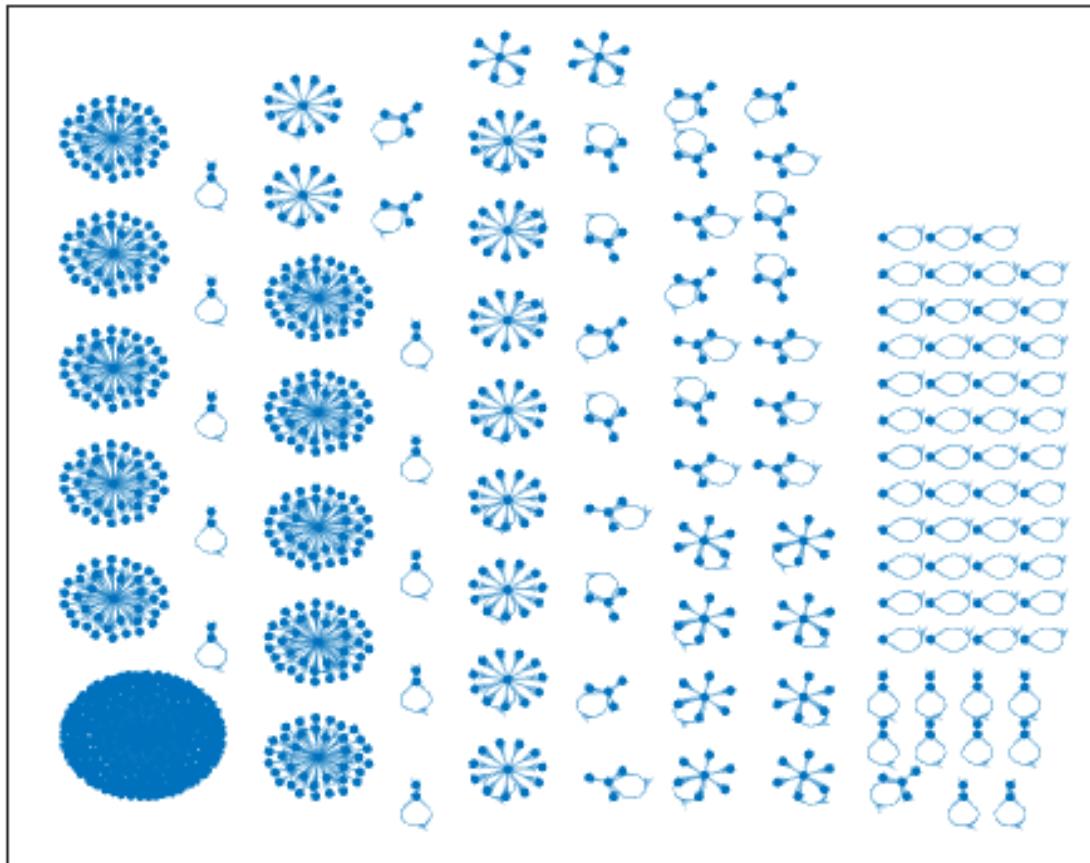
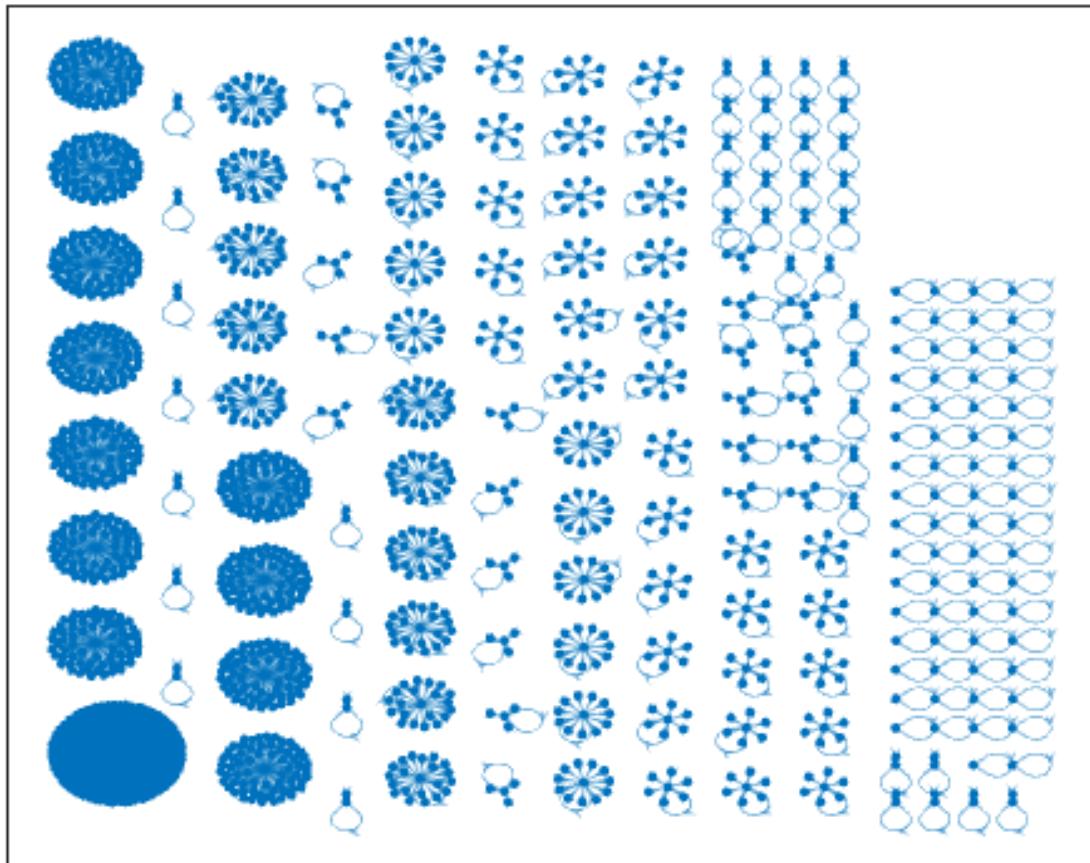


Figura 3.55: Atractor regla 4 n=9

Figura 3.56: Atractor regla 4 $n=10$

Figura 3.57: Atractor regla 4 $n=11$

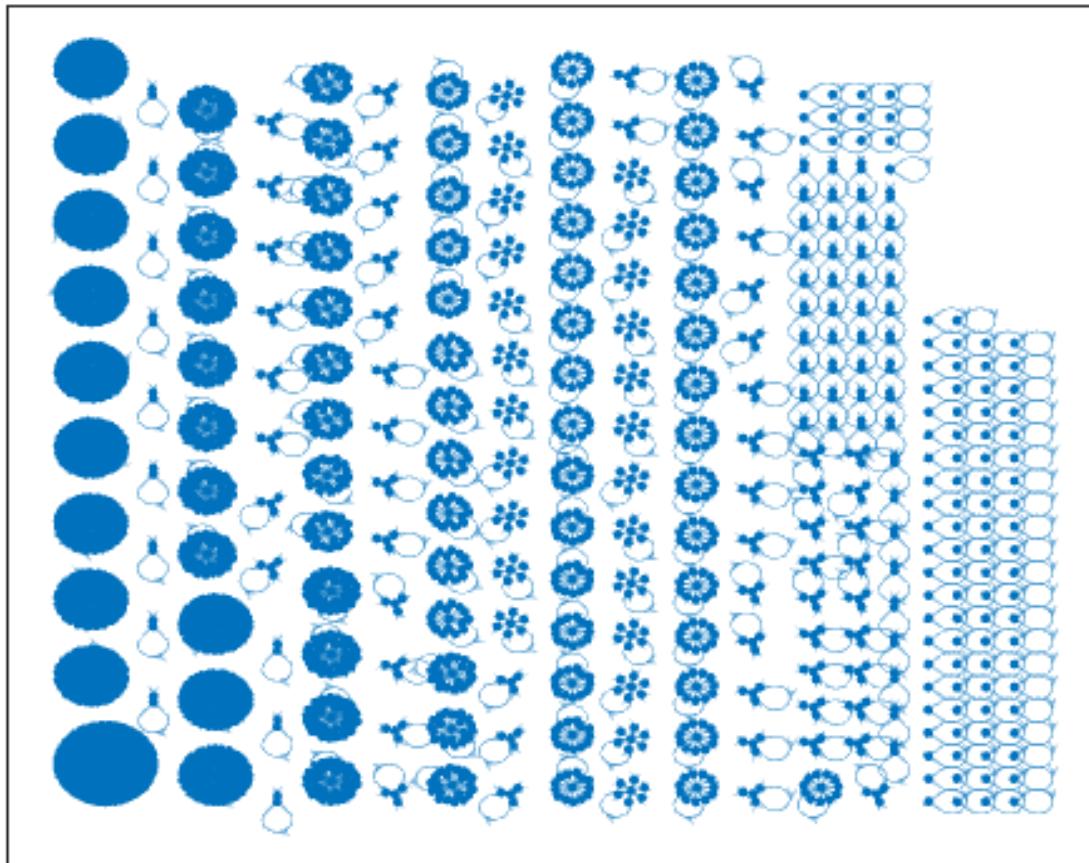
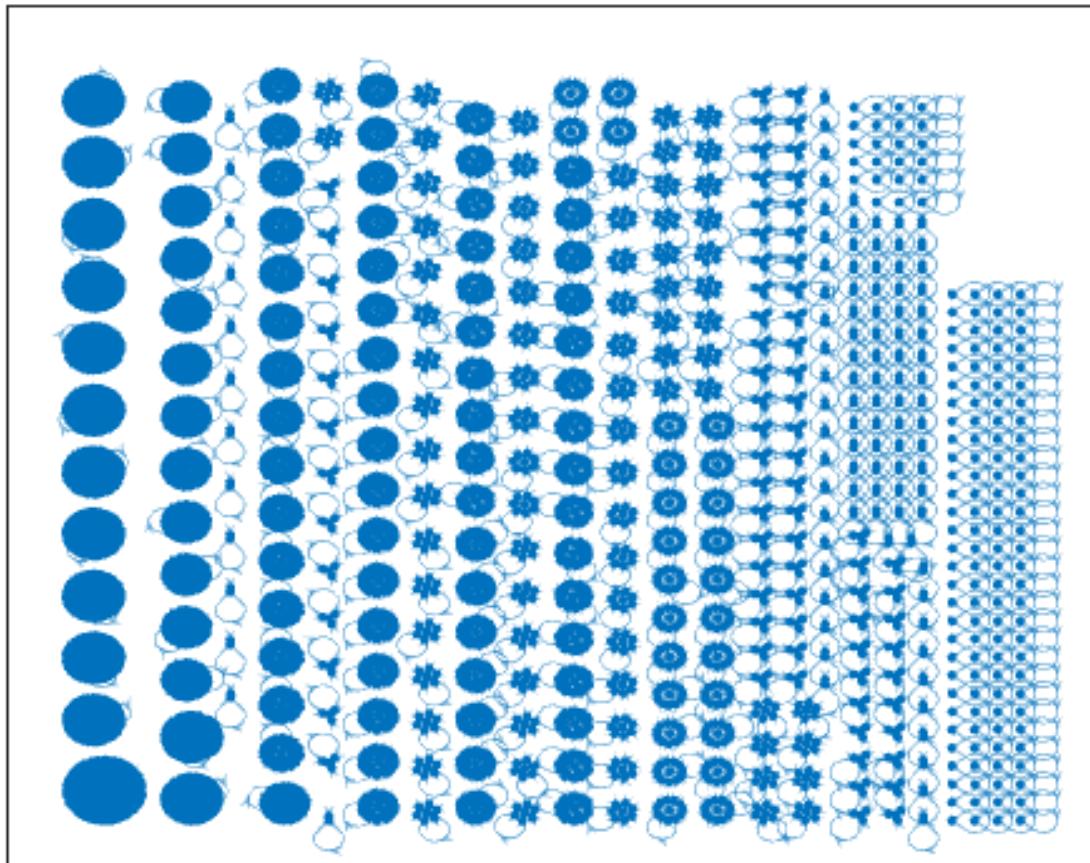


Figura 3.58: Atractor regla 4 n=12

Figura 3.59: Atractor regla 4 $n=13$

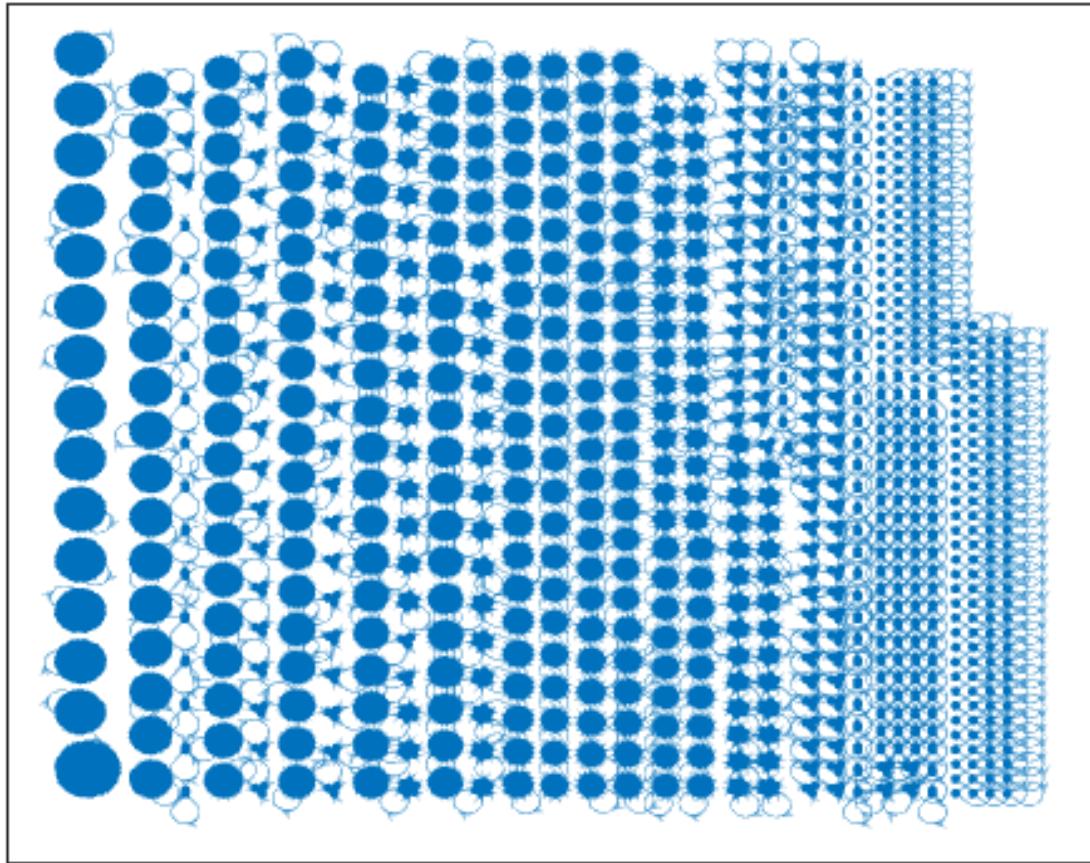


Figura 3.60: Atractor regla 4 n=14

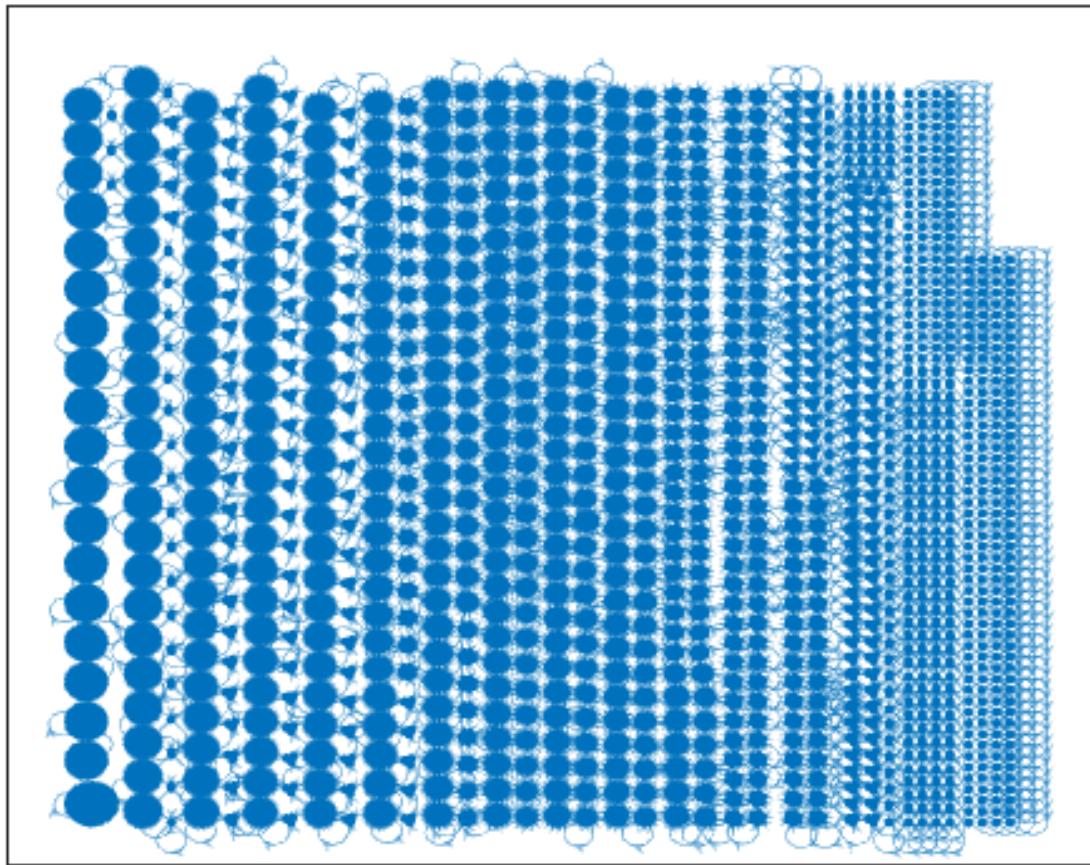


Figura 3.61: Atractor regla 4 $n=15$

3.6. Reglas 5,95

Respecto a la regla 5 se aprecia que mientras más grande es el tamaño de la cadena (n) sucede algo similar que con la regla anterior ya que mientras crece n surgen nuevos atractores autoreferenciados y según a como los ordena matlab surgen atractores «idénticos» o que tienen la misma forma como se aprecia en la figura 3.65.

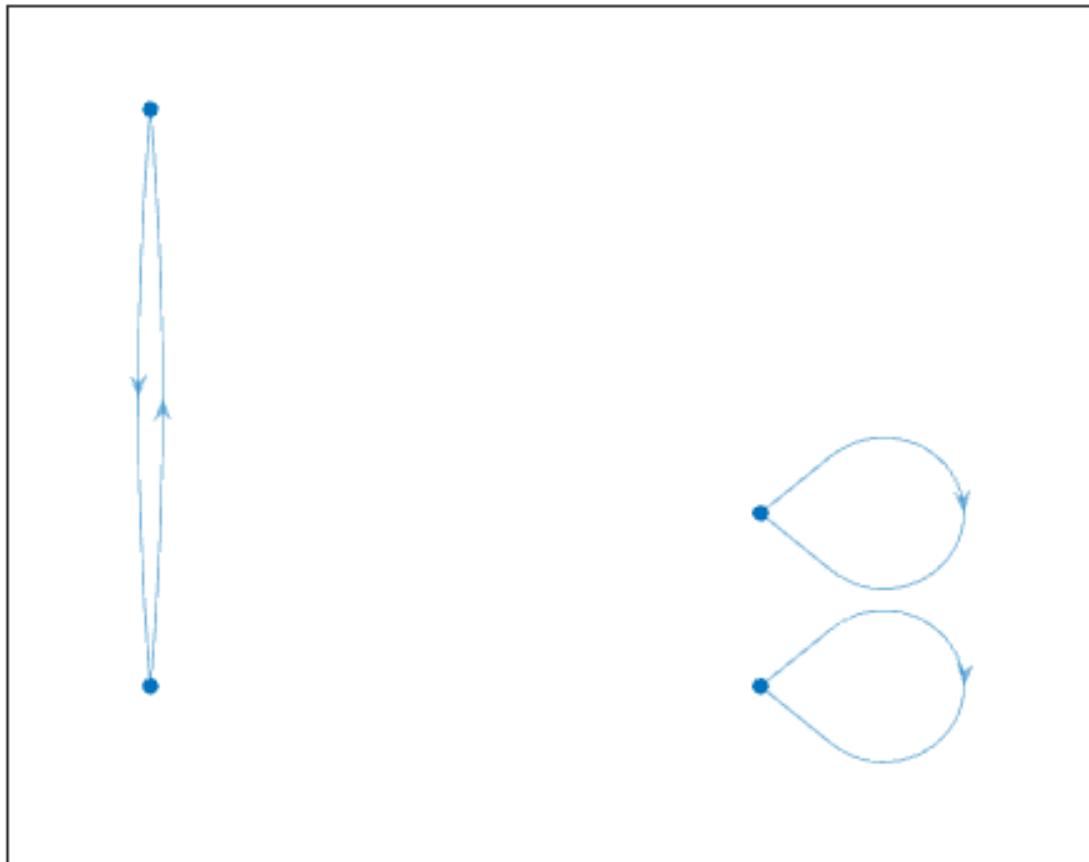


Figura 3.62: Atractor regla 5 $n=2$

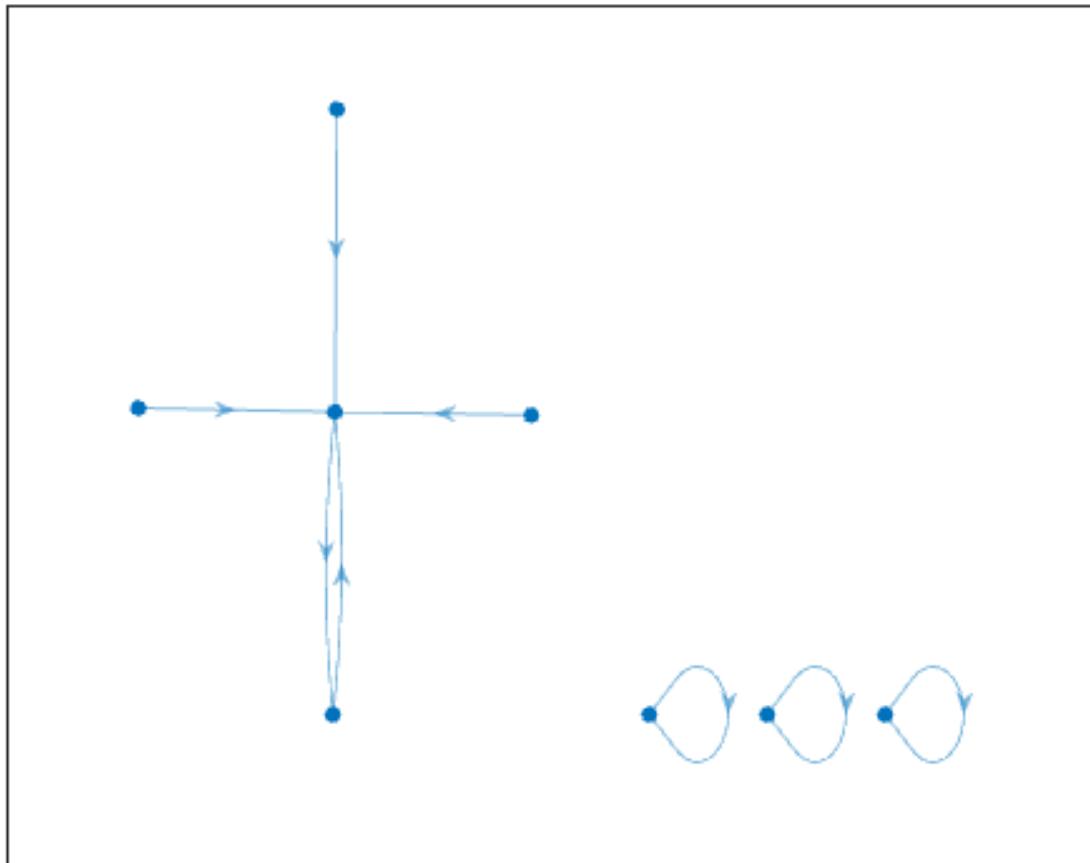


Figura 3.63: Atractor regla 5 n=3

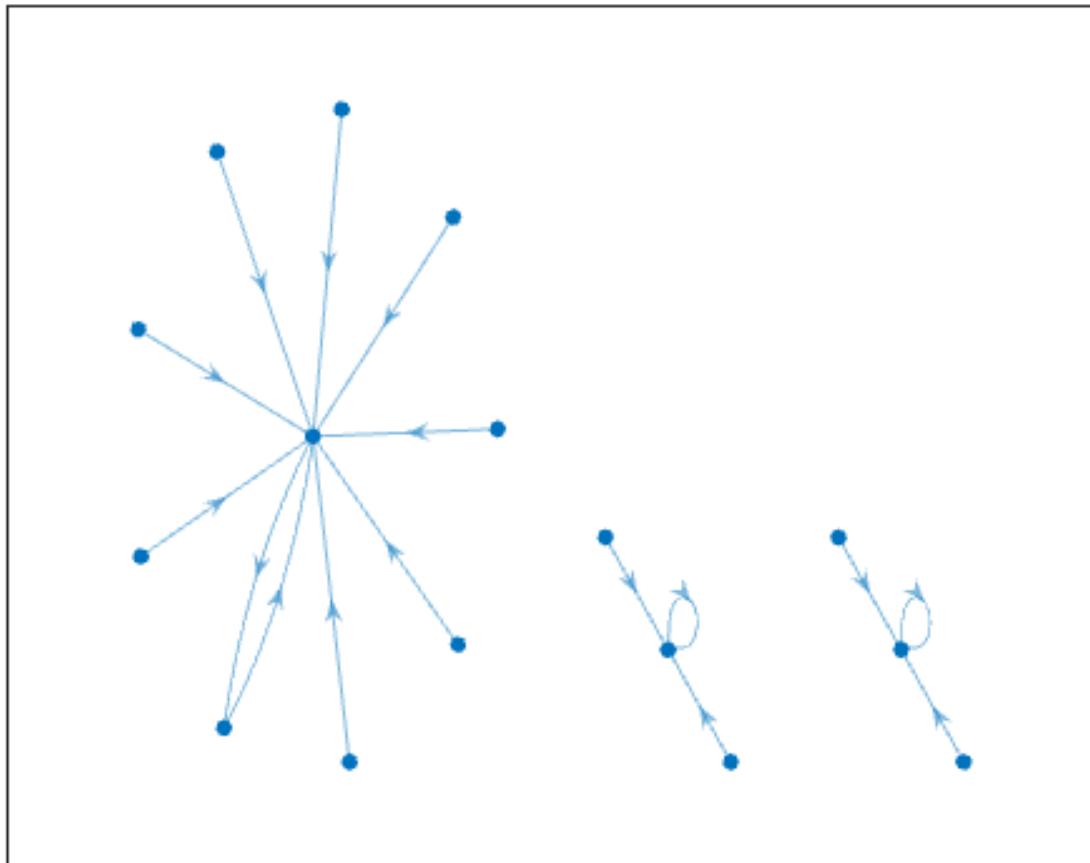


Figura 3.64: Atractor regla 5 n=4

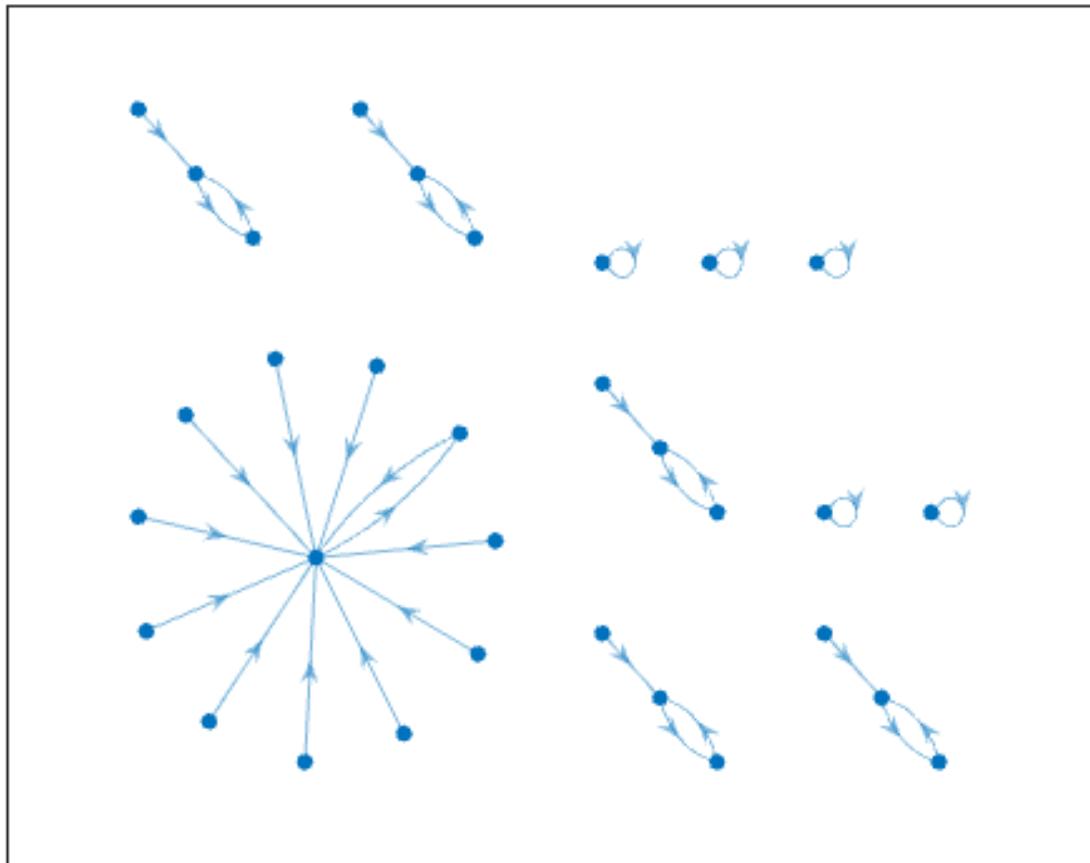


Figura 3.65: Atractor regla 5 n=5

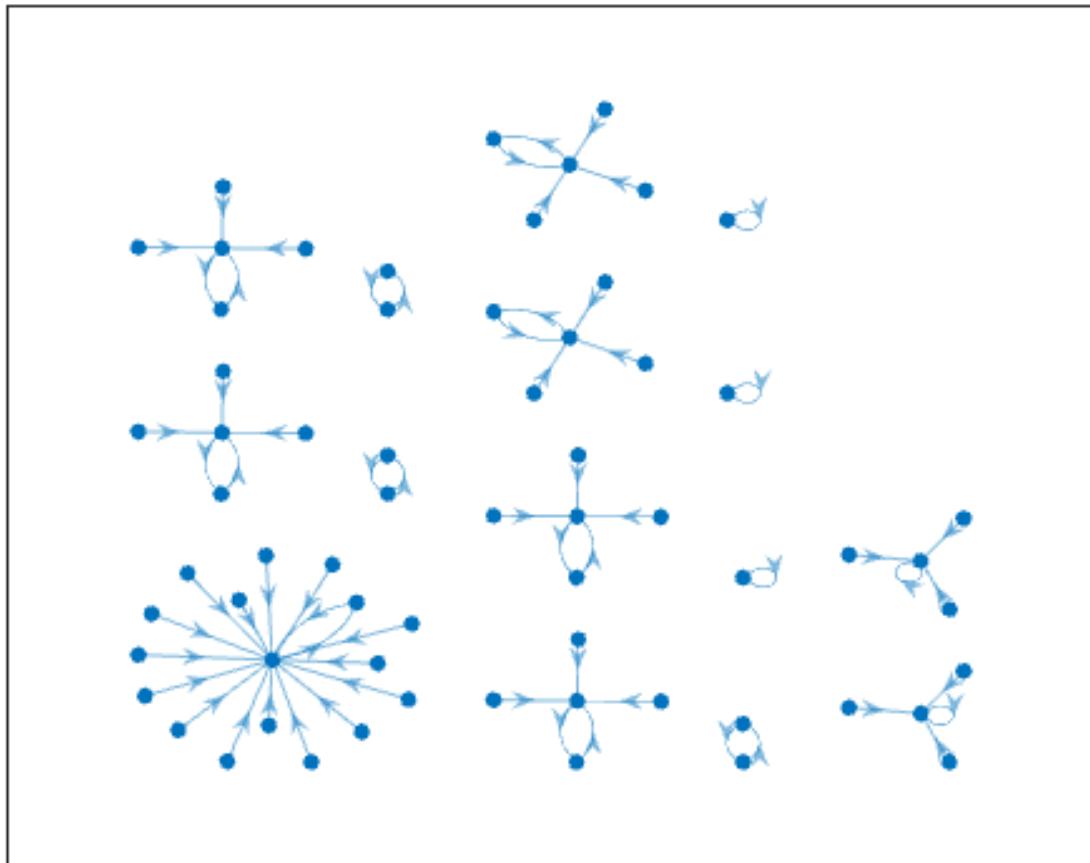


Figura 3.66: Atractor regla 5 n=6

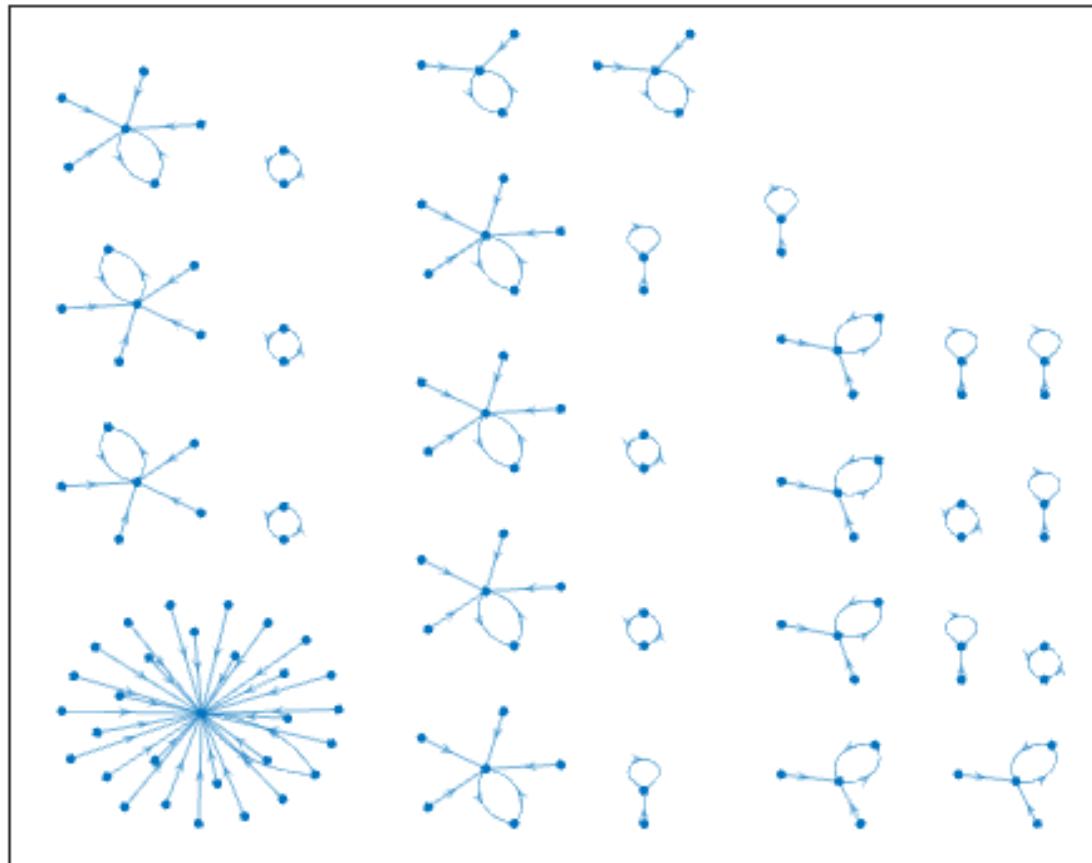


Figura 3.67: Atractor regla 5 n=7

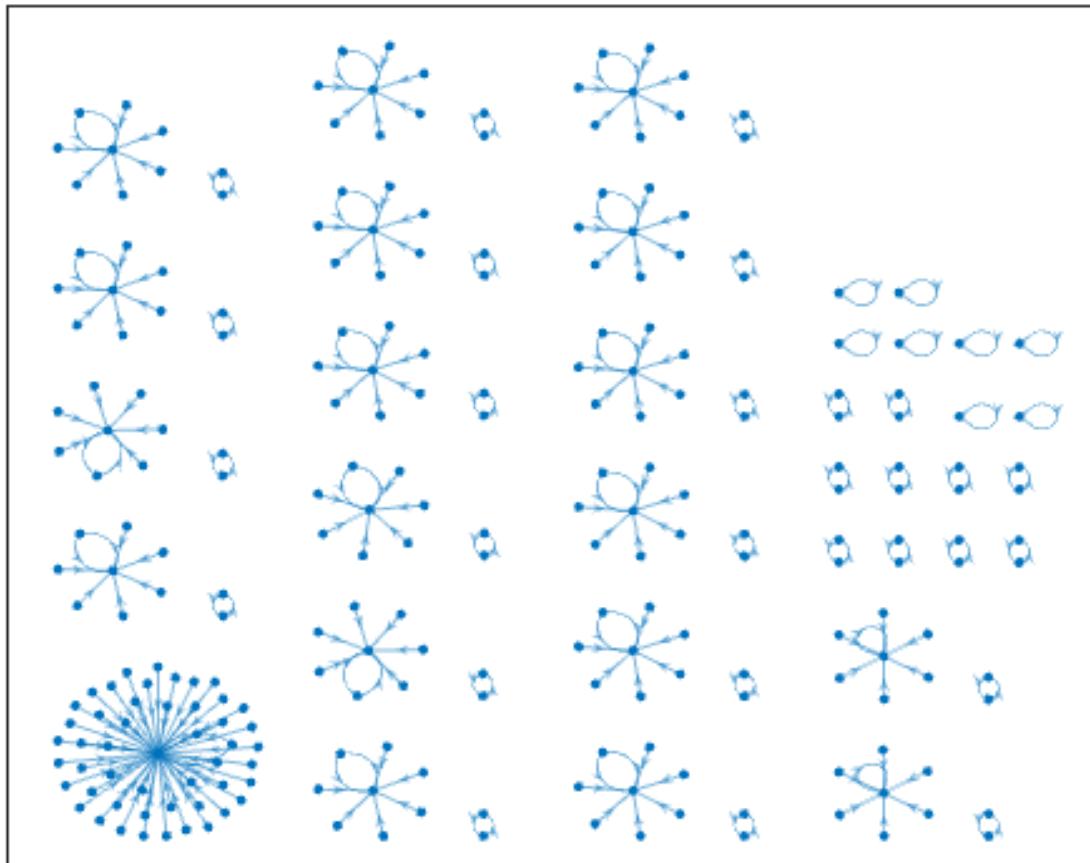


Figura 3.68: Atractor regla 5 n=8

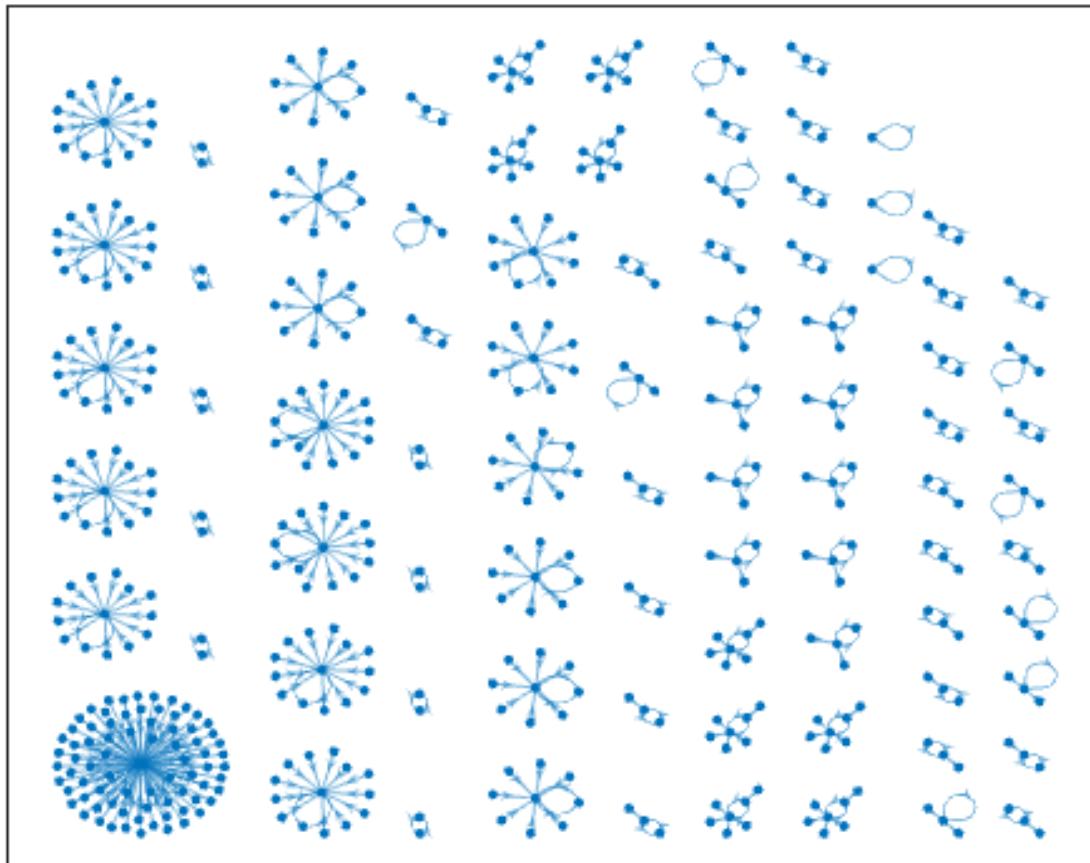


Figura 3.69: Atractor regla 5 n=9

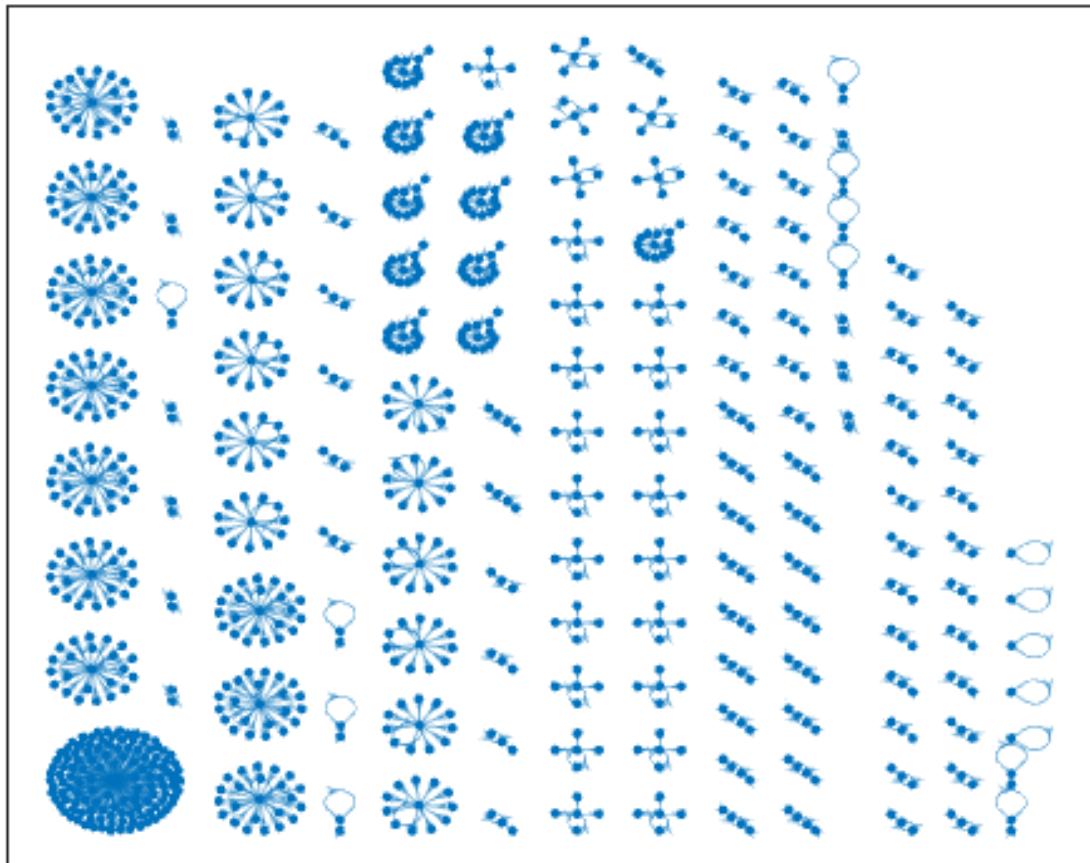


Figura 3.70: Atractor regla 5 n=10

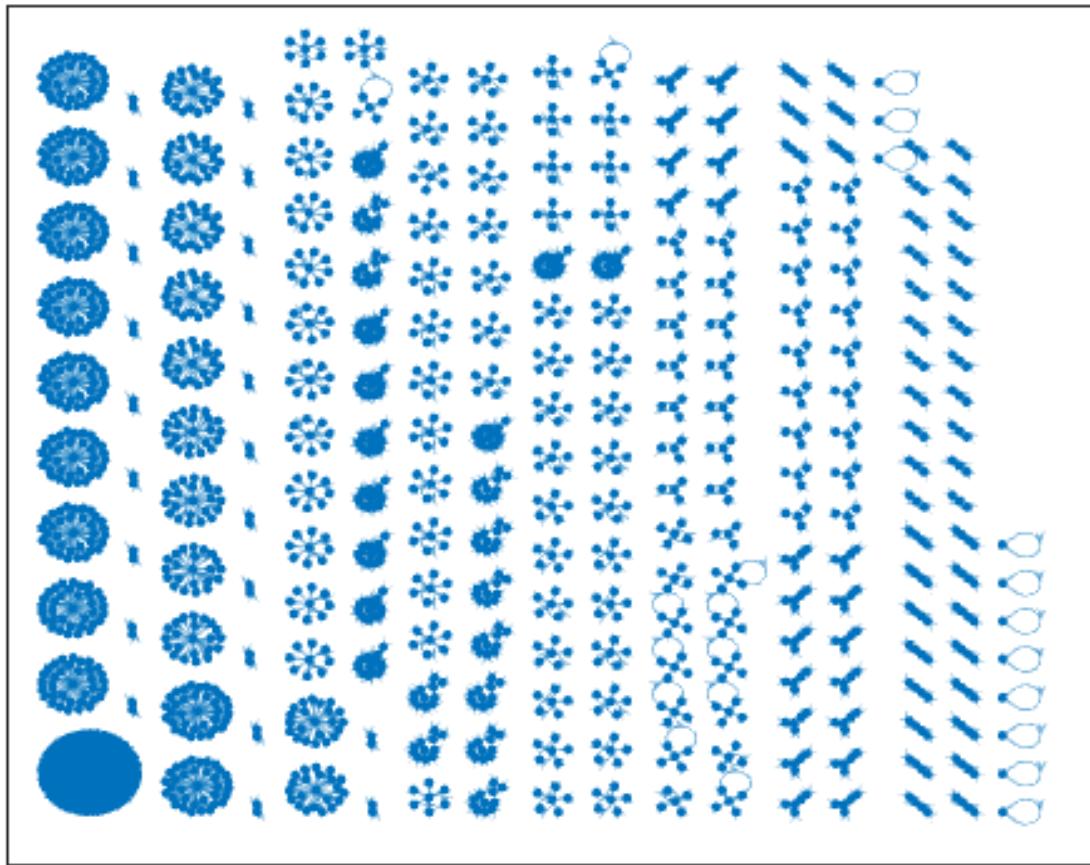


Figura 3.71: Atractor regla 5 n=11

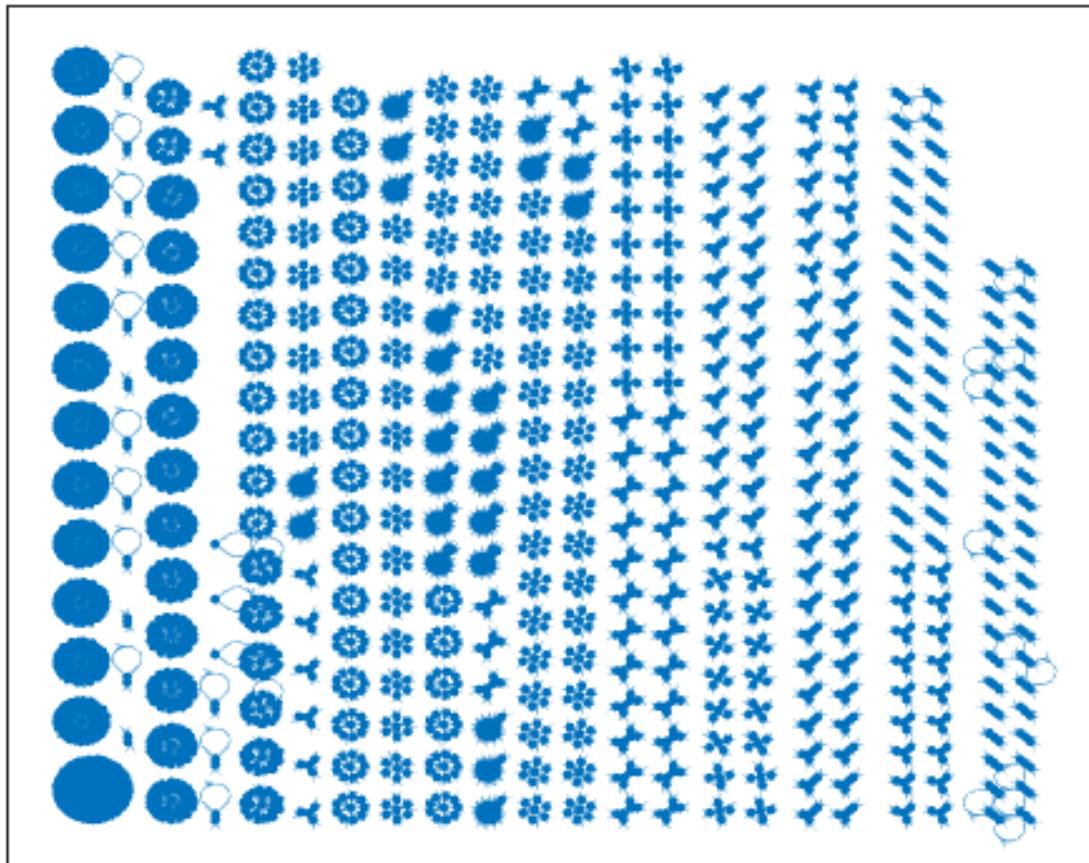


Figura 3.72: Atractor regla 5 n=12

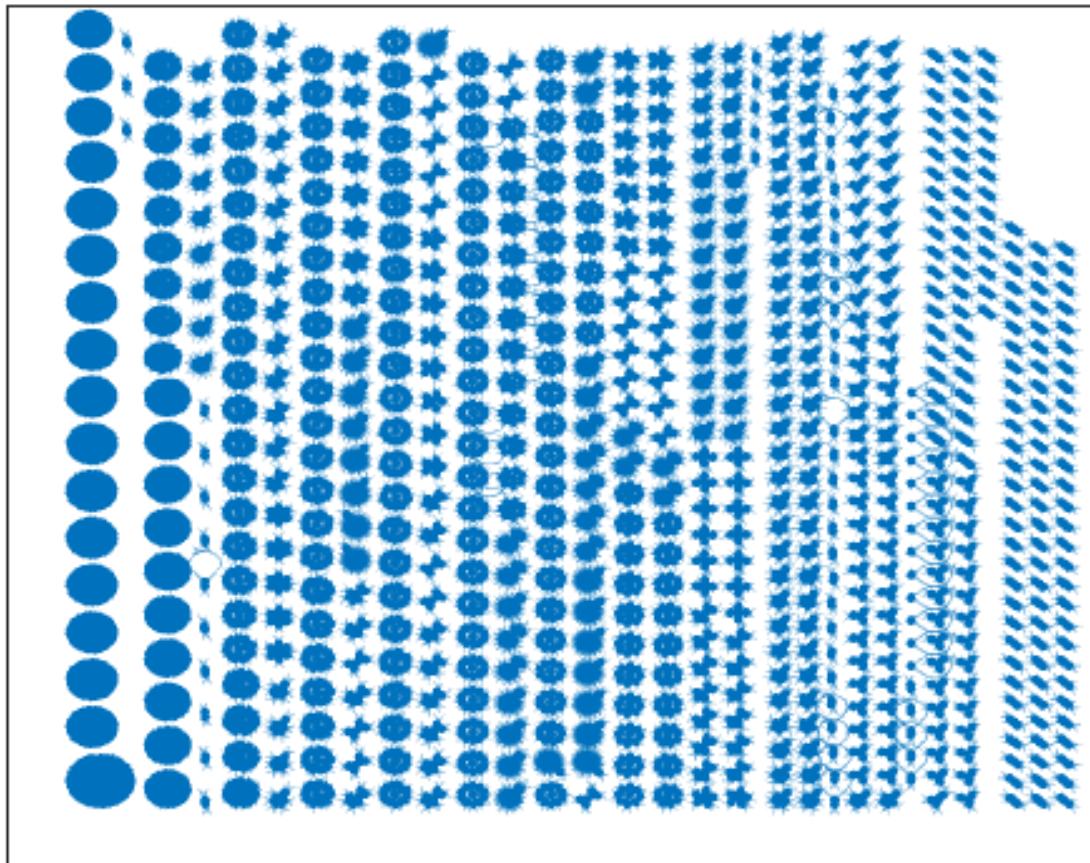


Figura 3.73: Atractor regla 5 $n=13$

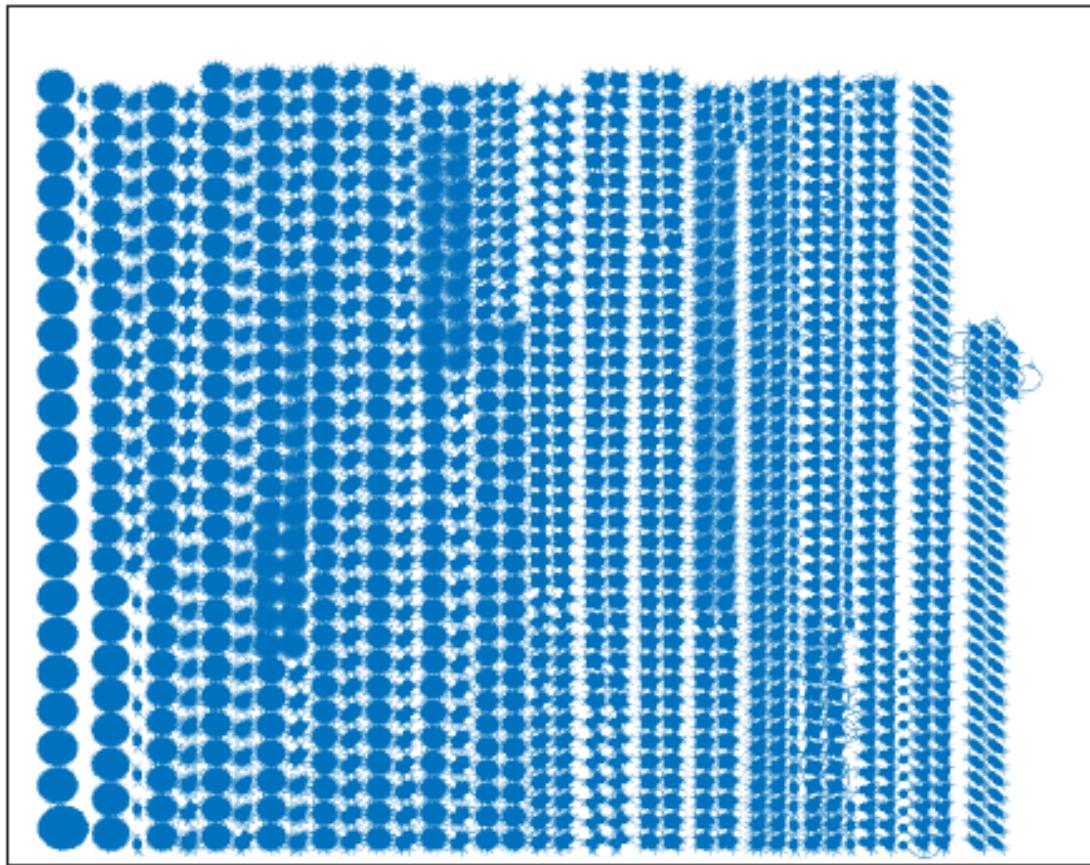
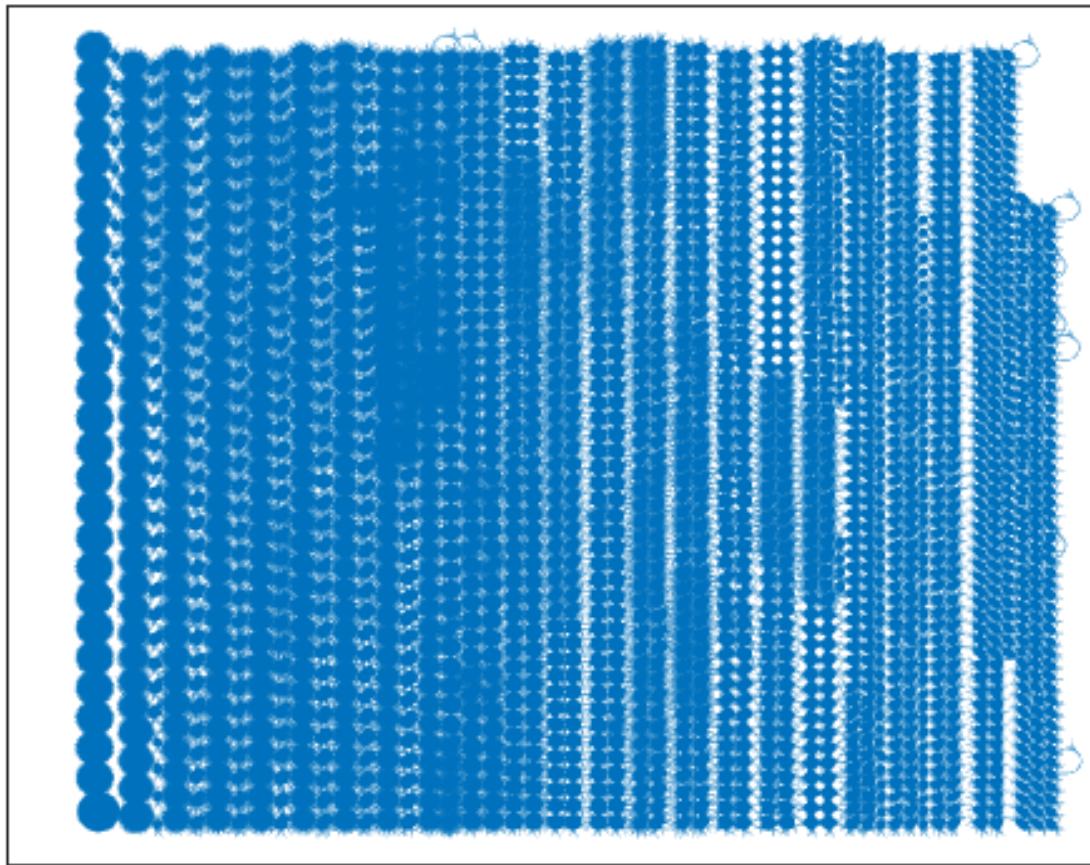


Figura 3.74: Atractor regla 5 n=14

Figura 3.75: Atractor regla 5 $n=15$

3.7. Reglas 6,20,159,215

Respecto a la regla 6 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen ciertos polígonos evolucionan mezclándose entre ellos para formar un nuevo atractor más grande, tal es el caso del cambio que se aprecia en la figura 3.82 a la figura 3.83, pasamos de tener 10 atractores a tener solo 4.

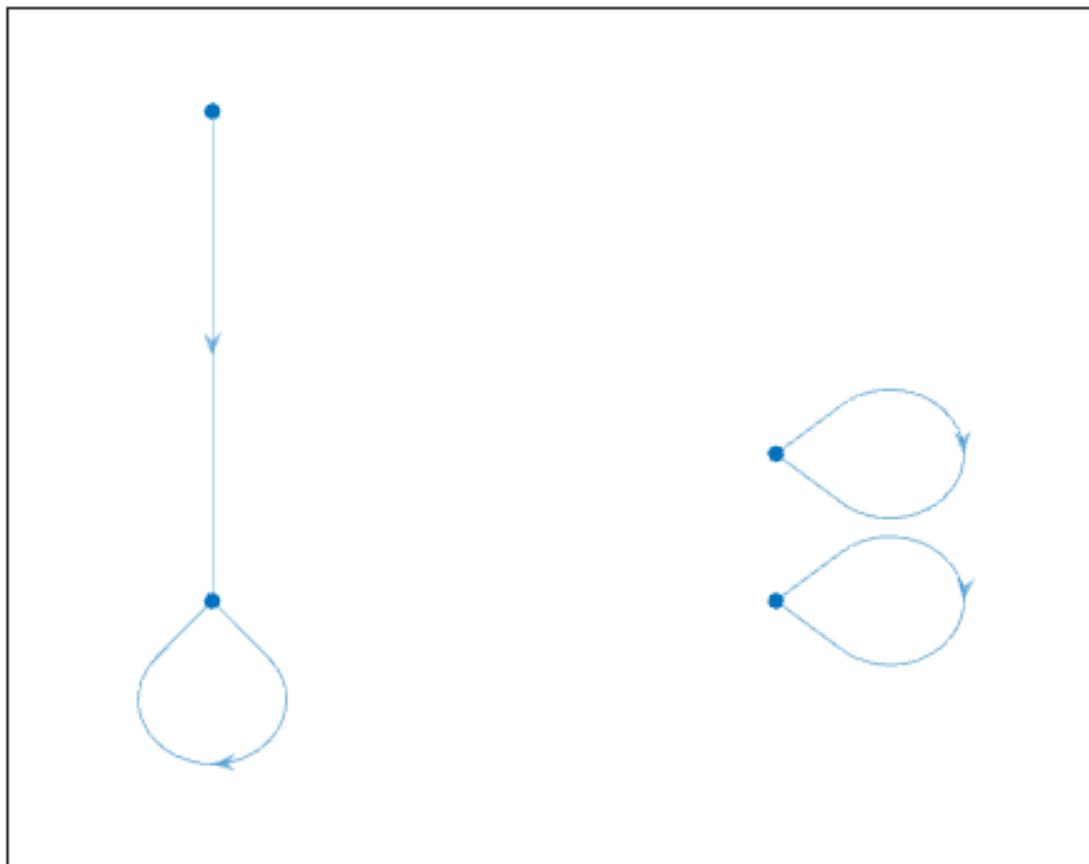


Figura 3.76: Atractor regla 6 $n=2$

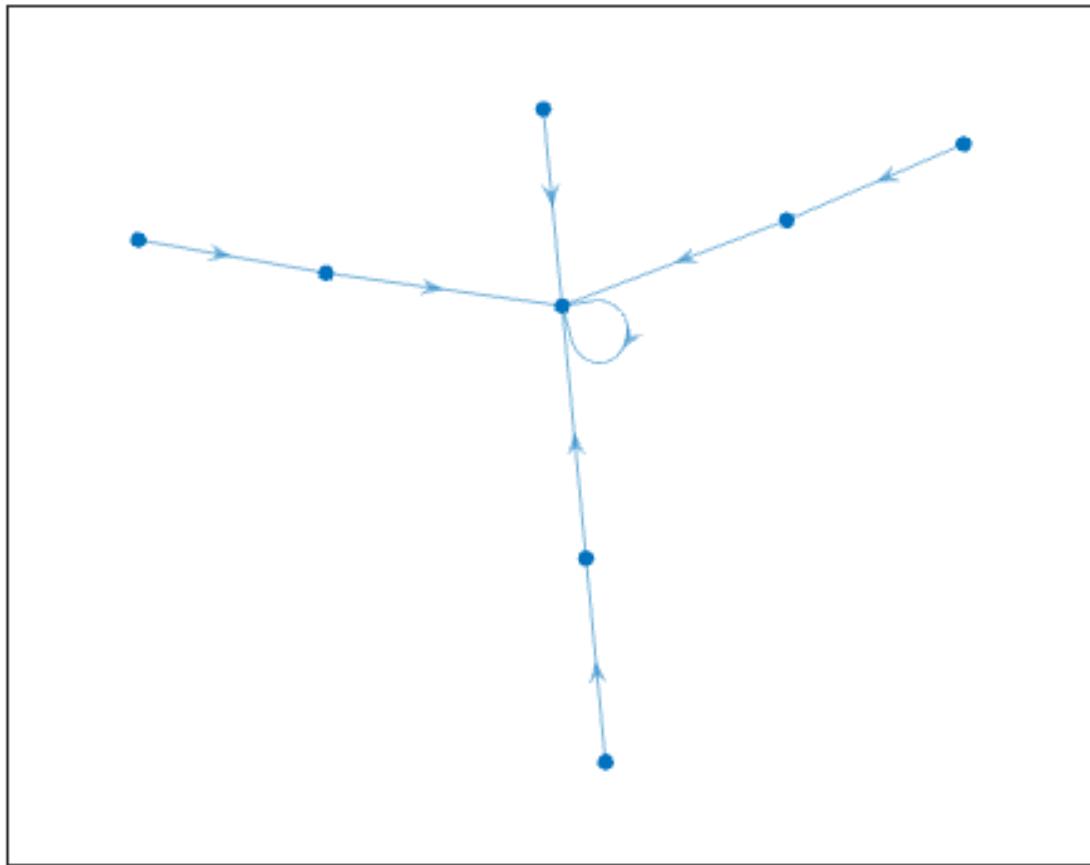


Figura 3.77: Atractor regla 6 n=3

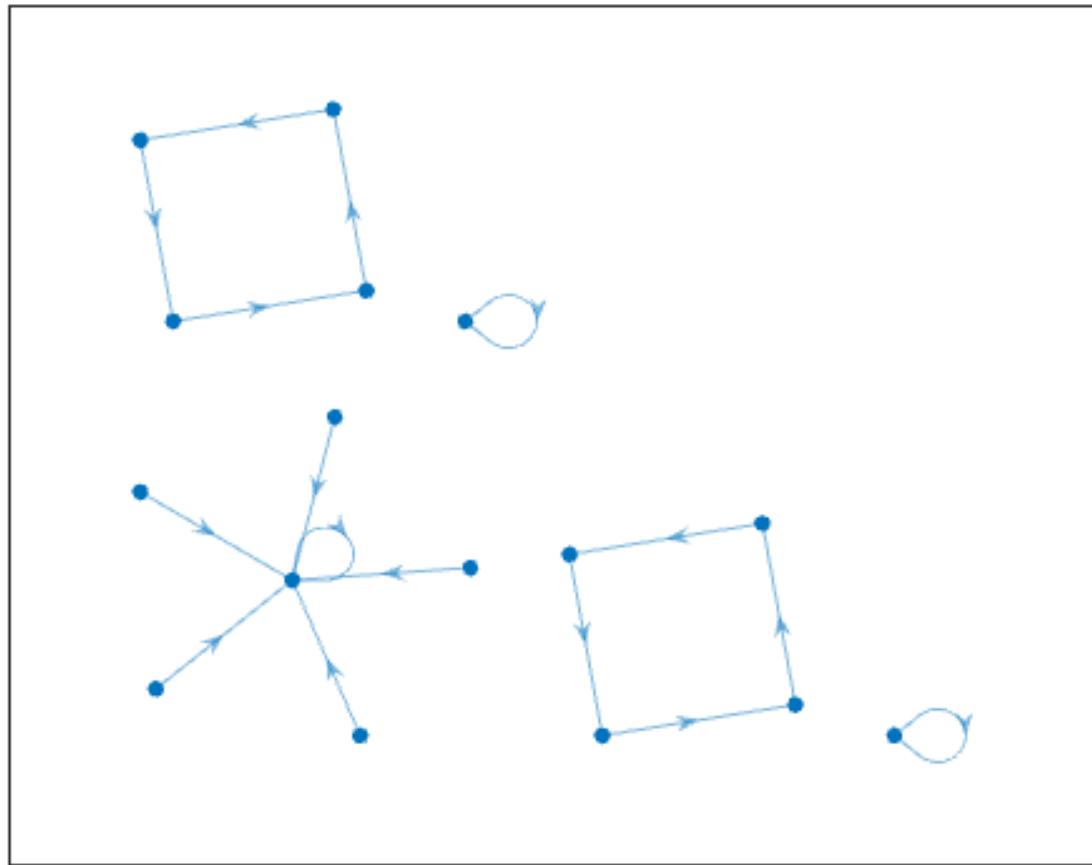


Figura 3.78: Atractor regla 6 n=4

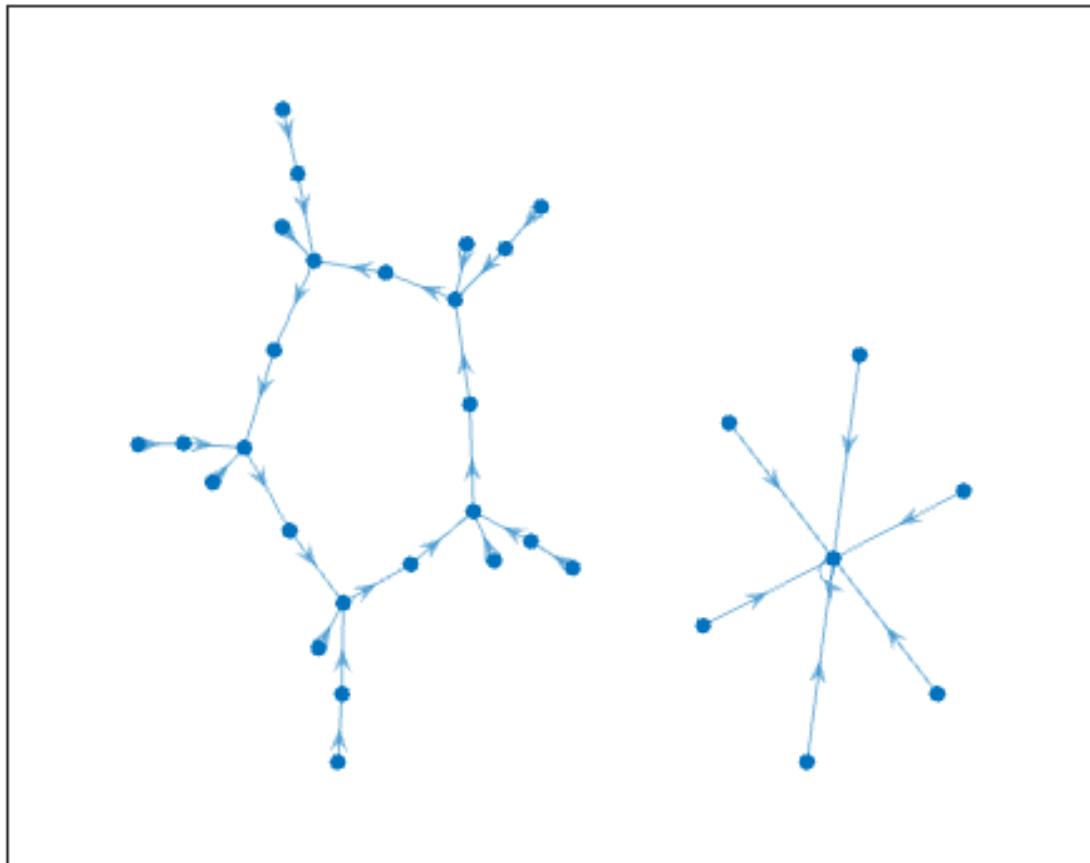


Figura 3.79: Atractor regla 6 n=5

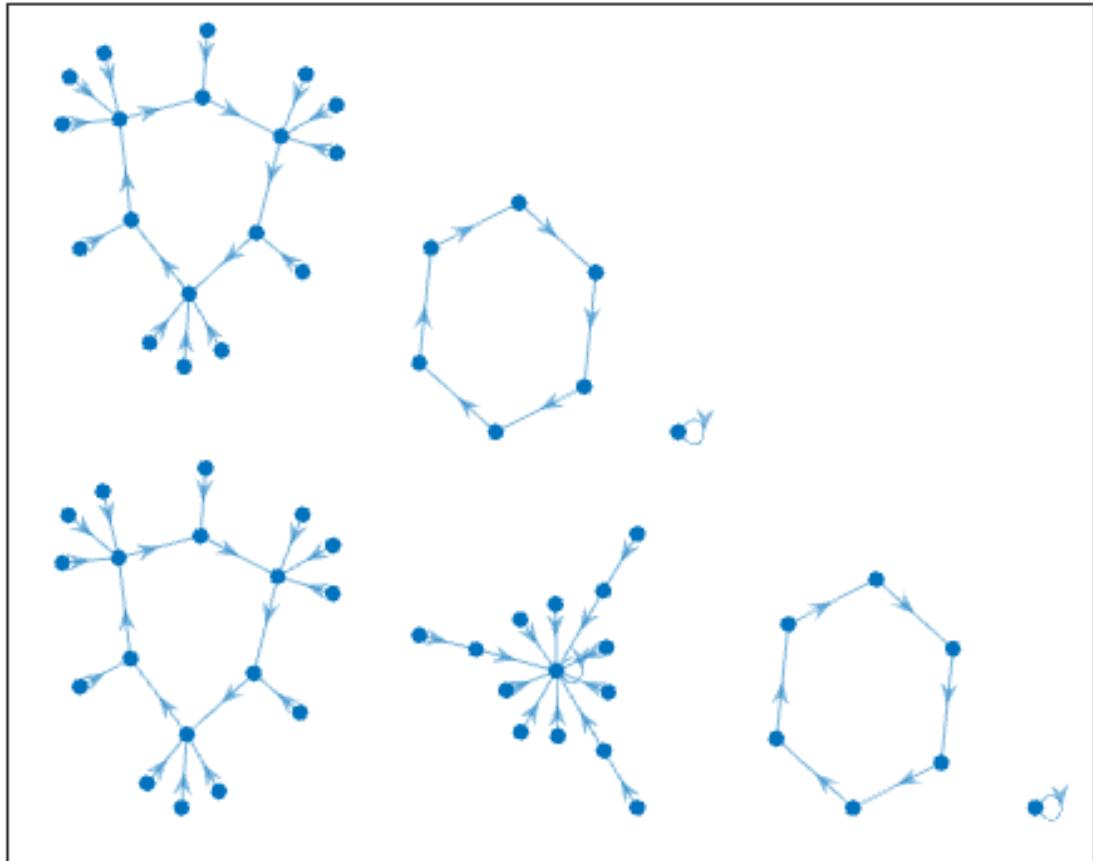


Figura 3.80: Atractor regla 6 n=6

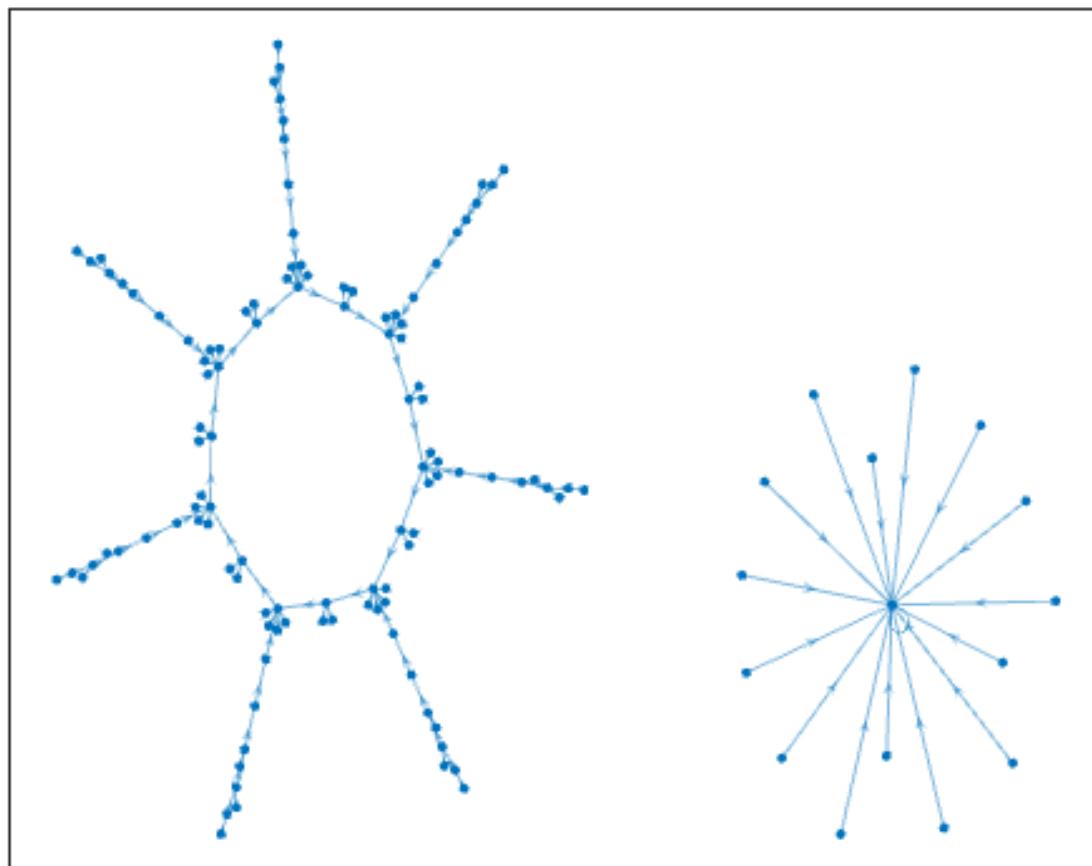
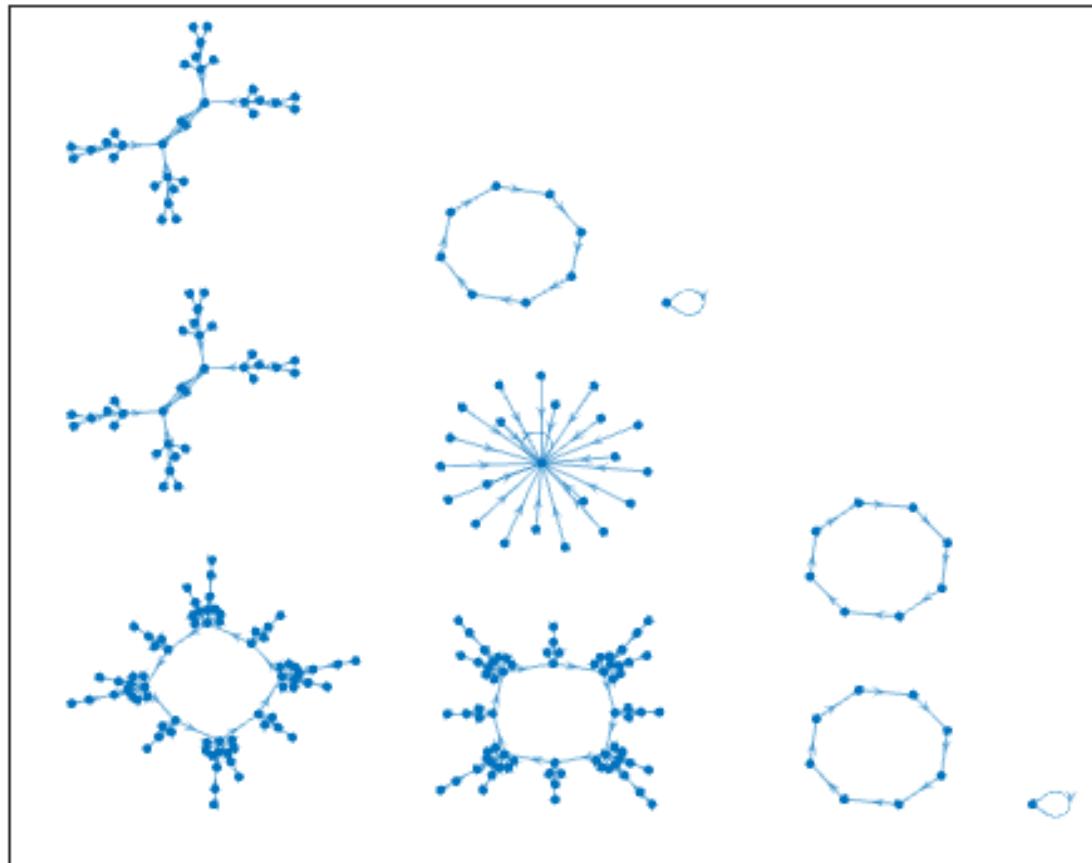
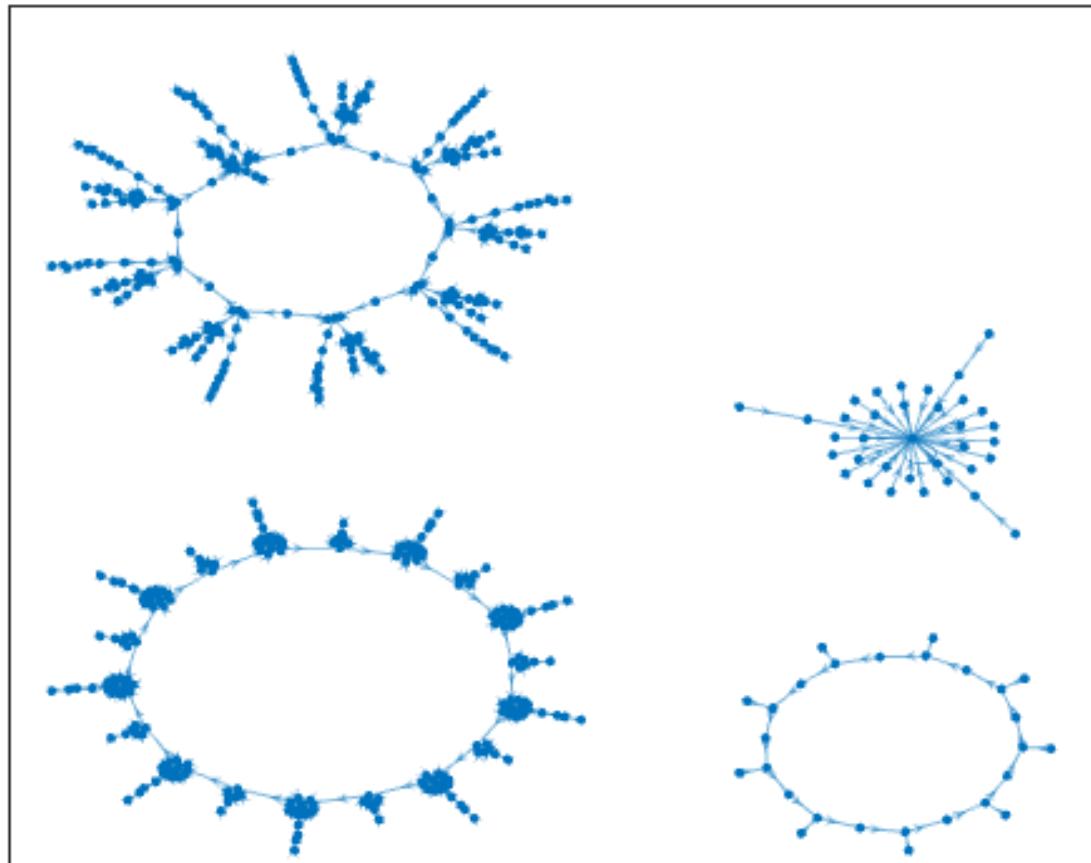
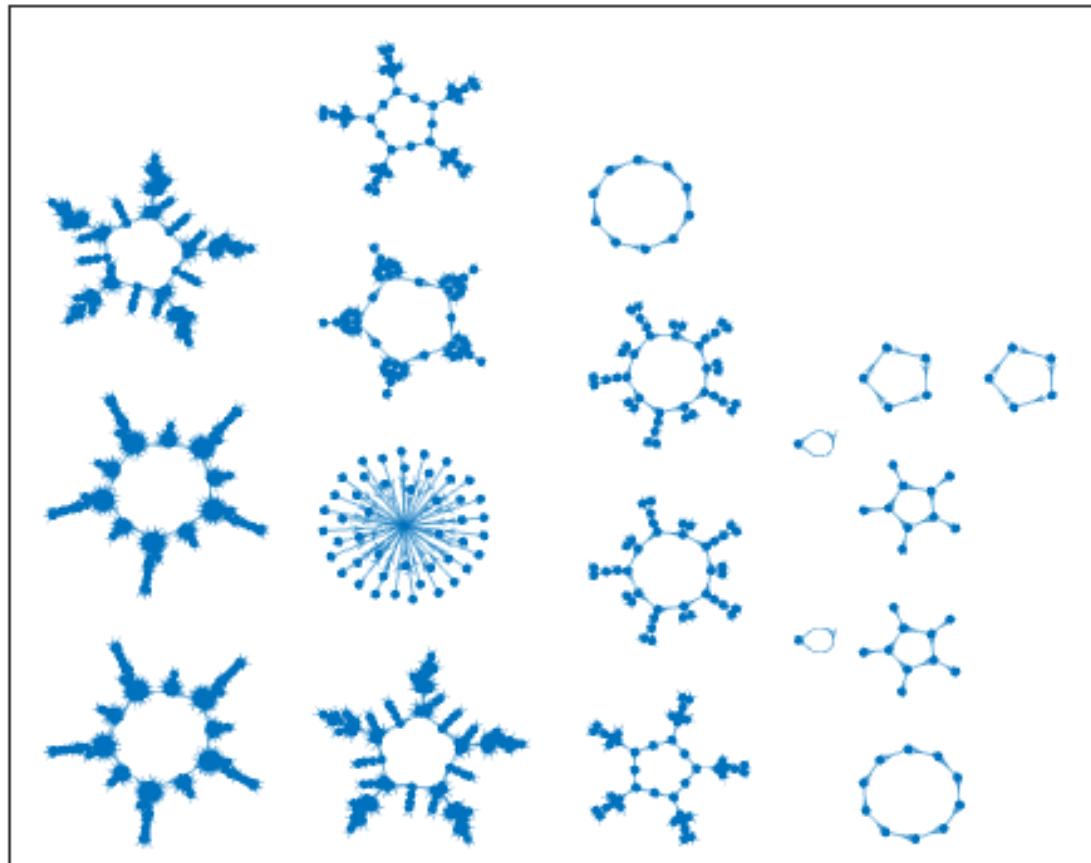


Figura 3.81: Atractor regla 6 n=7

Figura 3.82: Atractor regla 6 $n=8$

Figura 3.83: Atractor regla 6 $n=9$

Figura 3.84: Atractor regla 6 $n=10$

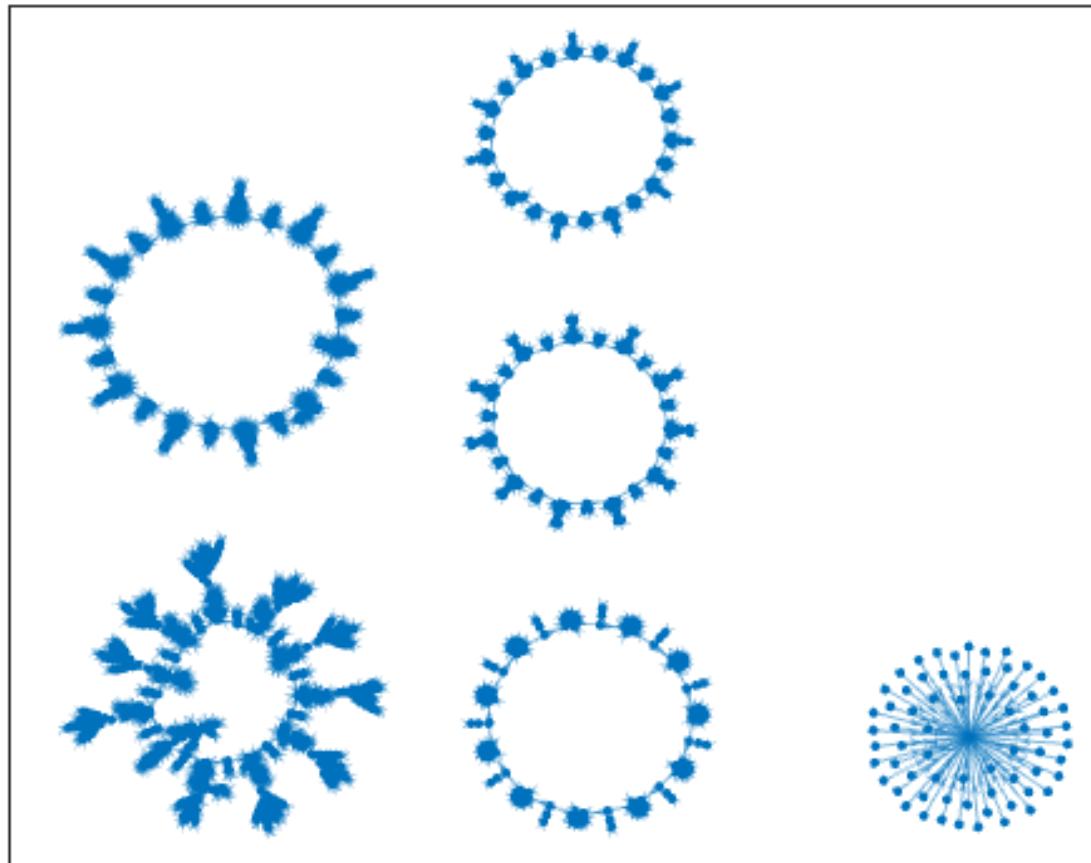


Figura 3.85: Atractor regla 6 n=11

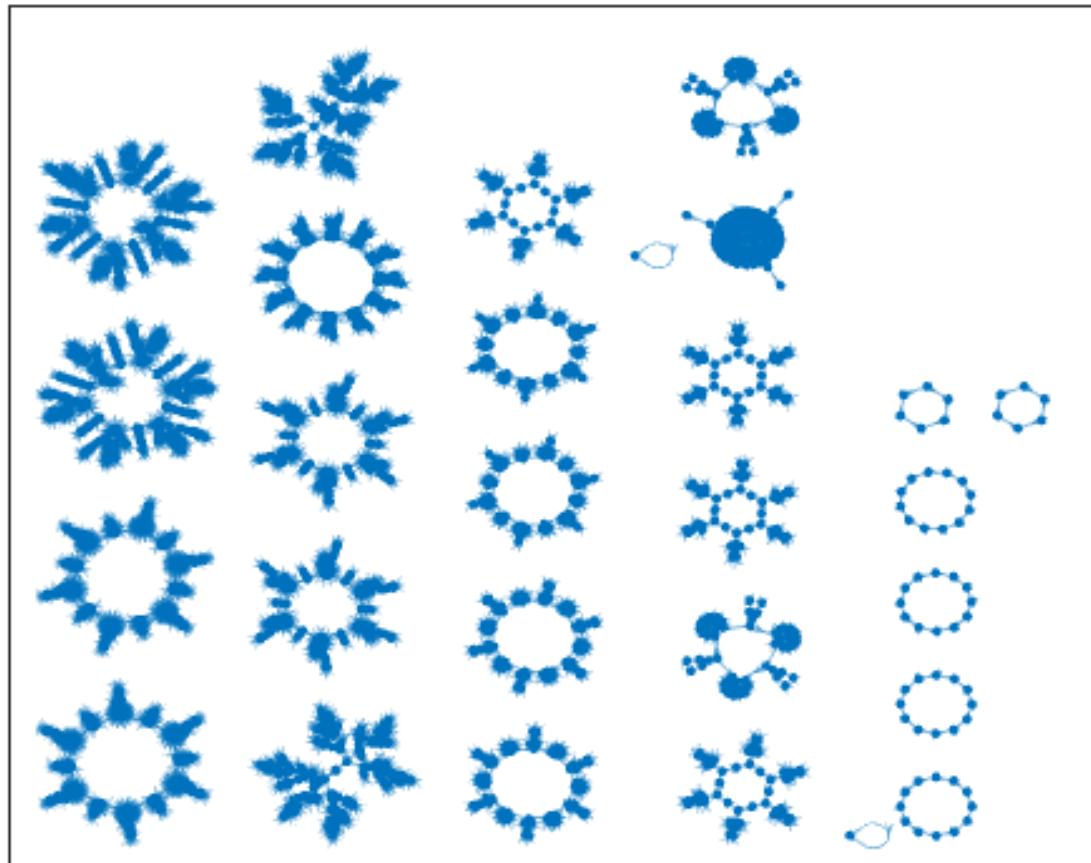


Figura 3.86: Atractor regla 6 n=12

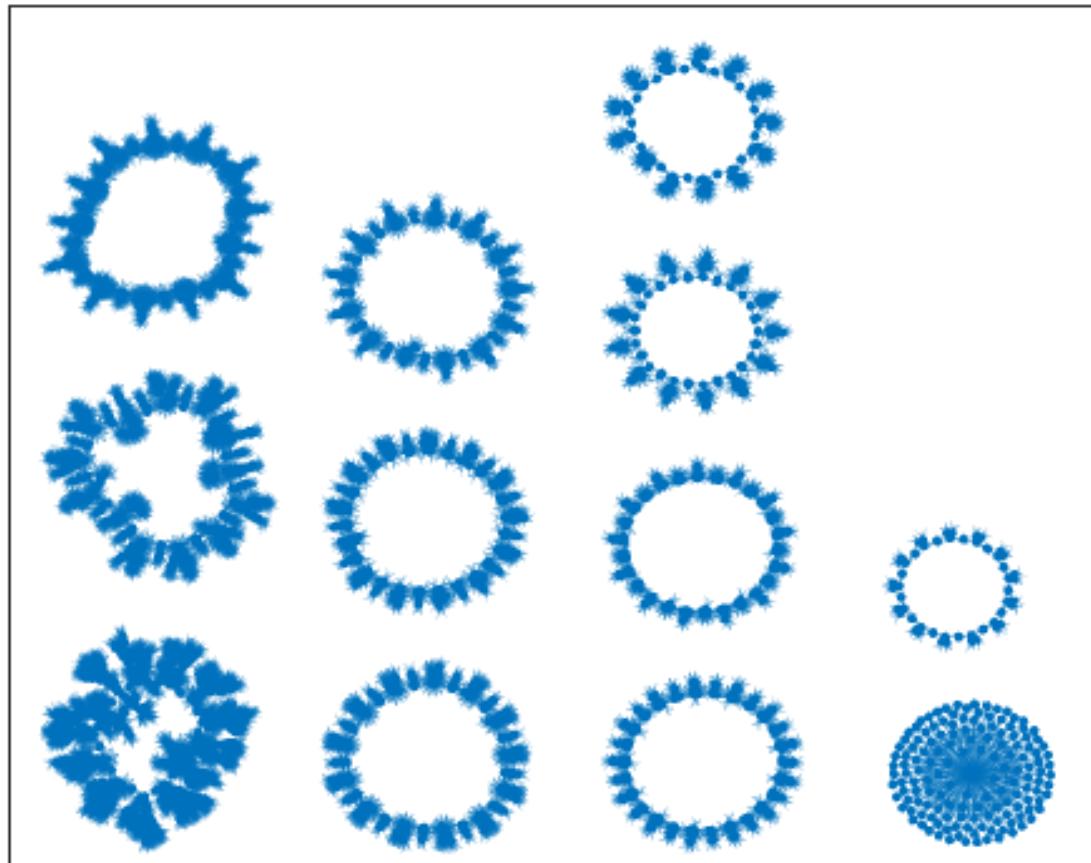
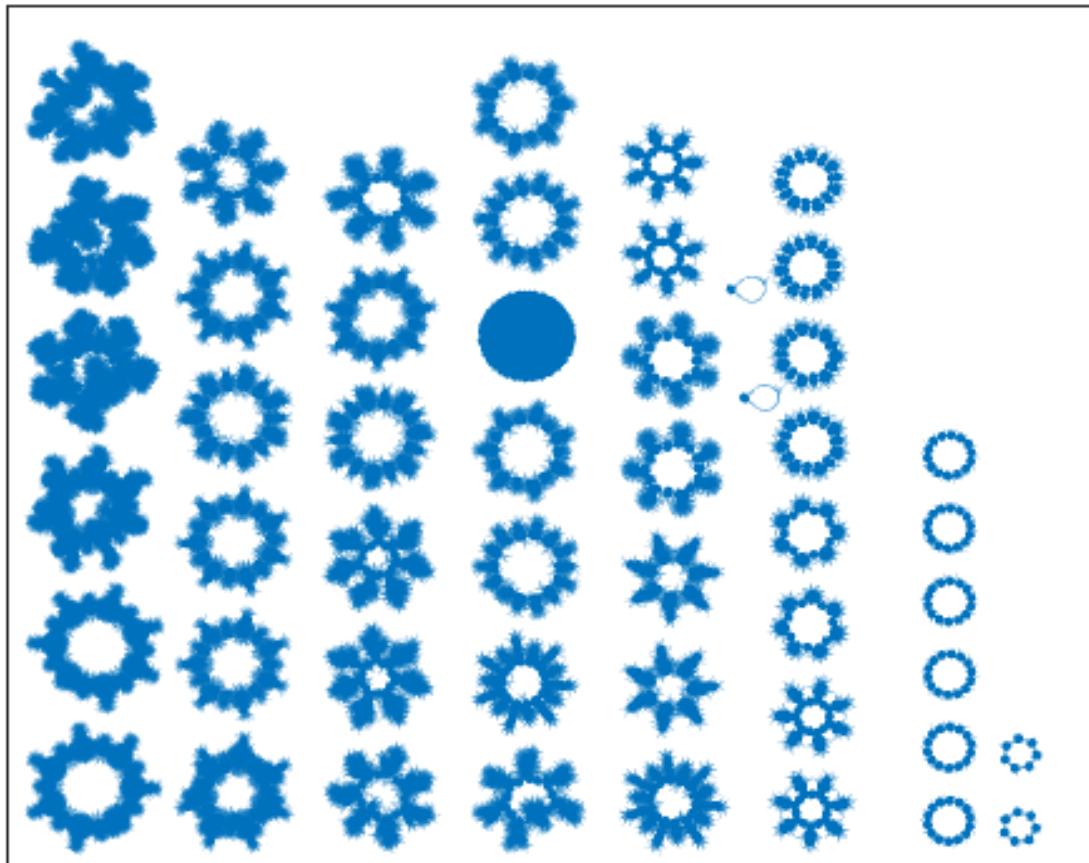


Figura 3.87: Atractor regla 6 n=13

Figura 3.88: Atractor regla 6 $n=14$

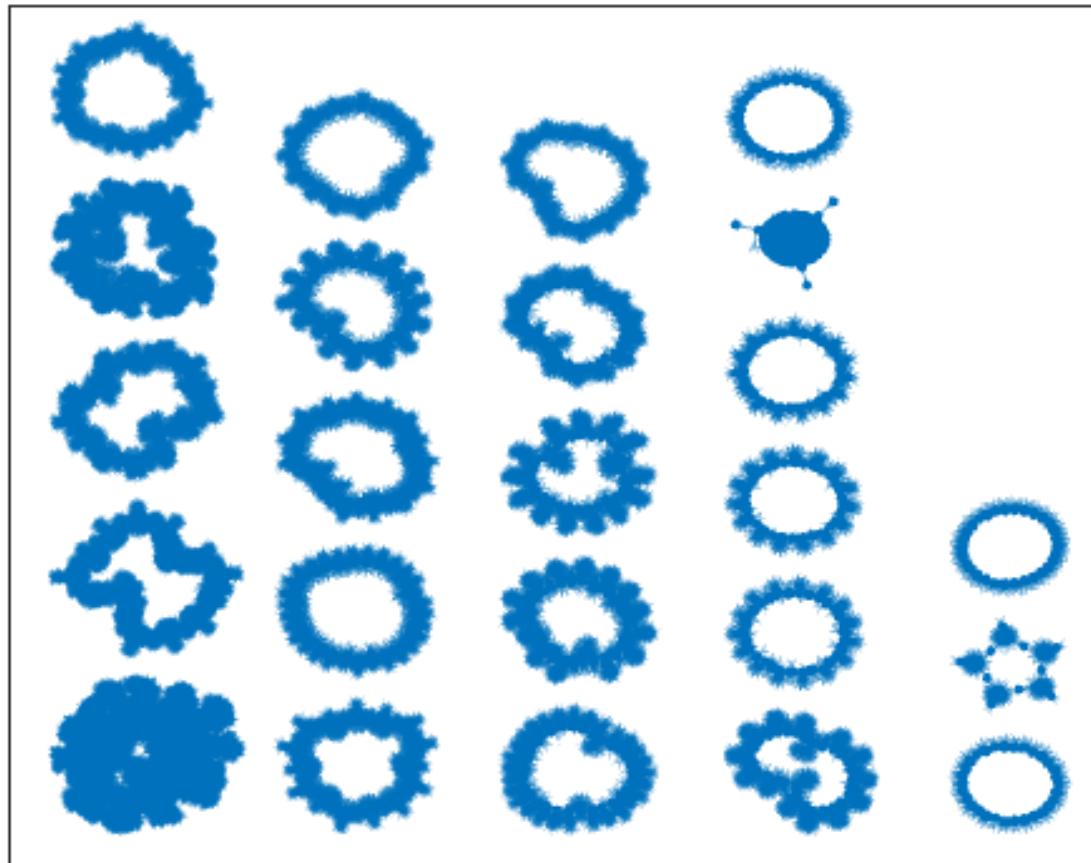


Figura 3.89: Atractor regla 6 n=15

3.8. Reglas 7,21,31,87

Respecto a la regla 7 se aprecia que mientras más grande es el tamaño de la cadena (n) específicamente en las n mayores a 10 se construyen atractores que tienen formas particulares como podría ser algo parecido a las imágenes de un organismo unicelular que se encuentran en los libros escolares de biología (figura 3.102).

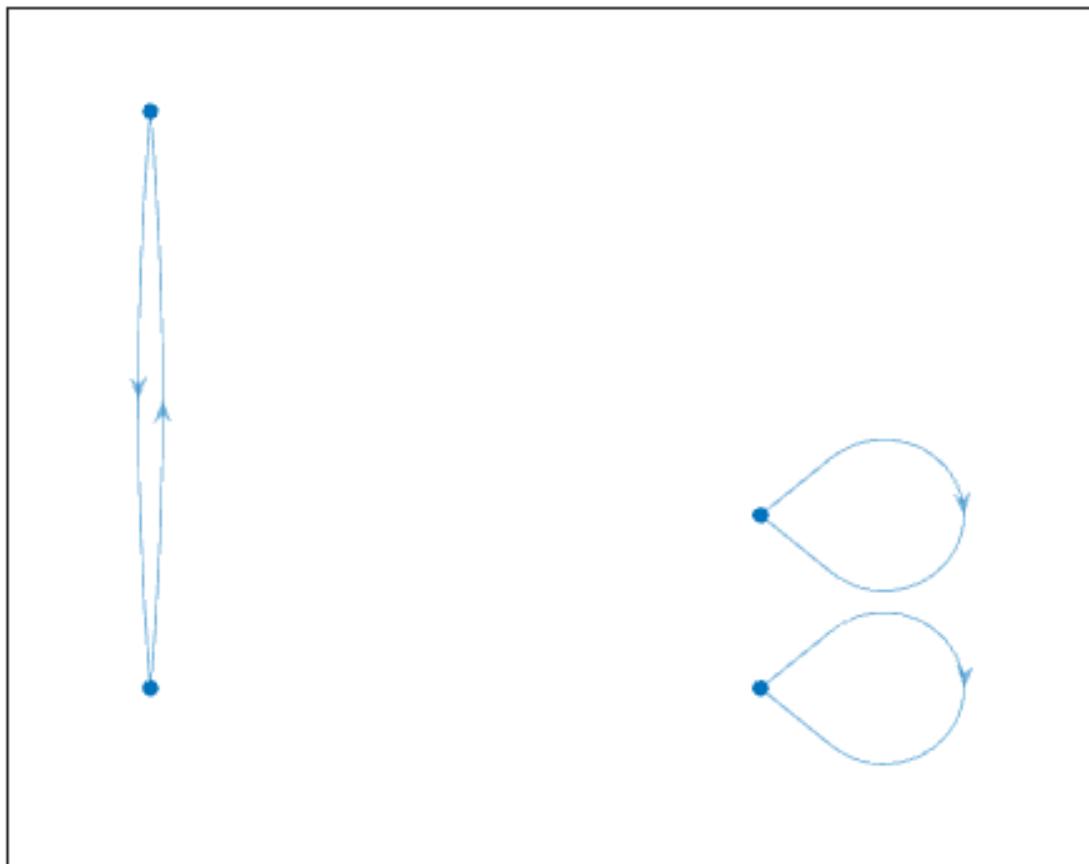
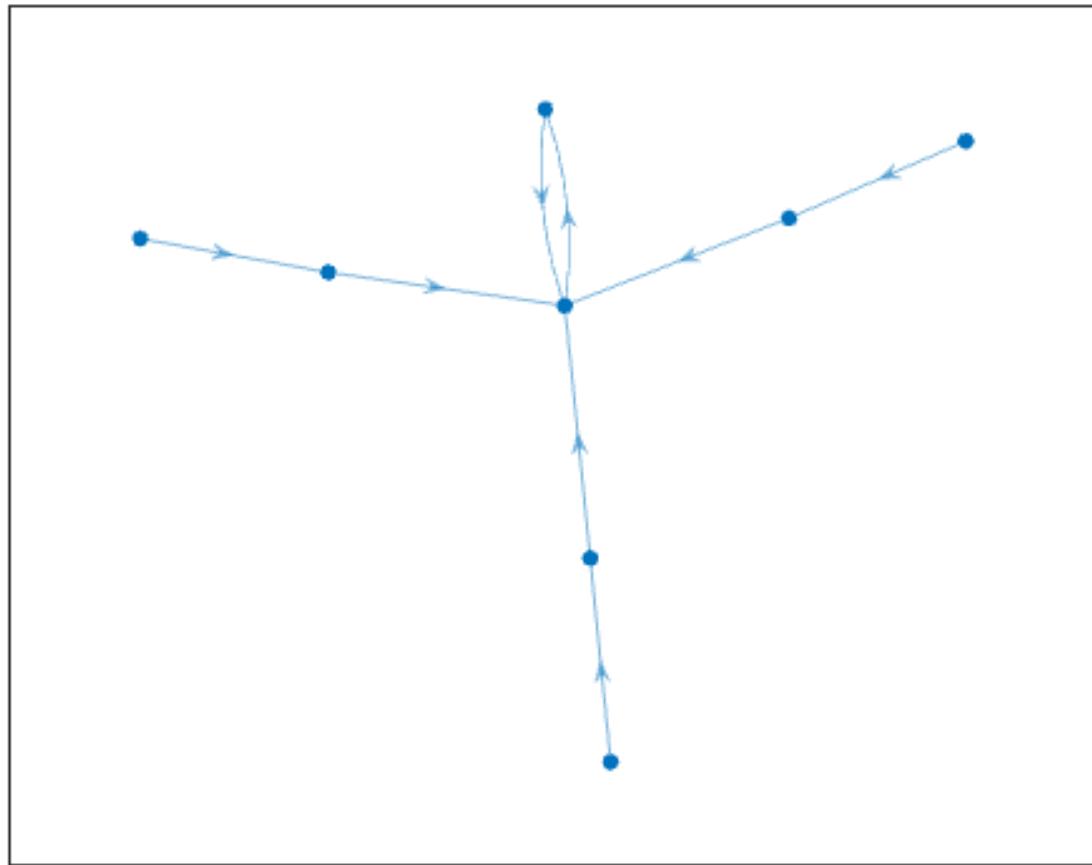


Figura 3.90: Atractor regla 7 $n=2$

Figura 3.91: Atractor regla 7 $n=3$

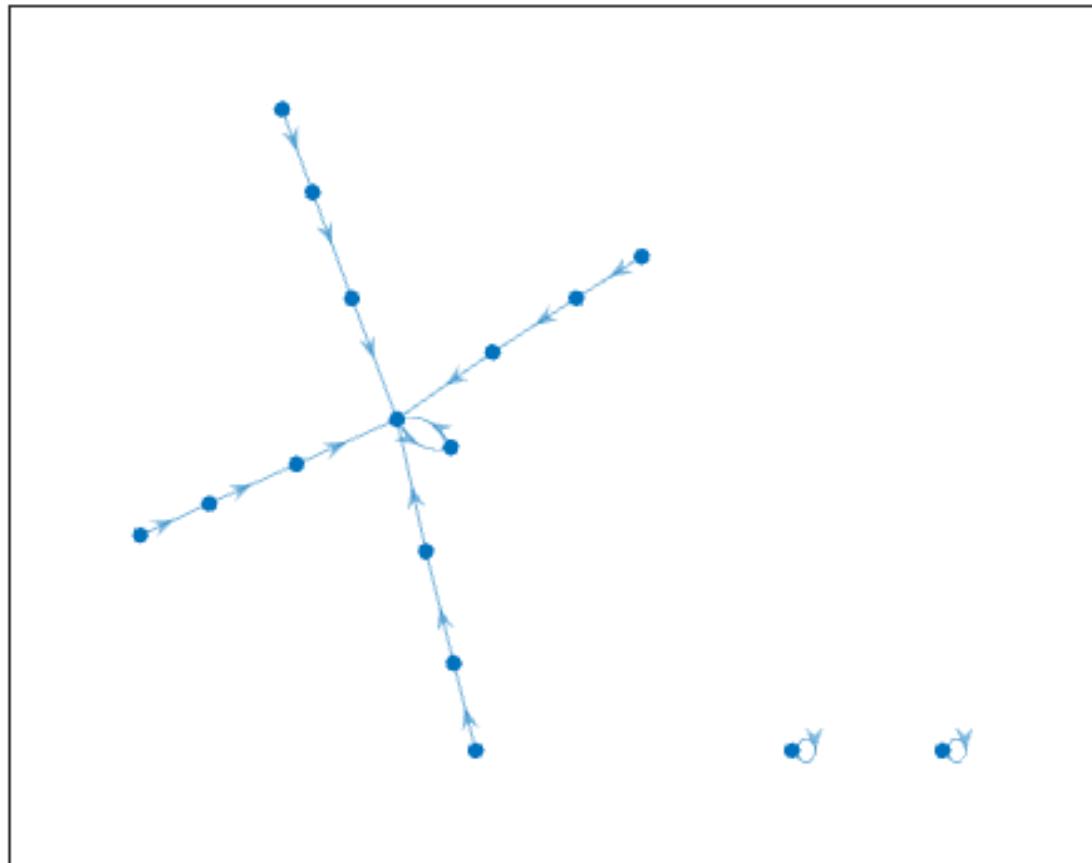


Figura 3.92: Atractor regla 7 n=4

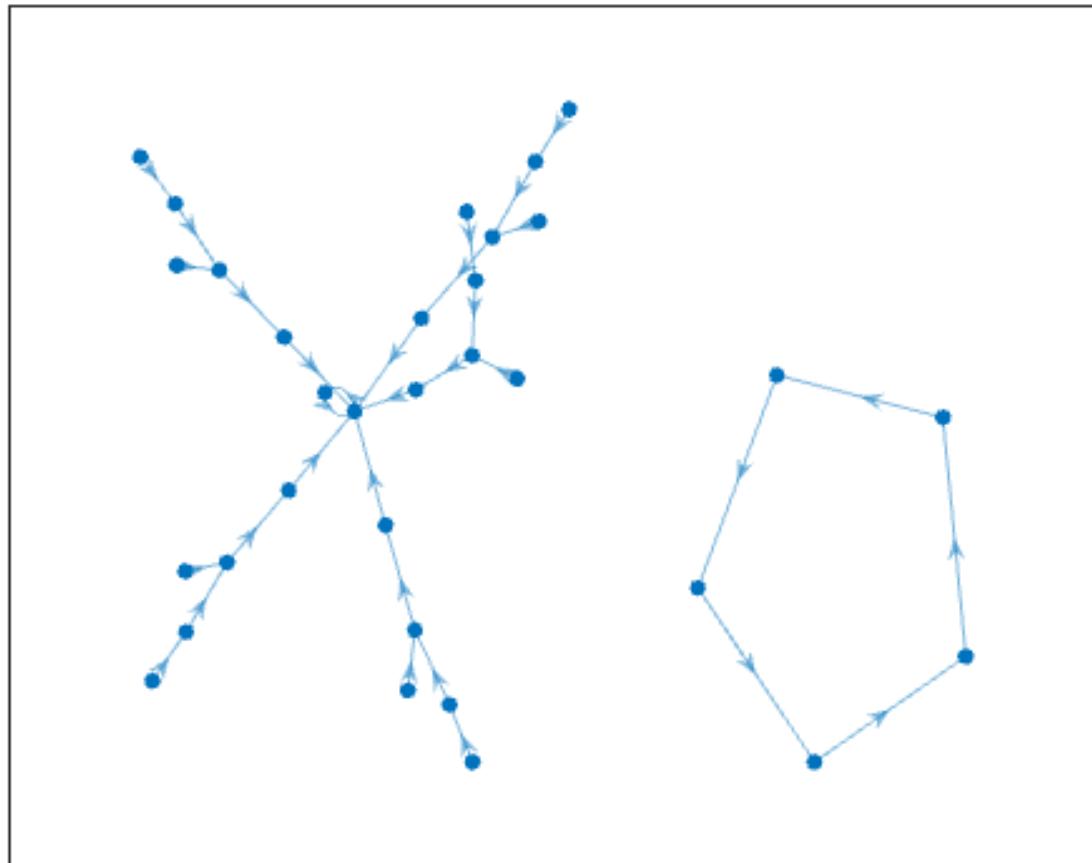
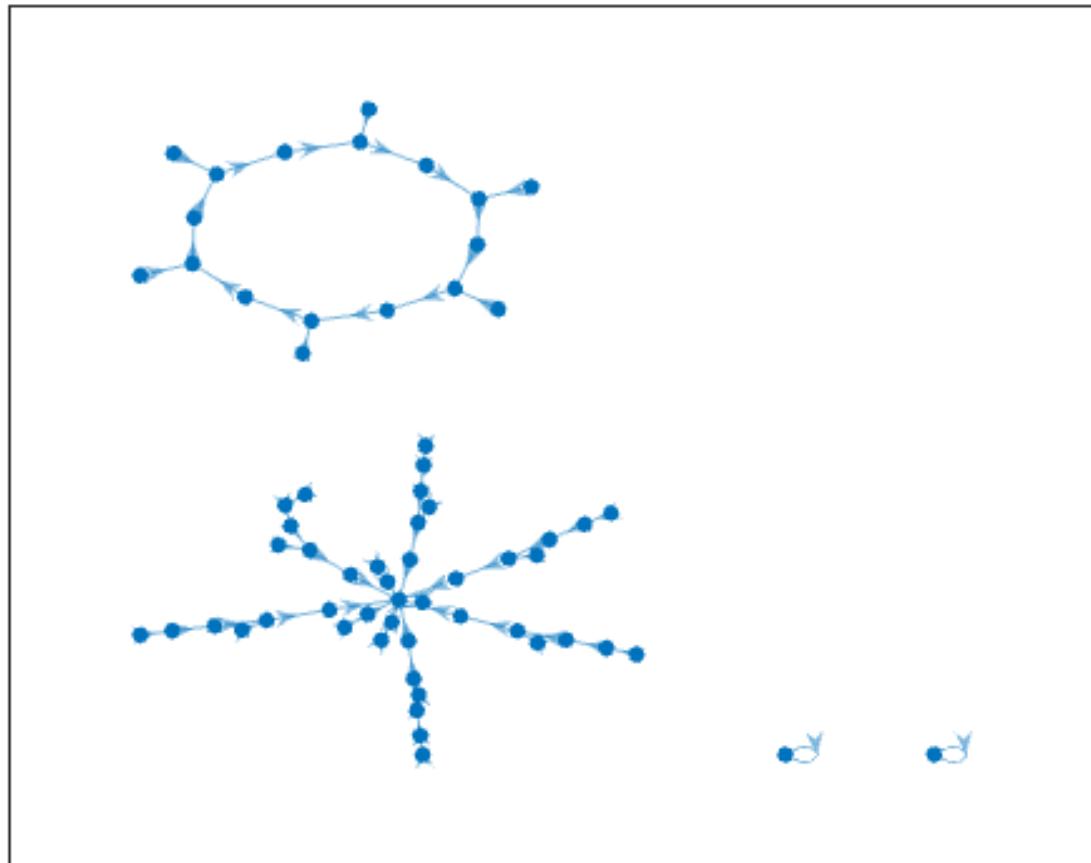
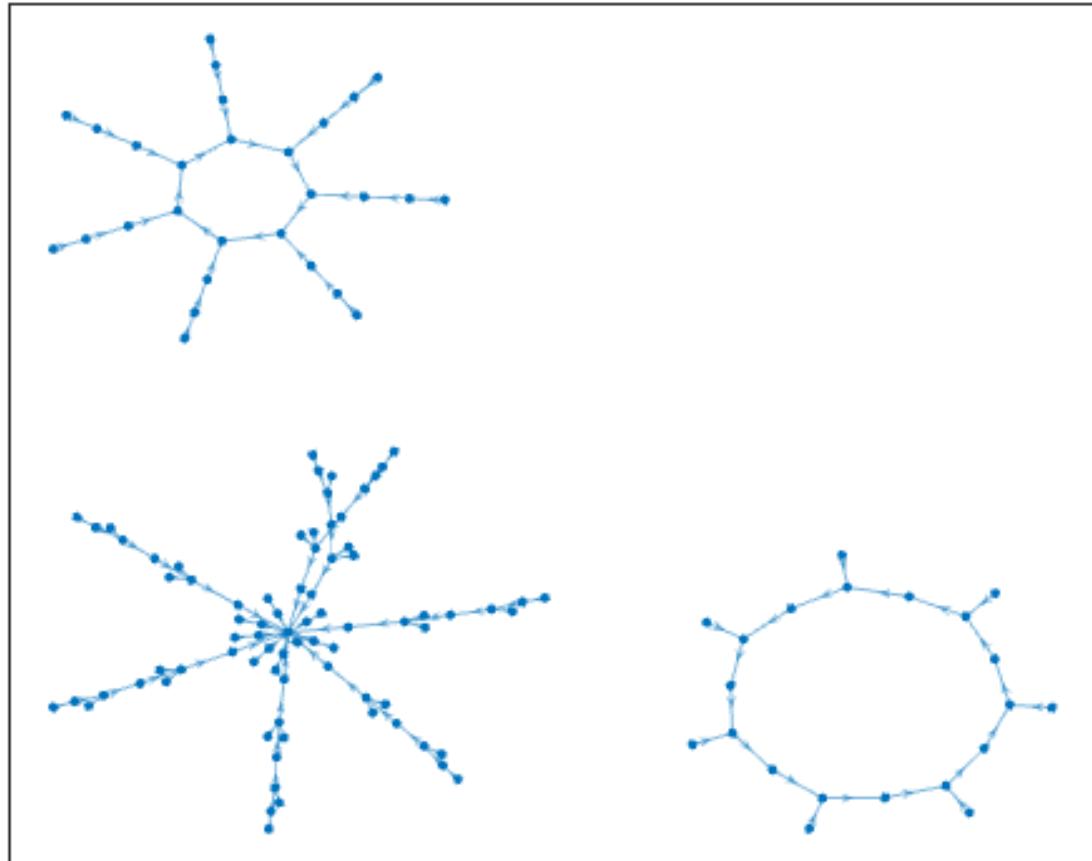
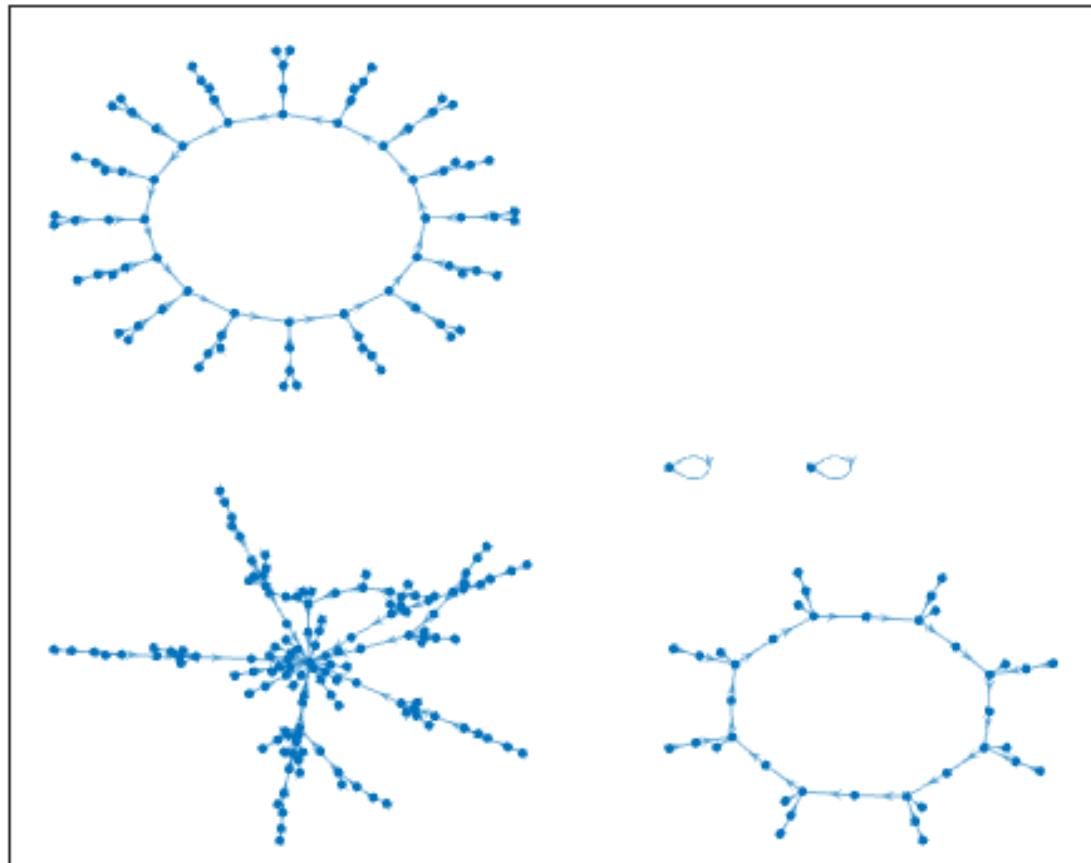
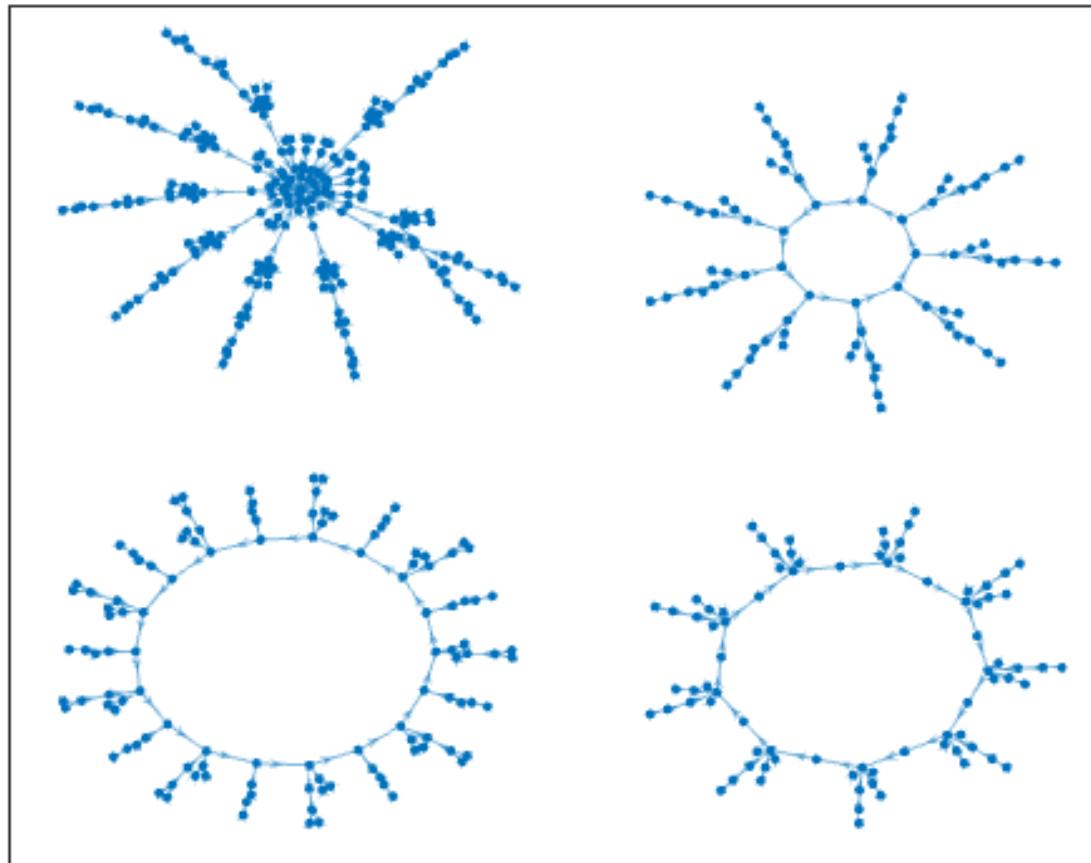


Figura 3.93: Atractor regla 7 n=5

Figura 3.94: Atractor regla 7 $n=6$

Figura 3.95: Atractor regla 7 $n=7$

Figura 3.96: Atractor regla 7 $n=8$

Figura 3.97: Atractor regla 7 $n=9$

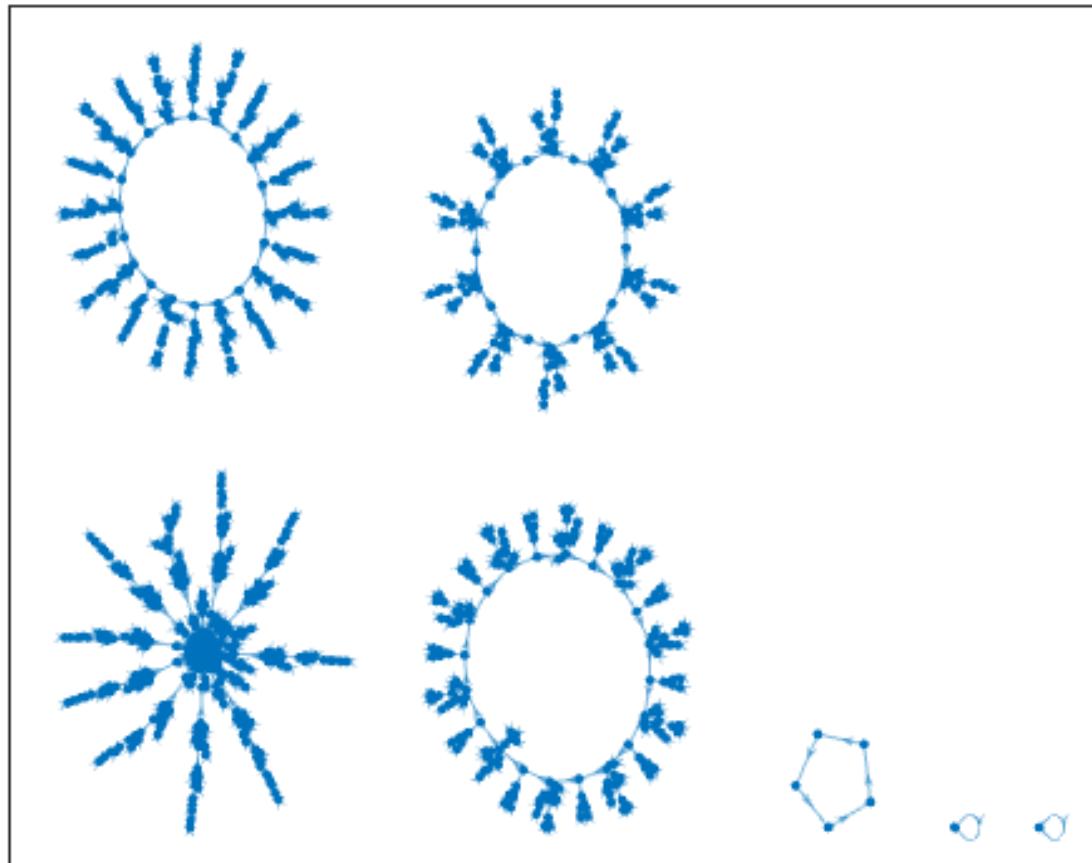
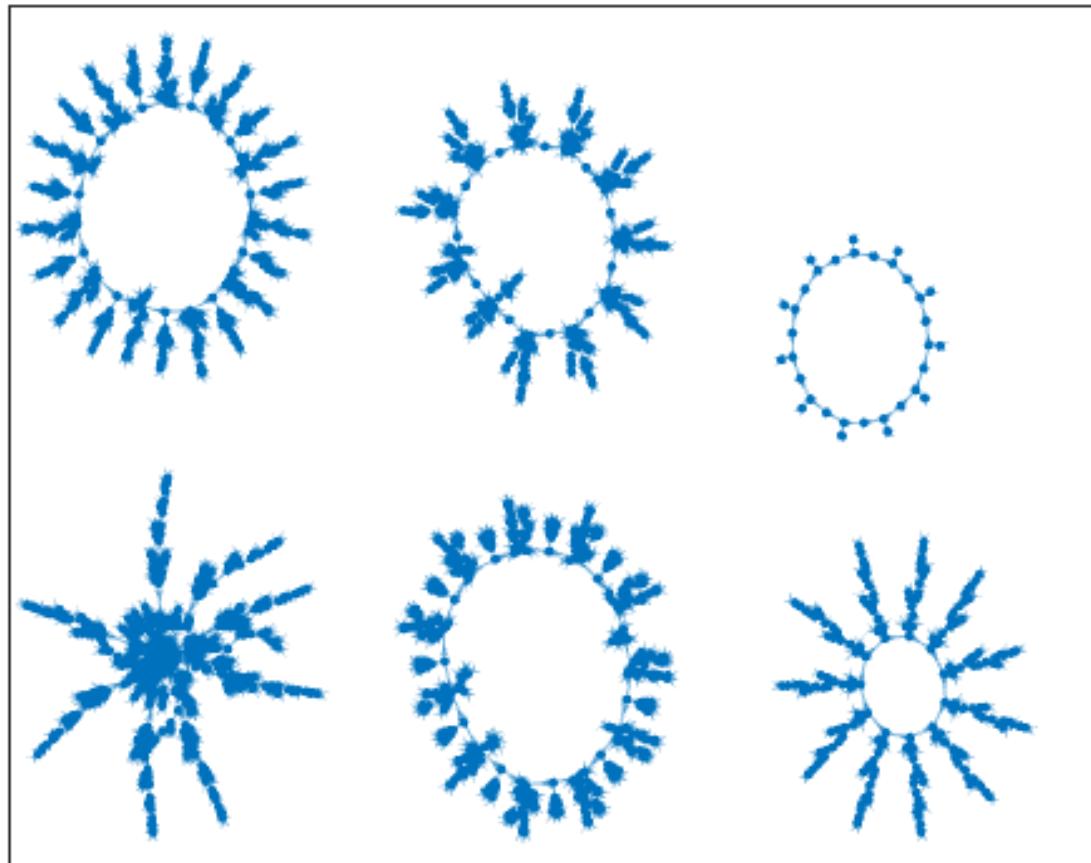


Figura 3.98: Atractor regla 7 n=10

Figura 3.99: Atractor regla 7 $n=11$

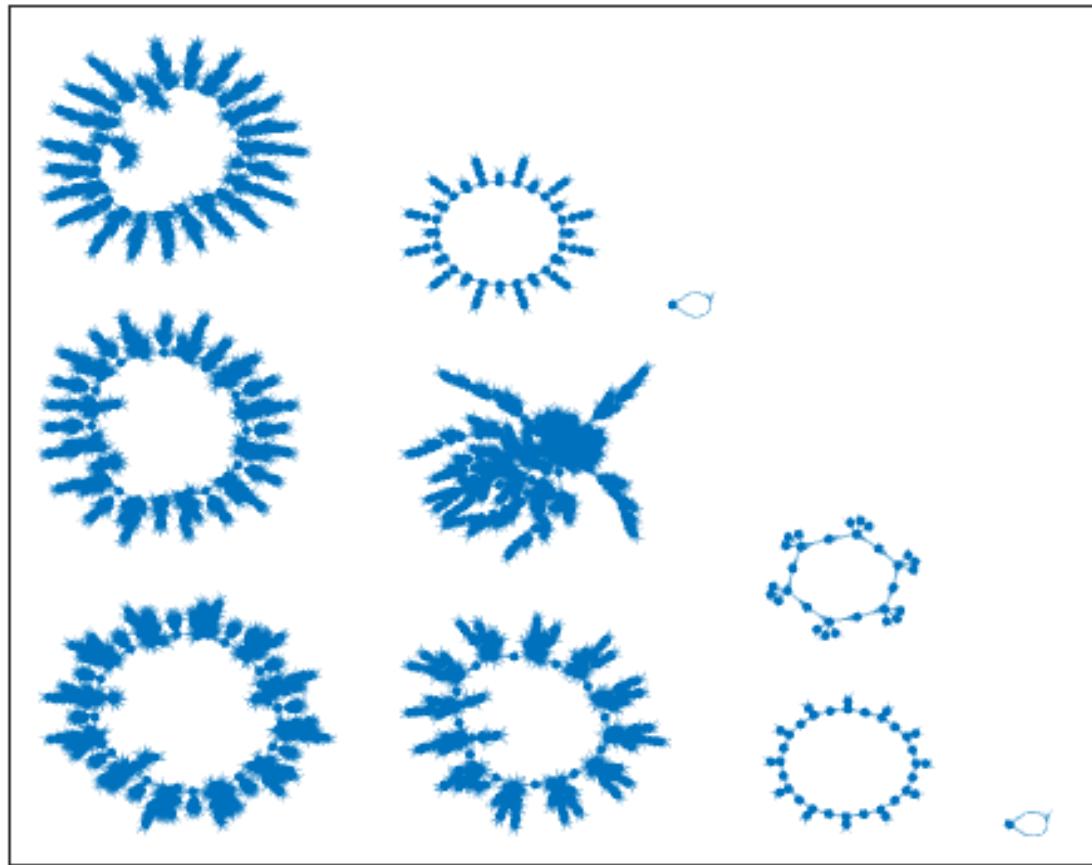
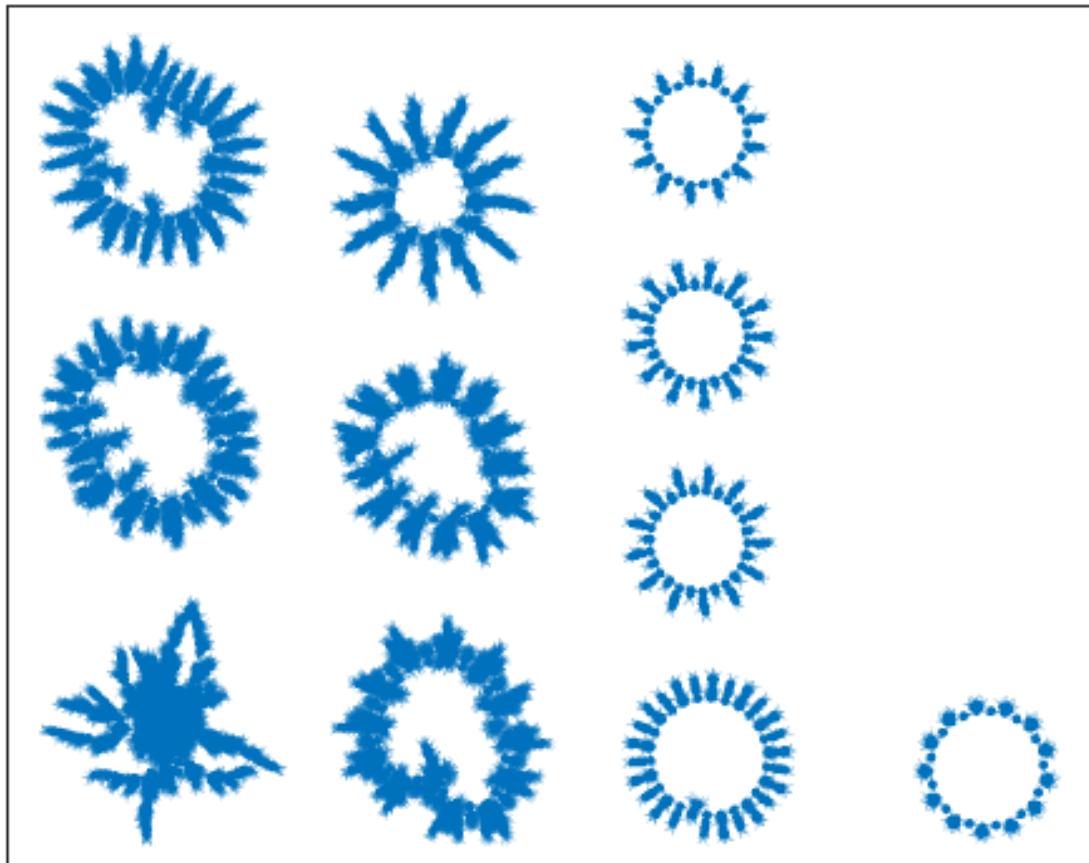
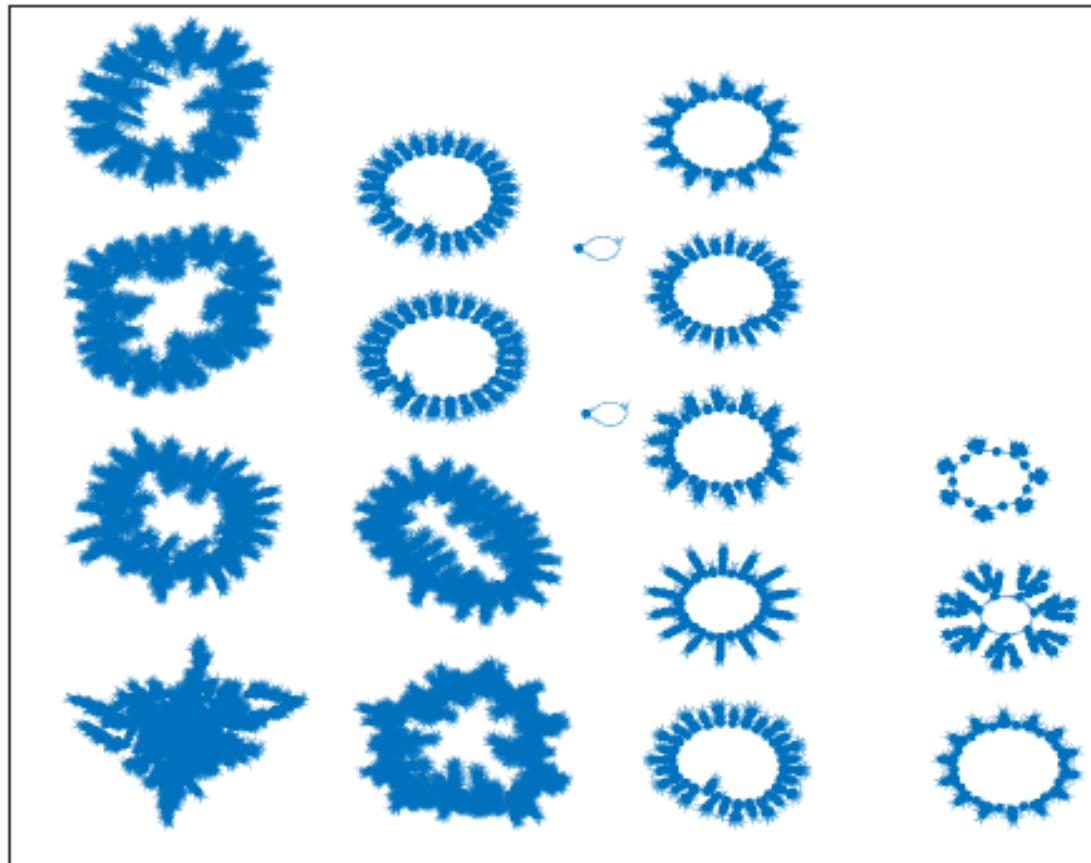


Figura 3.100: Atractor regla 7 $n=12$

Figura 3.101: Atractor regla 7 $n=13$

Figura 3.102: Atractor regla 7 $n=14$

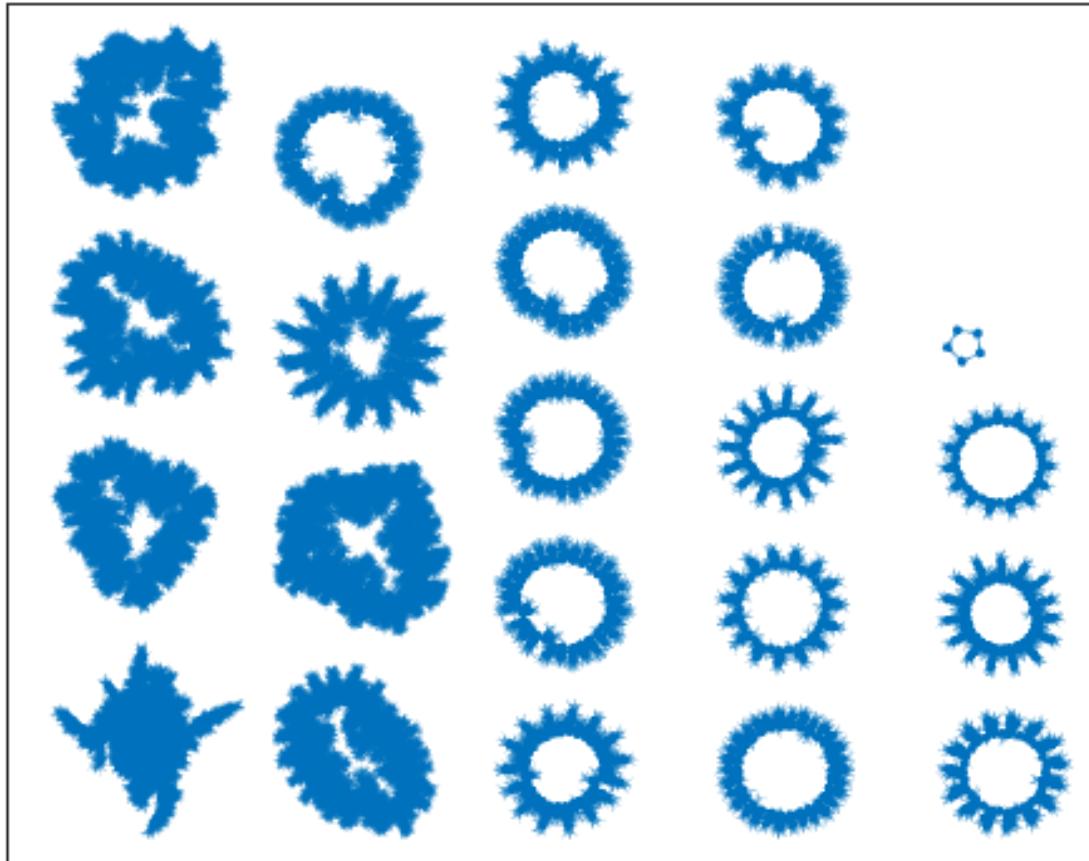


Figura 3.103: Atractor regla 7 $n=15$

3.9. Reglas 8,64,239,253

Respecto a la regla 8 se aprecia que mientras más grande es el tamaño de la cadena (n) se presenta un caso que no habíamos visto con las reglas anteriores, me refiero a que aquí no se crean nuevos atractores sino que mientras crece n aparecen nuevos nodos (jardín del edén) que convergen a un mismo nodo y este a su vez converge a un nodo principal que es el nodo que se mantiene siempre al centro.

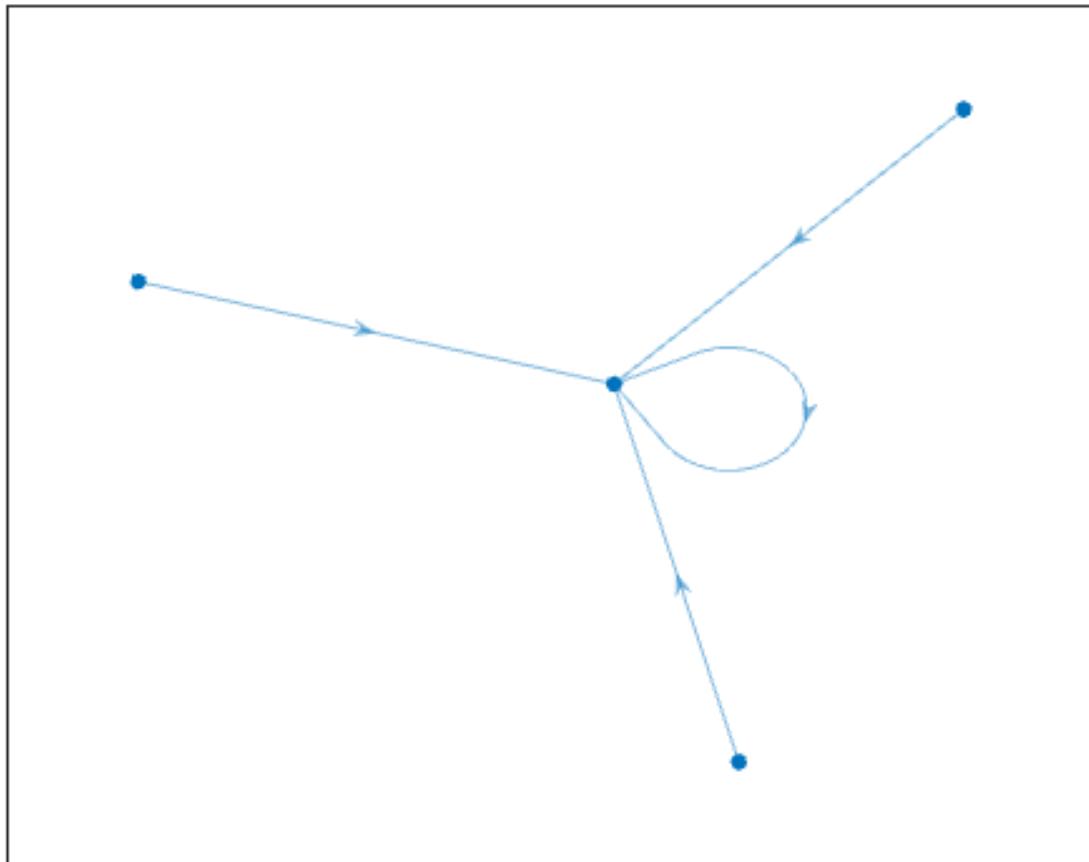
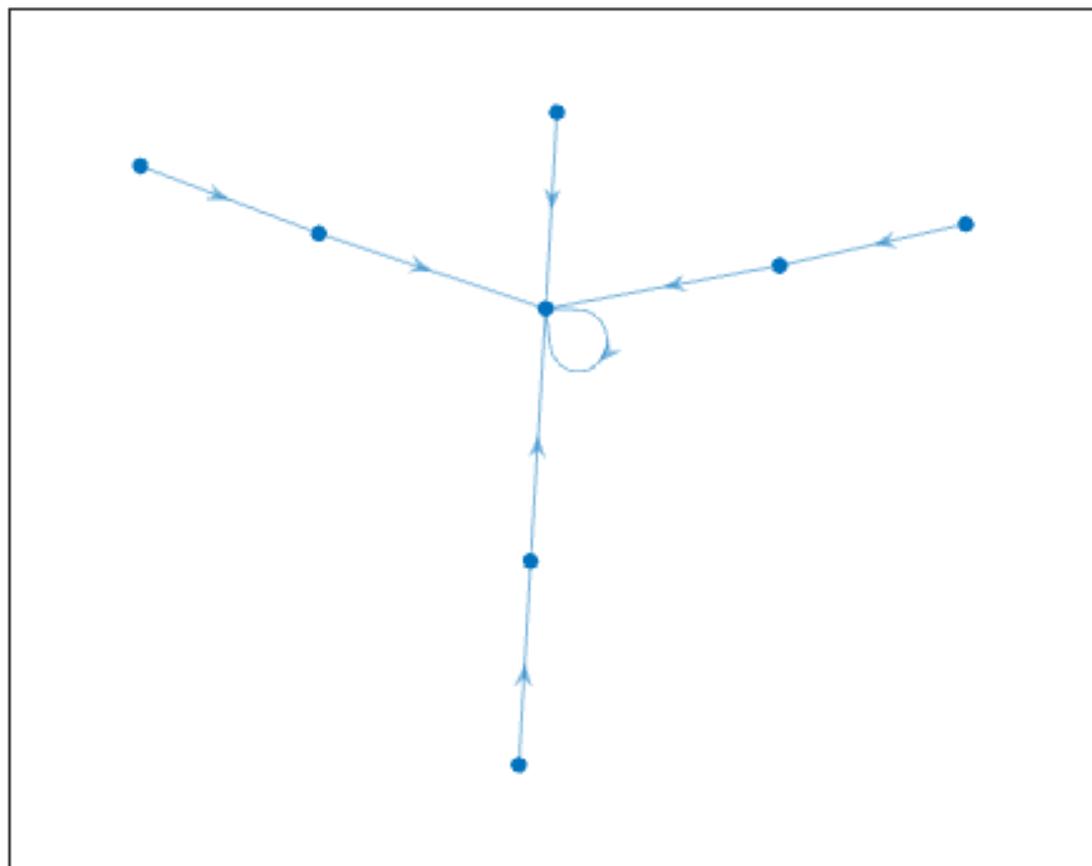


Figura 3.104: Atractor regla 8 $n=2$



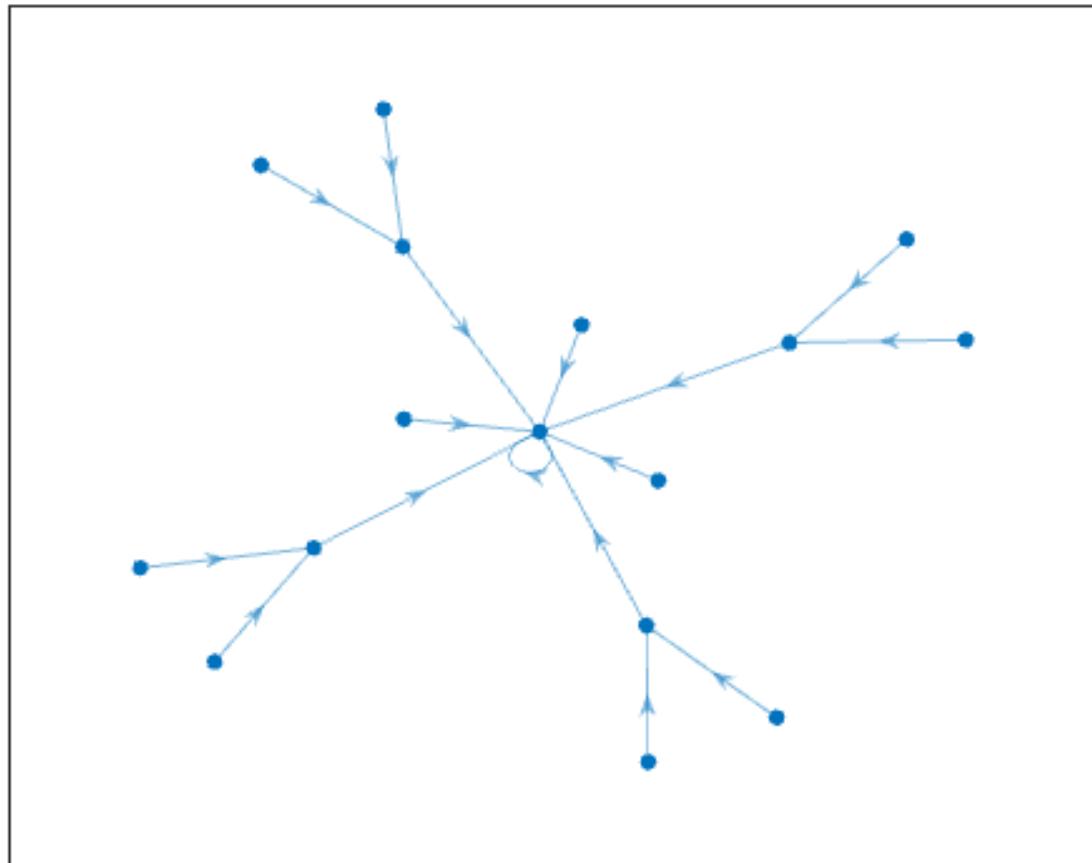


Figura 3.106: Atractor regla 8 n=4

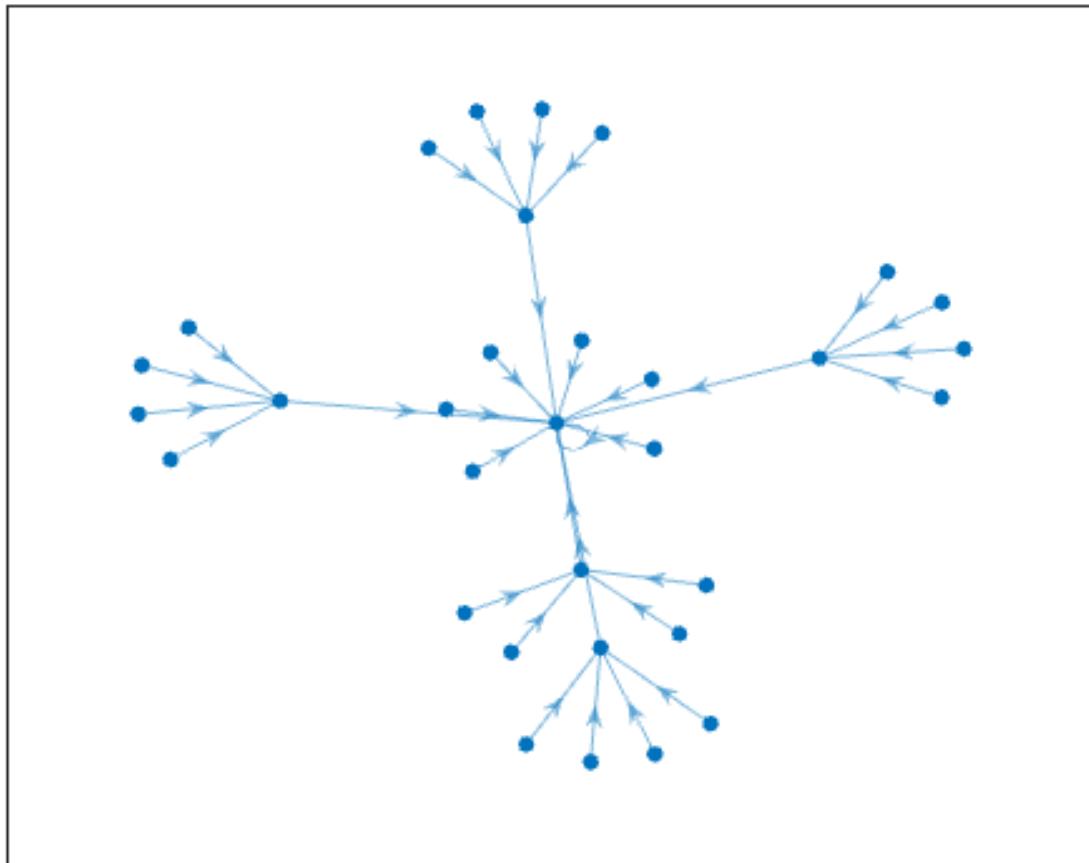


Figura 3.107: Atractor regla 8 n=5

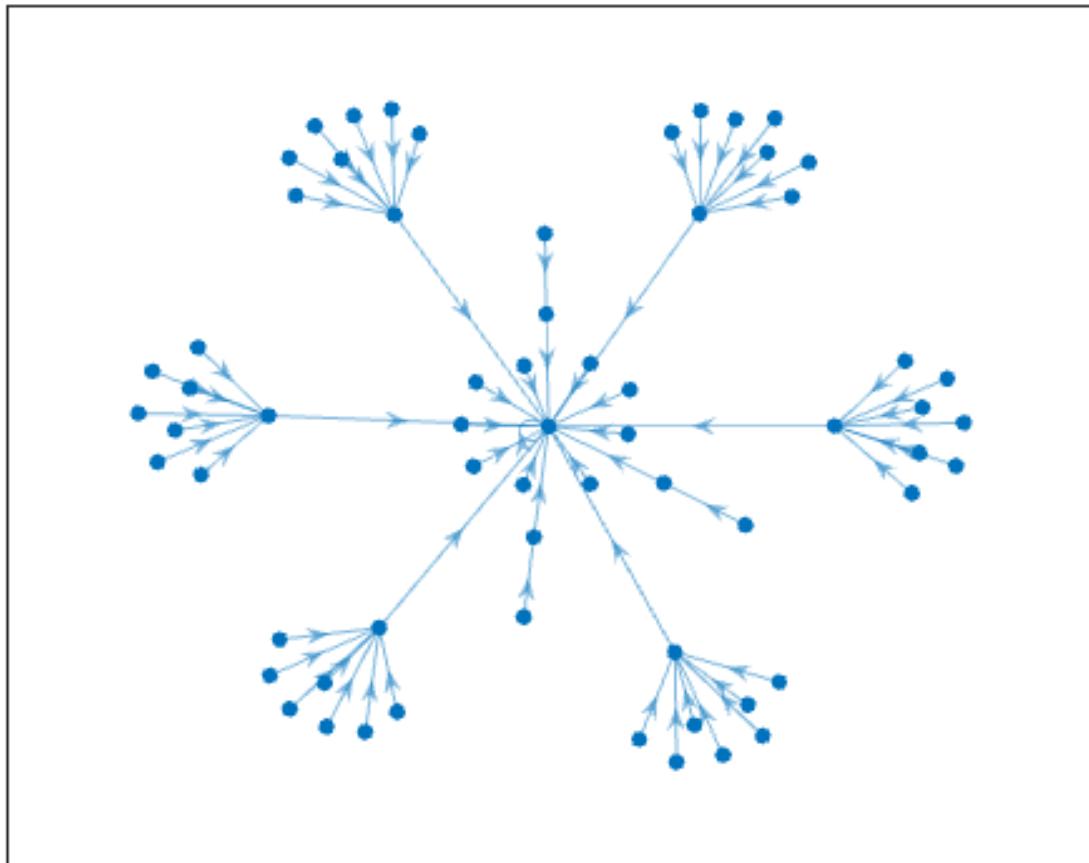


Figura 3.108: Atractor regla 8 n=6

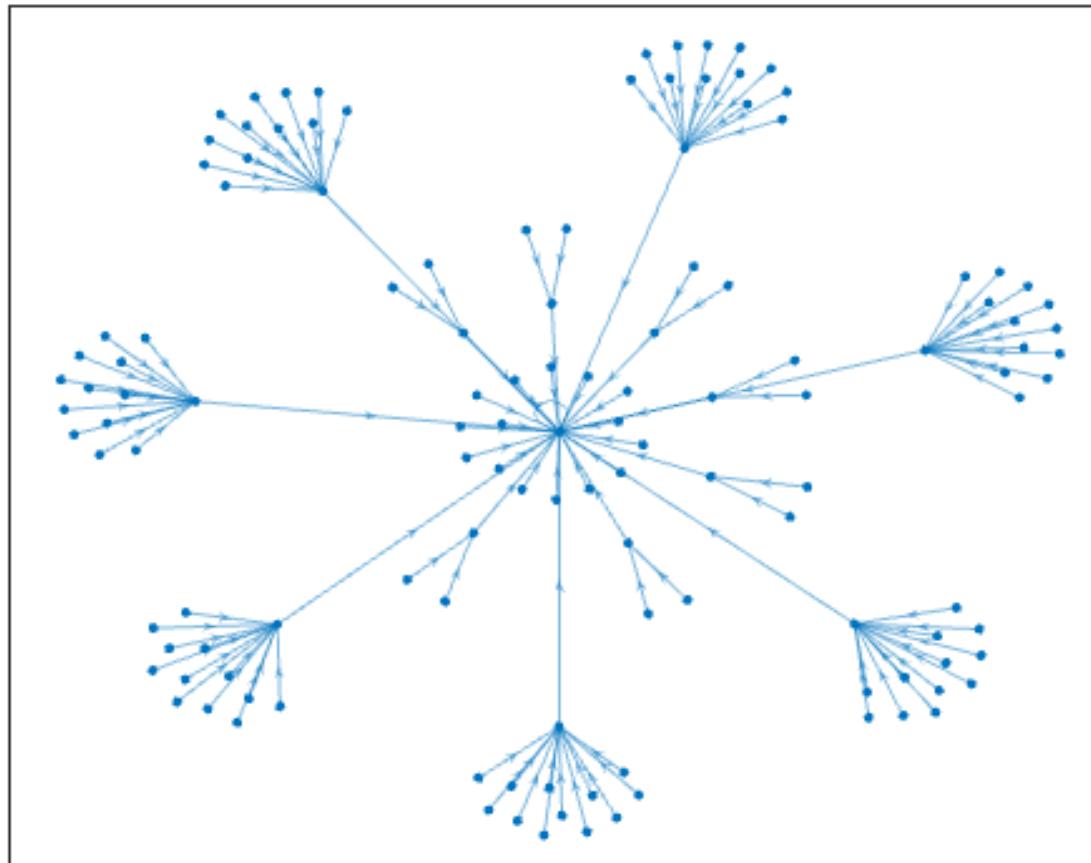


Figura 3.109: Atractor regla 8 n=7

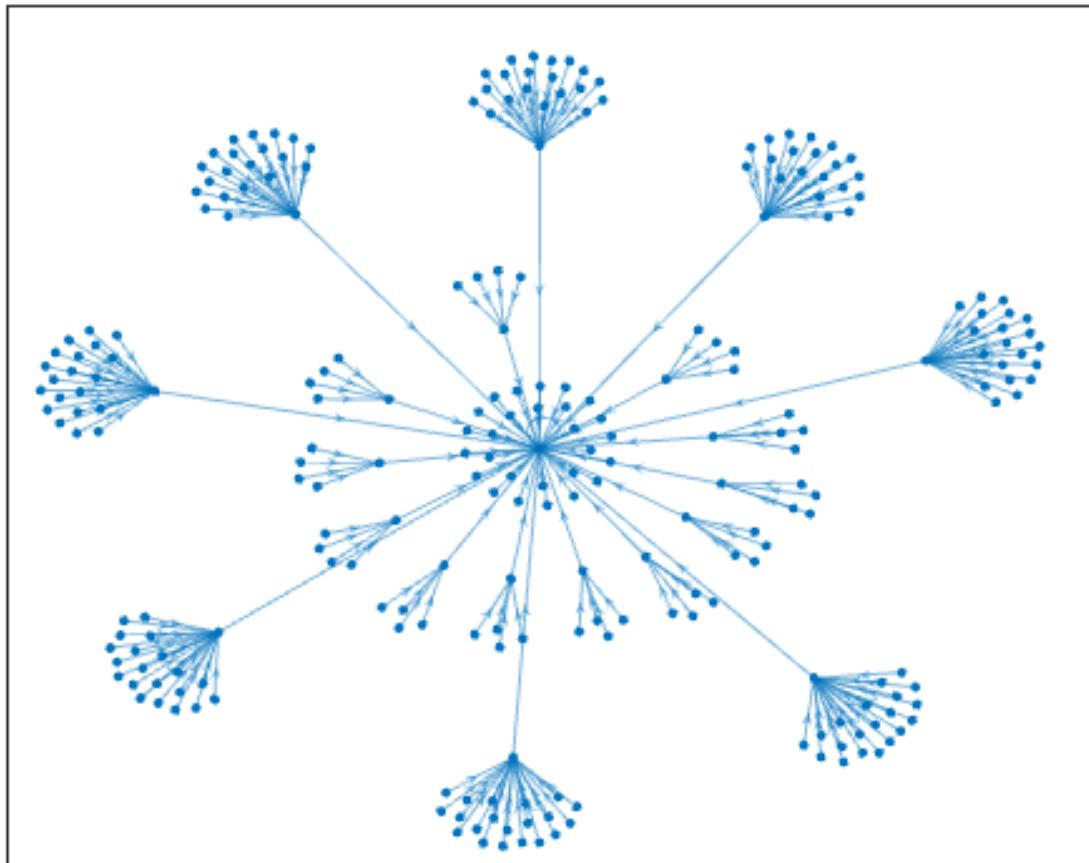


Figura 3.110: Atractor regla 8 n=8

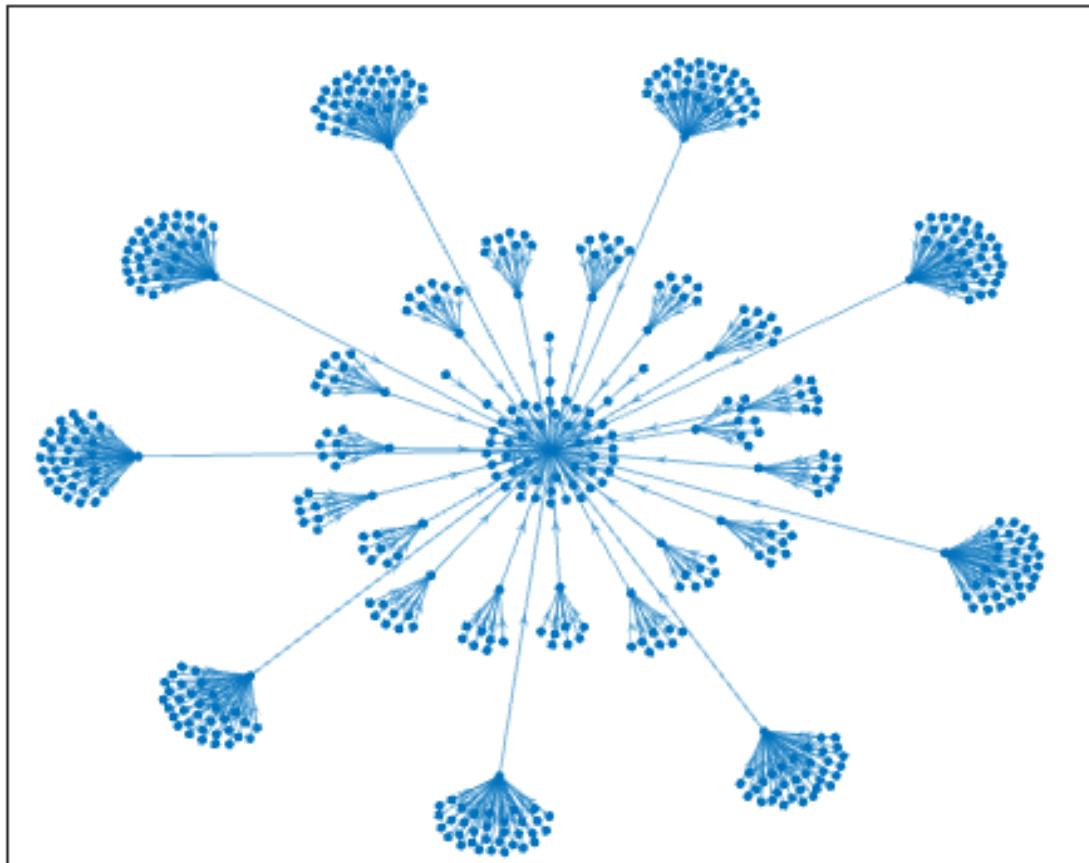


Figura 3.111: Atractor regla 8 n=9

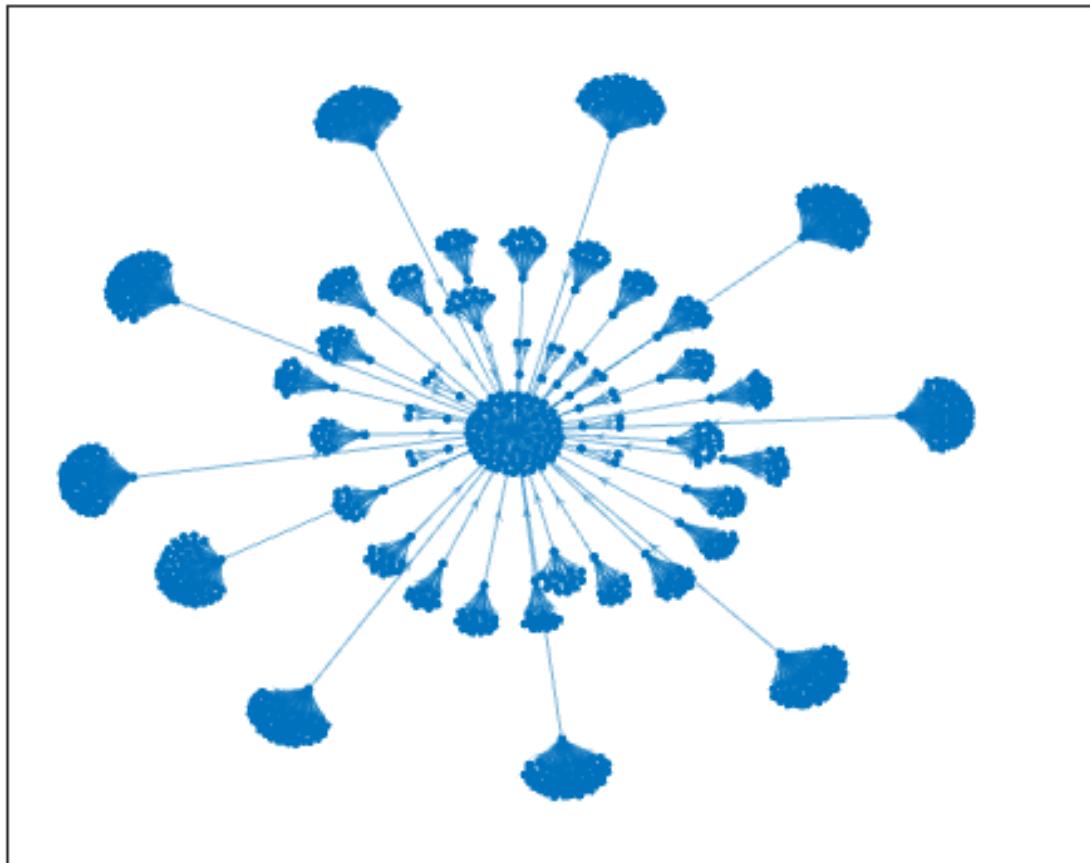


Figura 3.112: Atractor regla 8 n=10

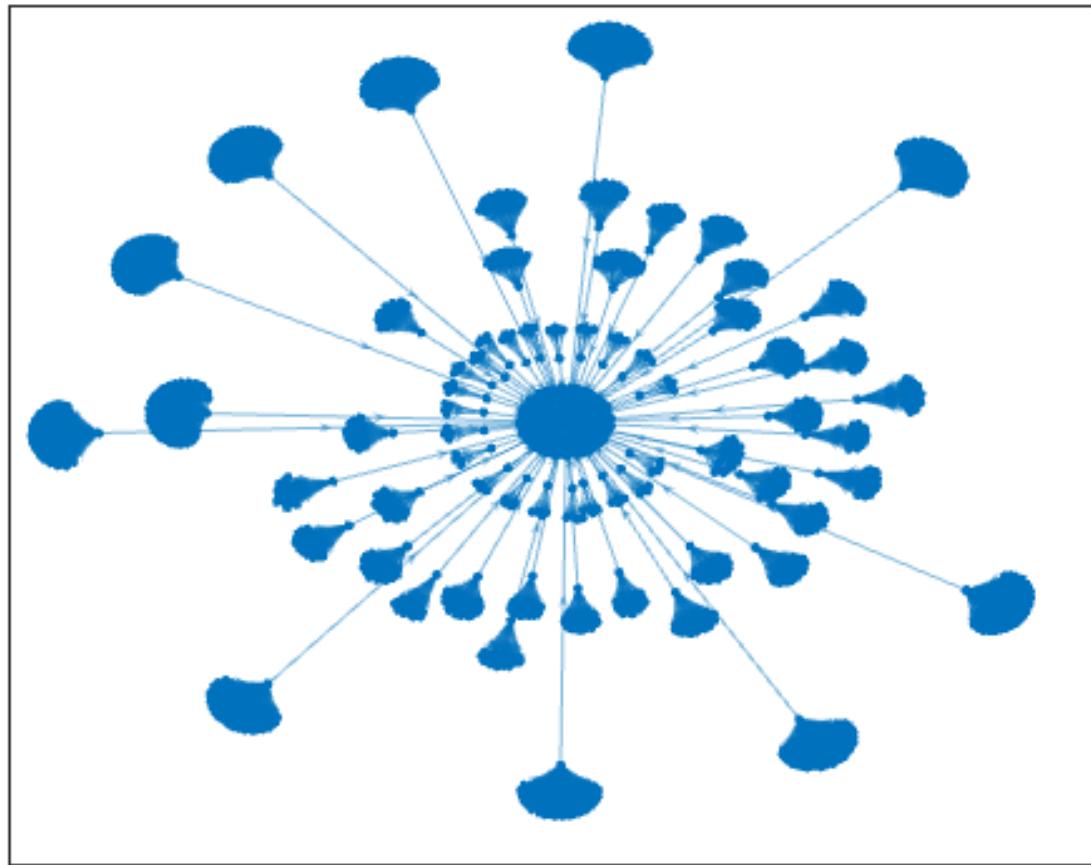


Figura 3.113: Atractor regla 8 n=11

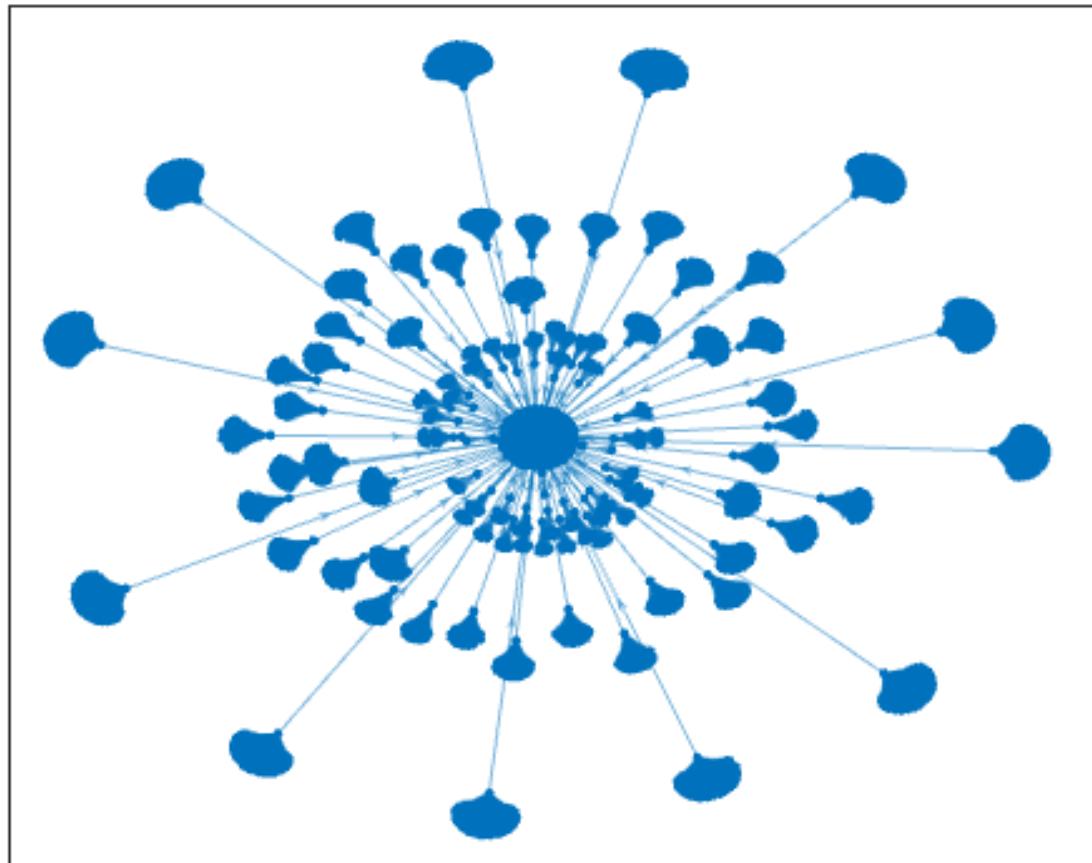


Figura 3.114: Atractor regla 8 n=12

3.10. Reglas 9,65,111,125

Respecto a la regla 9 se aprecia que mientras más grande es el tamaño de la cadena (n) vemos que surgen nuevos nodos que en un tamaño de cadena están separados pero al siguiente tamaño de cadena se juntan y posteriormente se vuelven a separar formando nuevos atractores, observe el caso de las imágenes 3.117, 3.118 y 3.119.

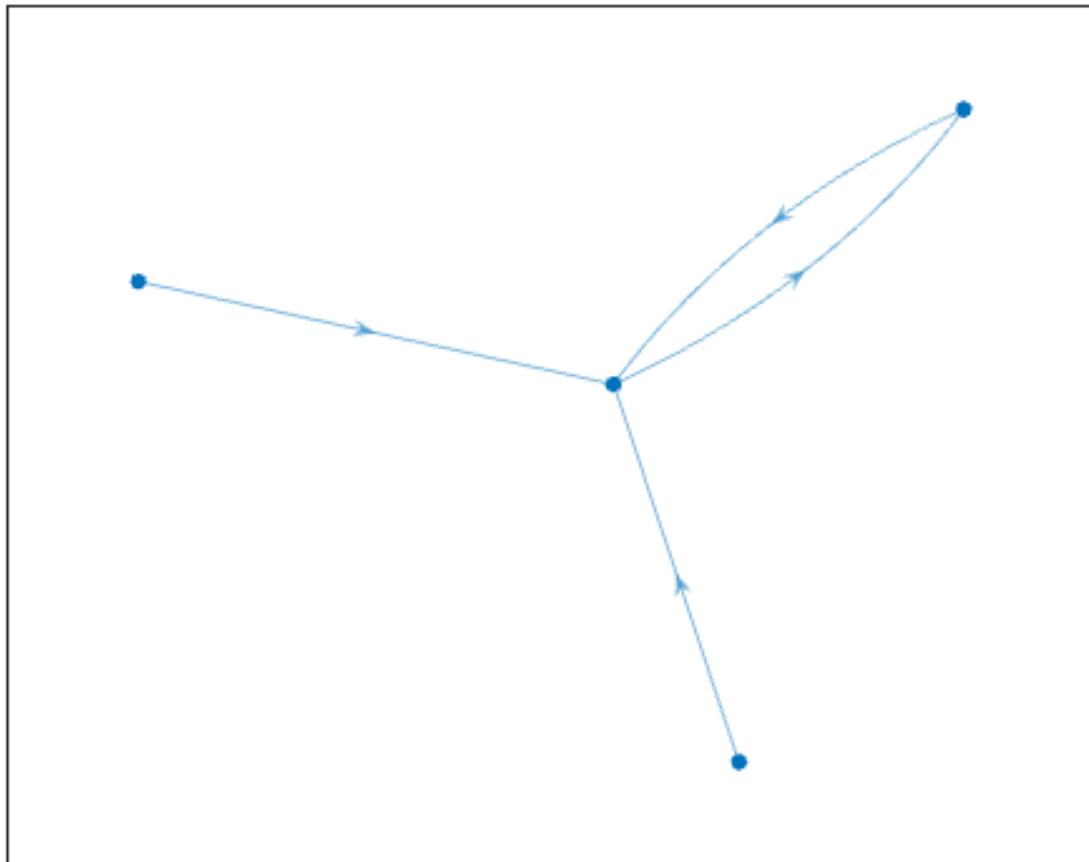


Figura 3.115: Atractor regla 9 $n=2$

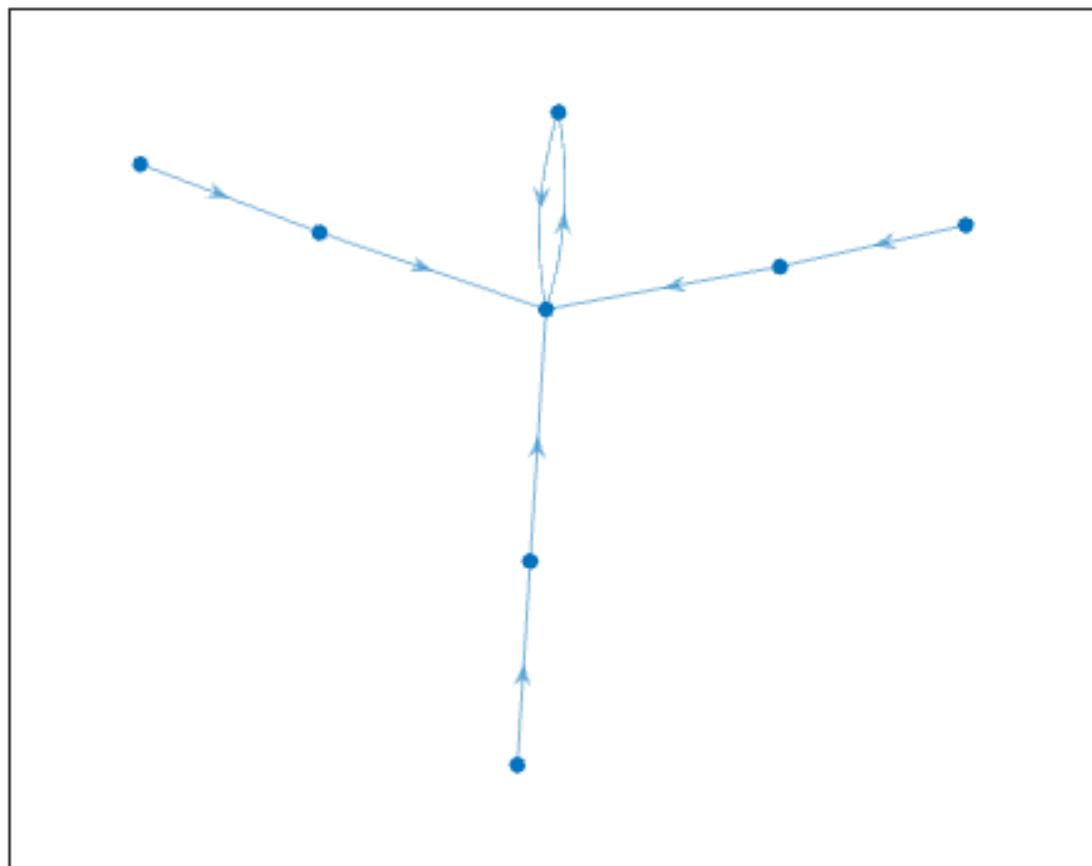
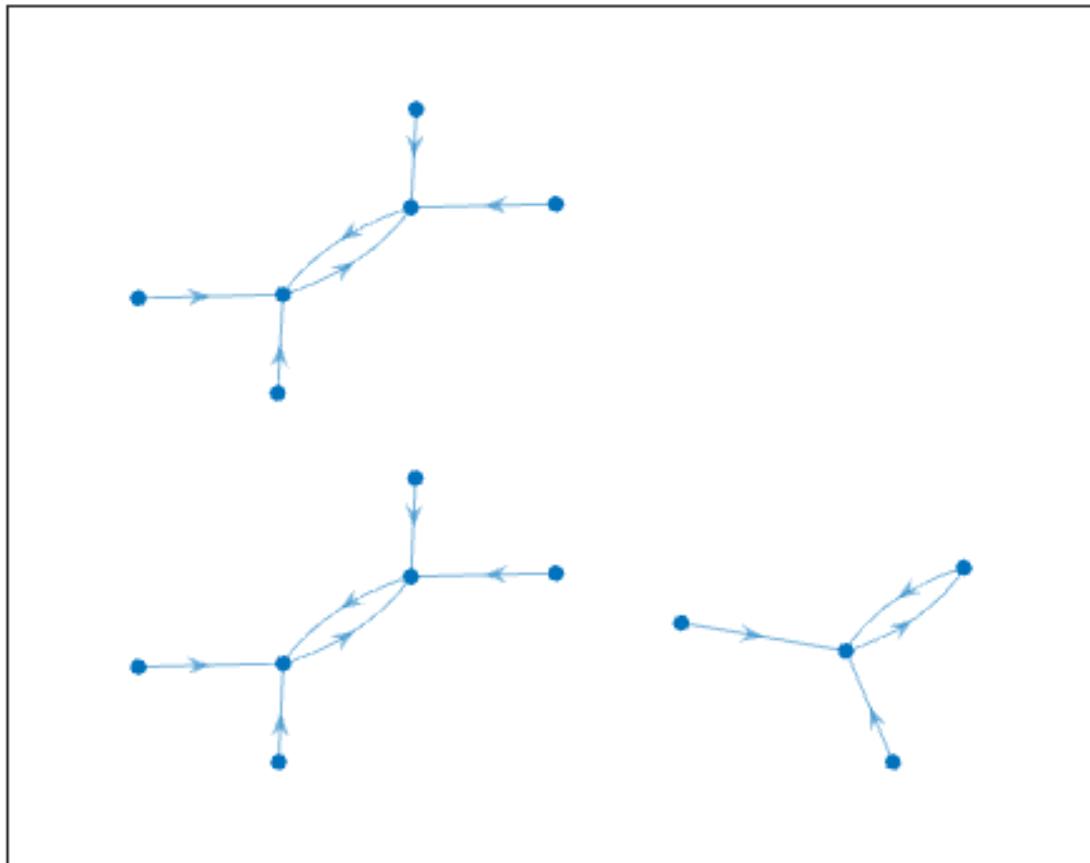
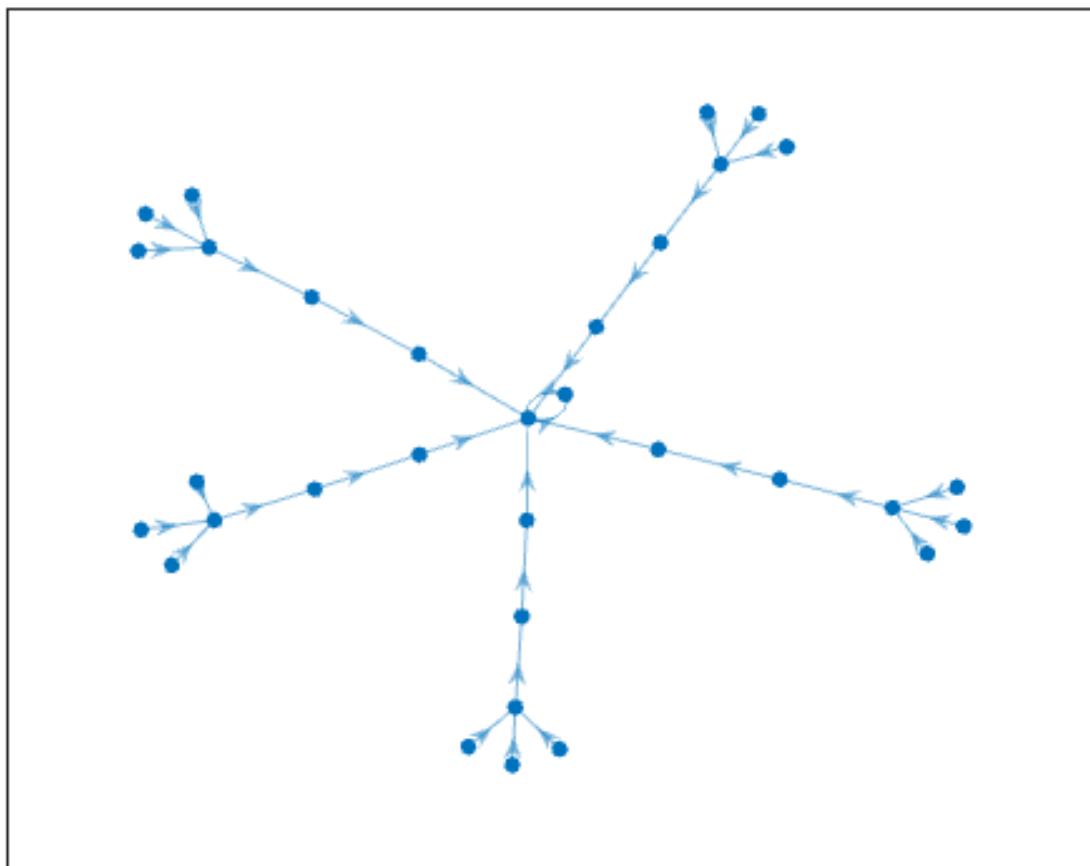
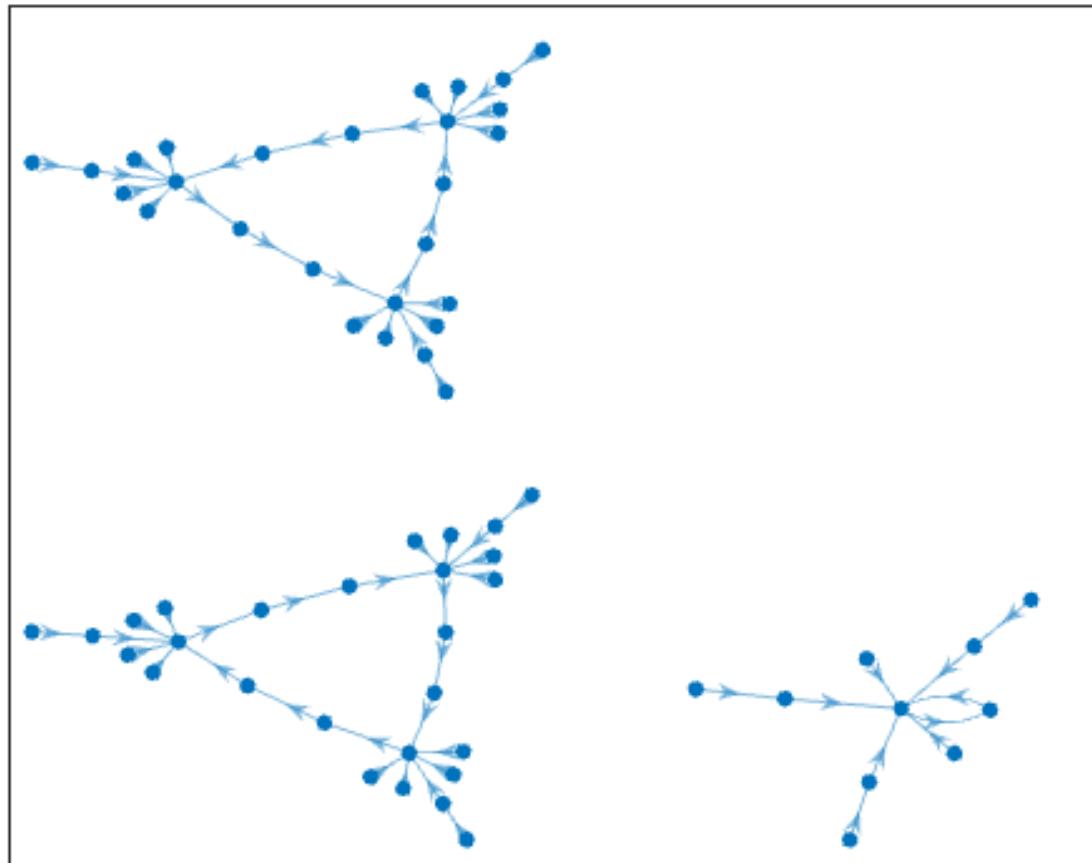


Figura 3.116: Atractor regla 9 n=3

Figura 3.117: Atractor regla 9 $n=4$

Figura 3.118: Atractor regla 9 $n=5$

Figura 3.119: Atractor regla 9 $n=6$

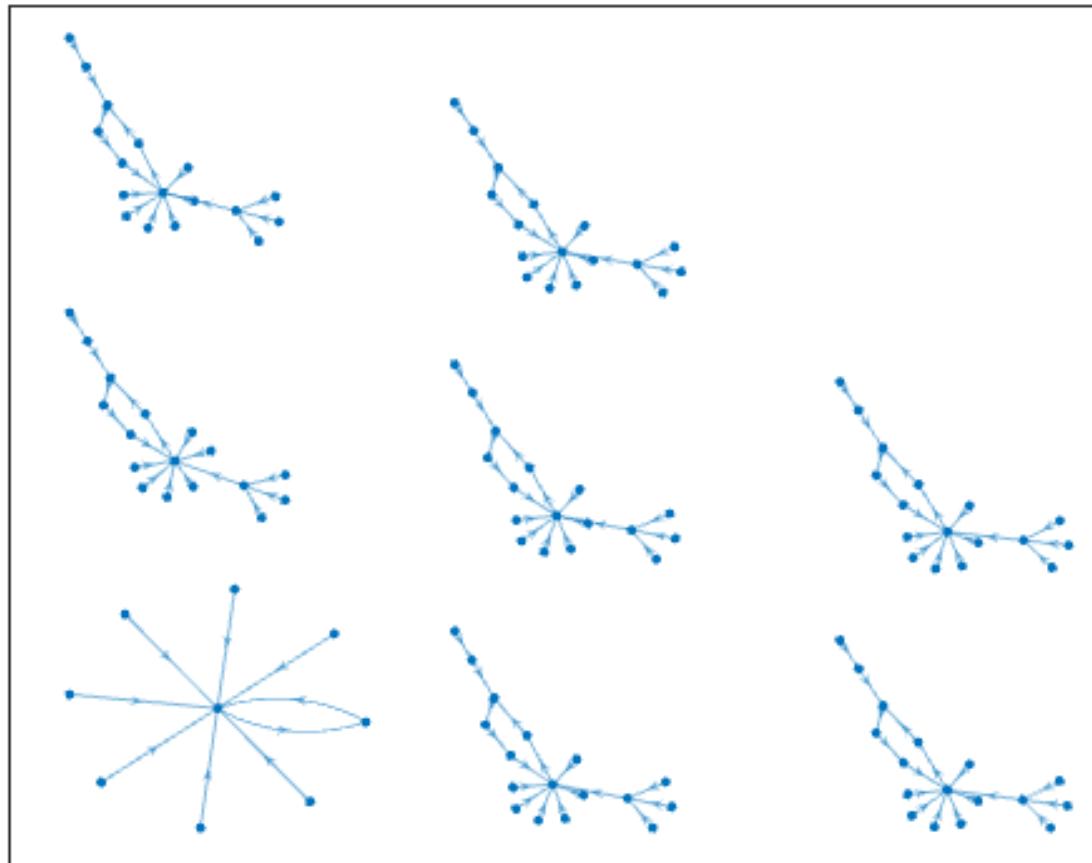


Figura 3.120: Atractor regla 9 n=7

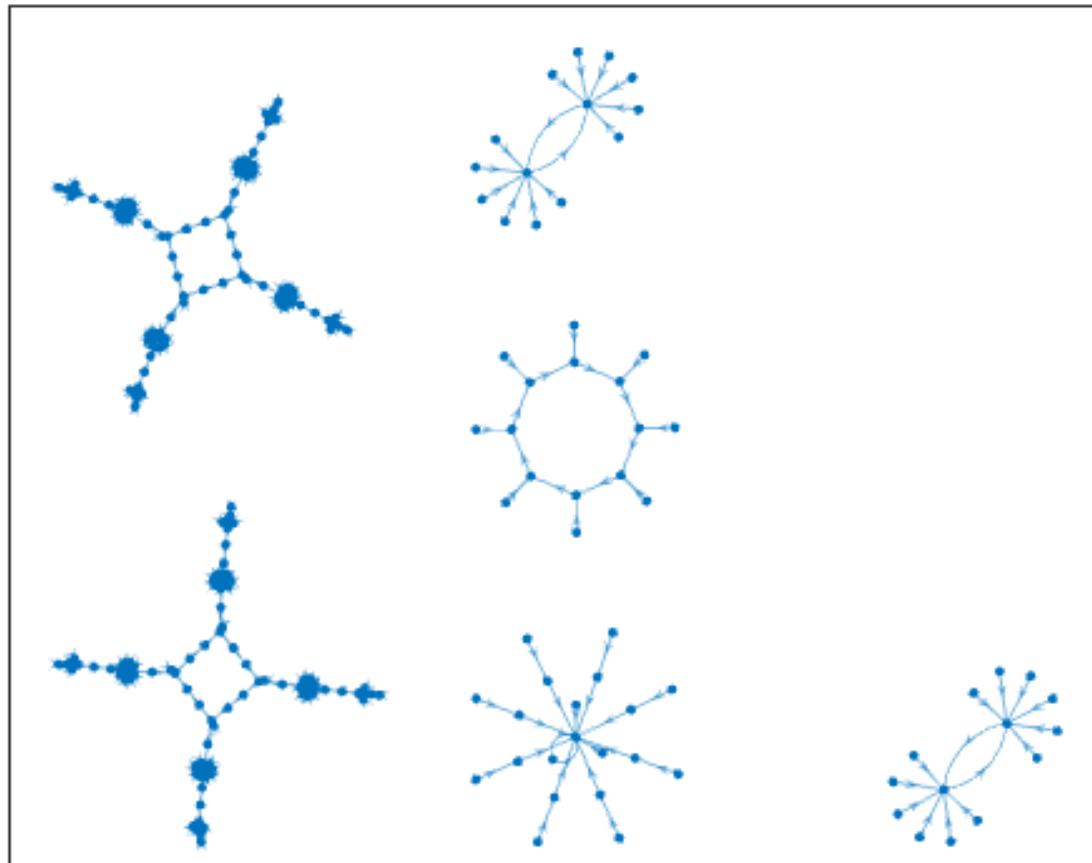
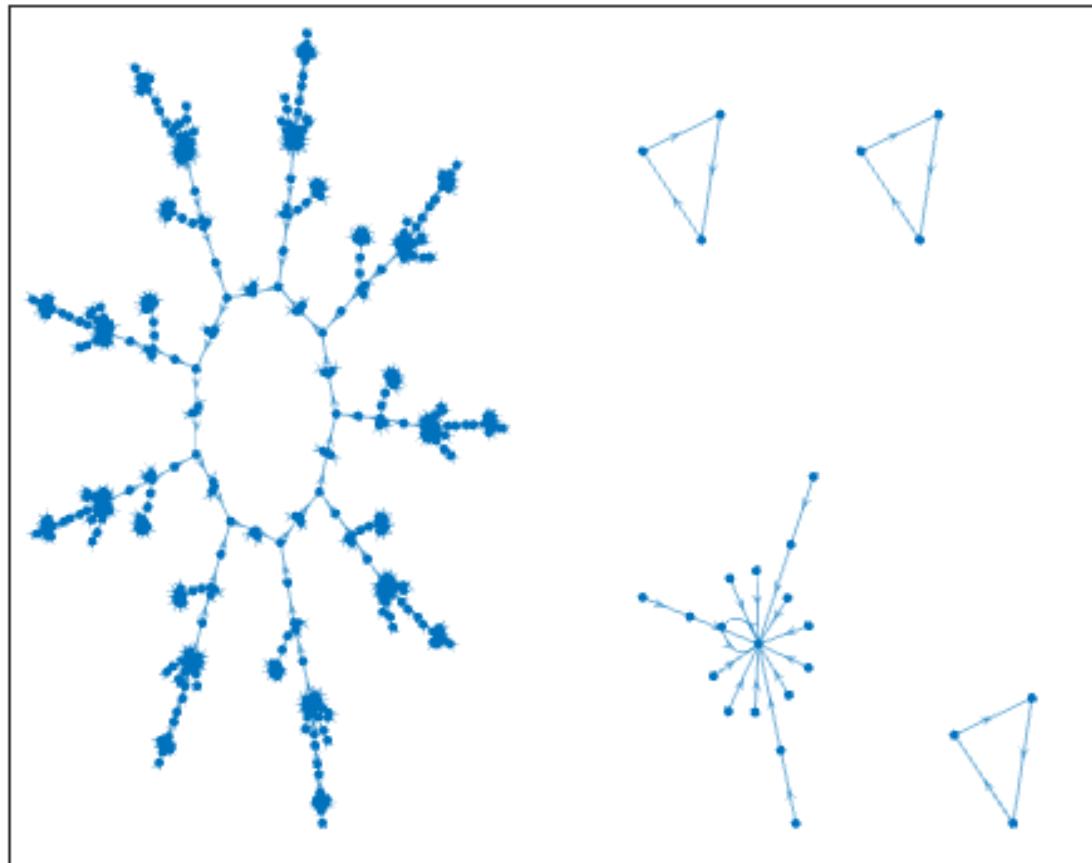
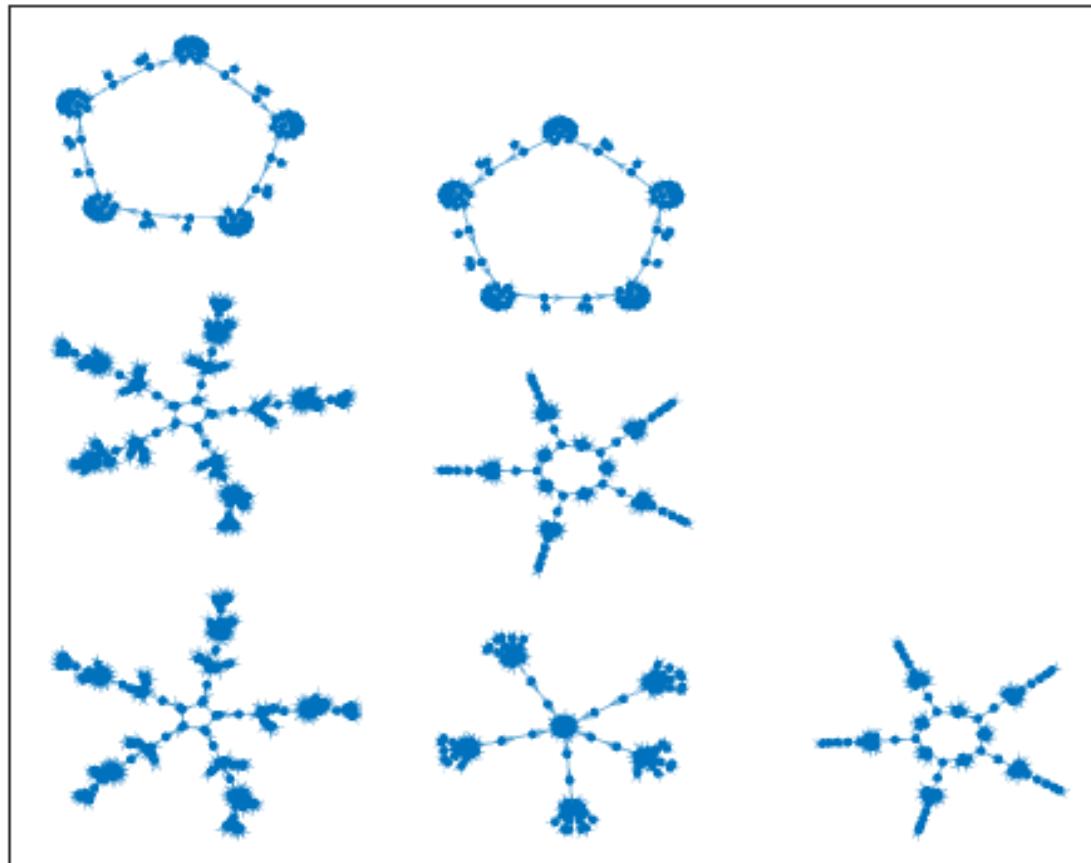
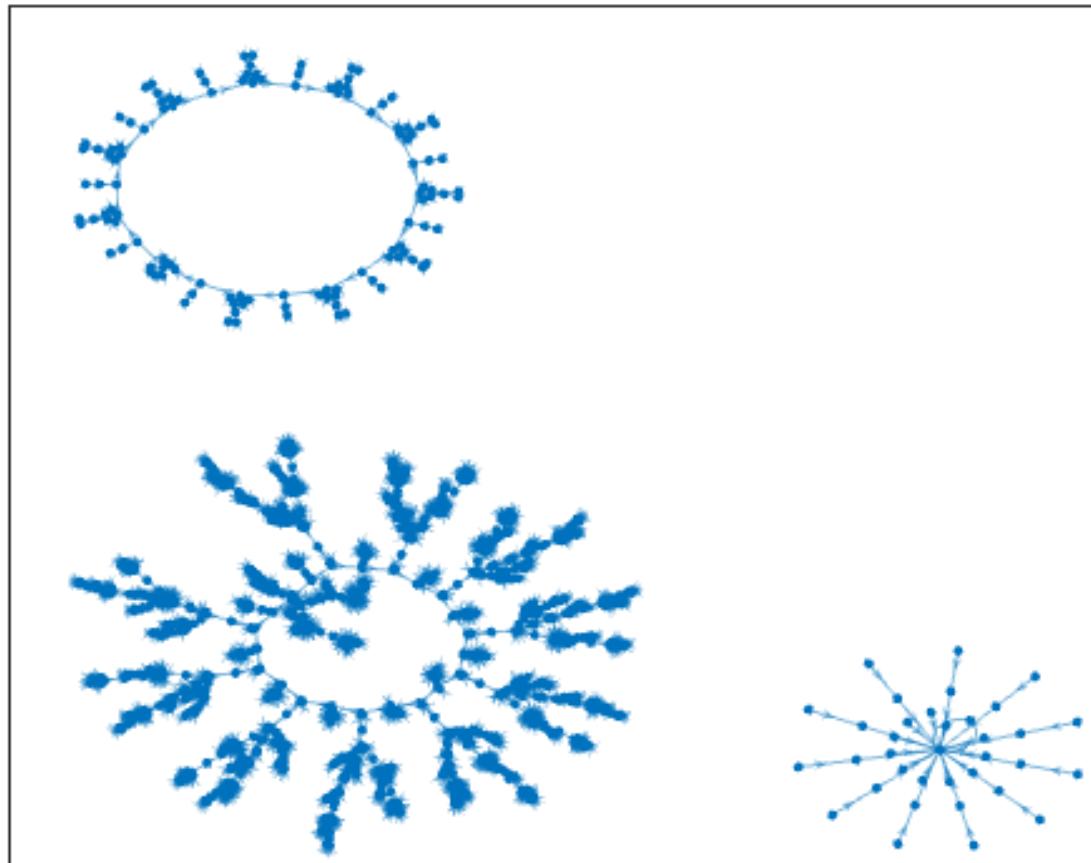
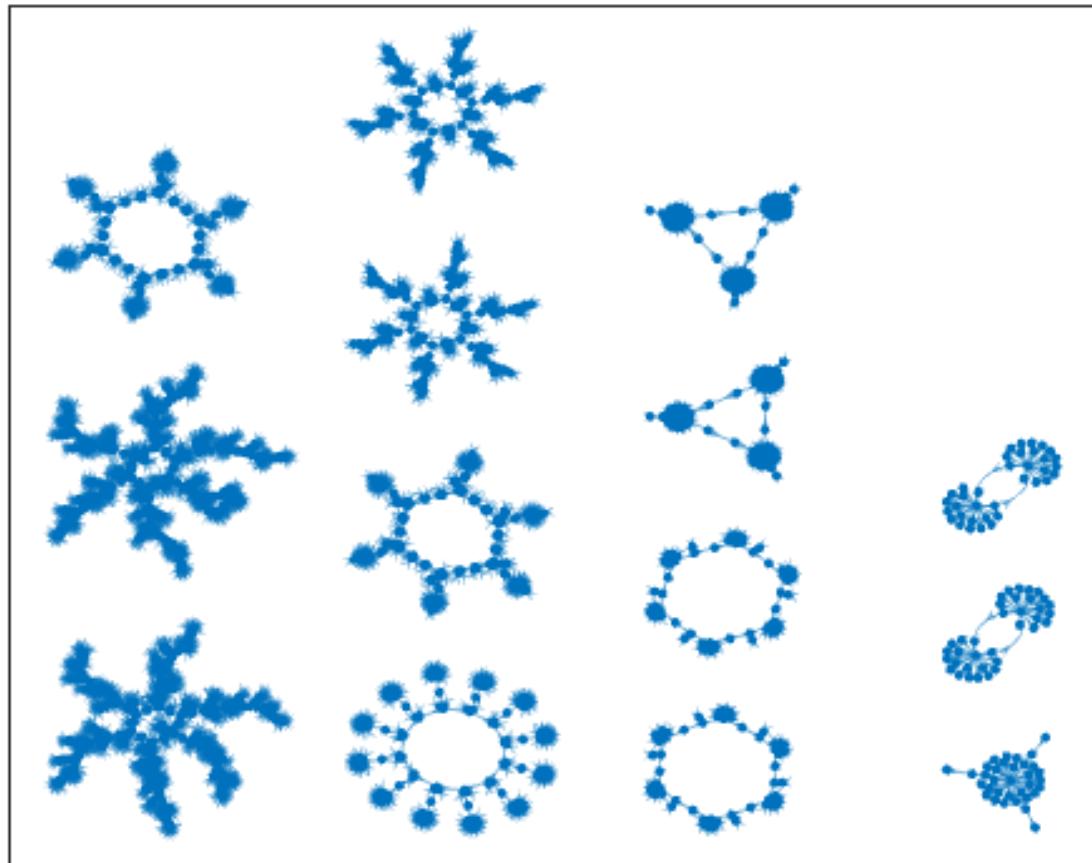


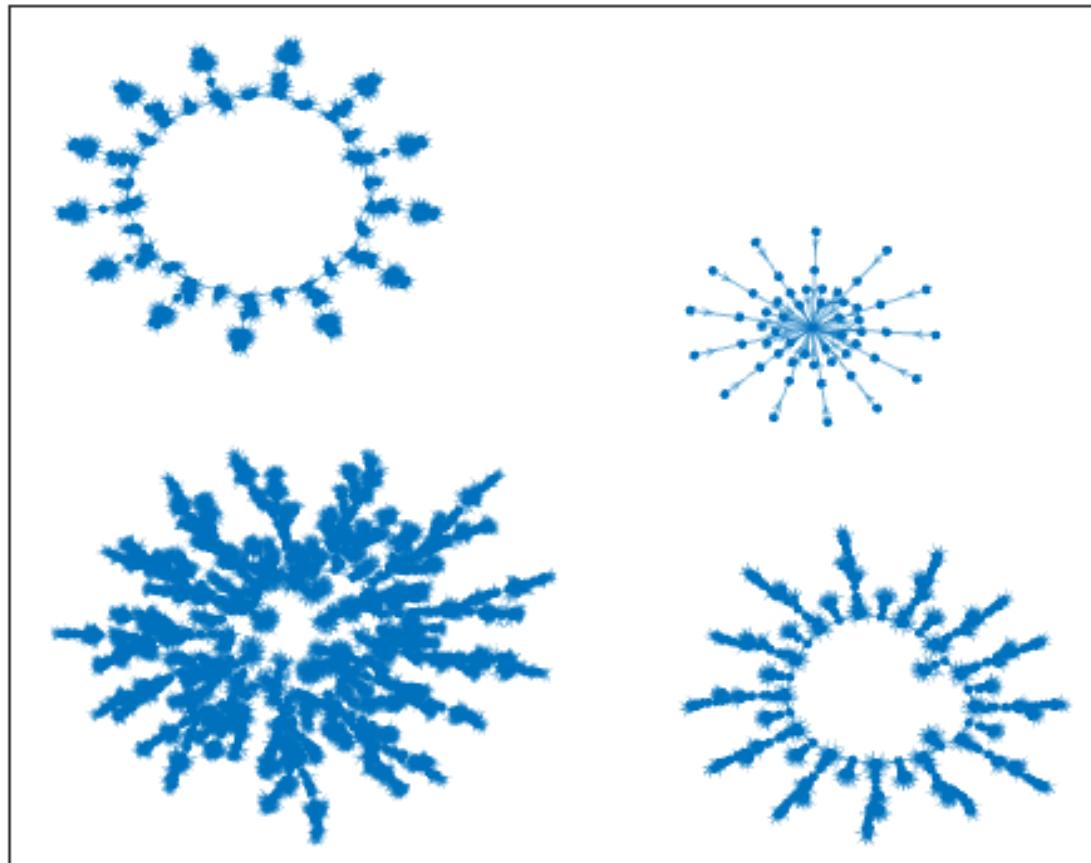
Figura 3.121: Atractor regla 9 n=8

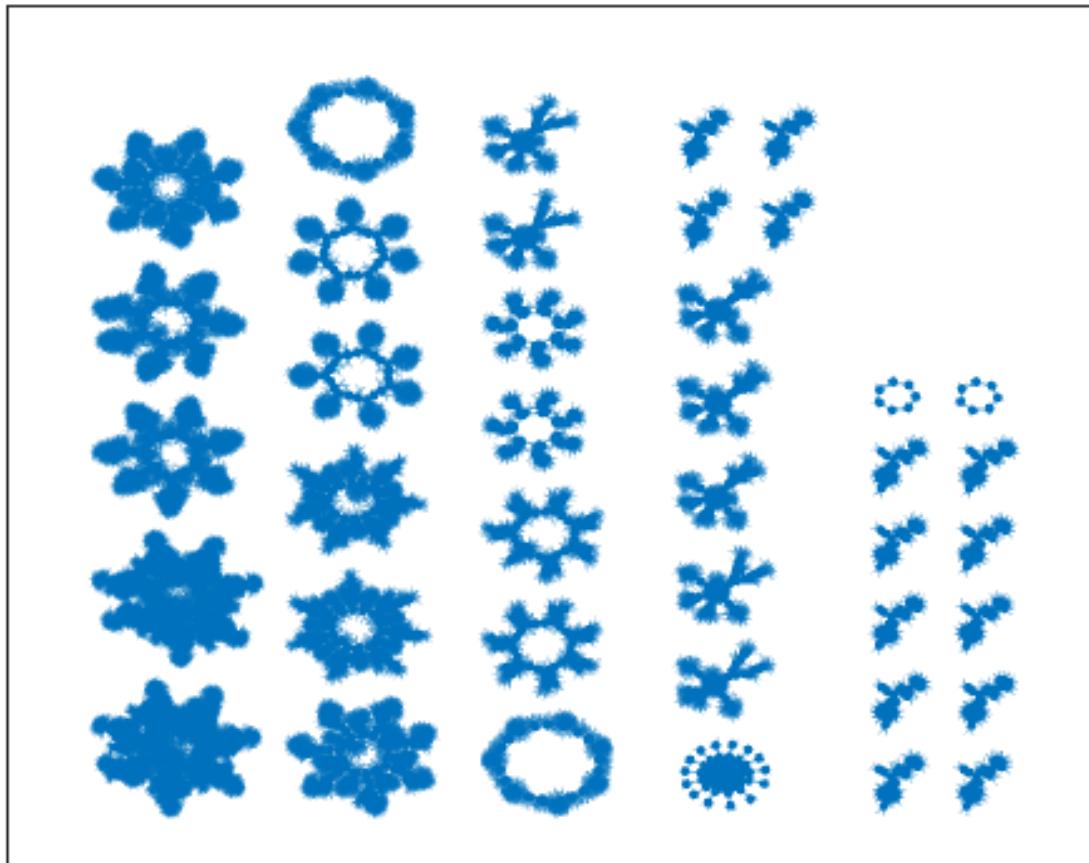
Figura 3.122: Atractor regla 9 $n=9$

Figura 3.123: Atractor regla 9 $n=10$

Figura 3.124: Atractor regla 9 $n=11$

Figura 3.125: Atractor regla 9 $n=12$

Figura 3.126: Atractor regla 9 $n=13$

Figura 3.127: Atractor regla 9 $n=14$

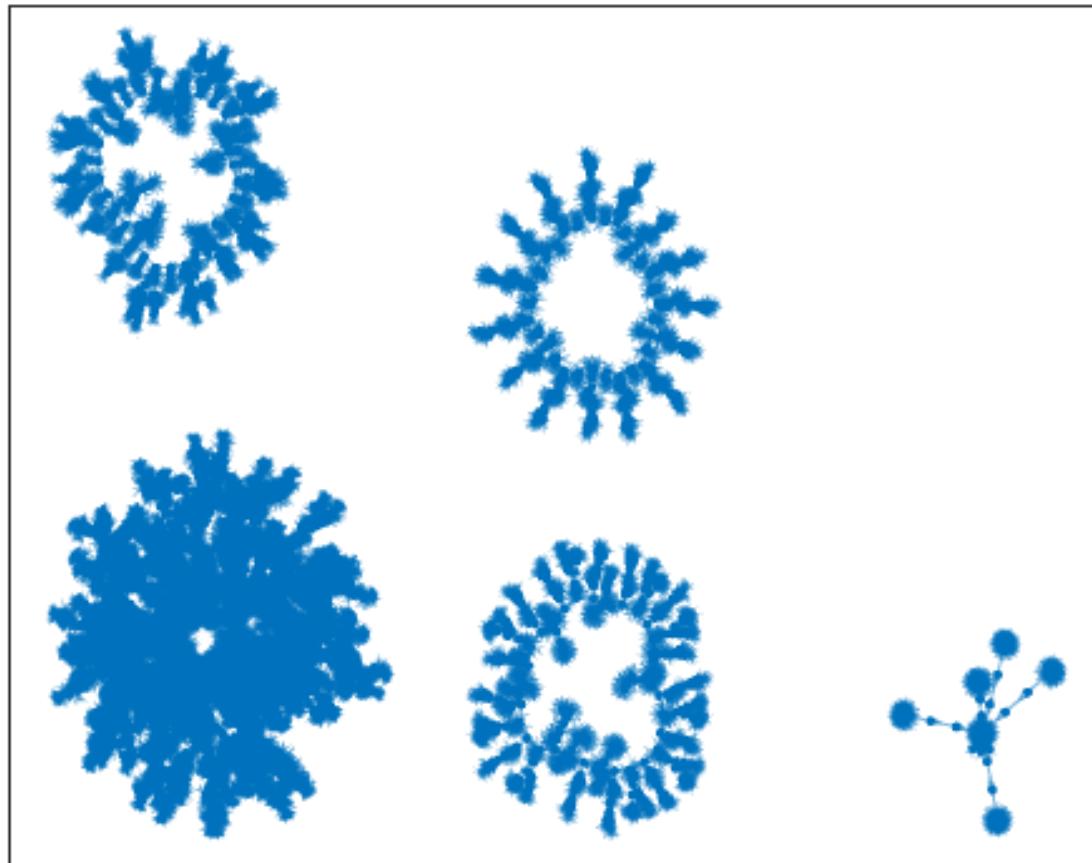


Figura 3.128: Atractor regla 9 n=15

3.11. Reglas 10,80,175,245

Respecto a la regla 10 se aprecia que mientras más grande es el tamaño de la cadena (n) aparecen nuevos atractores con forma de polígonos que evolucionan convirtiéndose en atractores más grandes (atraen más nodos).

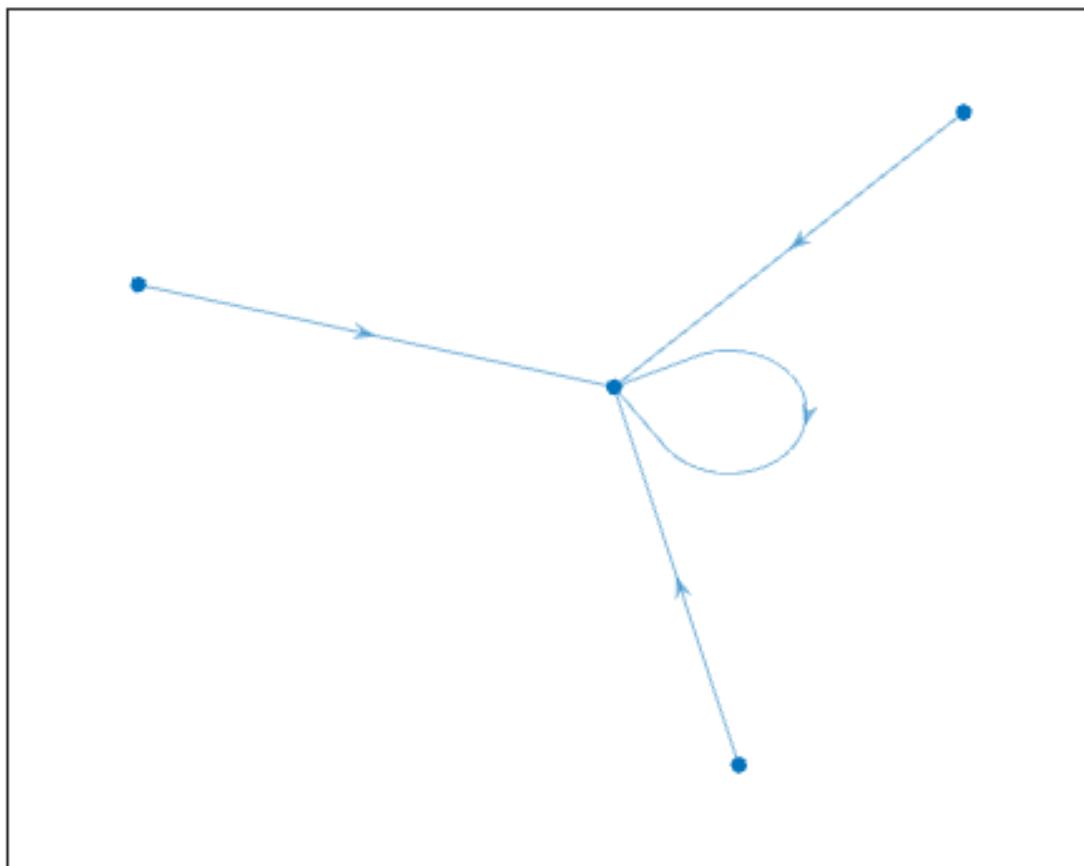


Figura 3.129: Atractor regla 10 $n=2$

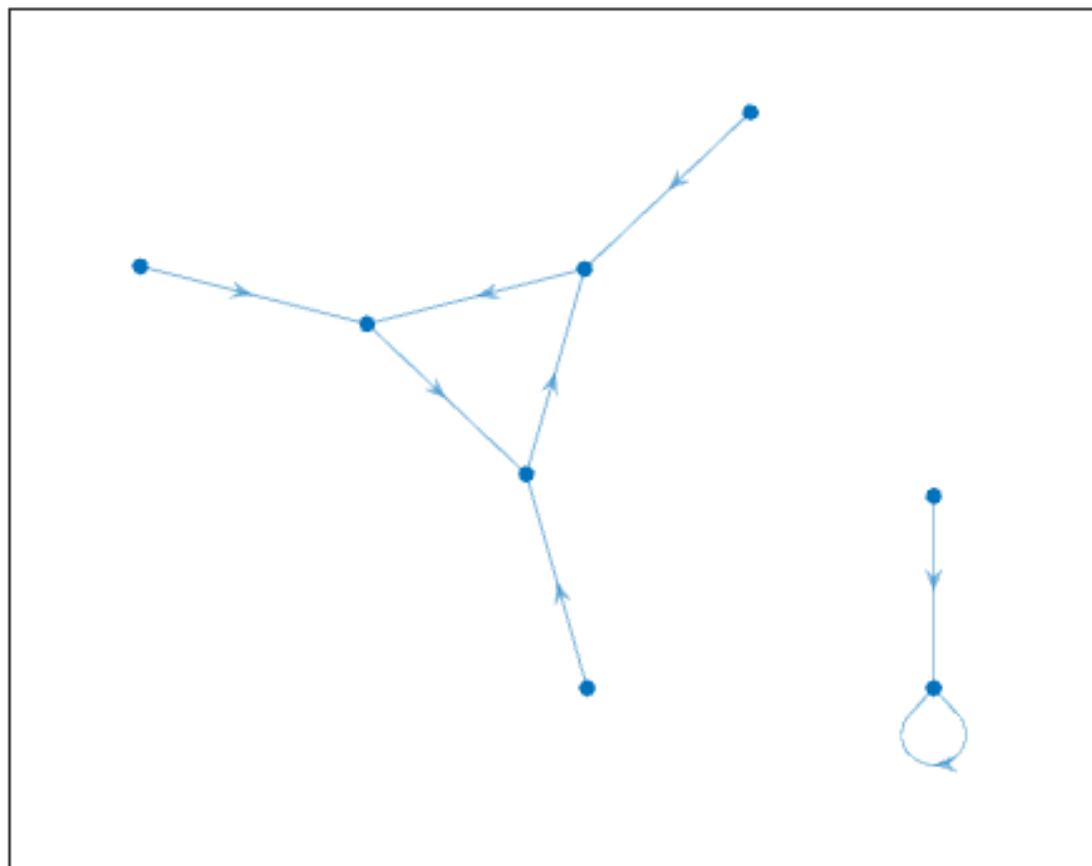


Figura 3.130: Atractor regla 10 n=3

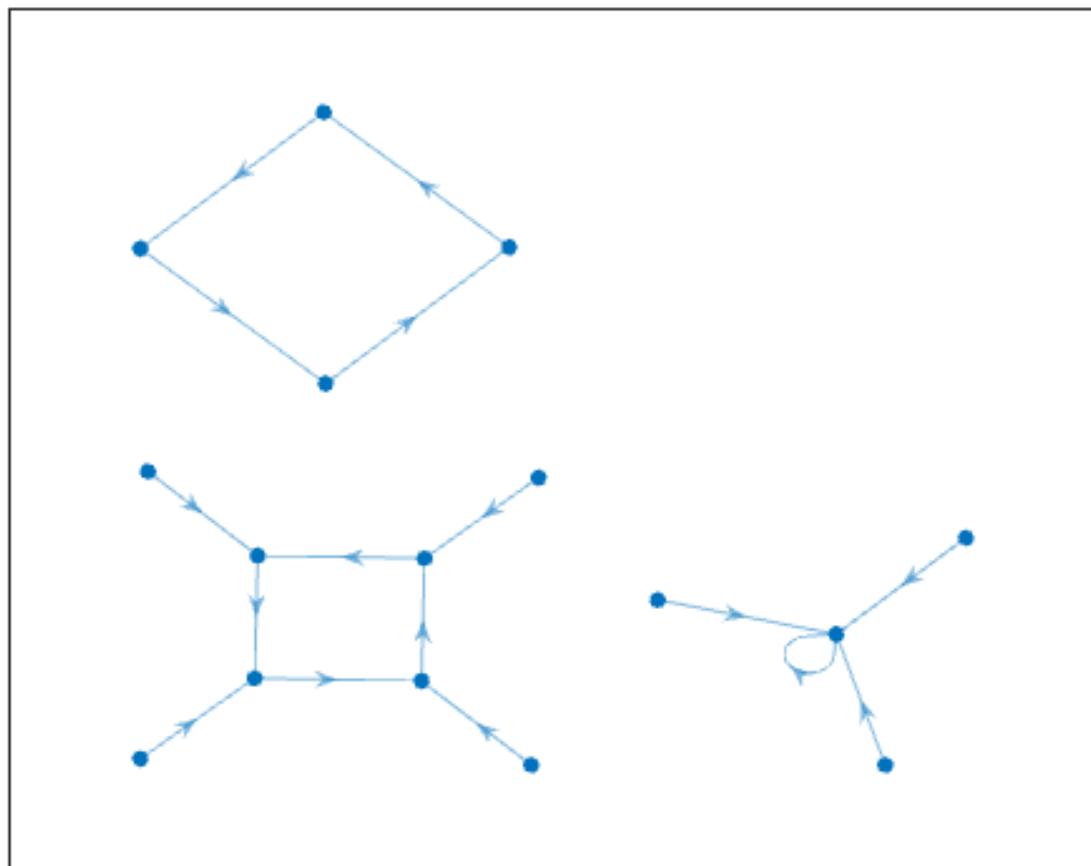


Figura 3.131: Atractor regla 10 n=4

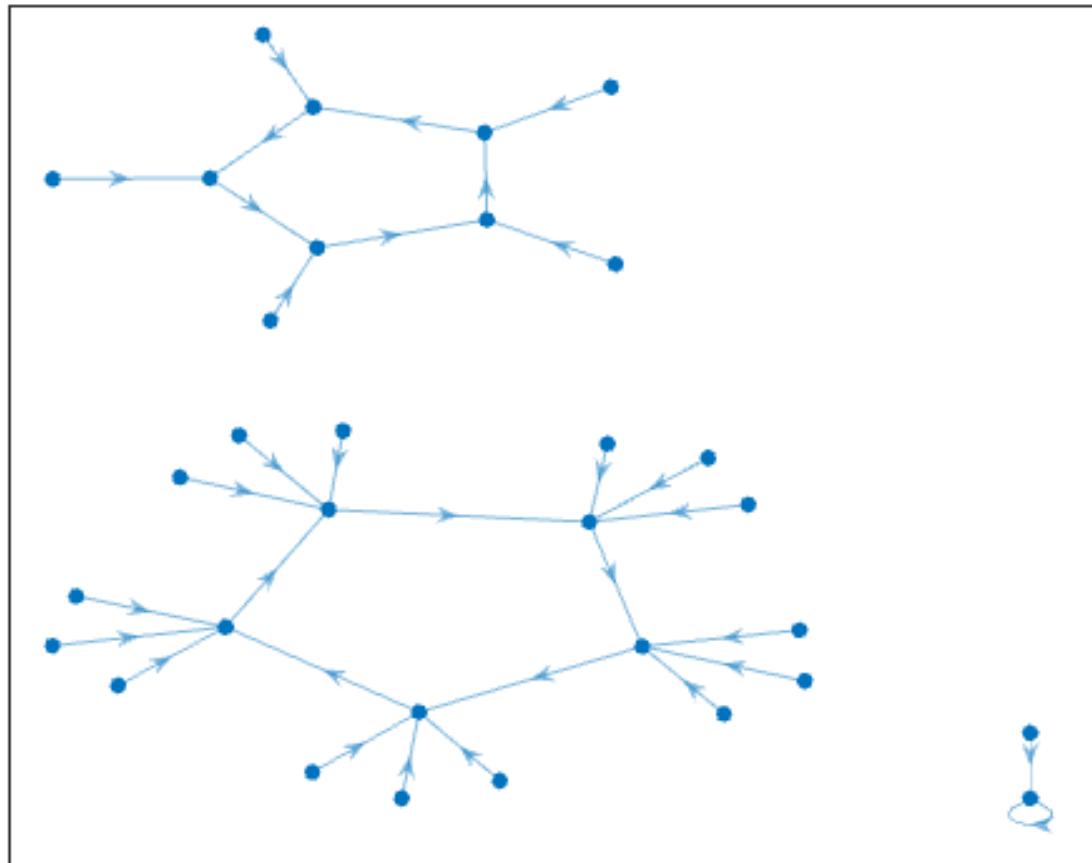


Figura 3.132: Atractor regla 10 n=5

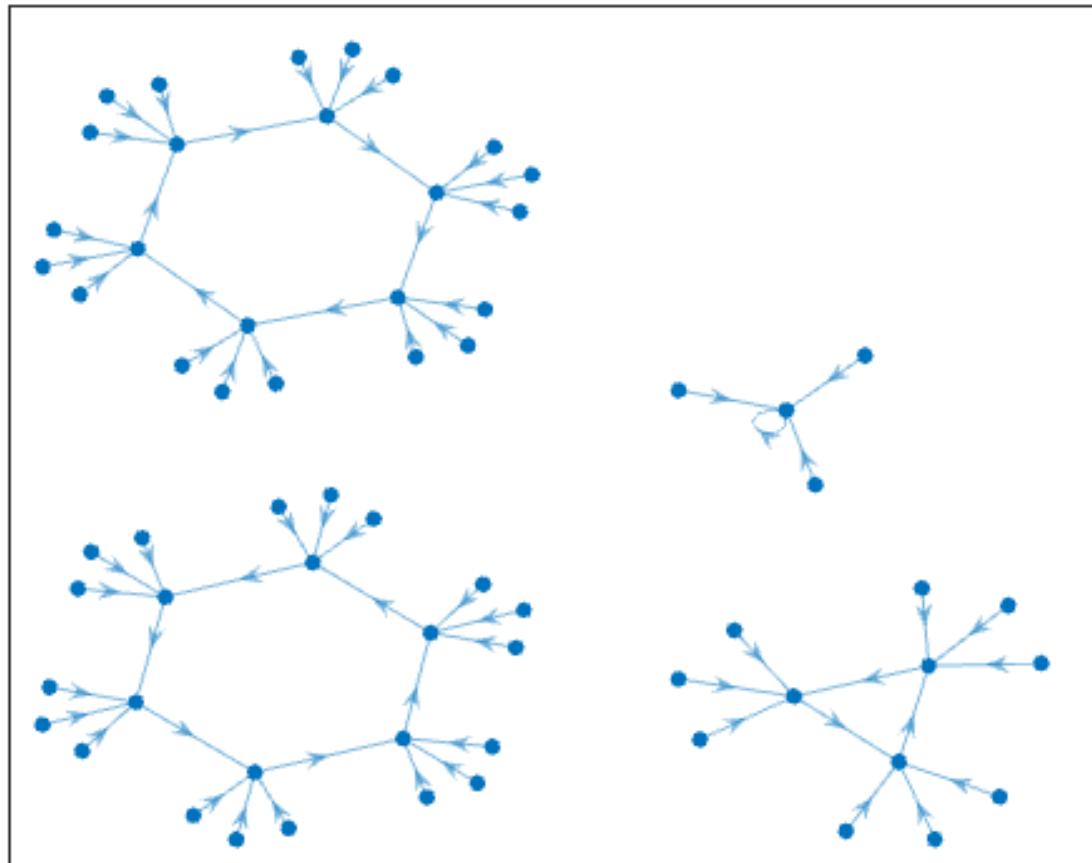


Figura 3.133: Atractor regla 10 n=6

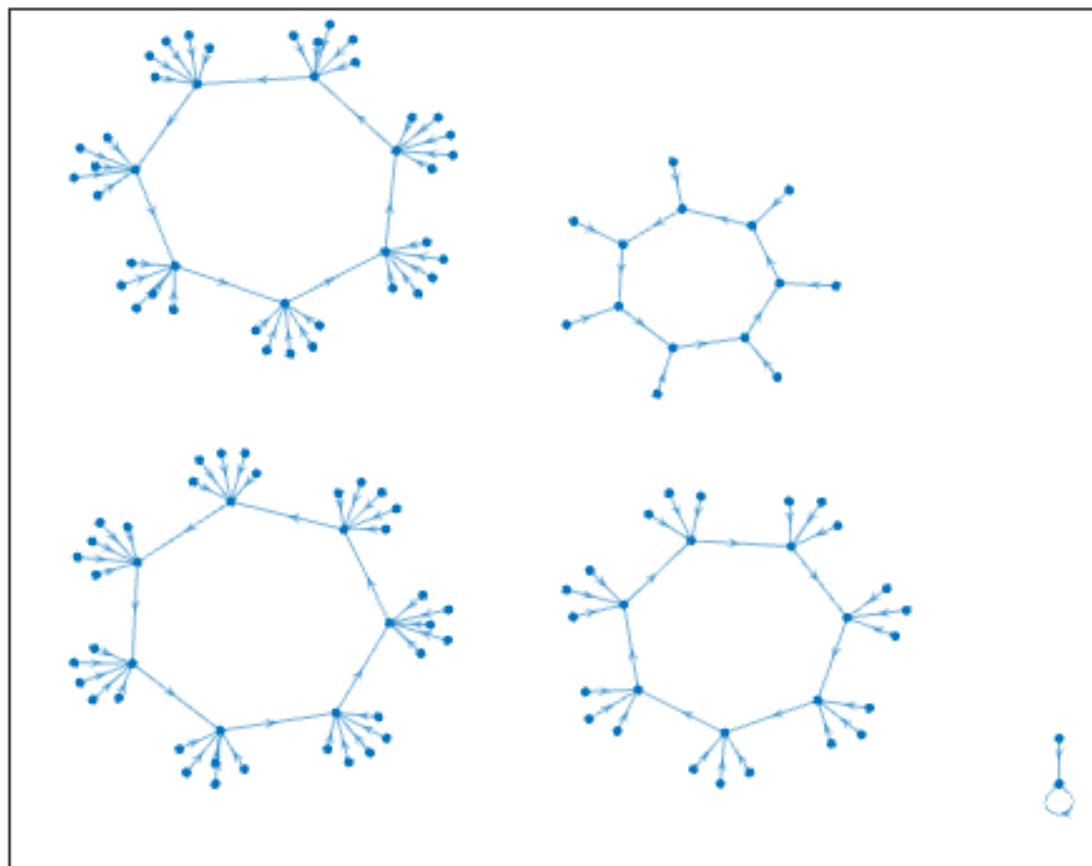


Figura 3.134: Atractor regla 10 n=7

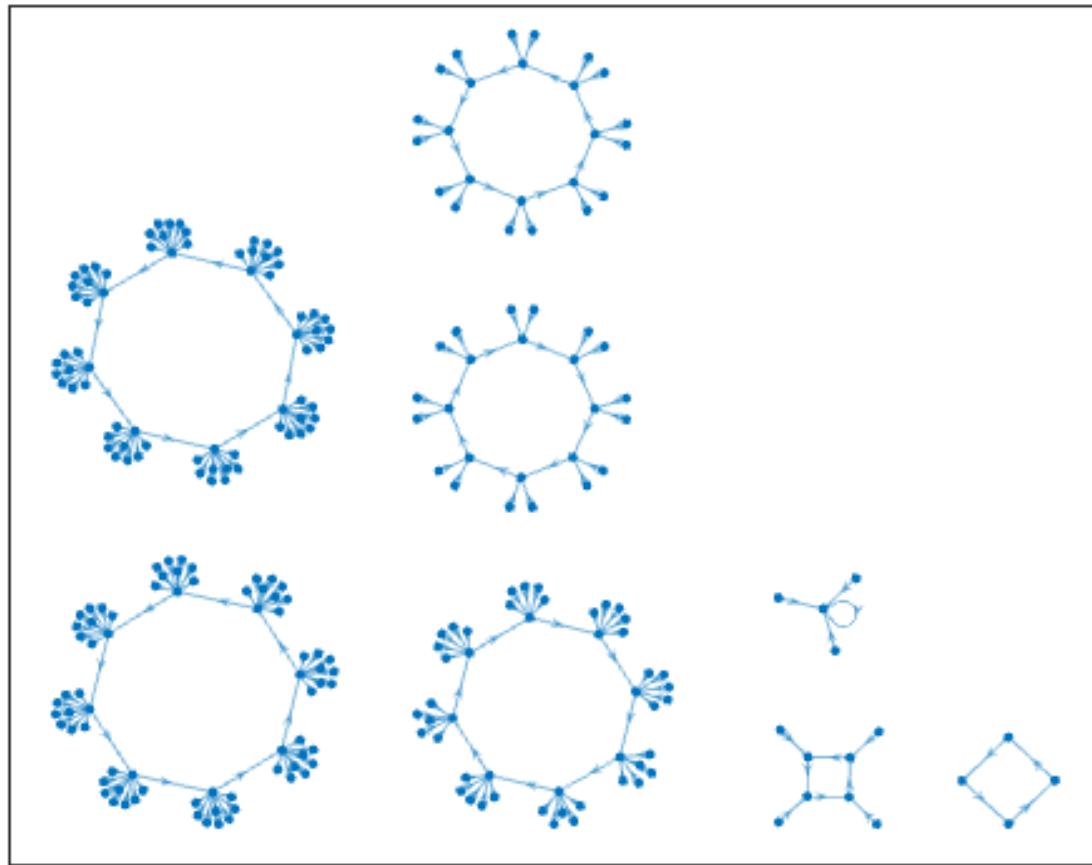


Figura 3.135: Atractor regla 10 n=8

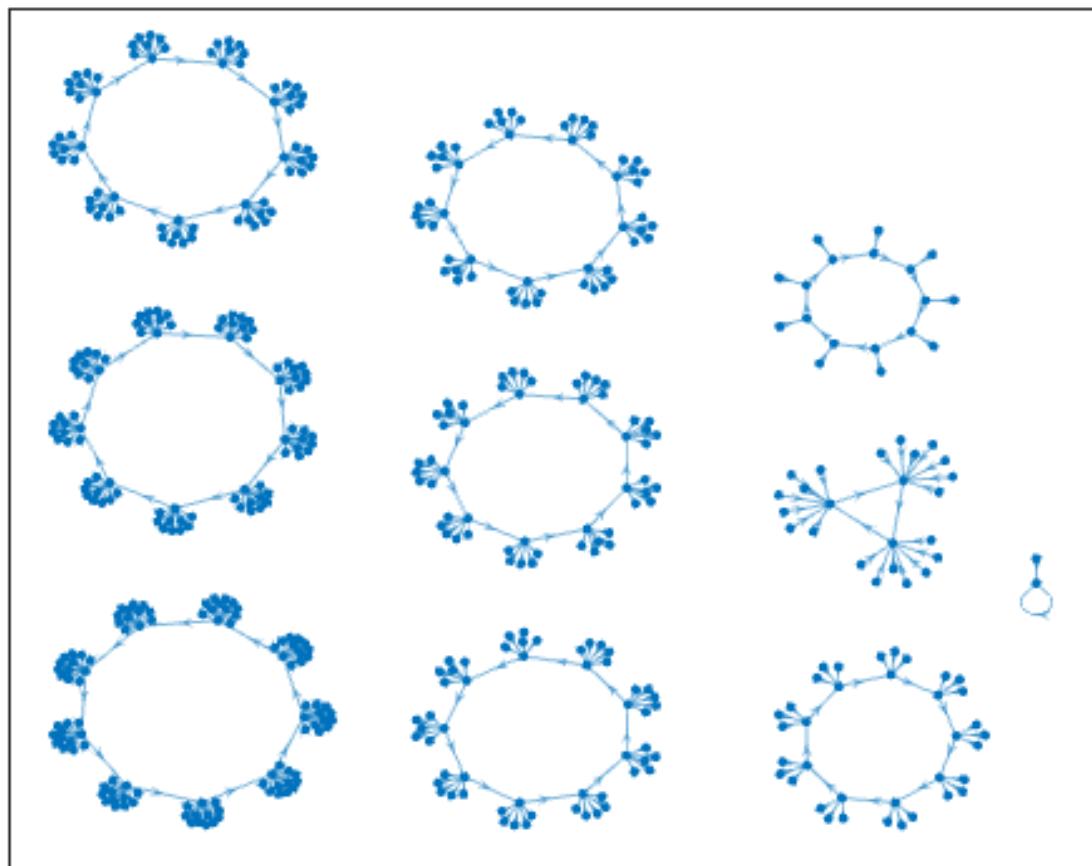


Figura 3.136: Atractor regla 10 n=9

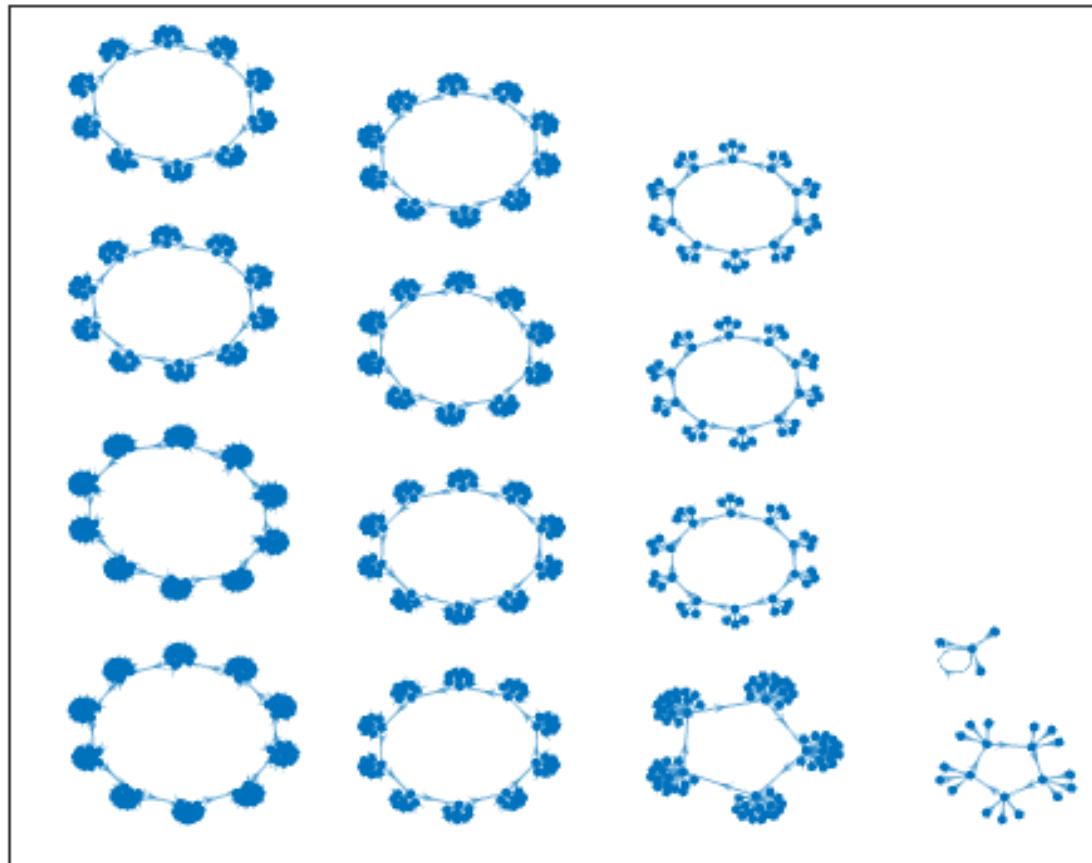


Figura 3.137: Atractor regla 10 n=10

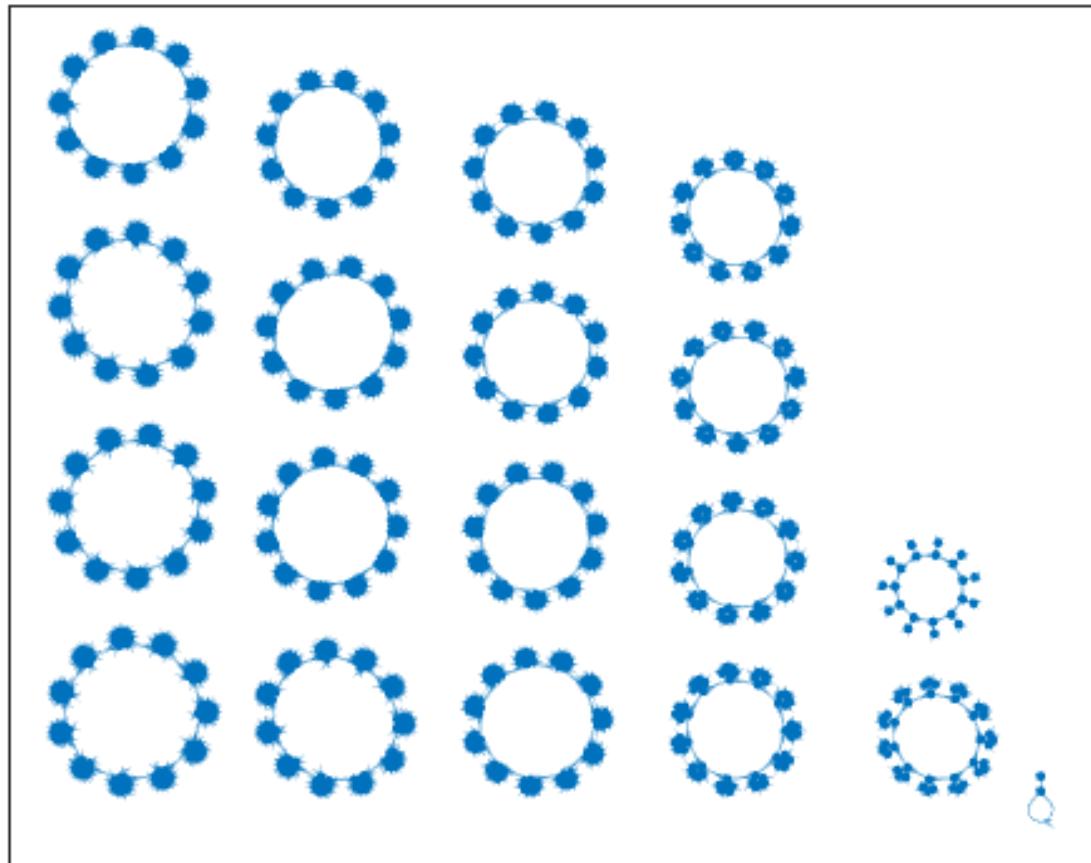


Figura 3.138: Atractor regla 10 n=11

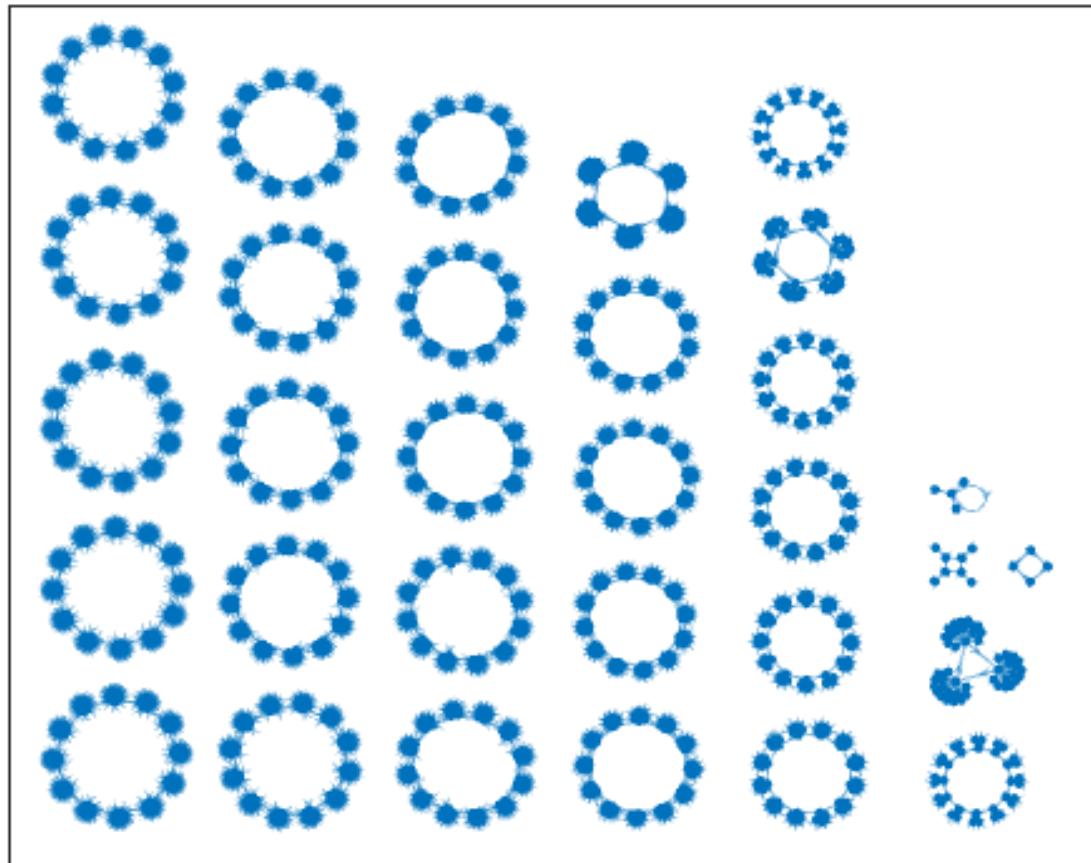


Figura 3.139: Atractor regla 10 n=12

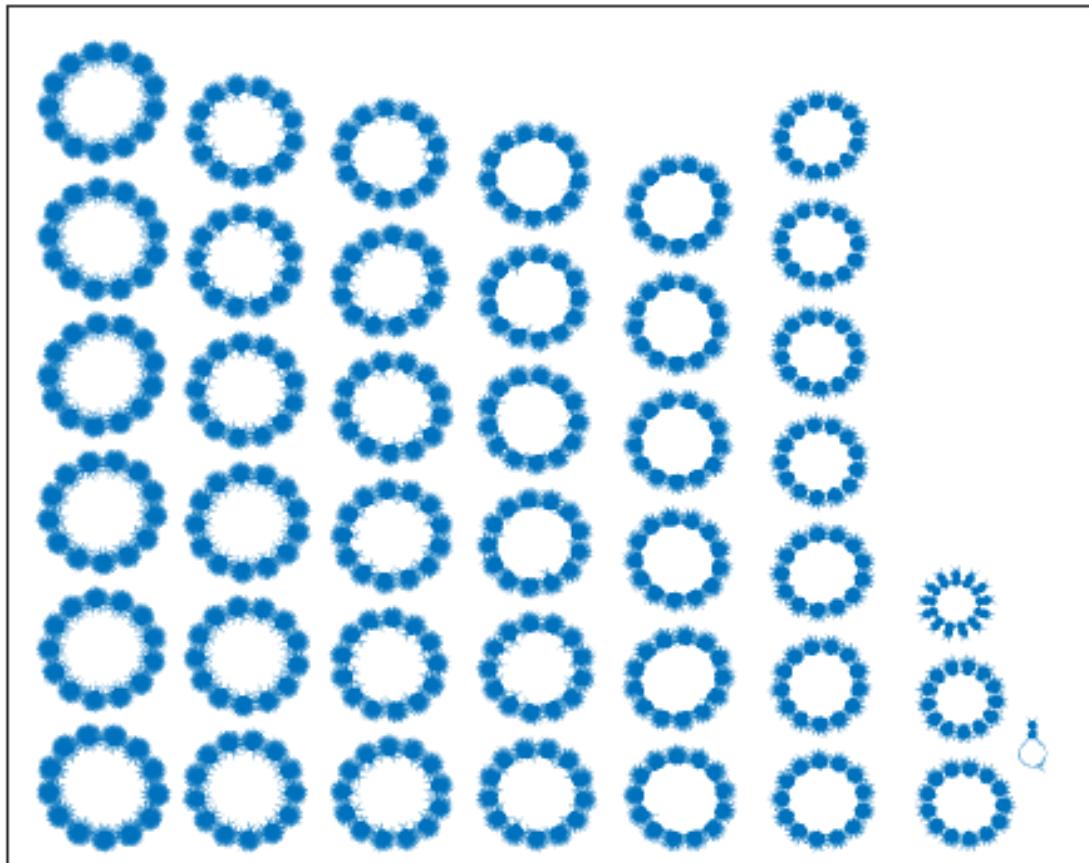


Figura 3.140: Atractor regla 10 $n=13$

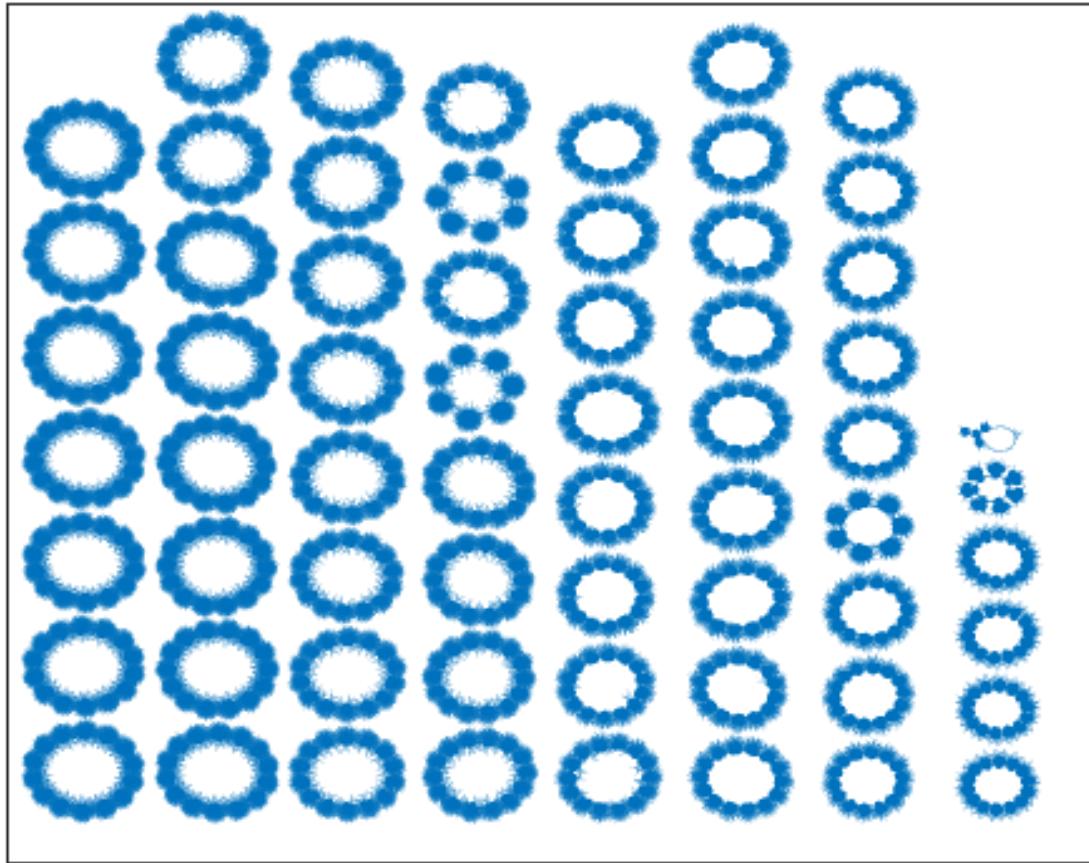


Figura 3.141: Atractor regla 10 n=14

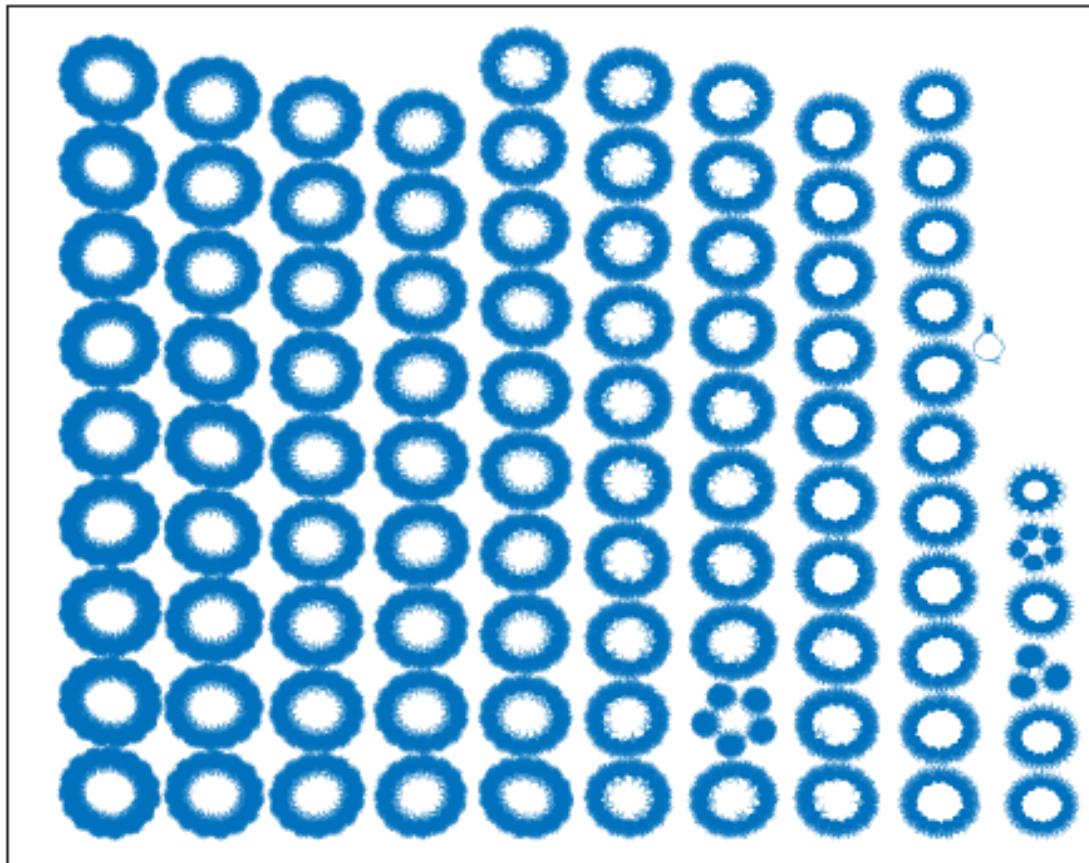


Figura 3.142: Atractor regla 10 n=15

3.12. Reglas 11,47,81,117

Respecto a la regla 11 se aprecia que mientras más grande es el tamaño de la cadena (n) aparecen atractores con forma de polígono que en cada incremento de n pareciera que evolucionan a un atractor más complejo, esto se aprecia gráficamente en las imágenes 3.144, 3.145, 3.146 que el polígono que representa el atractor en cada evolución está aumentando en uno su número de lados.

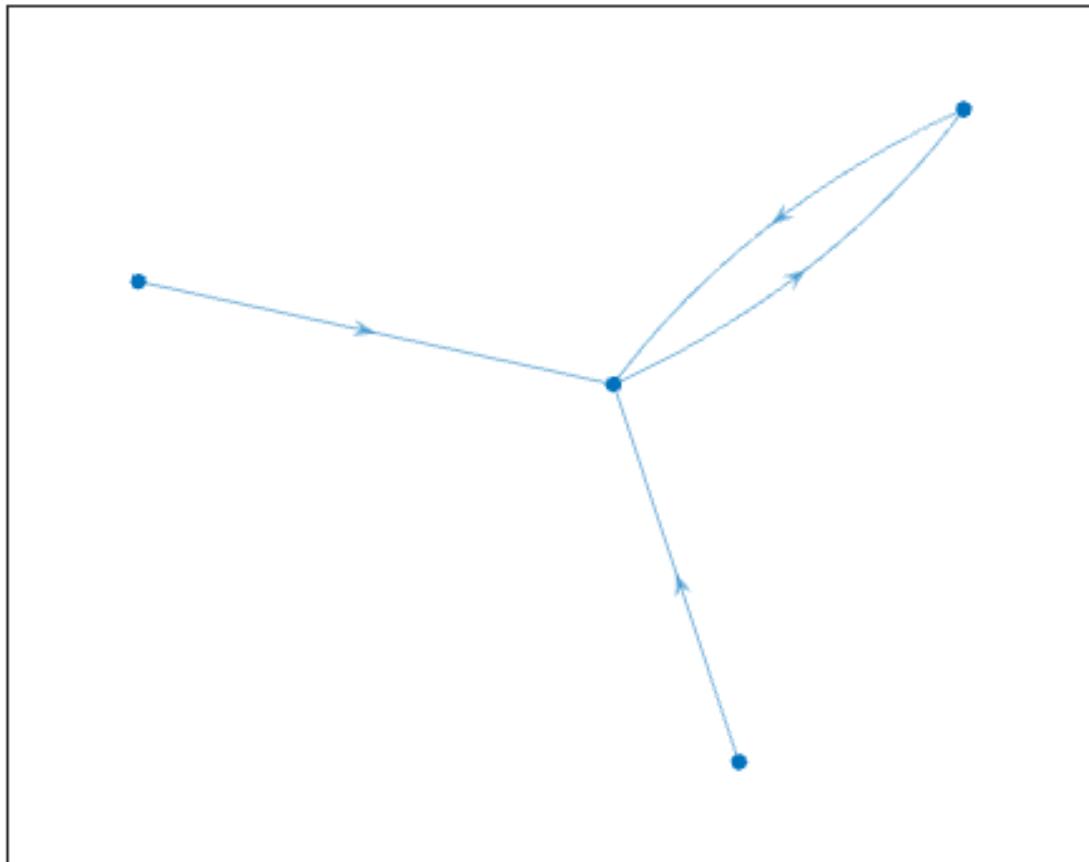


Figura 3.143: Atractor regla 11 $n=2$

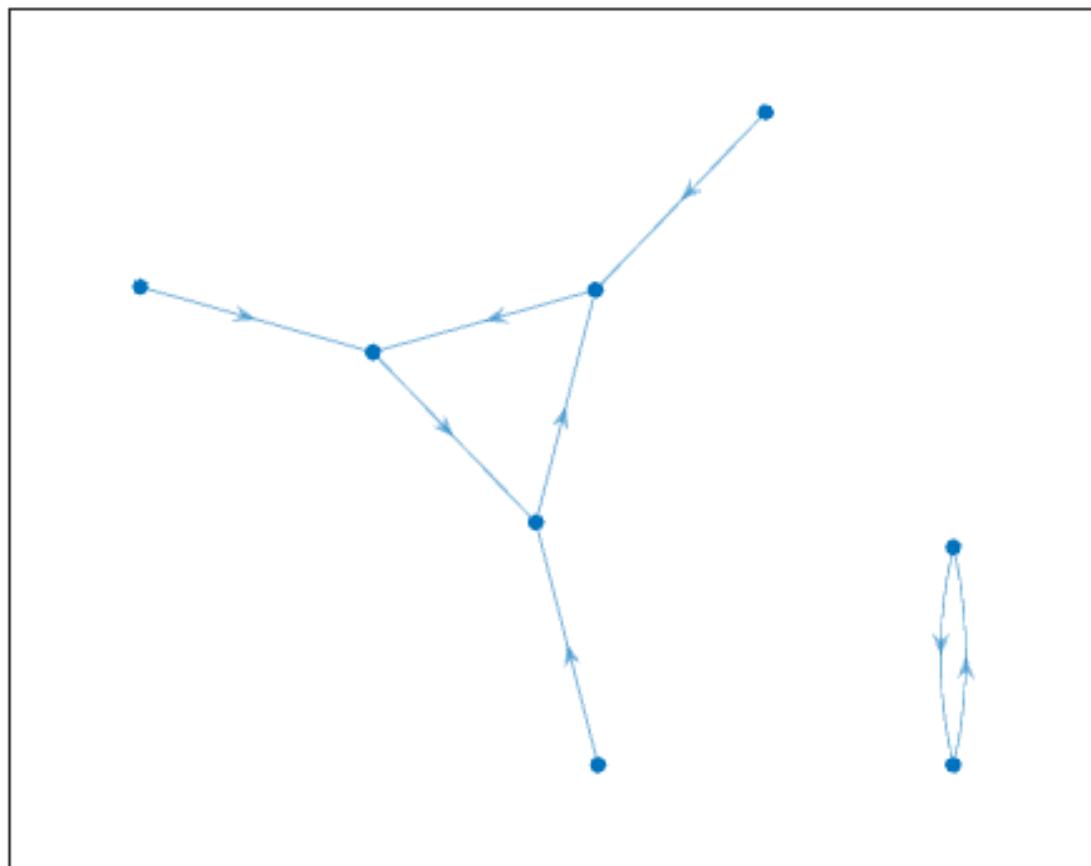
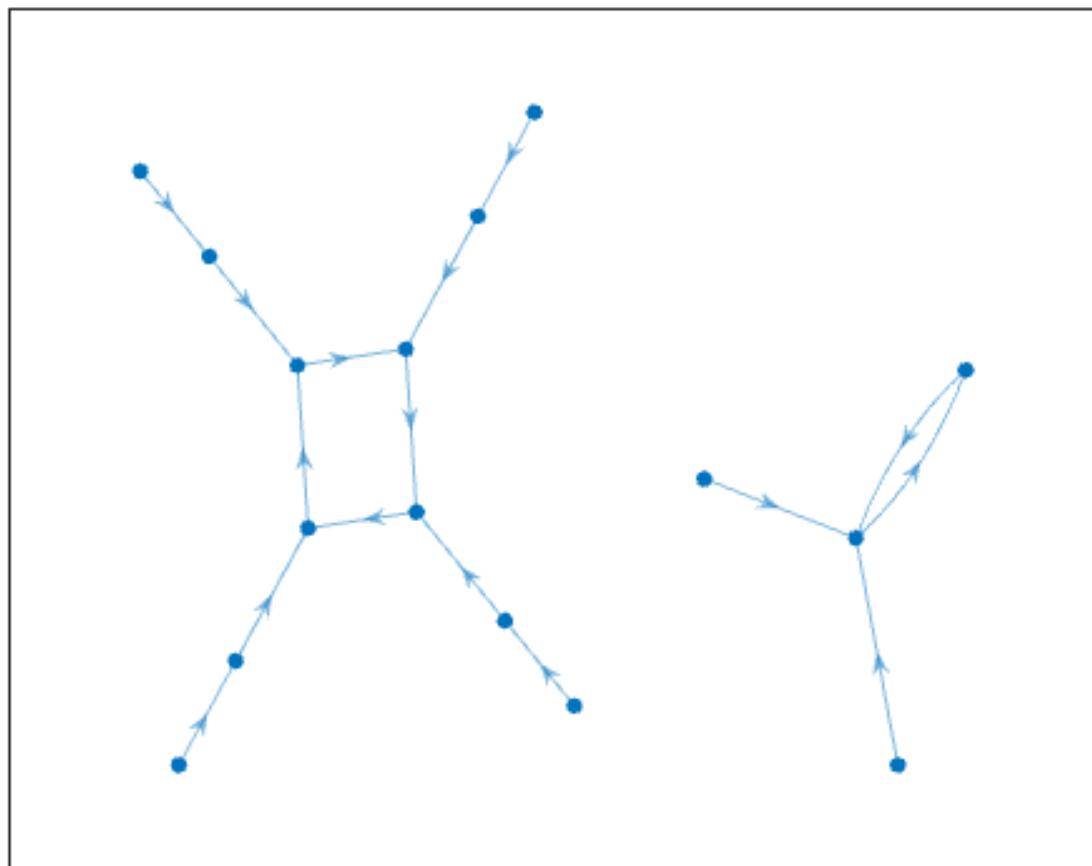


Figura 3.144: Atractor regla 11 n=3

Figura 3.145: Atractor regla 11 $n=4$

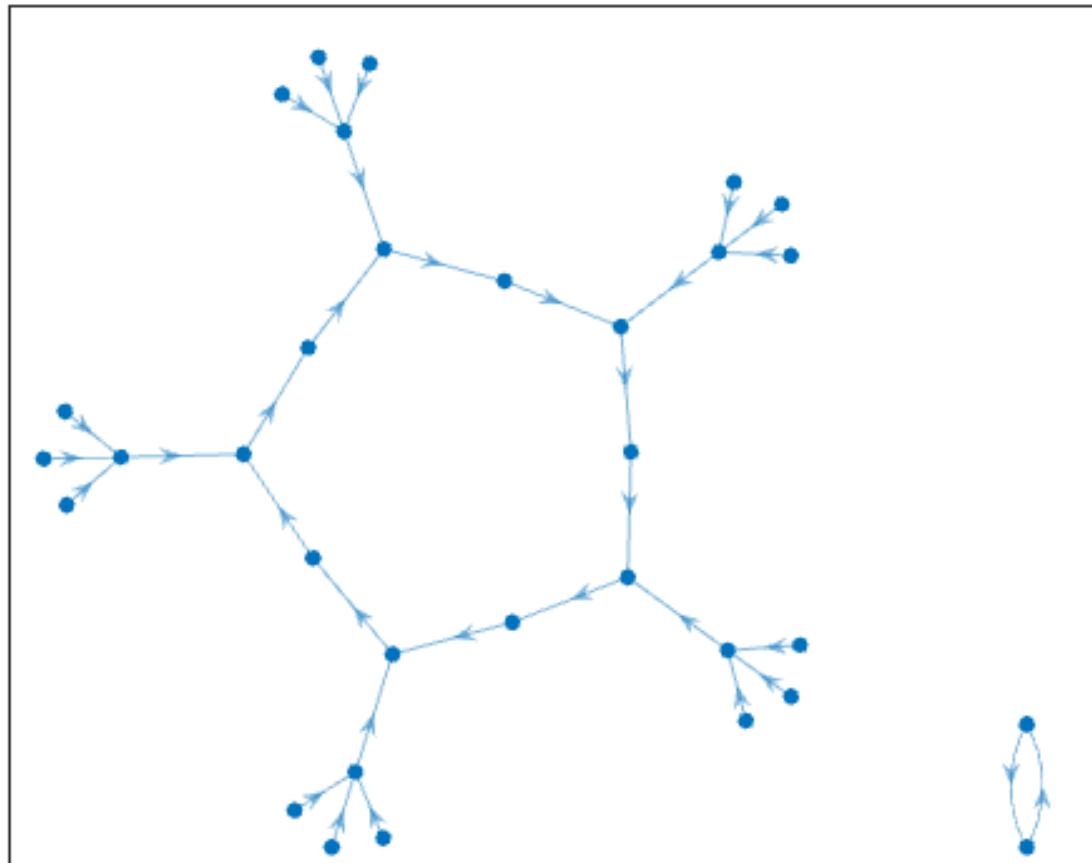
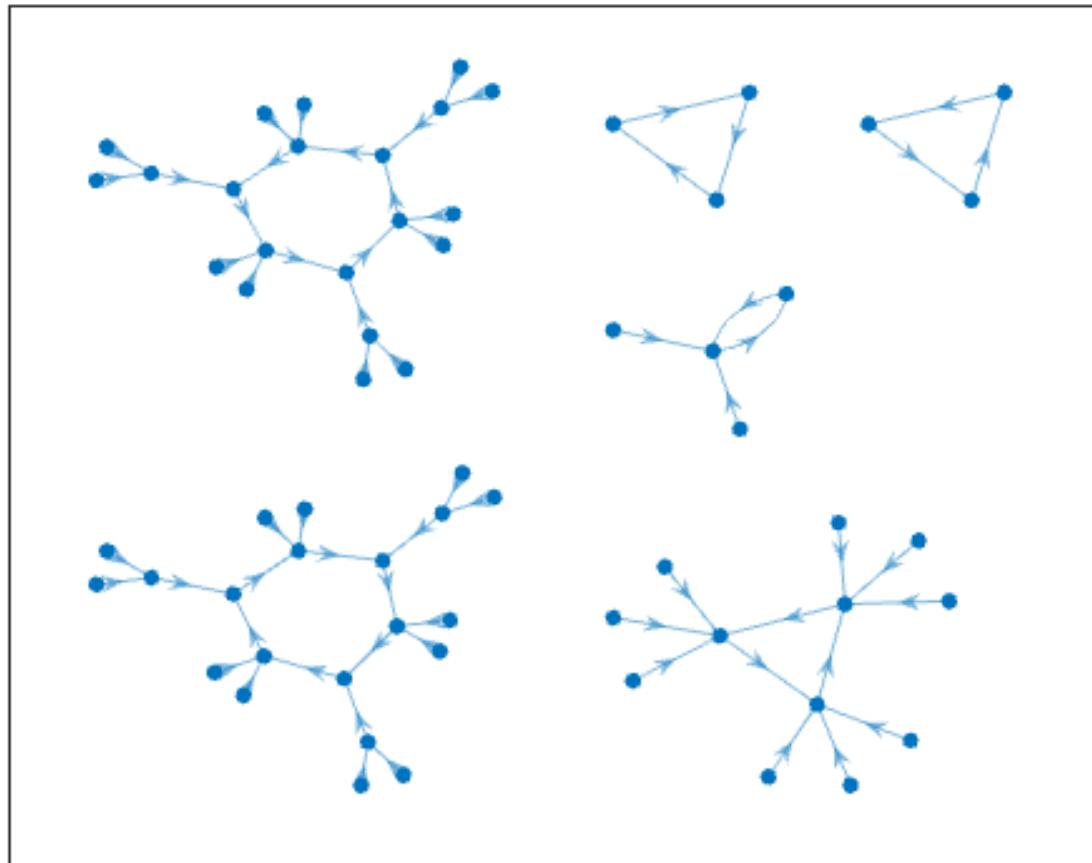
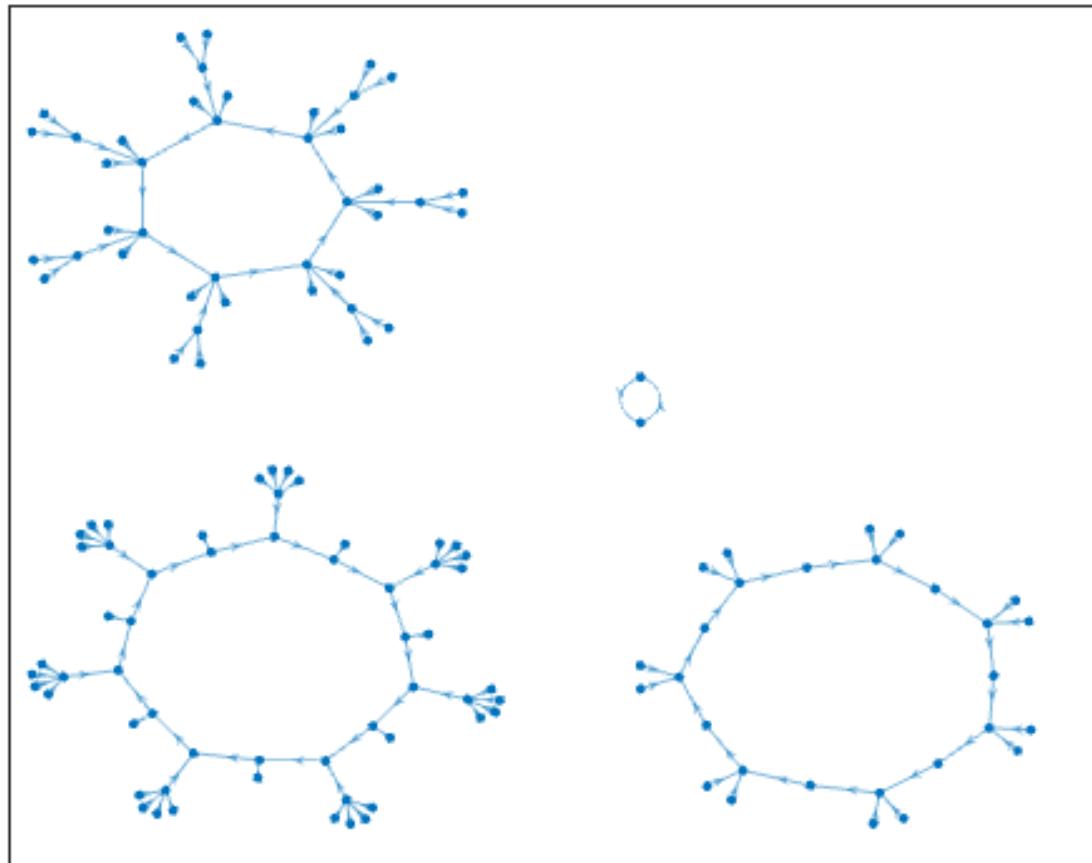


Figura 3.146: Atractor regla 11 n=5

Figura 3.147: Atractor regla 11 $n=6$

Figura 3.148: Atractor regla 11 $n=7$

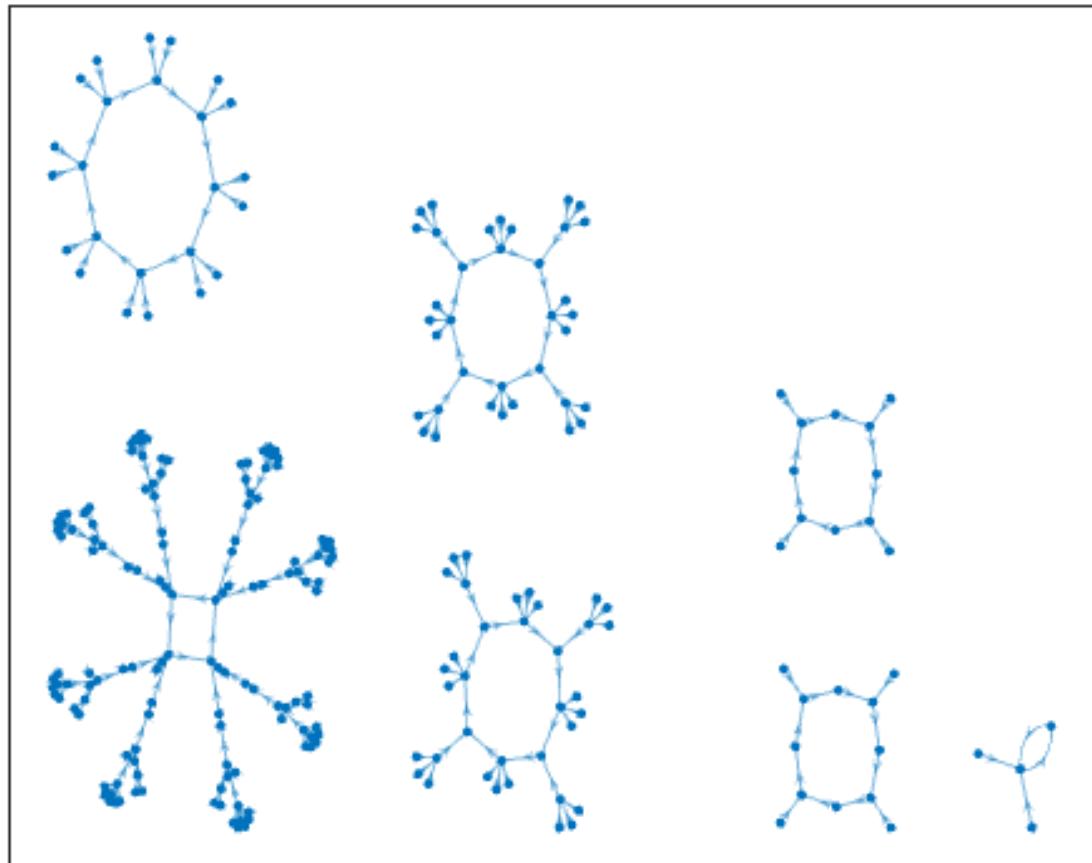


Figura 3.149: Atractor regla 11 n=8

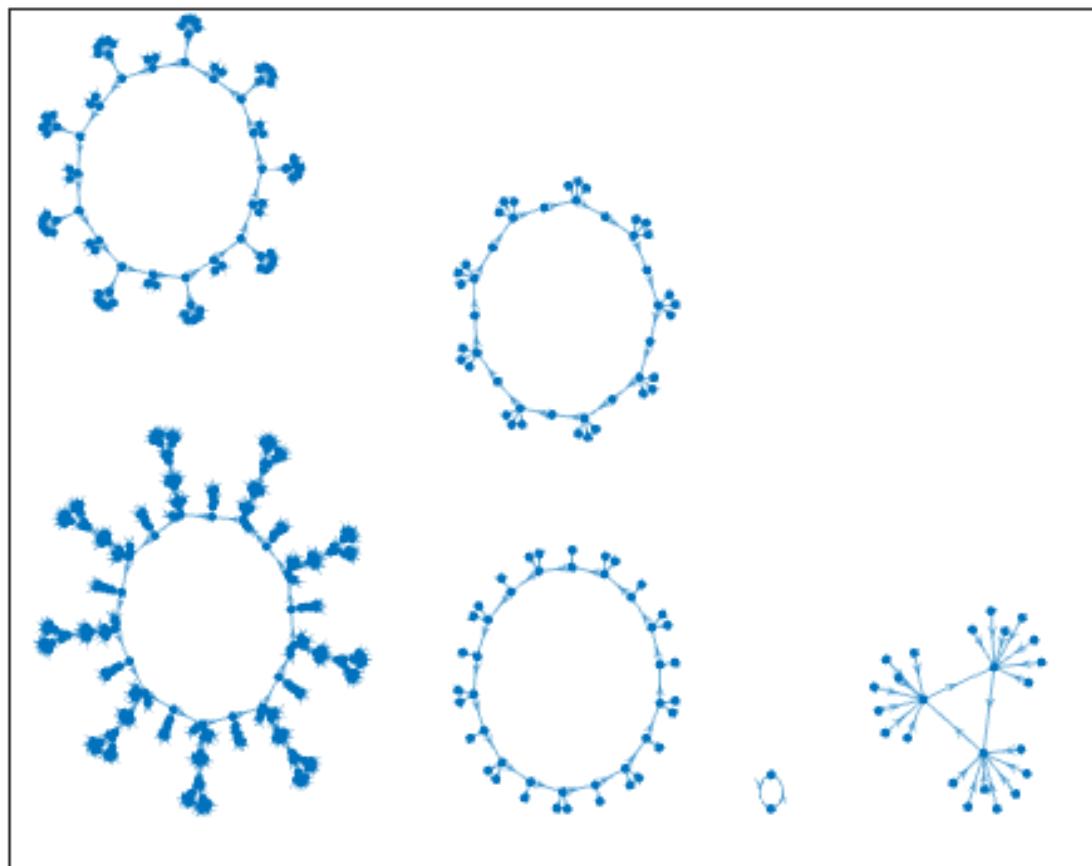


Figura 3.150: Atractor regla 11 n=9

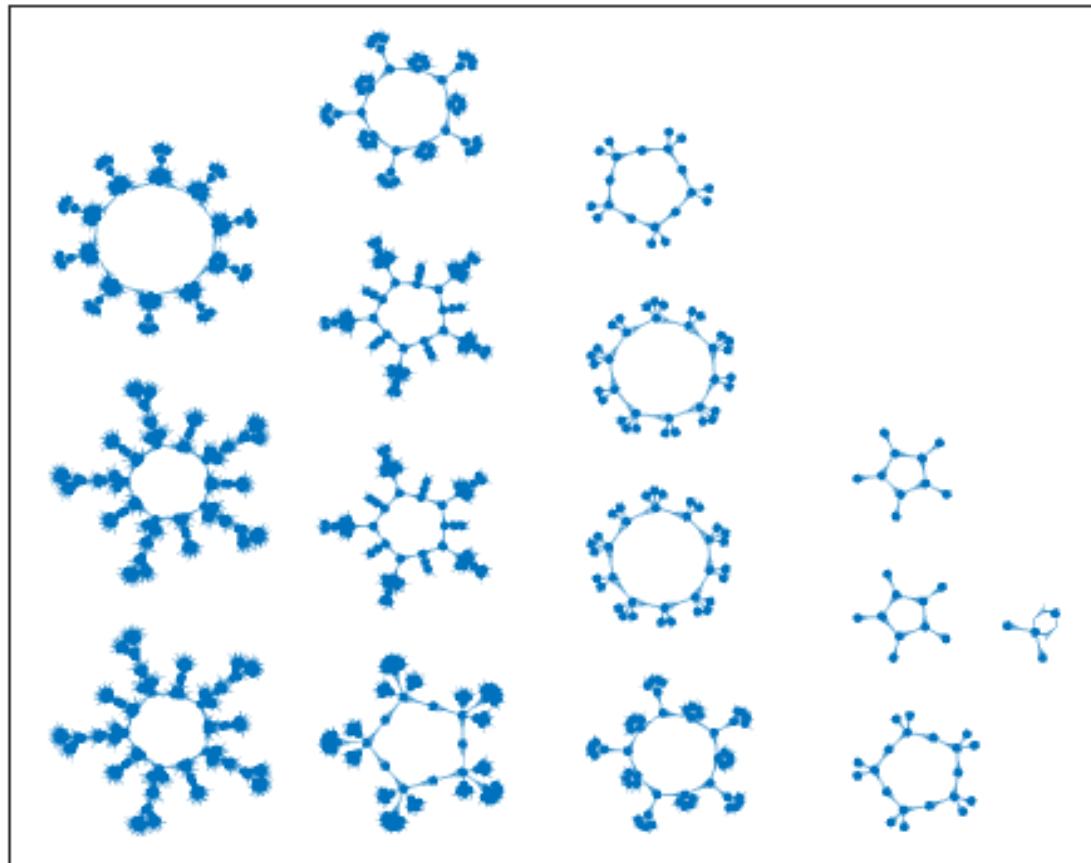


Figura 3.151: Atractor regla 11 n=10

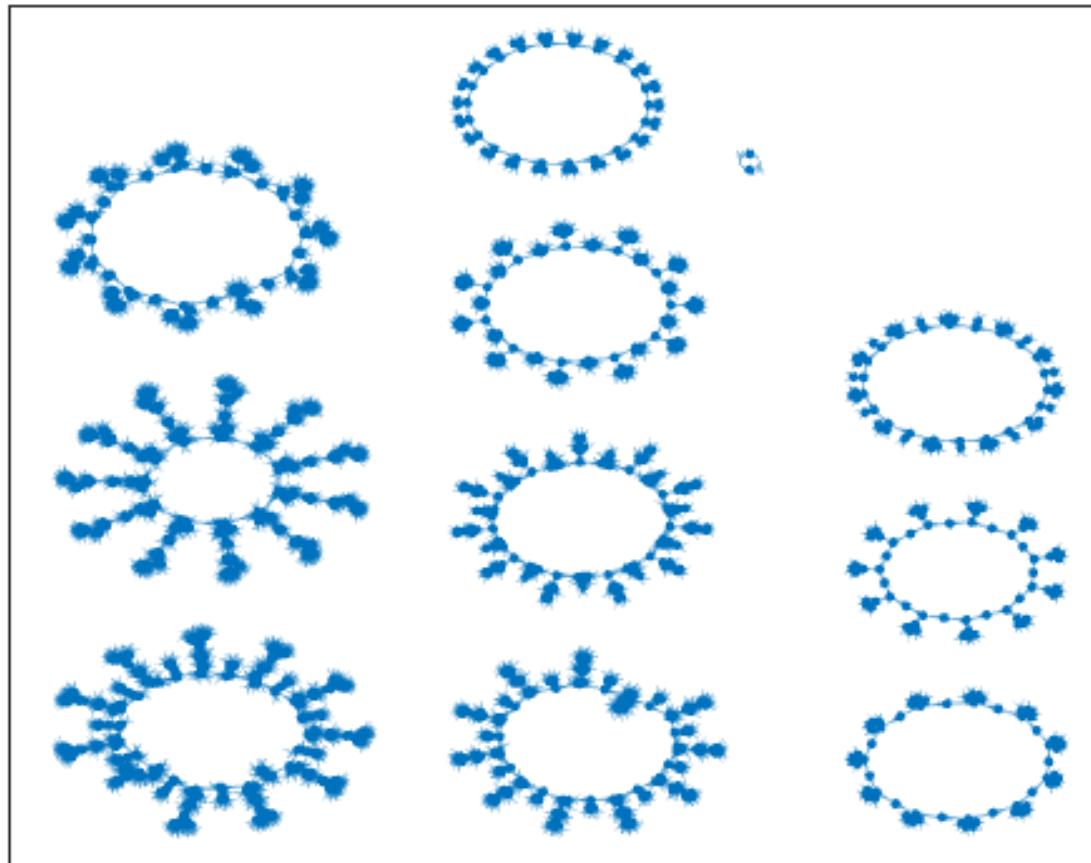


Figura 3.152: Atractor regla 11 n=11

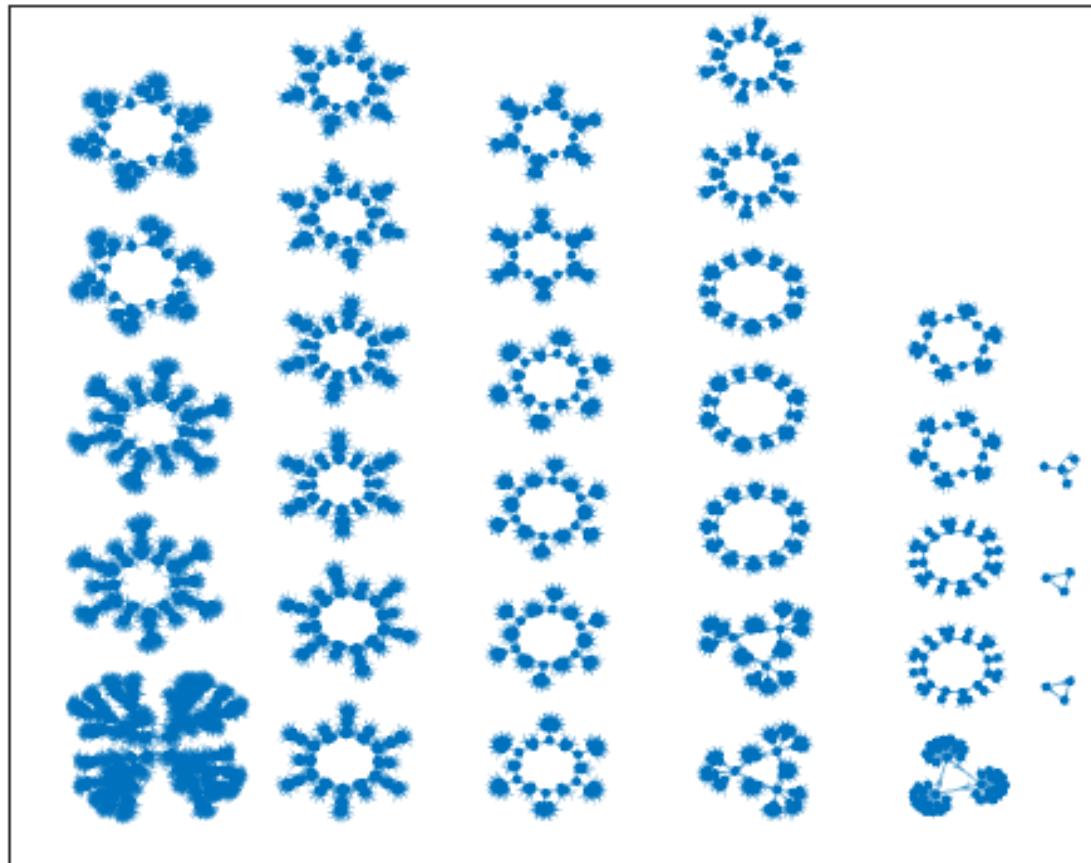


Figura 3.153: Atractor regla 11 n=12

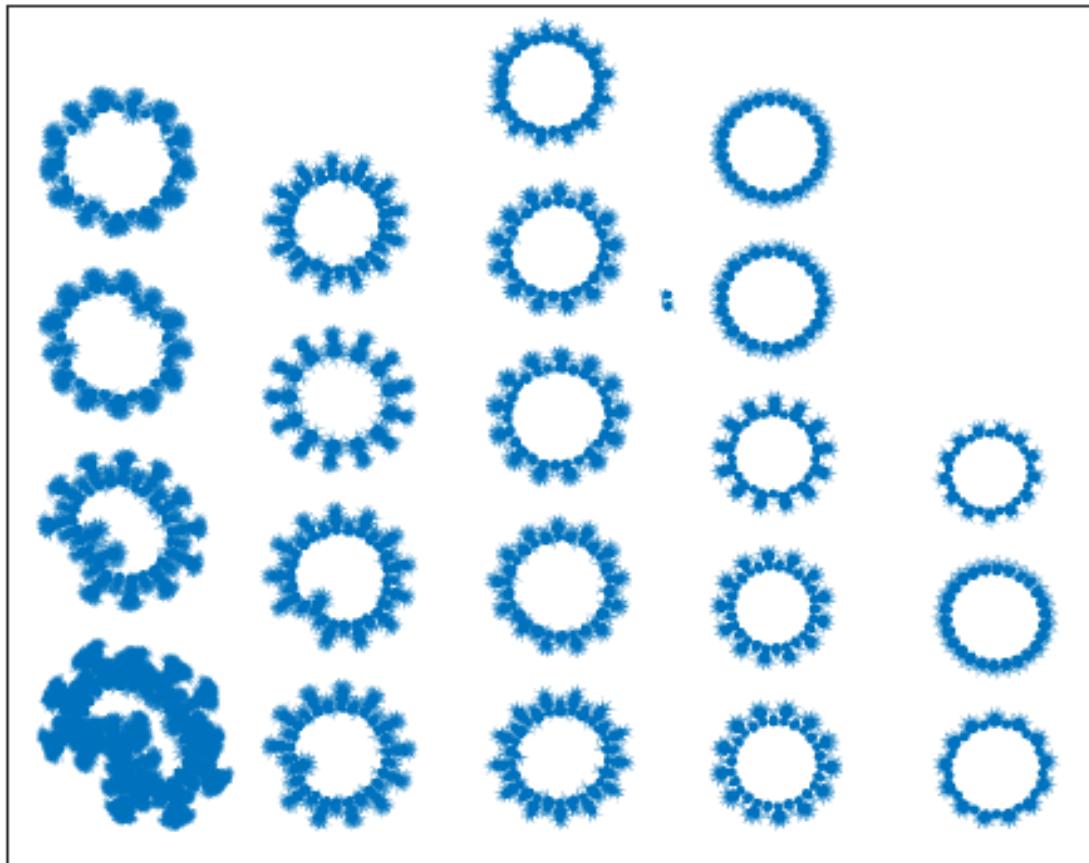


Figura 3.154: Atractor regla 11 n=13

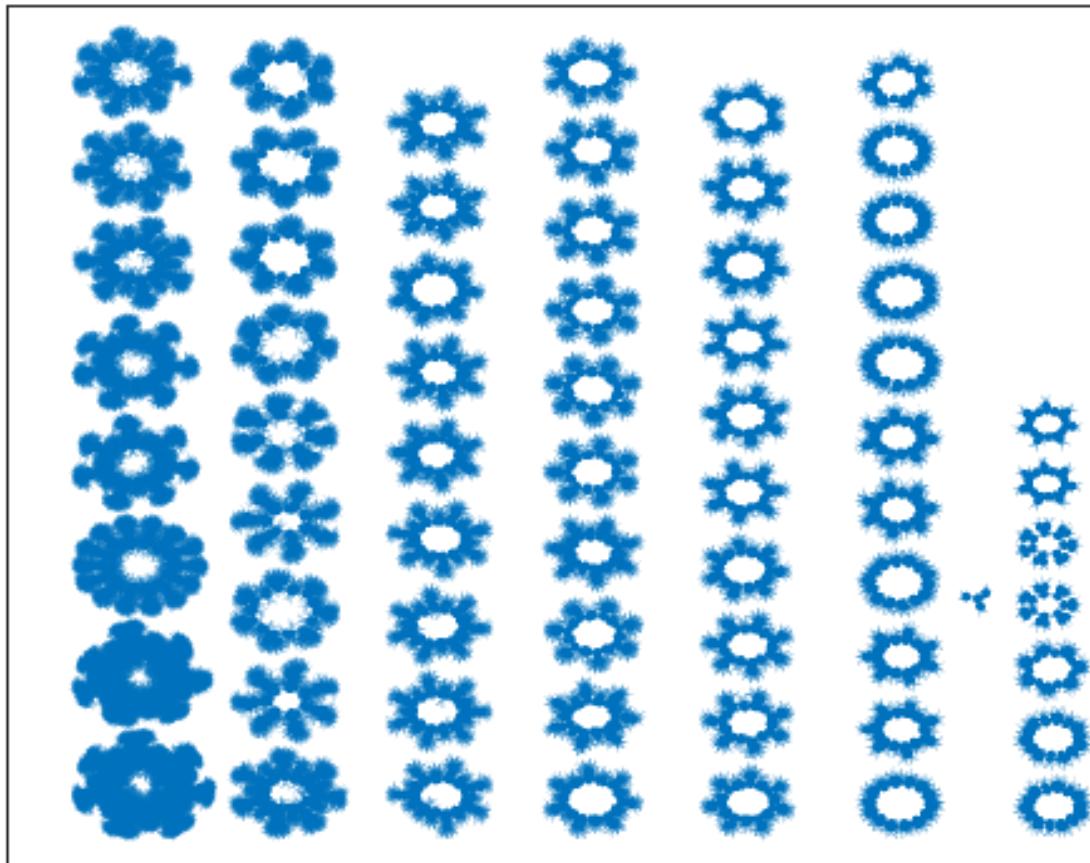


Figura 3.155: Atractor regla 11 n=14

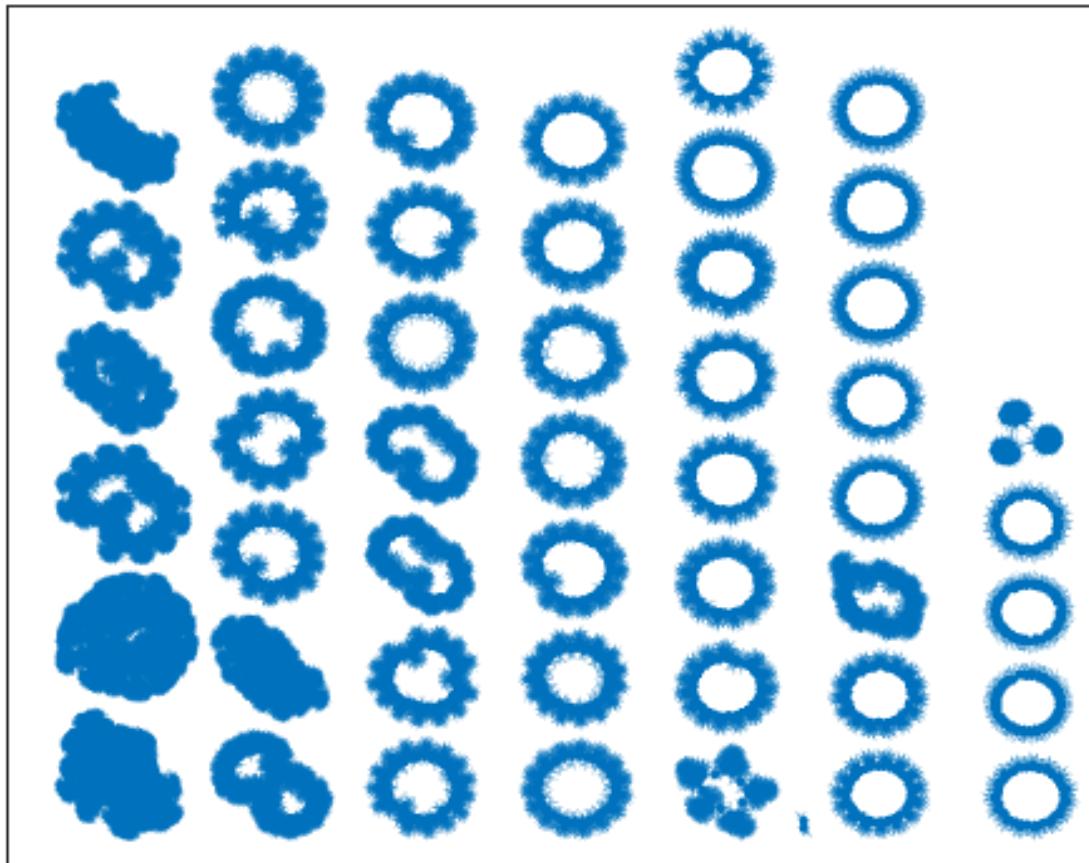


Figura 3.156: Atractor regla 11 n=15

3.13. Reglas 12,68,207,221

Respecto a la regla 12 se aprecia que mientras más grande es el tamaño de la cadena (n) no hay una «mezcla» de atractores sino que cada uno por si solo va aumentando el número de nodos que convergen a él, teniendo así bastantes atractores en las imágenes que representan a los atractores con tamaño de cadena 10 o más.

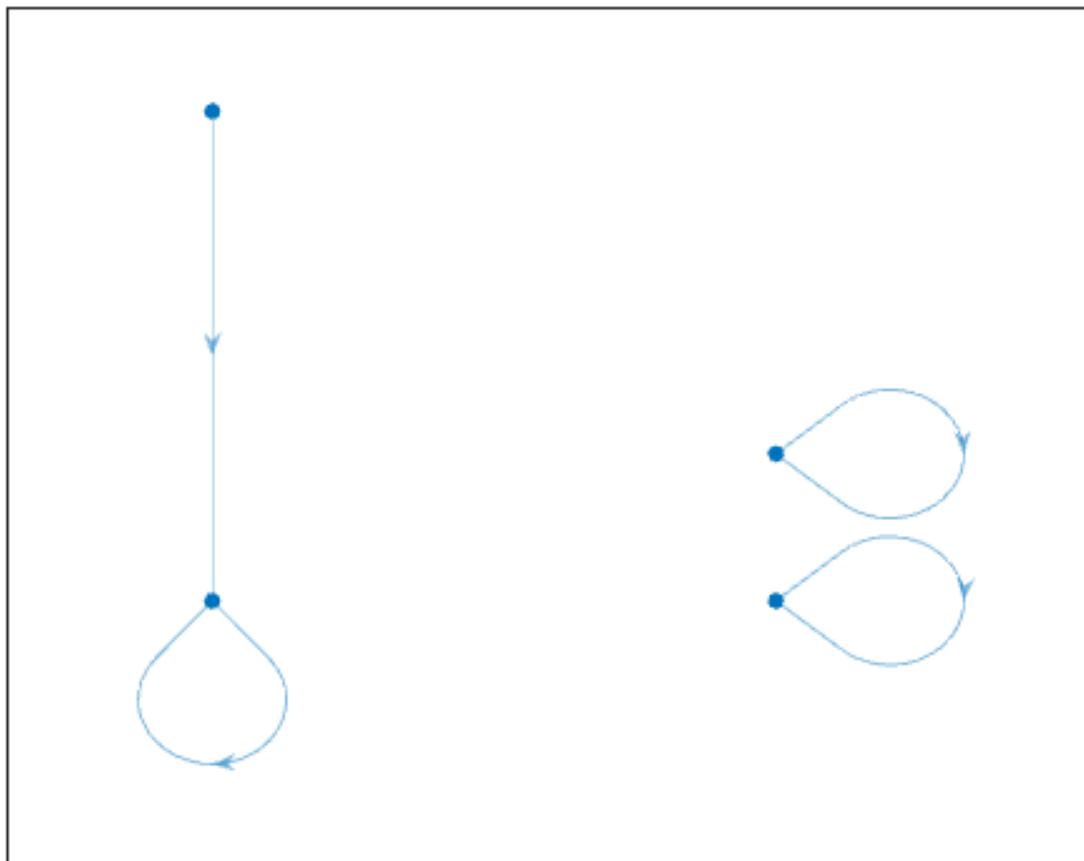


Figura 3.157: Atractor regla 12 $n=2$

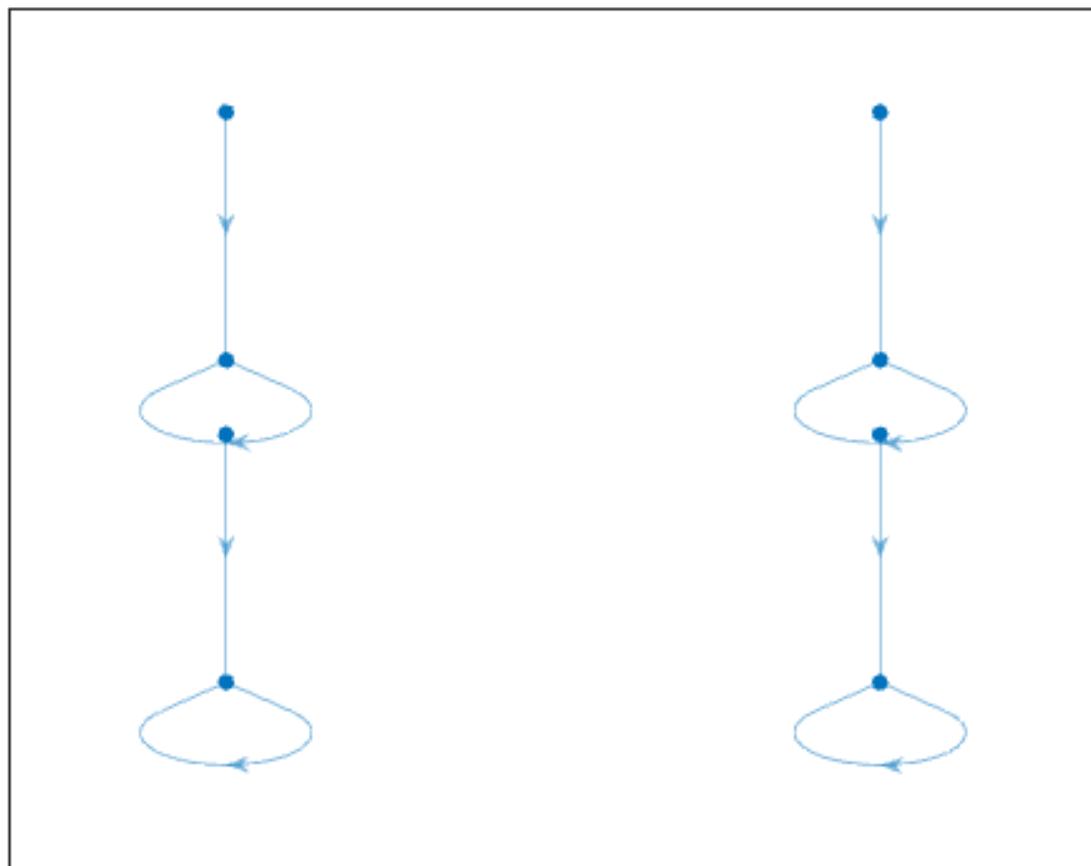


Figura 3.158: Atractor regla 12 n=3

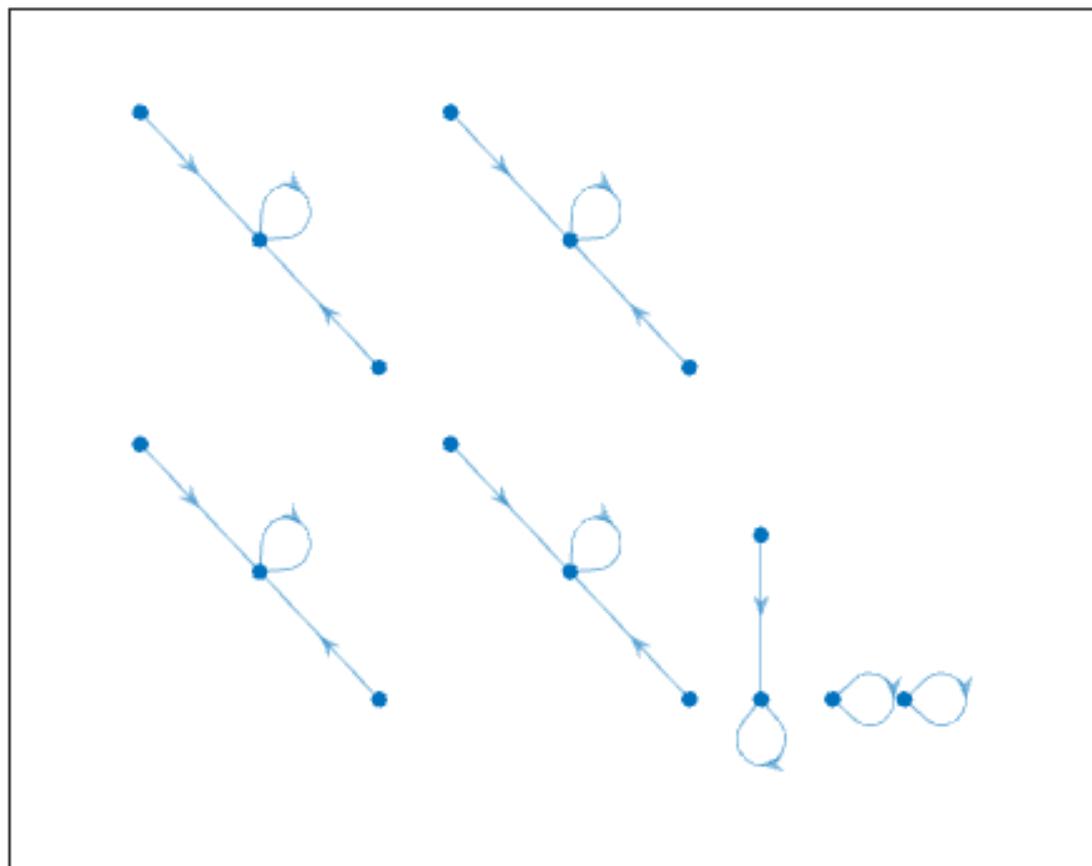


Figura 3.159: Atractor regla 12 n=4

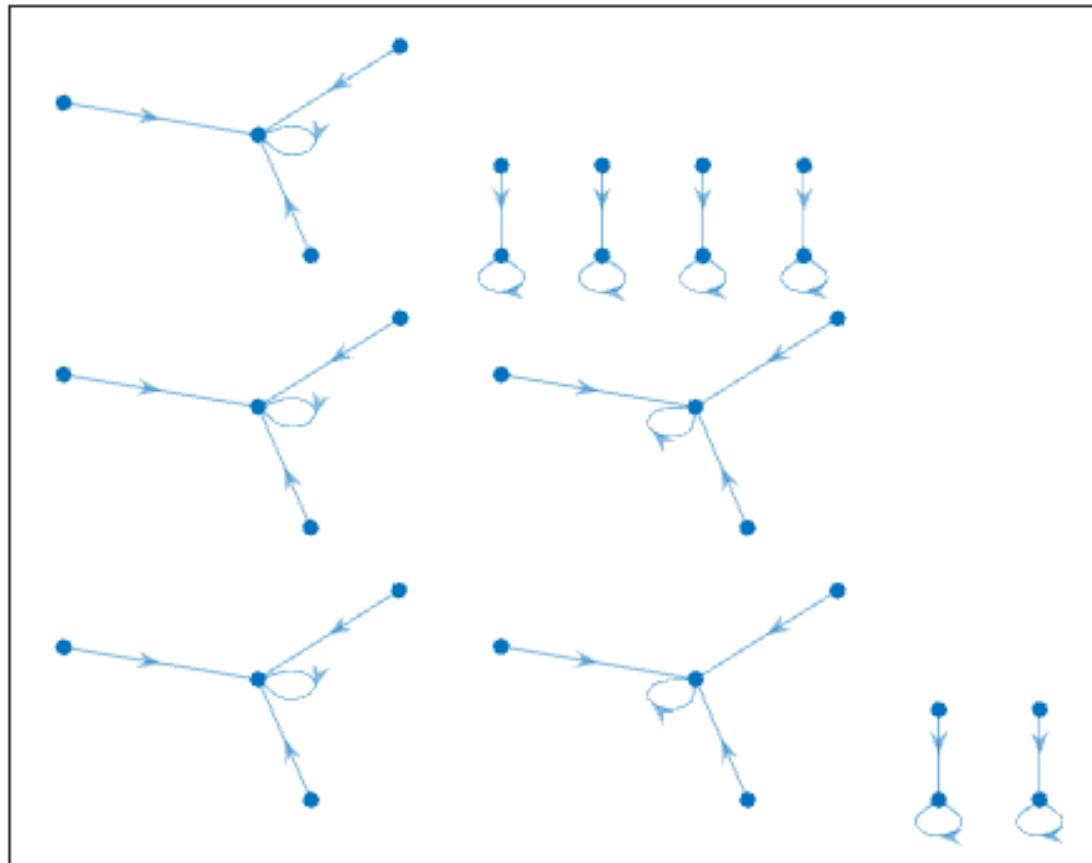


Figura 3.160: Atractor regla 12 n=5

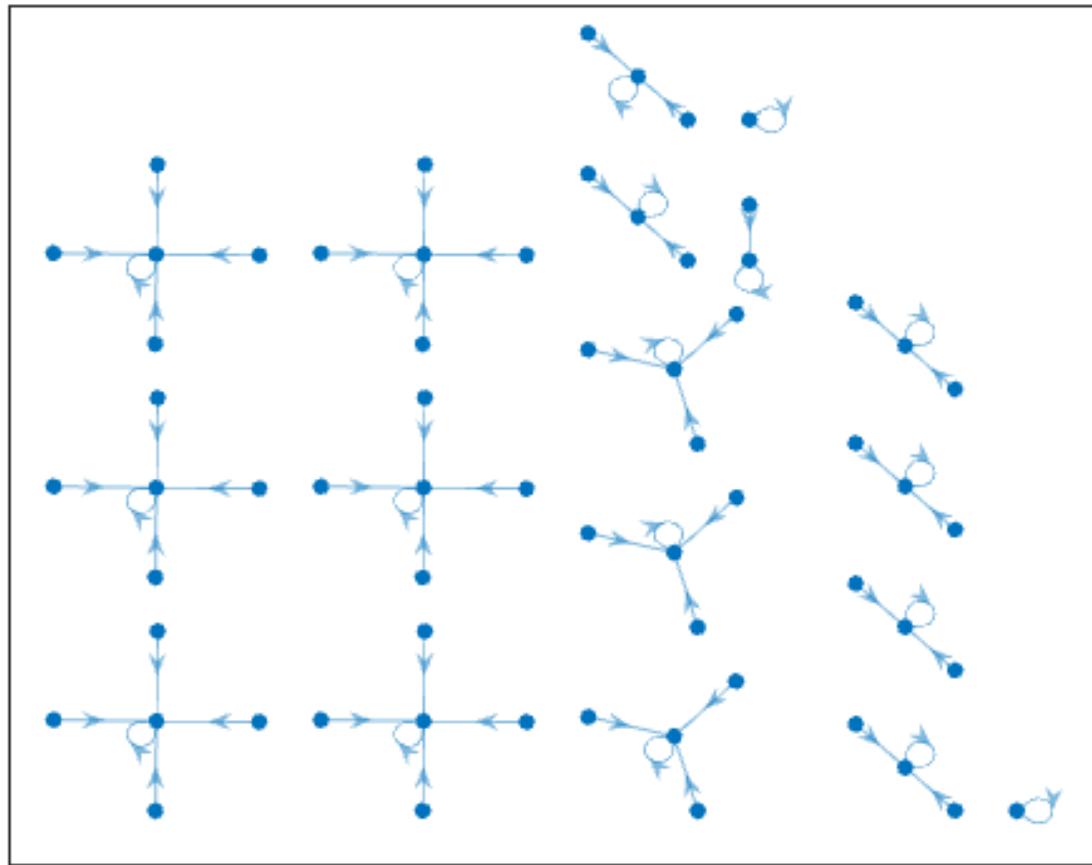


Figura 3.161: Atractor regla 12 n=6

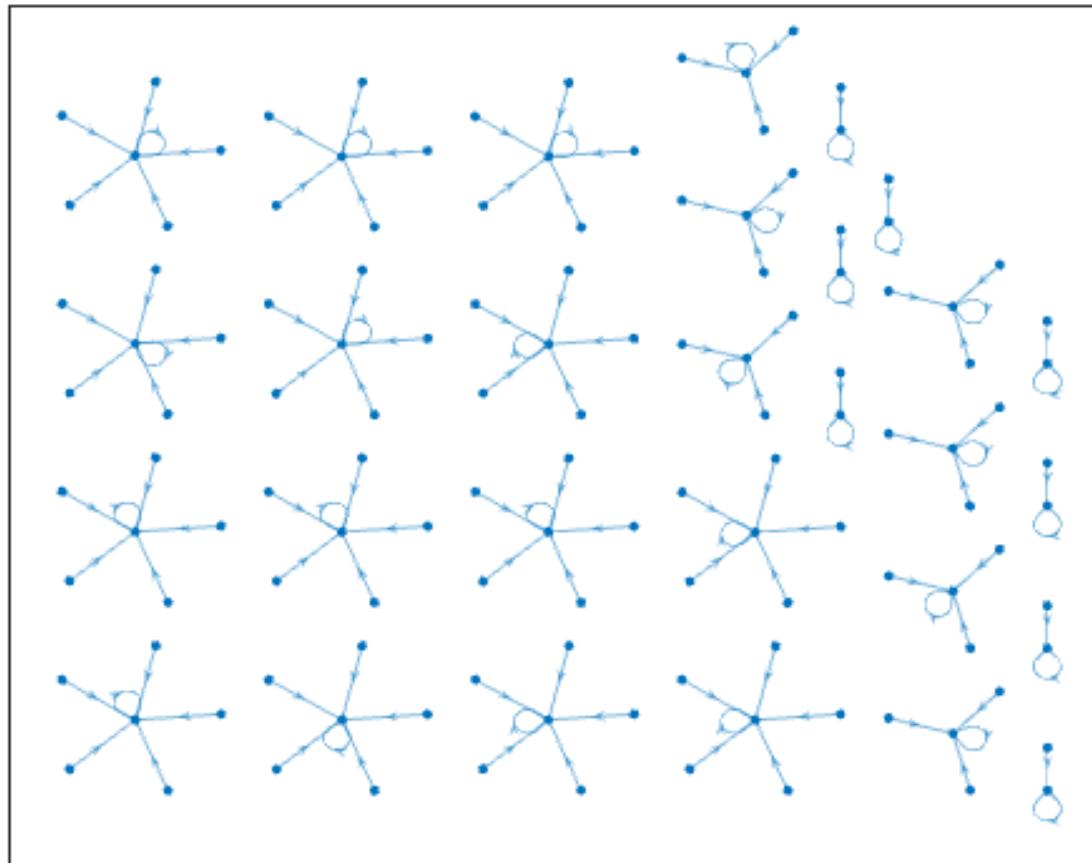


Figura 3.162: Atractor regla 12 n=7

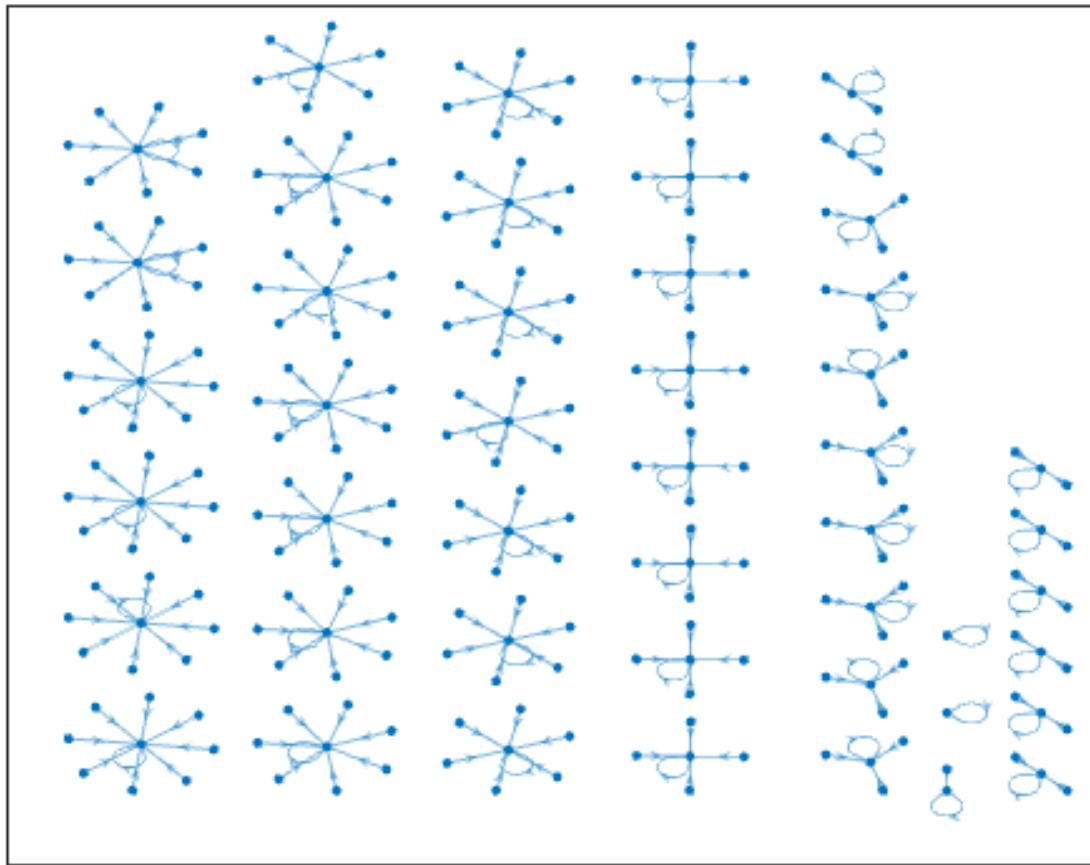


Figura 3.163: Atractor regla 12 n=8

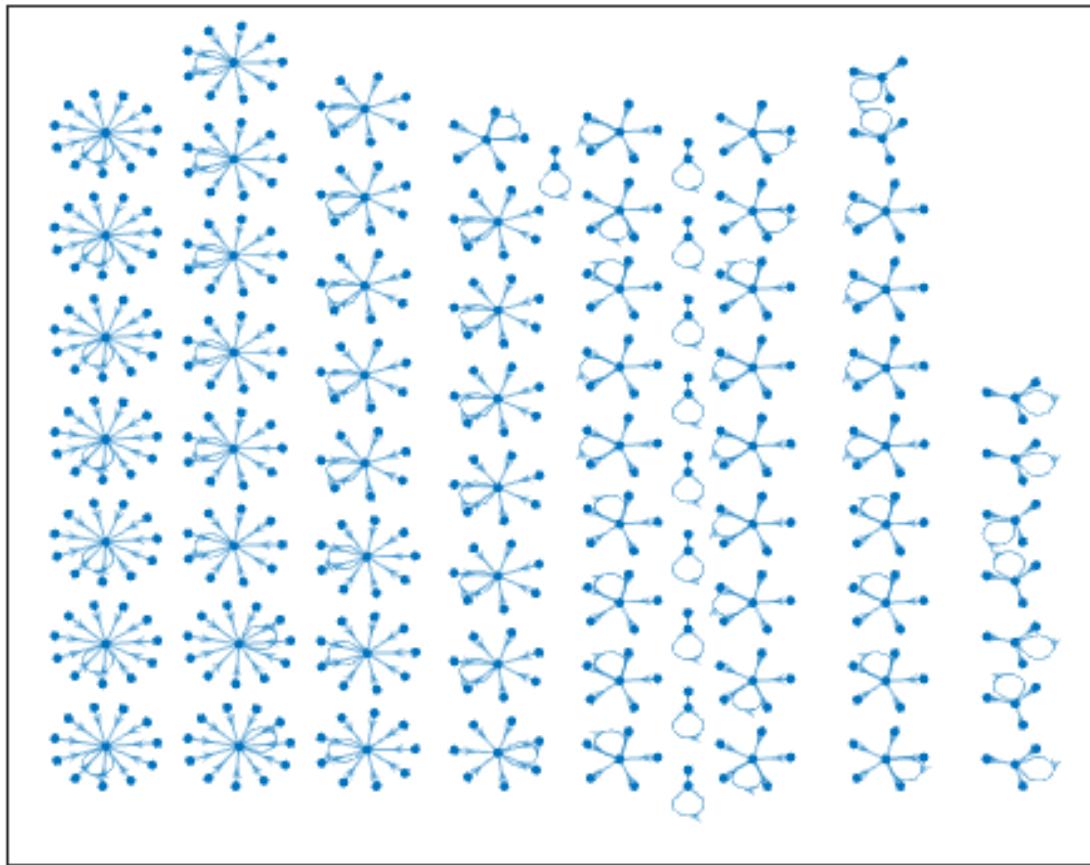
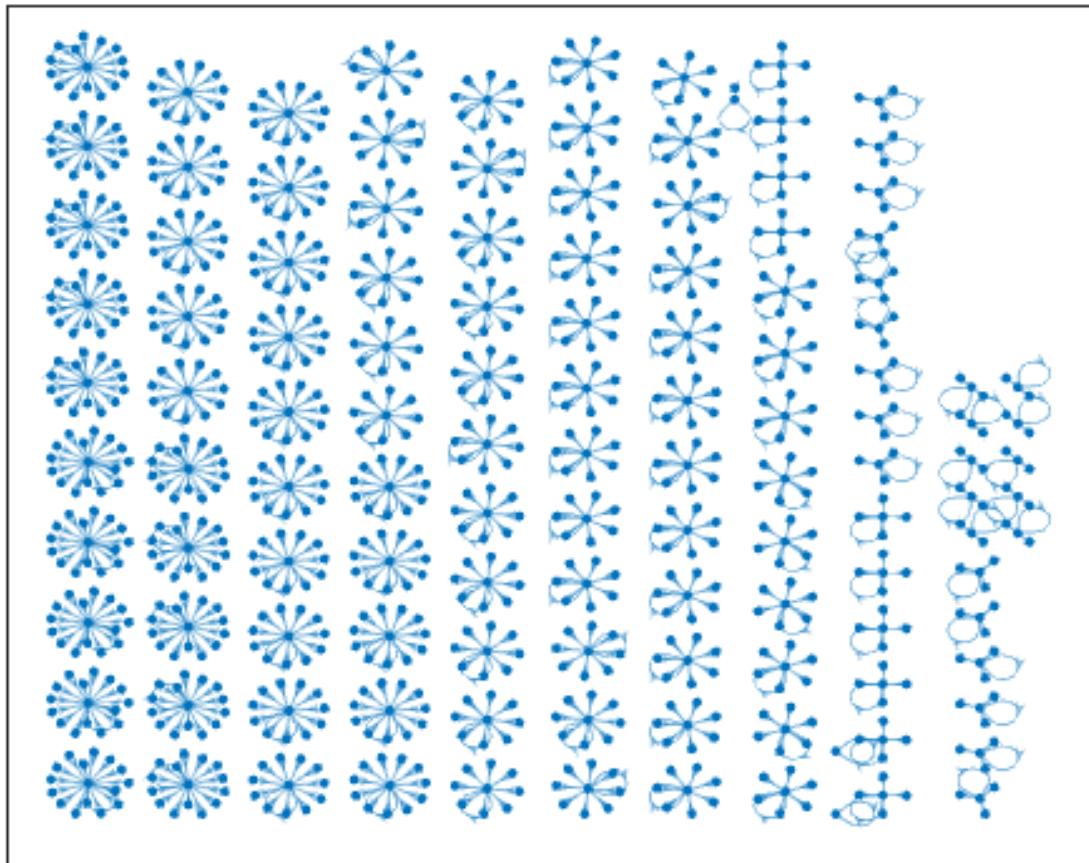
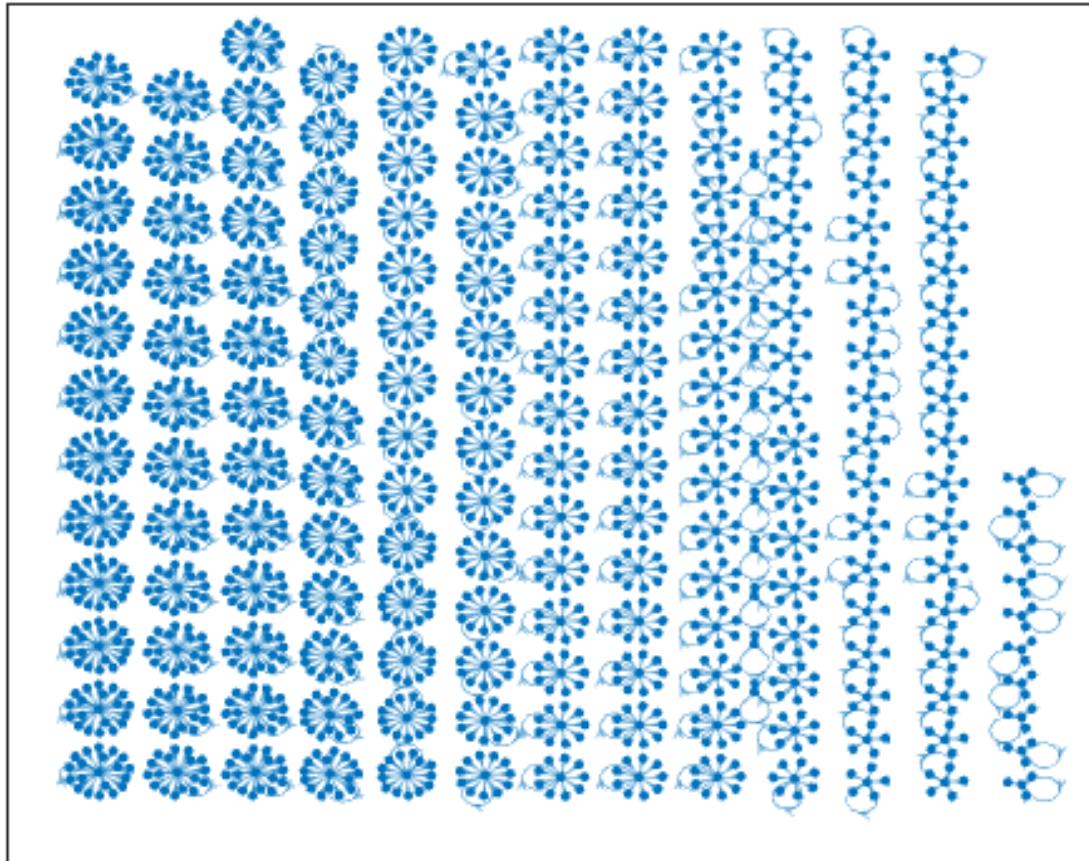


Figura 3.164: Atractor regla 12 n=9

Figura 3.165: Atractor regla 12 $n=10$

Figura 3.166: Atractor regla 12 $n=11$

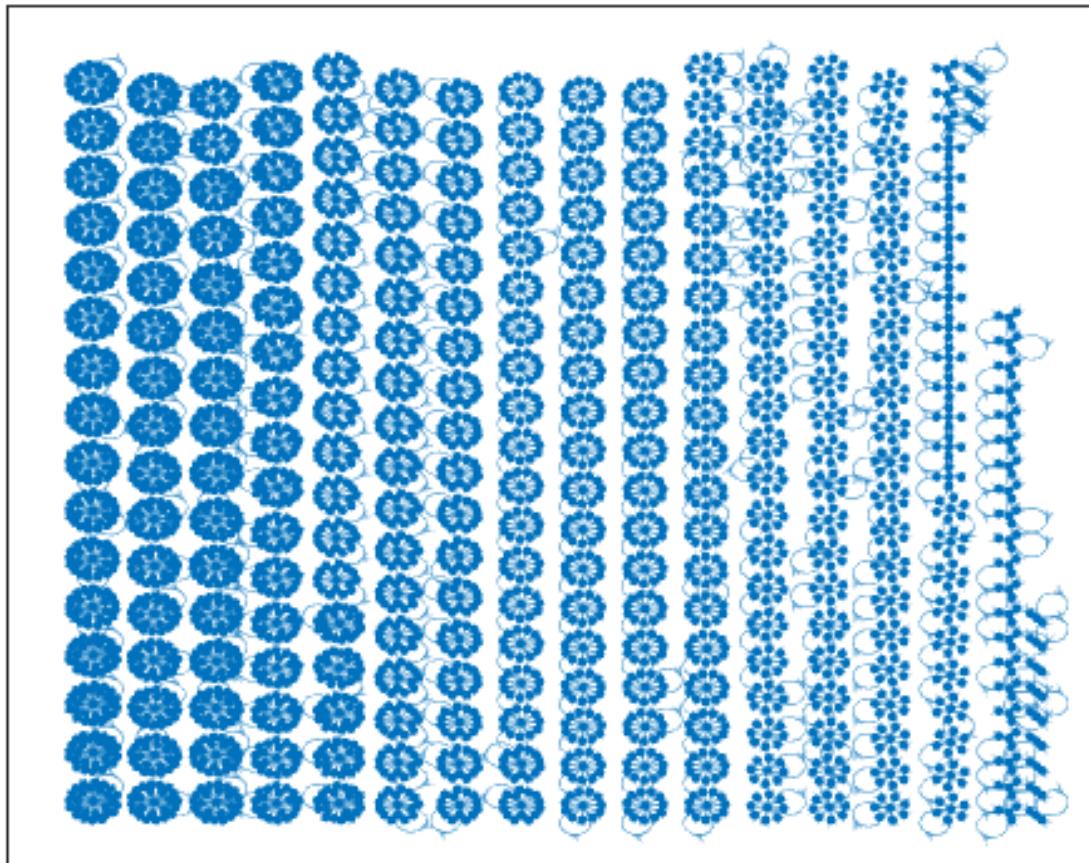


Figura 3.167: Atractor regla 12 n=12

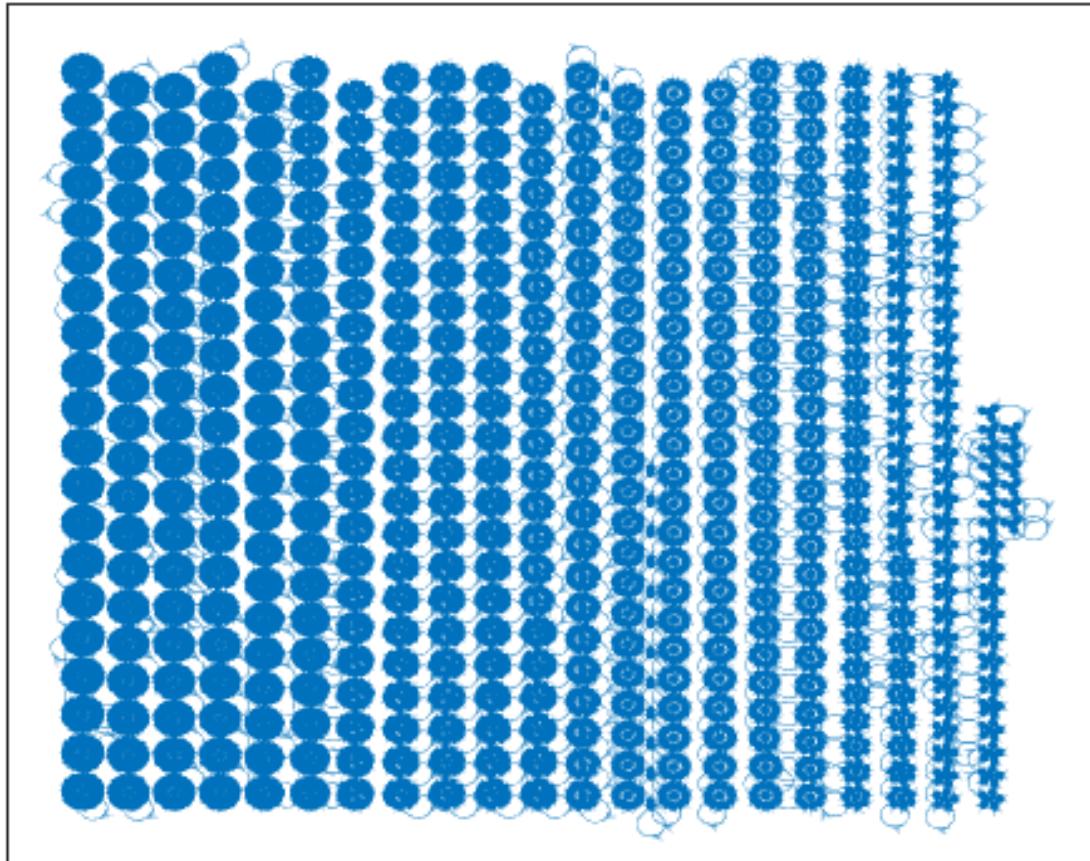


Figura 3.168: Atractor regla 12 n=13

3.14. Reglas 13,69,79,93

Respecto a la regla 13 se aprecia que mientras más grande es el tamaño de la cadena (n) atractores que en un momento estaban separados se unen para formar nuevos atractores más complejos y que por la cantidad de nodos que convengen en él mismo se ve solo una «plasta» que pareciera una figura de una araña o un ave.

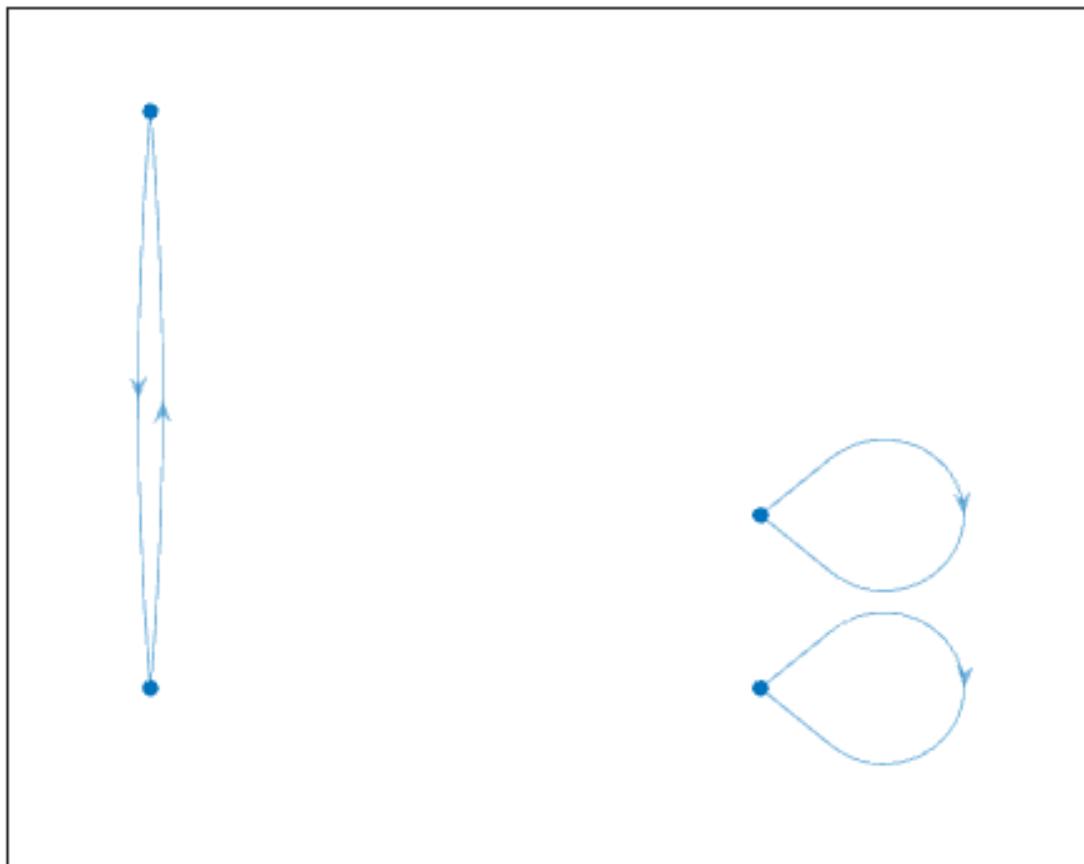


Figura 3.169: Atractor regla 13 $n=2$

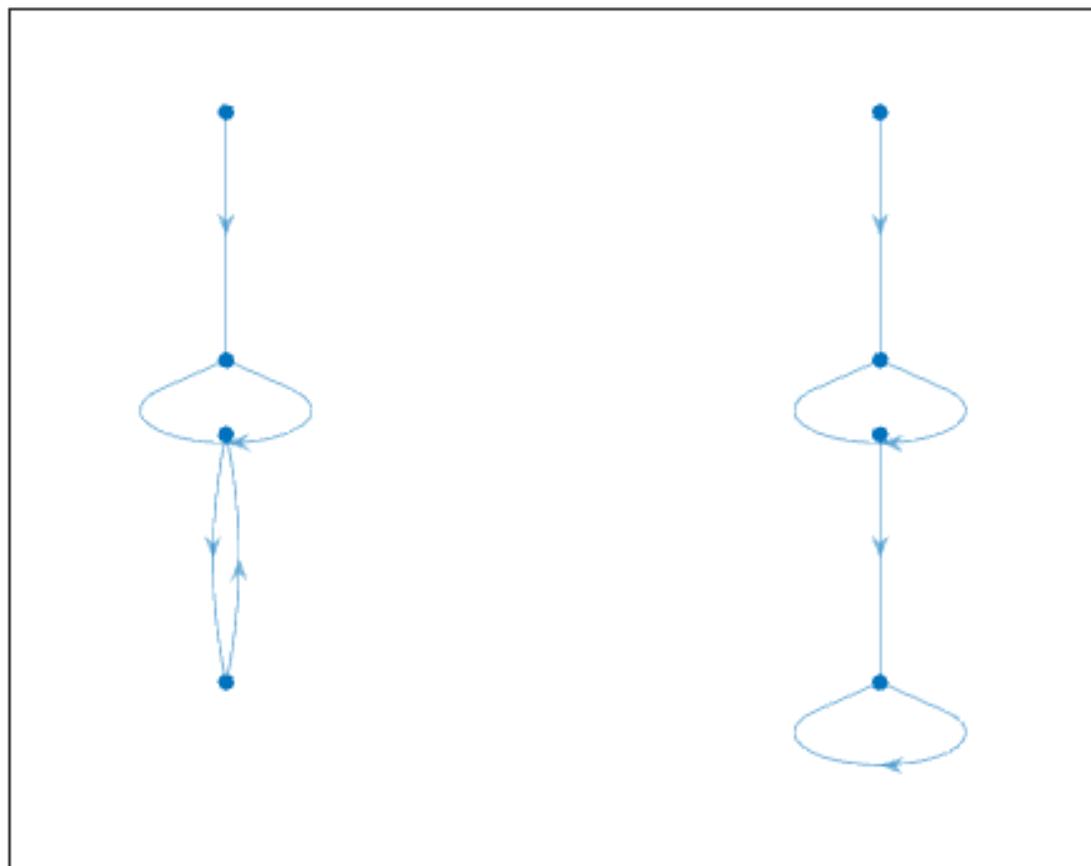


Figura 3.170: Atractor regla 13 n=3

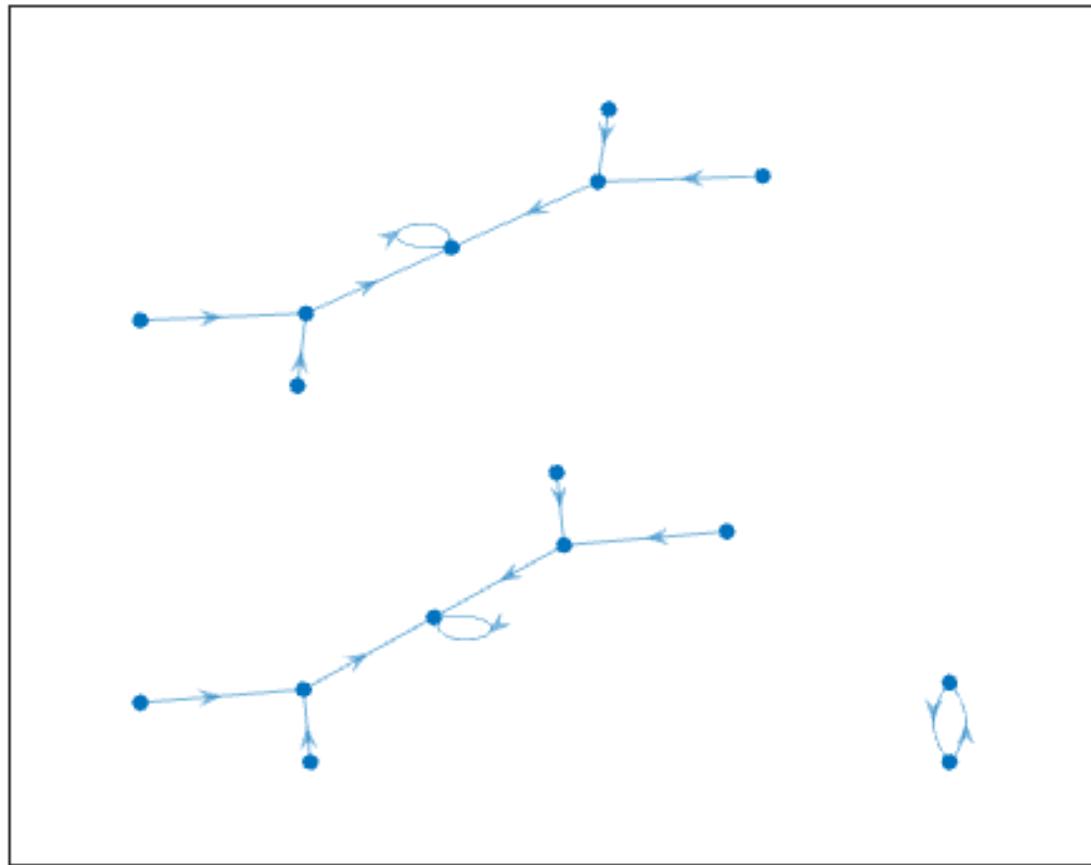
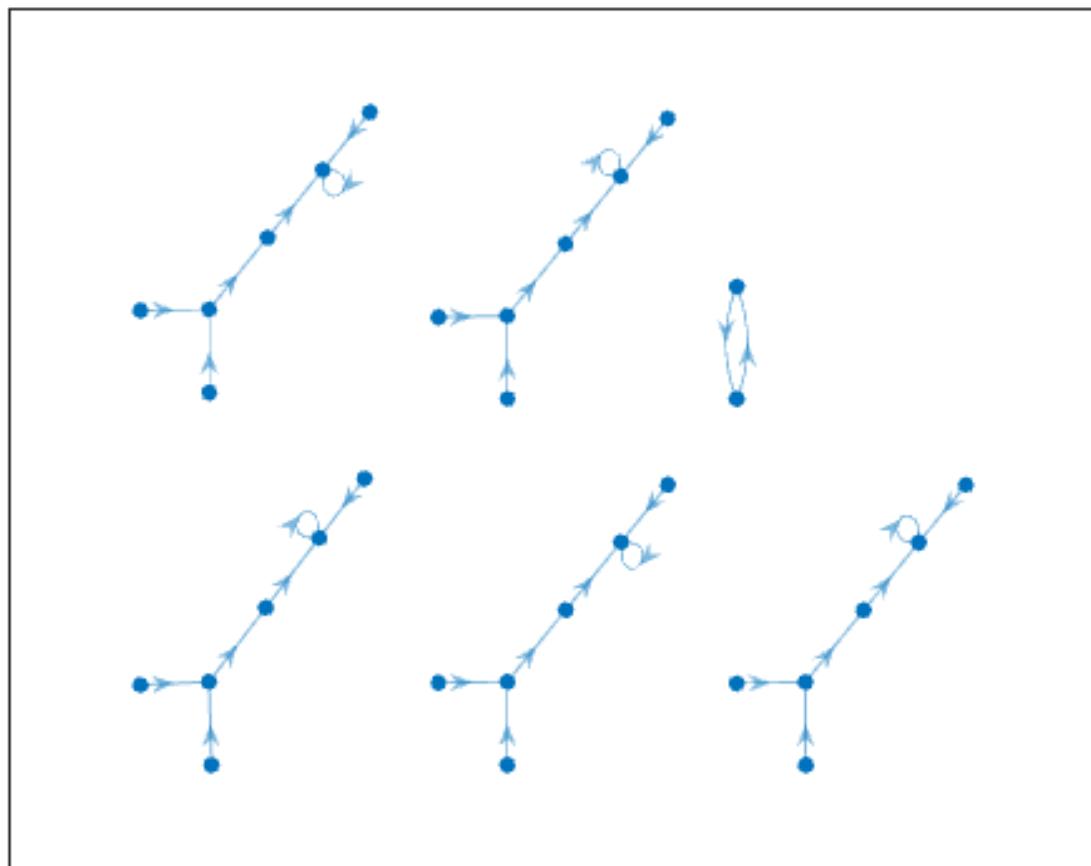
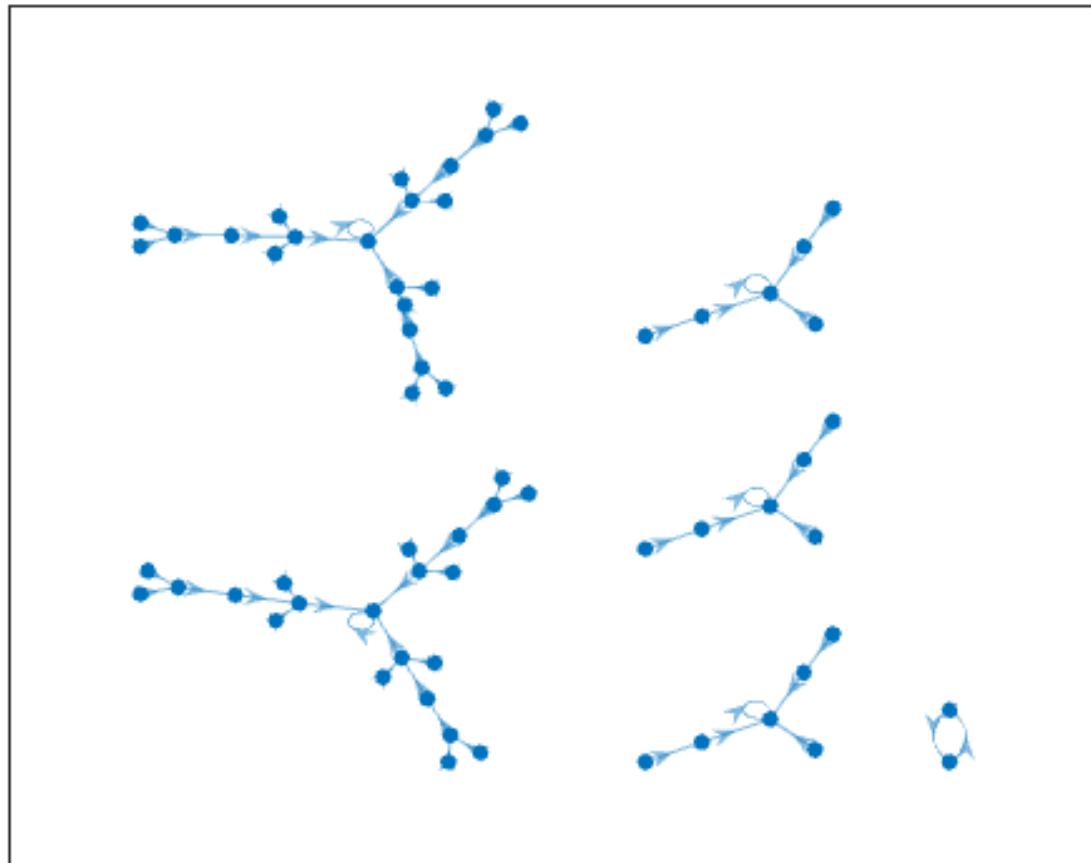
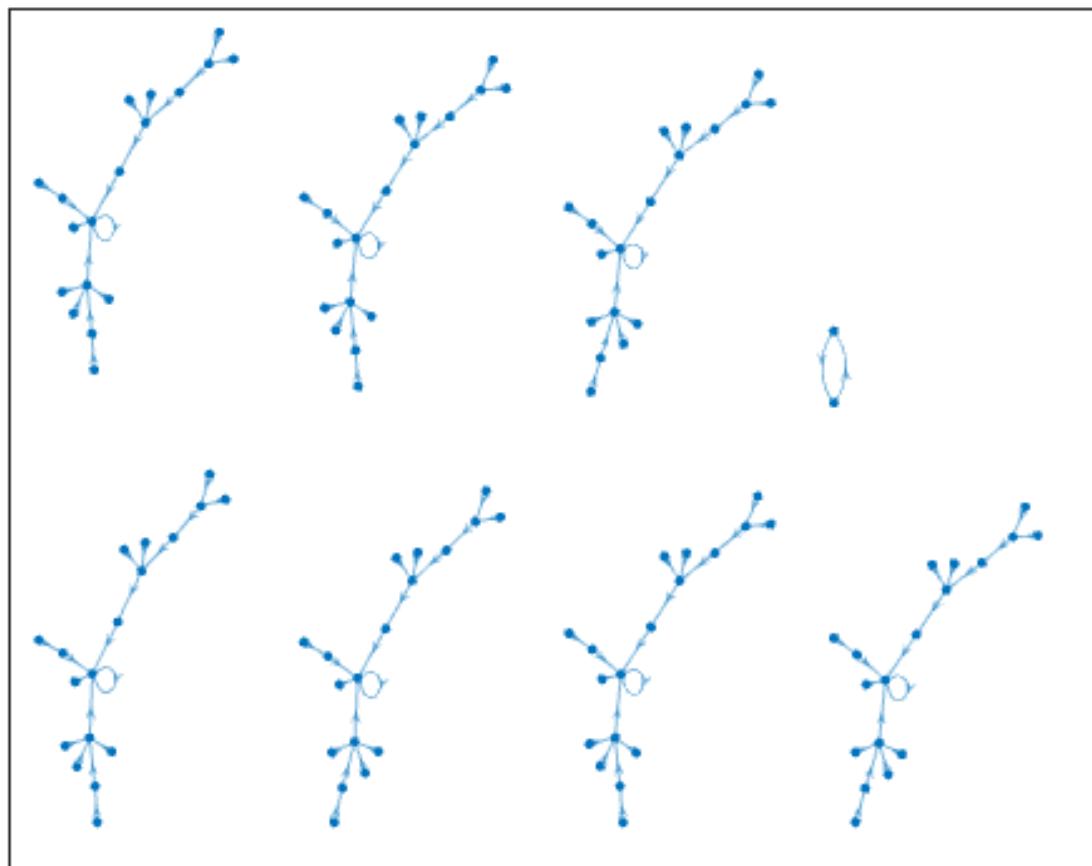


Figura 3.171: Atractor regla 13 n=4

Figura 3.172: Atractor regla 13 $n=5$

Figura 3.173: Atractor regla 13 $n=6$

Figura 3.174: Atractor regla 13 $n=7$

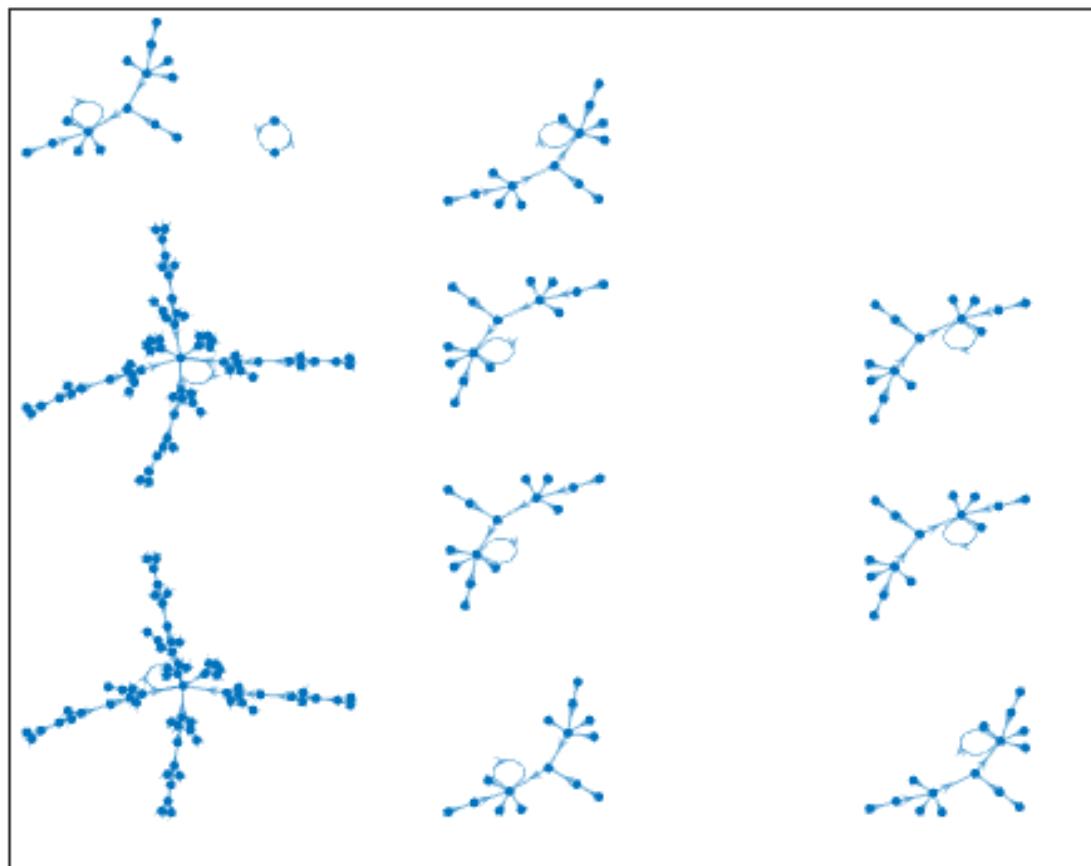
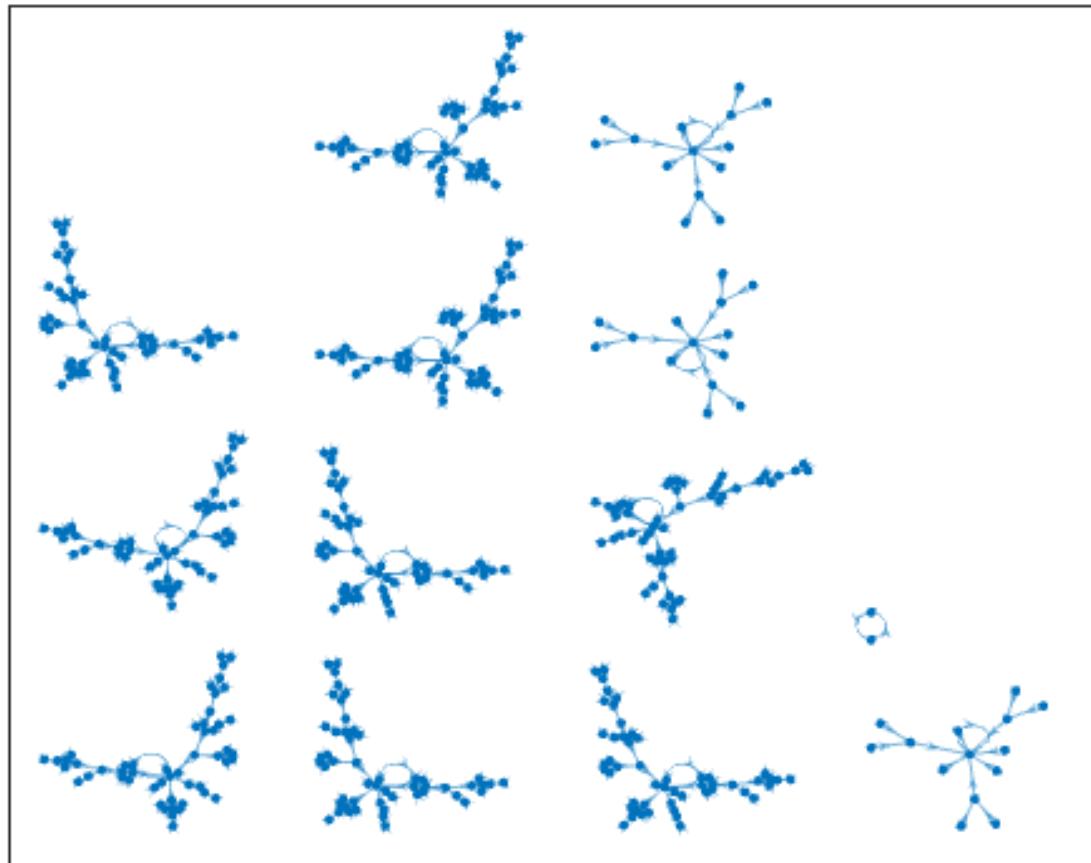


Figura 3.175: Atractor regla 13 n=8

Figura 3.176: Atractor regla 13 $n=9$

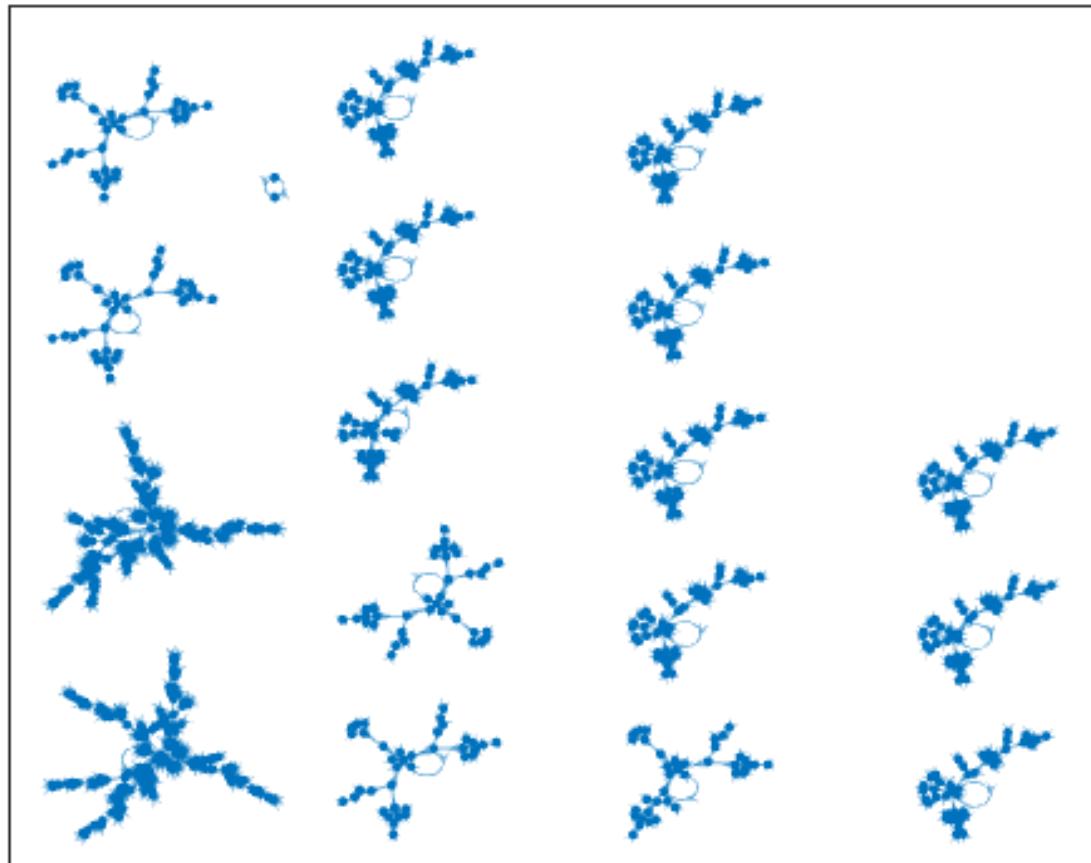


Figura 3.177: Atractor regla 13 n=10

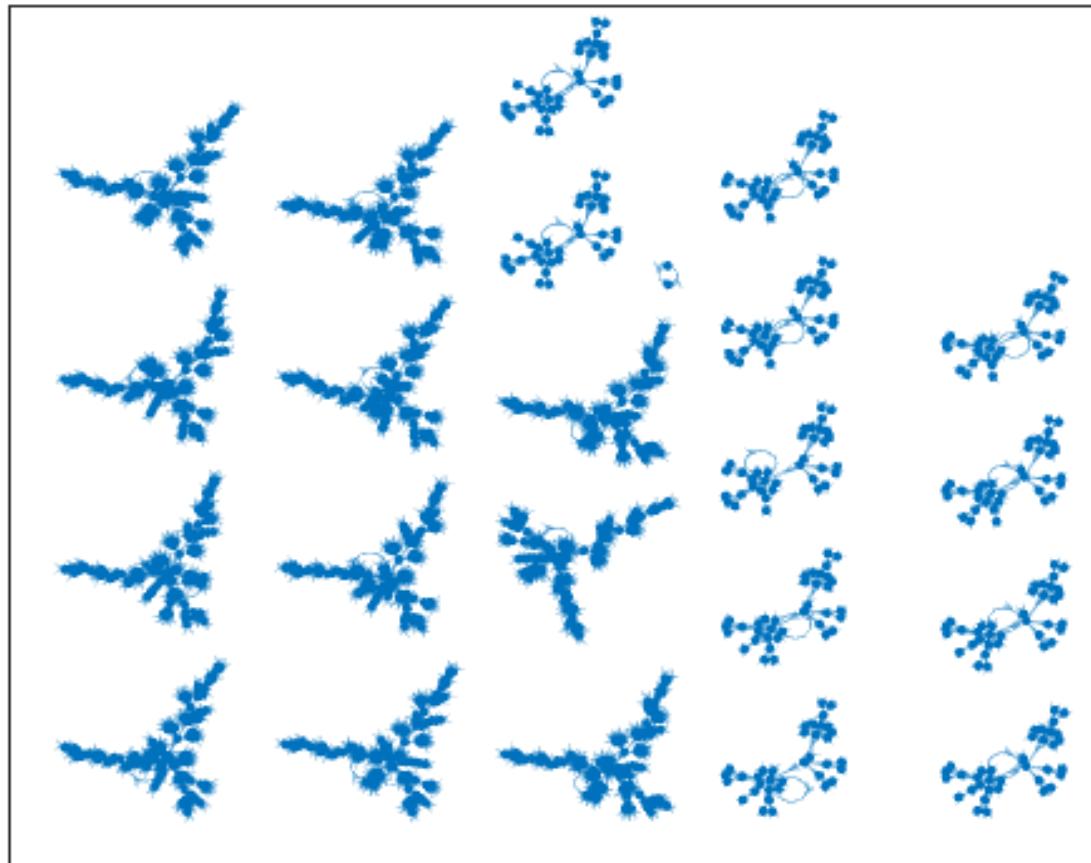


Figura 3.178: Atractor regla 13 n=11

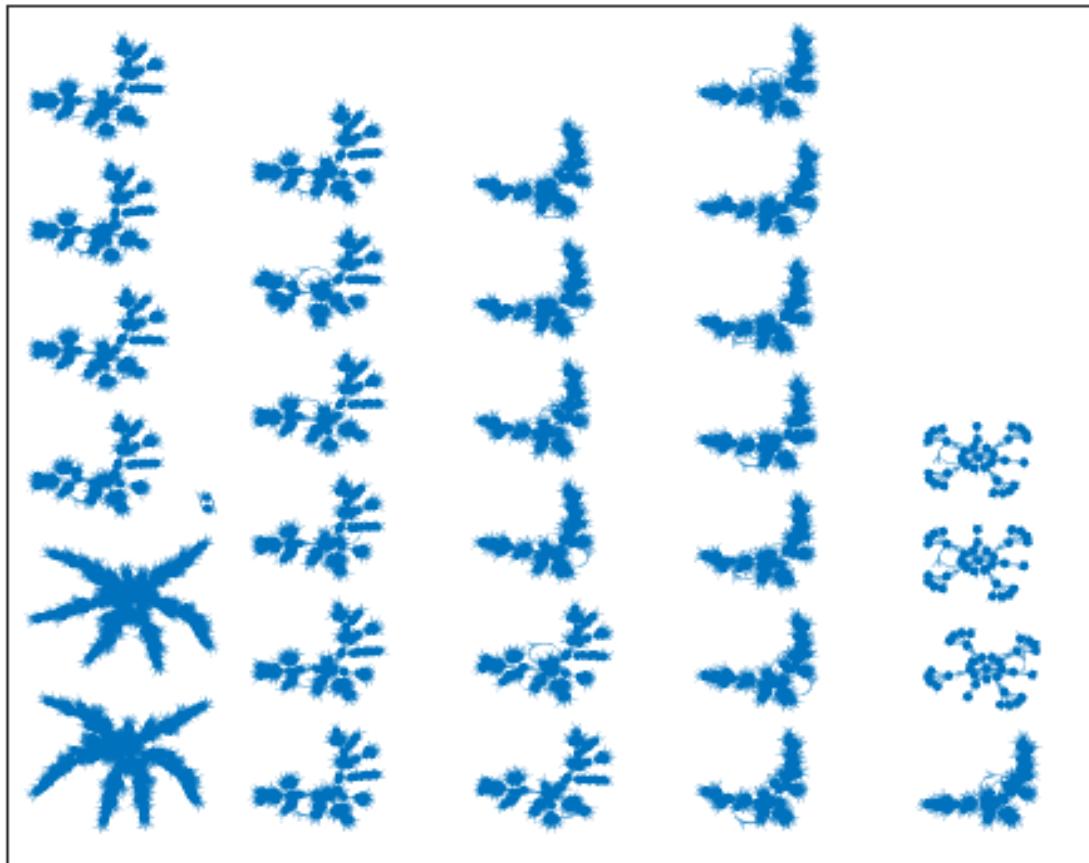


Figura 3.179: Atractor regla 13 n=12

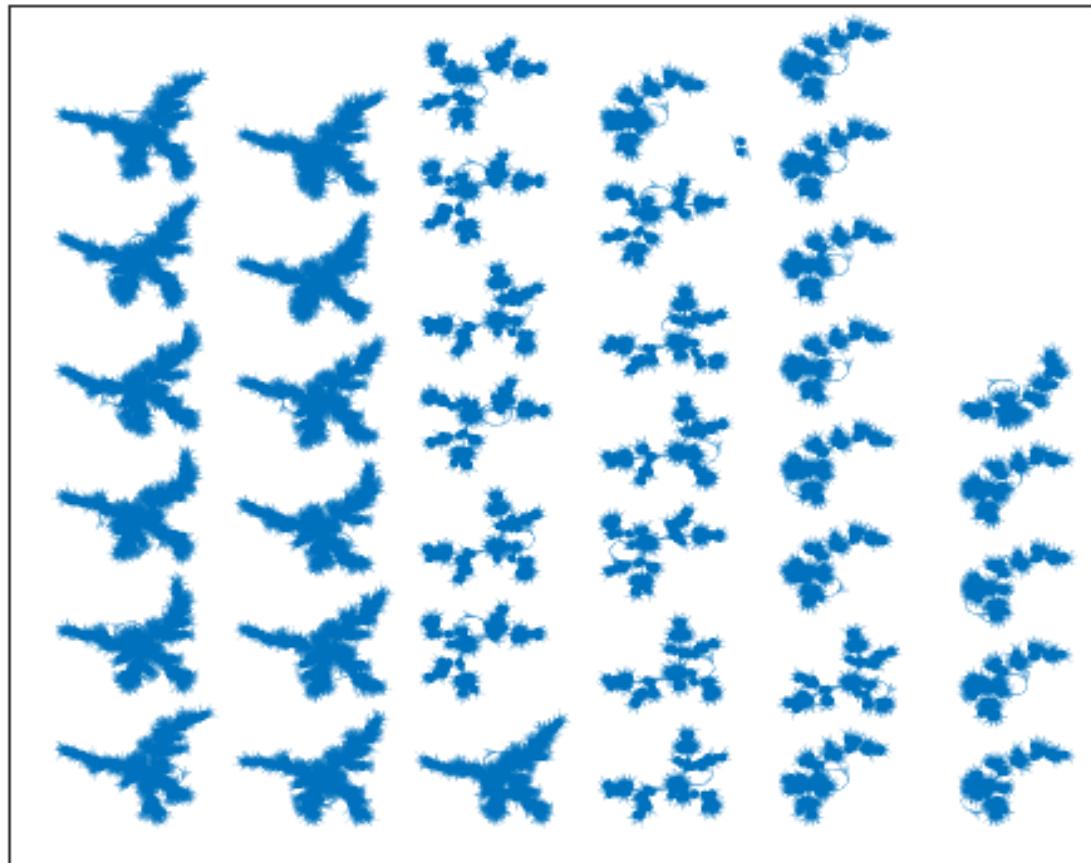


Figura 3.180: Atractor regla 13 n=13

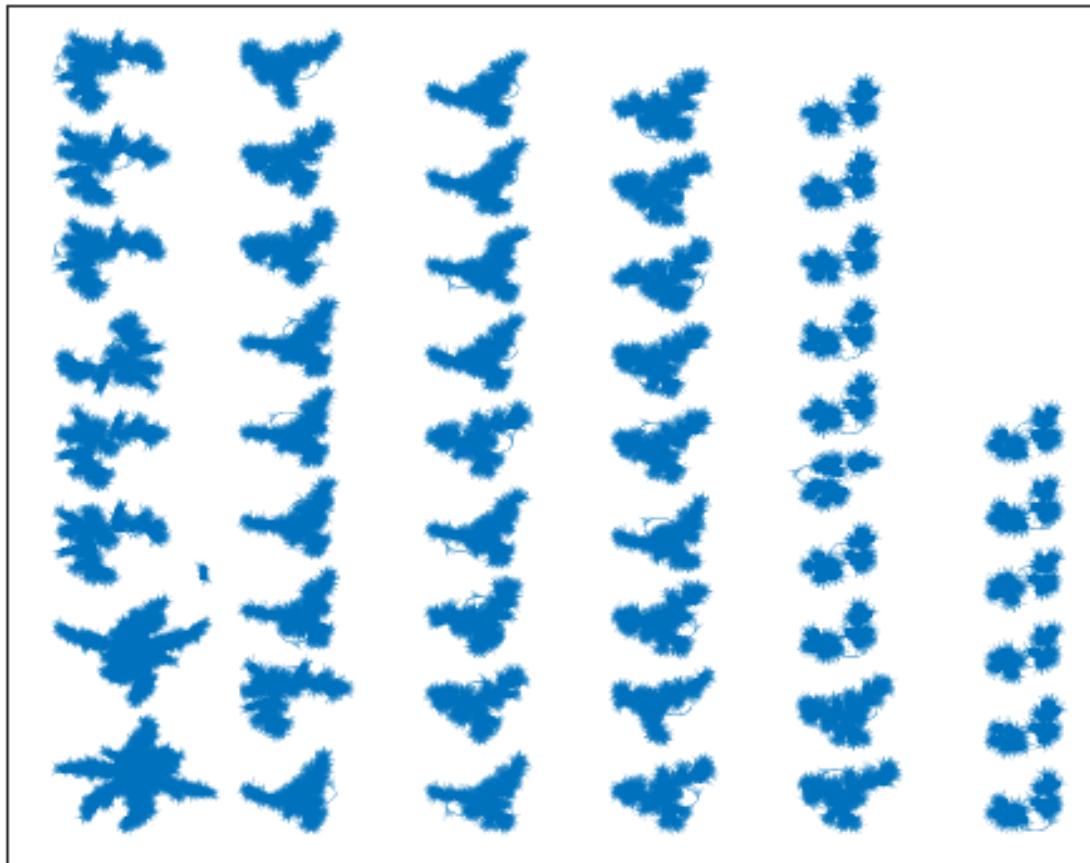


Figura 3.181: Atractor regla 13 n=14

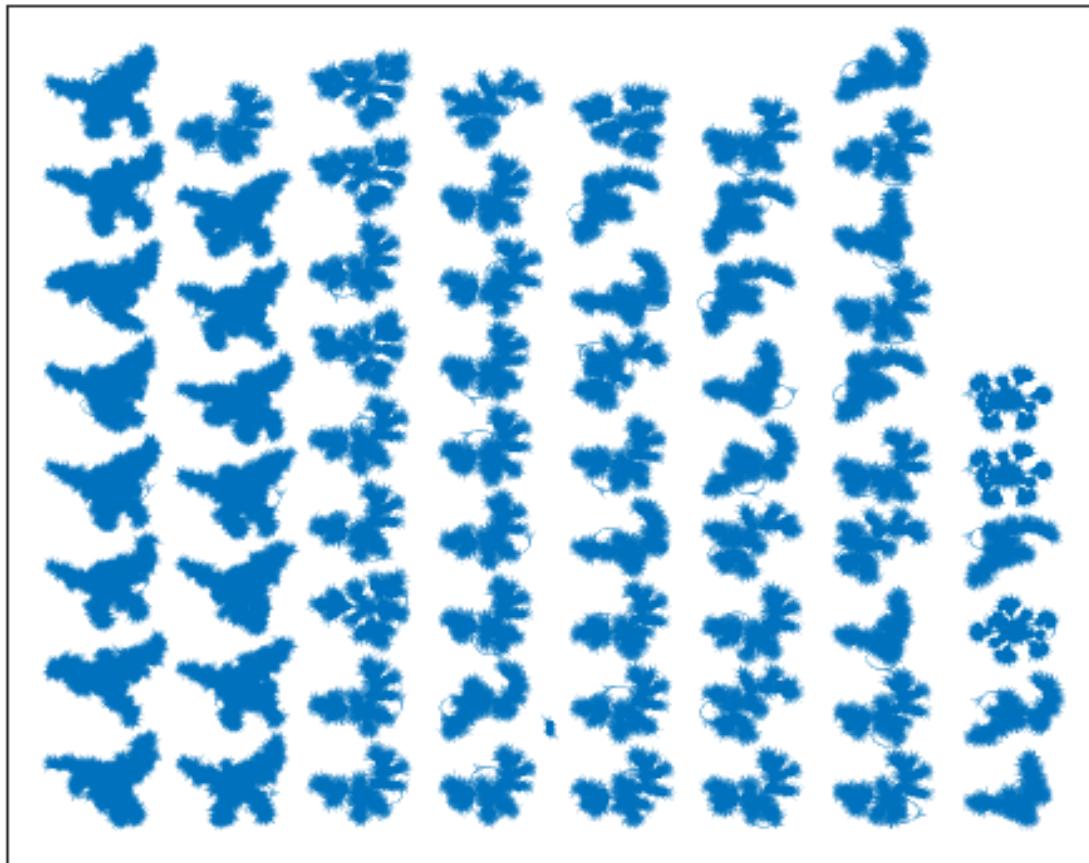


Figura 3.182: Atractor regla 13 $n=15$

3.15. Reglas 14,84,143,213

Respecto a la regla 14 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen nuevos atractores que evolucionan en atractores más complejos y mientras sucede esto surgen atractores autorreferenciados que en siguientes evoluciones se convierten en atractores más complejos y que al menos hasta la evolución de $n=15$ al menos aparece un atractor autoreferenciado.

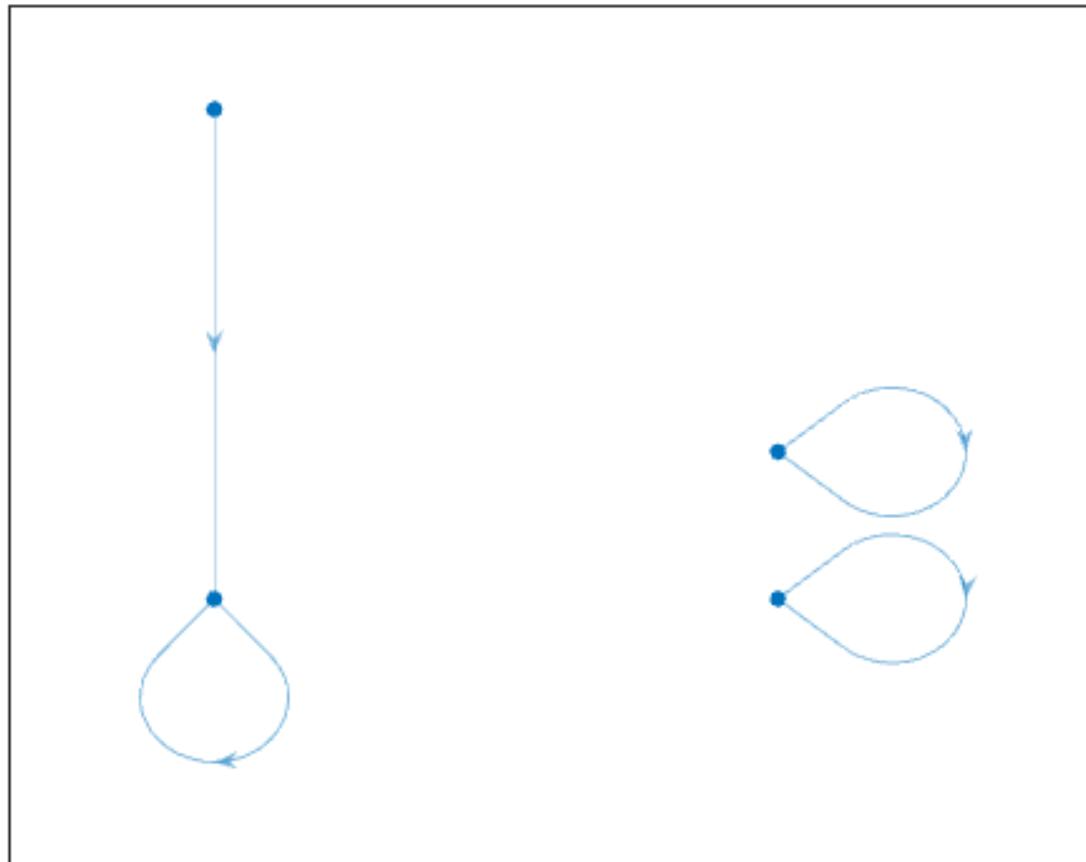


Figura 3.183: Atractor regla 14 $n=2$

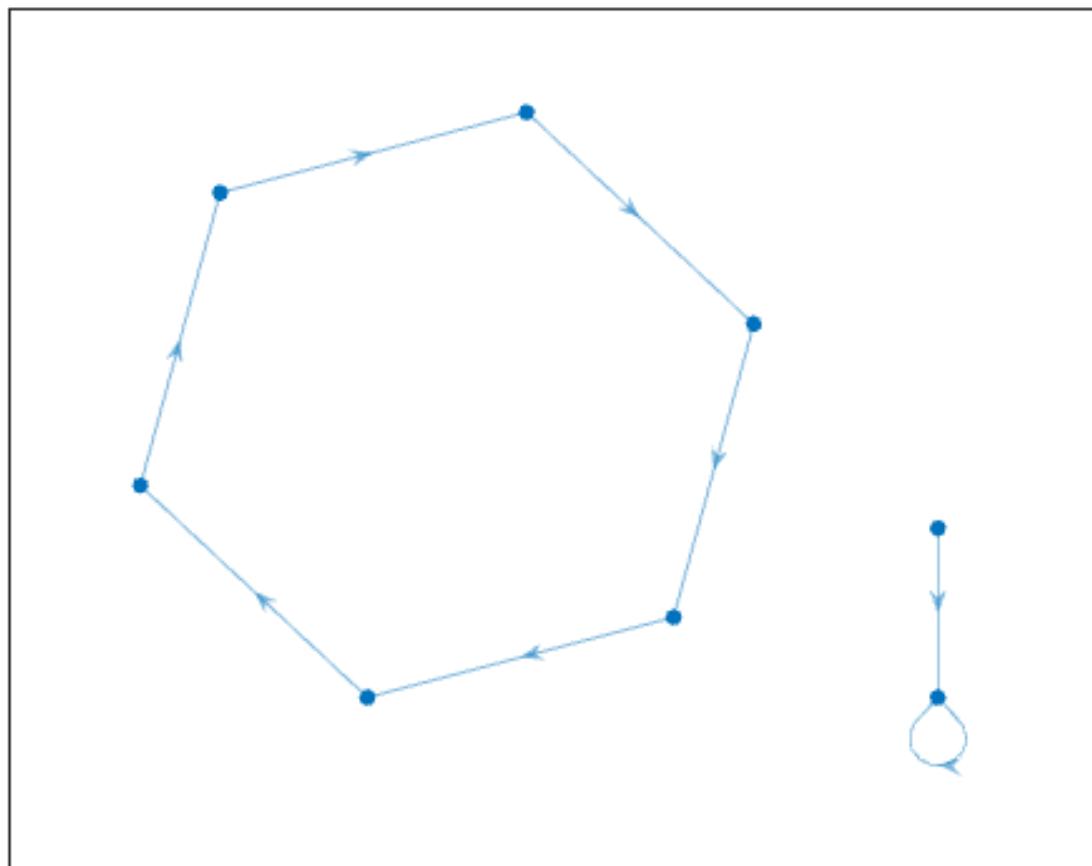
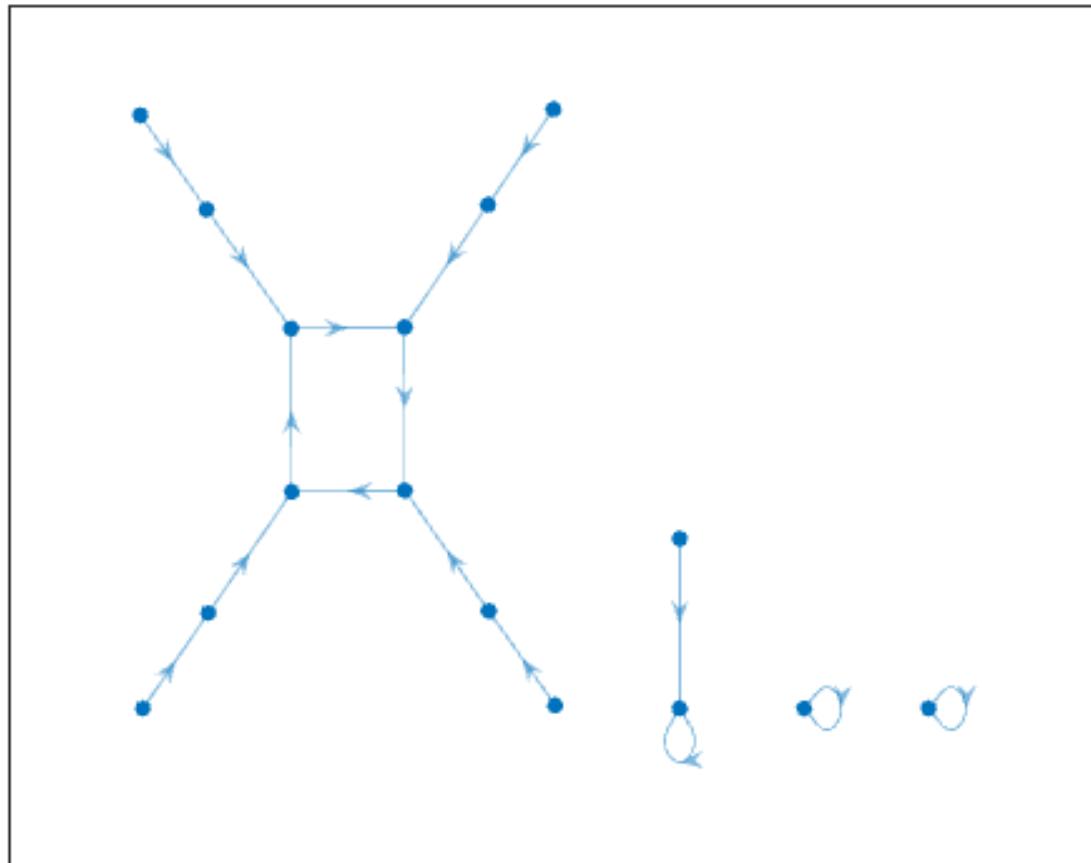


Figura 3.184: Atractor regla 14 n=3

Figura 3.185: Atractor regla 14 $n=4$

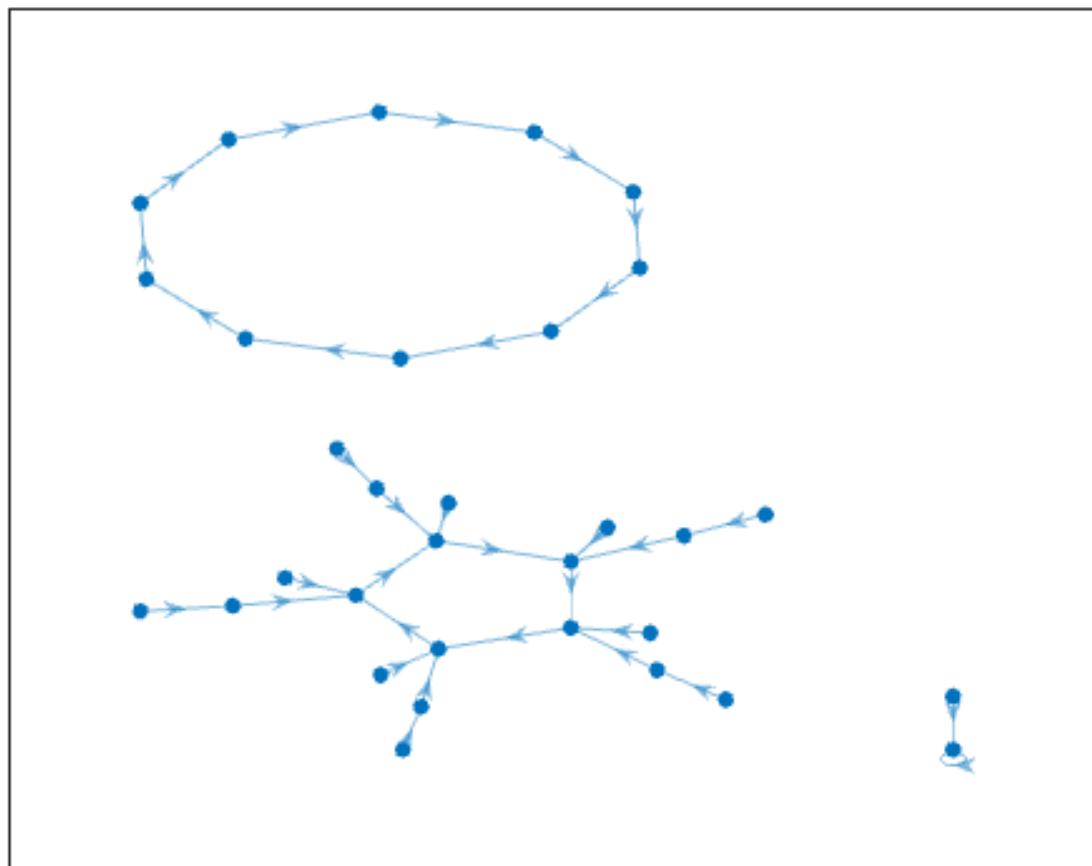
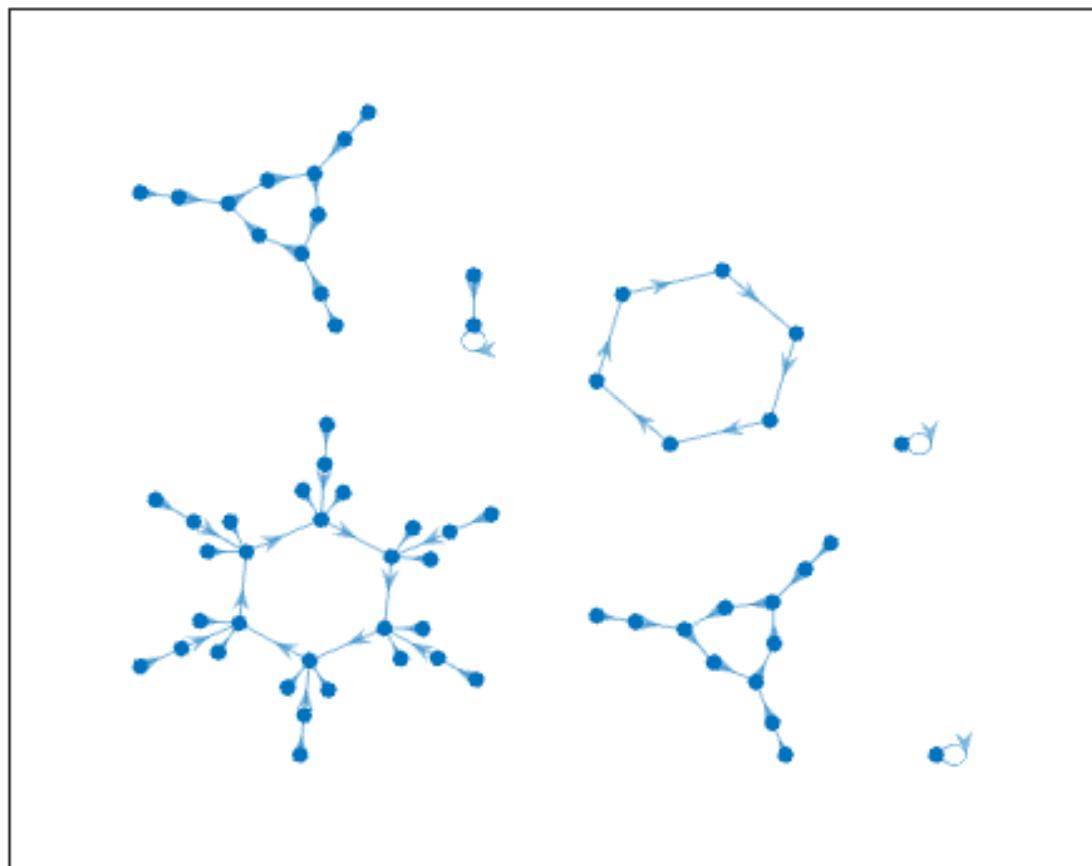
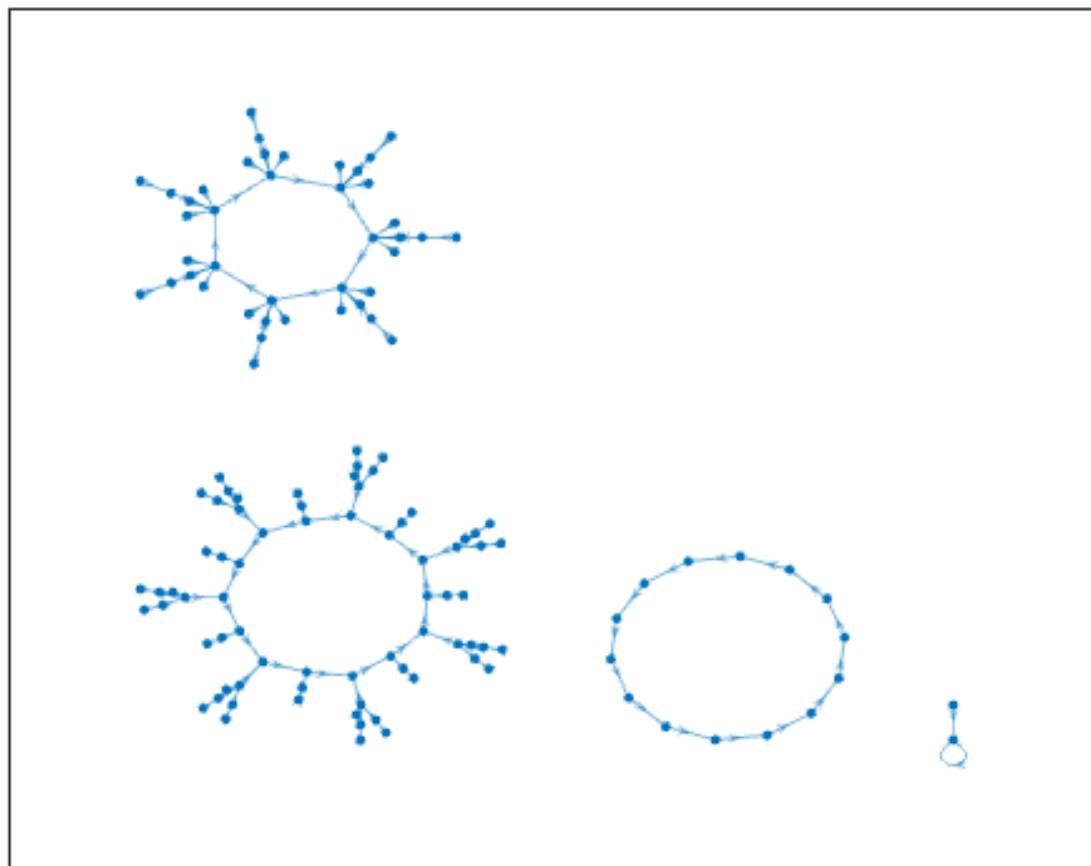
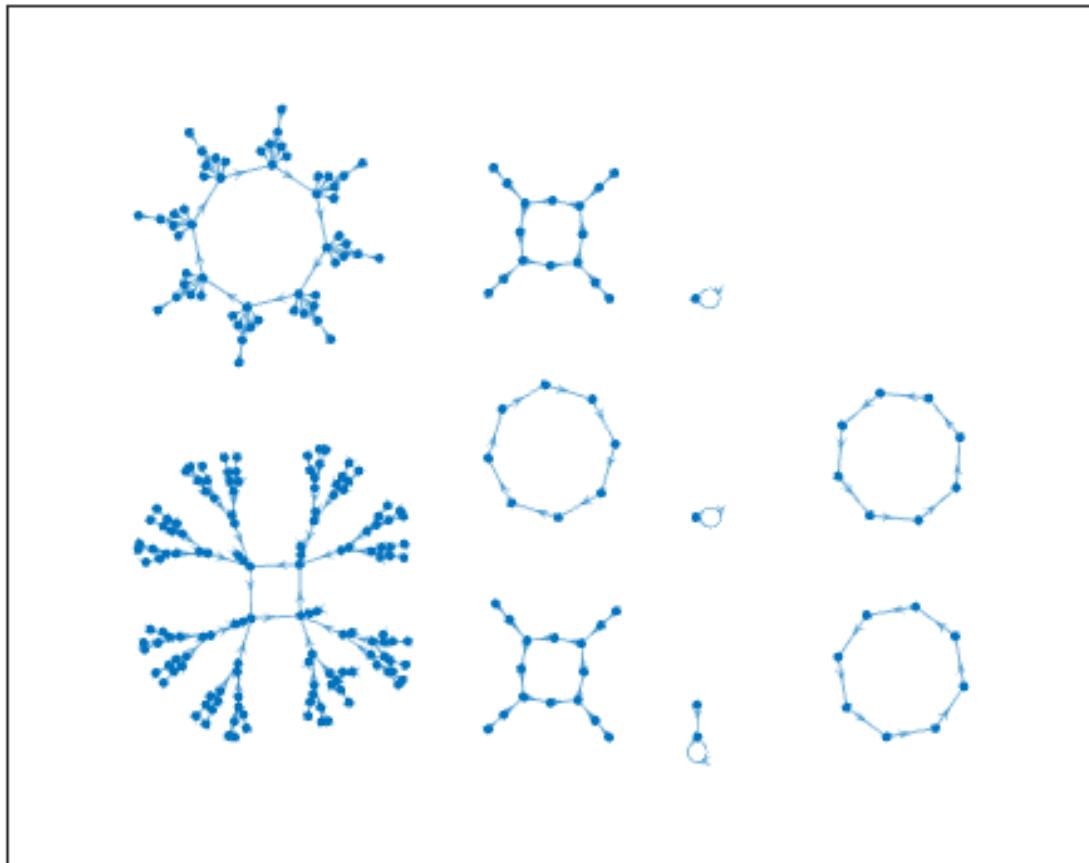


Figura 3.186: Atractor regla 14 n=5

Figura 3.187: Atractor regla 14 $n=6$

Figura 3.188: Atractor regla 14 $n=7$

Figura 3.189: Atractor regla 14 $n=8$

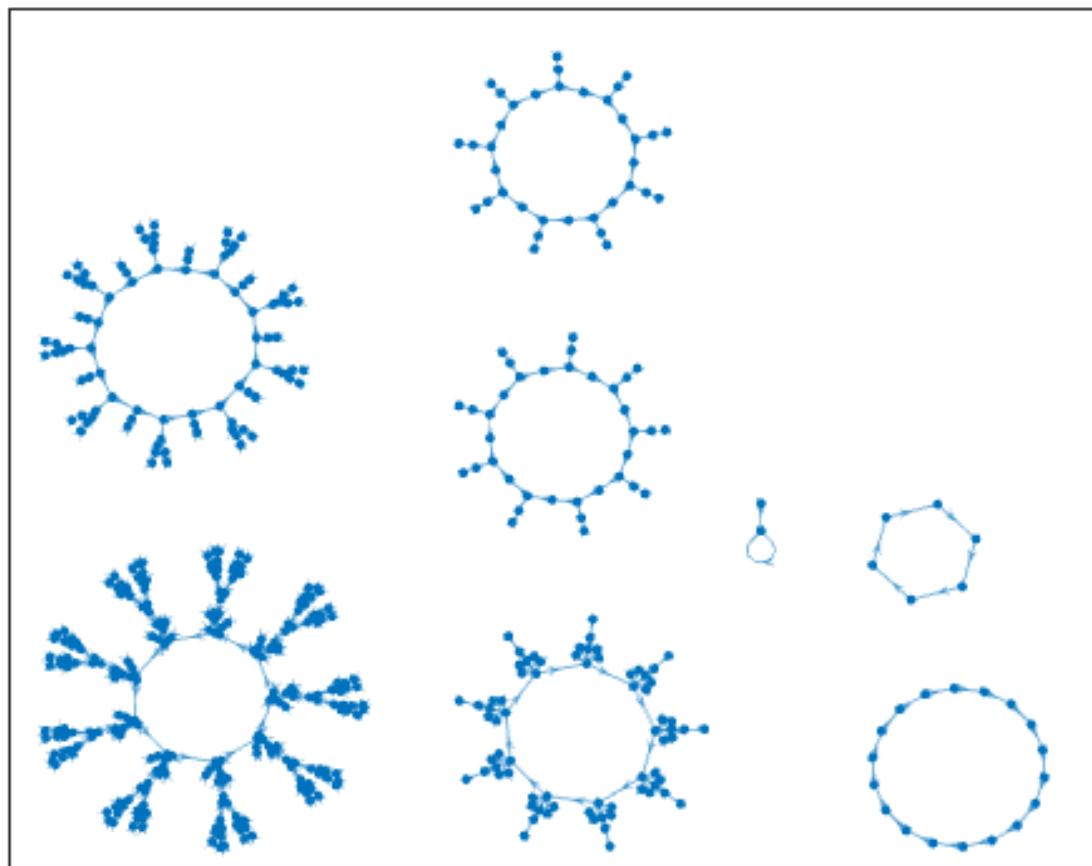
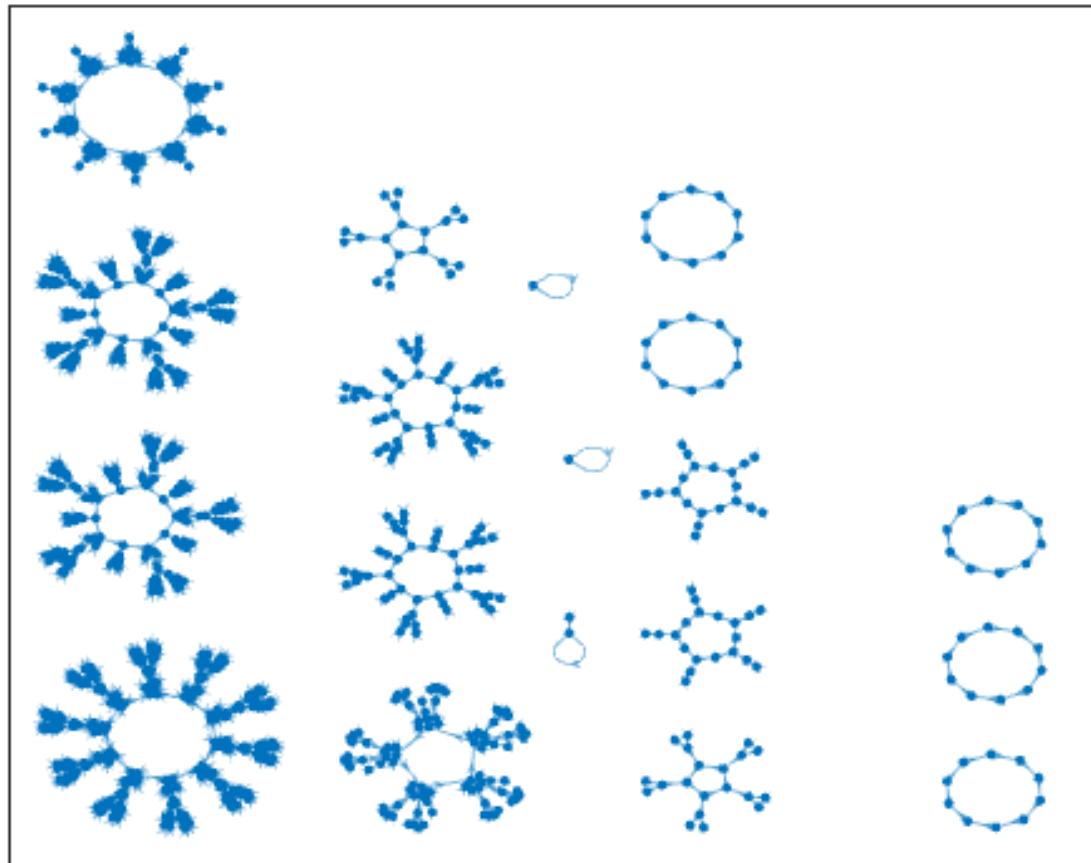


Figura 3.190: Atractor regla 14 n=9

Figura 3.191: Atractor regla 14 $n=10$

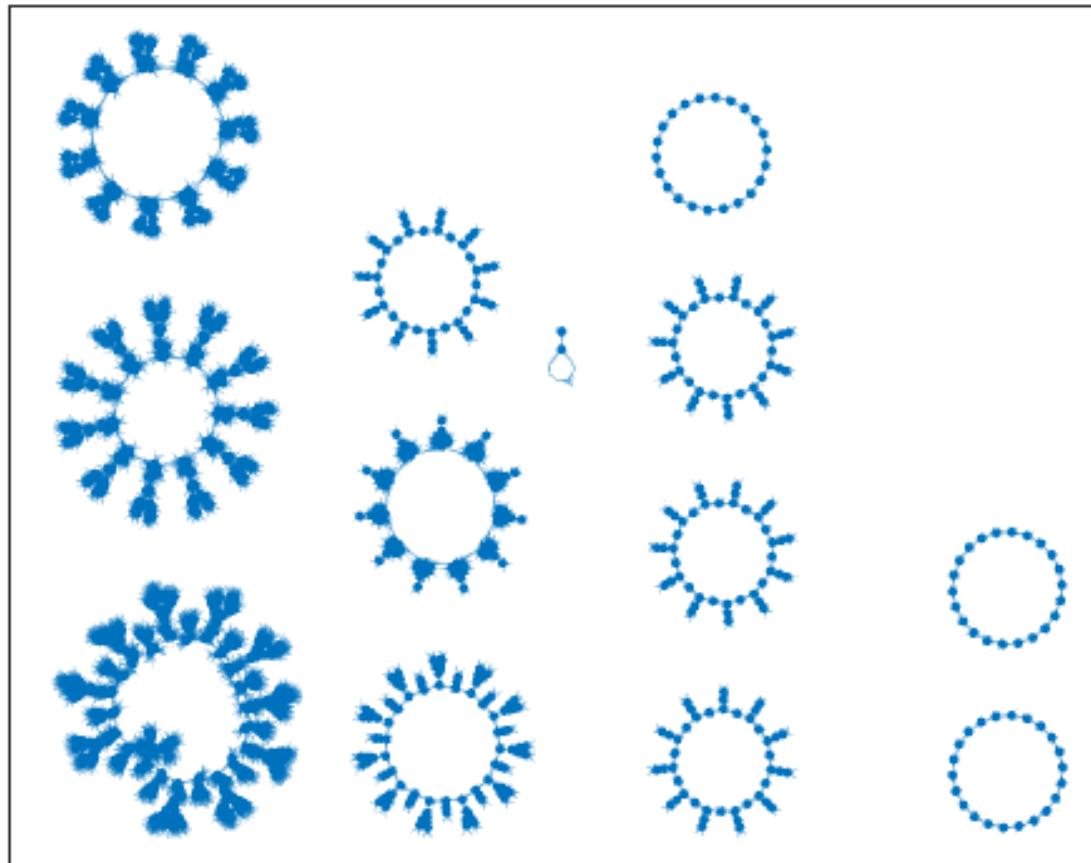
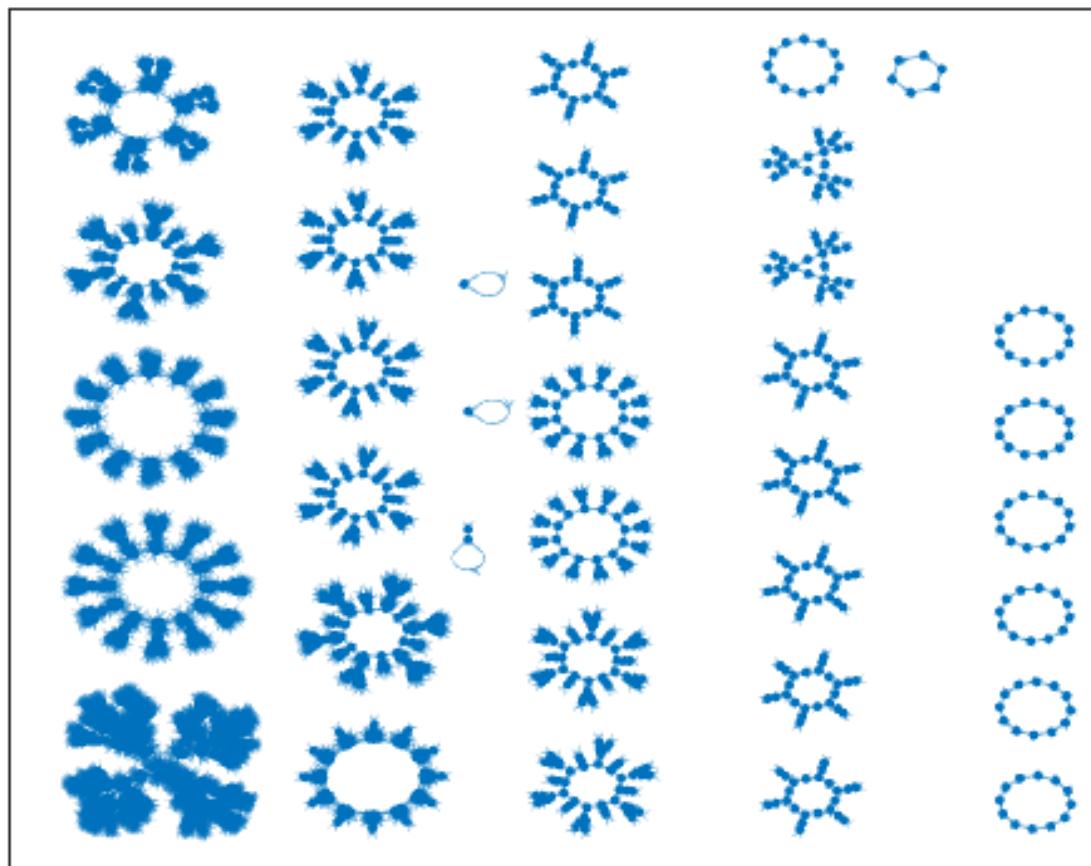


Figura 3.192: Atractor regla 14 n=11

Figura 3.193: Atractor regla 14 $n=12$

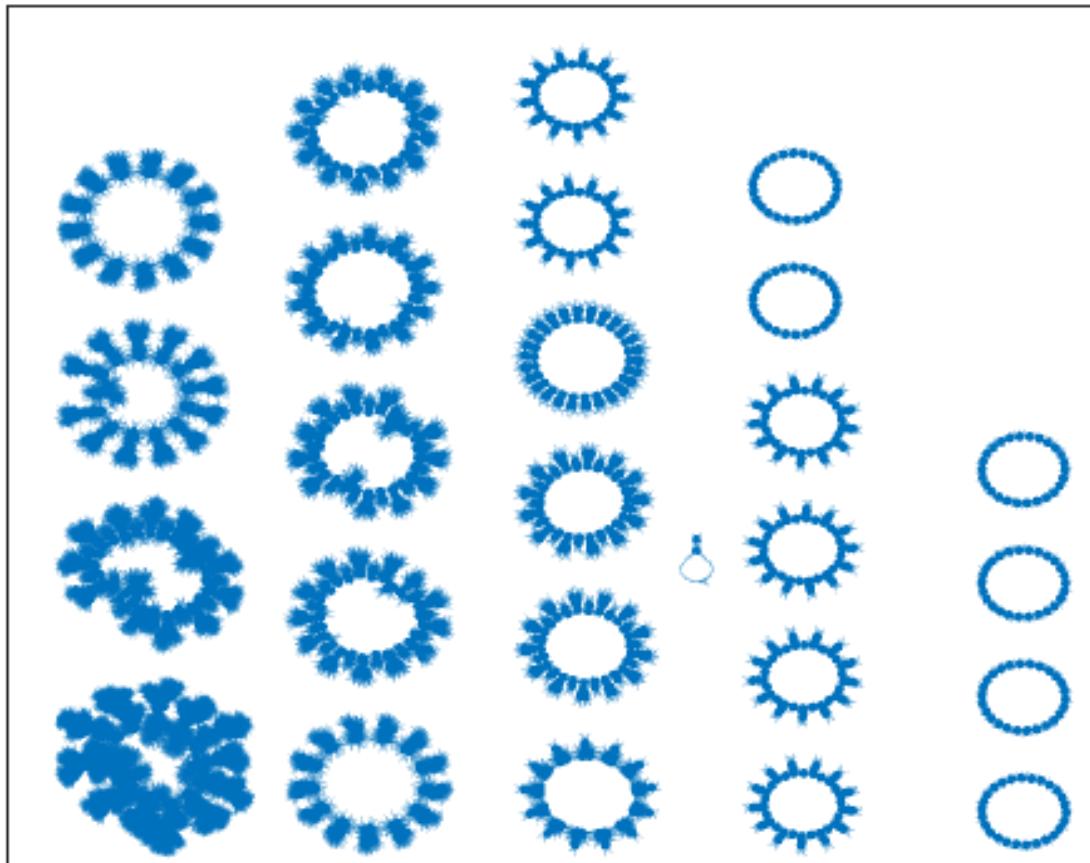
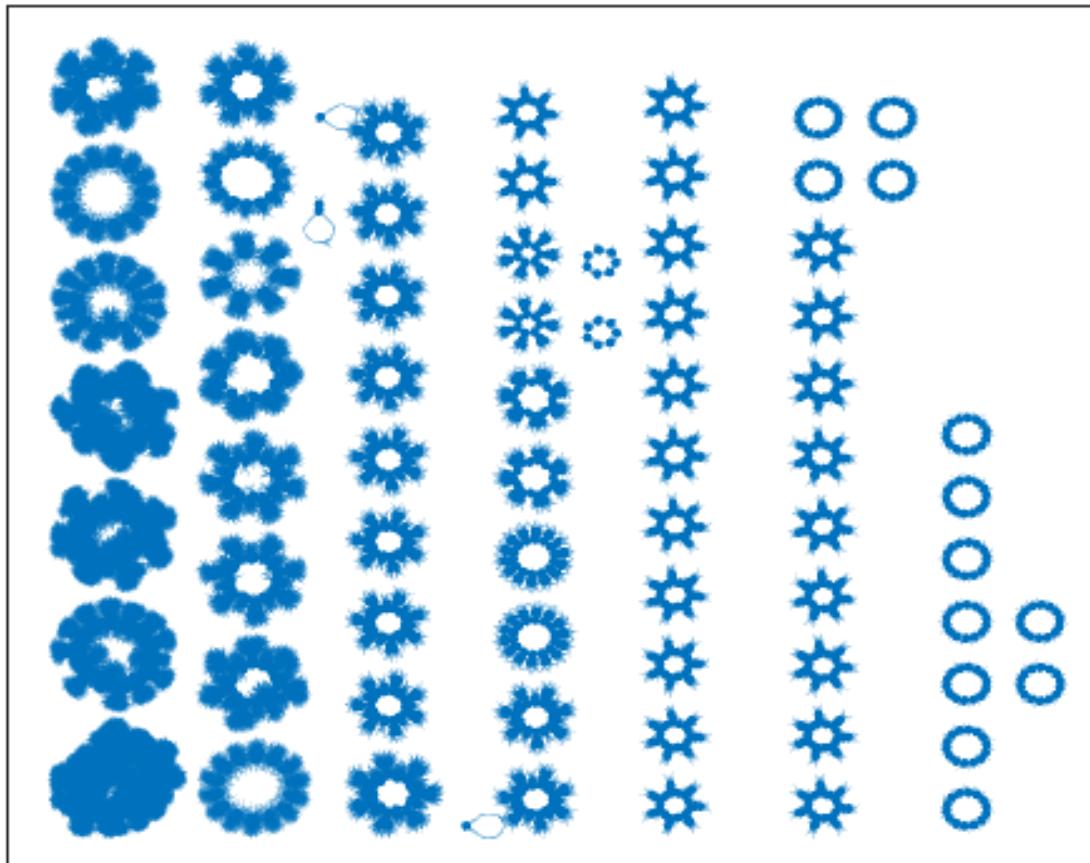
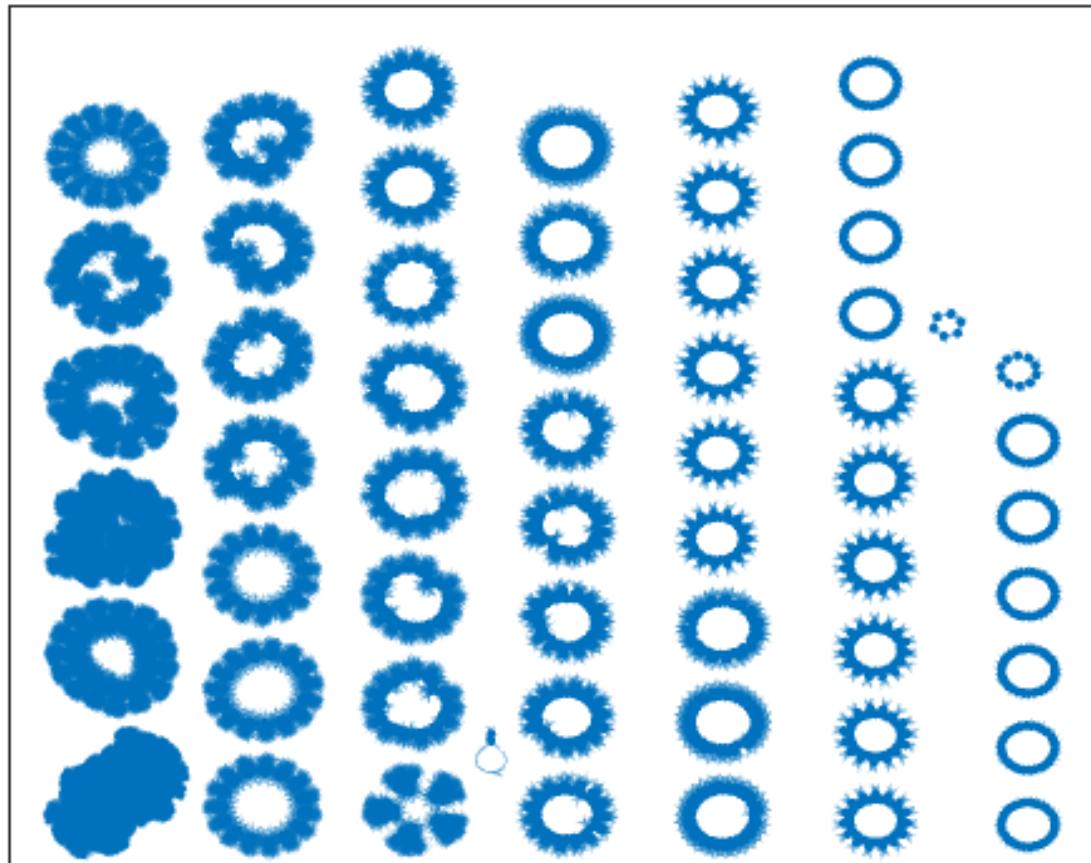


Figura 3.194: Atractor regla 14 n=13

Figura 3.195: Atractor regla 14 $n=14$

Figura 3.196: Atractor regla 14 $n=15$

3.16. Reglas 15,85

Respecto a la regla 15 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen nuevos atractores que posteriormente pareciera que generaran copias de sí mismos ya que están surgiendo atractores idénticos en imagen ya que obviamente tienen nodos distintos pero que matlab les otorga la misma configuración.

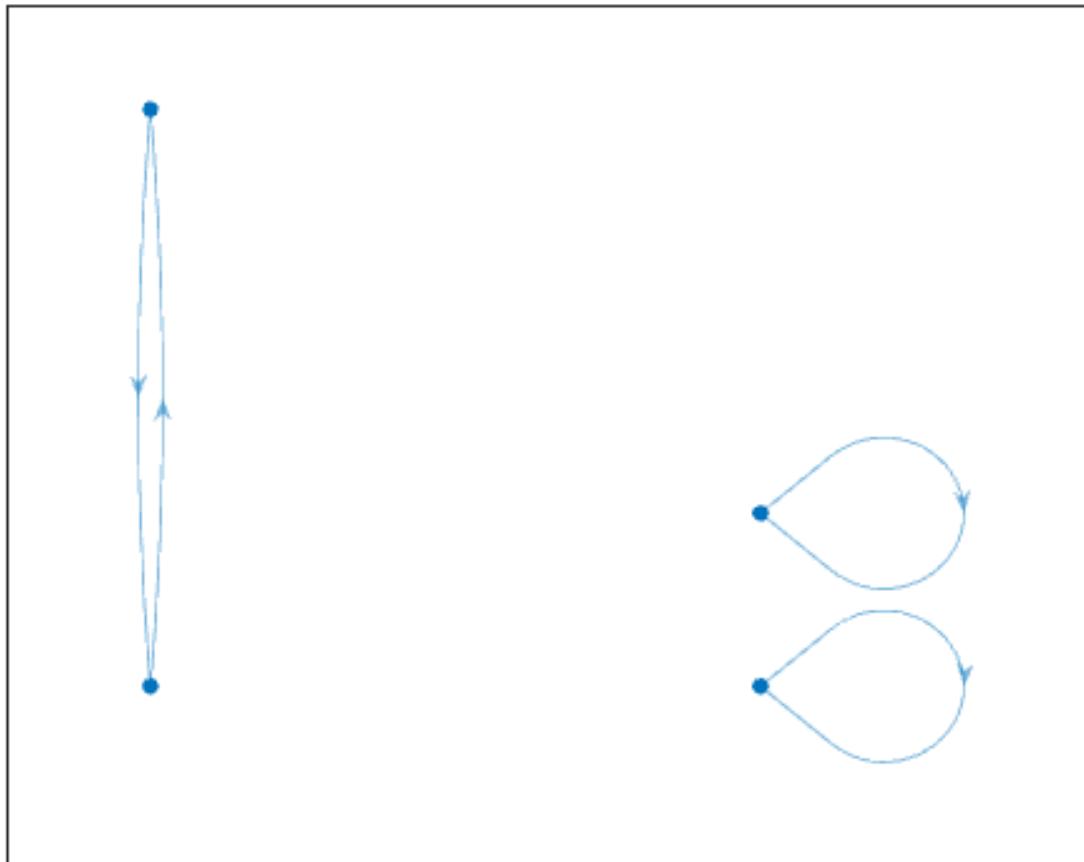


Figura 3.197: Atractor regla 15 n=2

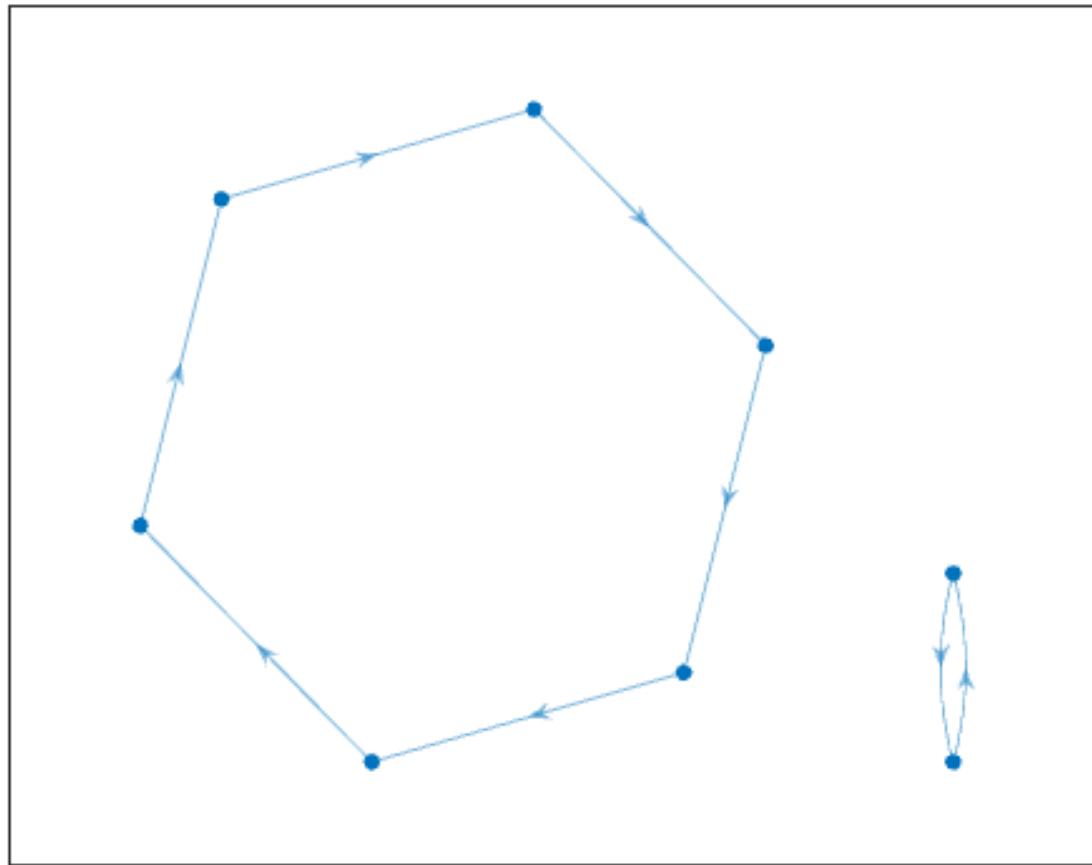
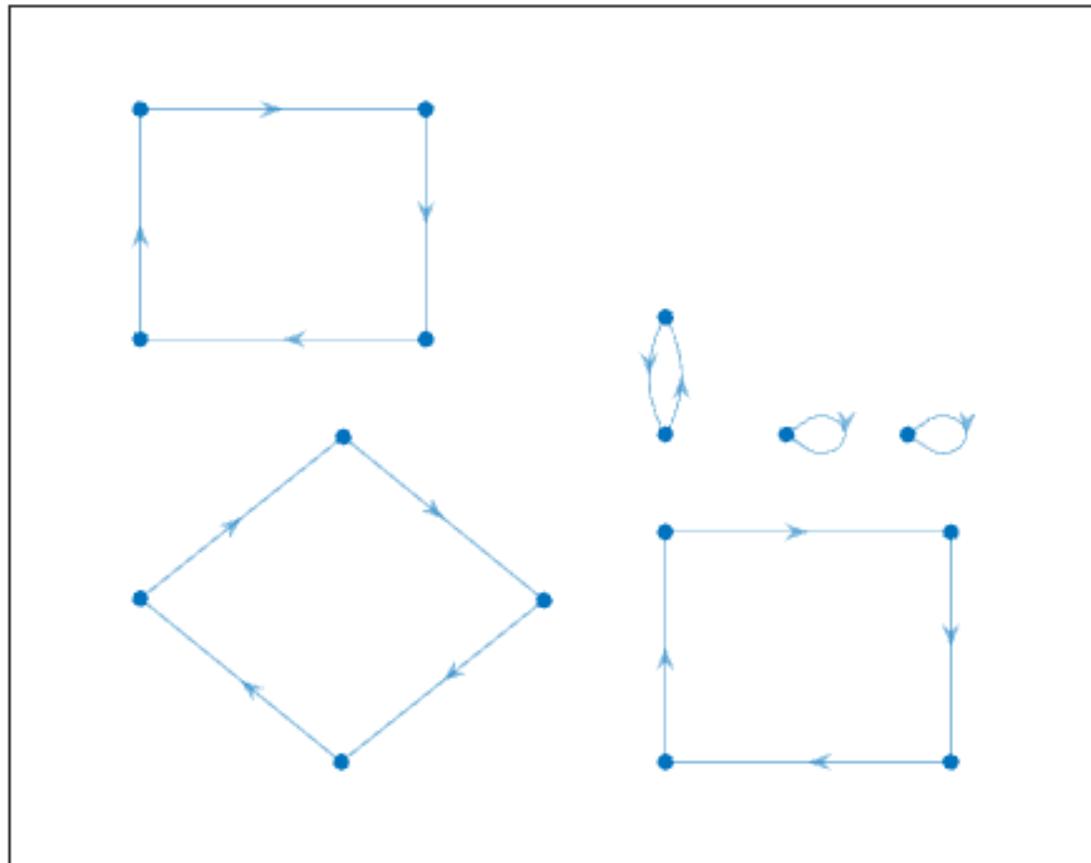


Figura 3.198: Atractor regla 15 n=3

Figura 3.199: Atractor regla 15 $n=4$

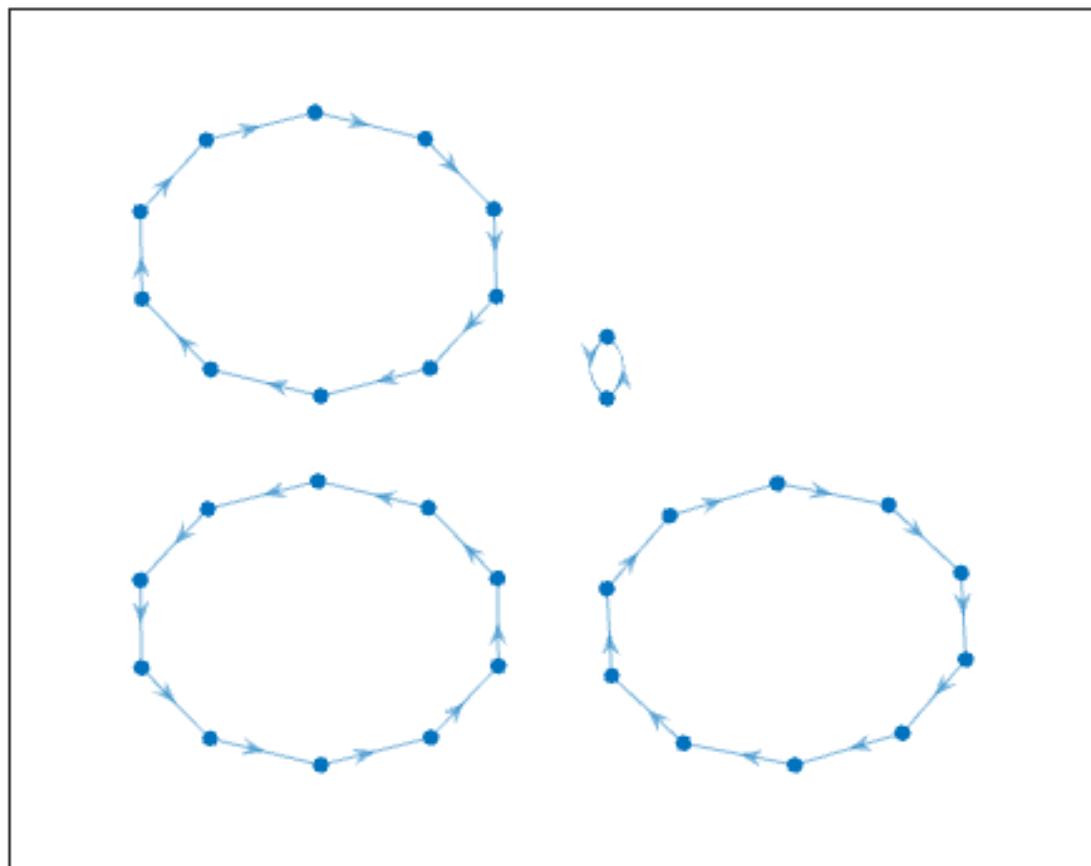


Figura 3.200: Atractor regla 15 n=5

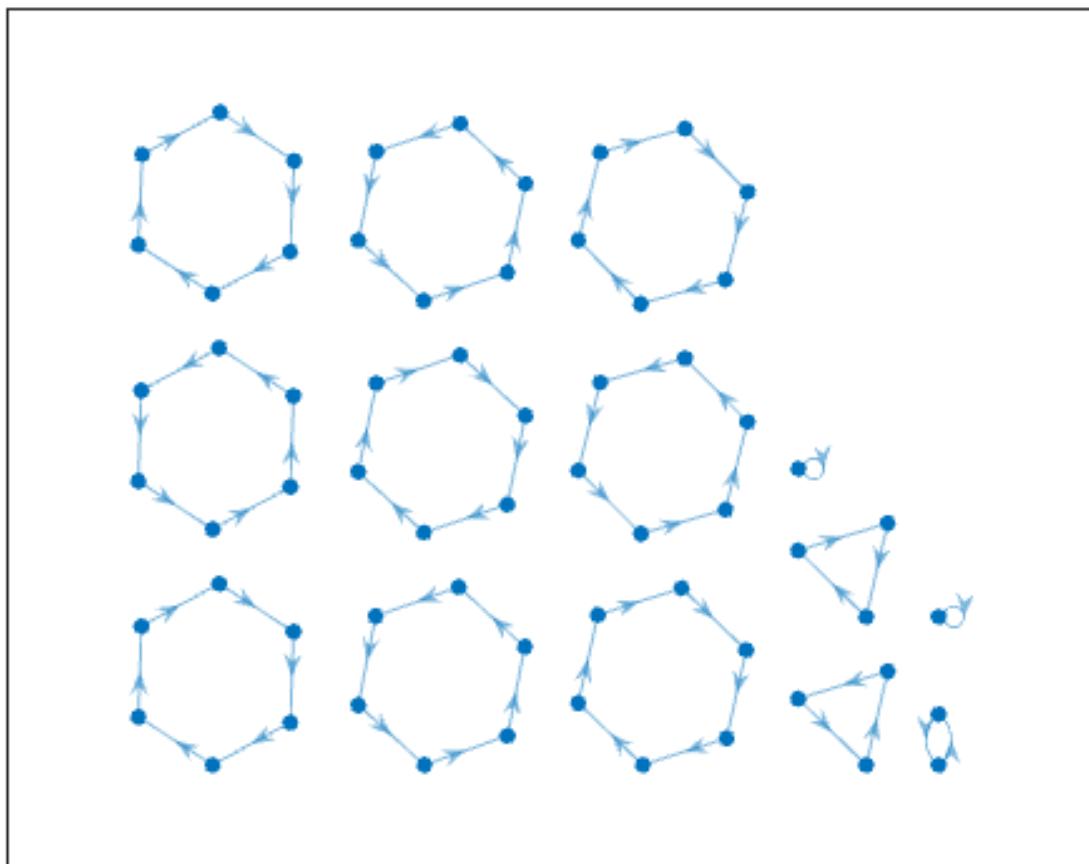


Figura 3.201: Atractor regla 15 n=6

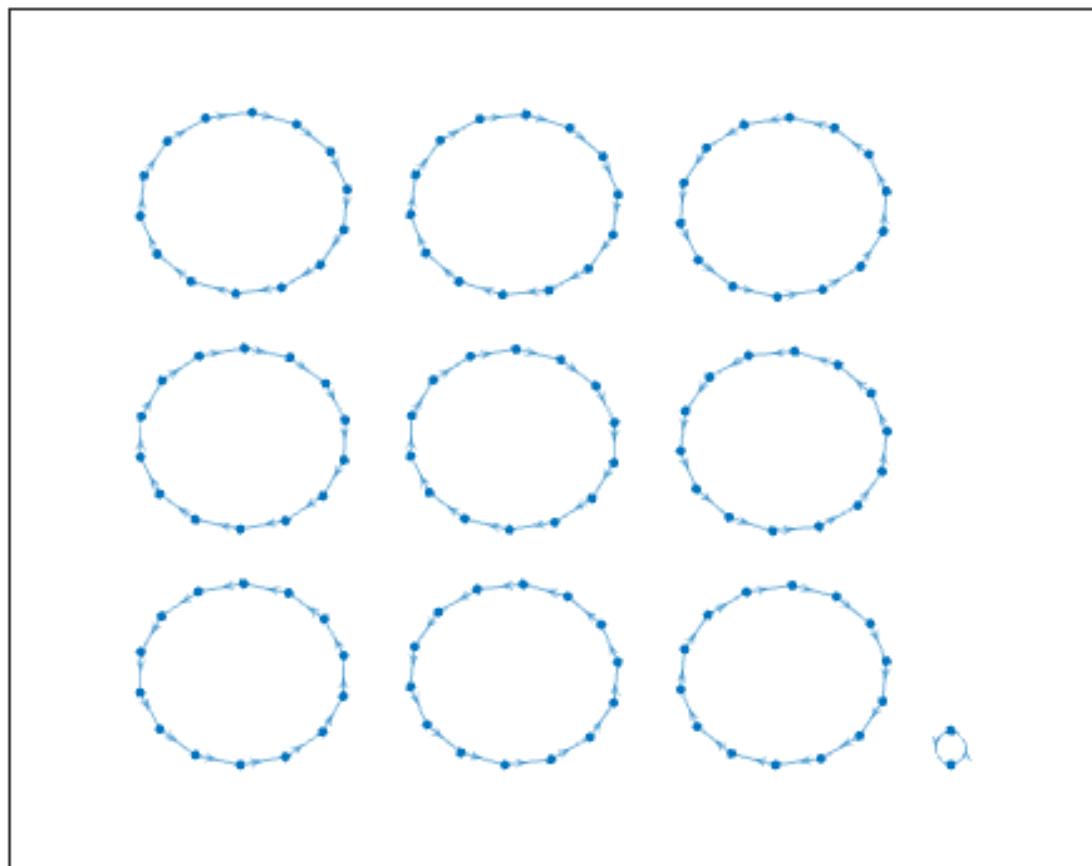


Figura 3.202: Atractor regla 15 n=7

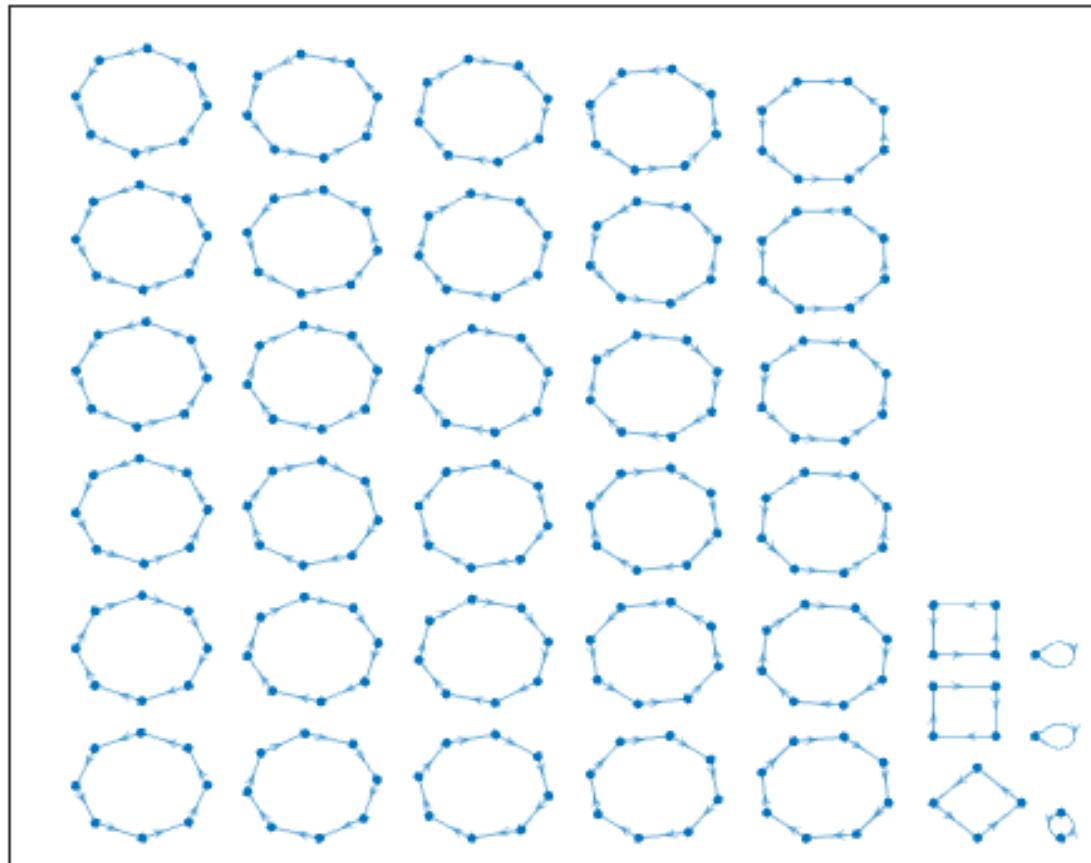


Figura 3.203: Atractor regla 15 n=8

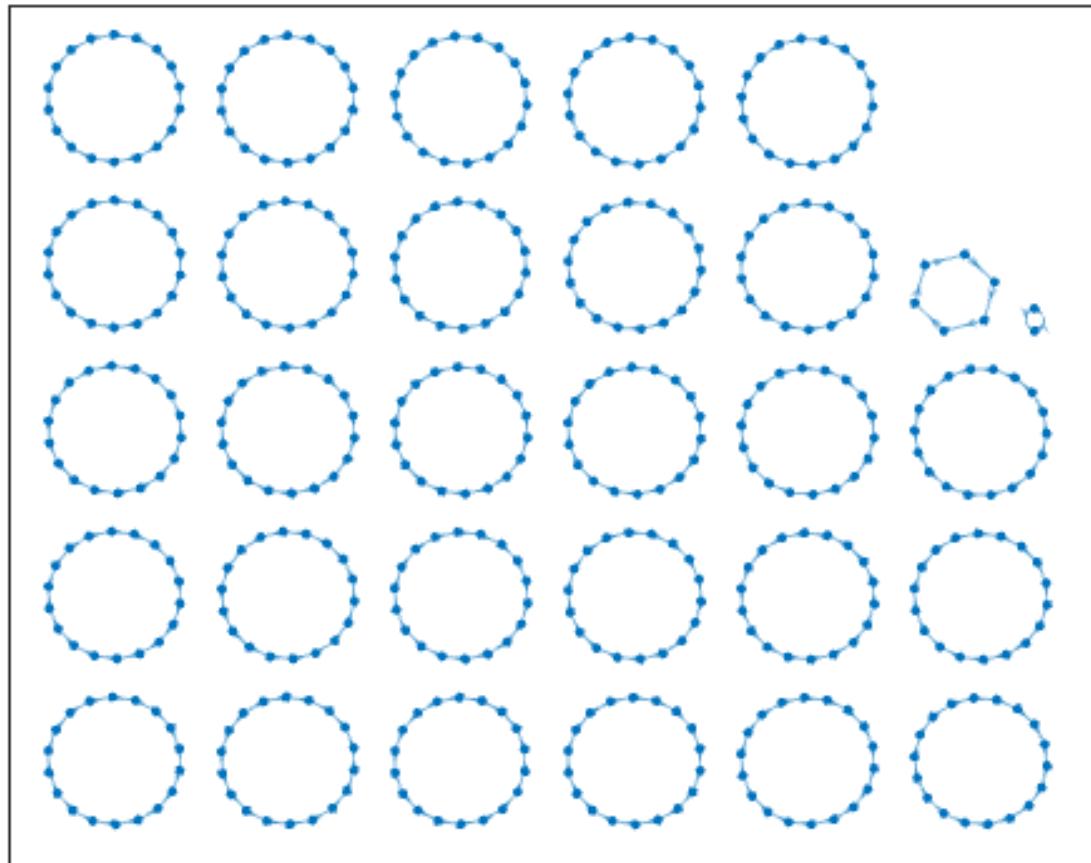


Figura 3.204: Atractor regla 15 n=9

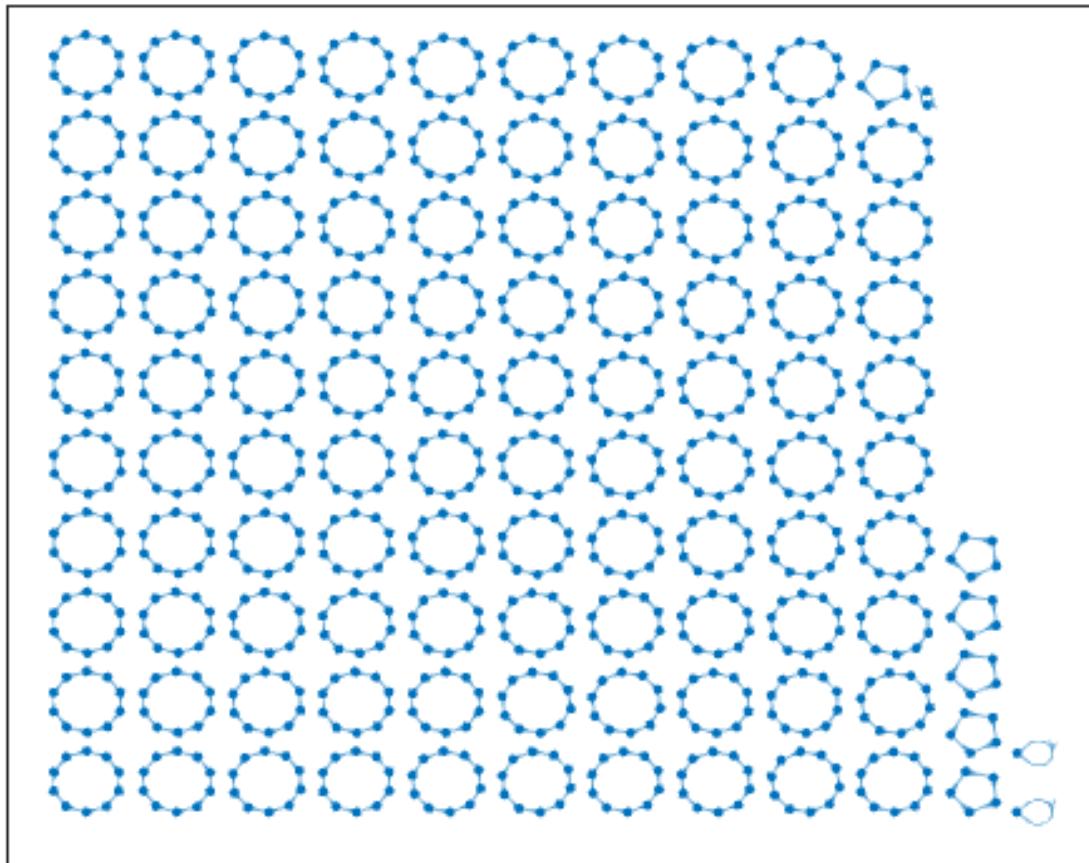


Figura 3.205: Atractor regla 15 n=10

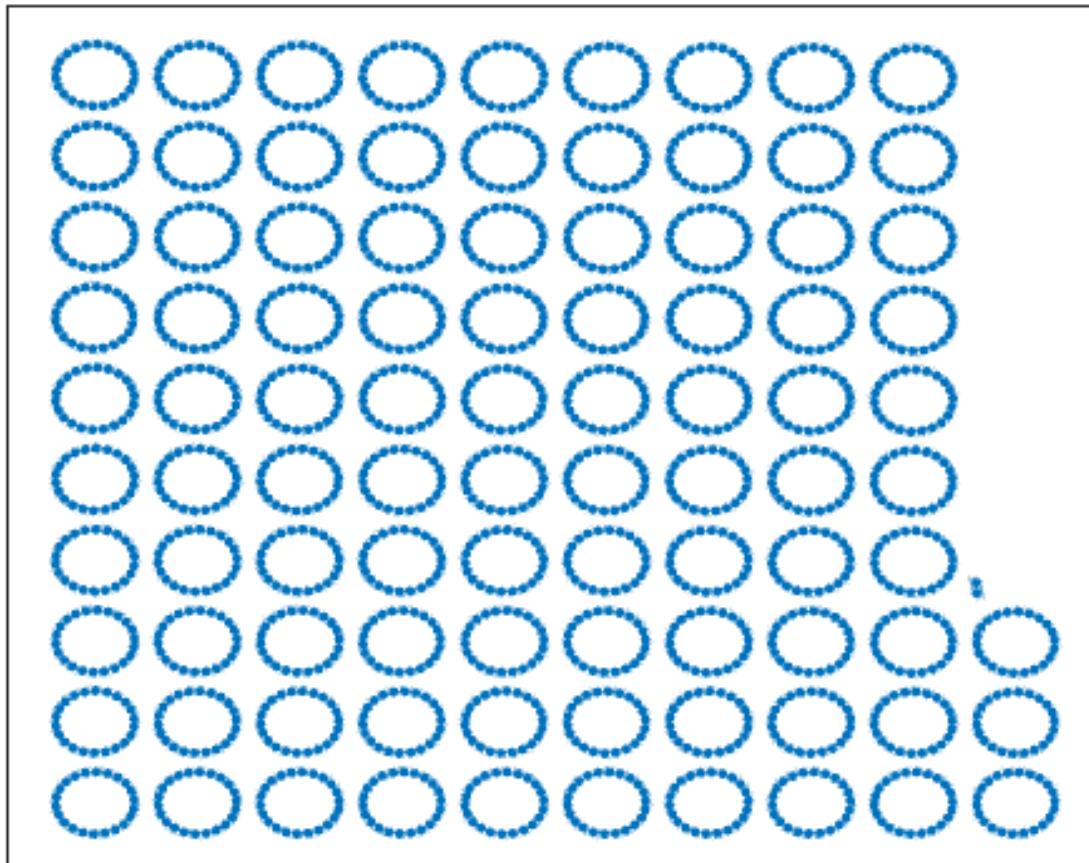


Figura 3.206: Atractor regla 15 n=11

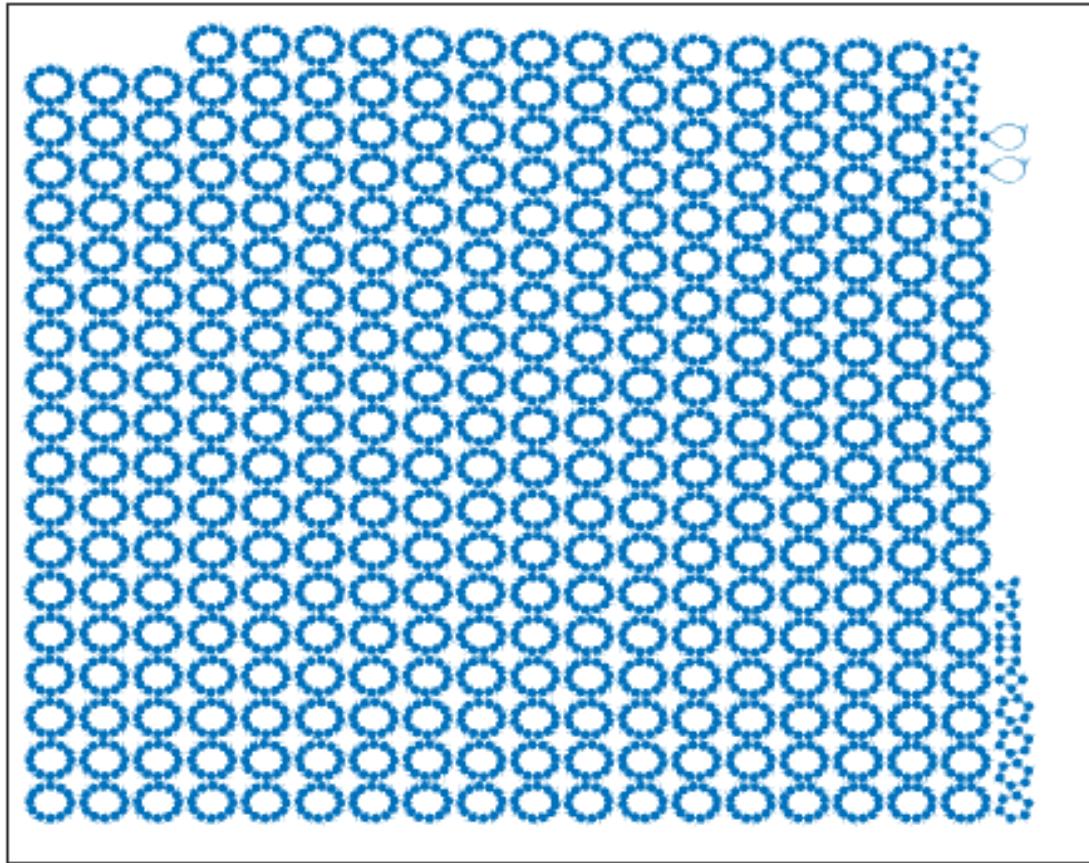


Figura 3.207: Atractor regla 15 n=12

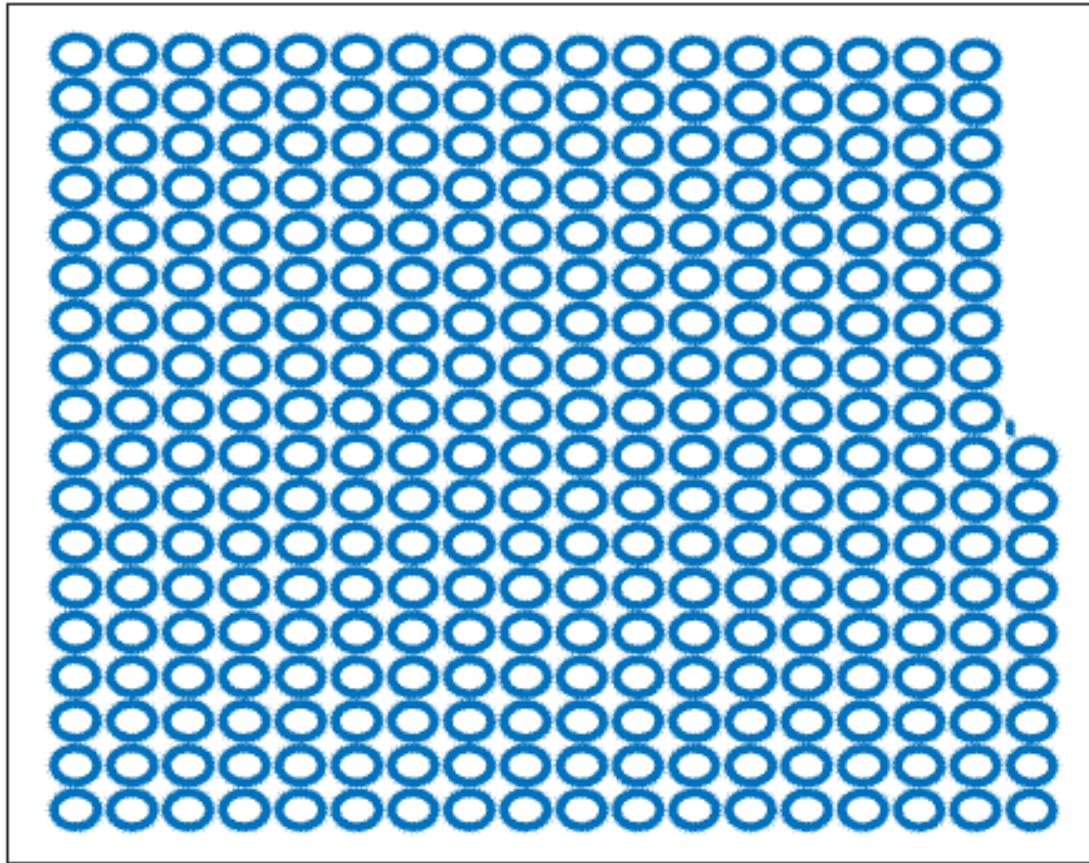


Figura 3.208: Atractor regla 15 n=13

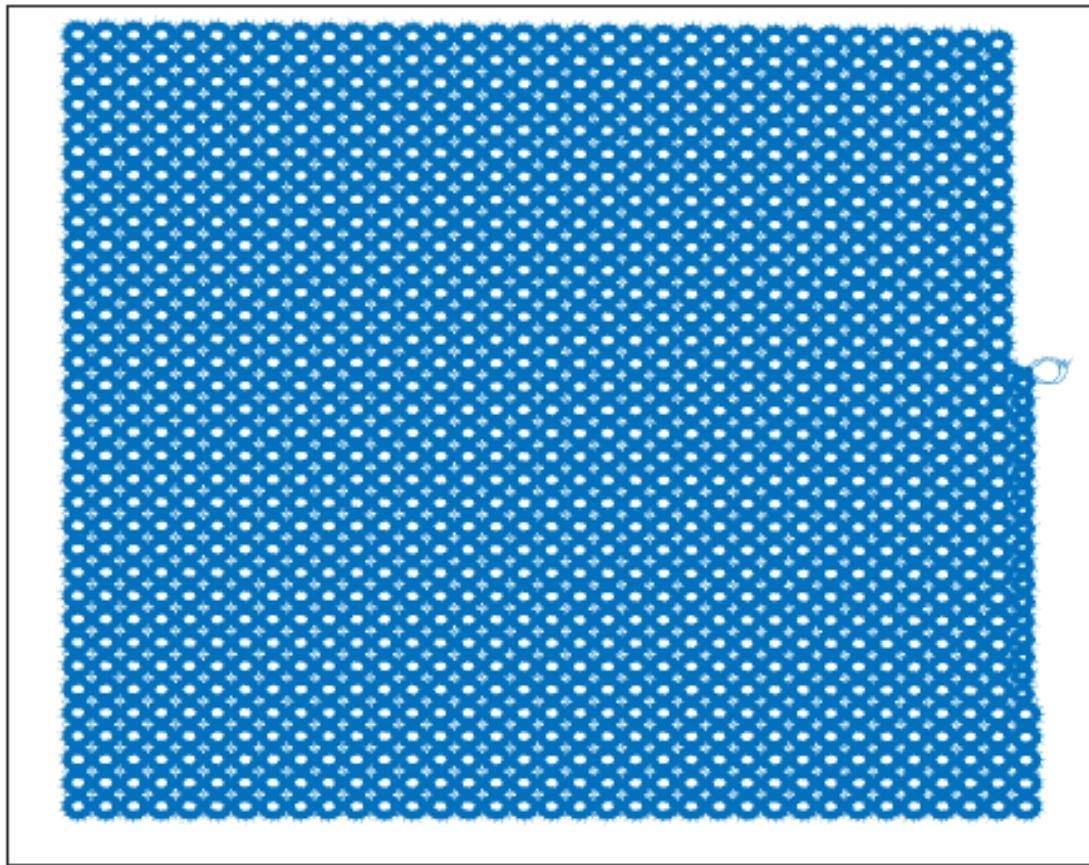


Figura 3.209: Atractor regla 15 n=14

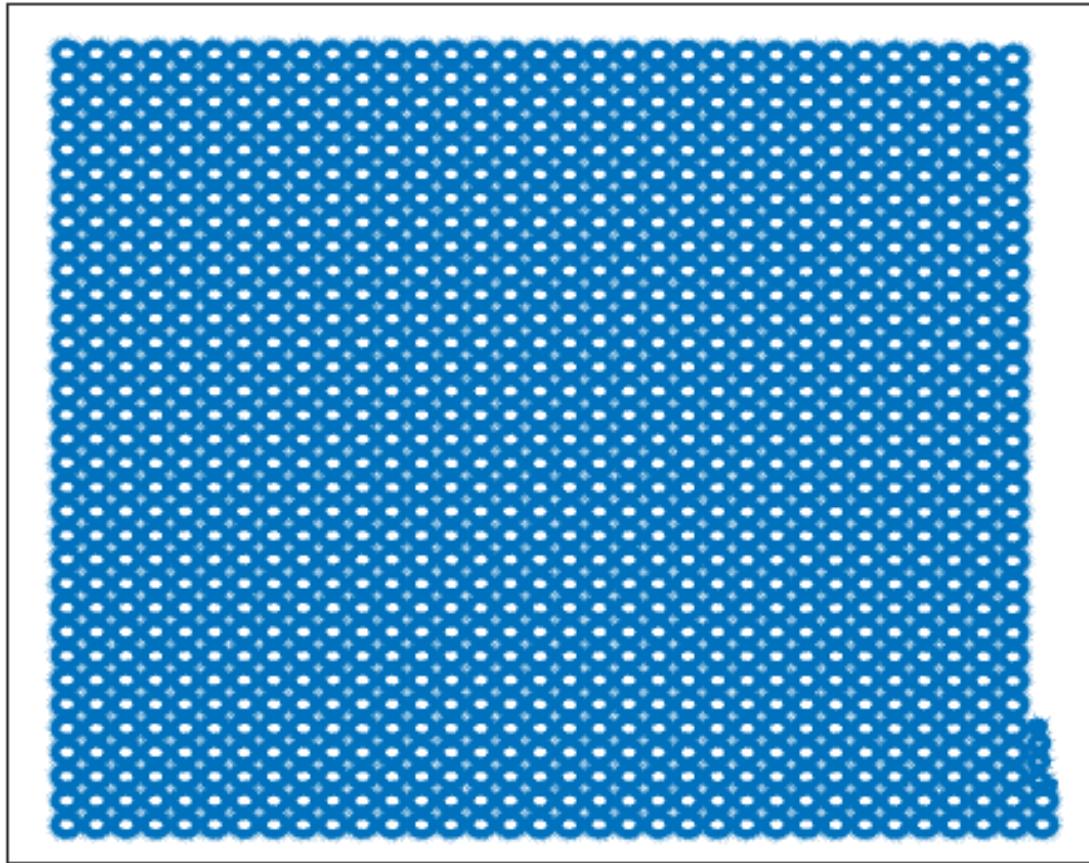


Figura 3.210: Atractor regla 15 $n=15$

3.17. Reglas 18,183

Respecto a la regla 18 se aprecia que mientras más grande es el tamaño de la cadena (n) pareciera que el atractor va a tomar una forma como de un árbol pero al continuar incrementando la n hasta llegar a 15 se aprecia que los atractores se separaron para formar algo como una «colonia» de atractores pequeños y un atractor gigante que no se le ve forma.

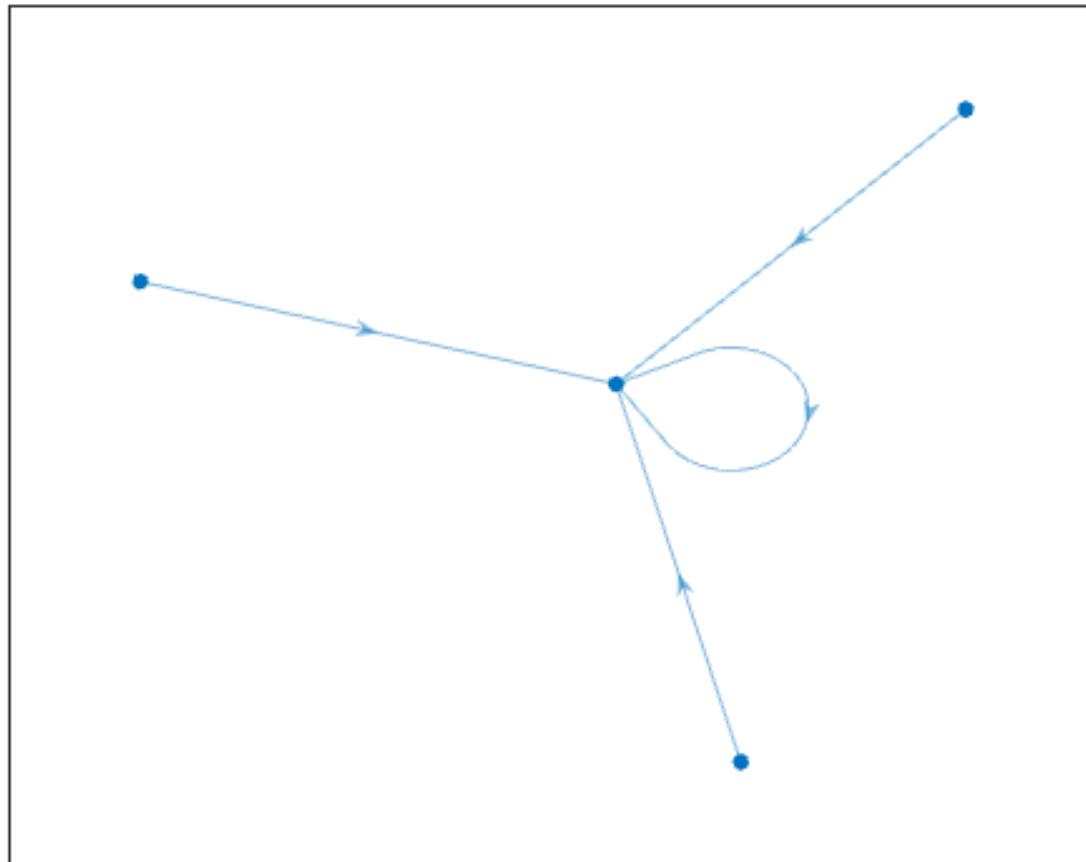


Figura 3.211: Atractor regla 18 $n=2$

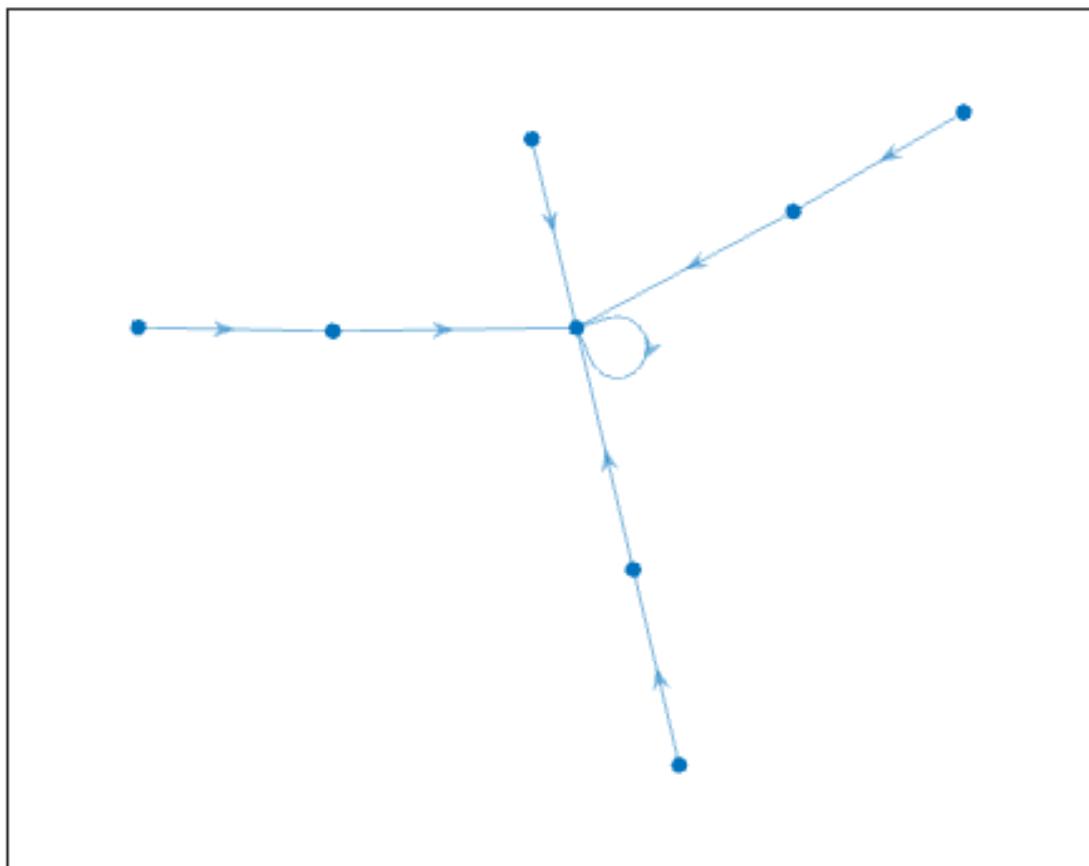


Figura 3.212: Atractor regla 18 n=3

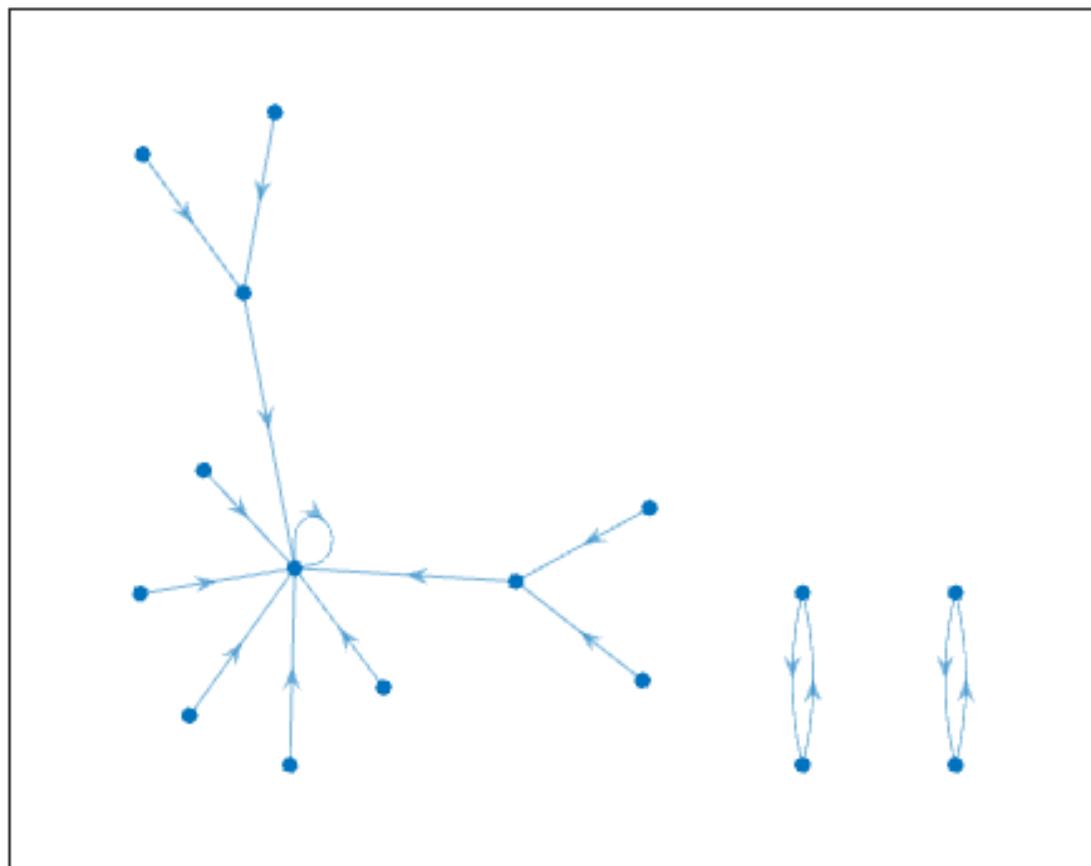


Figura 3.213: Atractor regla 18 n=4

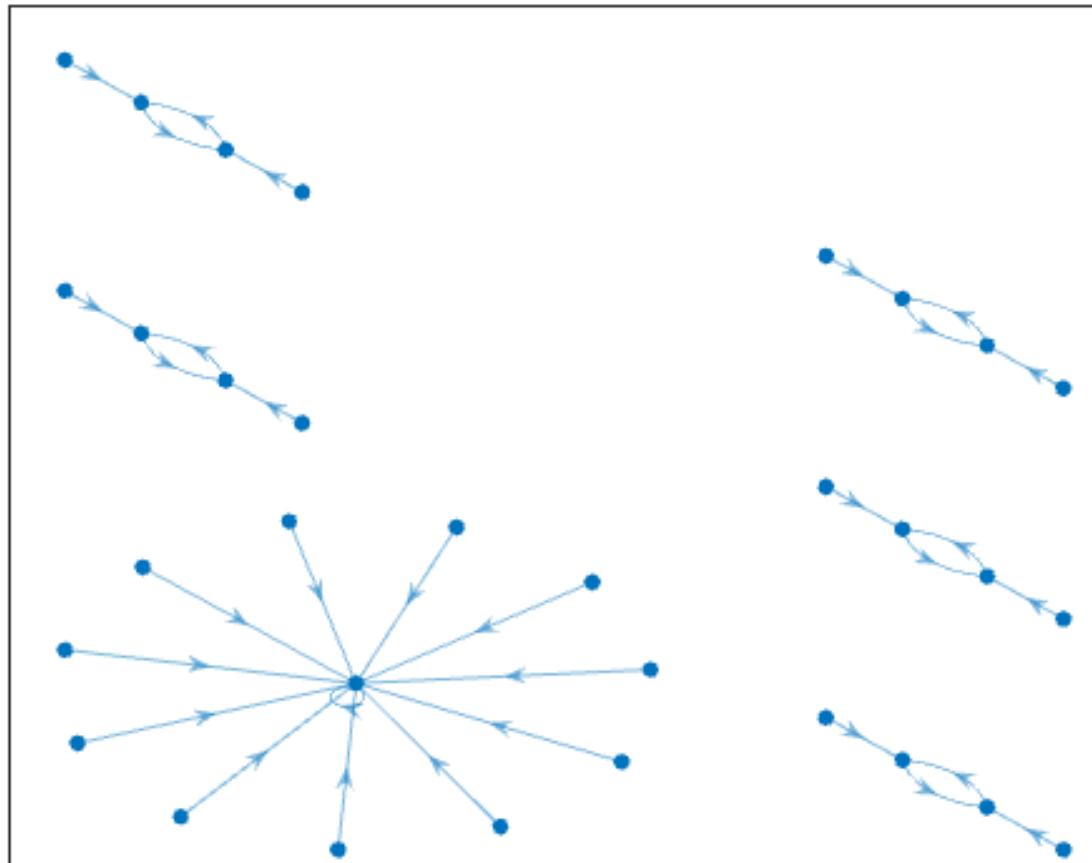


Figura 3.214: Atractor regla 18 n=5

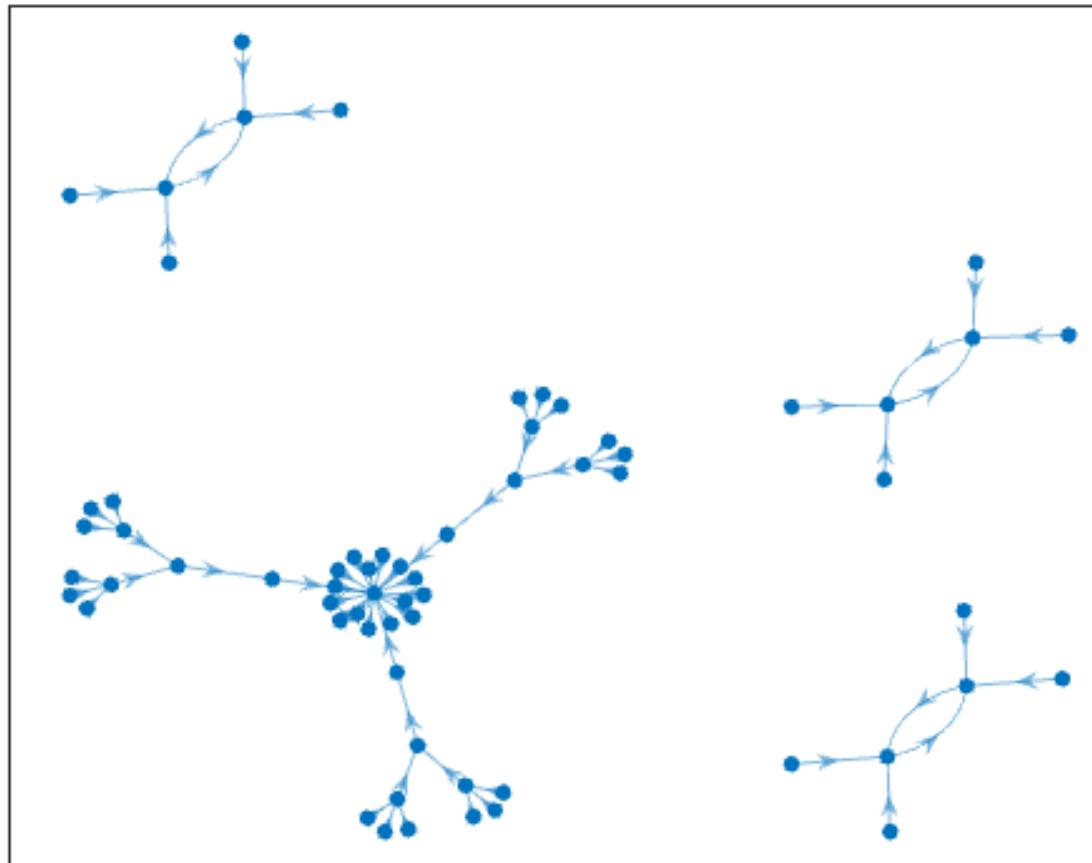


Figura 3.215: Atractor regla 18 n=6

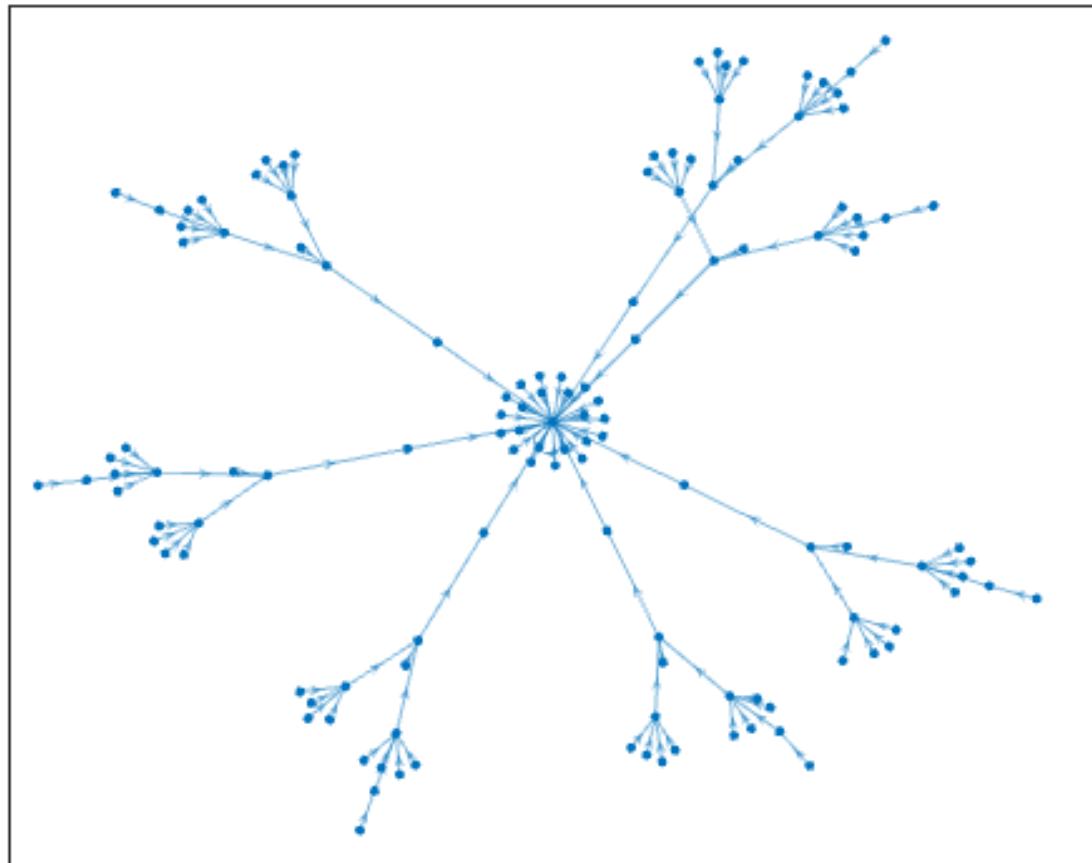
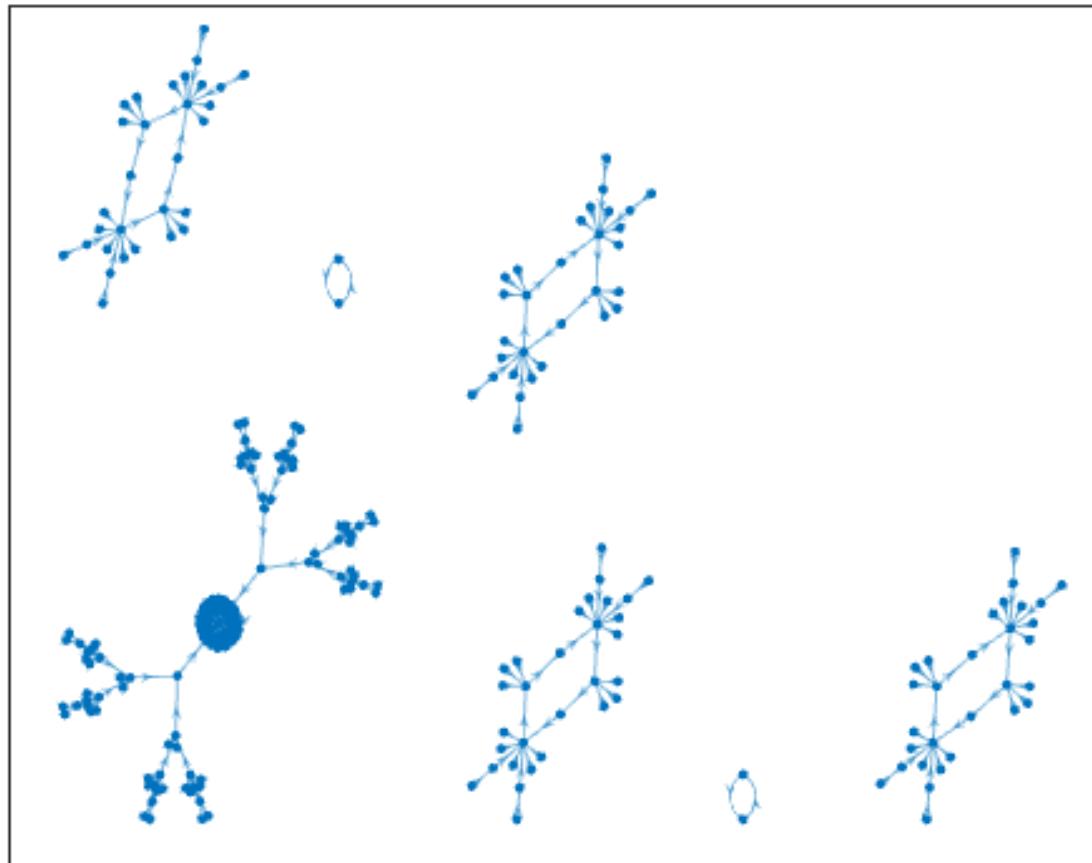


Figura 3.216: Atractor regla 18 n=7

Figura 3.217: Atractor regla 18 $n=8$

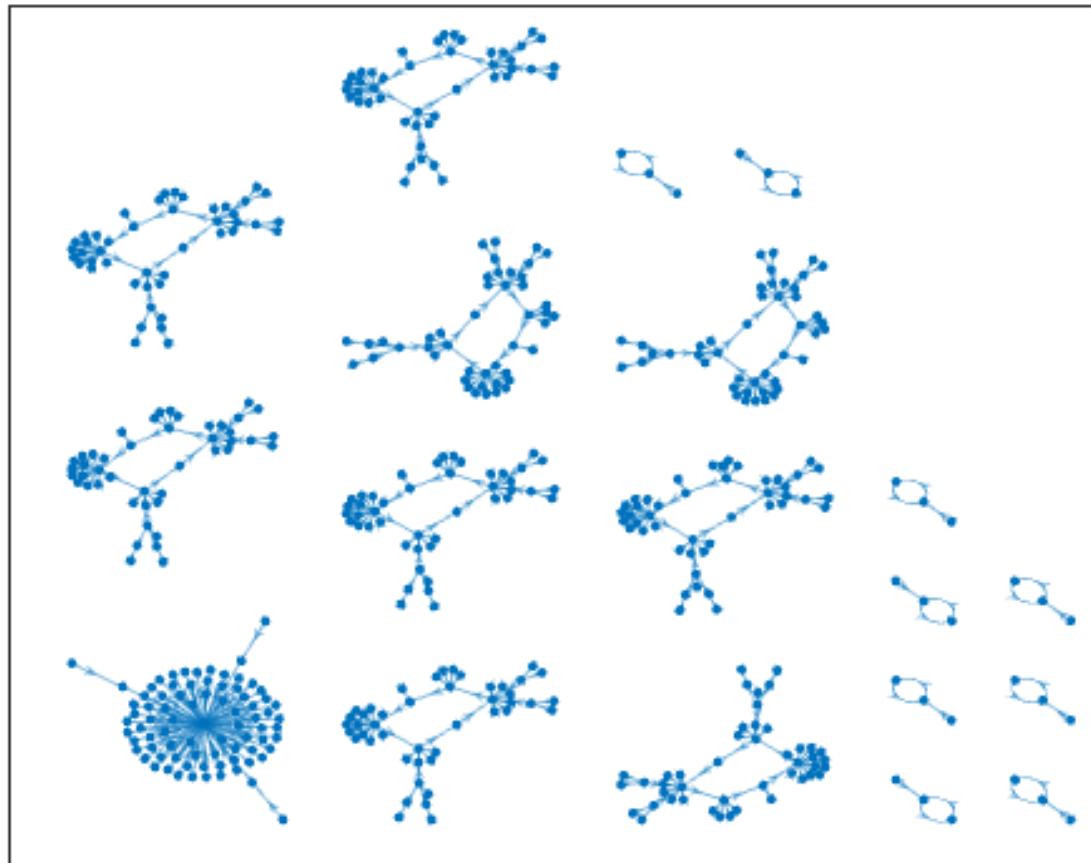


Figura 3.218: Atractor regla 18 n=9

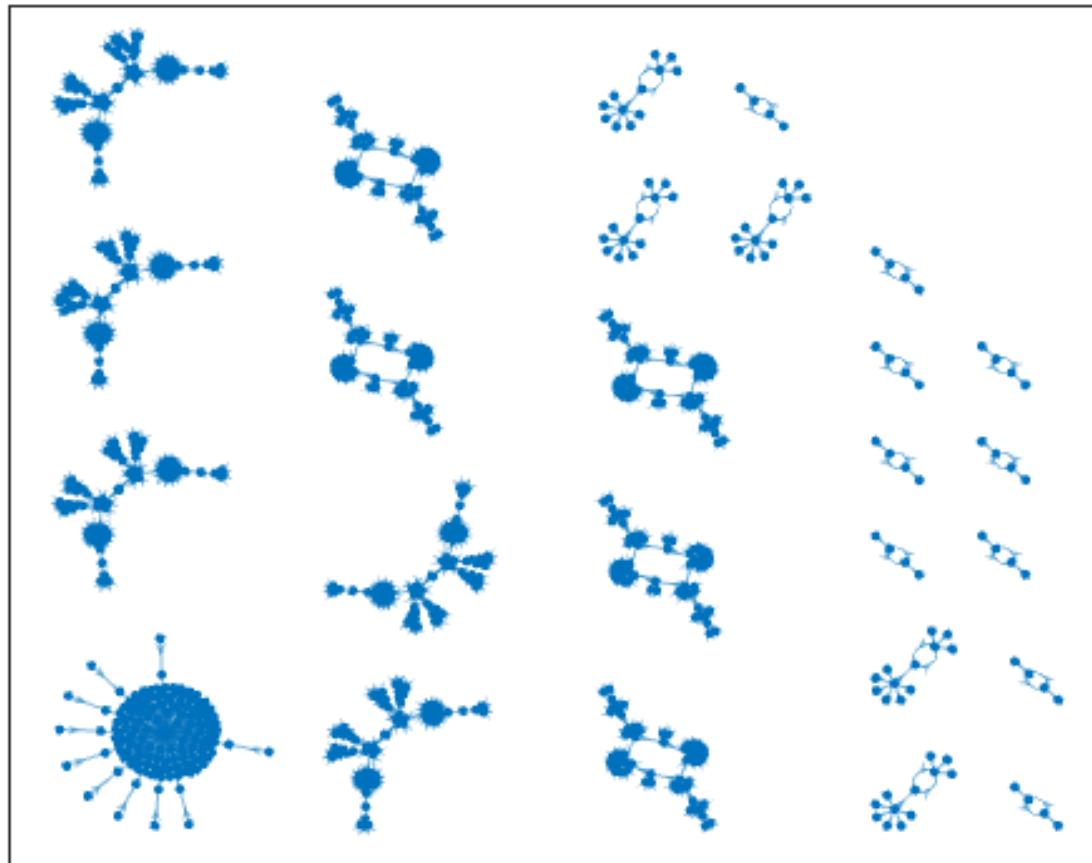


Figura 3.219: Atractor regla 18 n=10

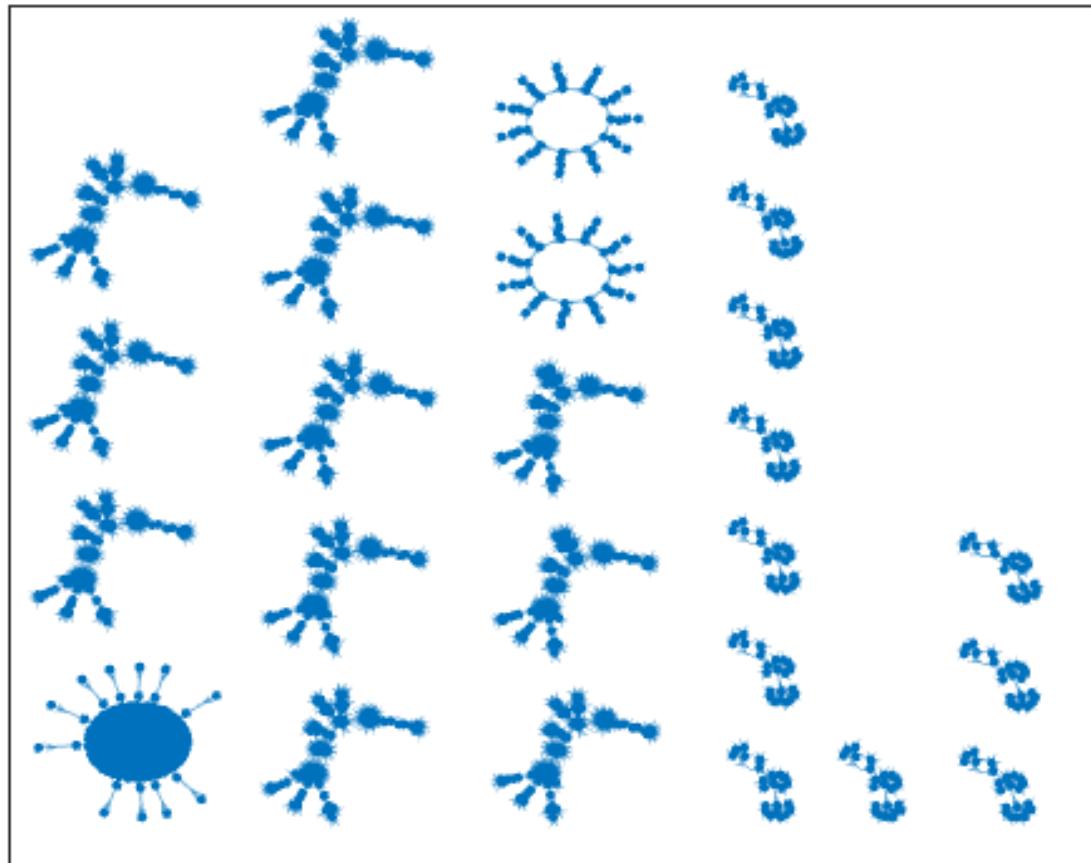


Figura 3.220: Atractor regla 18 n=11

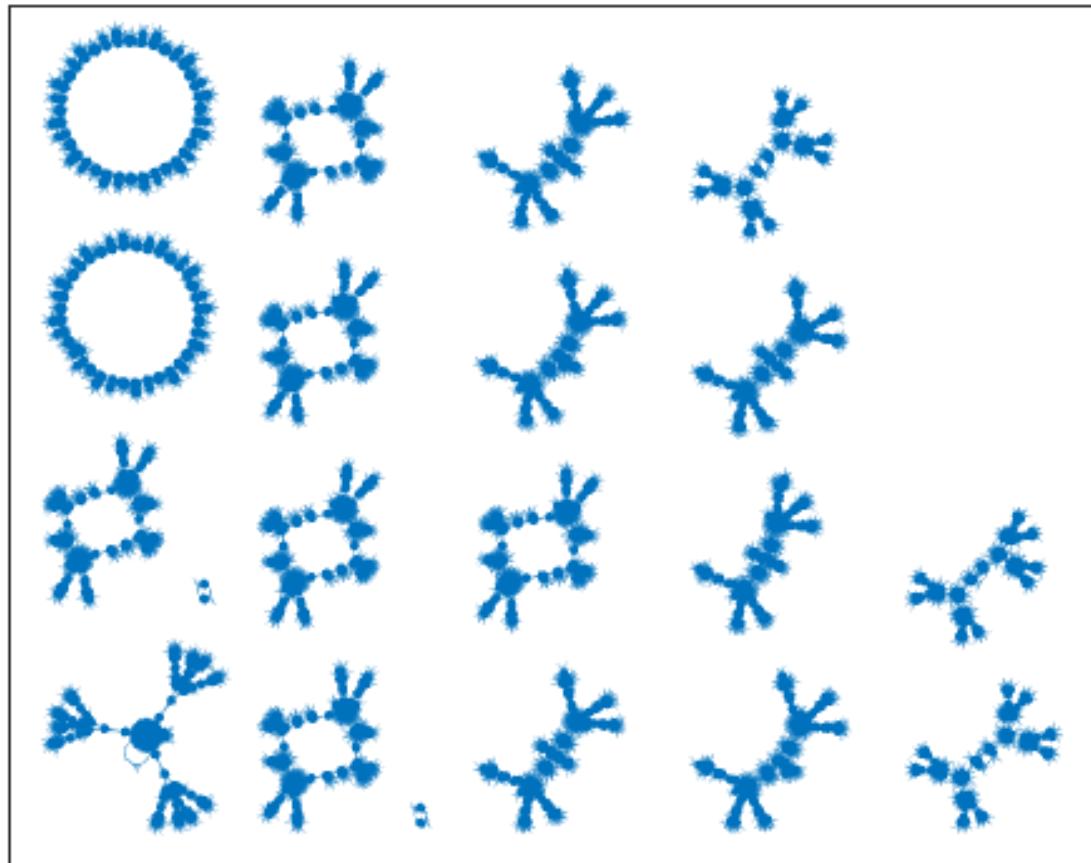
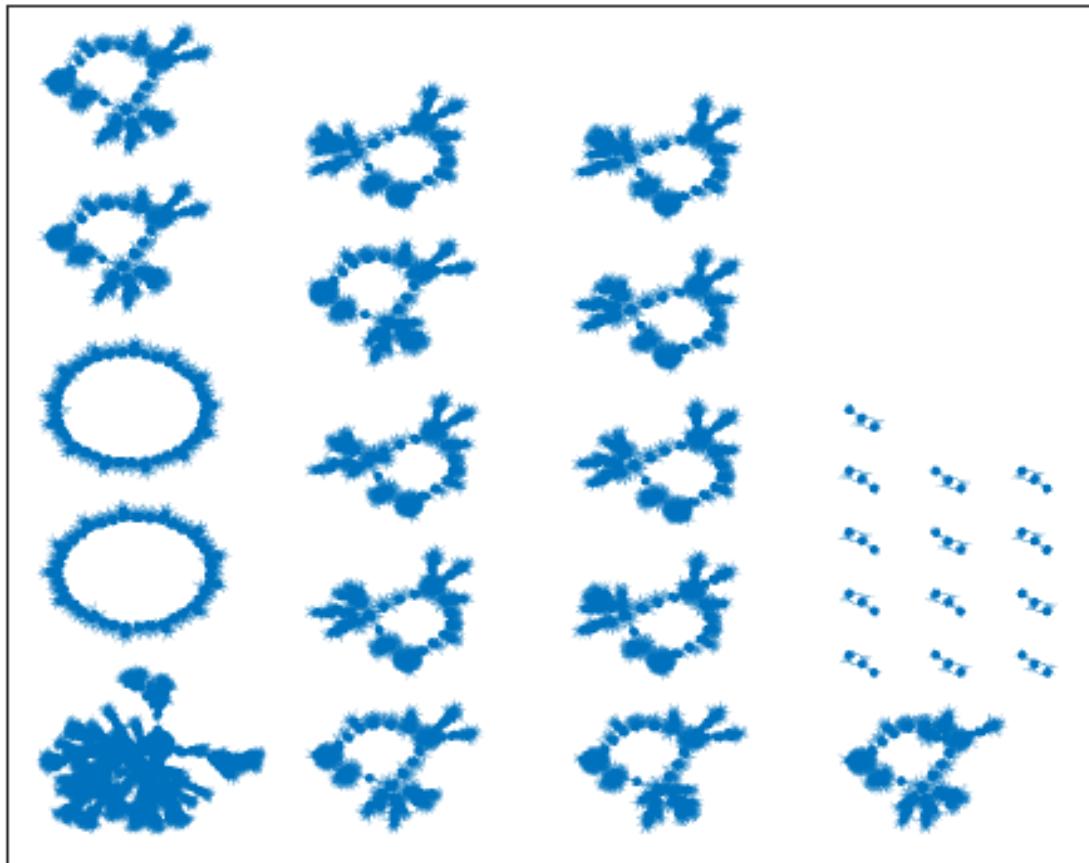
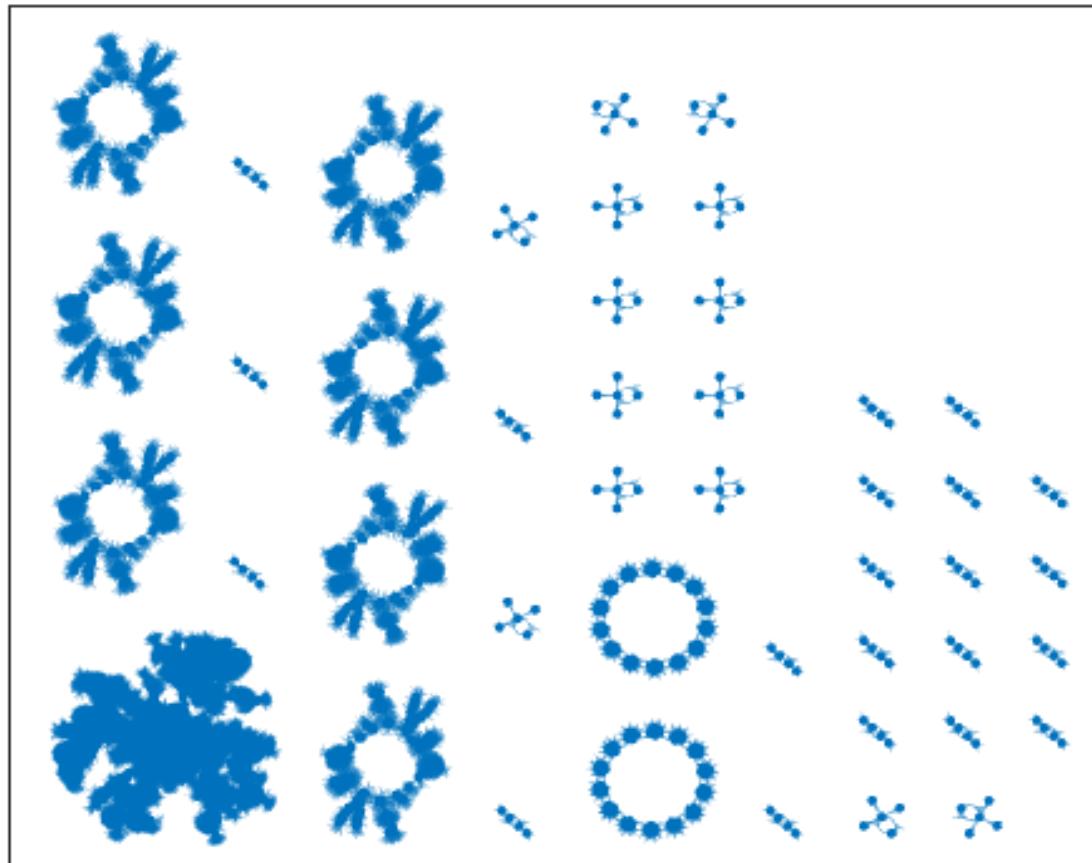


Figura 3.221: Atractor regla 18 n=12

Figura 3.222: Atractor regla 18 $n=13$

Figura 3.223: Atractor regla 18 $n=14$

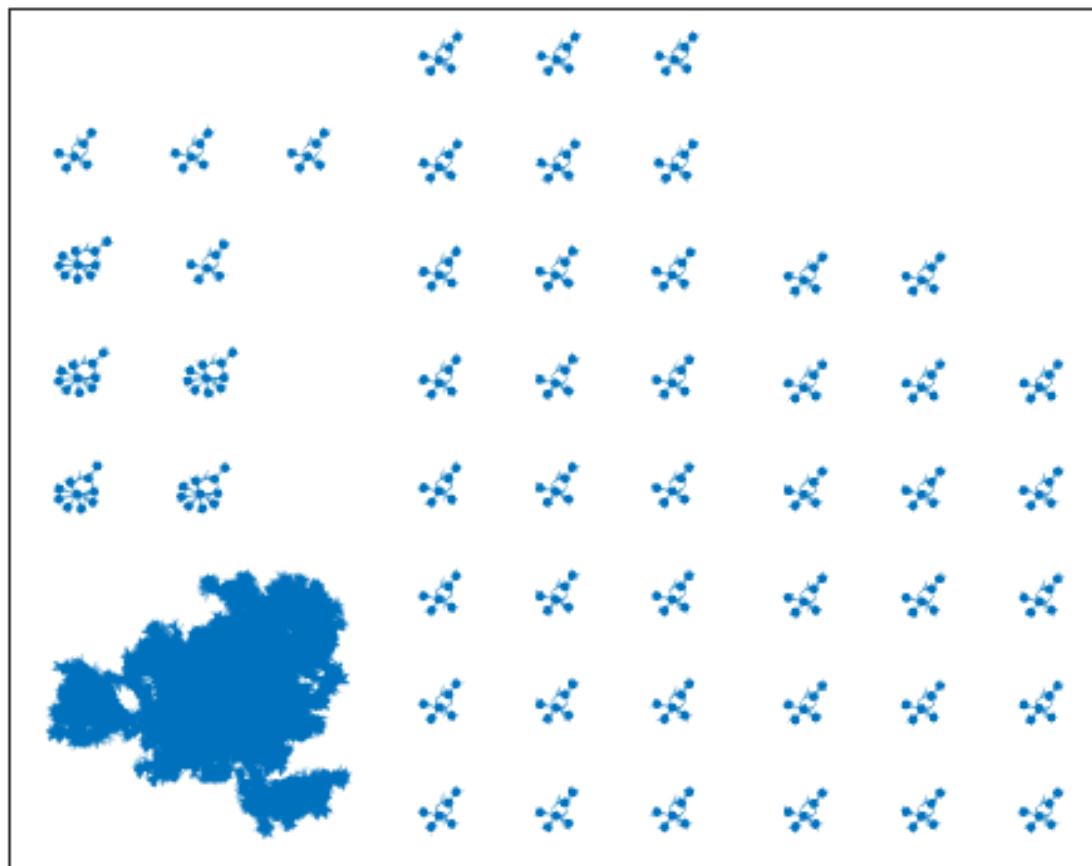


Figura 3.224: Atractor regla 18 n=15

3.18. Reglas 19,55

Respecto a la regla 19 se aprecia que mientras más grande es el tamaño de la cadena (n) aparecen atractores que por sí solos evolucionan en cada incremento de n para así convertirse en atractores más complejos sin necesidad que mezclarse con otros.

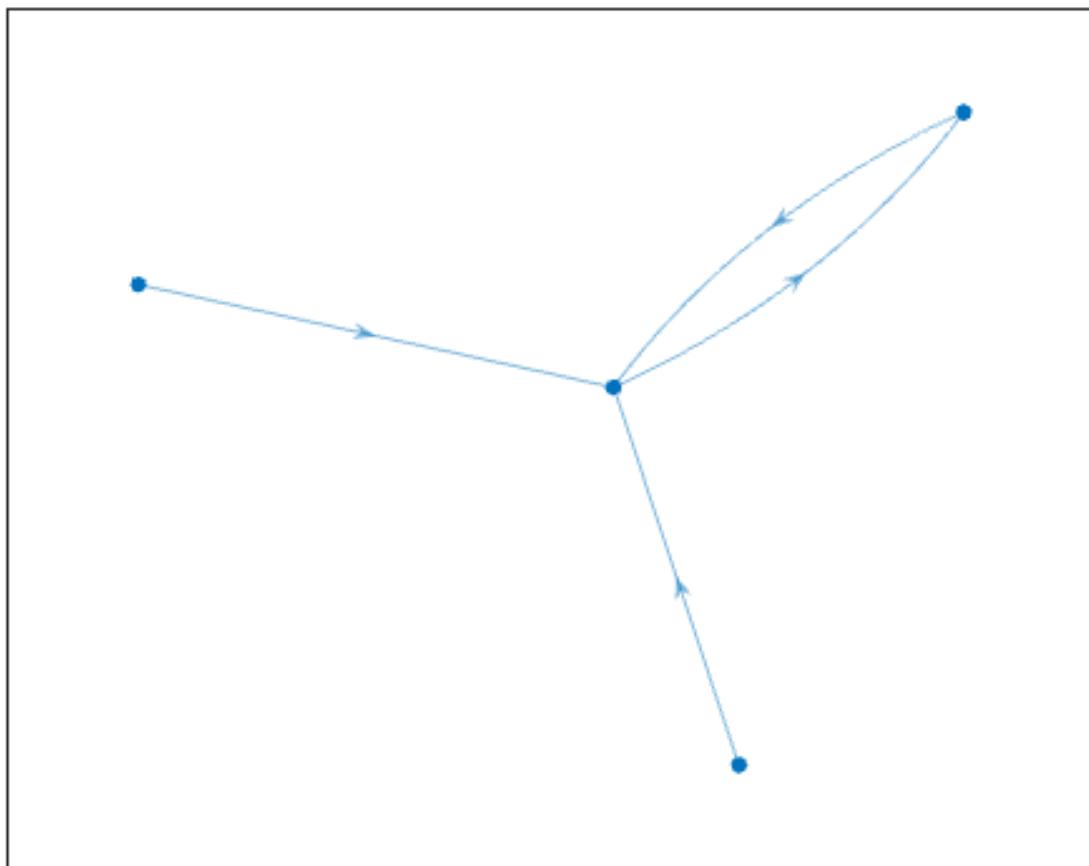
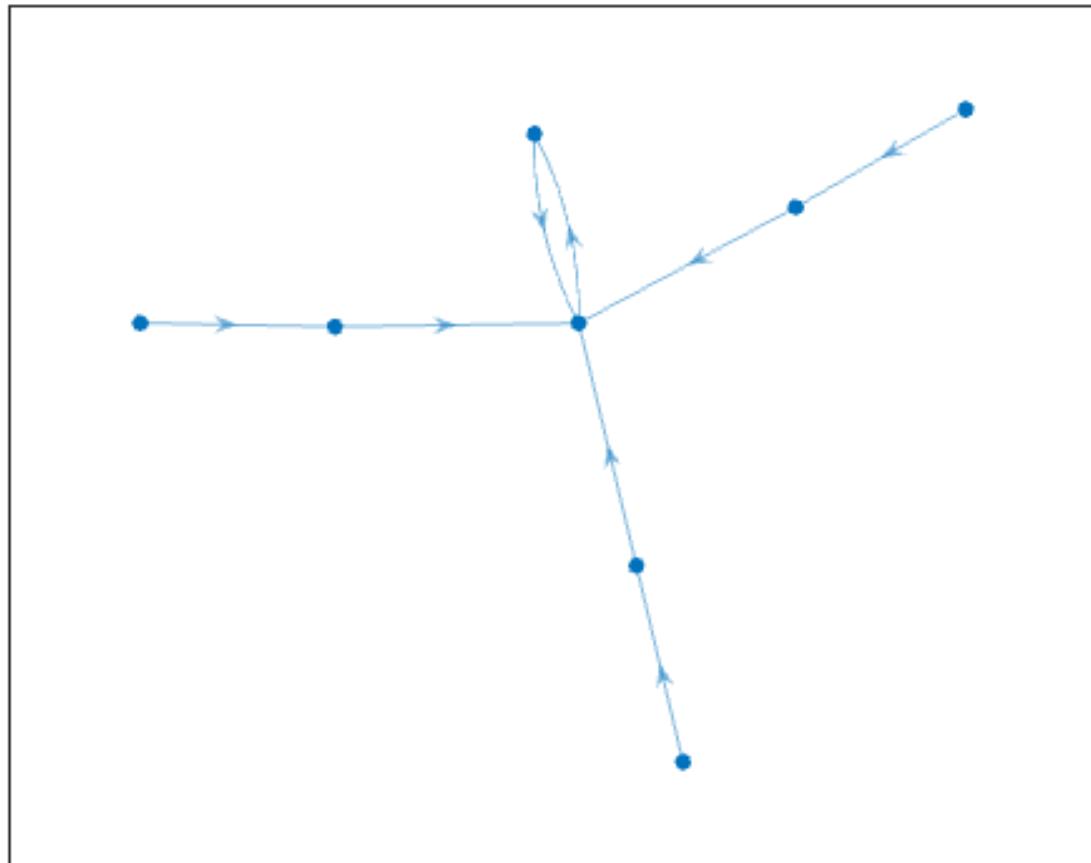


Figura 3.225: Atractor regla 19 $n=2$

Figura 3.226: Atractor regla 19 $n=3$

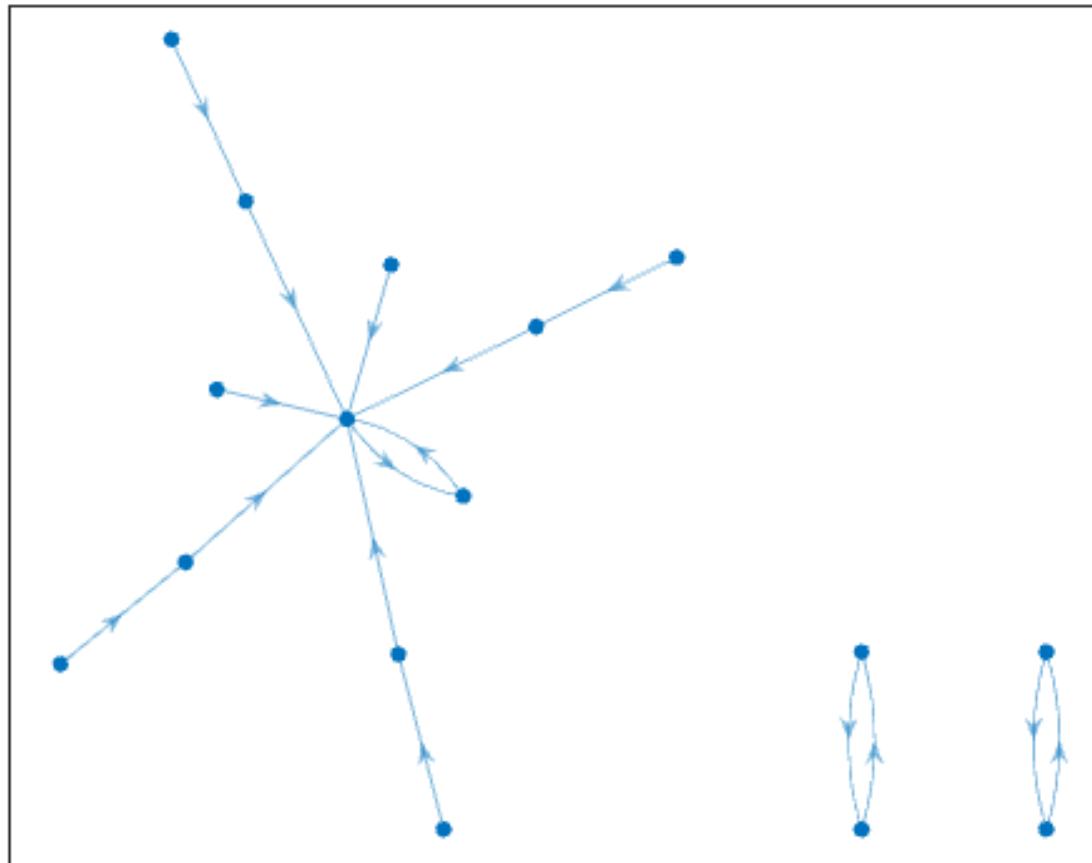


Figura 3.227: Atractor regla 19 n=4

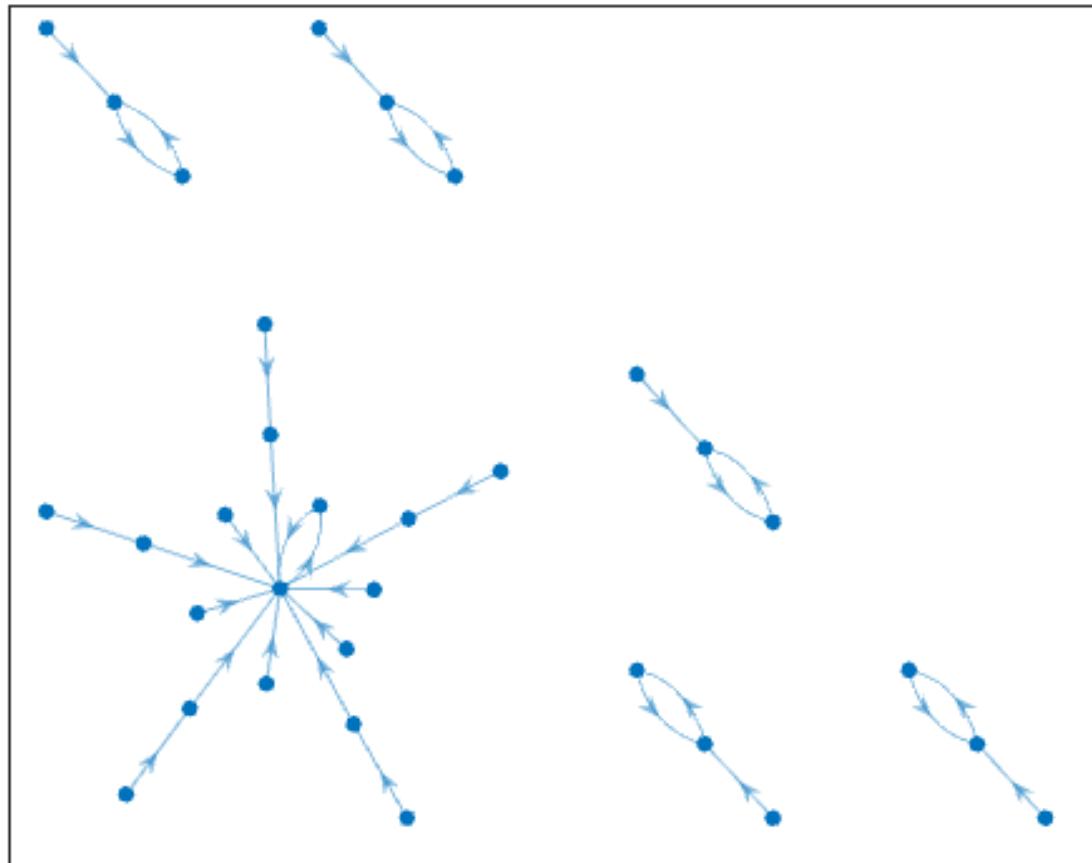
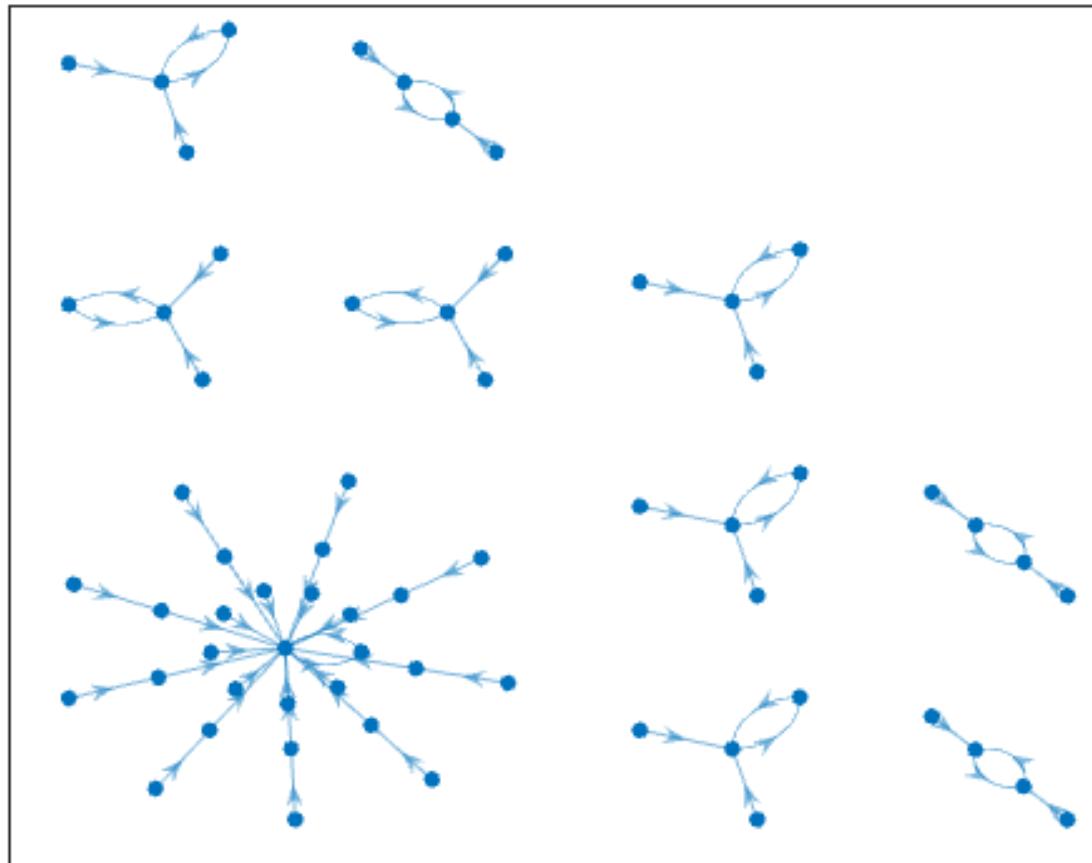


Figura 3.228: Atractor regla 19 n=5

Figura 3.229: Atractor regla 19 $n=6$

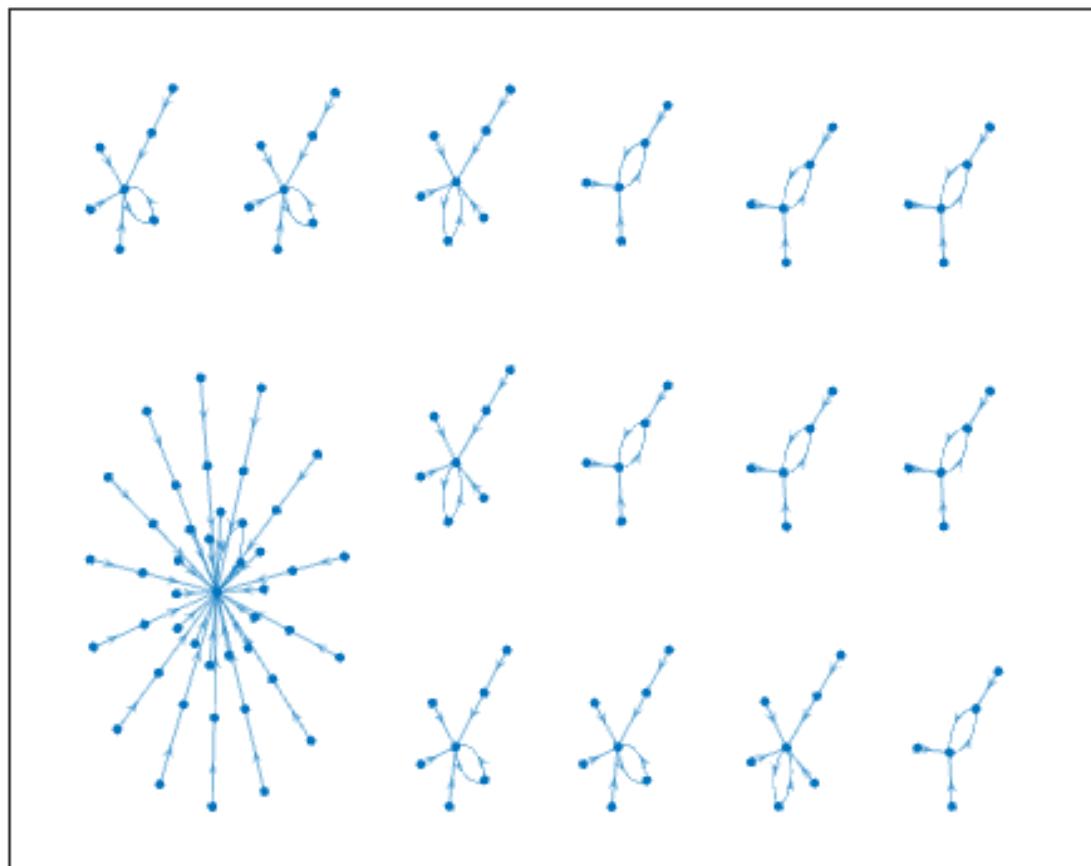


Figura 3.230: Atractor regla 19 n=7

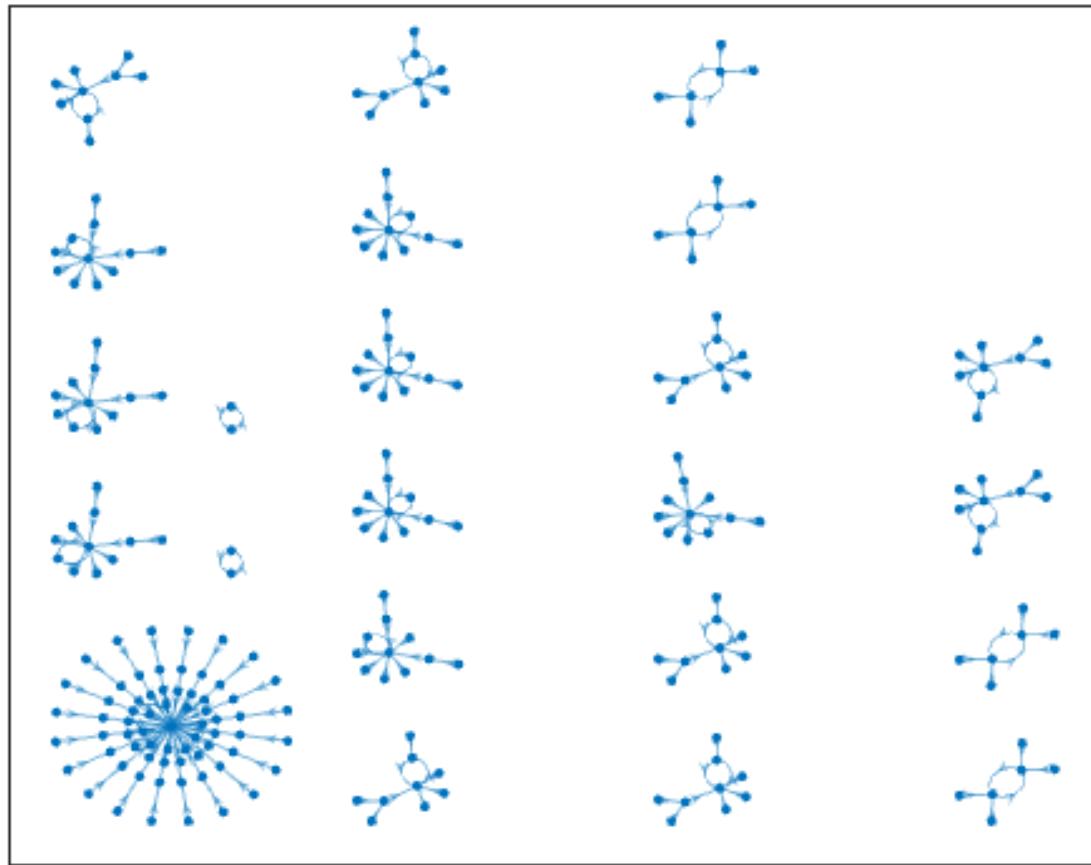


Figura 3.231: Atractor regla 19 n=8

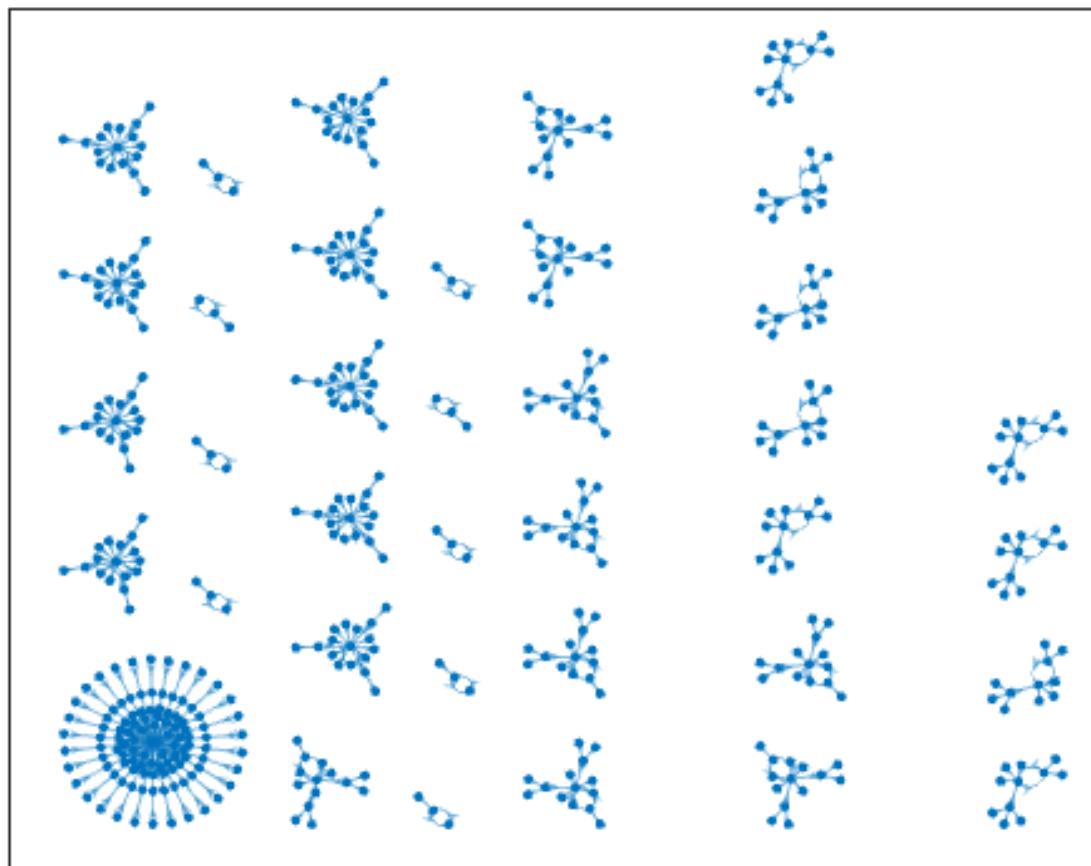


Figura 3.232: Atractor regla 19 n=9

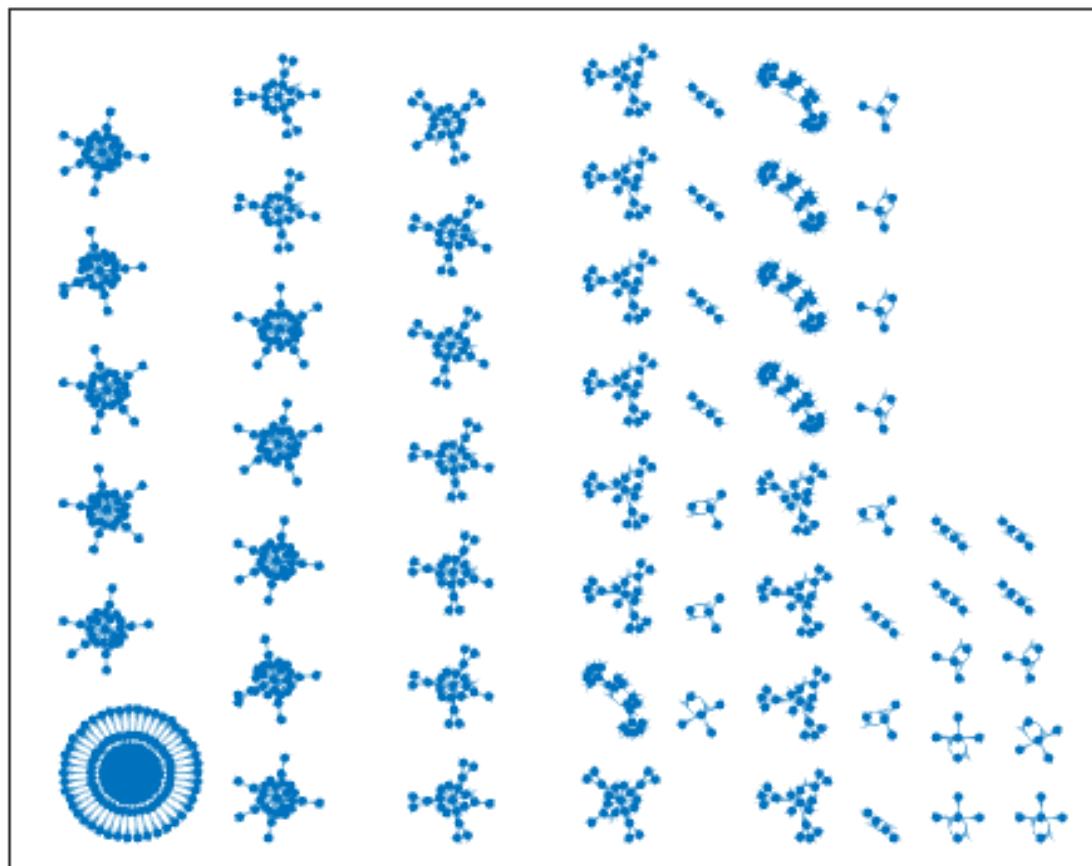
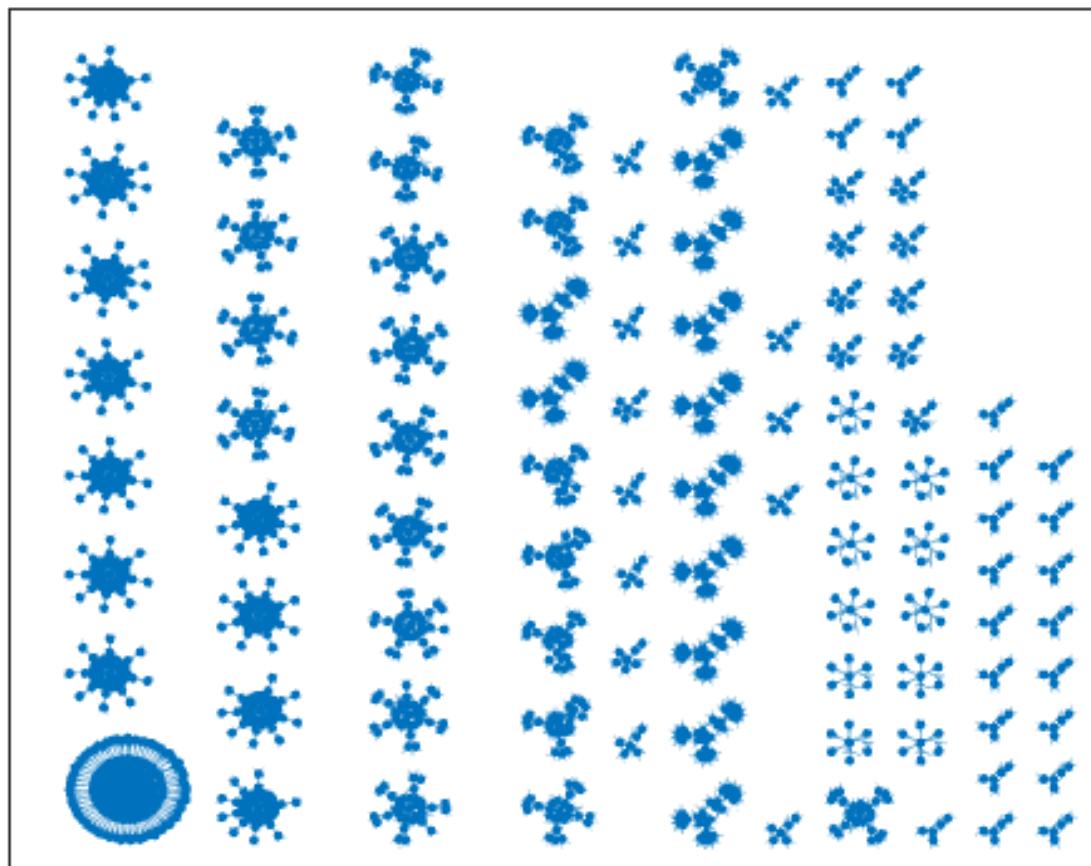


Figura 3.233: Atractor regla 19 n=10

Figura 3.234: Atractor regla 19 $n=11$

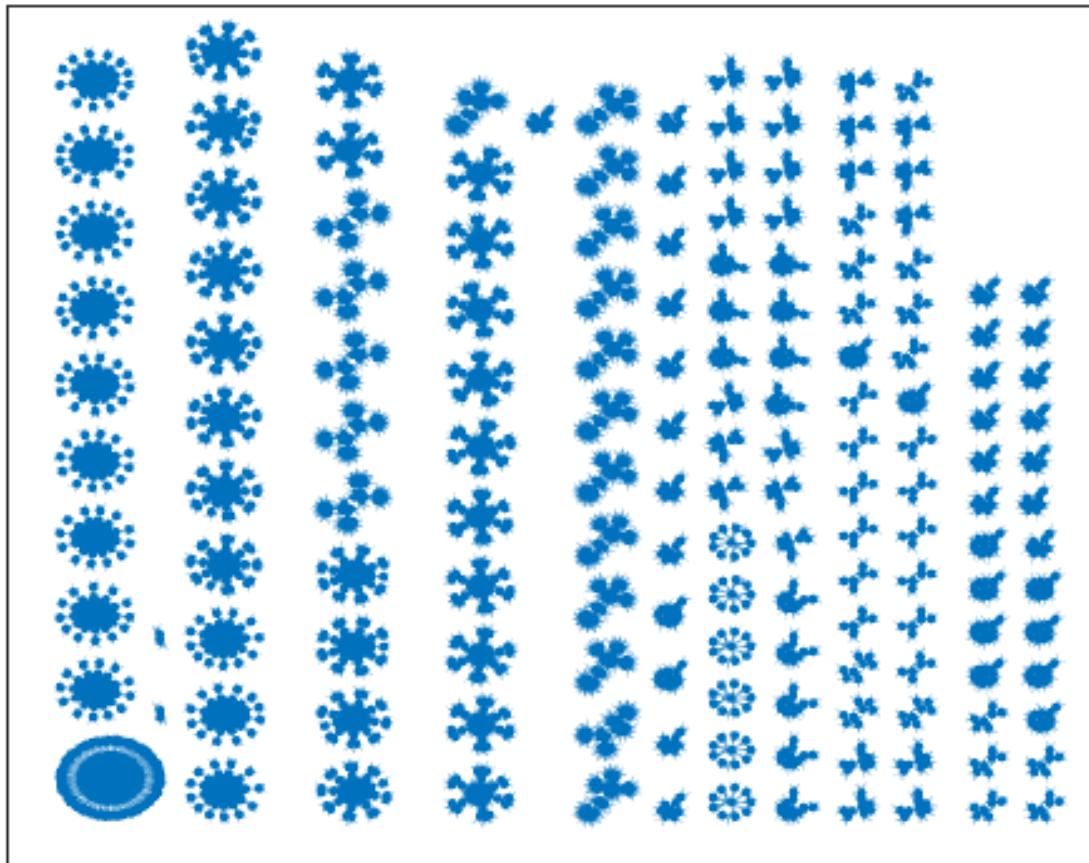
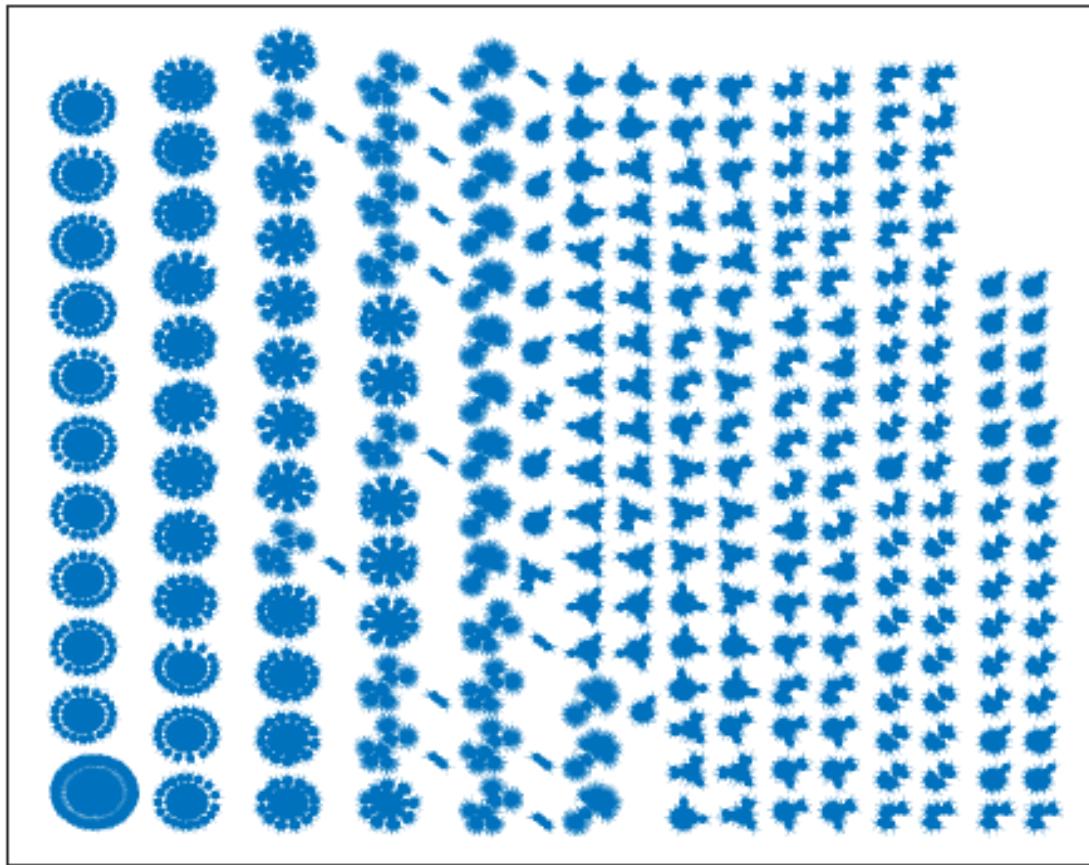
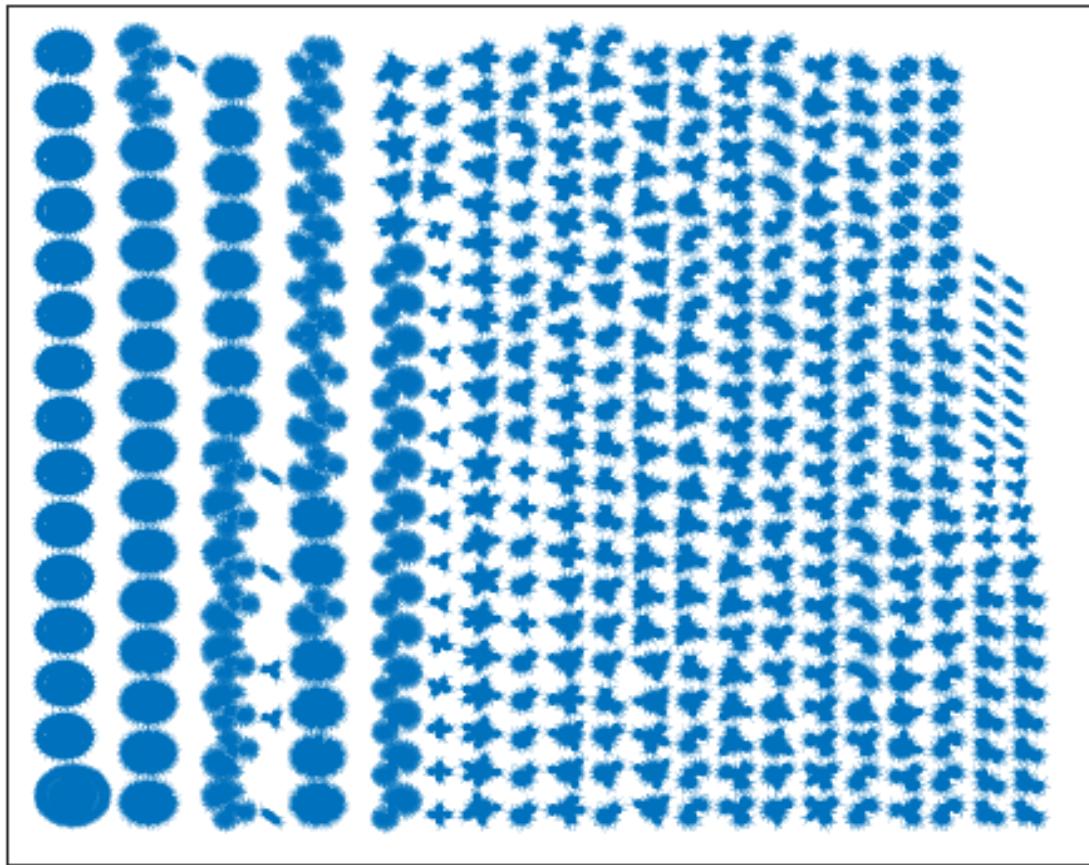


Figura 3.235: Atractor regla 19 n=12

Figura 3.236: Atractor regla 19 $n=13$

Figura 3.237: Atractor regla 19 $n=14$

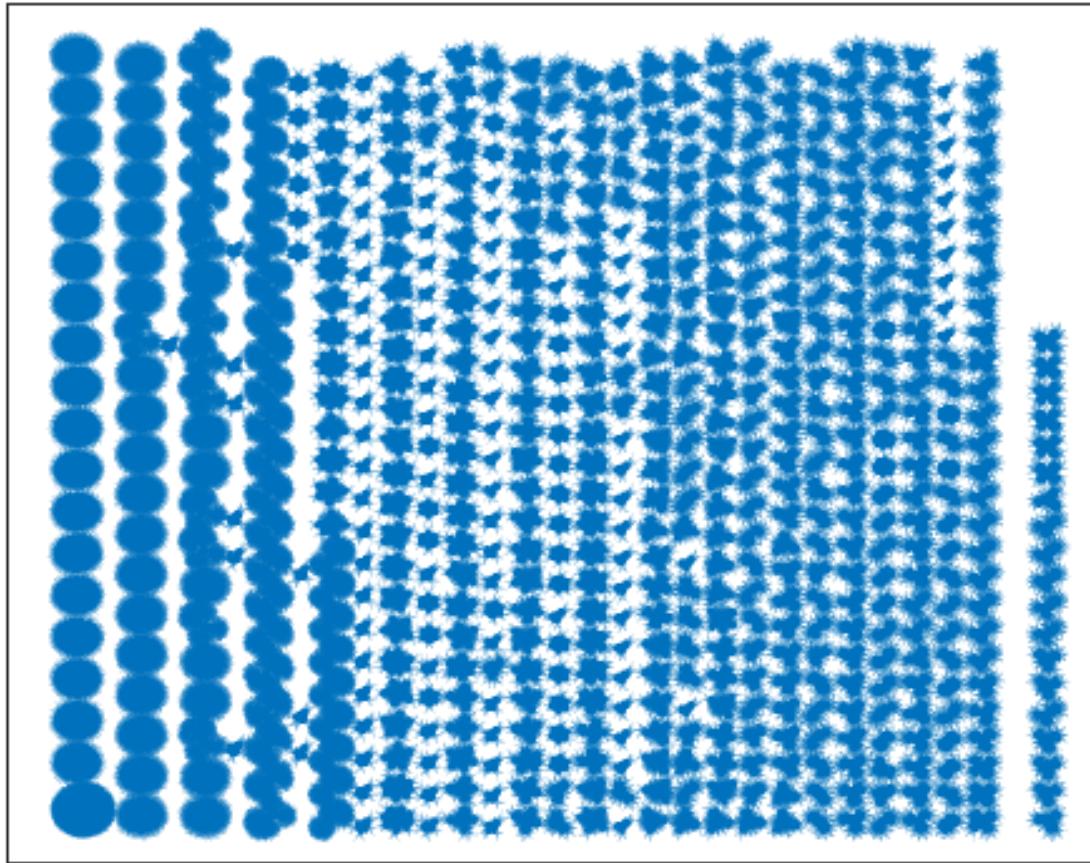


Figura 3.238: Atractor regla 19 $n=15$

3.19. Reglas 22,151

Respecto a la regla 22 se aprecia que mientras más grande es el tamaño de la cadena (n) pareciera que el que va a evolucionar es un solo atractor pero mientras incrementamos n surgen nuevos atractores que «compiten»; por decirlo de alguna forma, compiten en ir aumentando la cantidad de nodos que convienen a ellos (imágenes 3.246 y 3.247) pero al llegar a $n=14$ se observa que al final un atractor fue el que «absorbió» a otros.

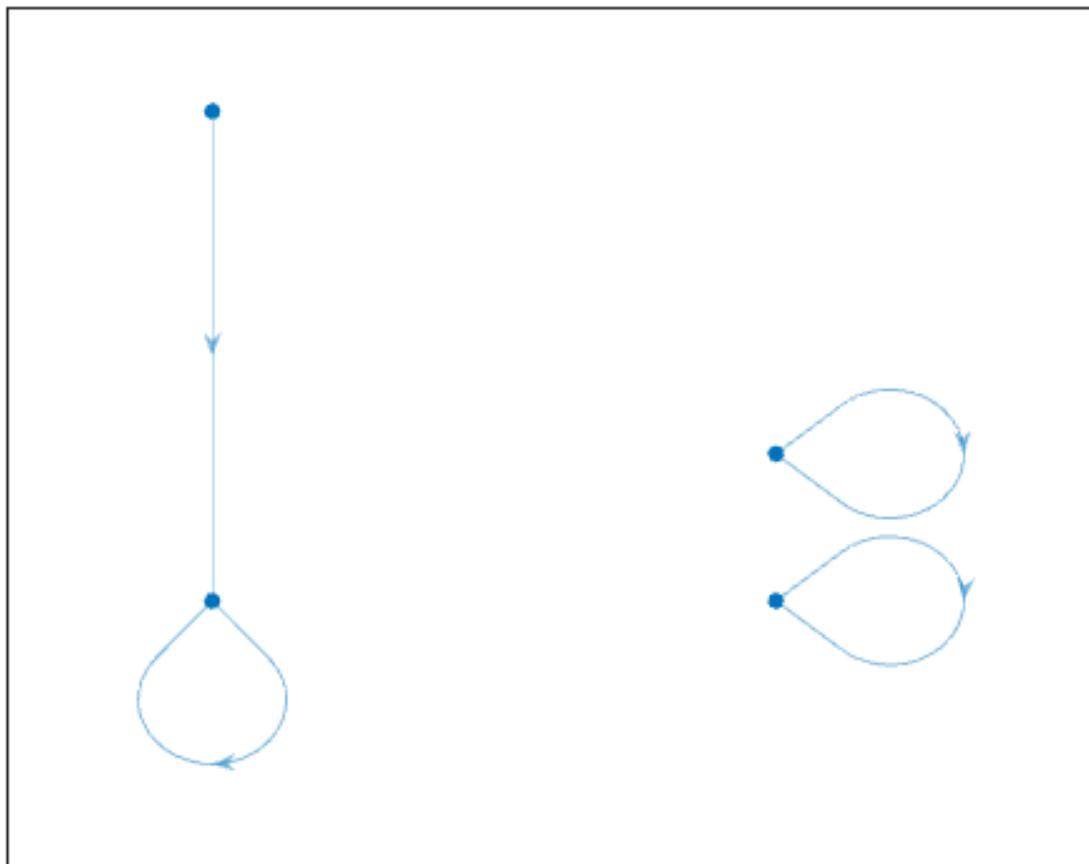
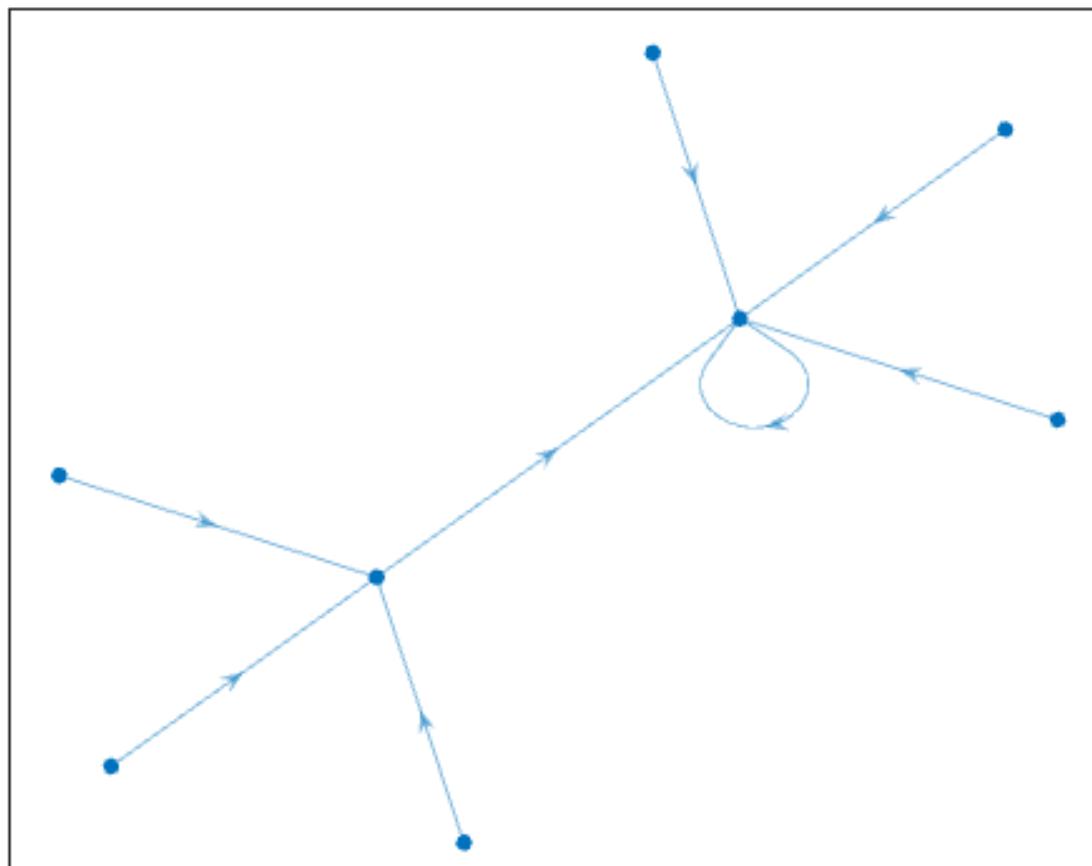
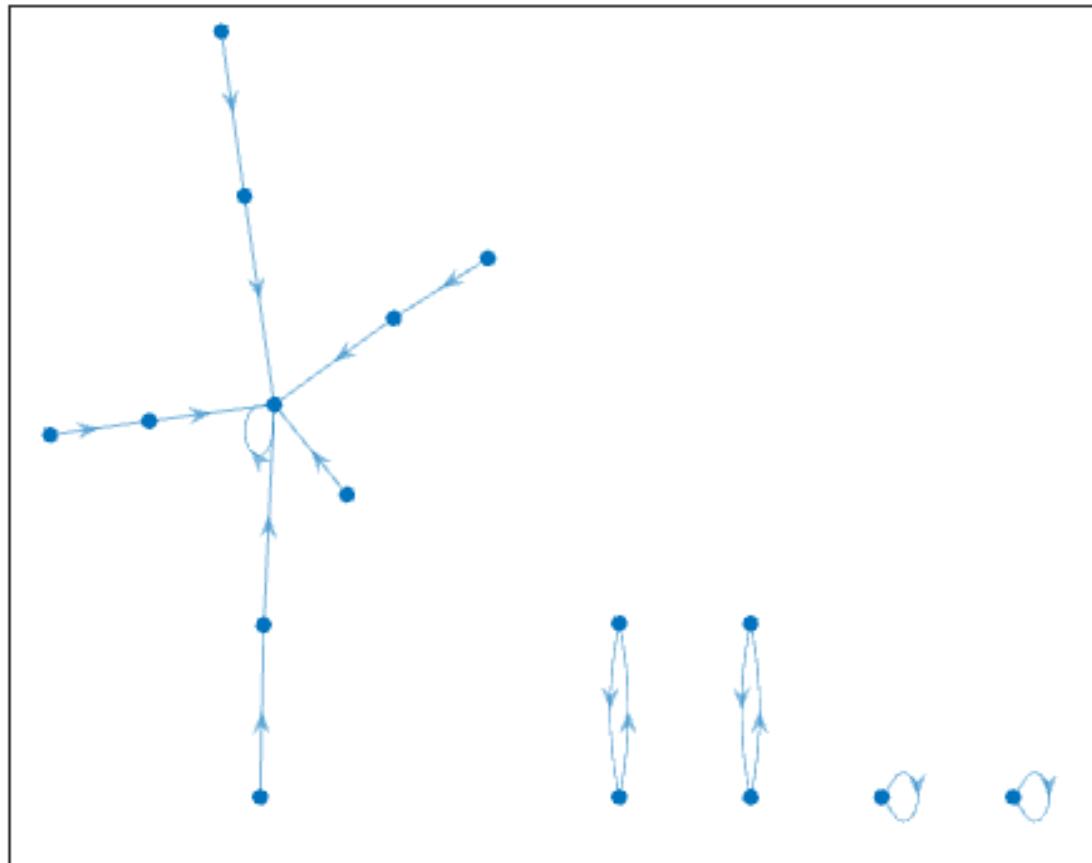


Figura 3.239: Atractor regla 22 $n=2$

Figura 3.240: Atractor regla 22 $n=3$

Figura 3.241: Atractor regla 22 $n=4$

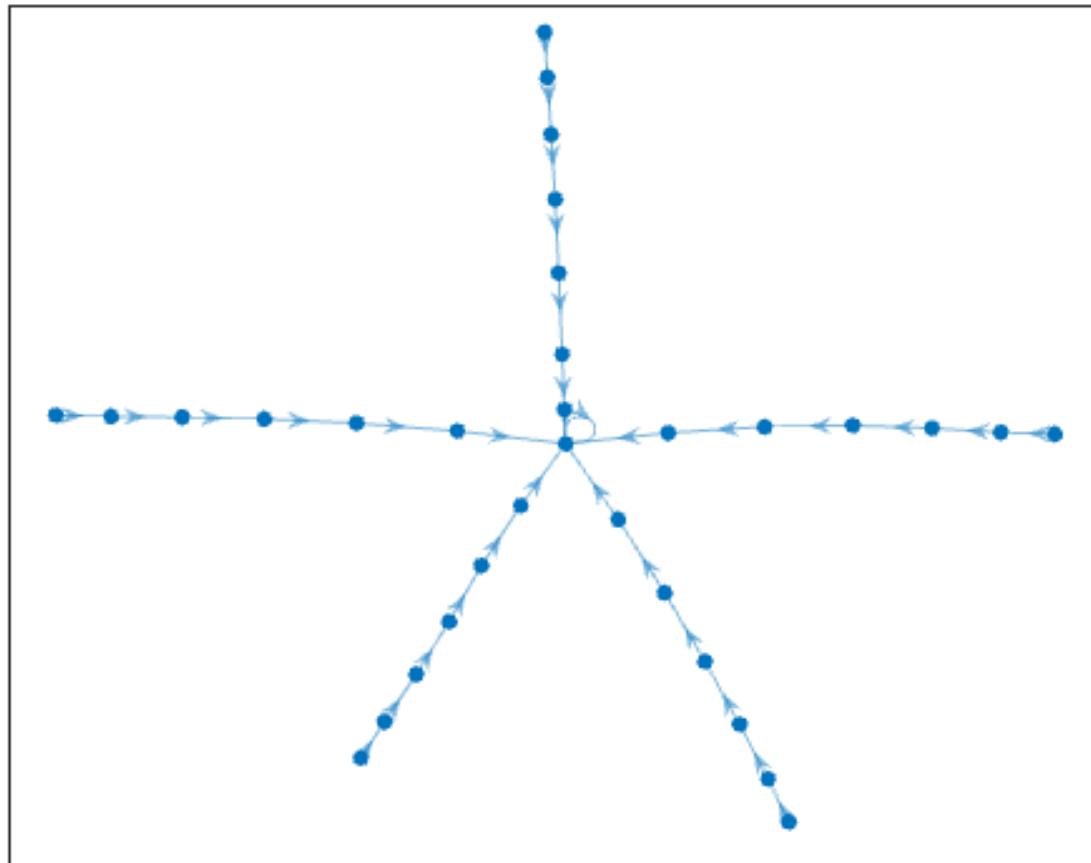


Figura 3.242: Atractor regla 22 n=5

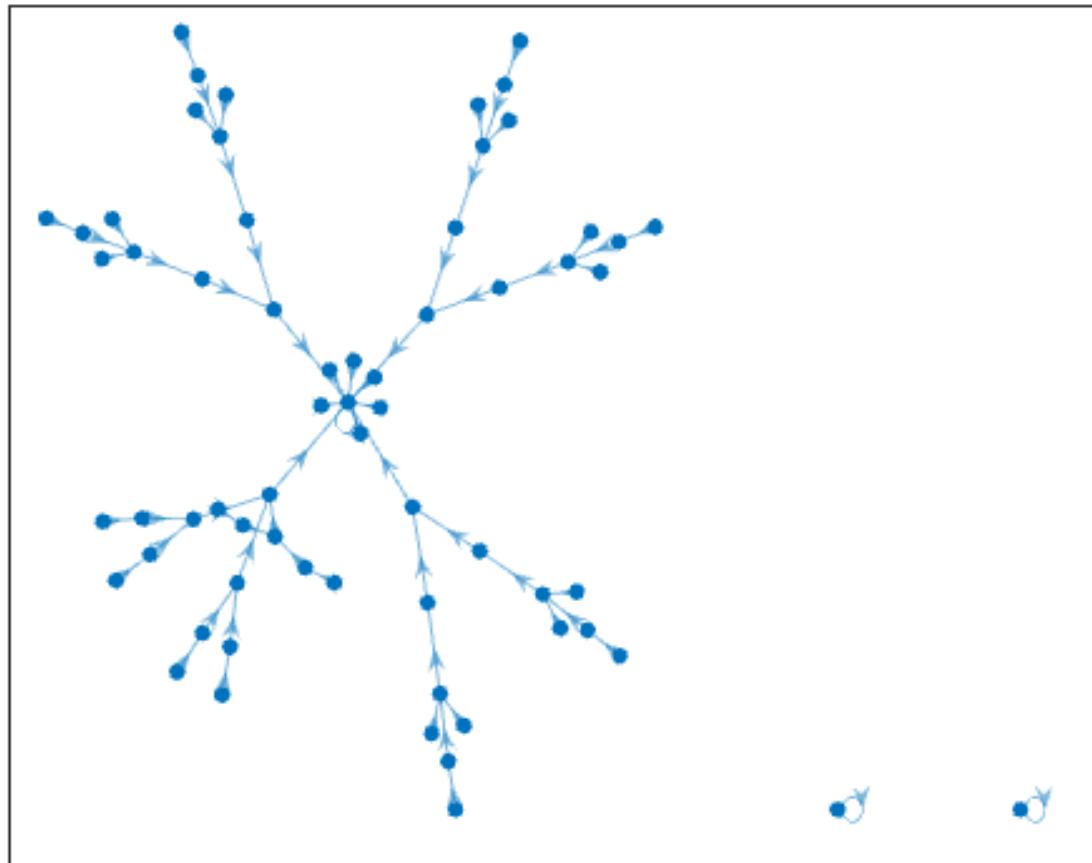
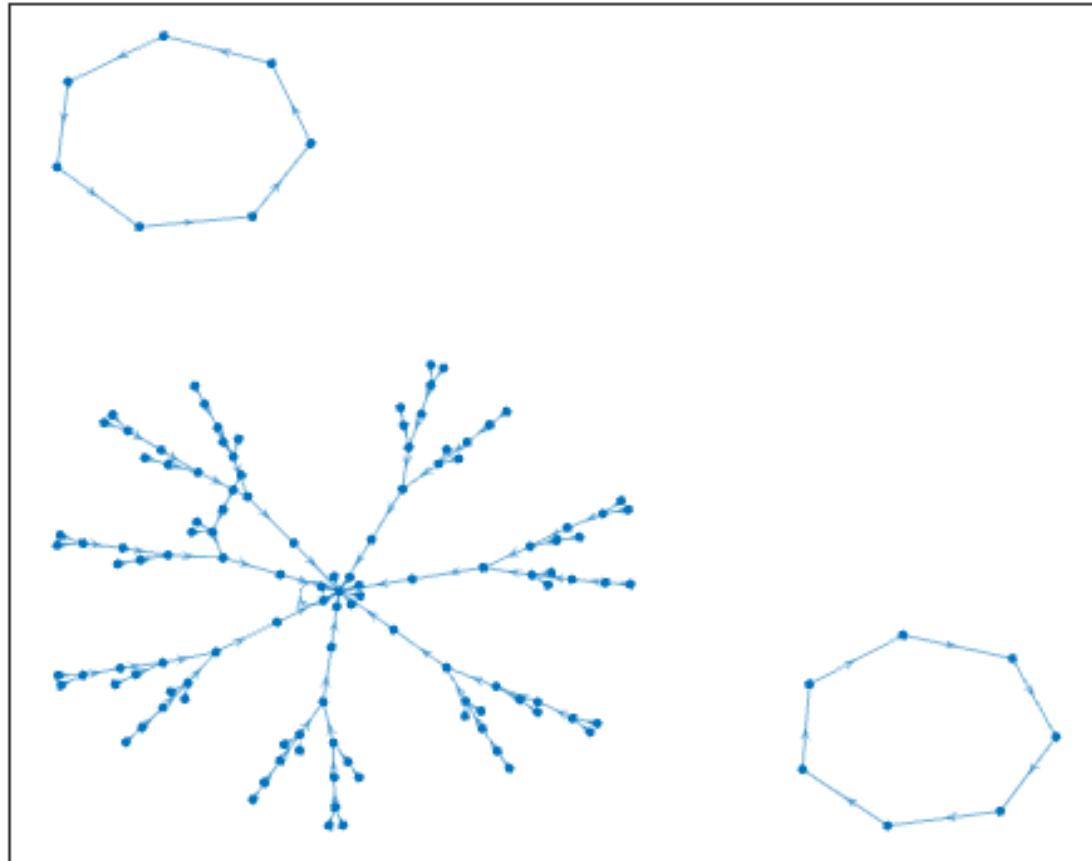


Figura 3.243: Atractor regla 22 n=6

Figura 3.244: Atractor regla 22 $n=7$

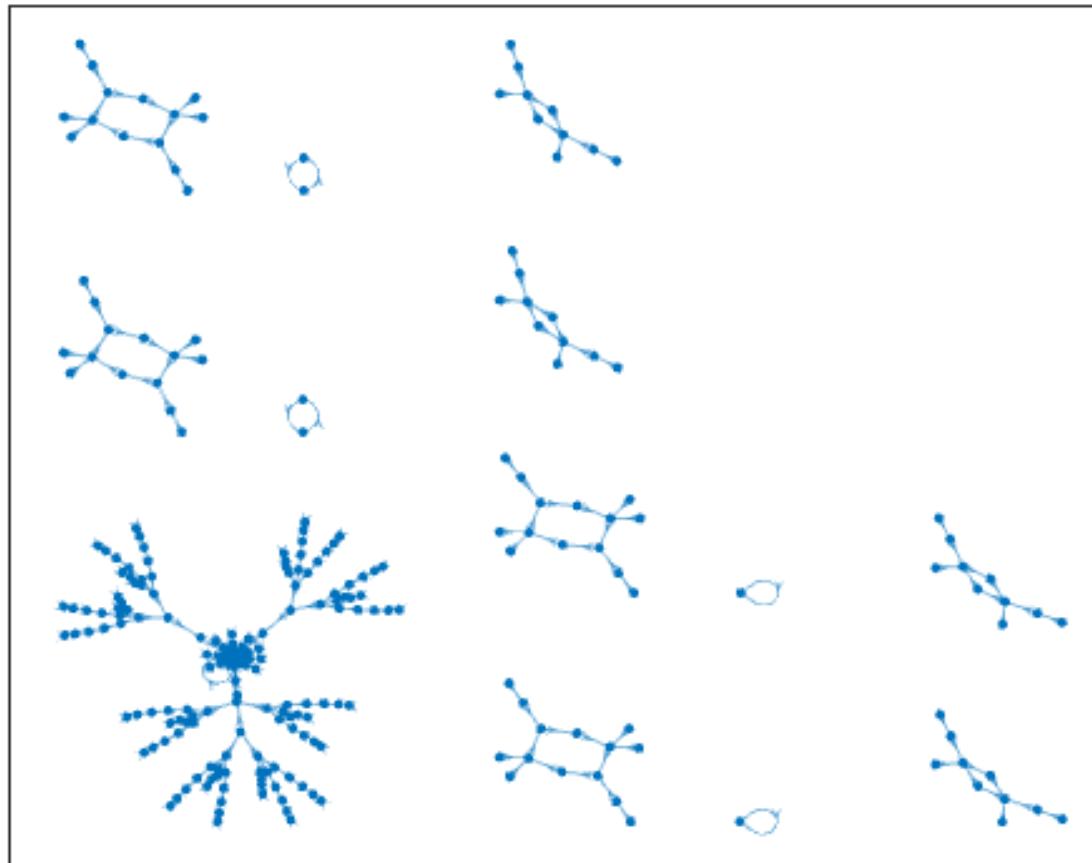
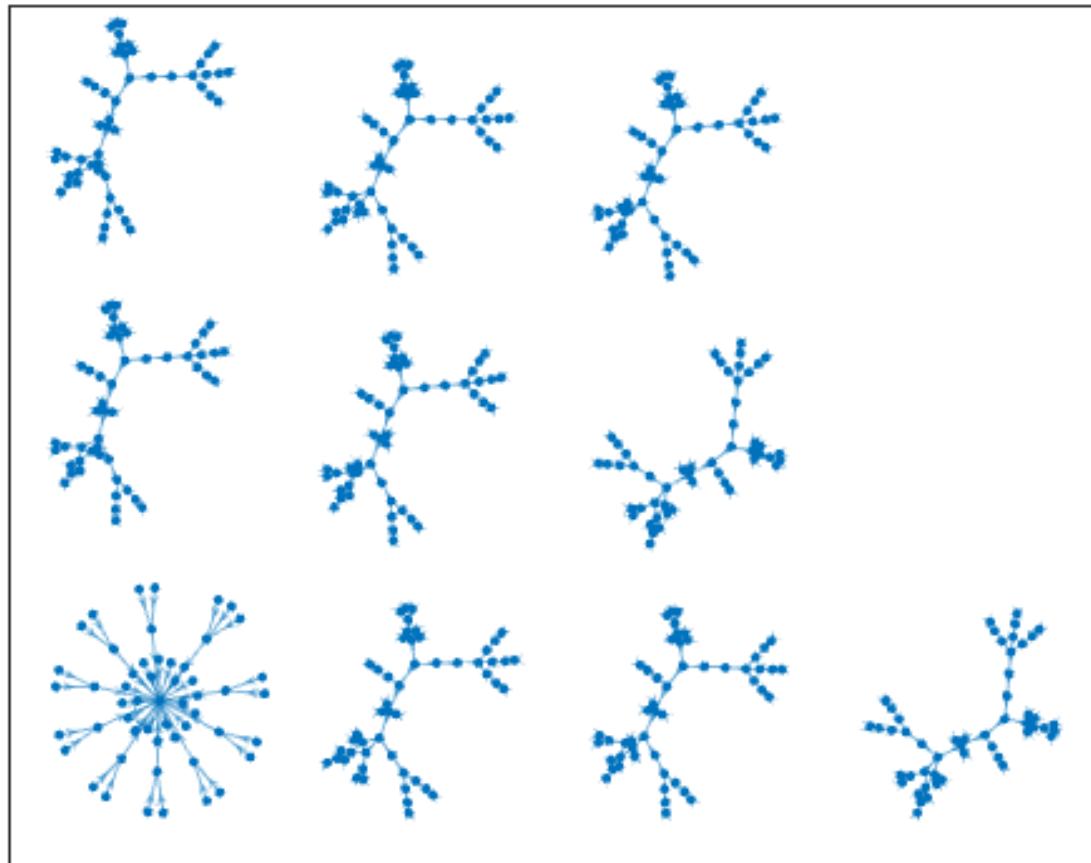
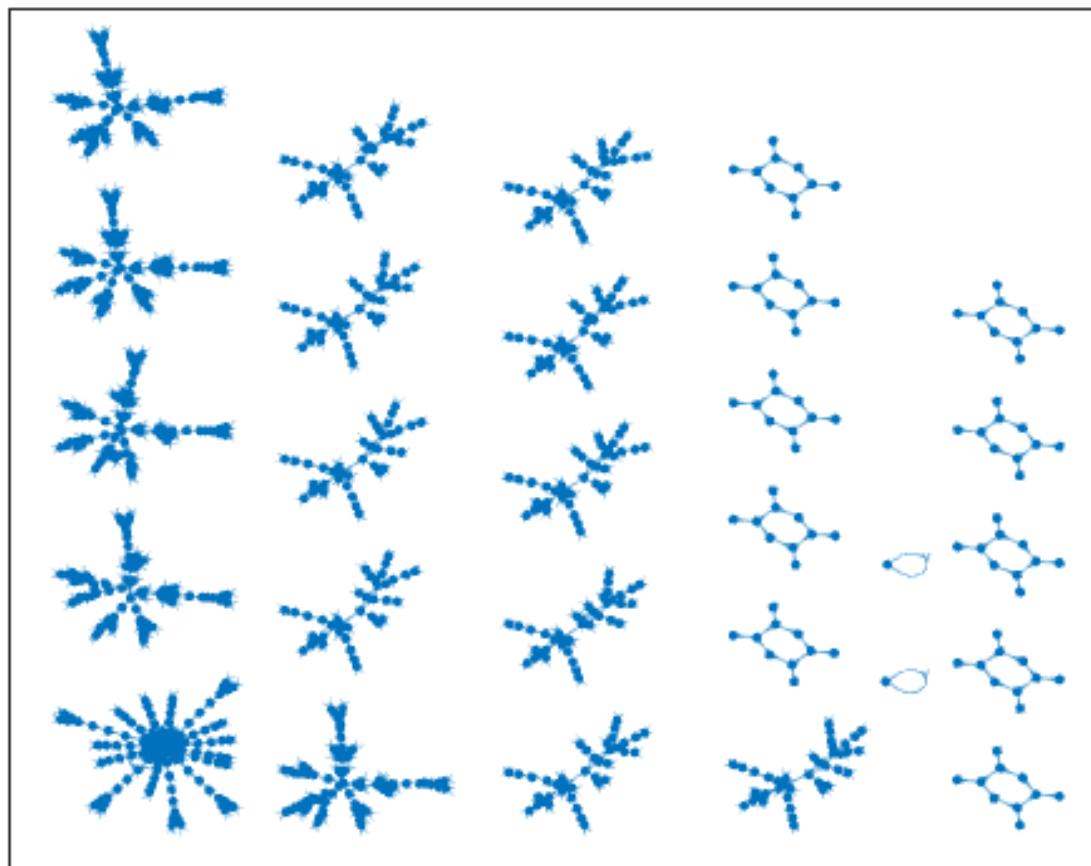


Figura 3.245: Atractor regla 22 n=8

Figura 3.246: Atractor regla 22 $n=9$

Figura 3.247: Atractor regla 22 $n=10$

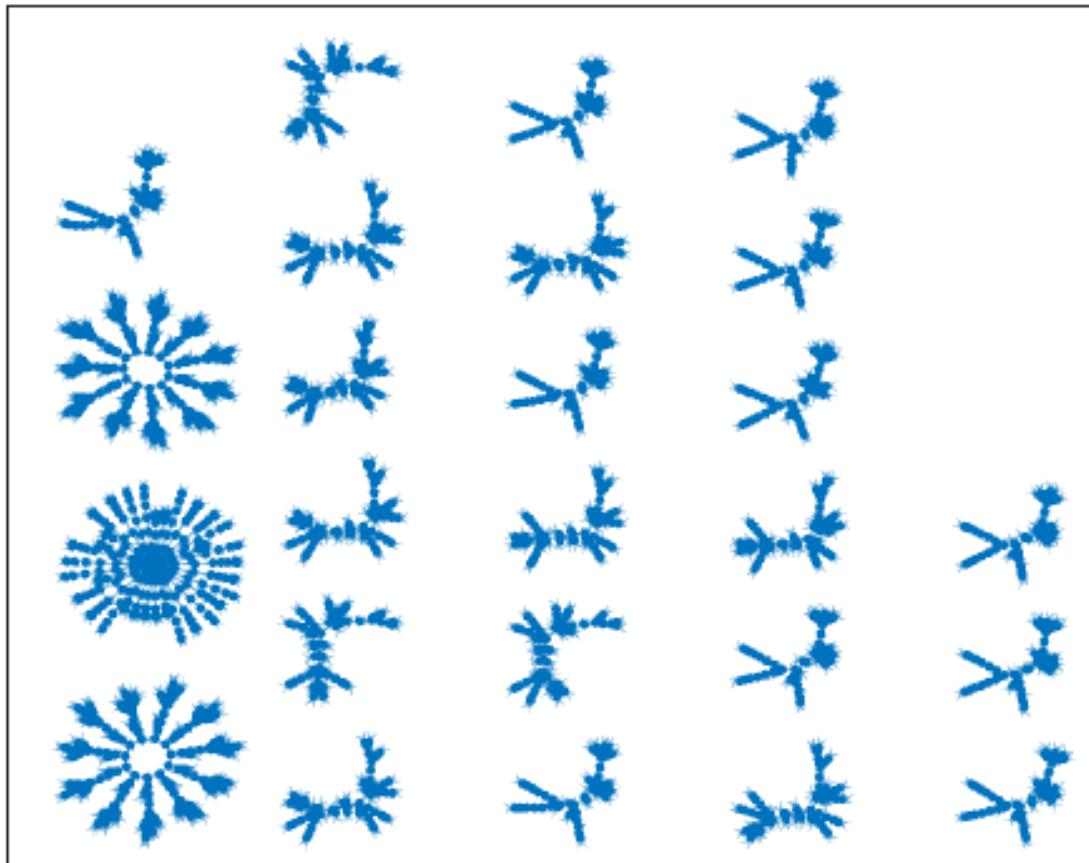
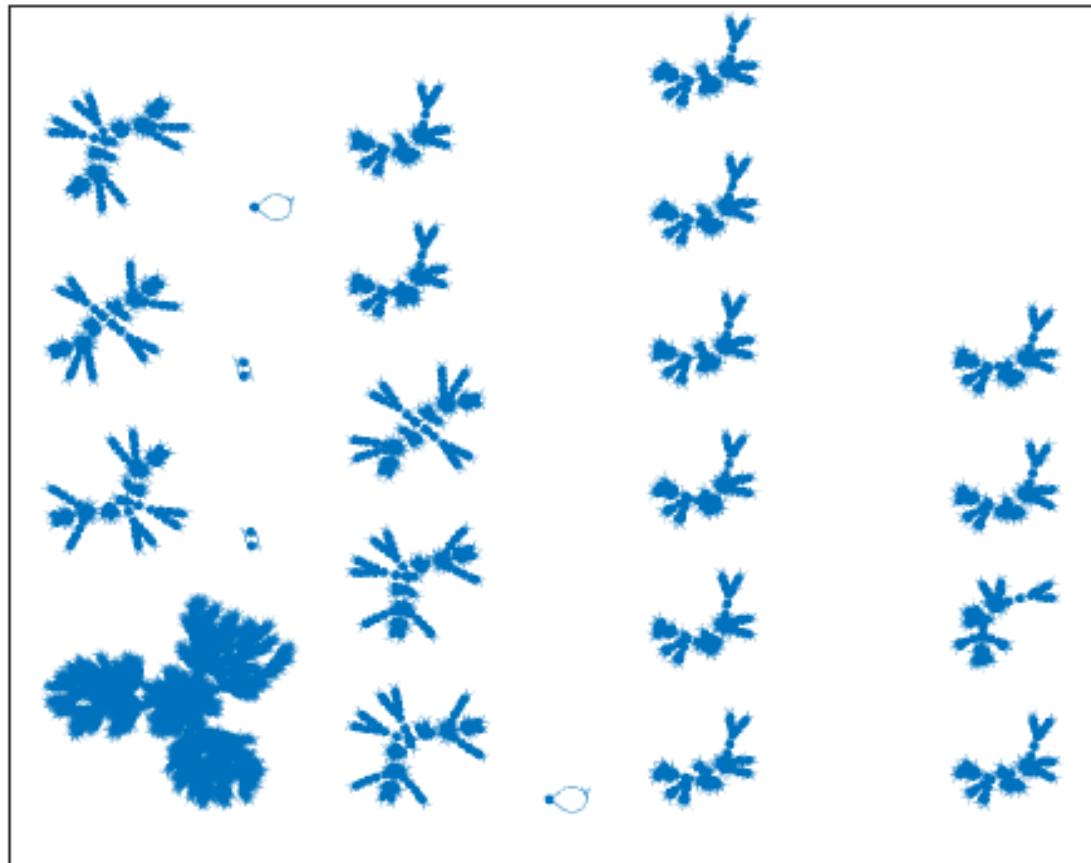


Figura 3.248: Atractor regla 22 $n=11$

Figura 3.249: Atractor regla 22 $n=12$

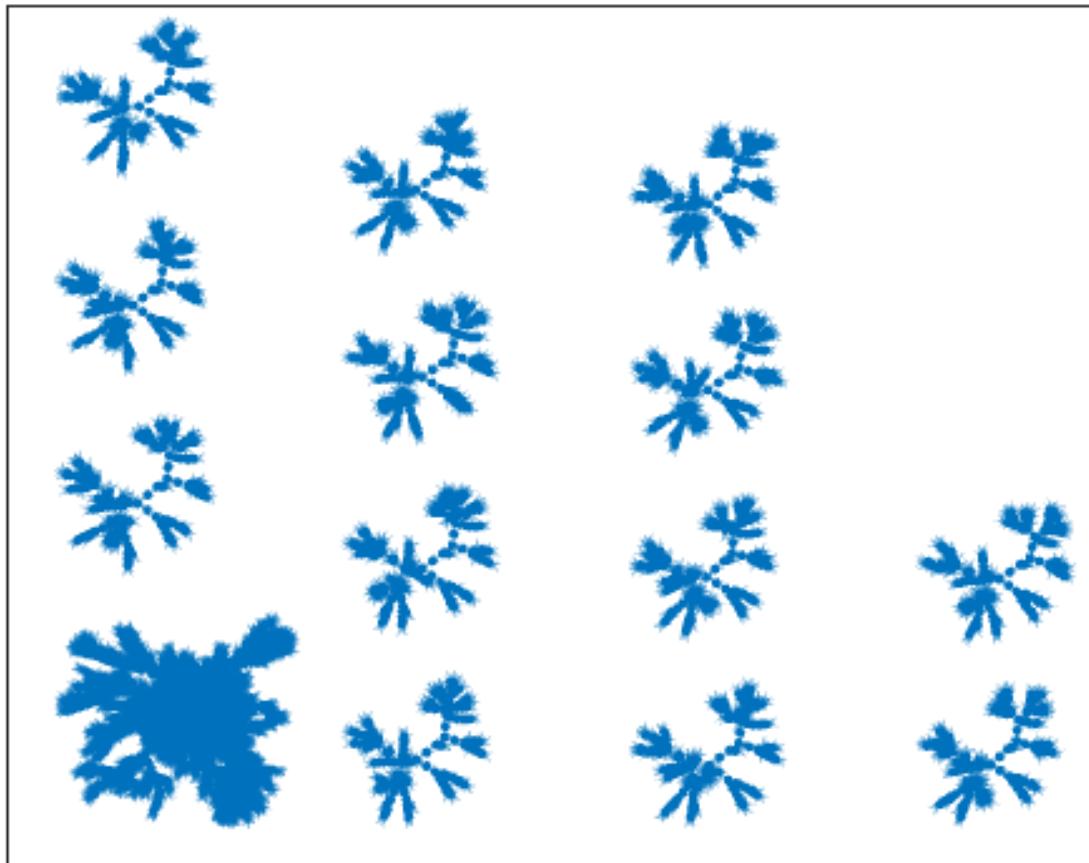


Figura 3.250: Atractor regla 22 $n=13$

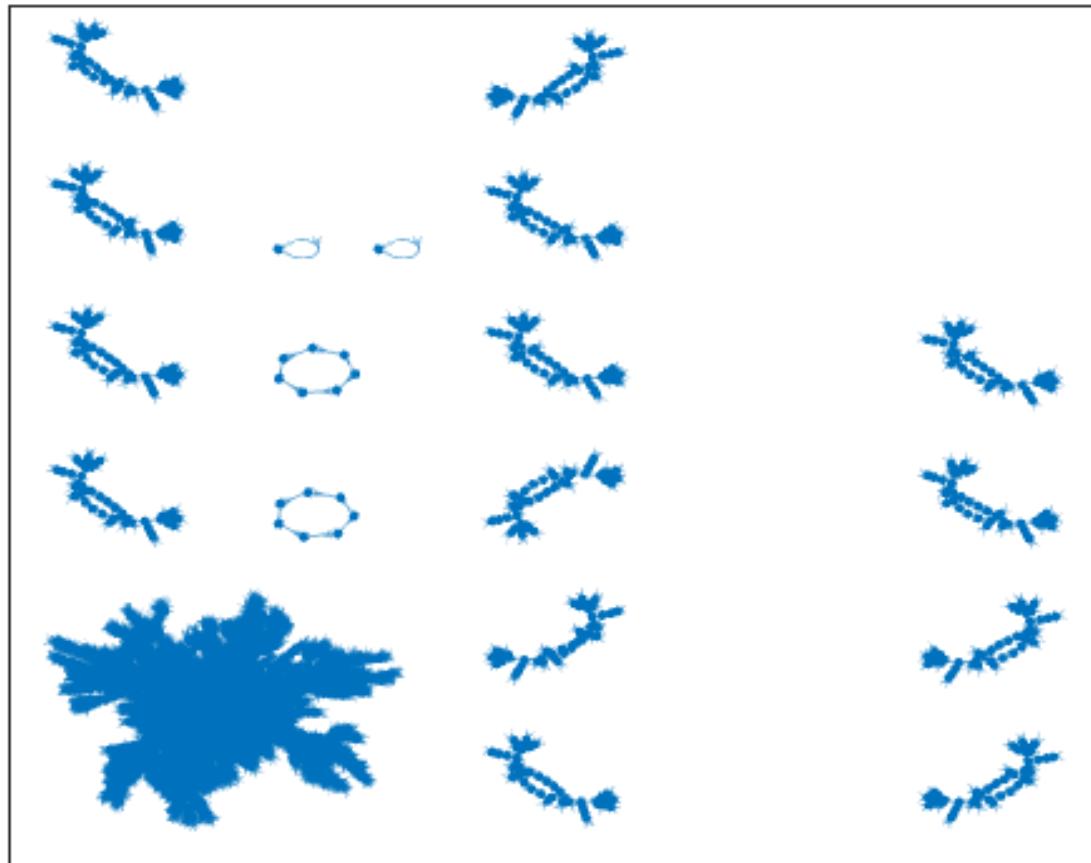


Figura 3.251: Atractor regla 22 n=14

3.20. Reglas 23

Respecto a la regla 23 se aprecia que mientras más grande es el tamaño de la cadena (n) el atractor que aparece en la imagen 3.253 que surgen en $n=3$ se mantiene hasta $n=15$ (en las imágenes se ubica en la esquina inferior izquierda), este atractor mantuvo su forma «original» y solo fueron apareciendo nodos hoja que convergen en sus extremos.

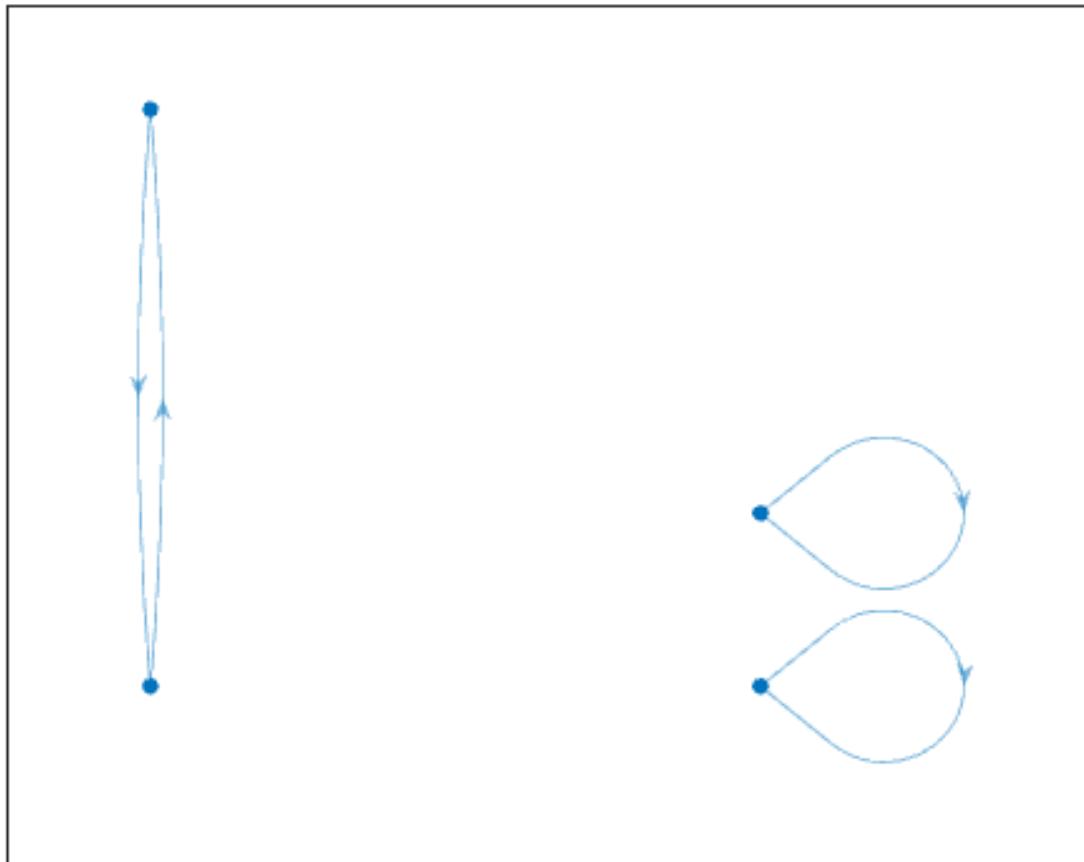


Figura 3.252: Atractor regla 23 $n=2$

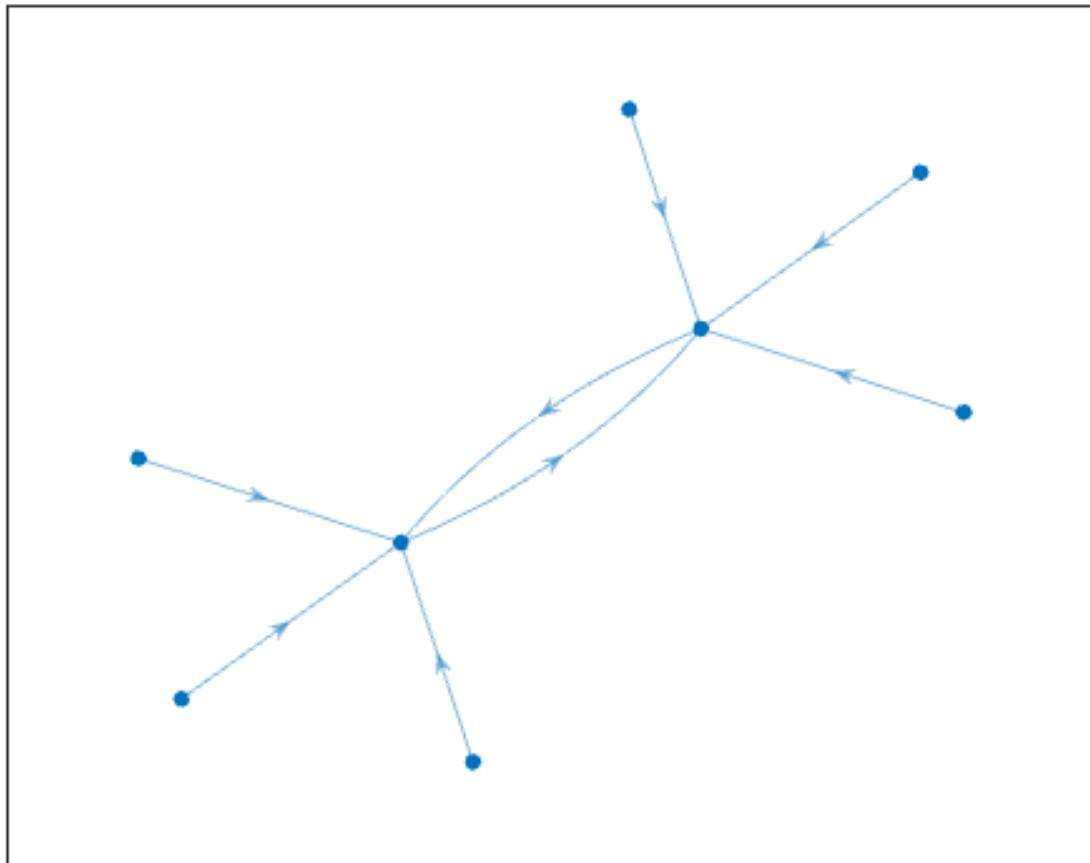
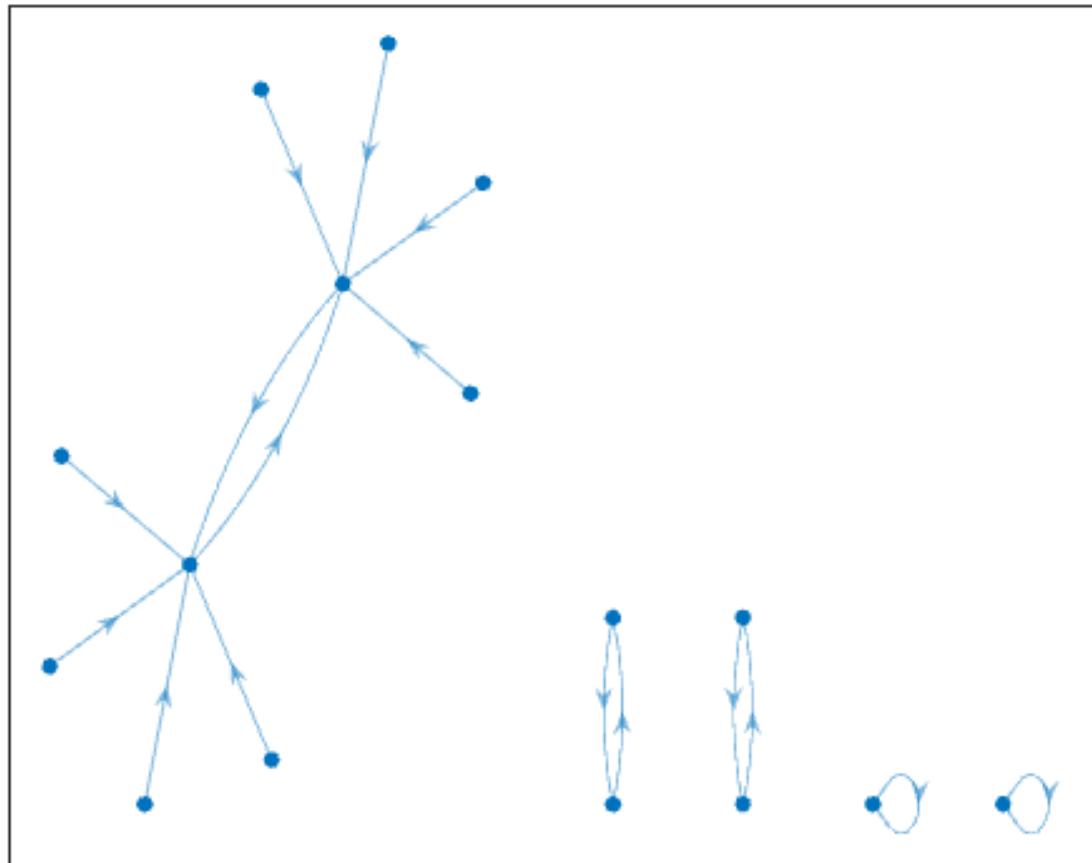


Figura 3.253: Atractor regla 23 n=3

Figura 3.254: Atractor regla 23 $n=4$

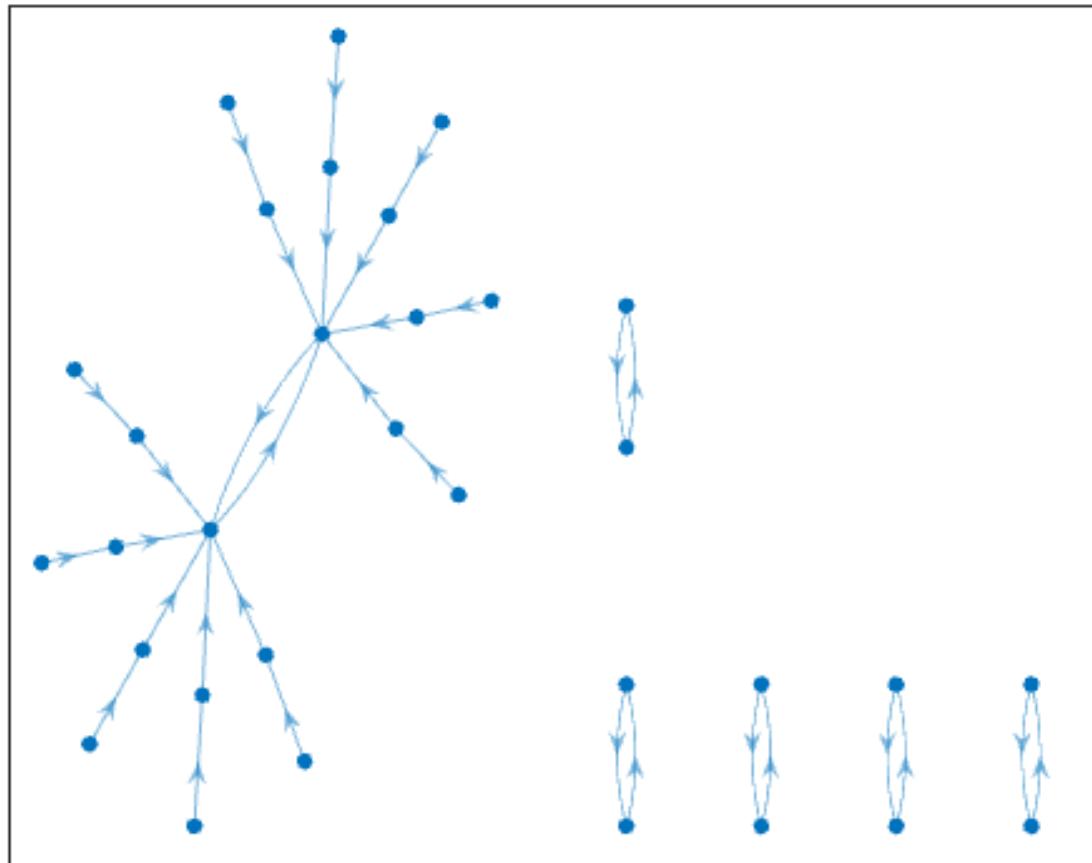


Figura 3.255: Atractor regla 23 n=5

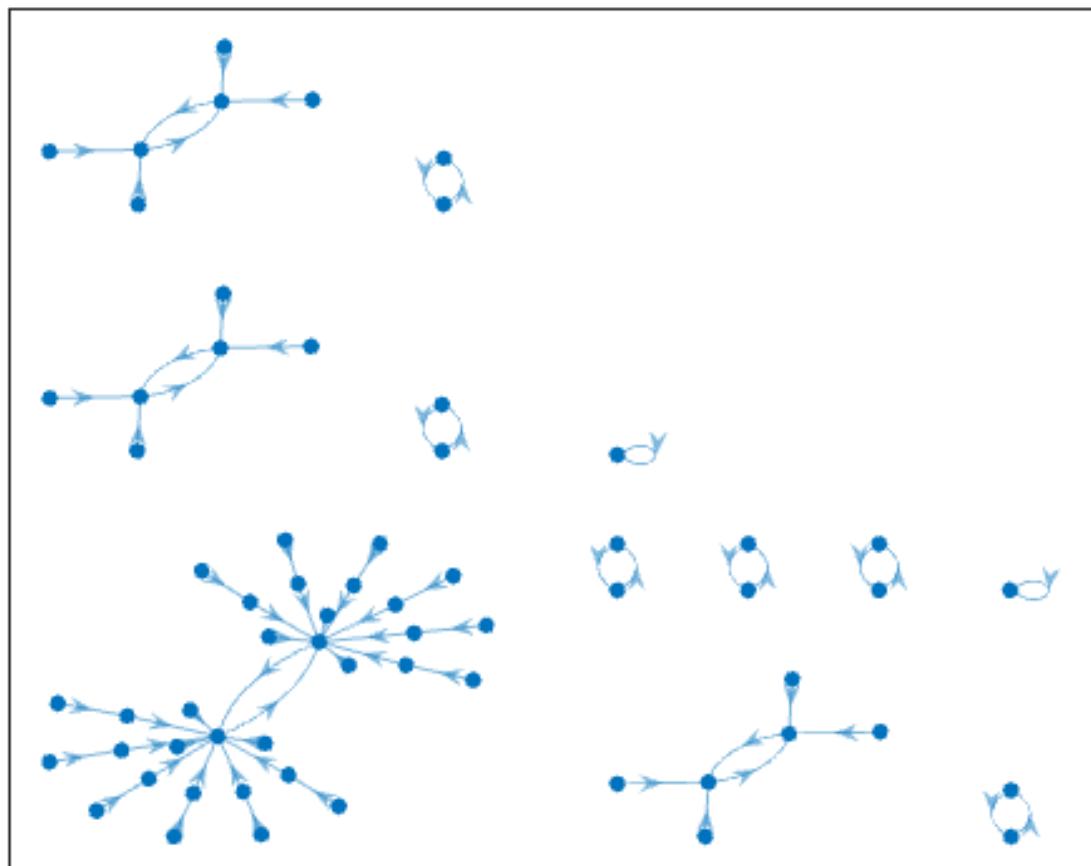


Figura 3.256: Atractor regla 23 n=6

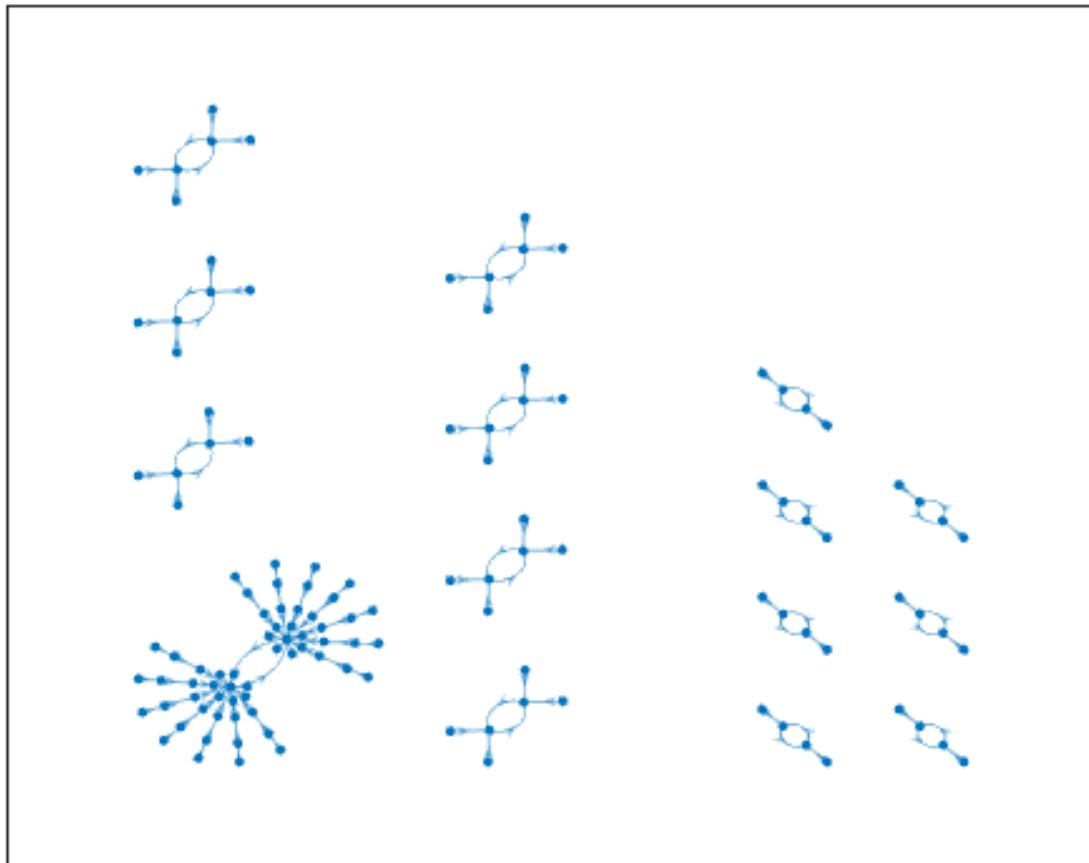


Figura 3.257: Atractor regla 23 n=7

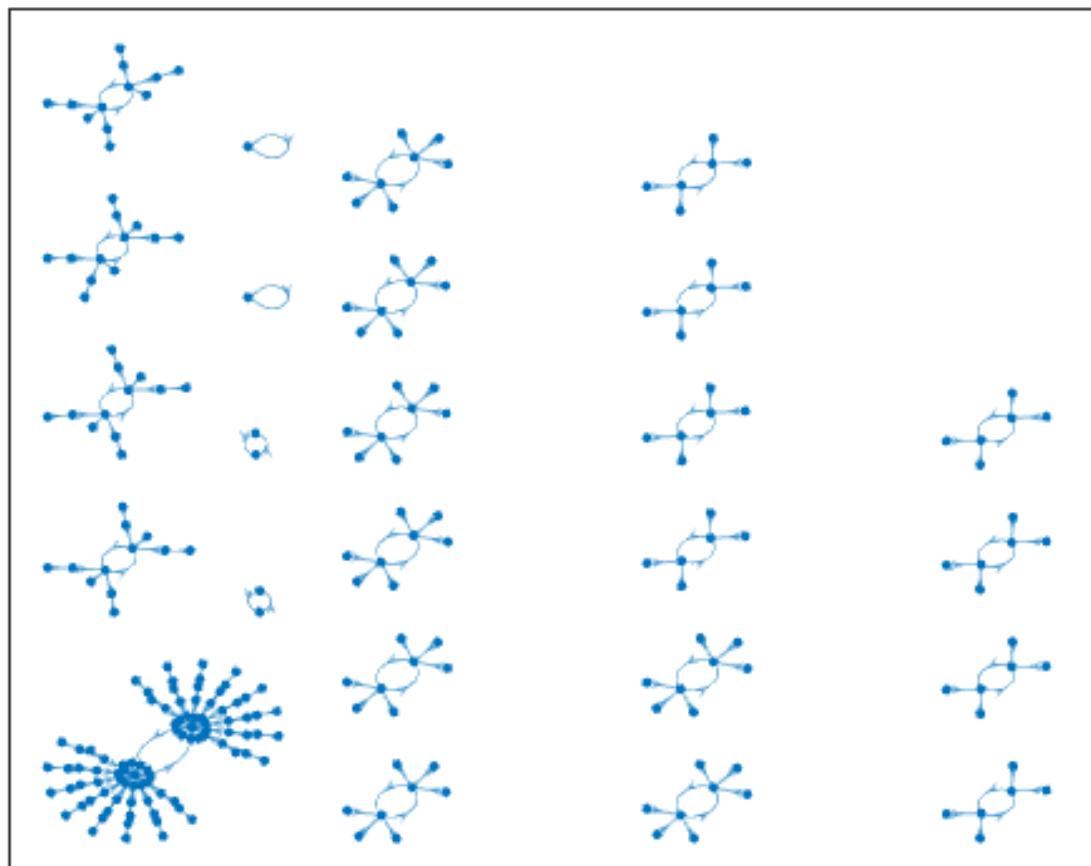


Figura 3.258: Atractor regla 23 n=8

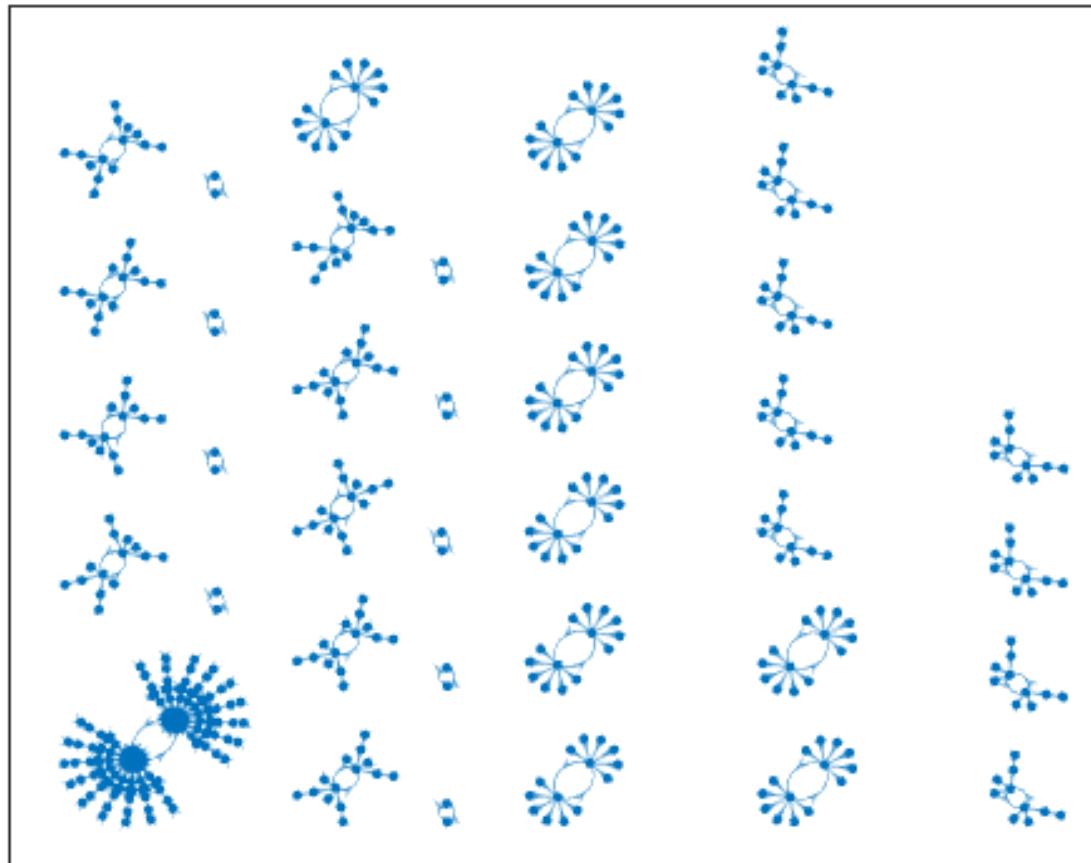


Figura 3.259: Atractor regla 23 n=9

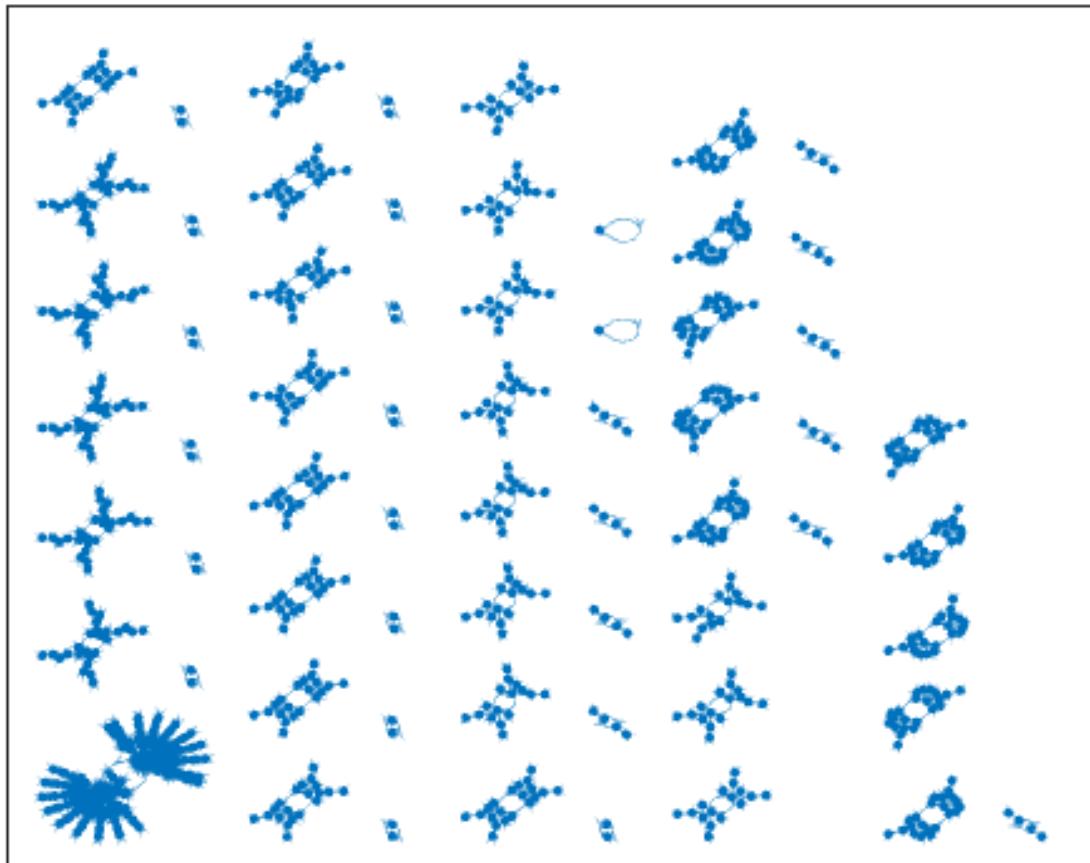


Figura 3.260: Atractor regla 23 n=10

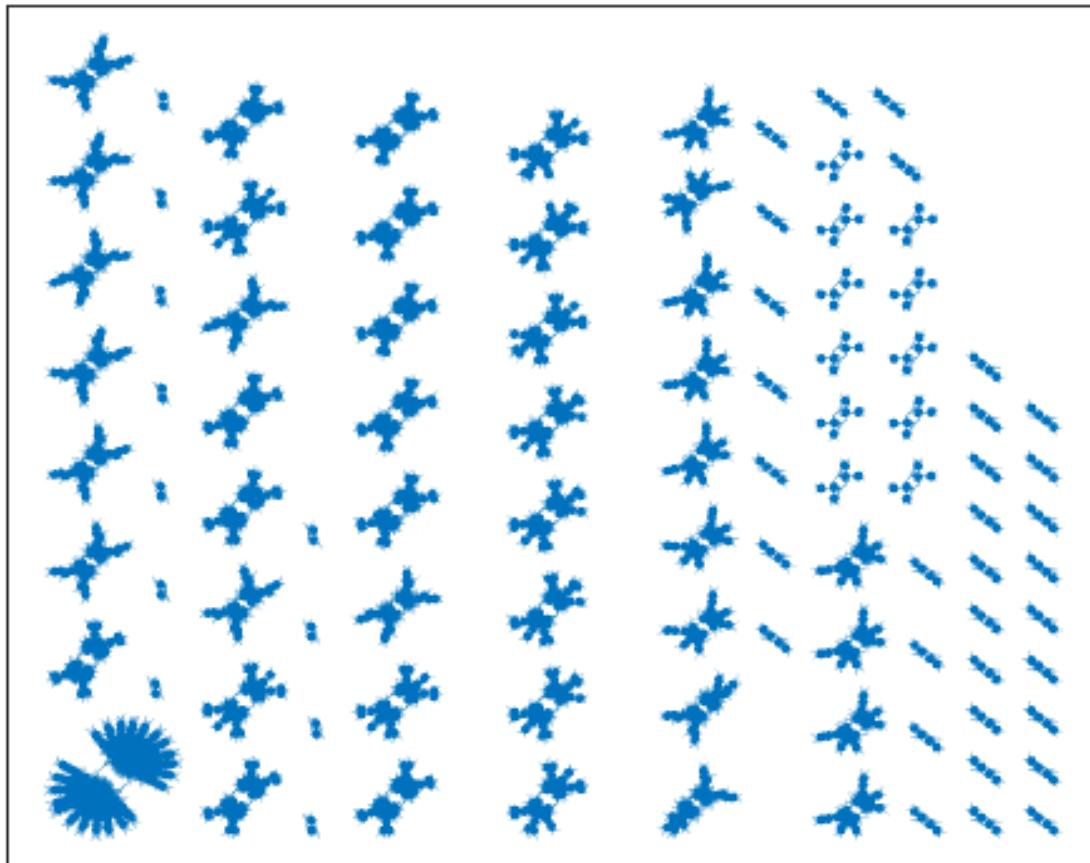


Figura 3.261: Atractor regla 23 n=11

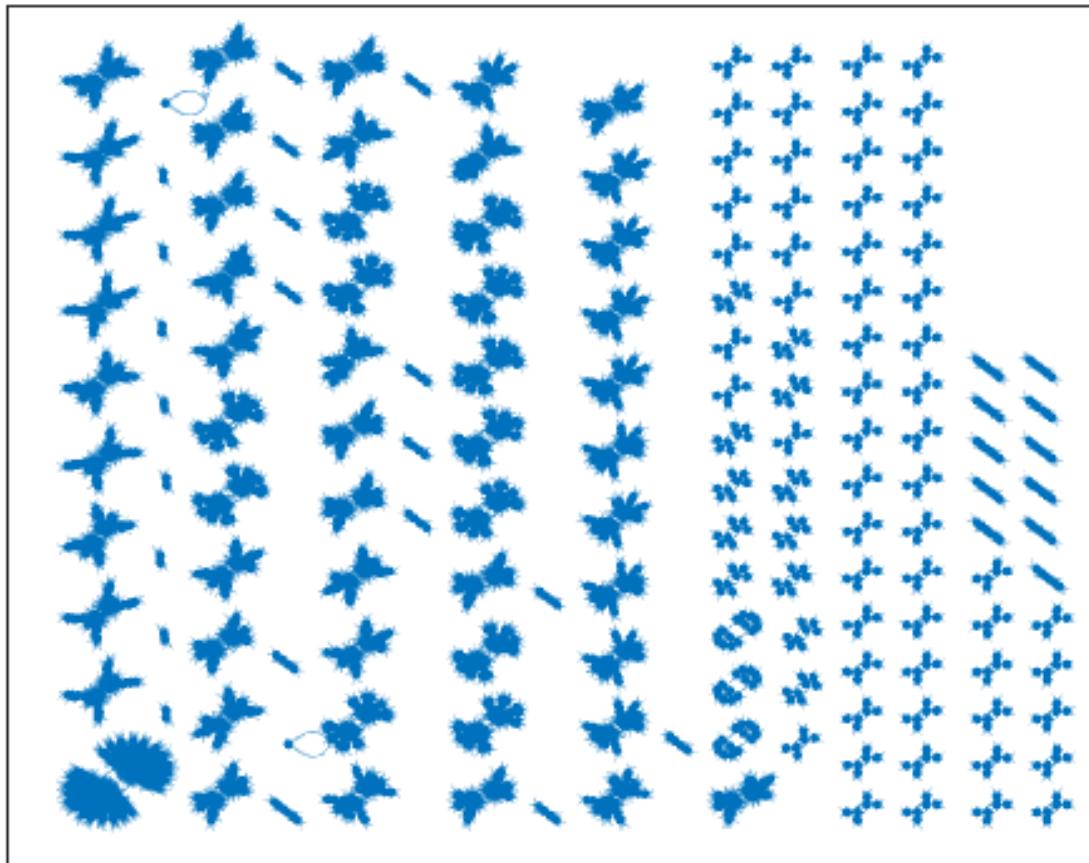


Figura 3.262: Atractor regla 23 n=12

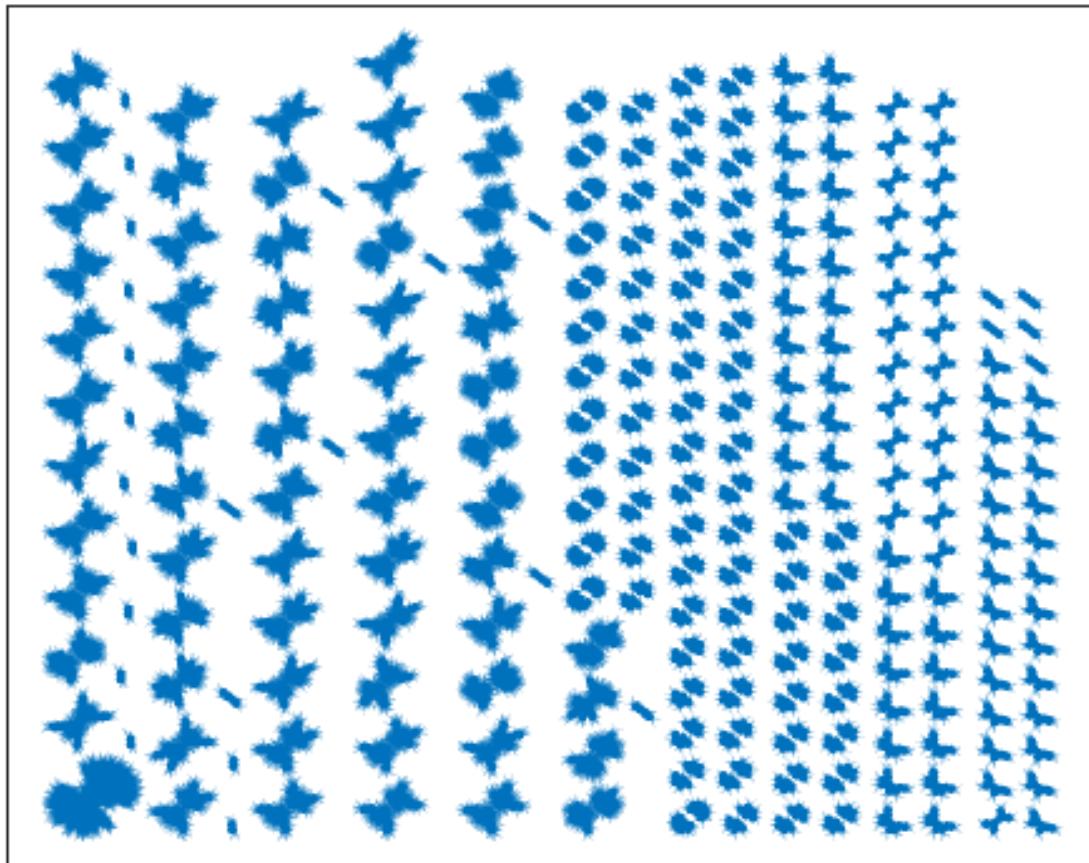


Figura 3.263: Atractor regla 23 $n=13$

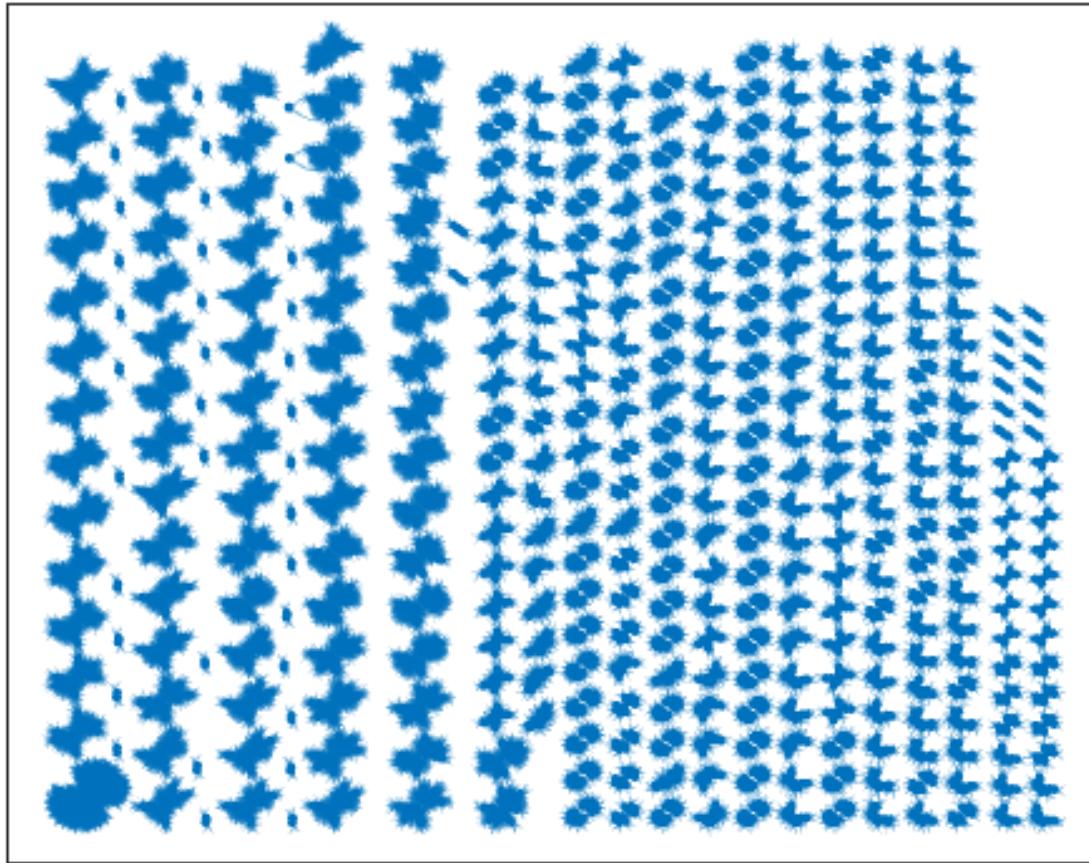


Figura 3.264: Atractor regla 23 n=14

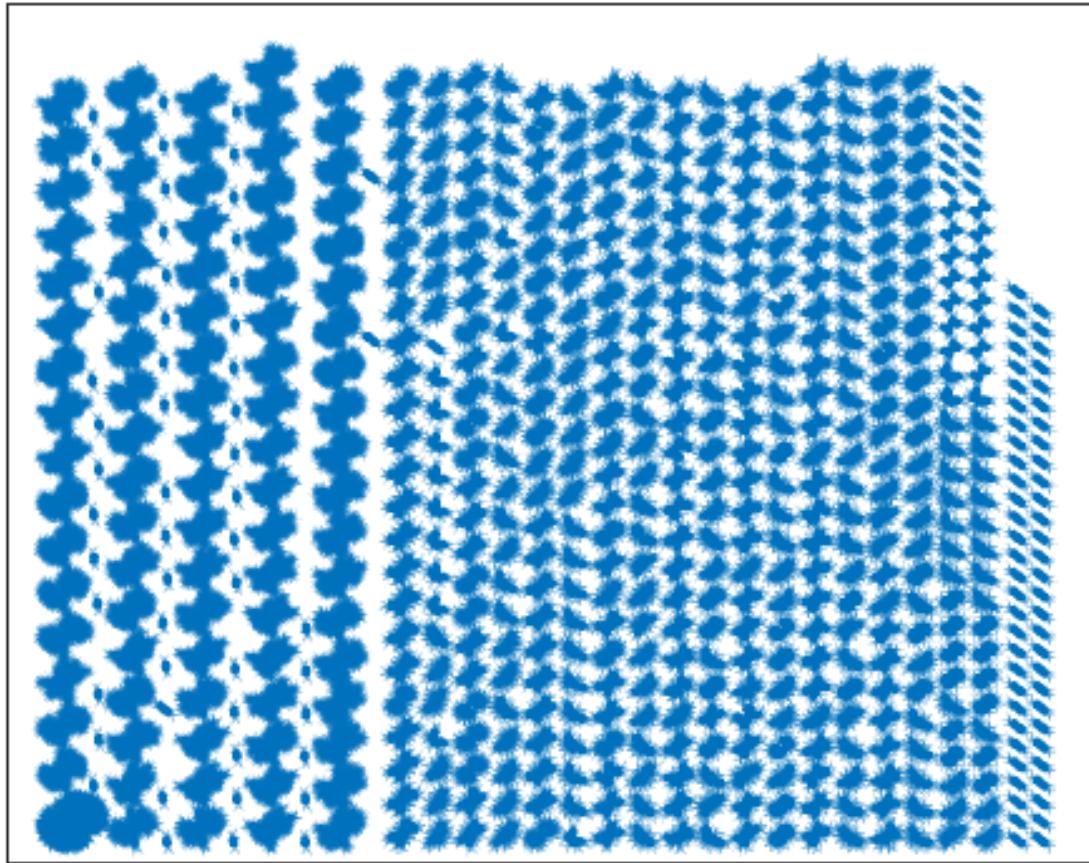


Figura 3.265: Atractor regla 23 n=15

3.21. Reglas 24,66,189,231

Respecto a la regla 24 se aprecia que mientras más grande es el tamaño de la cadena (n) al incrementar n en casi todas las evoluciones se mantiene constante la aparición de un atractor «simple» en el que los nodos que lo componen no exceden los 8 nodos.

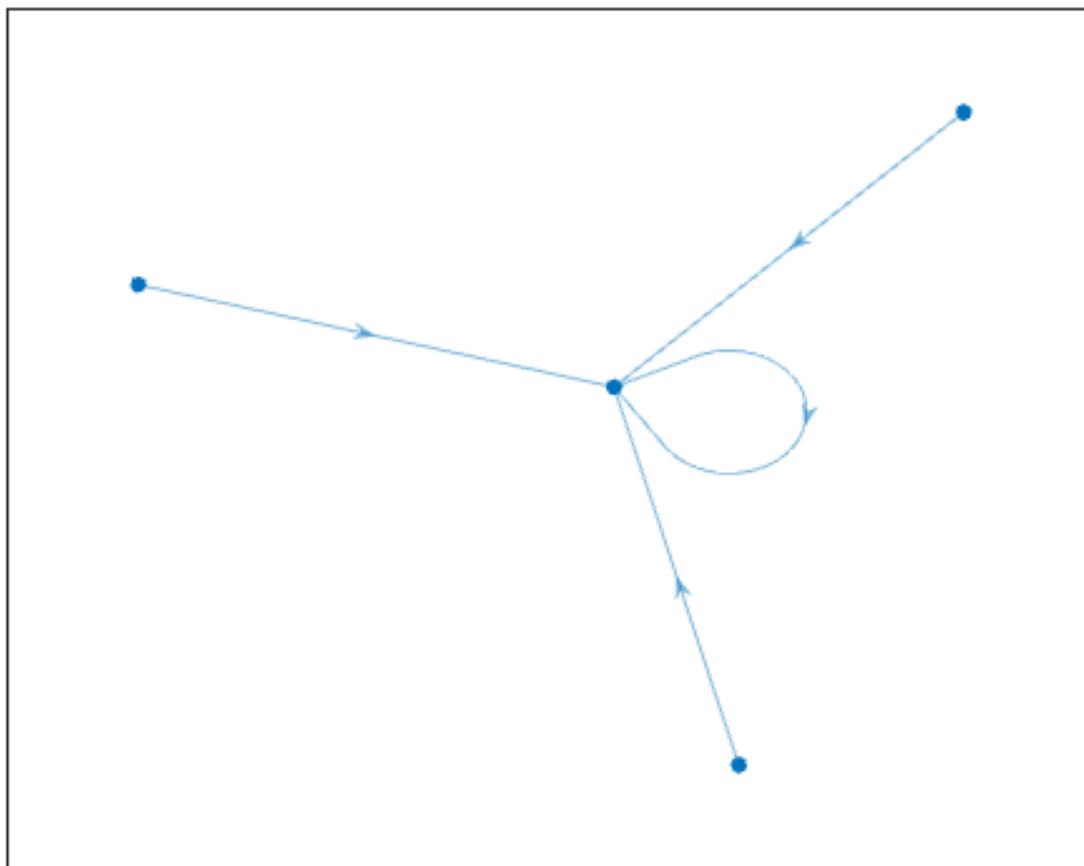


Figura 3.266: Atractor regla 24 $n=2$

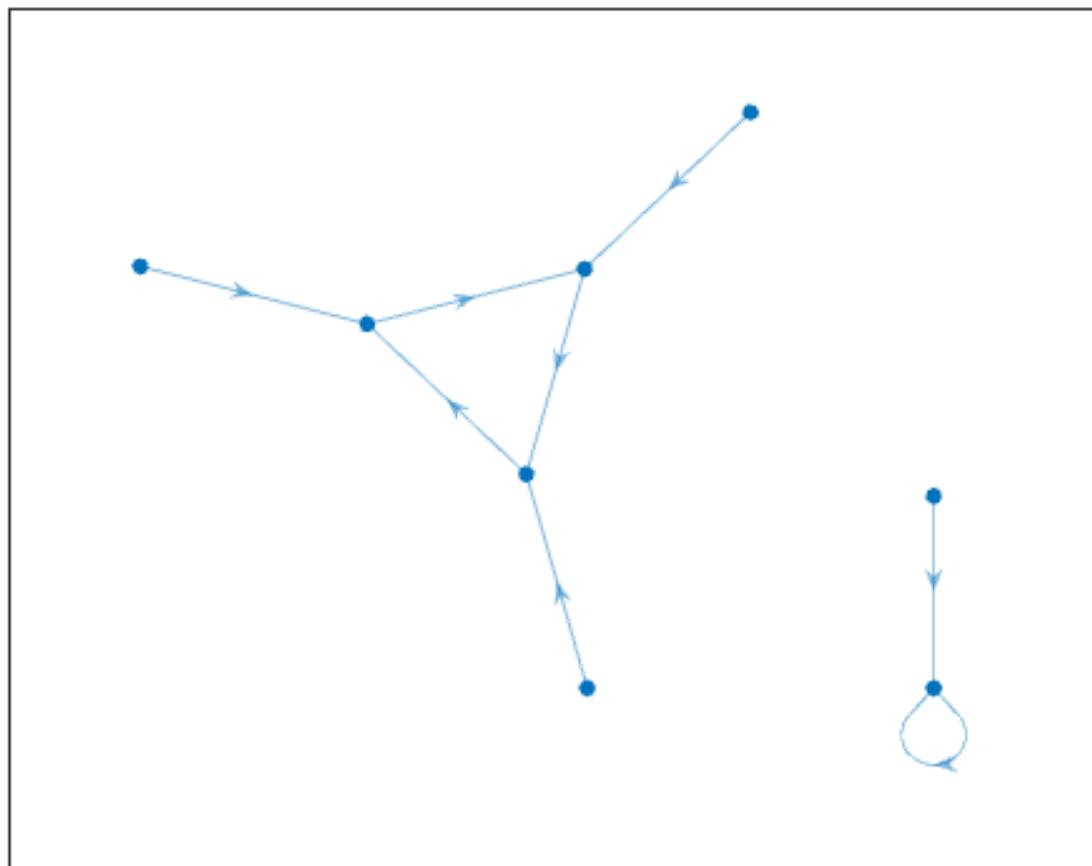


Figura 3.267: Atractor regla 24 n=3

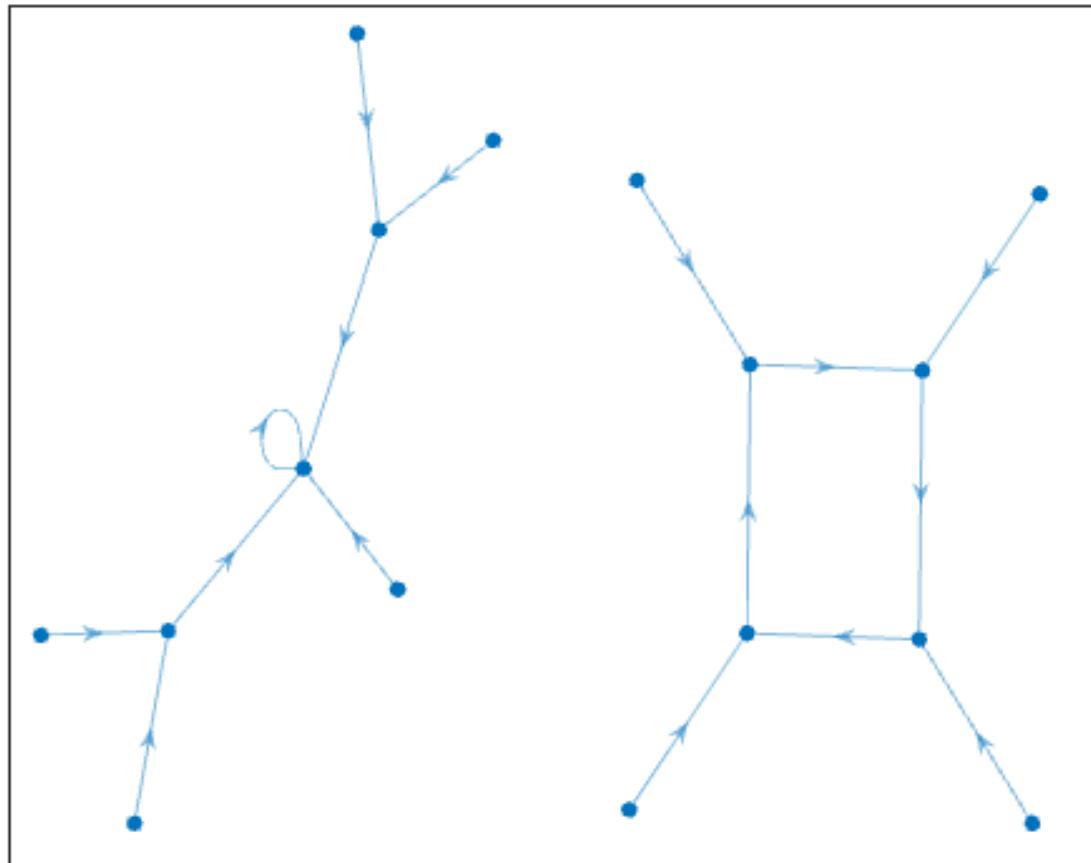
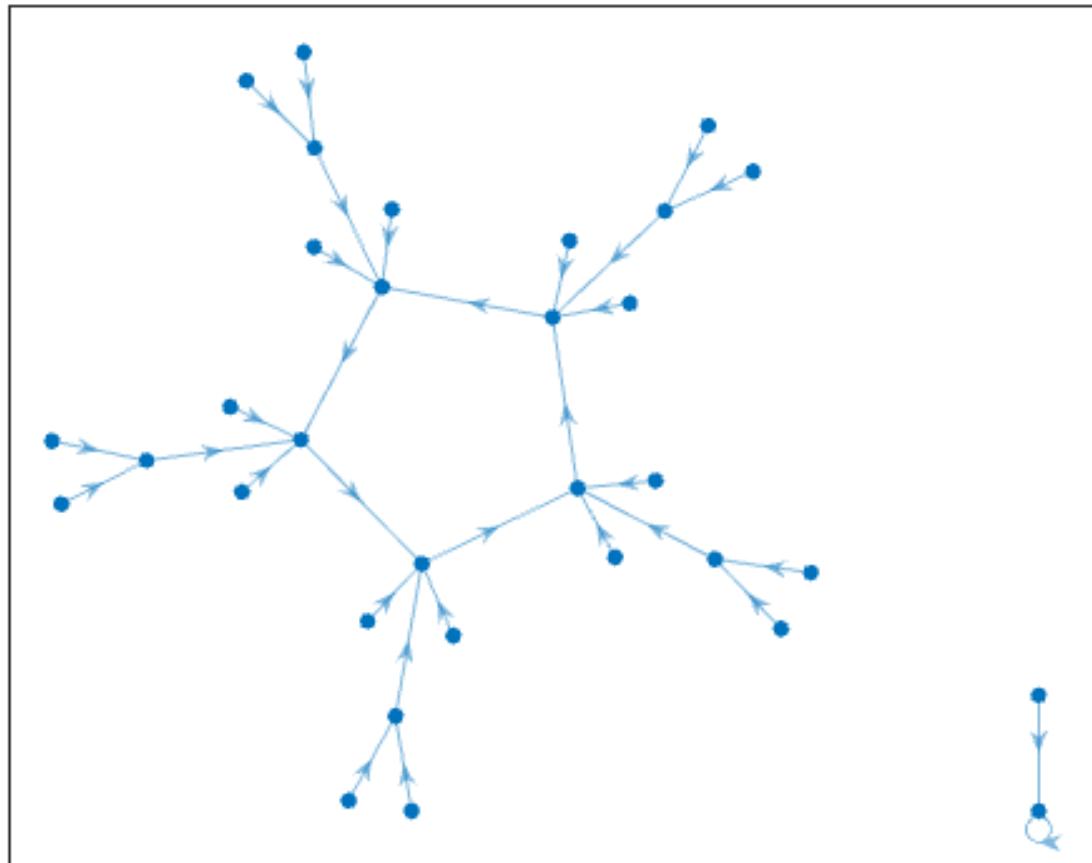
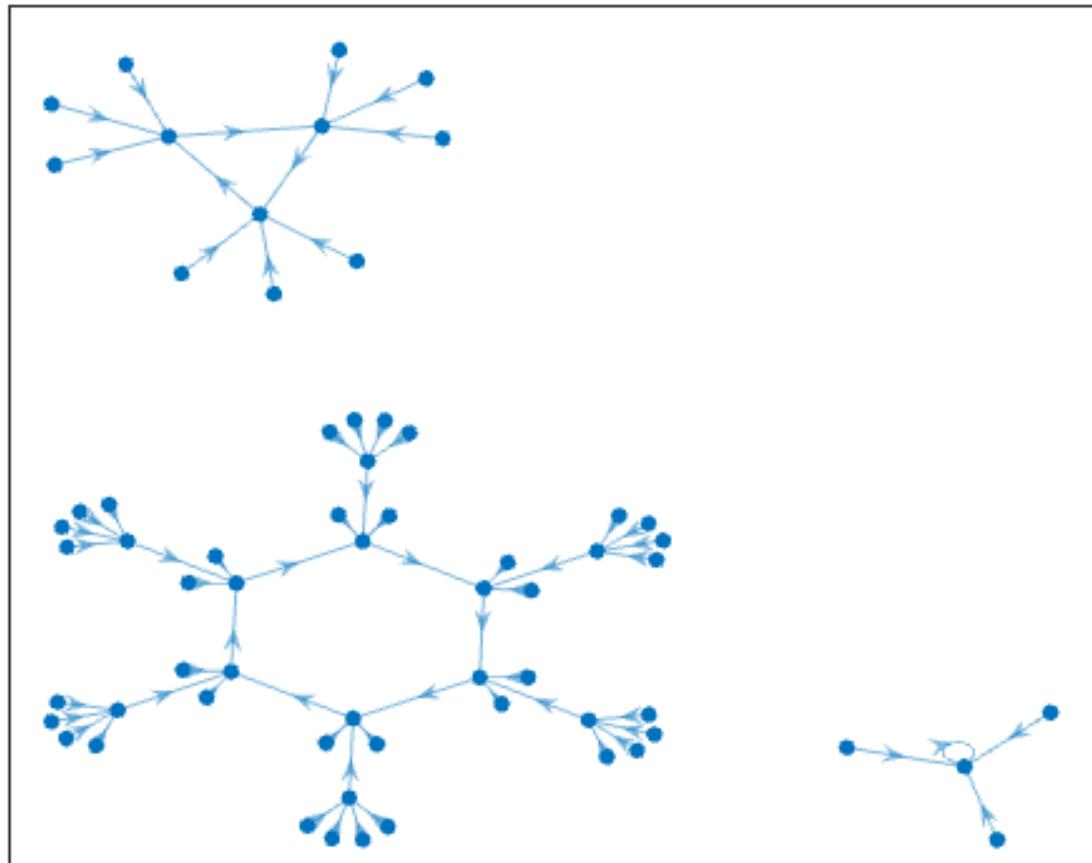
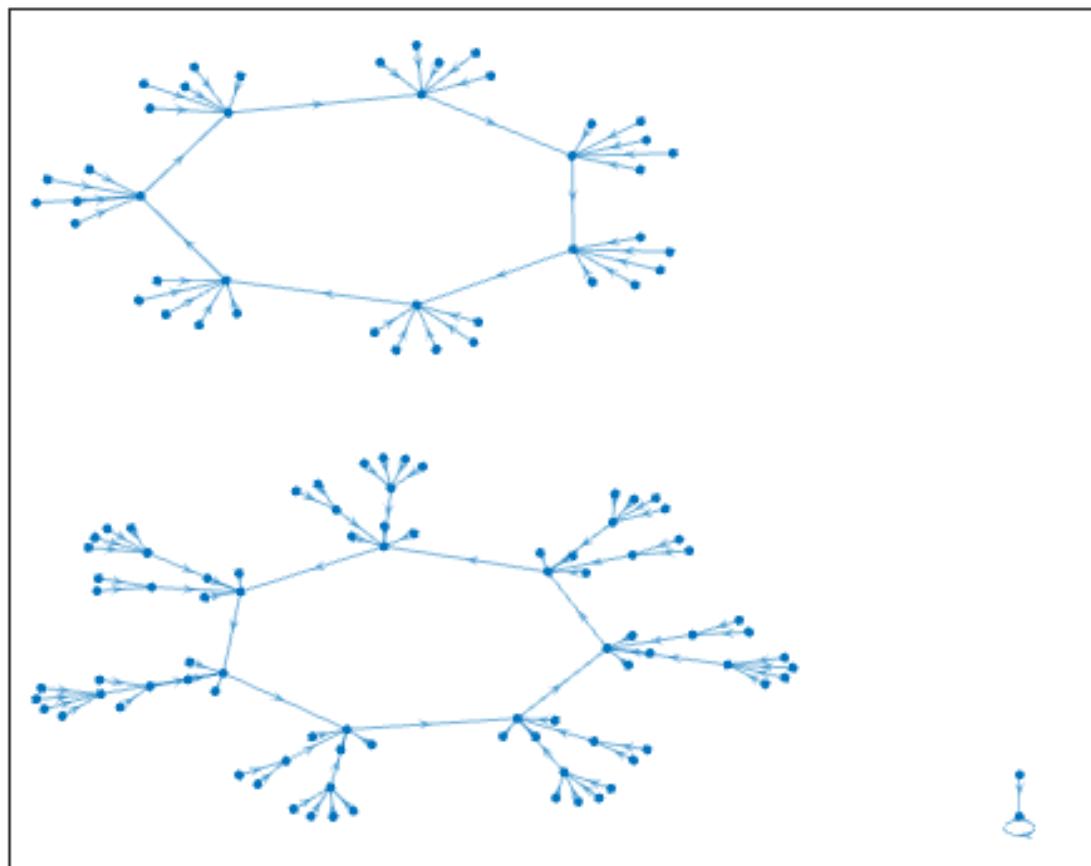
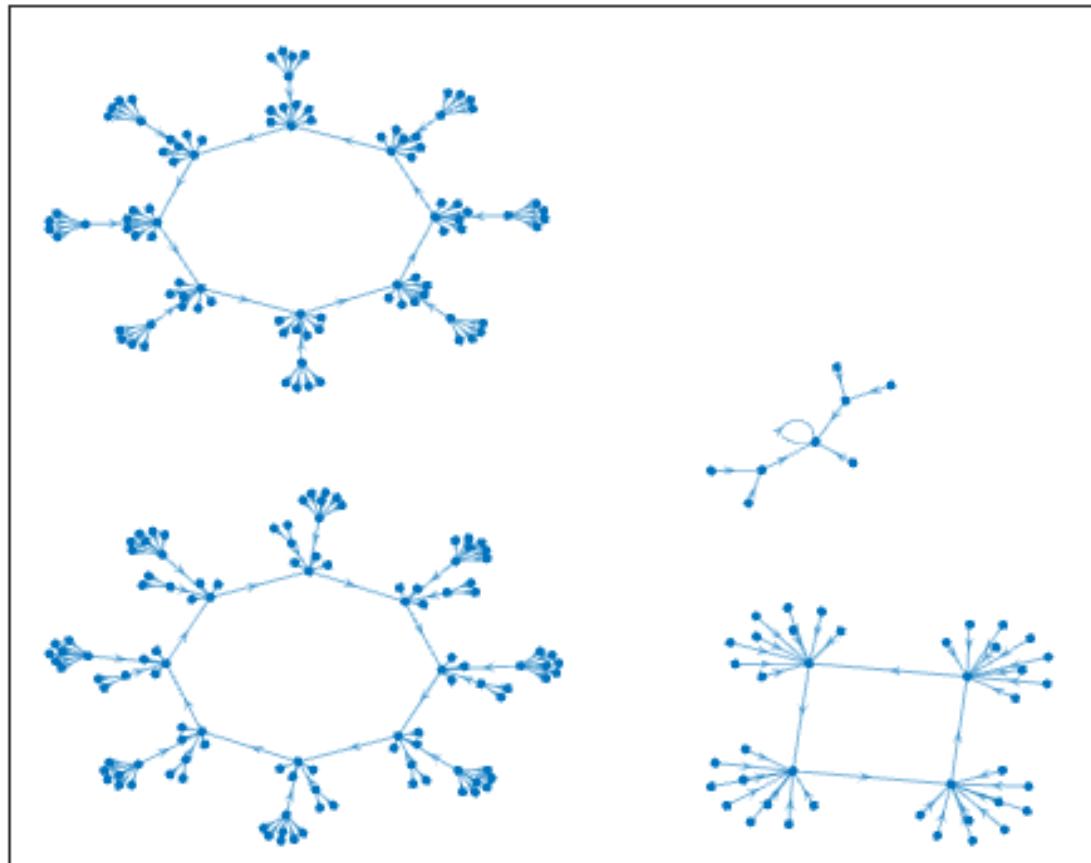


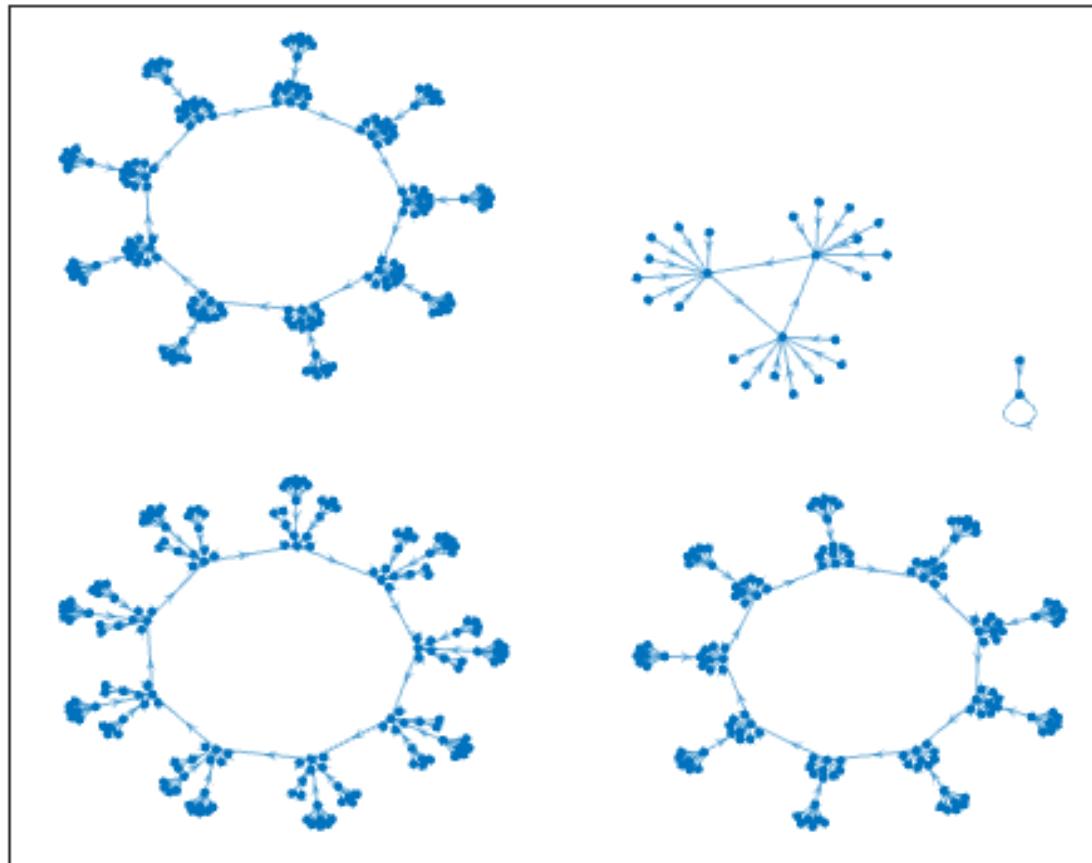
Figura 3.268: Atractor regla 24 n=4

Figura 3.269: Atractor regla 24 $n=5$

Figura 3.270: Atractor regla 24 $n=6$

Figura 3.271: Atractor regla 24 $n=7$

Figura 3.272: Atractor regla 24 $n=8$

Figura 3.273: Atractor regla 24 $n=9$

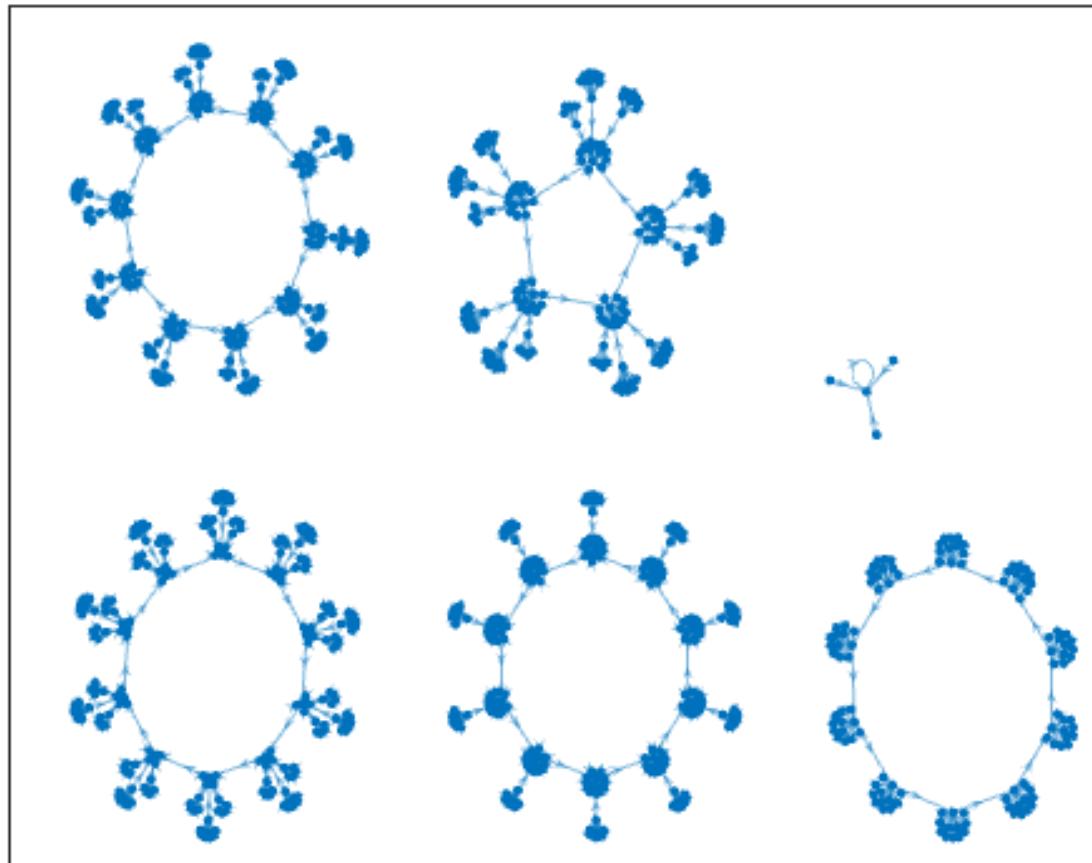


Figura 3.274: Atractor regla 24 n=10

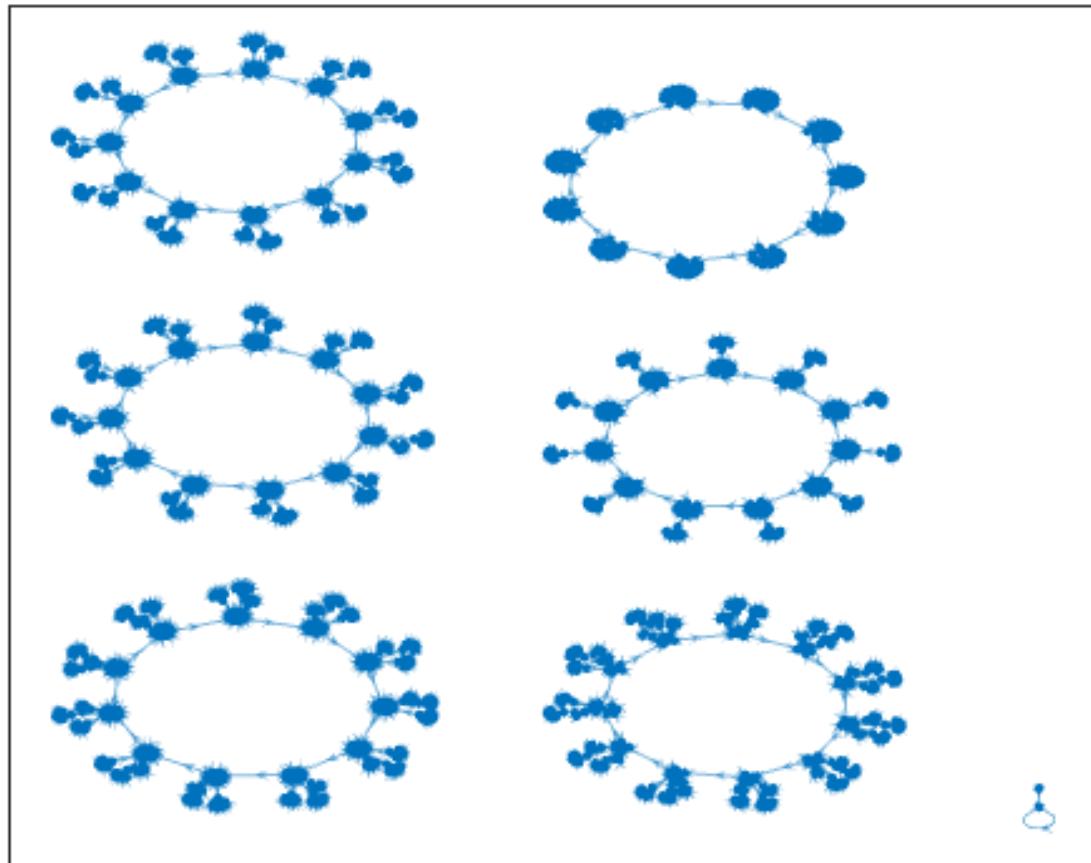


Figura 3.275: Atractor regla 24 n=11

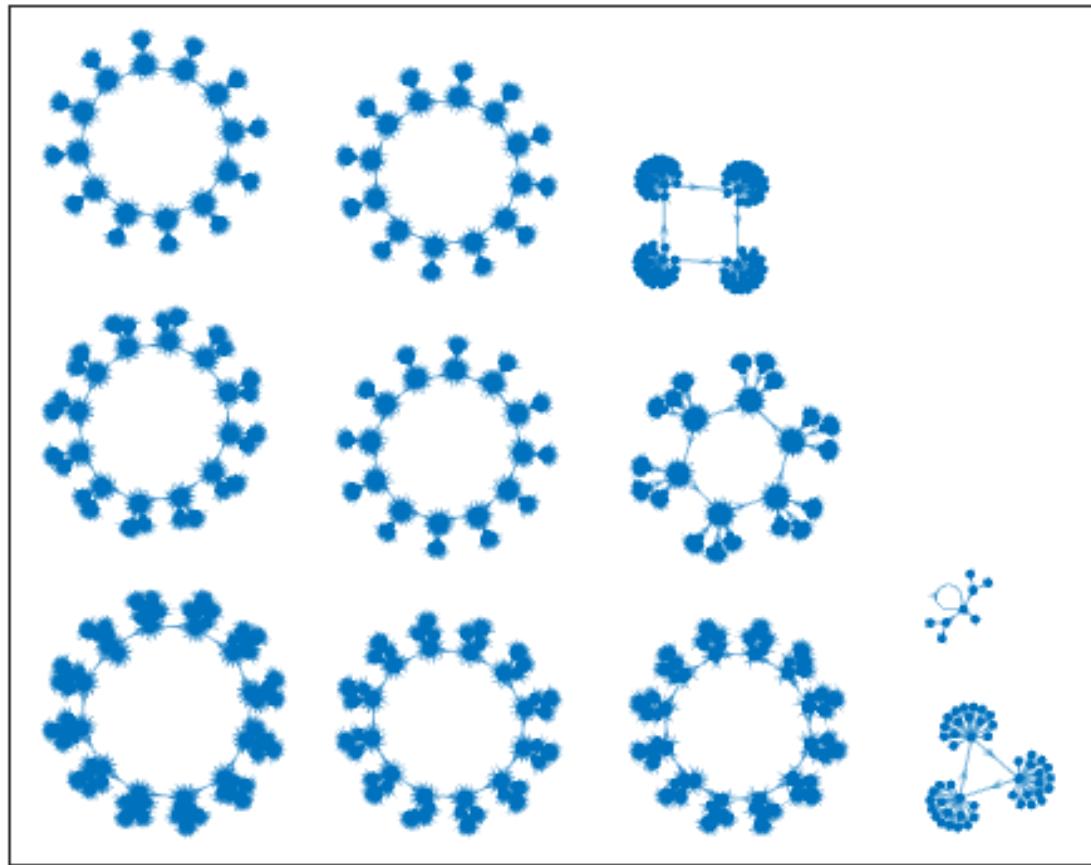


Figura 3.276: Atractor regla 24 n=12

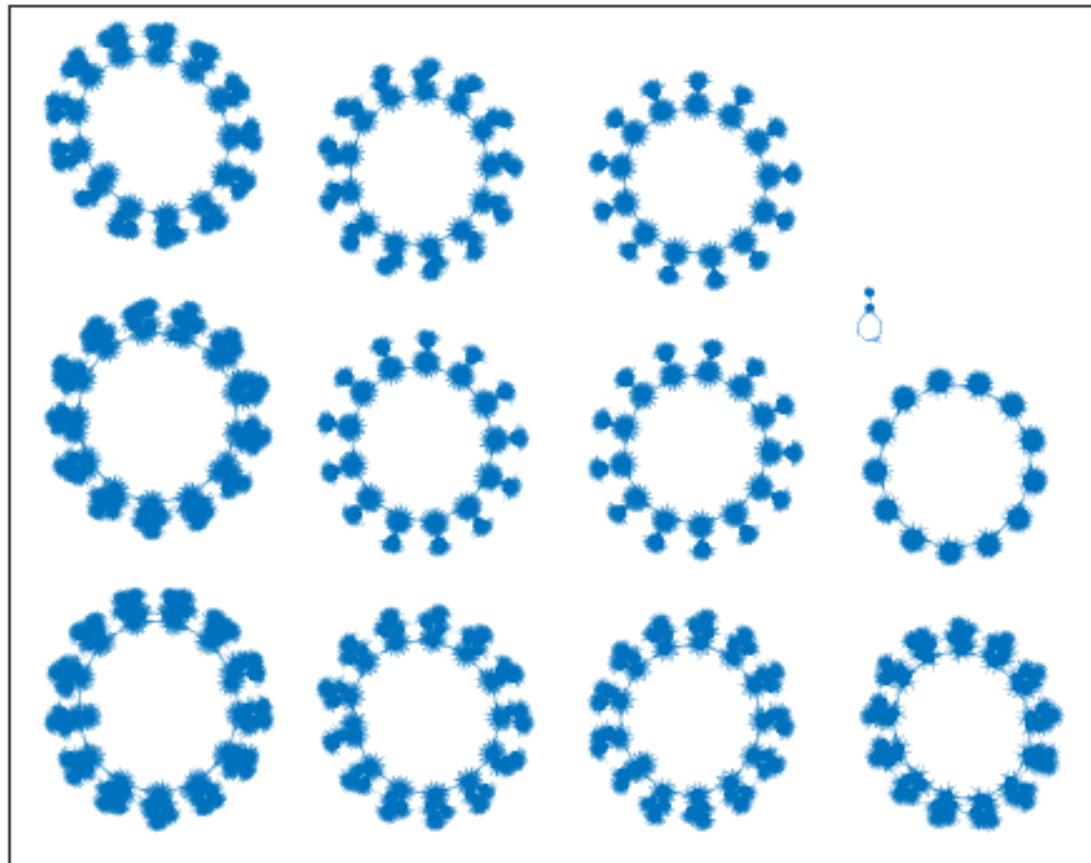


Figura 3.277: Atractor regla 24 n=13

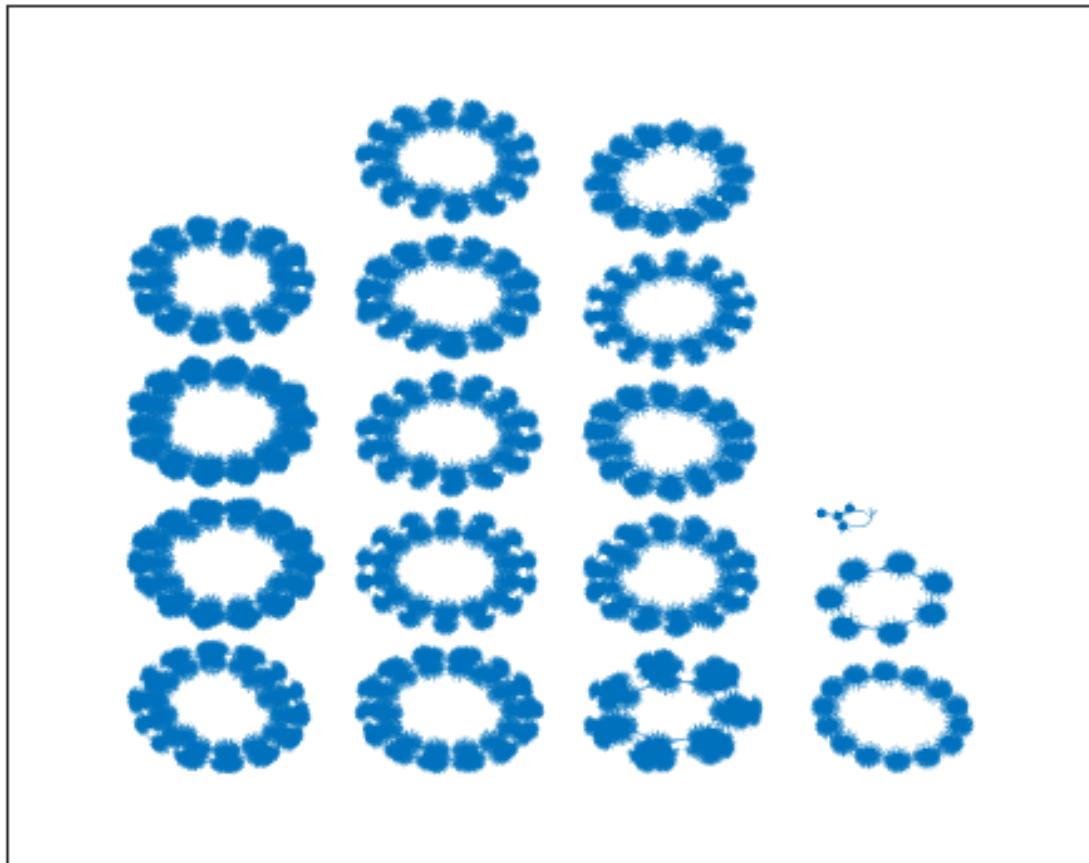
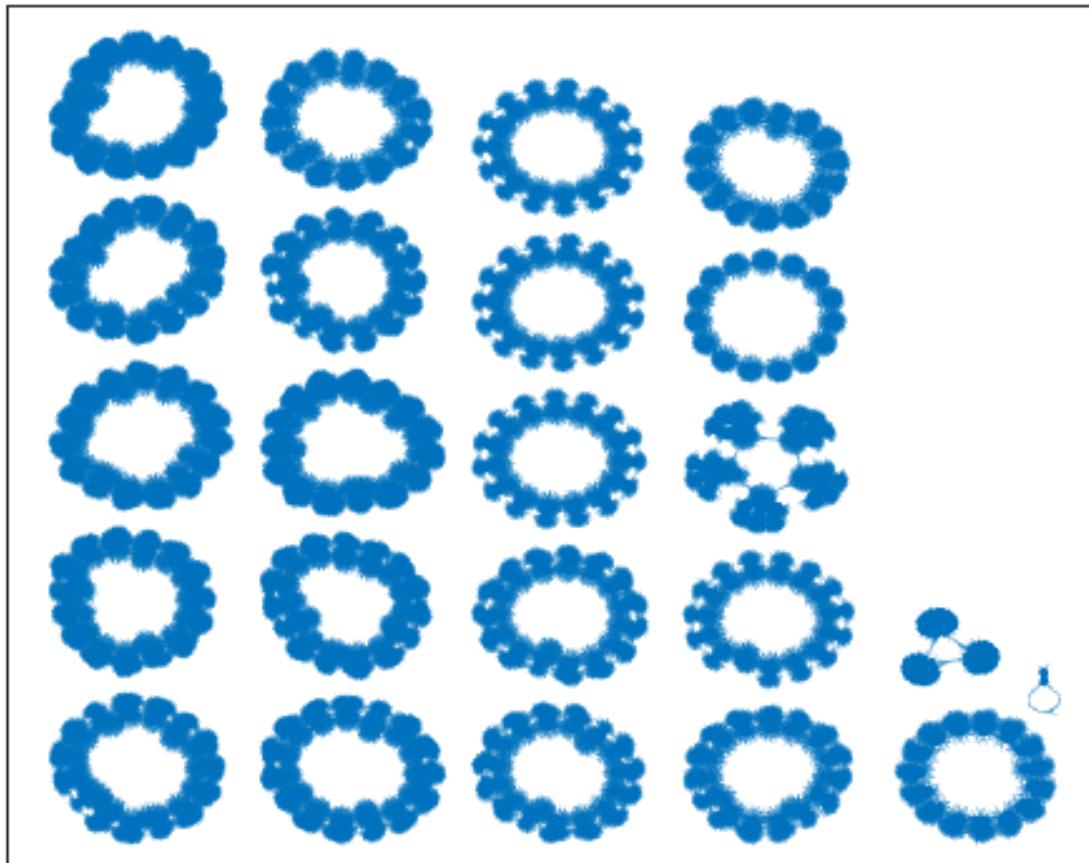


Figura 3.278: Atractor regla 24 n=14

Figura 3.279: Atractor regla 24 $n=15$

3.22. Reglas 25,61,67,103

Respecto a la regla 25 se aprecia que mientras más grande es el tamaño de la cadena (n) el atractor que surge en la imagen 3.283 y que posteriormente se va a ubicar en la esquina inferior izquierda se mantiene y solo incrementa el número de nodos que aparecen y convergen a él.

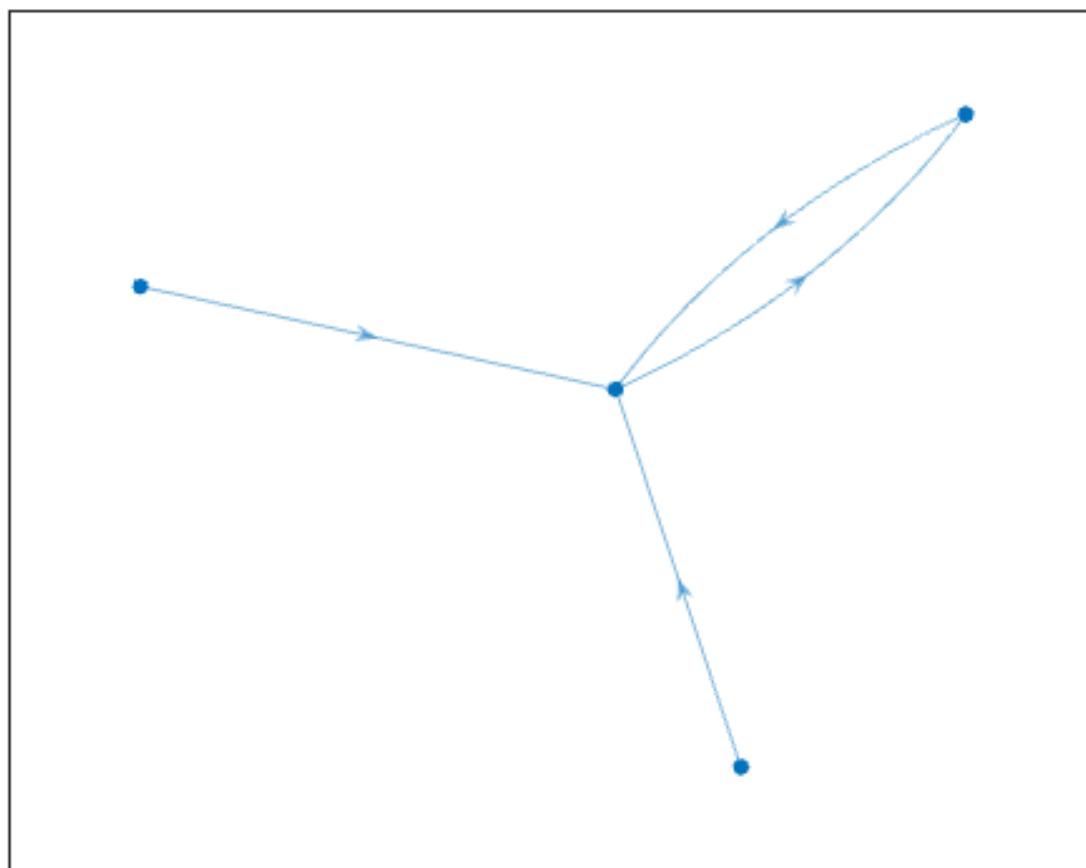


Figura 3.280: Atractor regla 25 n=2

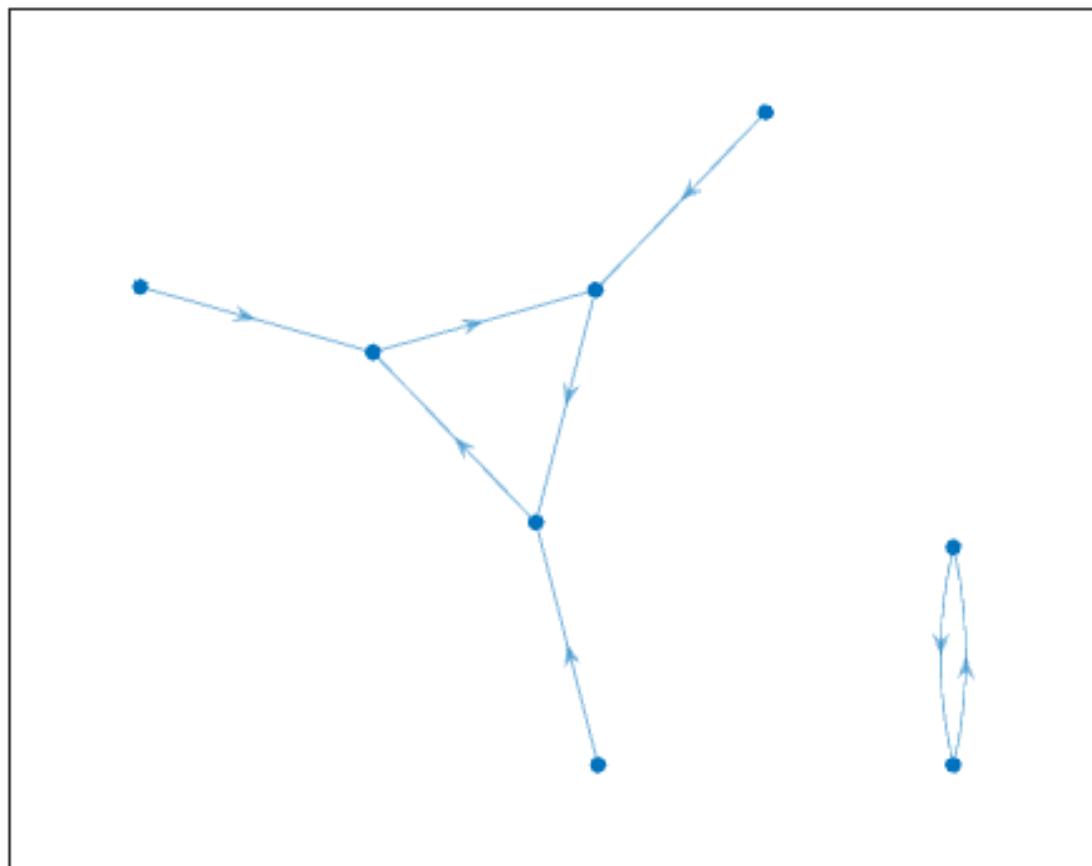


Figura 3.281: Atractor regla 25 n=3

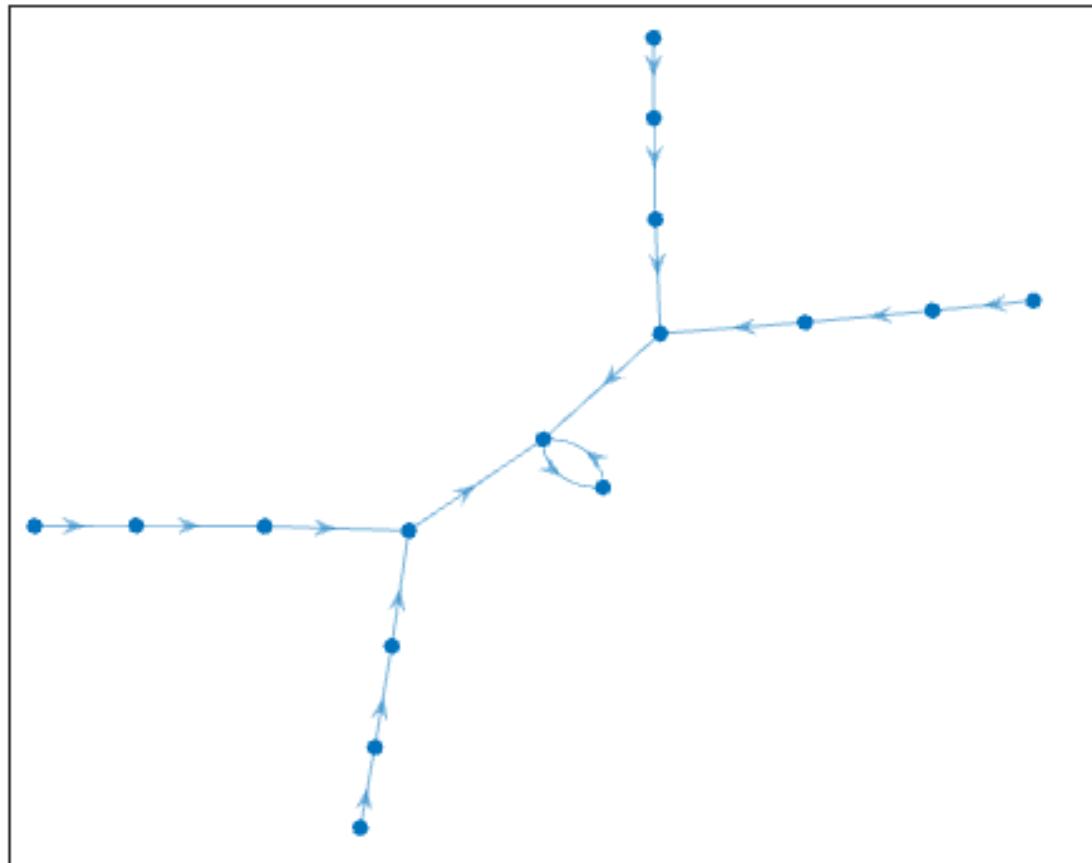


Figura 3.282: Atractor regla 25 n=4

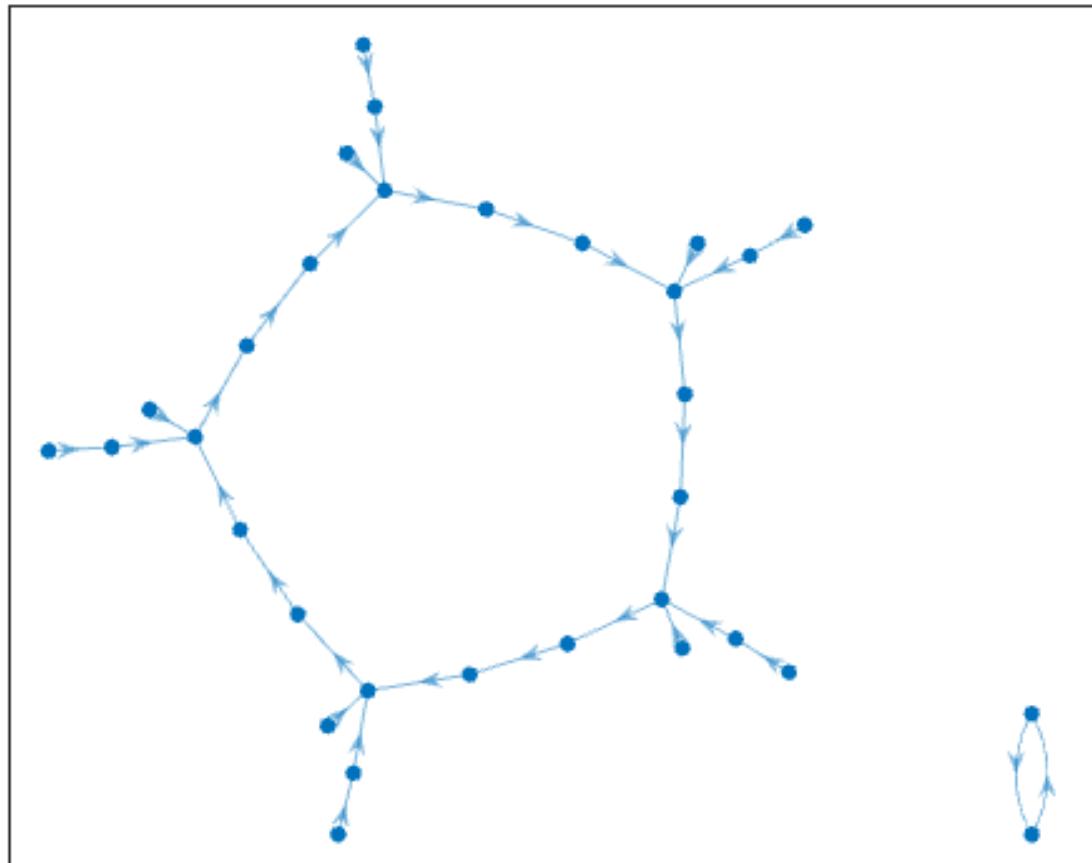


Figura 3.283: Atractor regla 25 n=5

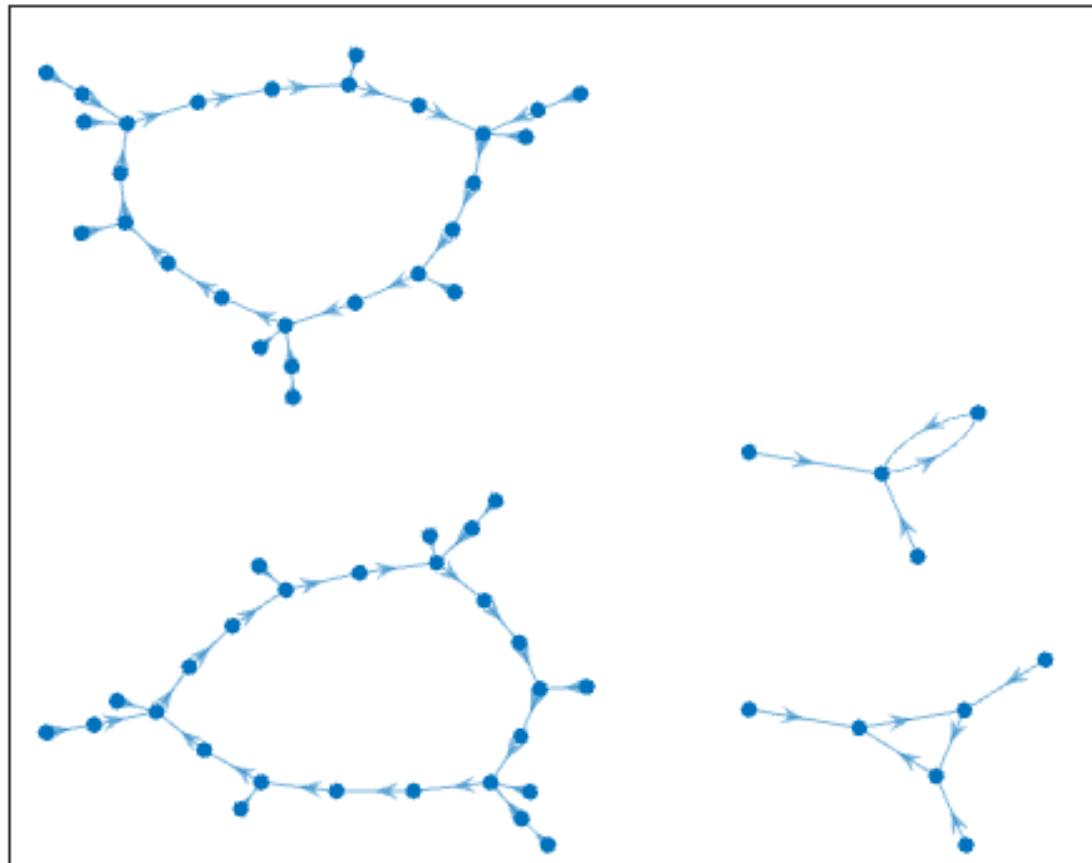


Figura 3.284: Atractor regla 25 n=6

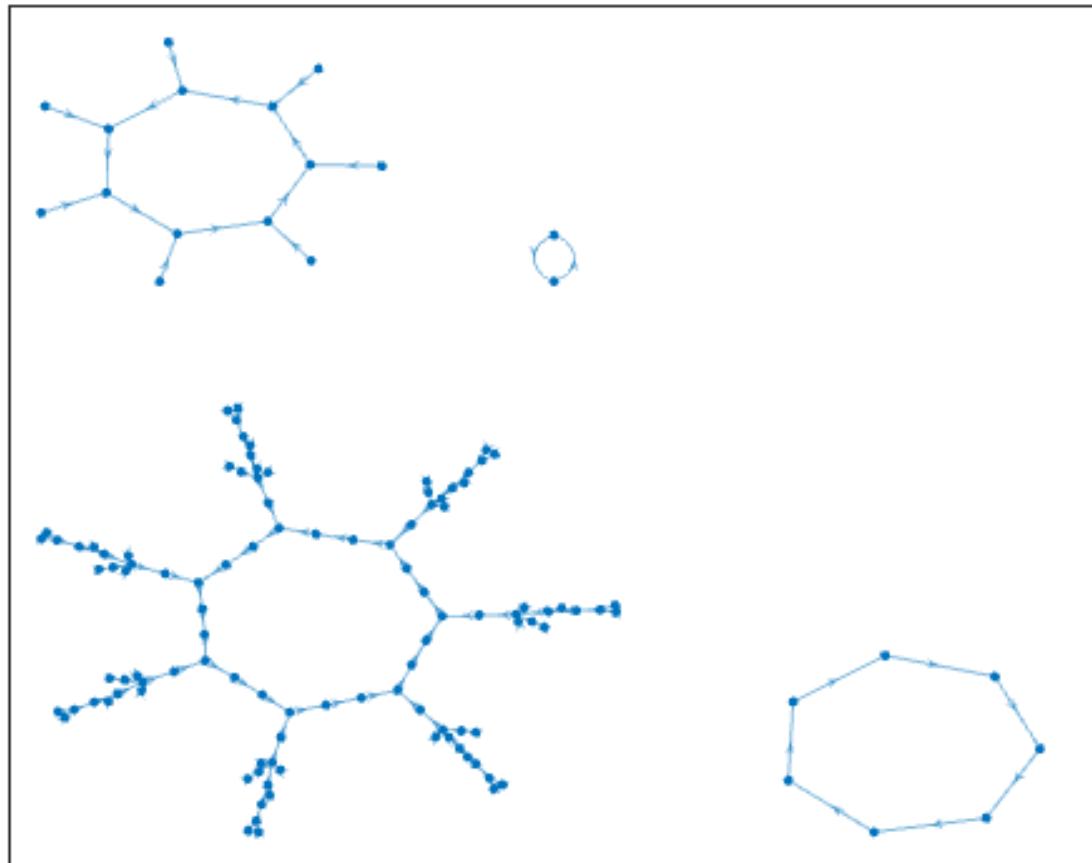
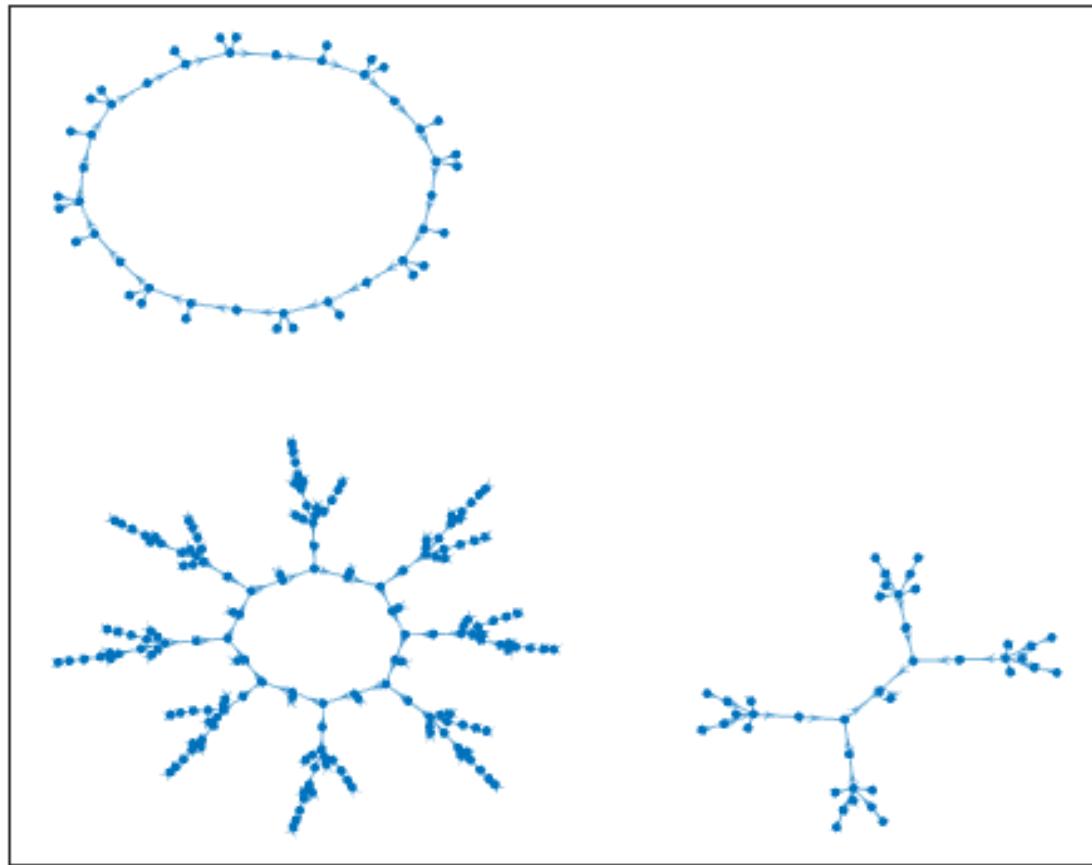


Figura 3.285: Atractor regla 25 n=7

Figura 3.286: Atractor regla 25 $n=8$

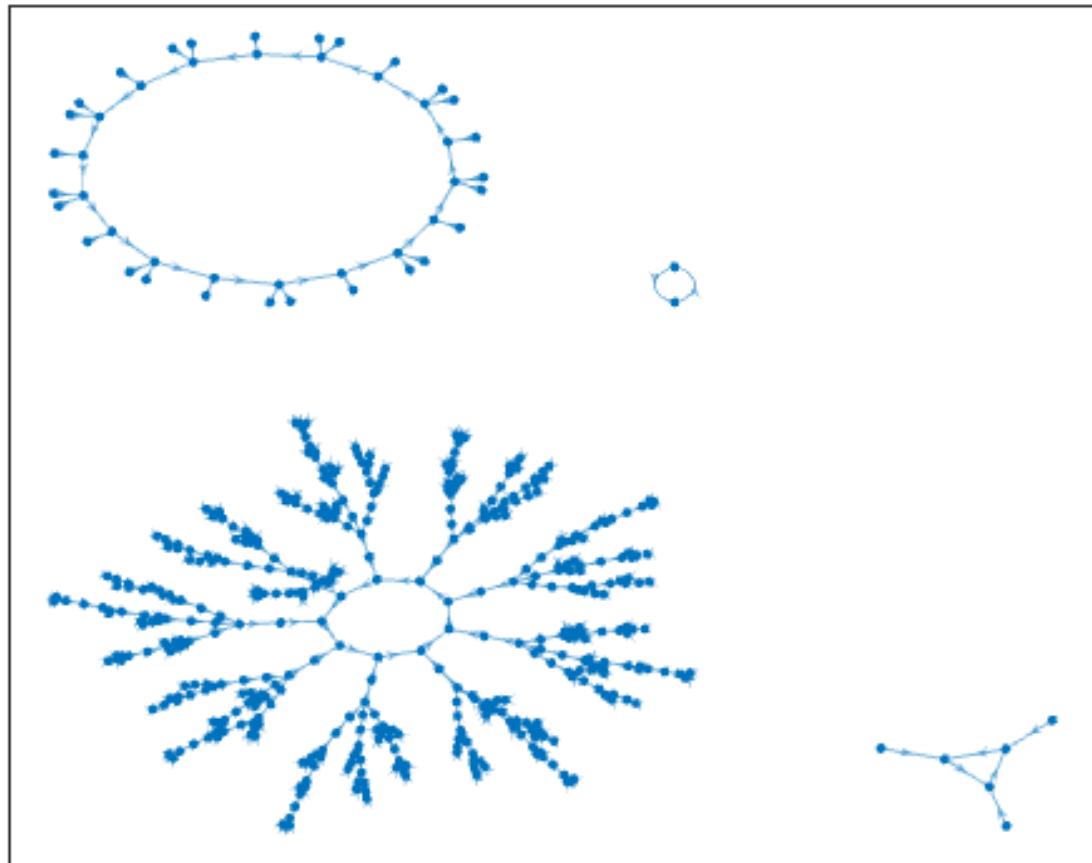


Figura 3.287: Atractor regla 25 n=9

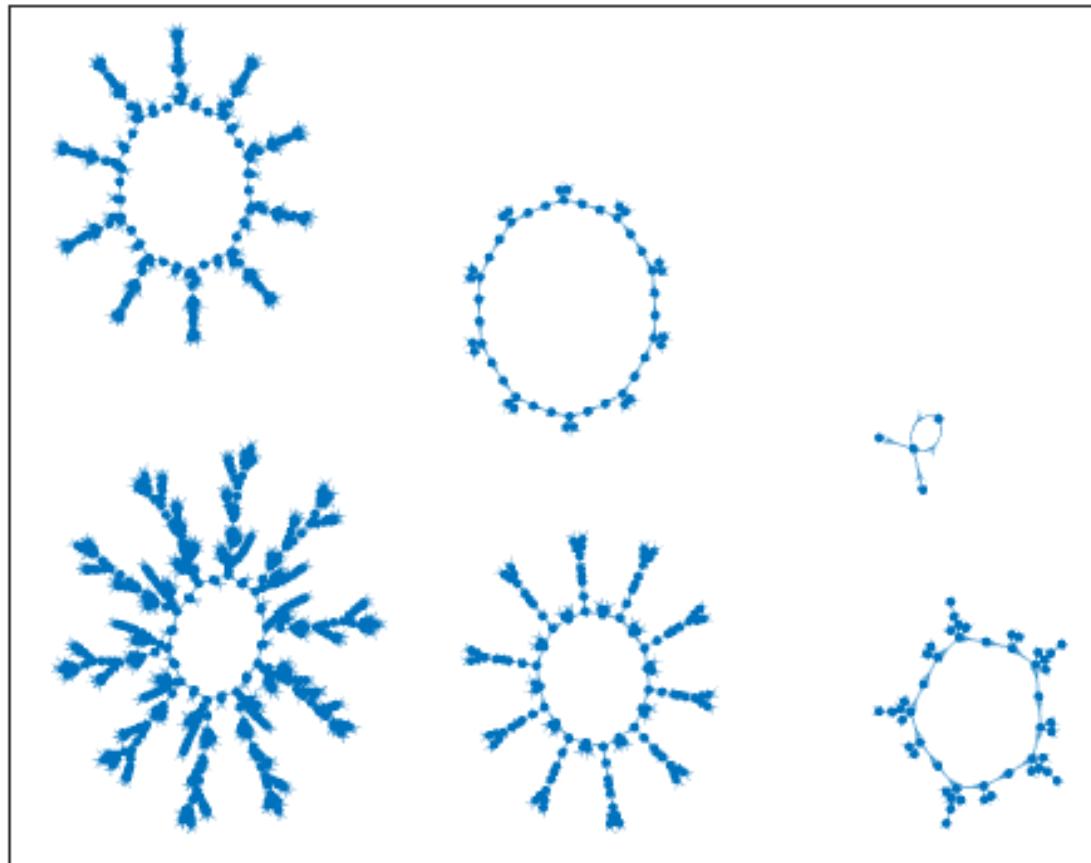
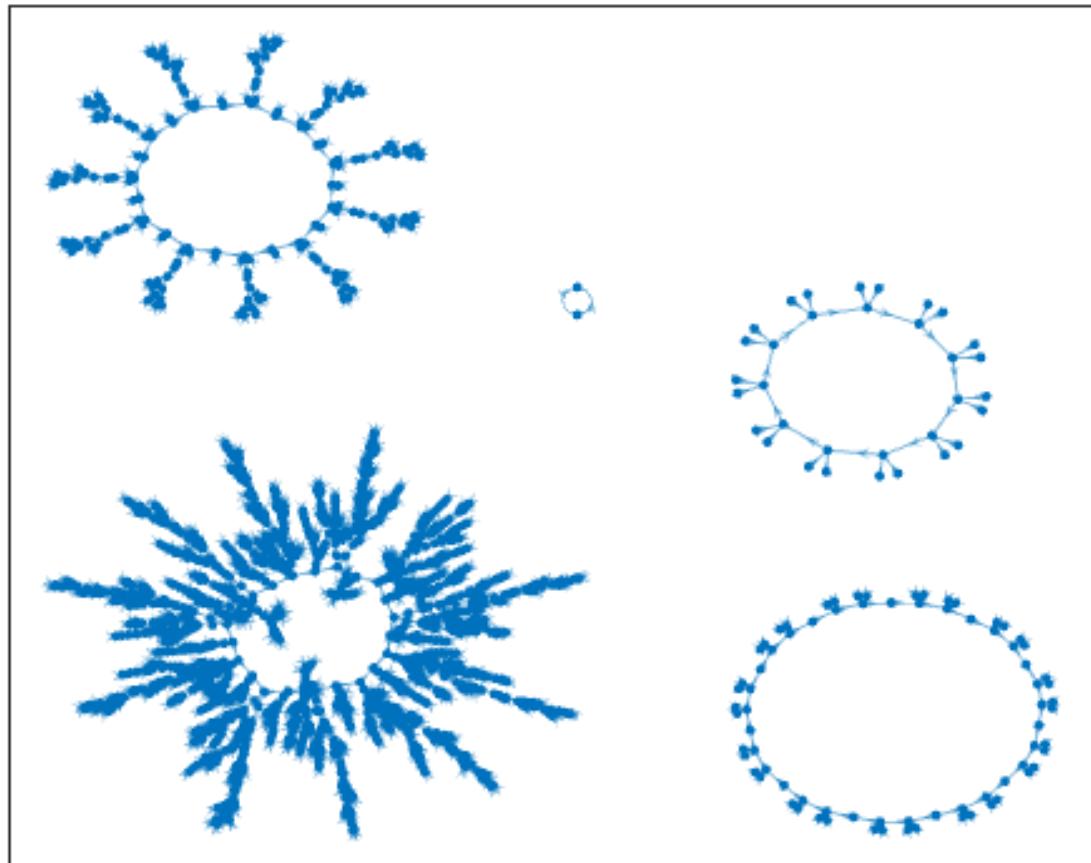


Figura 3.288: Atractor regla 25 n=10

Figura 3.289: Atractor regla 25 $n=11$

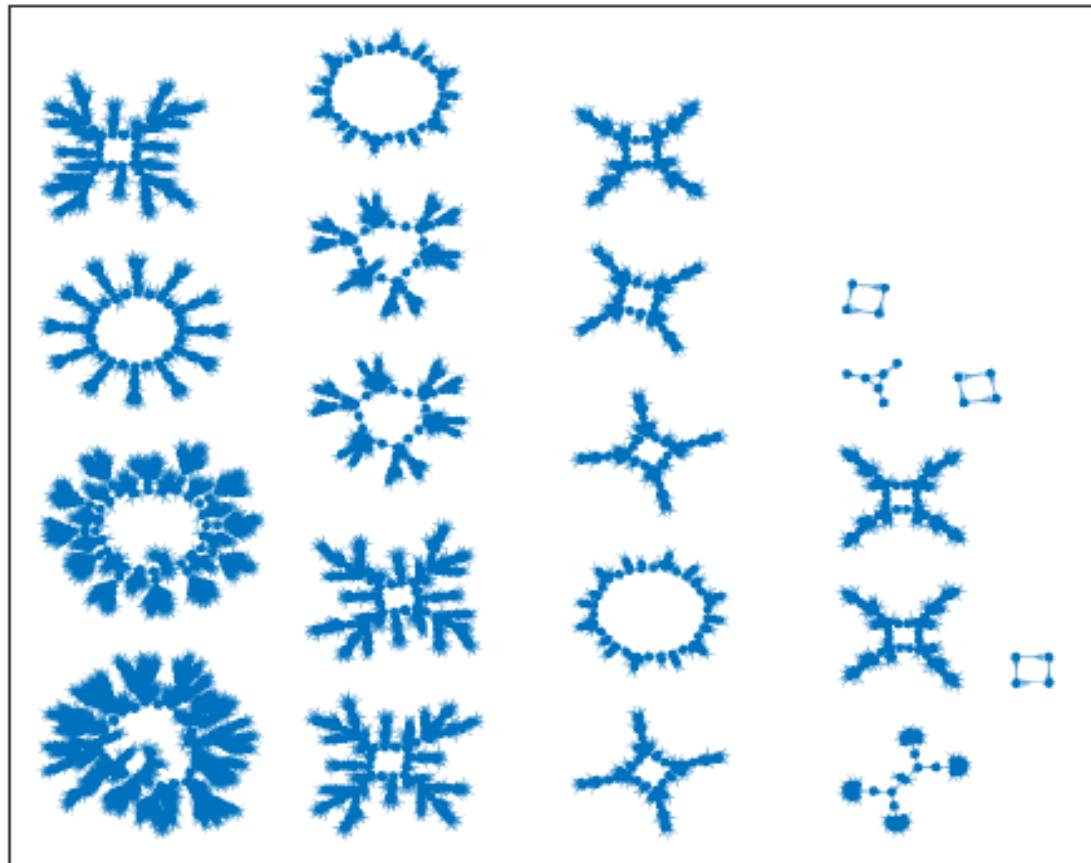


Figura 3.290: Atractor regla 25 n=12

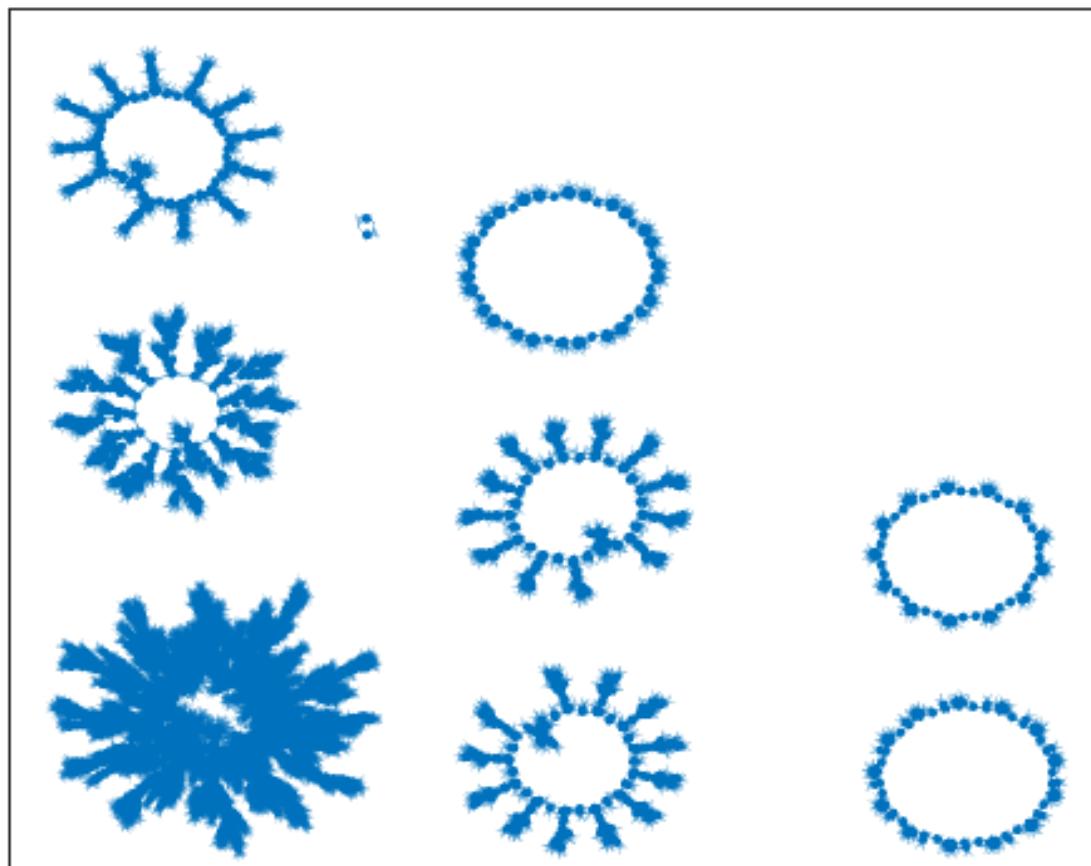
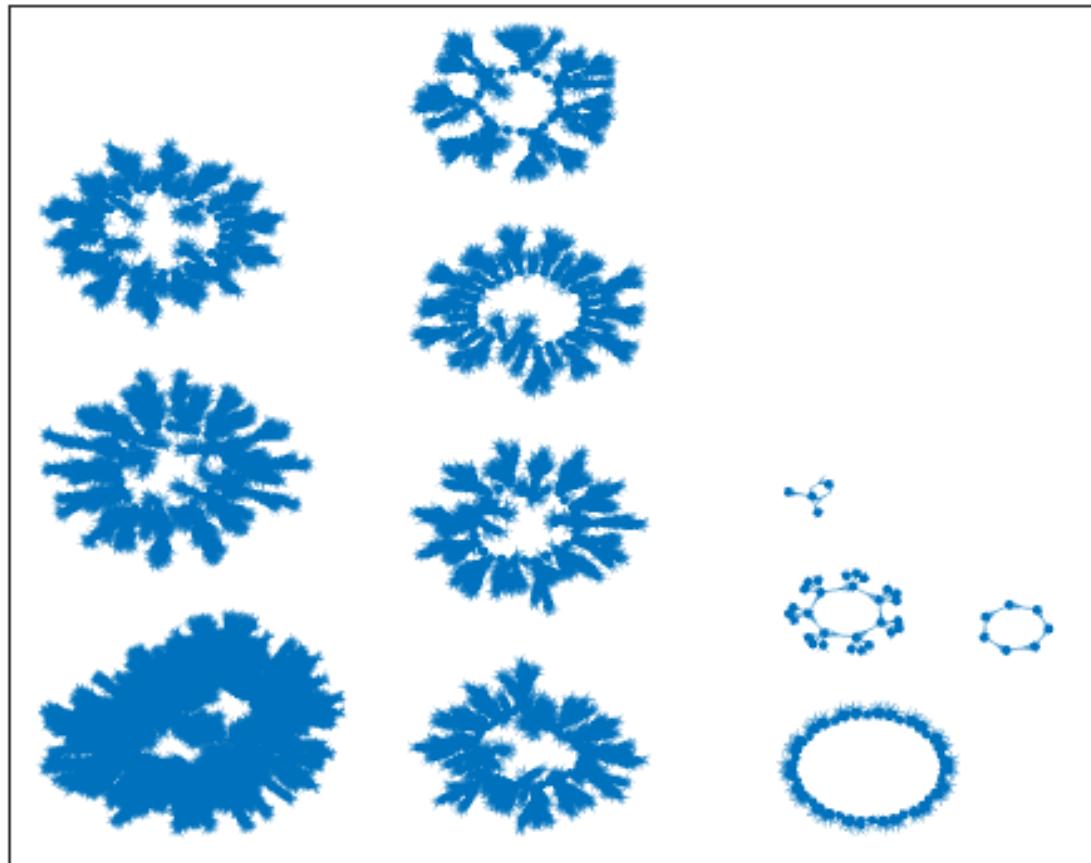


Figura 3.291: Atractor regla 25 n=13

Figura 3.292: Atractor regla 25 $n=14$

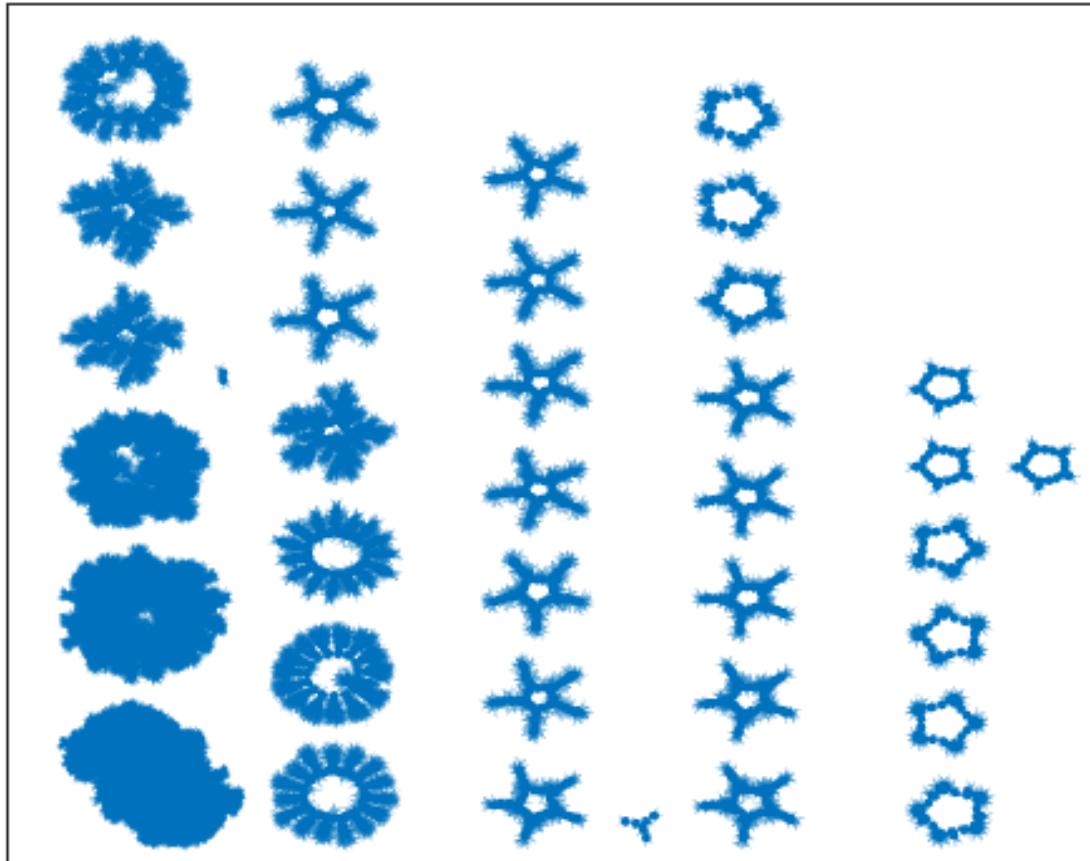


Figura 3.293: Atractor regla 25 n=15

3.23. Reglas 26,82,167,181

Respecto a la regla 26 se aprecia que mientras más grande es el tamaño de la cadena (n) a partir de una $n=7$ solo aparecen atractores «masivos» con alguna esporádica aparición de uno que otro atractor pequeño.

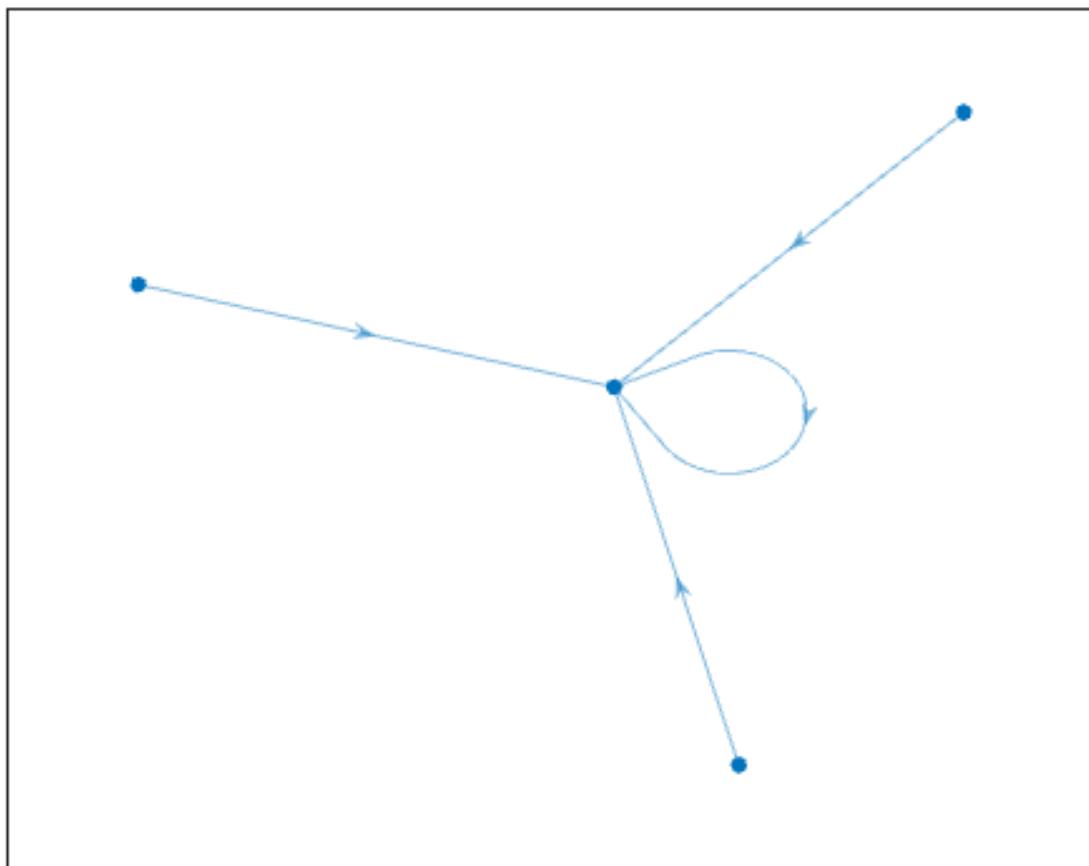


Figura 3.294: Atractor regla 26 $n=2$

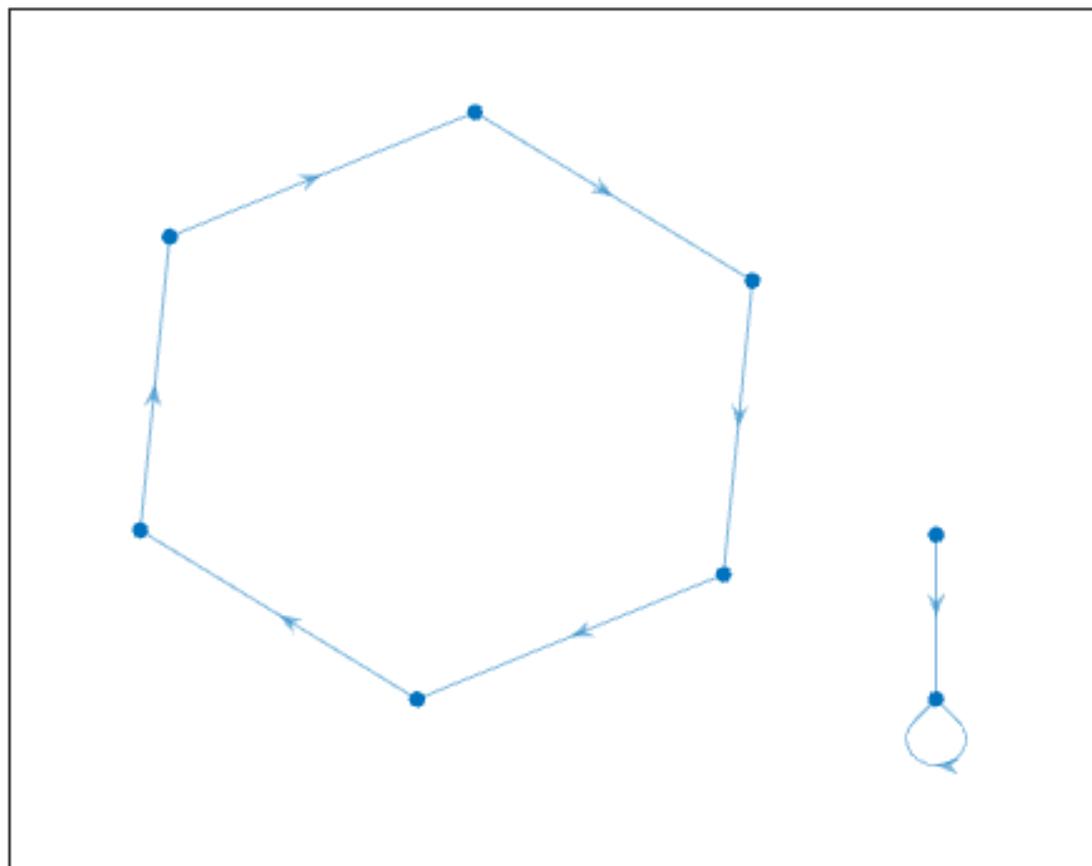


Figura 3.295: Atractor regla 26 n=3

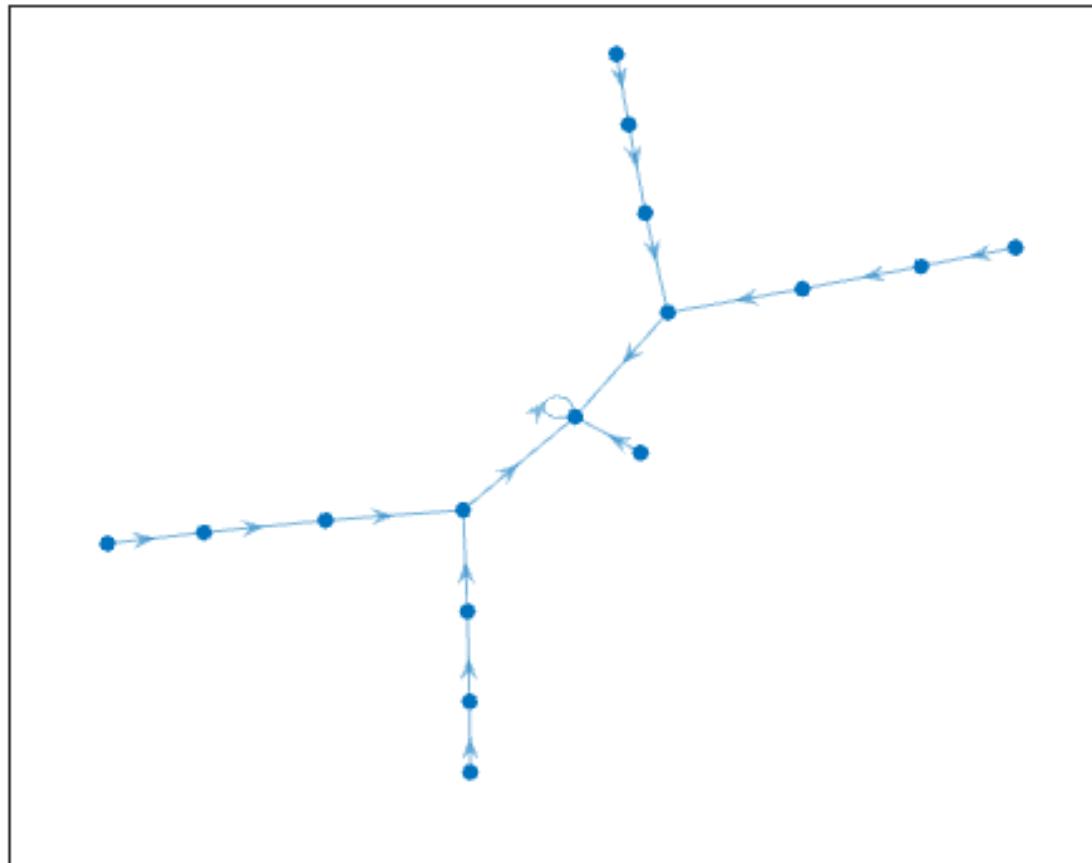


Figura 3.296: Atractor regla 26 n=4

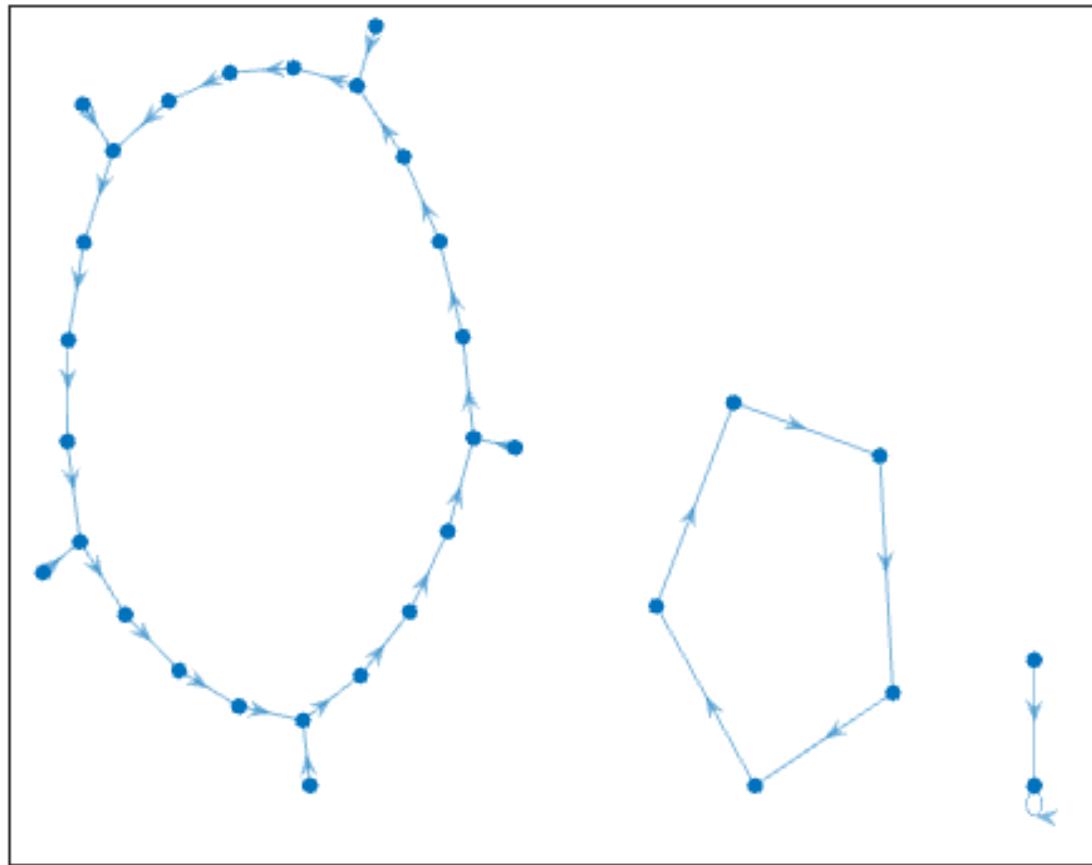


Figura 3.297: Atractor regla 26 n=5

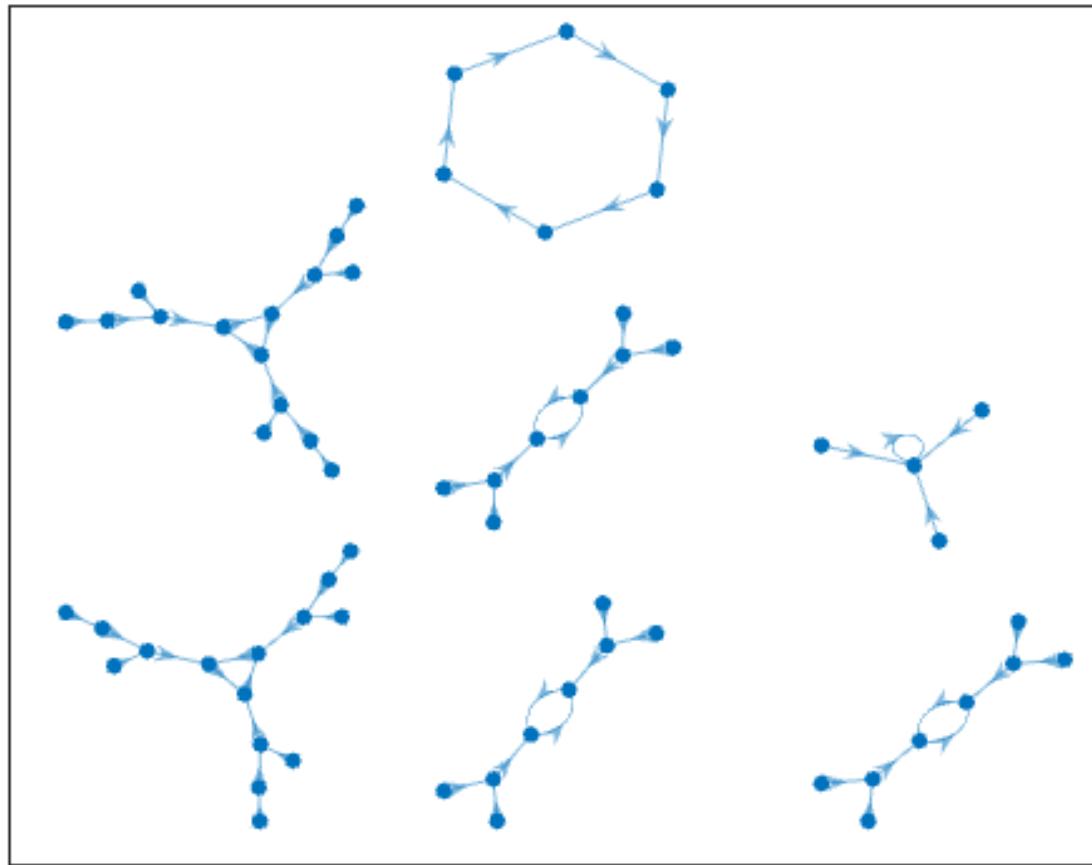


Figura 3.298: Atractor regla 26 n=6

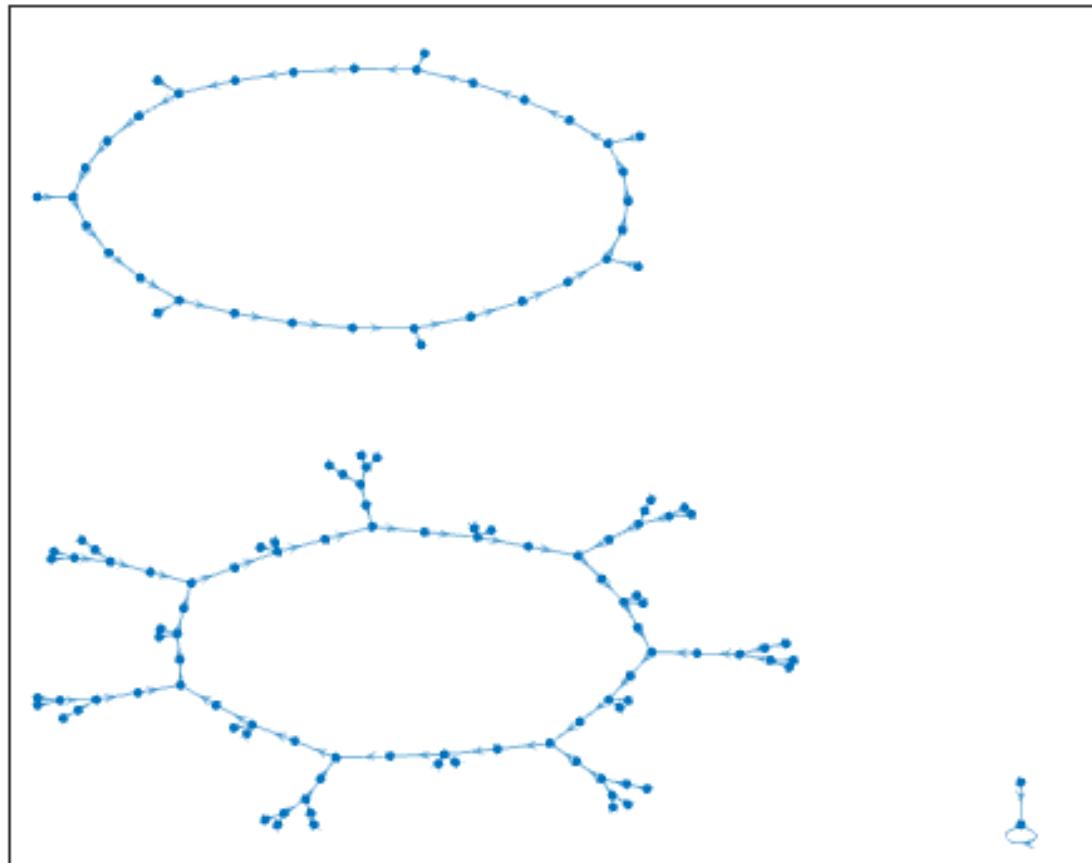


Figura 3.299: Atractor regla 26 n=7

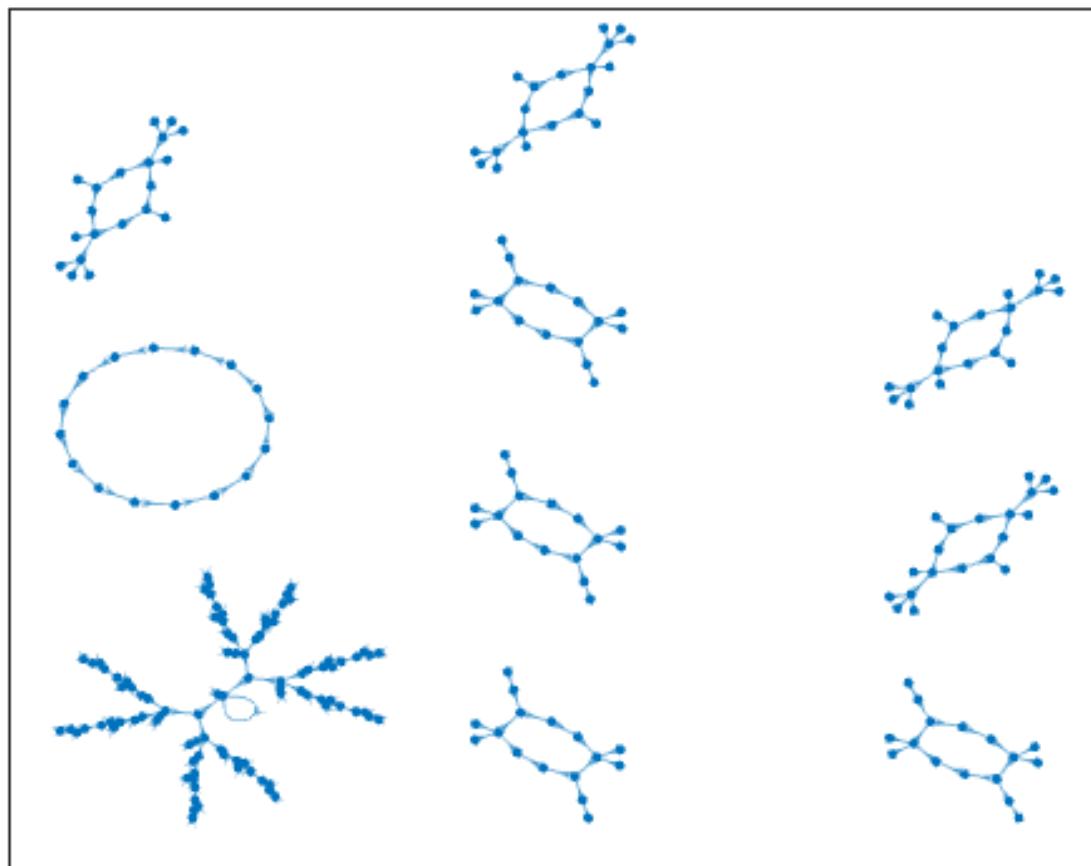
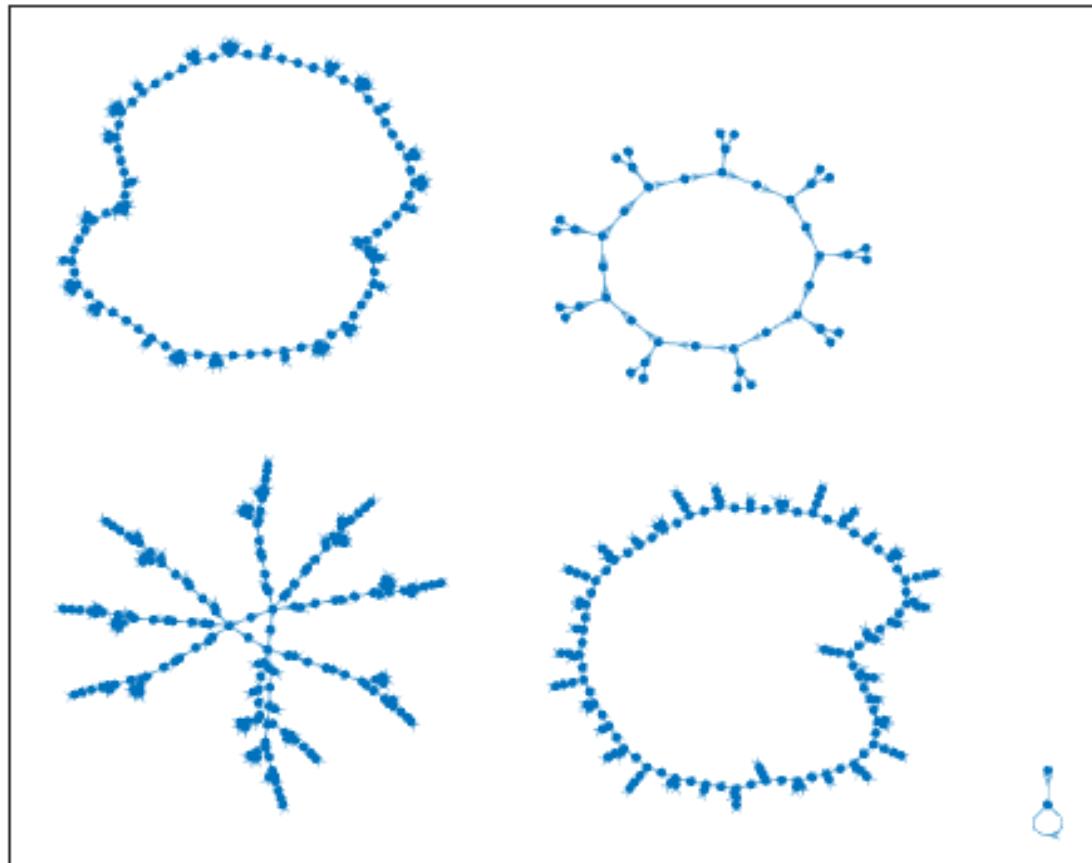


Figura 3.300: Atractor regla 26 n=8

Figura 3.301: Atractor regla 26 $n=9$

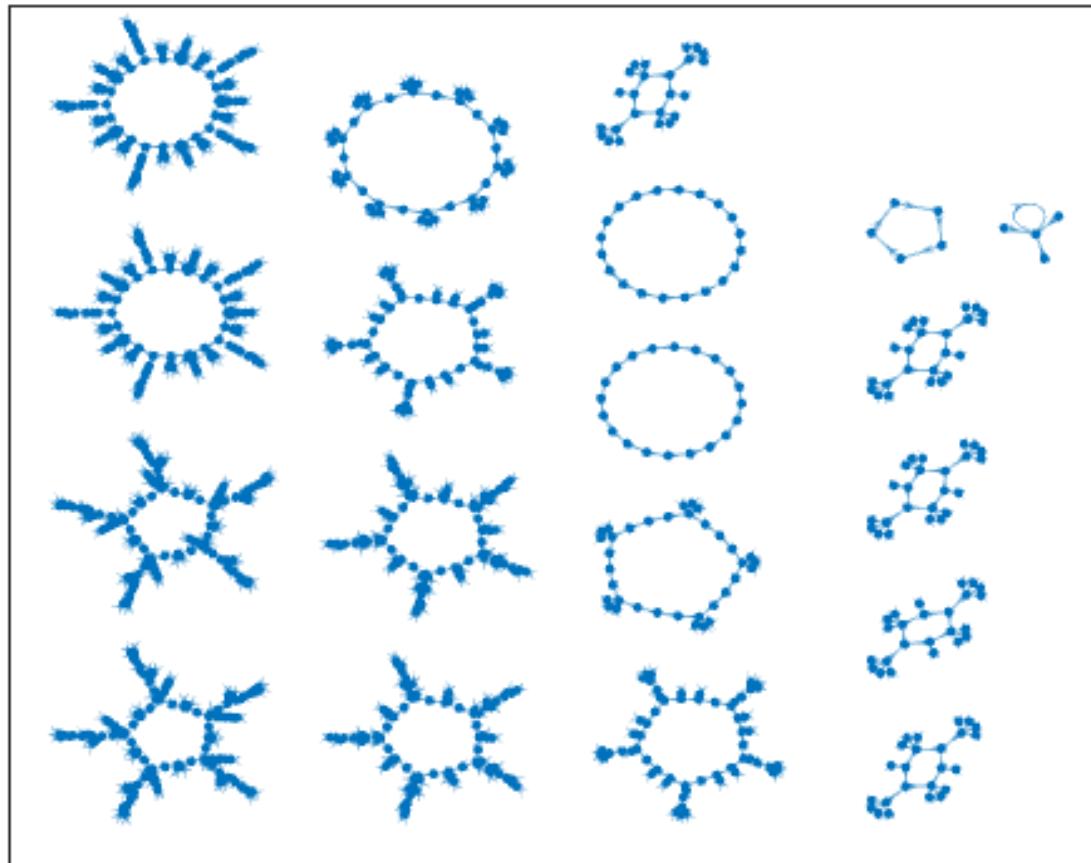


Figura 3.302: Atractor regla 26 n=10

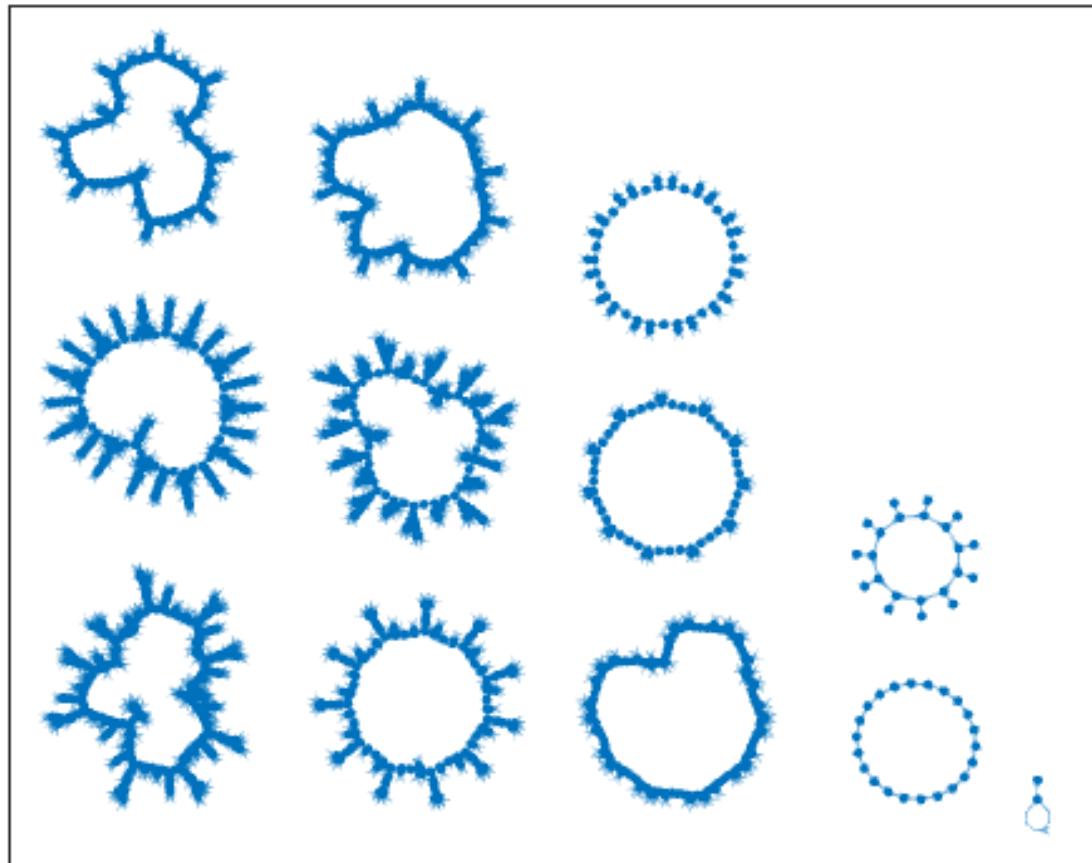


Figura 3.303: Atractor regla 26 $n=11$

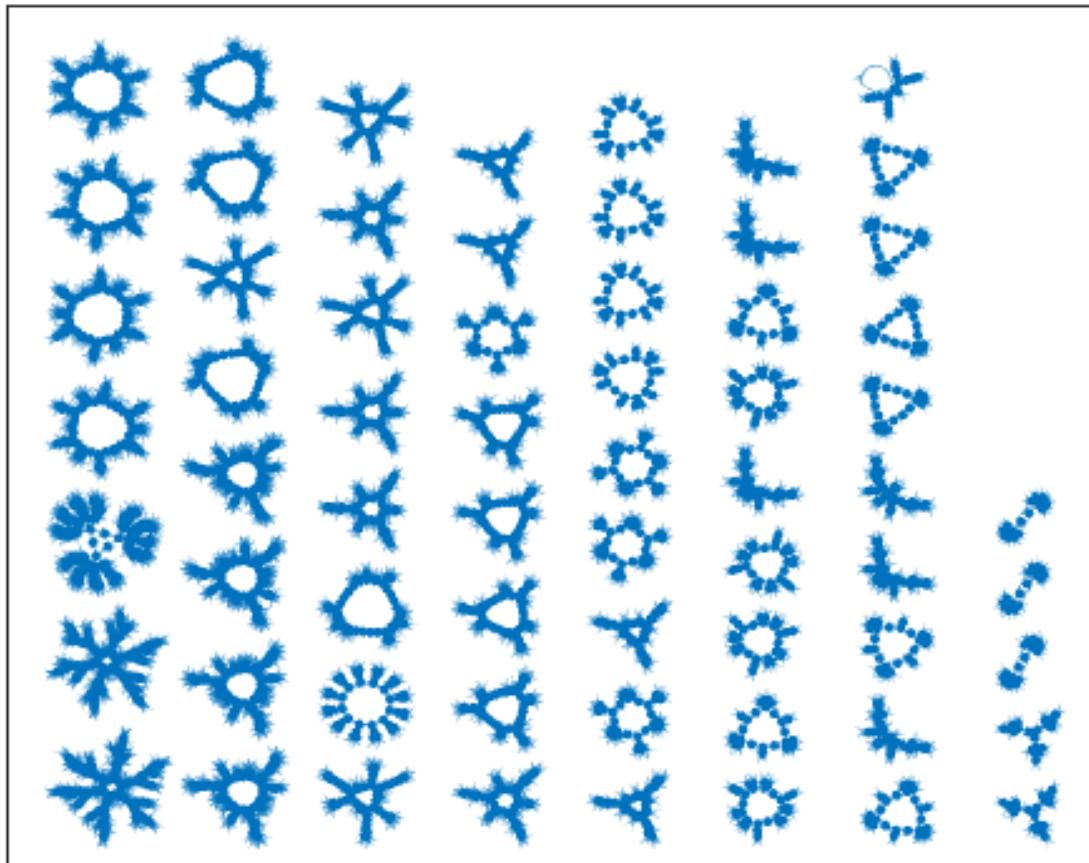
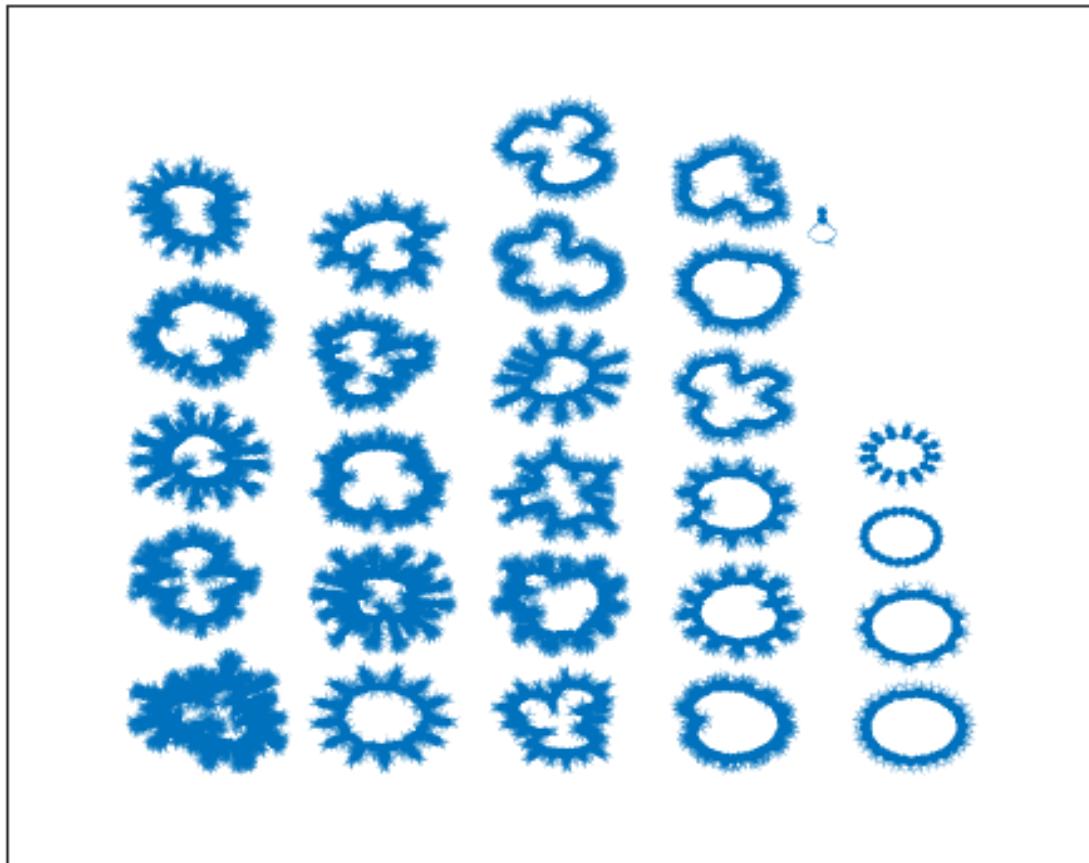


Figura 3.304: Atractor regla 26 n=12

Figura 3.305: Atractor regla 26 $n=13$

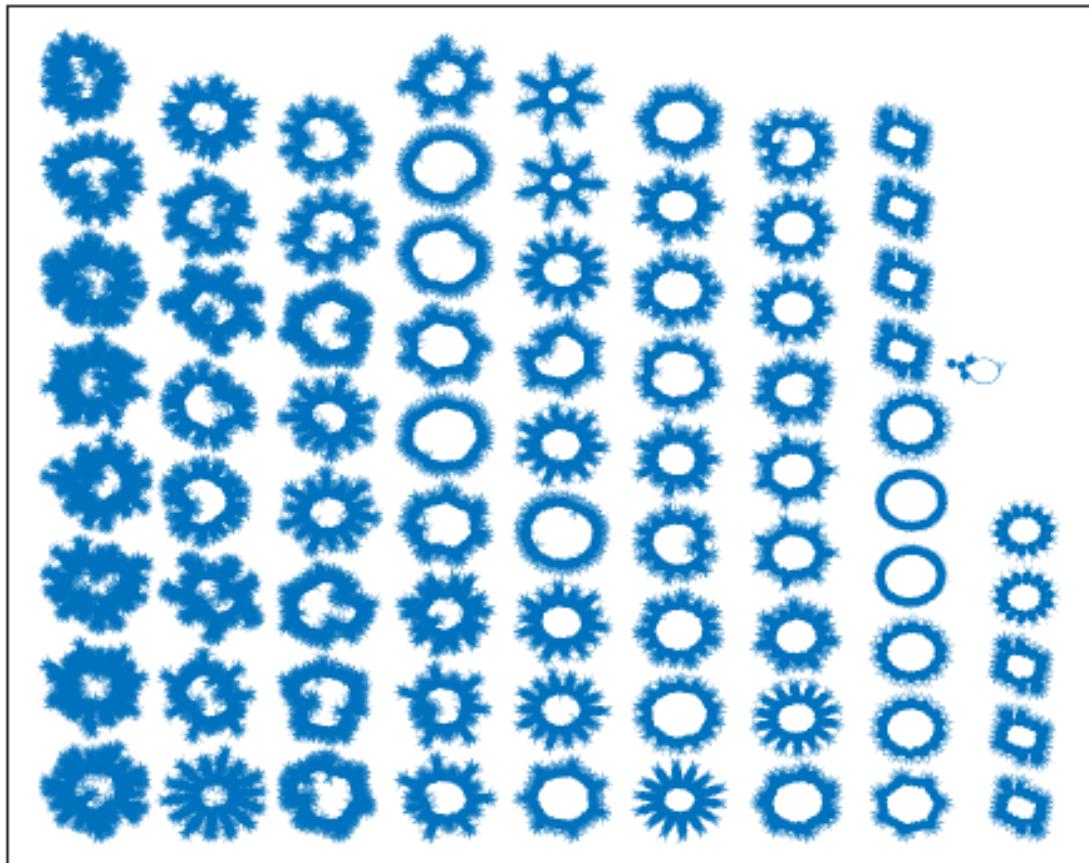


Figura 3.306: Atractor regla 26 n=14

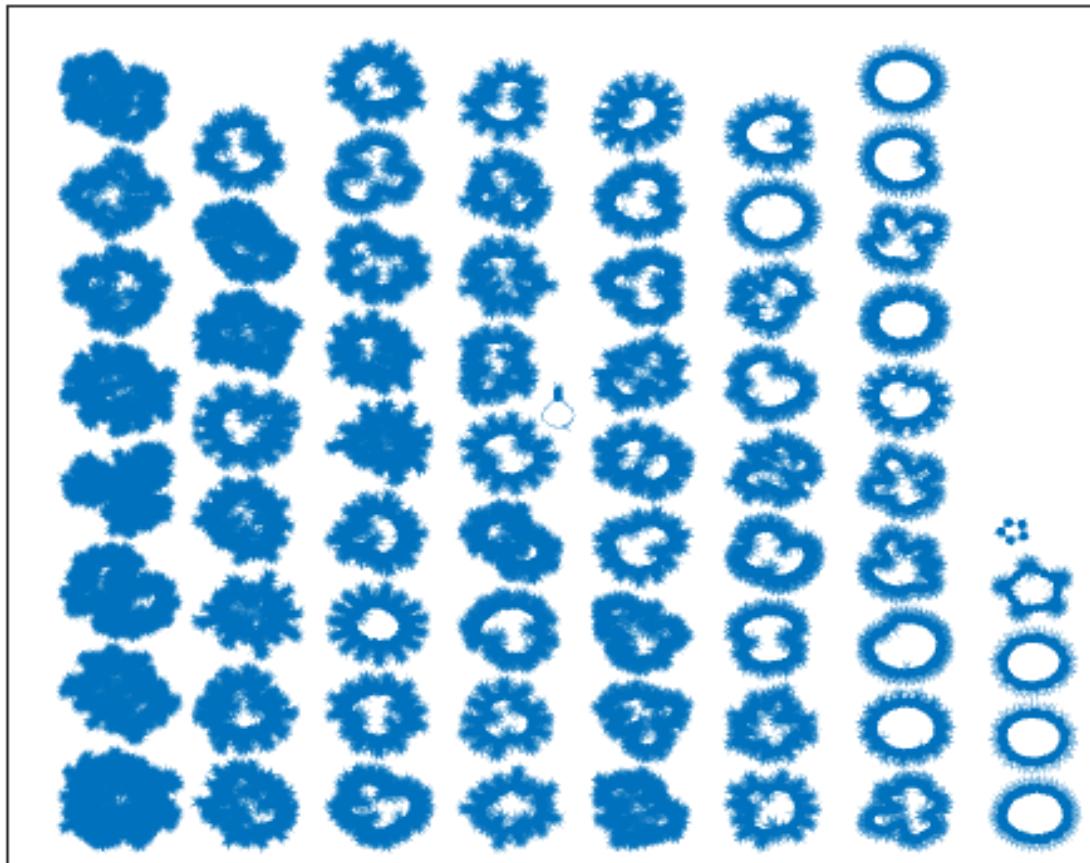


Figura 3.307: Atractor regla 26 n=15

3.24. Reglas 27,39,53,83

Respecto a la regla 27 se aprecia que mientras más grande es el tamaño de la cadena (n) pareciera que los nuevos atractores siguen el camino de los atractores que ya estaban antes que ellos por decirlo de alguna forma, esto da lugar a que, como se observa en las imágenes 3.314 en adelante, los atractores toman formas circulares.

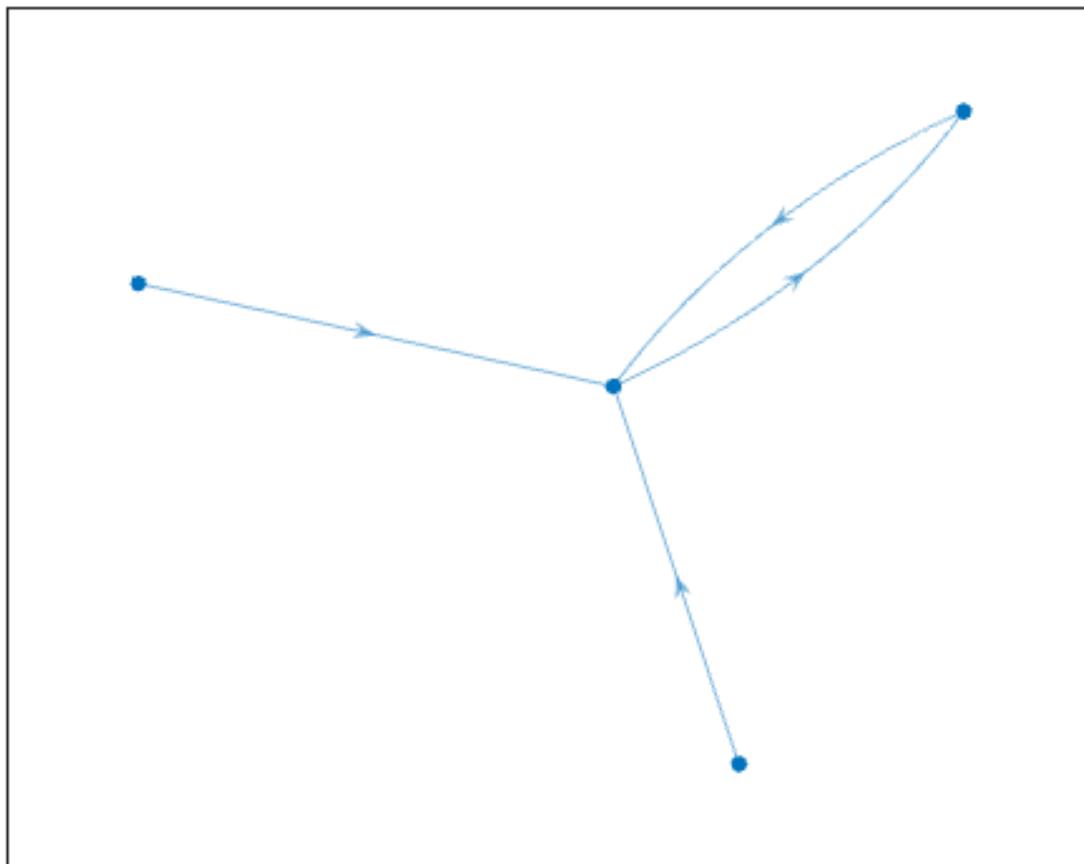


Figura 3.308: Atractor regla 27 $n=2$

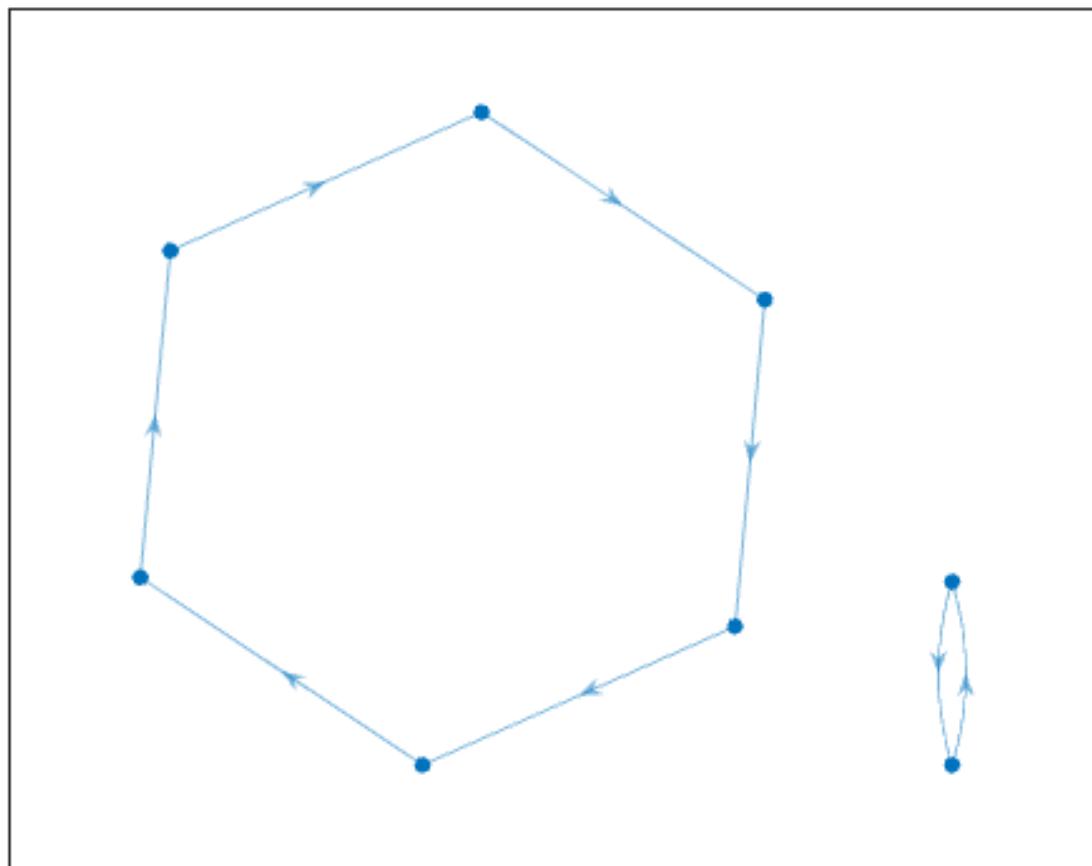


Figura 3.309: Atractor regla 27 n=3

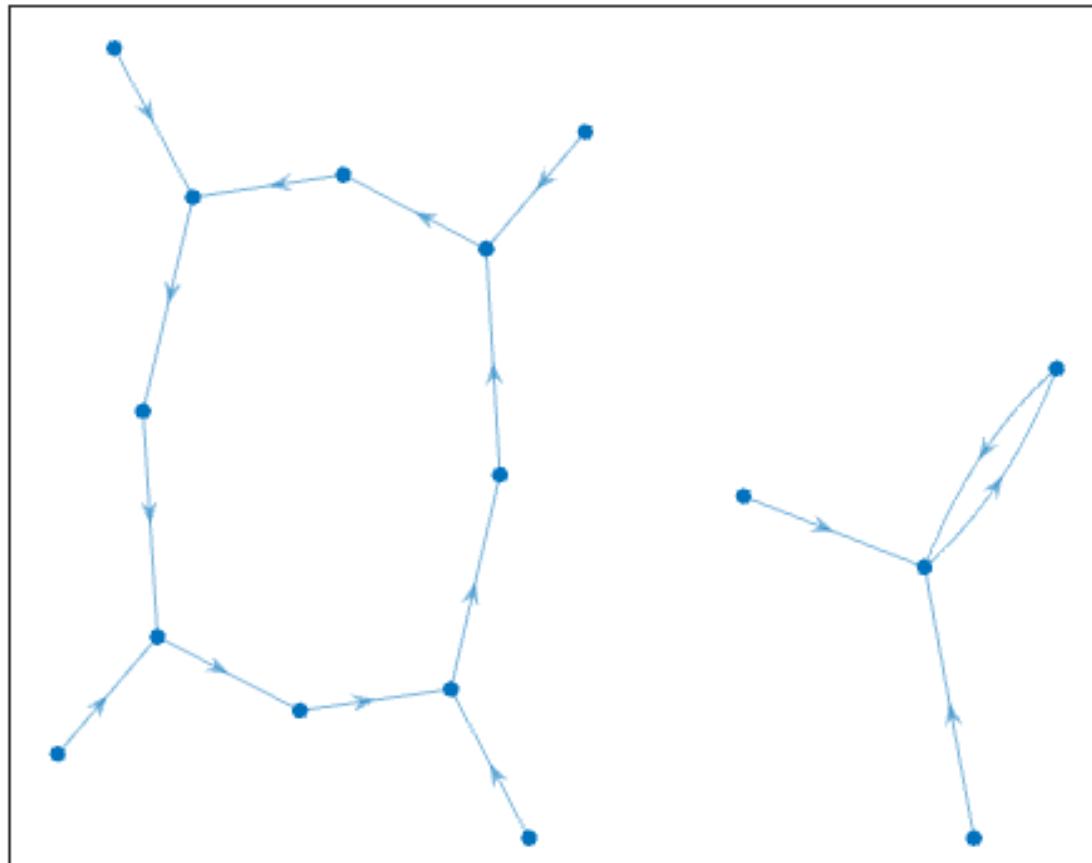
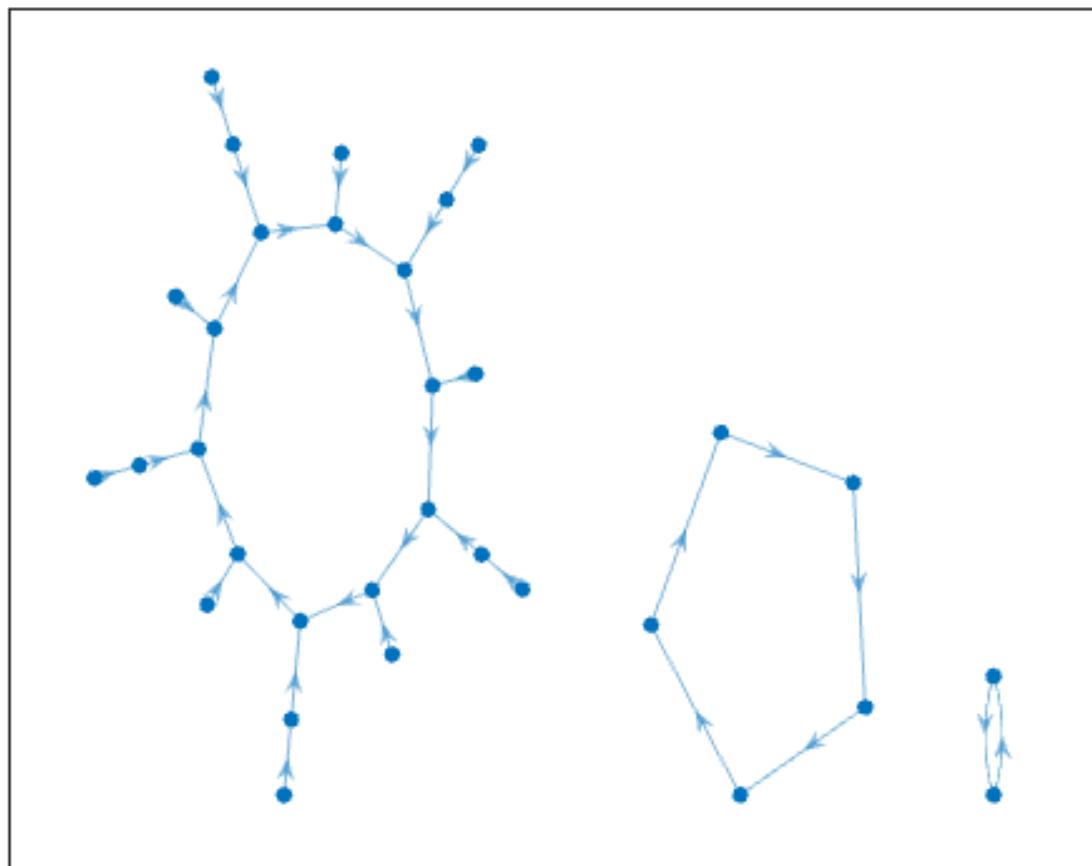


Figura 3.310: Atractor regla 27 n=4

Figura 3.311: Atractor regla 27 $n=5$

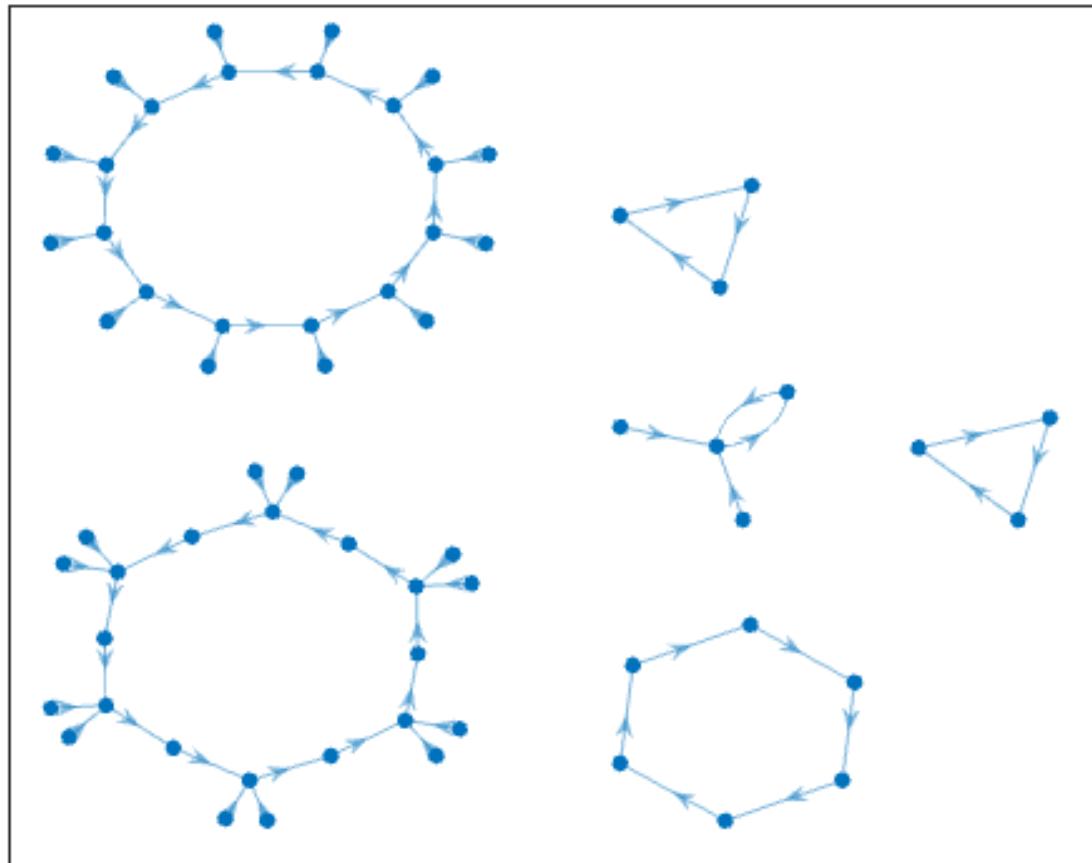


Figura 3.312: Atractor regla 27 n=6

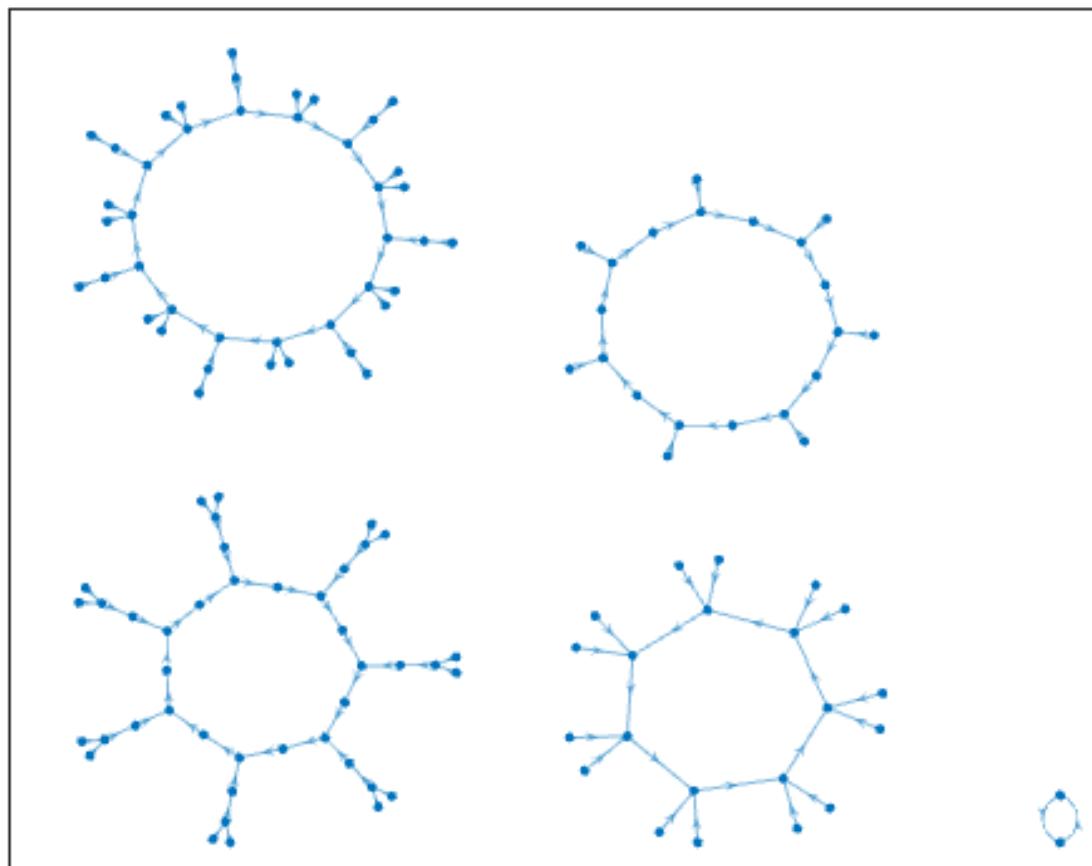
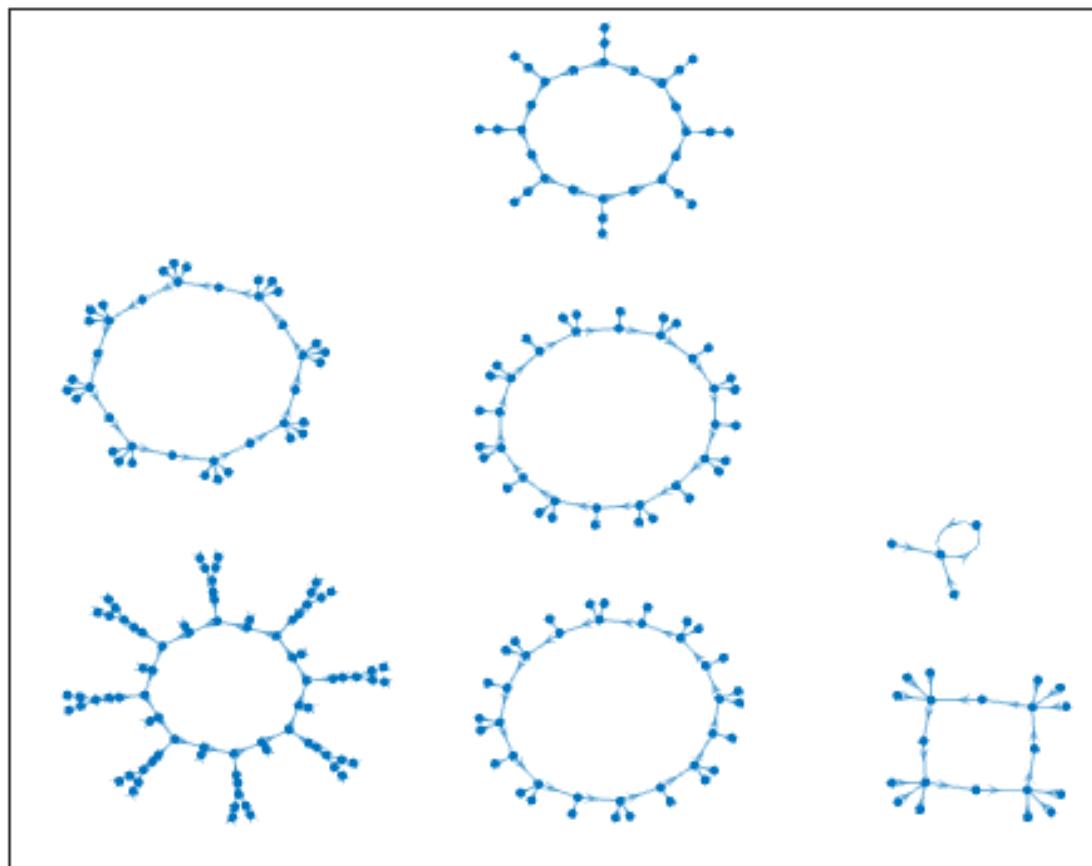


Figura 3.313: Atractor regla 27 n=7

Figura 3.314: Atractor regla 27 $n=8$

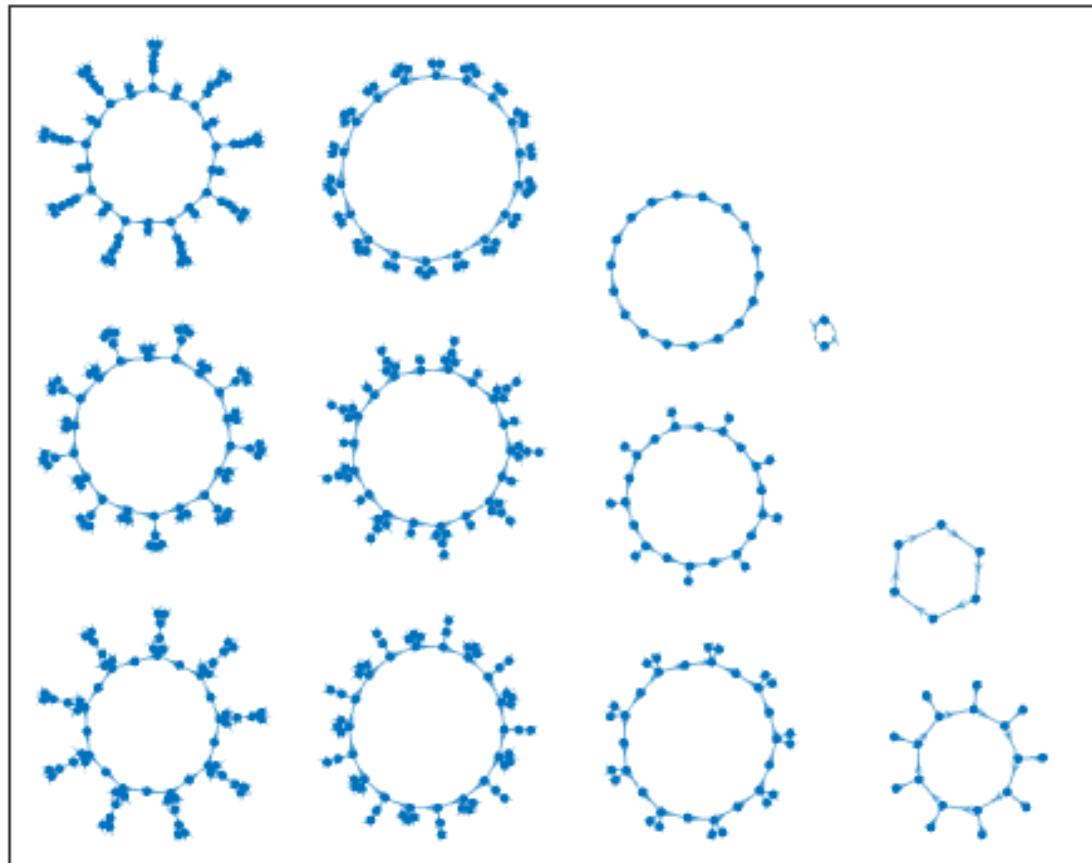


Figura 3.315: Atractor regla 27 n=9

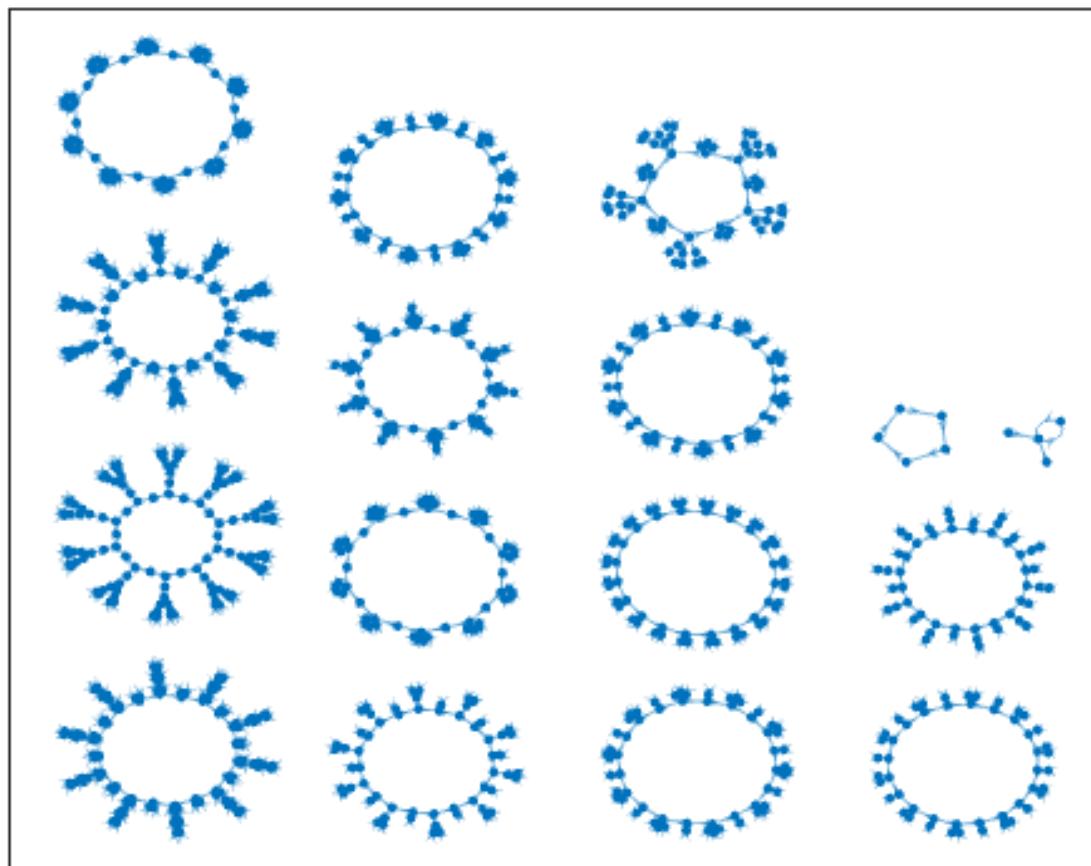


Figura 3.316: Atractor regla 27 n=10

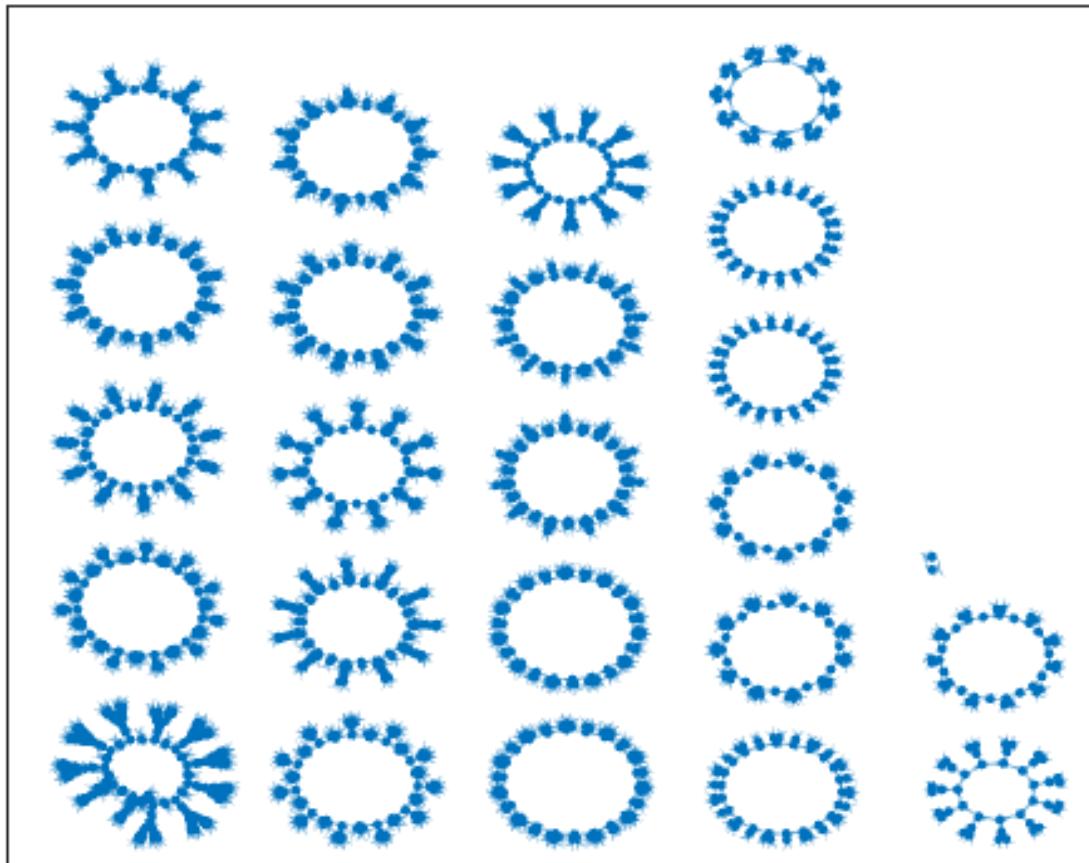
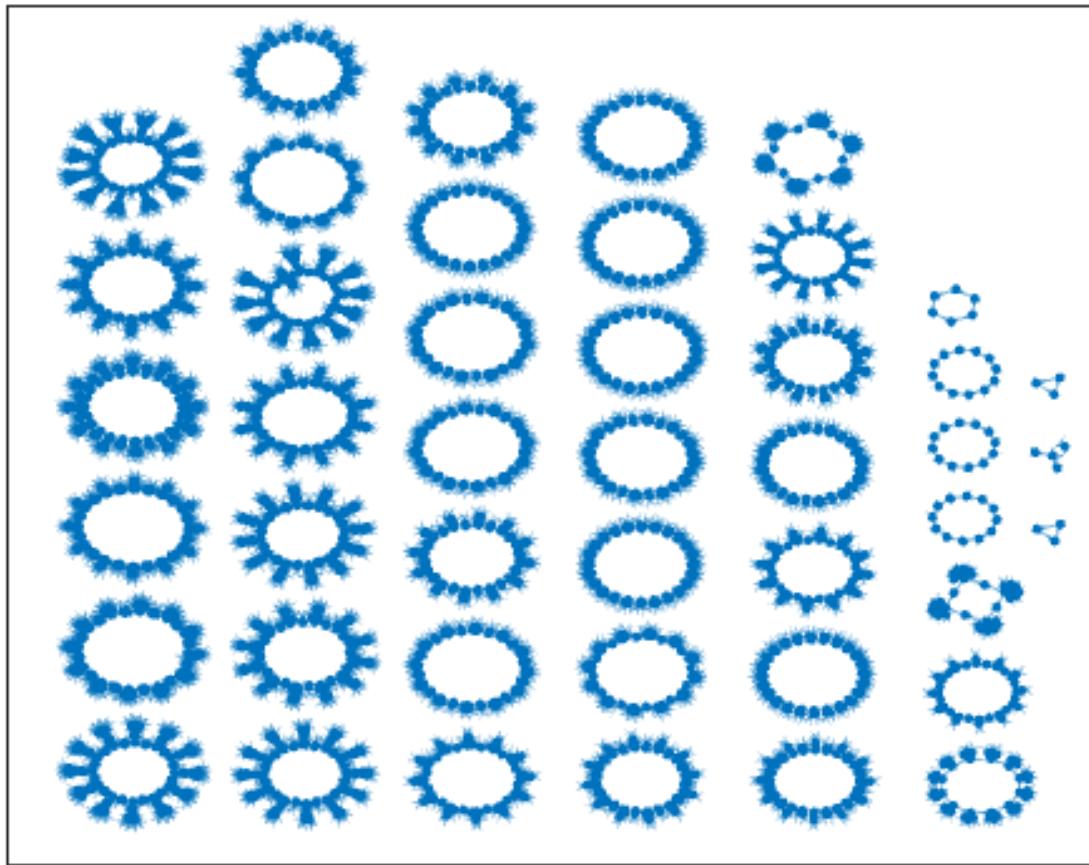


Figura 3.317: Atractor regla 27 n=11

Figura 3.318: Atractor regla 27 $n=12$

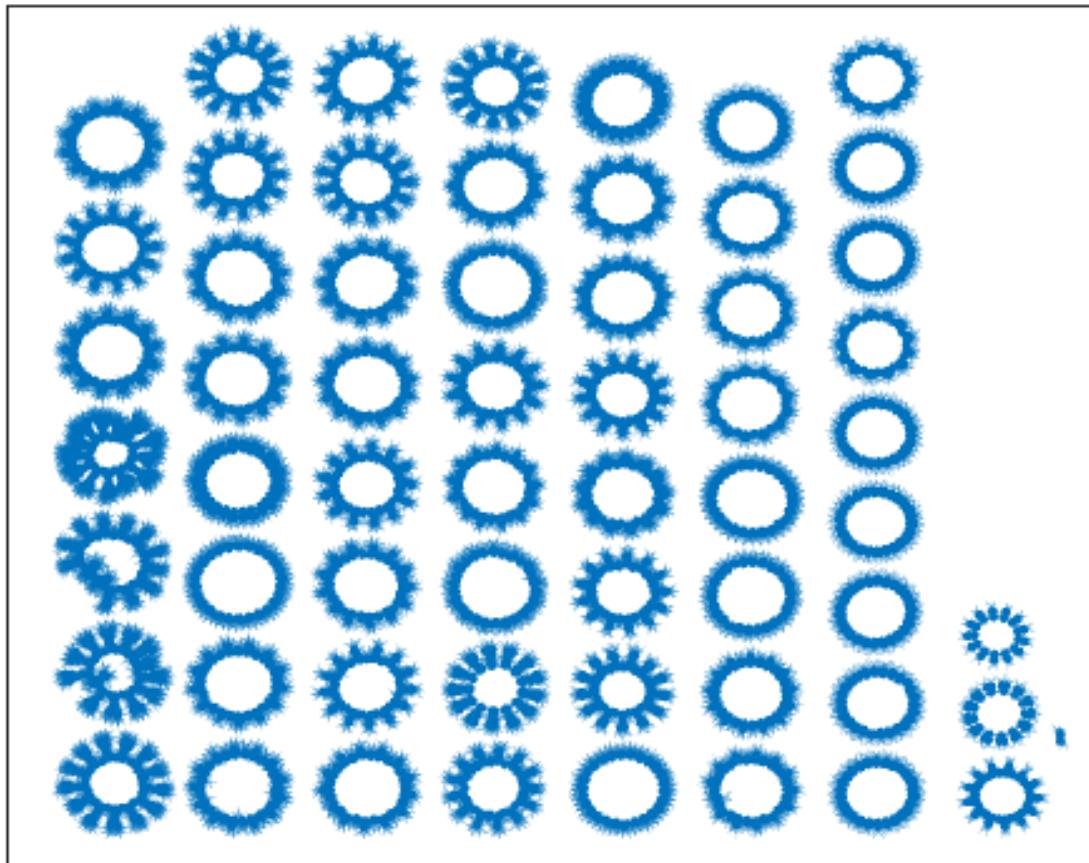


Figura 3.319: Atractor regla 27 $n=13$

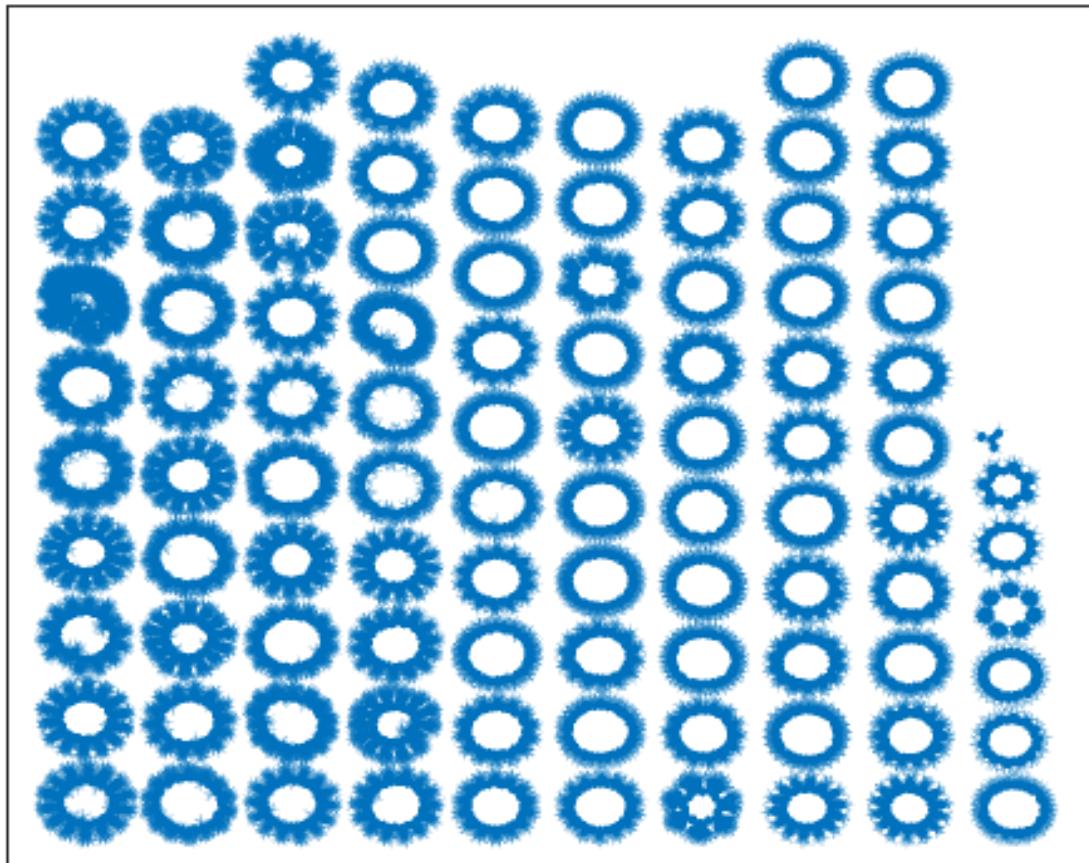


Figura 3.320: Atractor regla 27 n=14

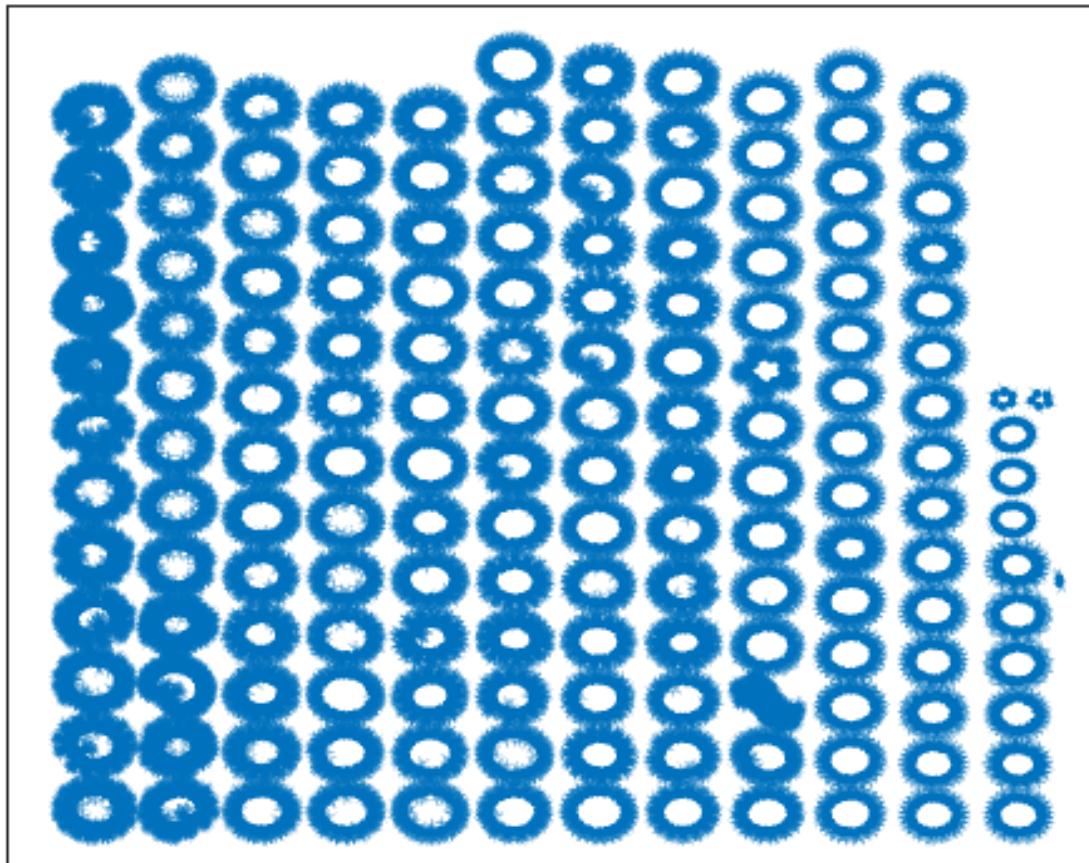


Figura 3.321: Atractor regla 27 n=15

3.25. Reglas 28,70,157,299

Respecto a la regla 28 se aprecia que mientras más grande es el tamaño de la cadena (n) en algunos tamaños de n aparecen en su mayoría «copias» de los atractores como se aprecia en las imágenes 3.325 y 3.327 y 3.330. En esta última se aprecia la «evolución» de los atractores según la configuración que matlab les otorga, de derecha a izquierda y de arriba a abajo.

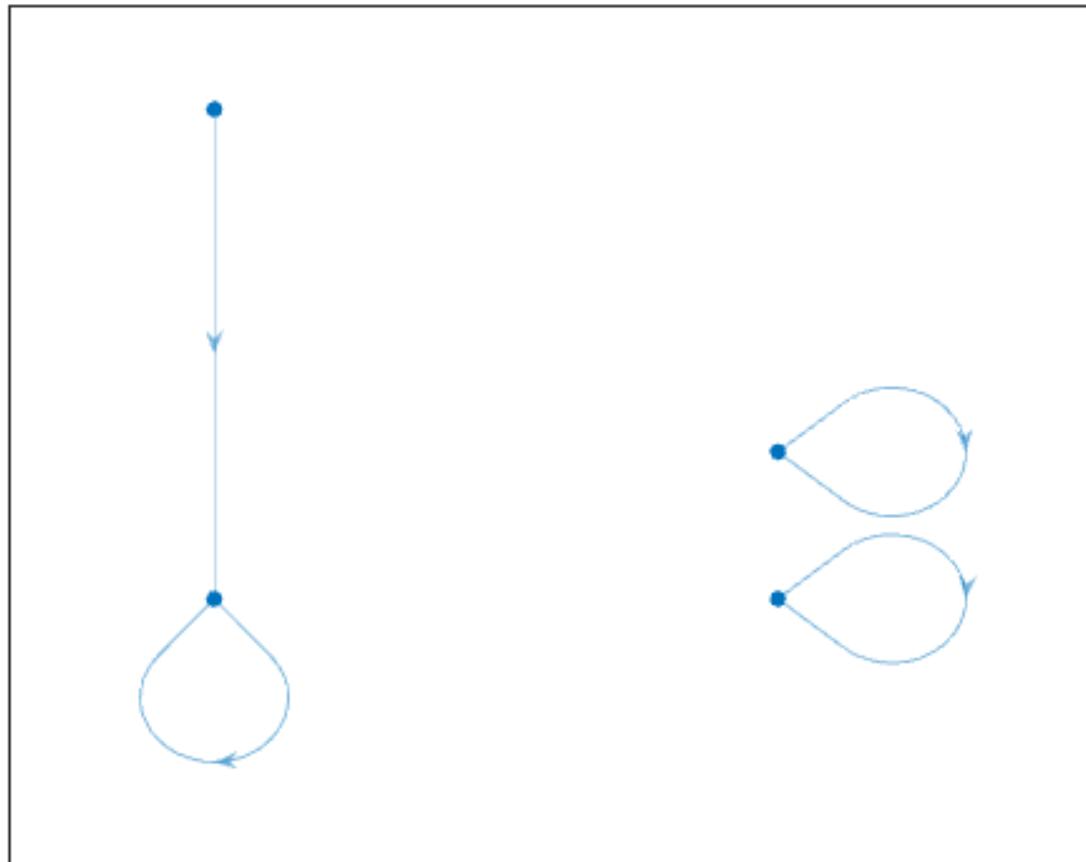


Figura 3.322: Atractor regla 28 n=2

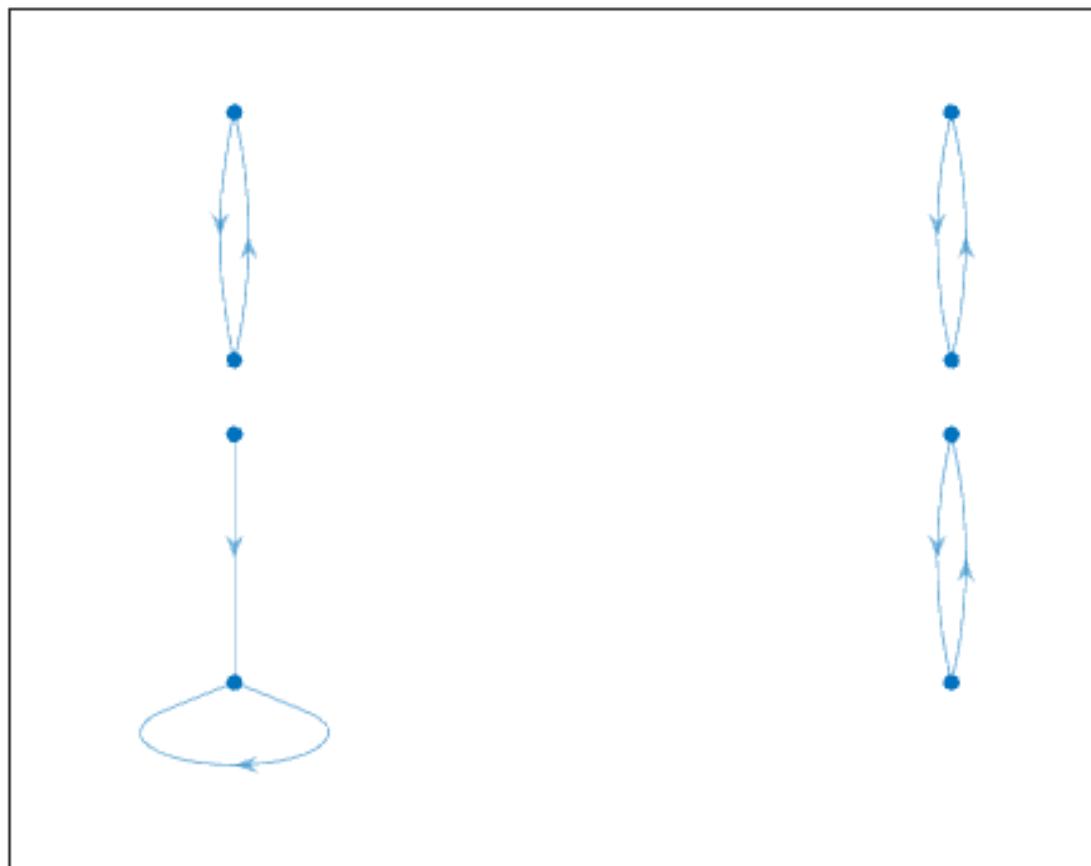


Figura 3.323: Atractor regla 28 n=3

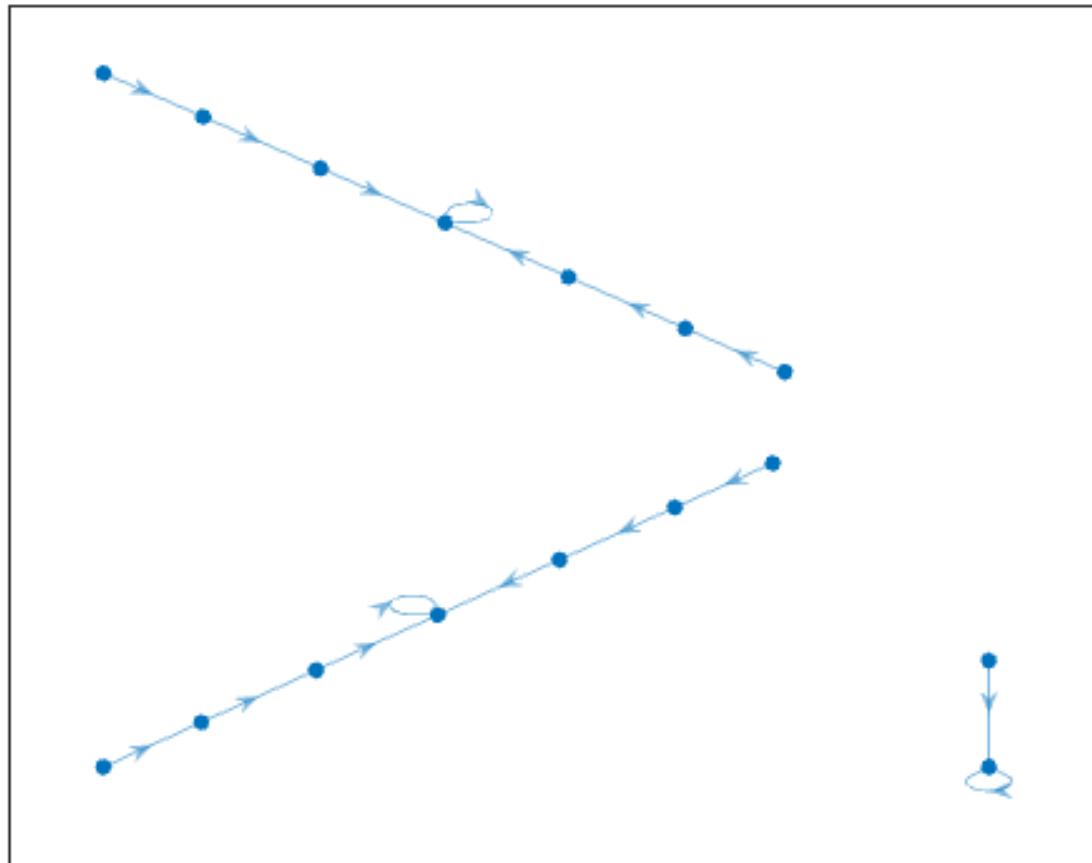


Figura 3.324: Atractor regla 28 n=4

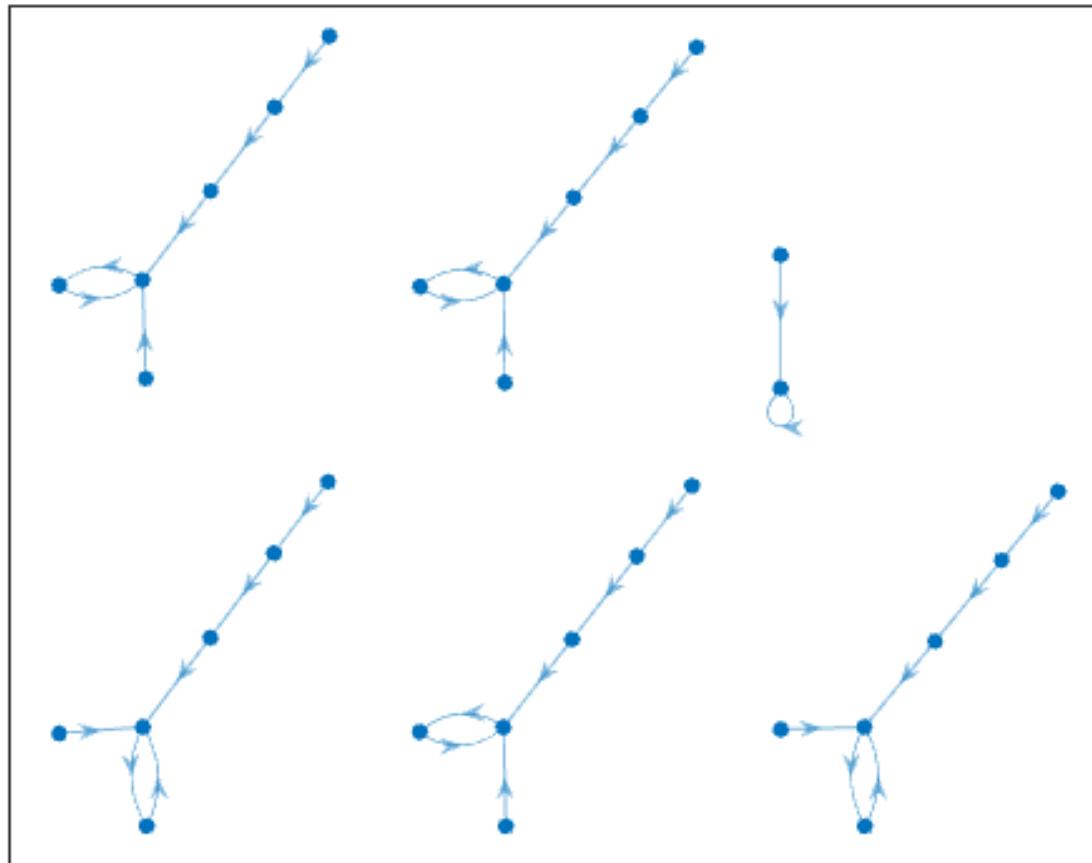


Figura 3.325: Atractor regla 28 n=5

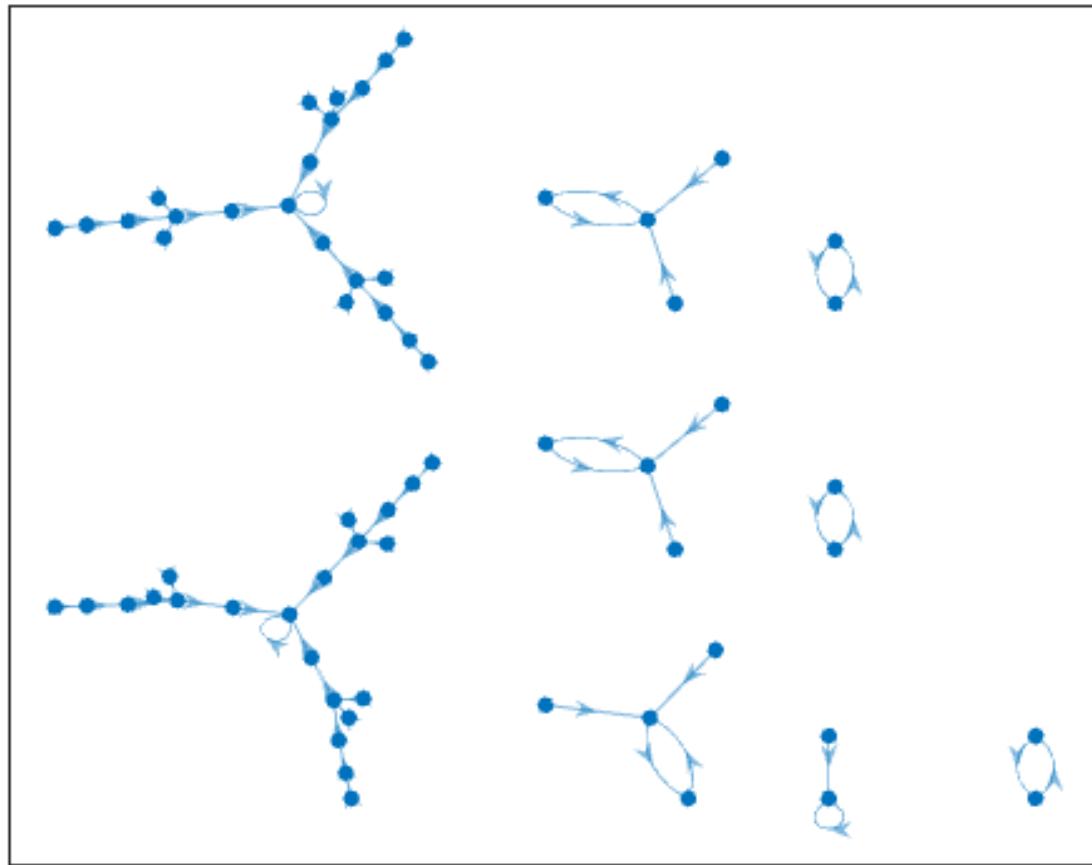


Figura 3.326: Atractor regla 28 n=6

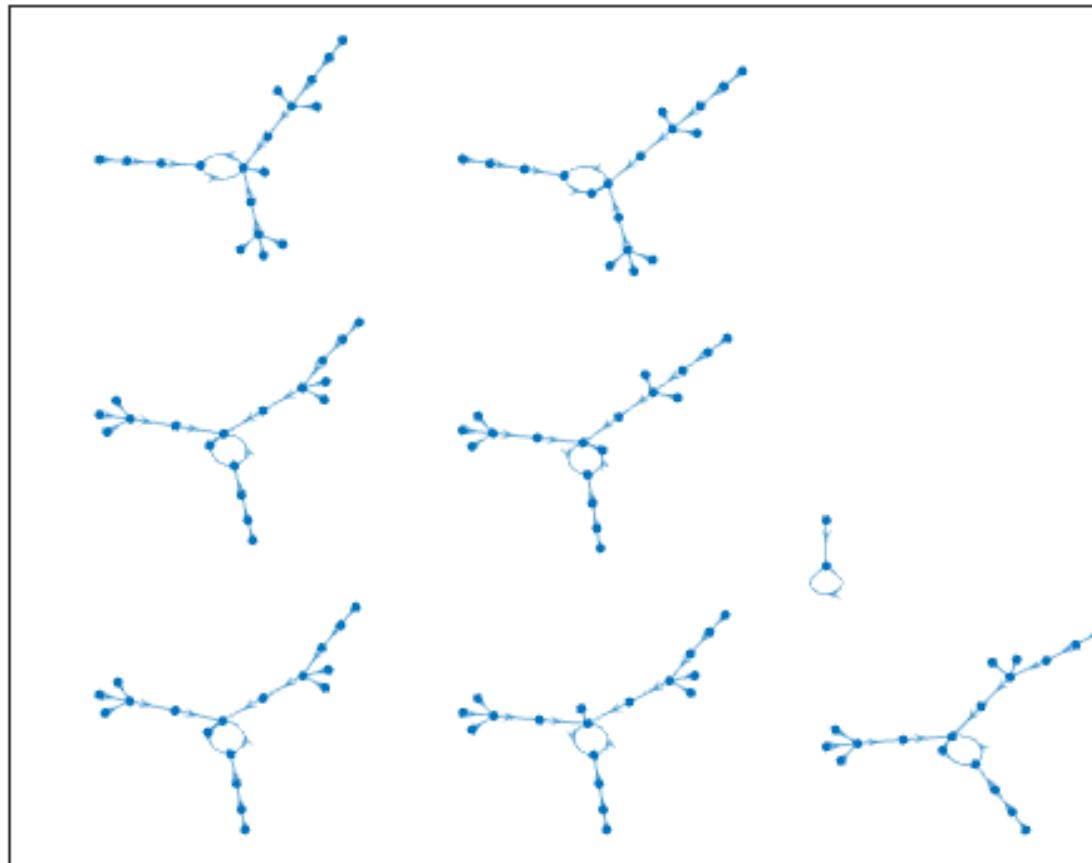
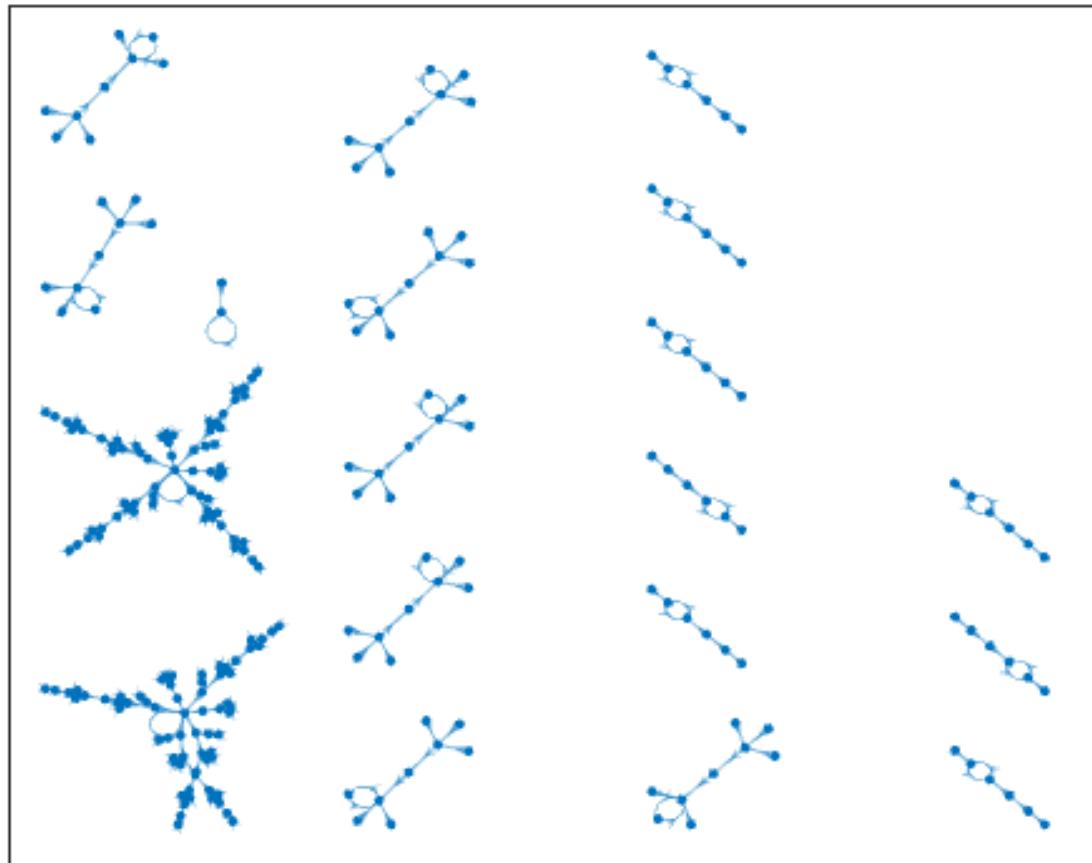


Figura 3.327: Atractor regla 28 n=7

Figura 3.328: Atractor regla 28 $n=8$

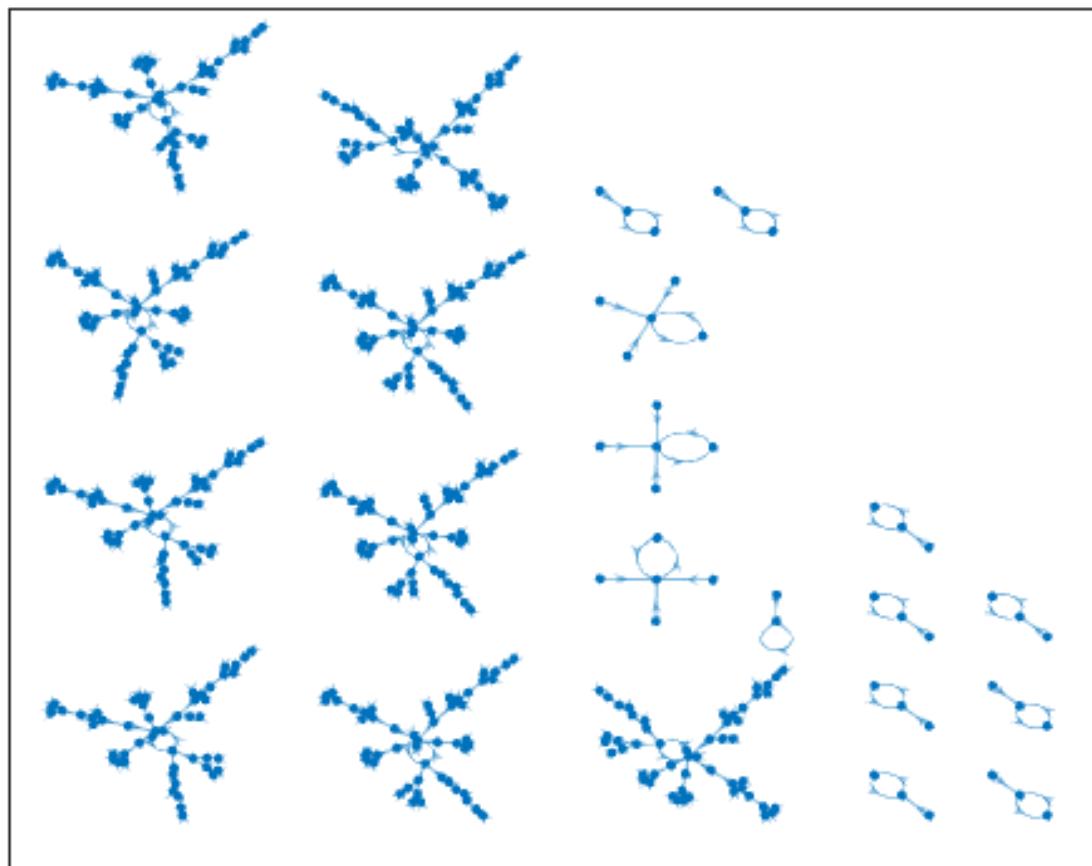


Figura 3.329: Atractor regla 28 n=9

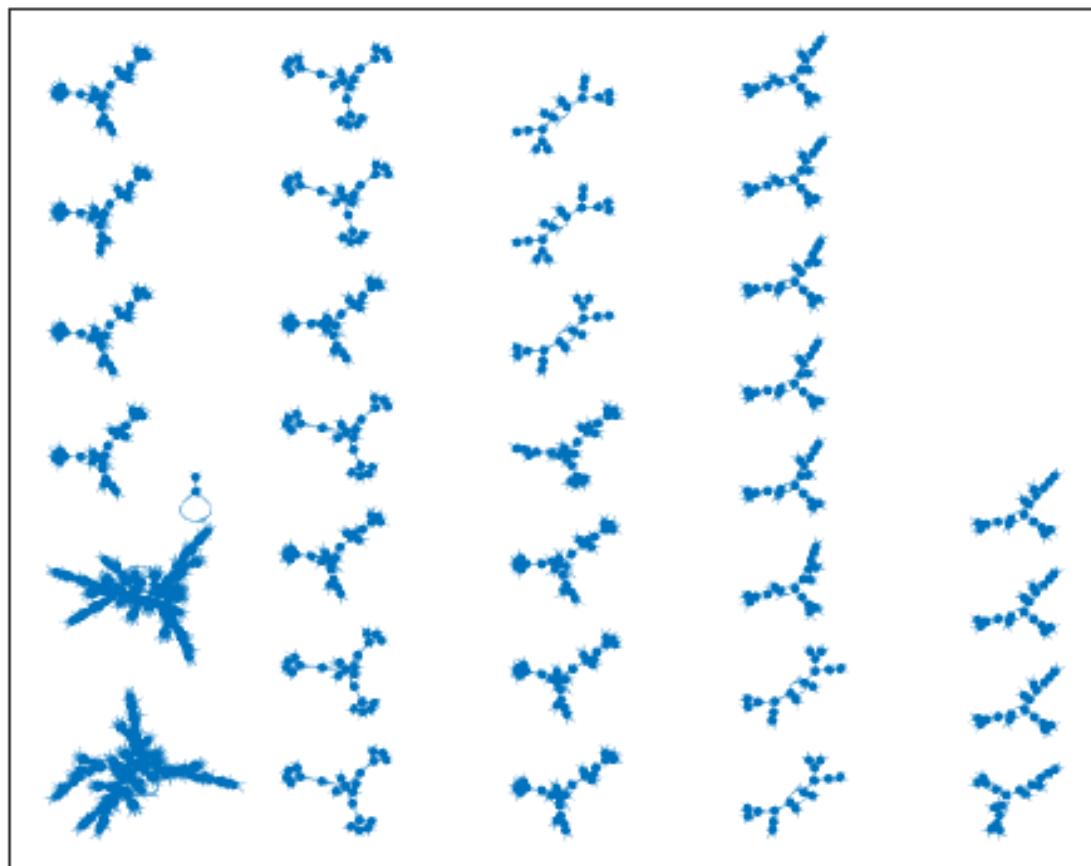


Figura 3.330: Atractor regla 28 n=10

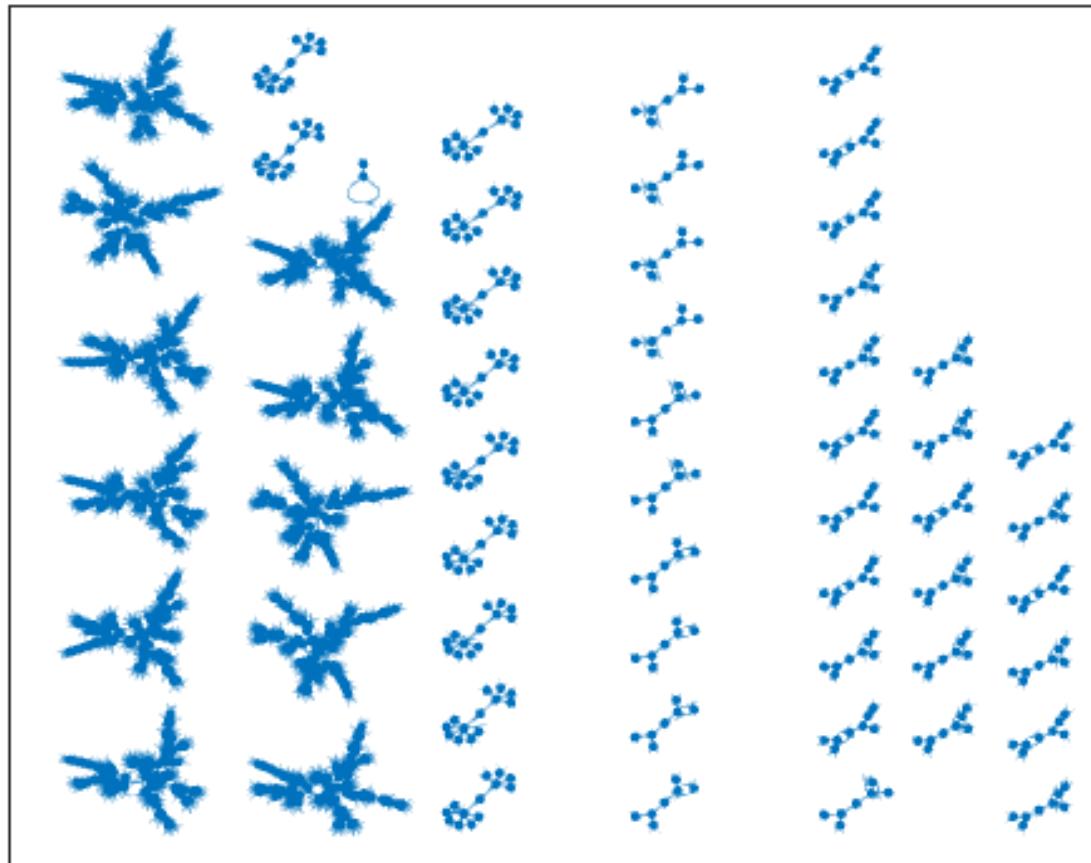
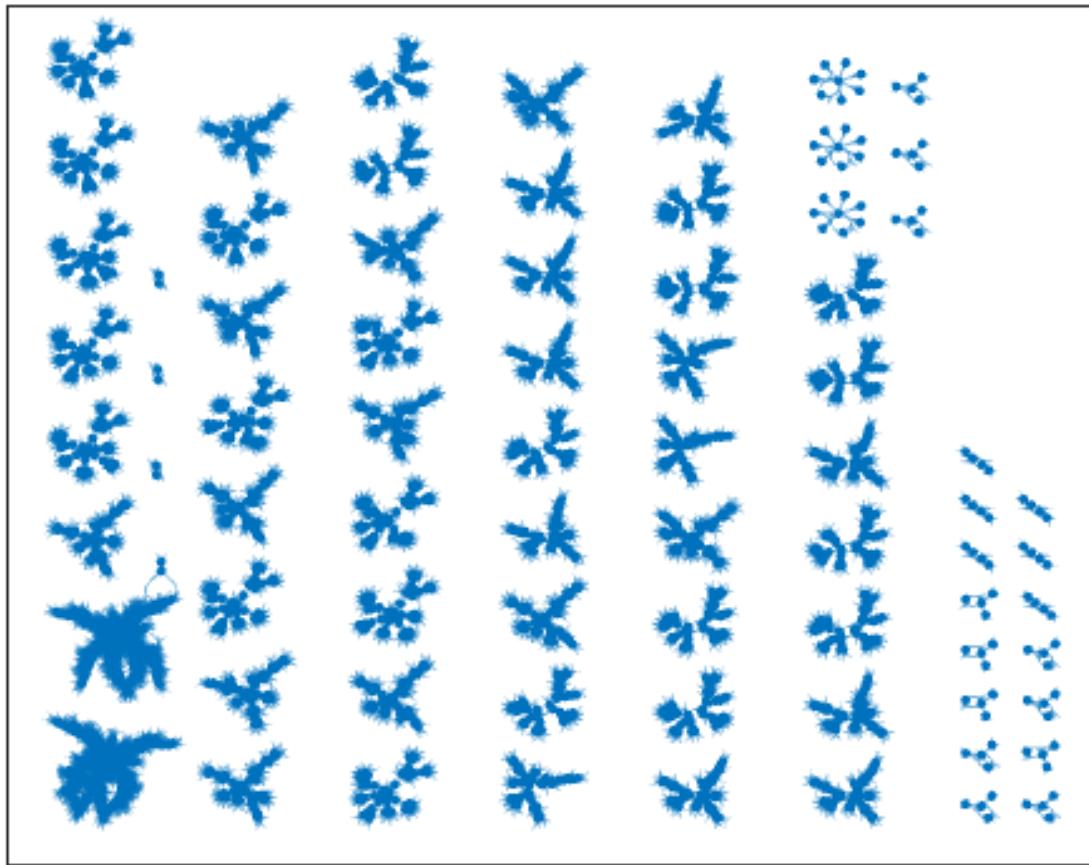


Figura 3.331: Atractor regla 28 n=11

Figura 3.332: Atractor regla 28 $n=12$

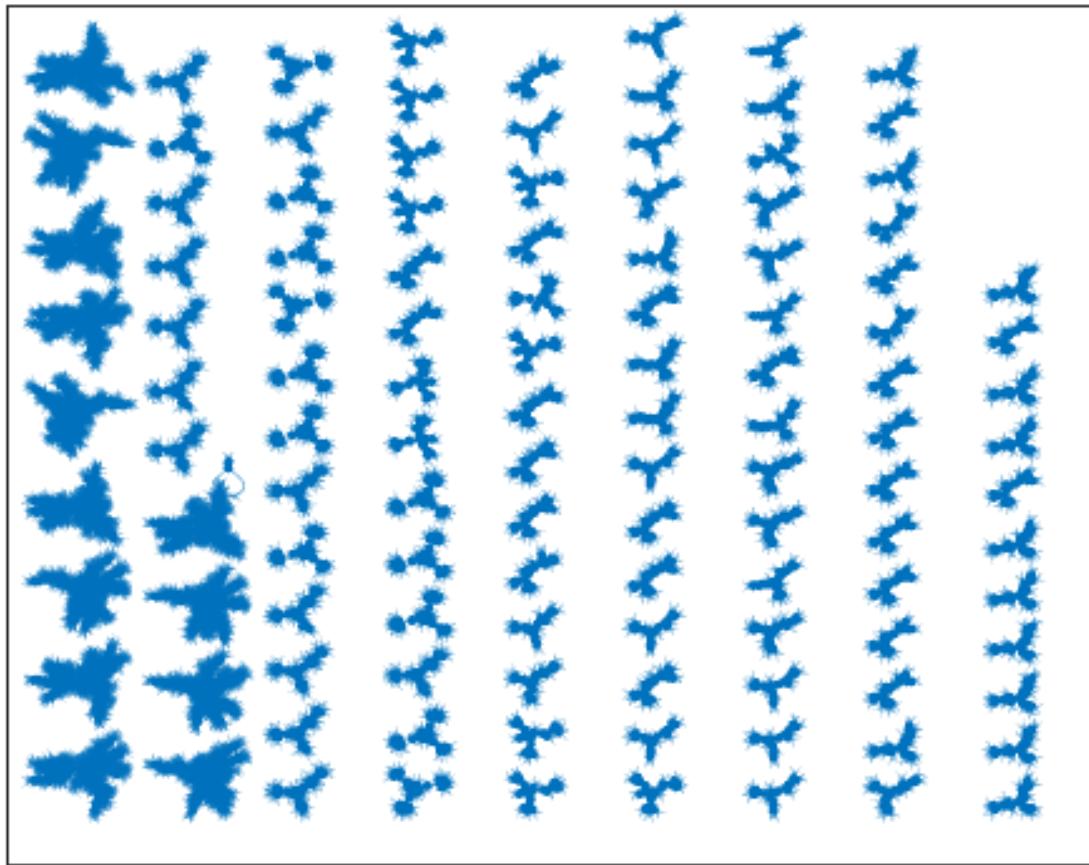
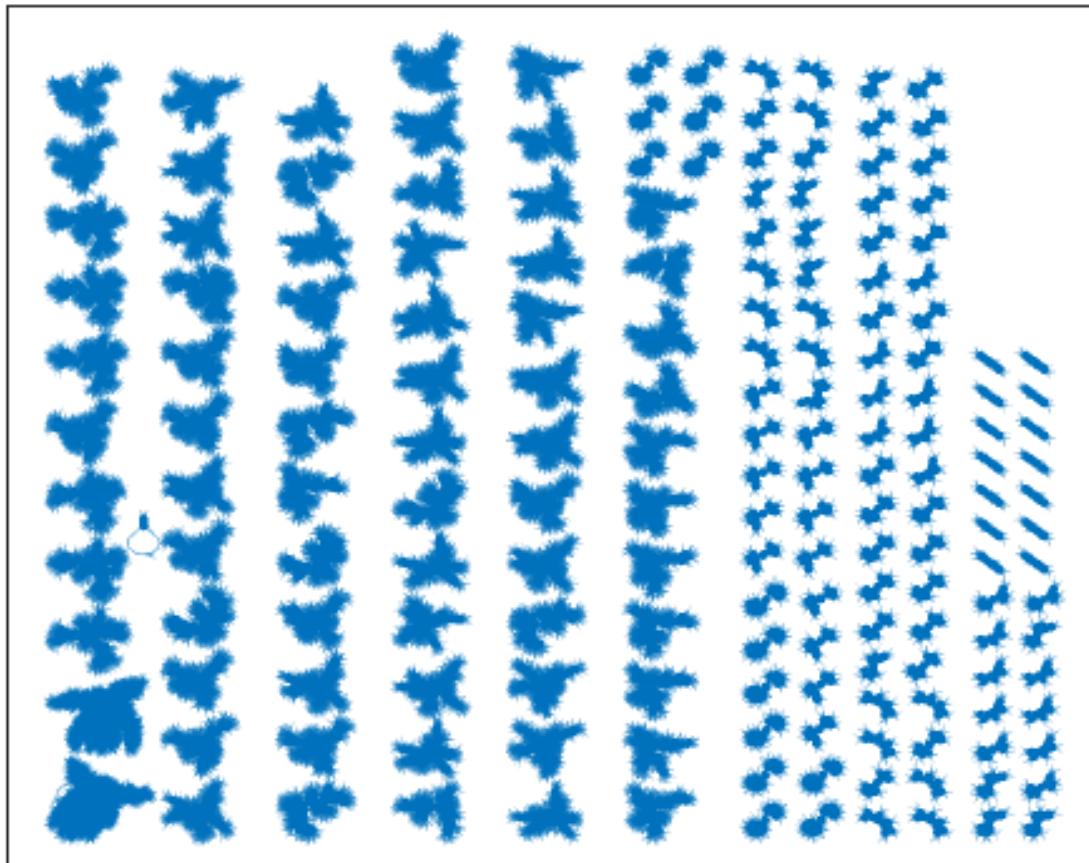


Figura 3.333: Atractor regla 28 n=13

Figura 3.334: Atractor regla 28 $n=14$

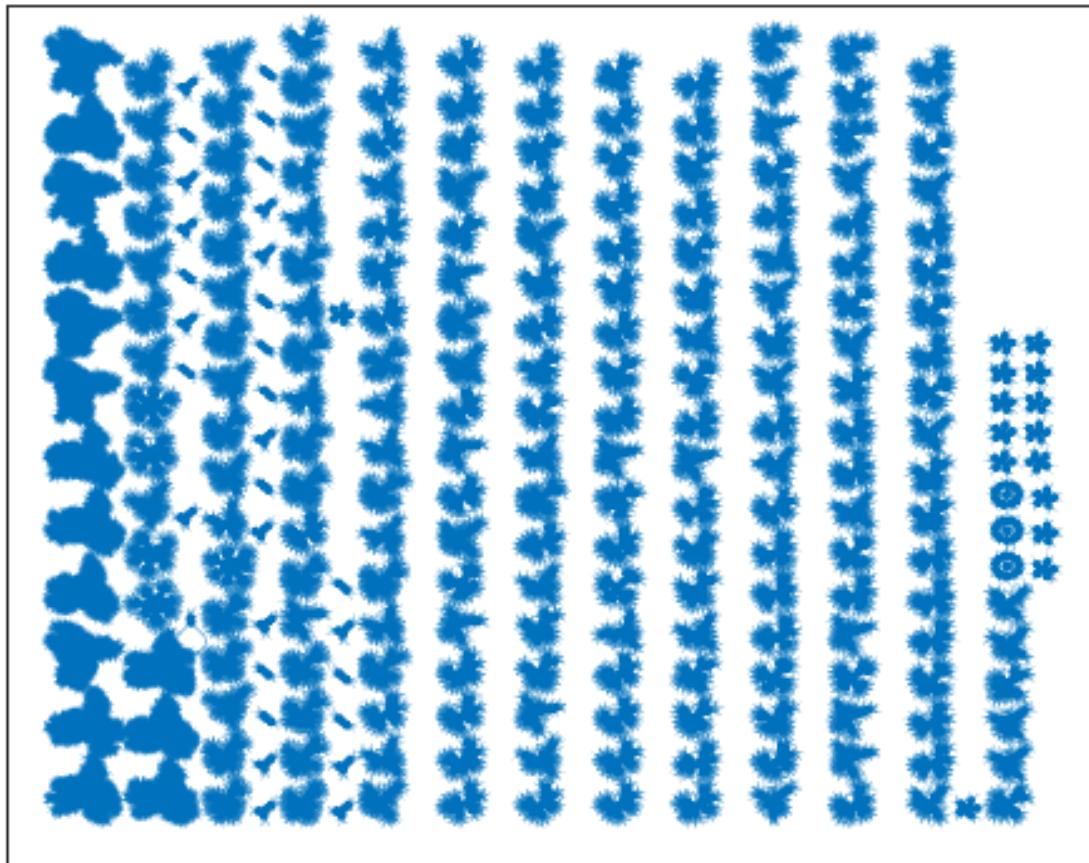


Figura 3.335: Atractor regla 28 n=15

3.26. Reglas 29,71

Respecto a la regla 29 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen nuevos atractores que evolucionan por sí solos sin necesidad de mezclarse con otros dando lugar a bastantes atractores que en las imágenes no se logran apreciar bien a partir de un $n=12$.

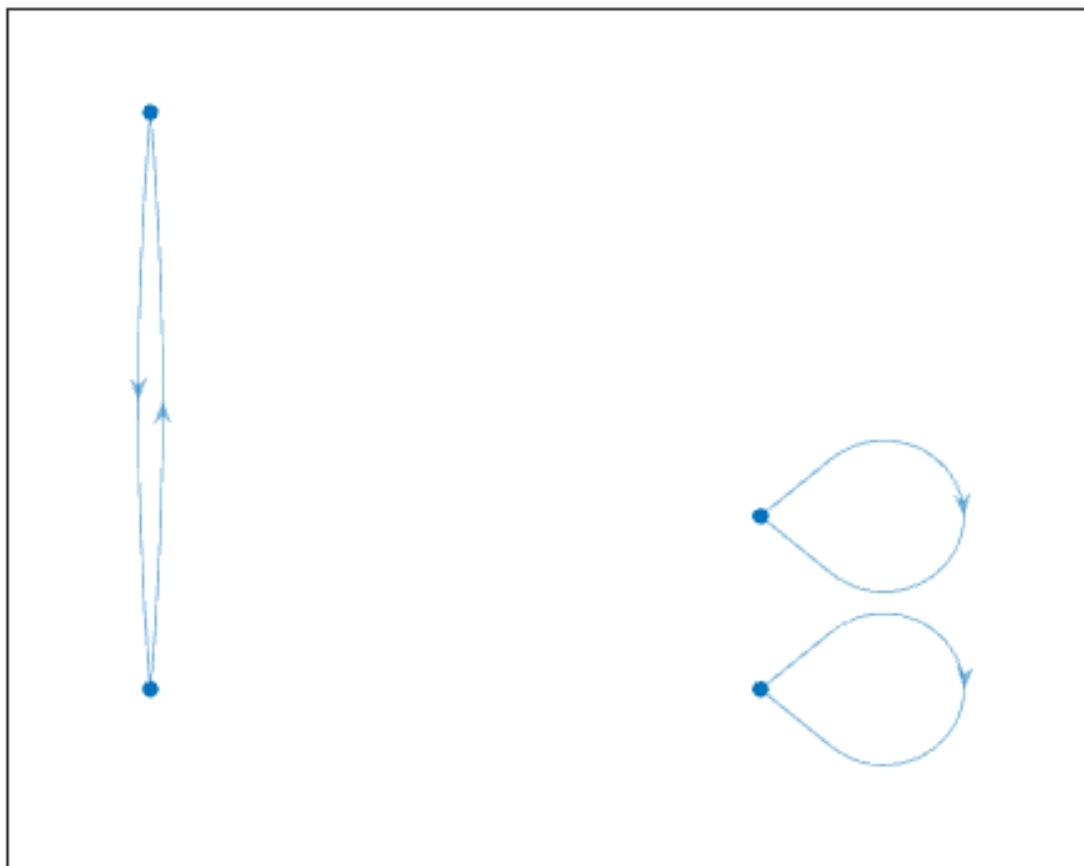


Figura 3.336: Atractor regla 29 $n=2$

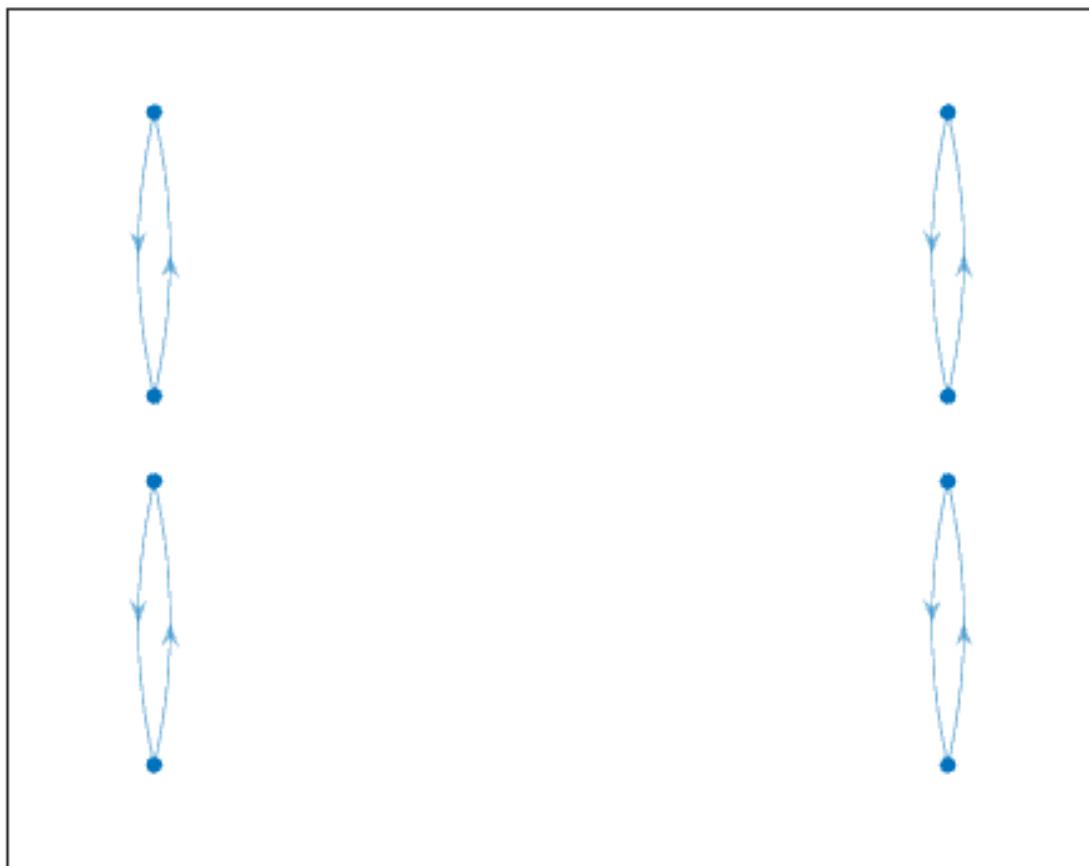
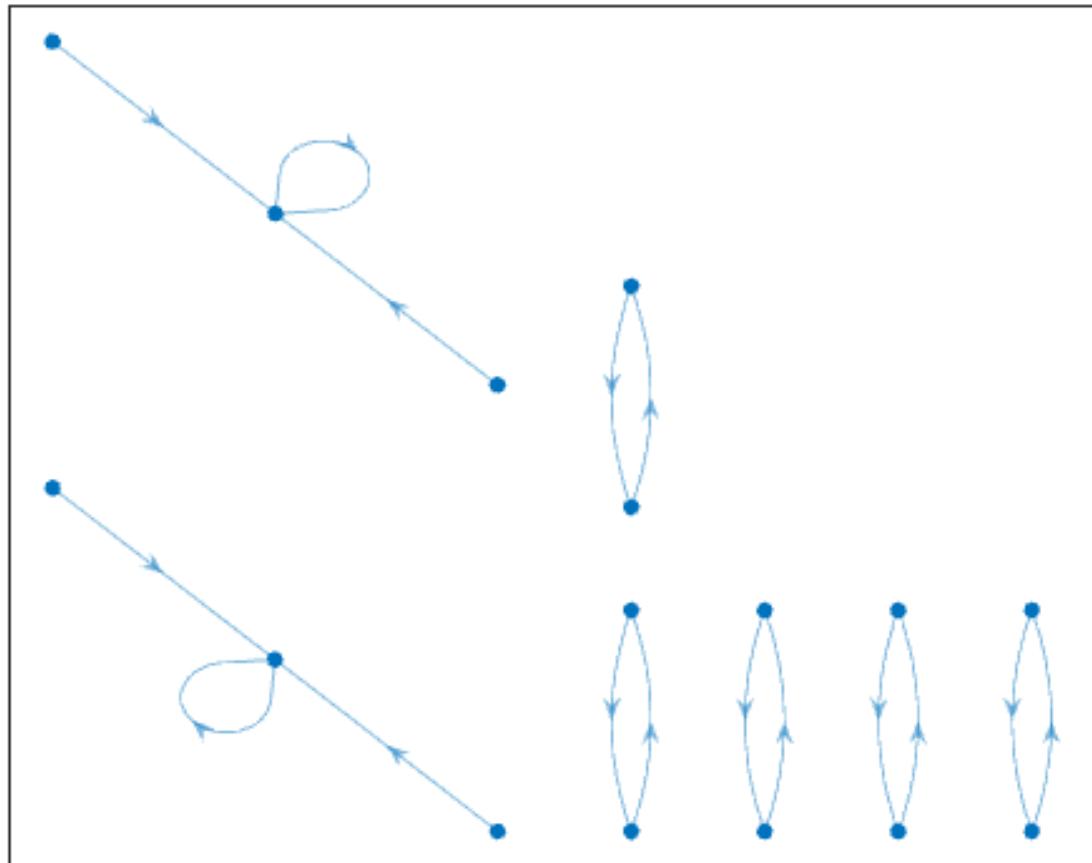


Figura 3.337: Atractor regla 29 n=3

Figura 3.338: Atractor regla 29 $n=4$

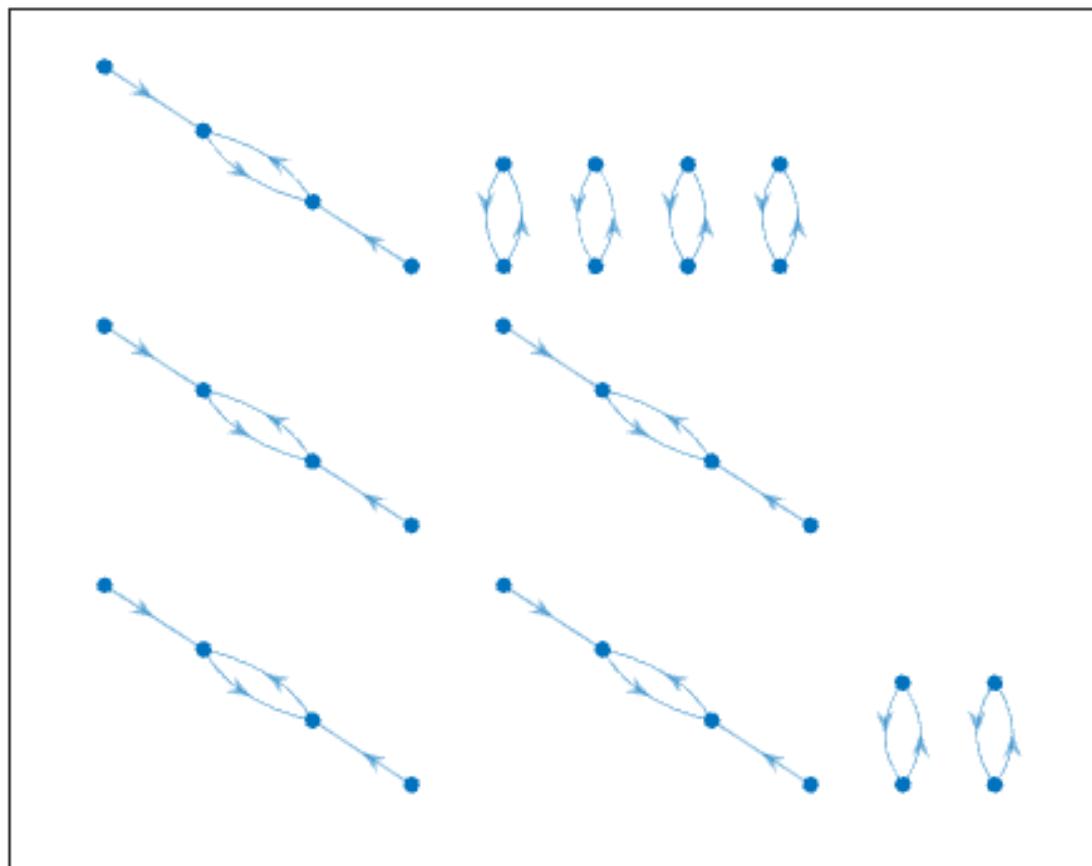


Figura 3.339: Atractor regla 29 n=5

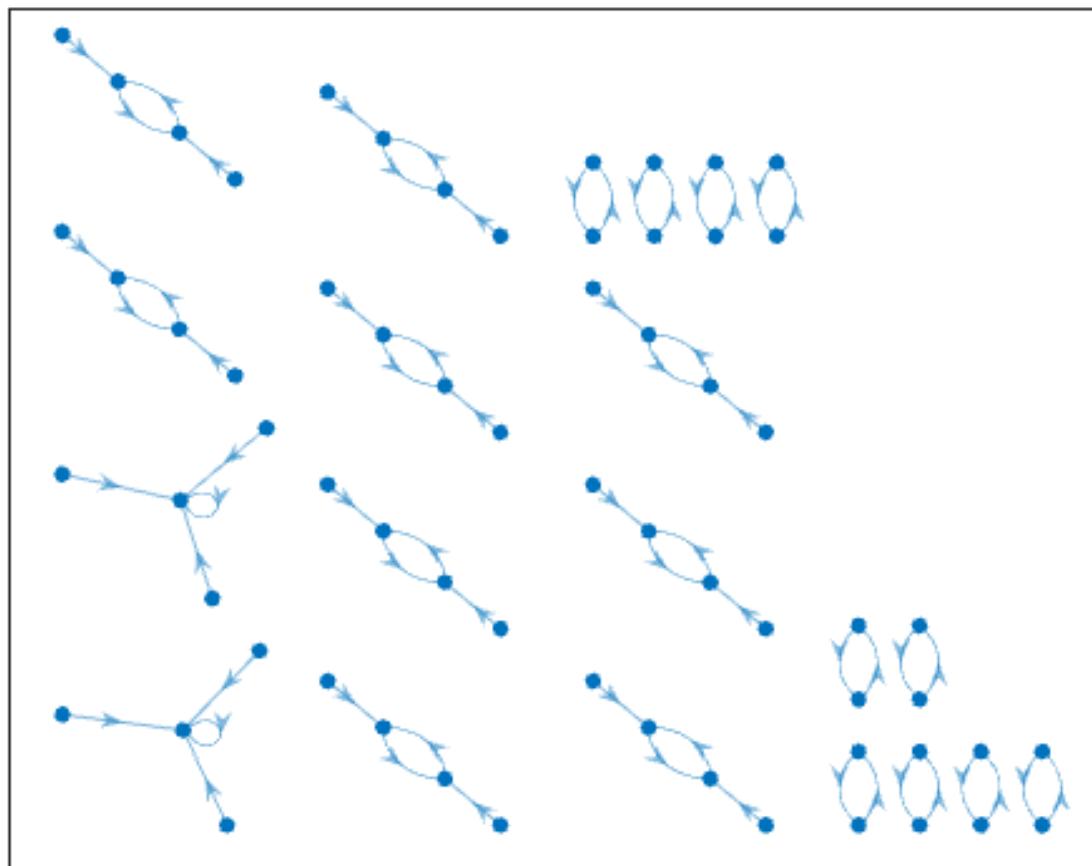


Figura 3.340: Atractor regla 29 n=6

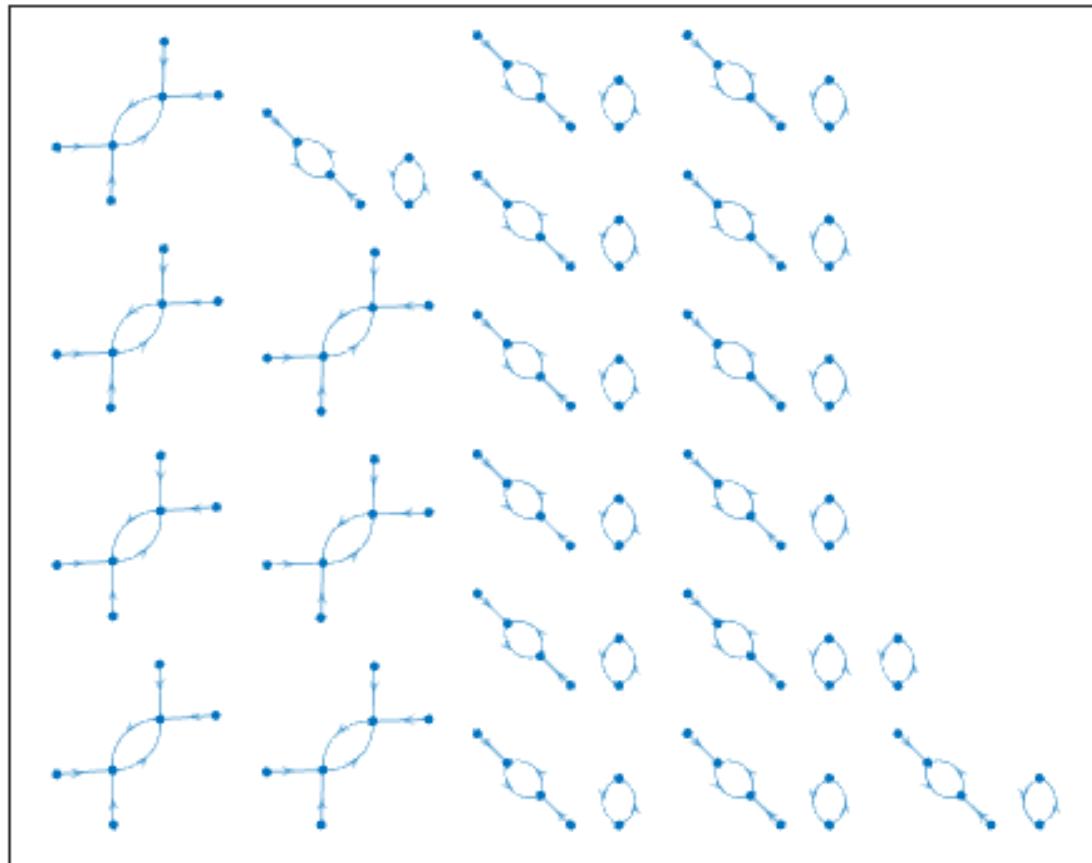


Figura 3.341: Atractor regla 29 n=7

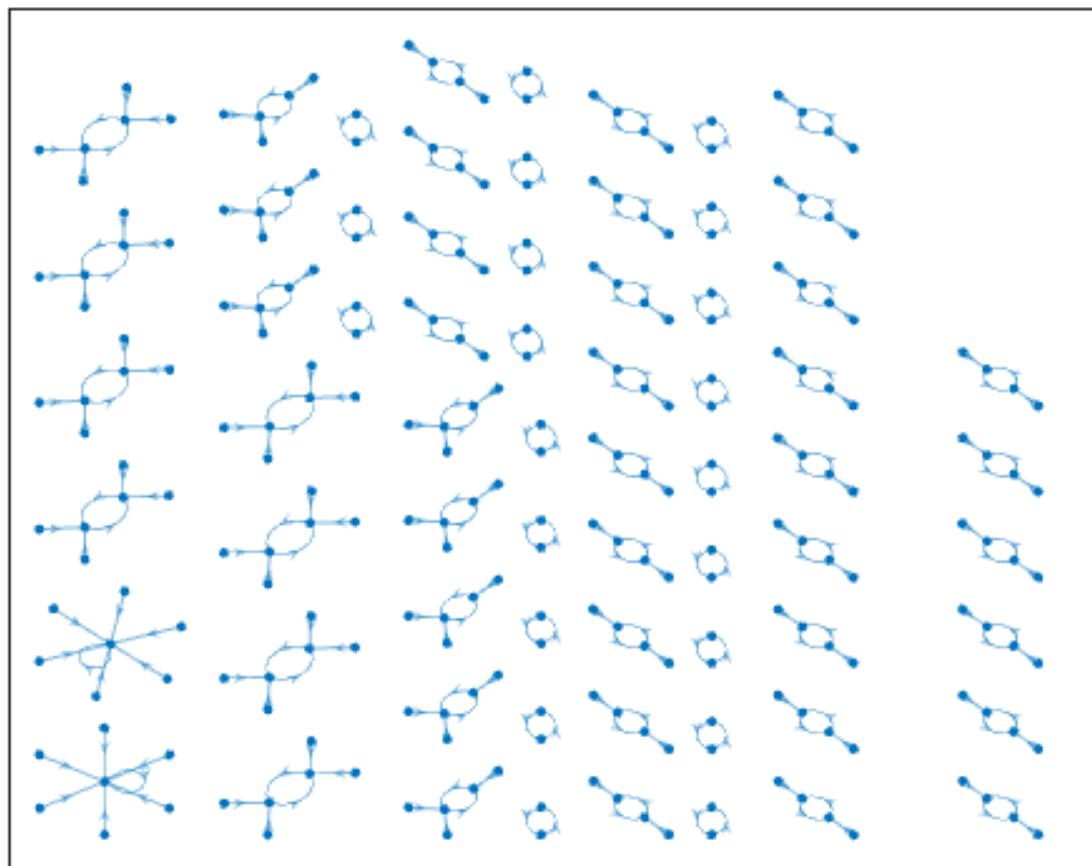


Figura 3.342: Atractor regla 29 n=8

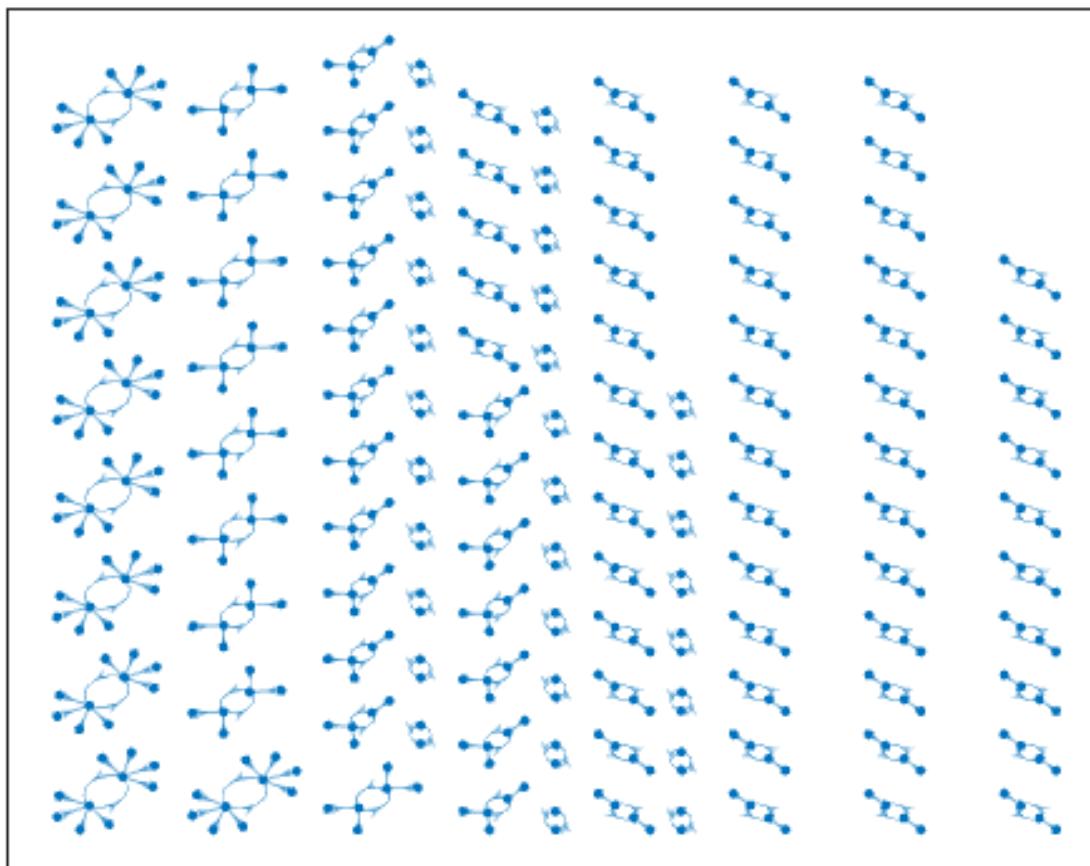


Figura 3.343: Atractor regla 29 n=9

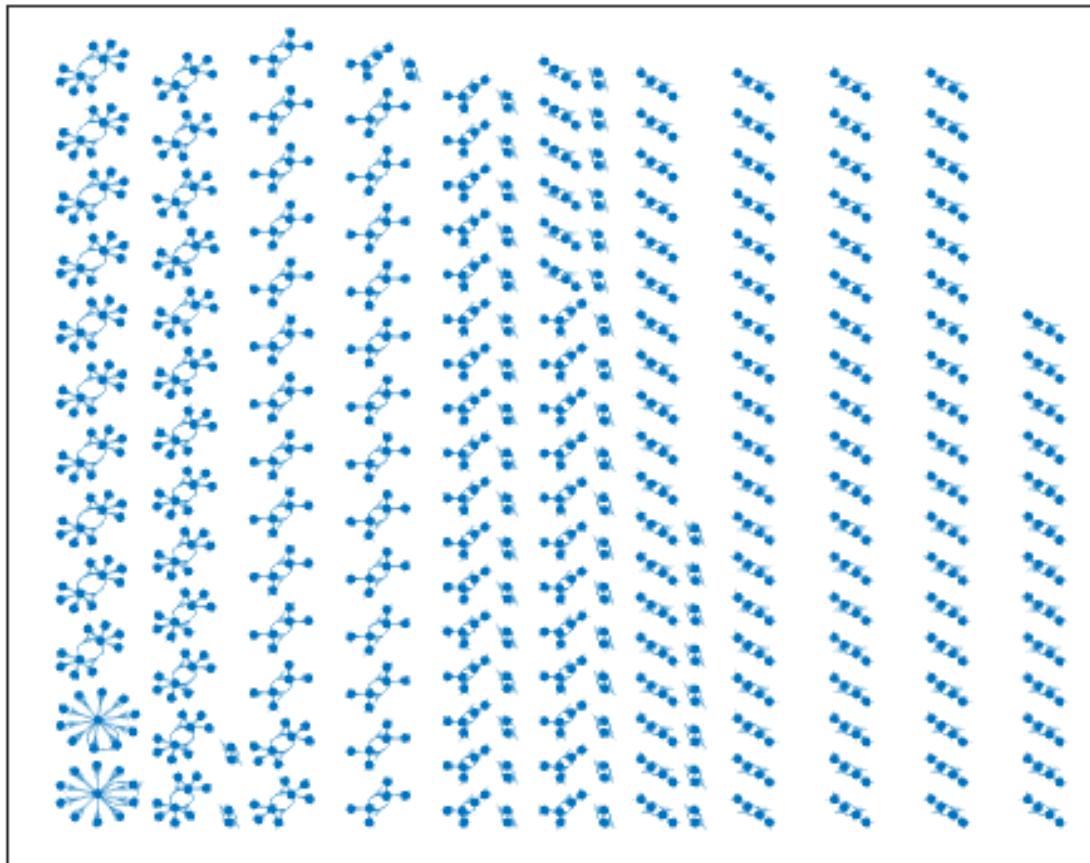


Figura 3.344: Atractor regla 29 n=10

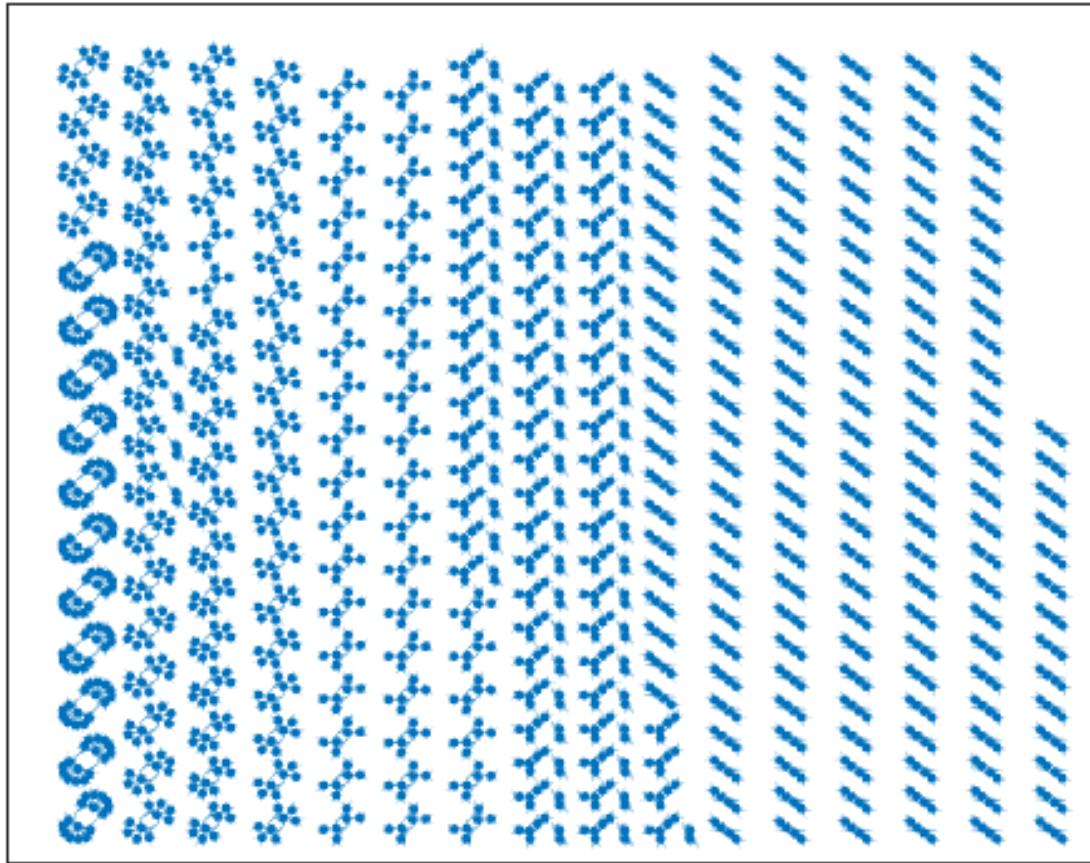


Figura 3.345: Atractor regla 29 n=11

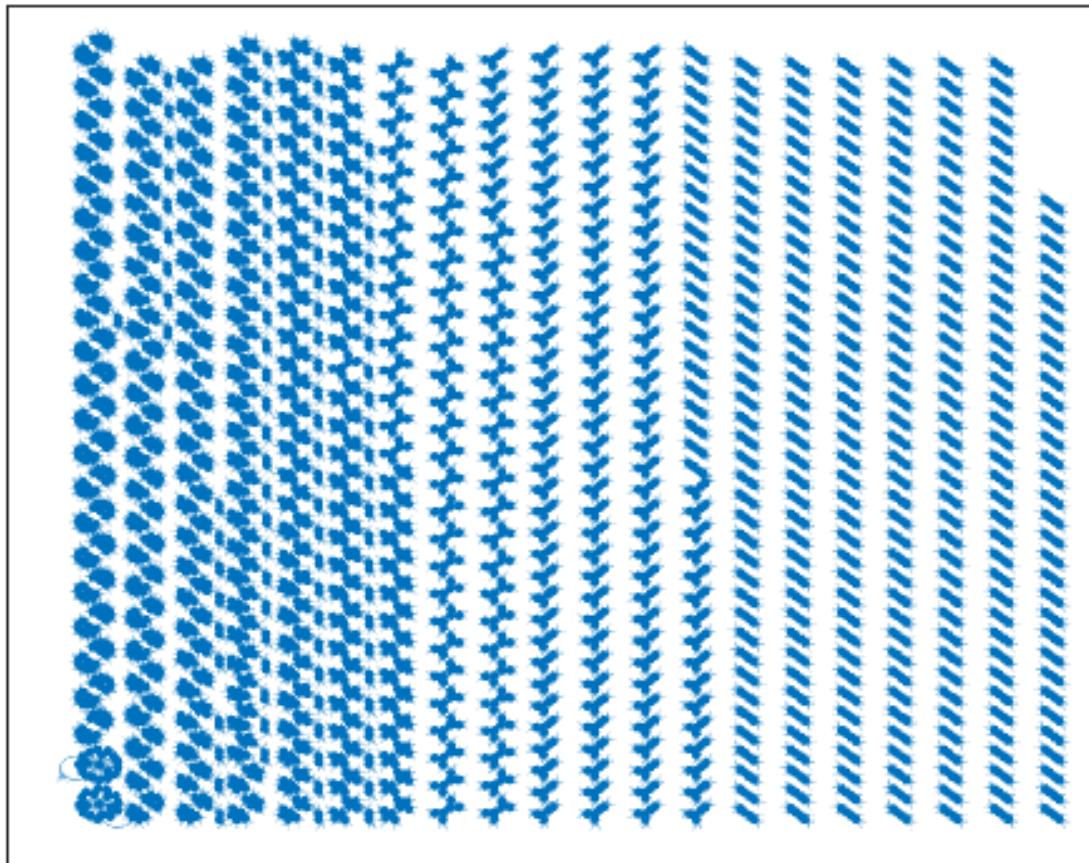


Figura 3.346: Atractor regla 29 n=12

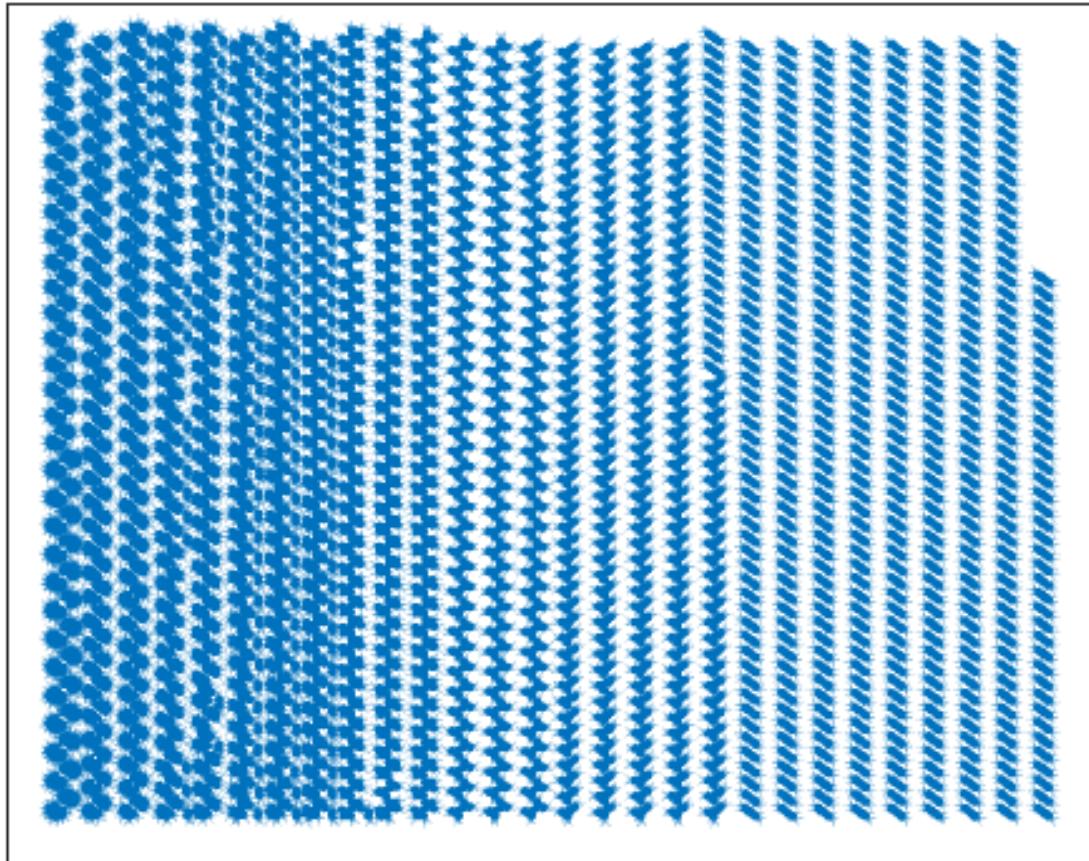
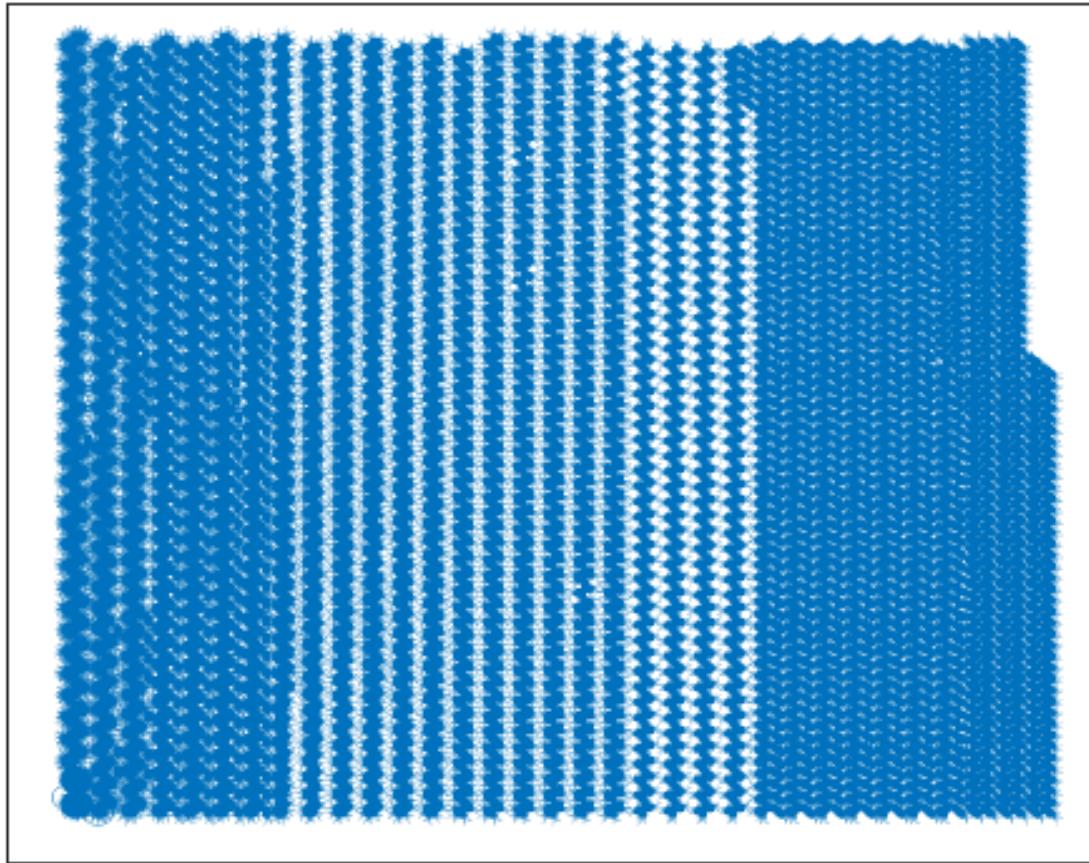


Figura 3.347: Atractor regla 29 $n=13$

Figura 3.348: Atractor regla 29 $n=14$

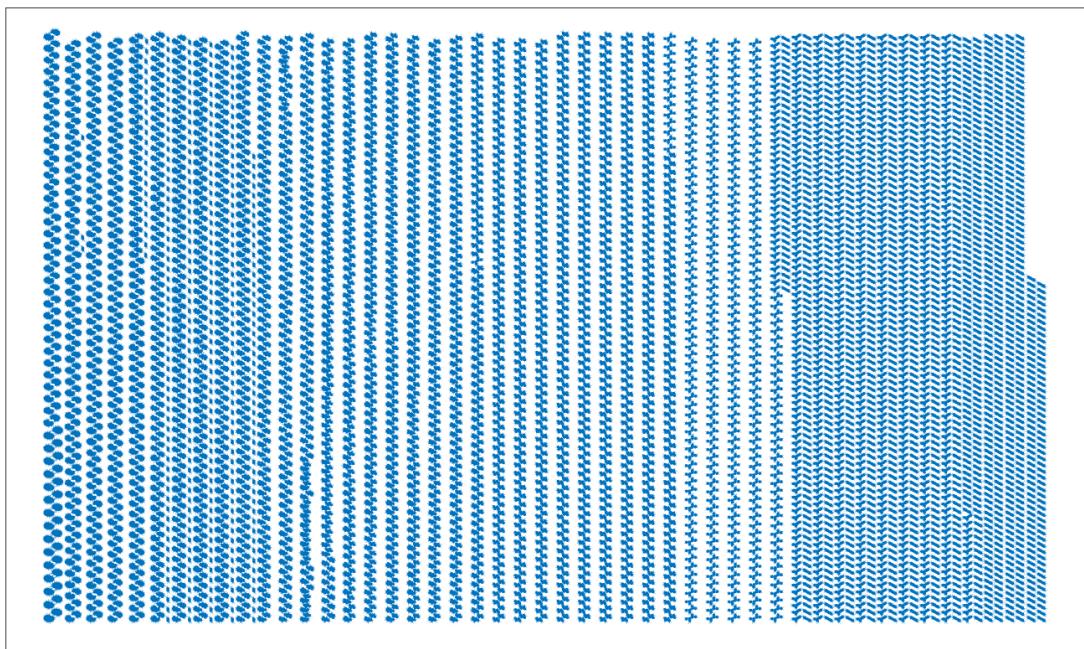


Figura 3.349: Atractor regla 29 $n=15$

3.27. Reglas 30,86,135,149

Respecto a la regla 30 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen comportamientos raros con el cómo matlab ordena los nodos ya que no se distinguen figuras bien acomodadas a partir de un n=7.

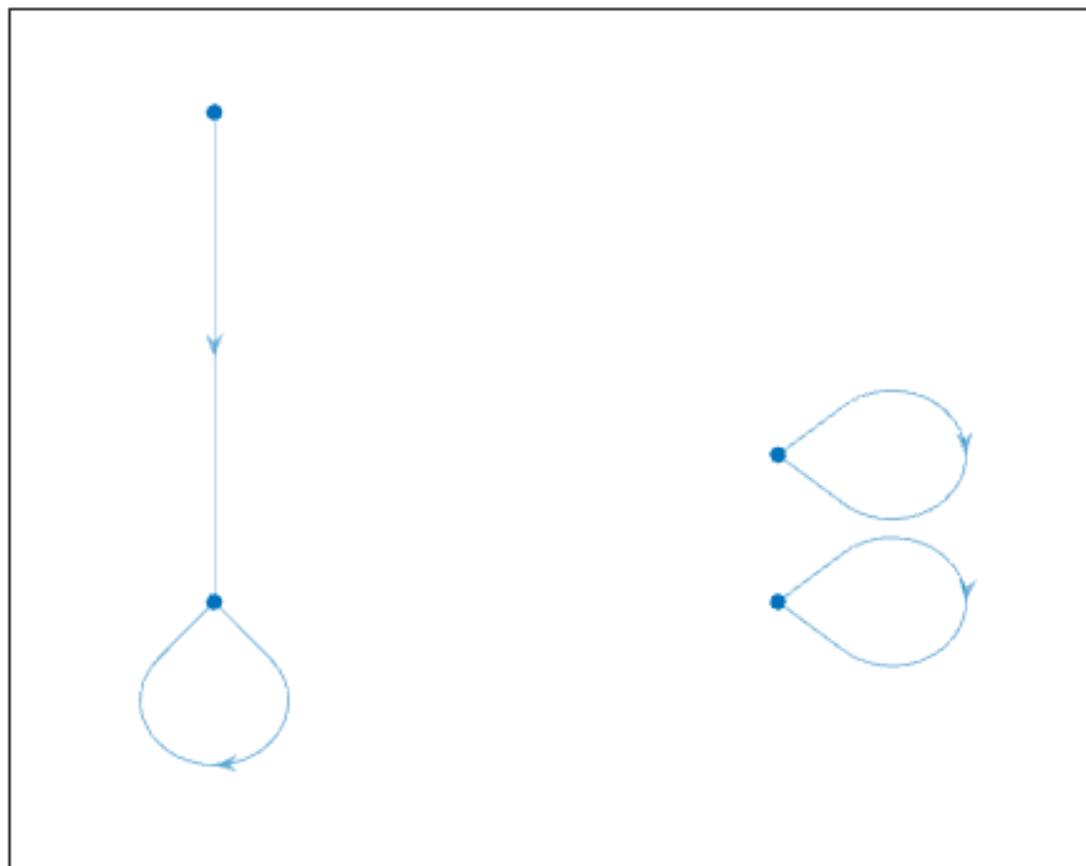


Figura 3.350: Atractor regla 30 n=2

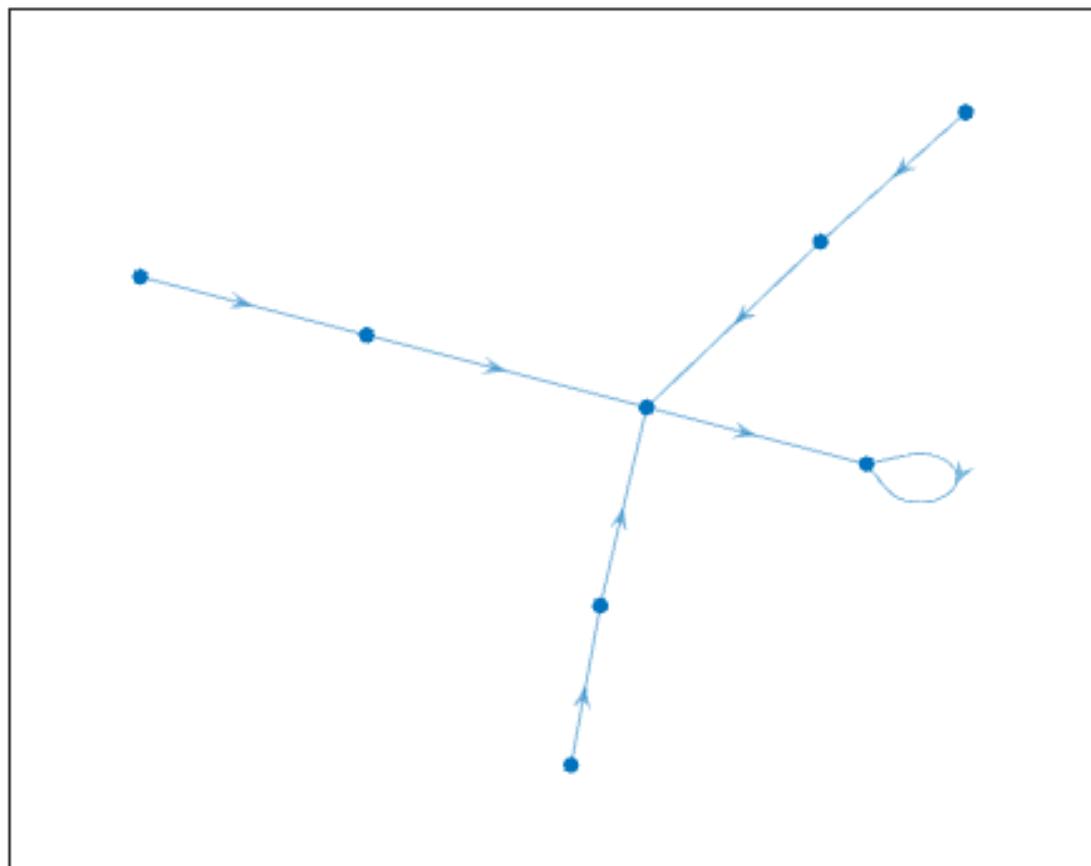


Figura 3.351: Atractor regla 30 n=3

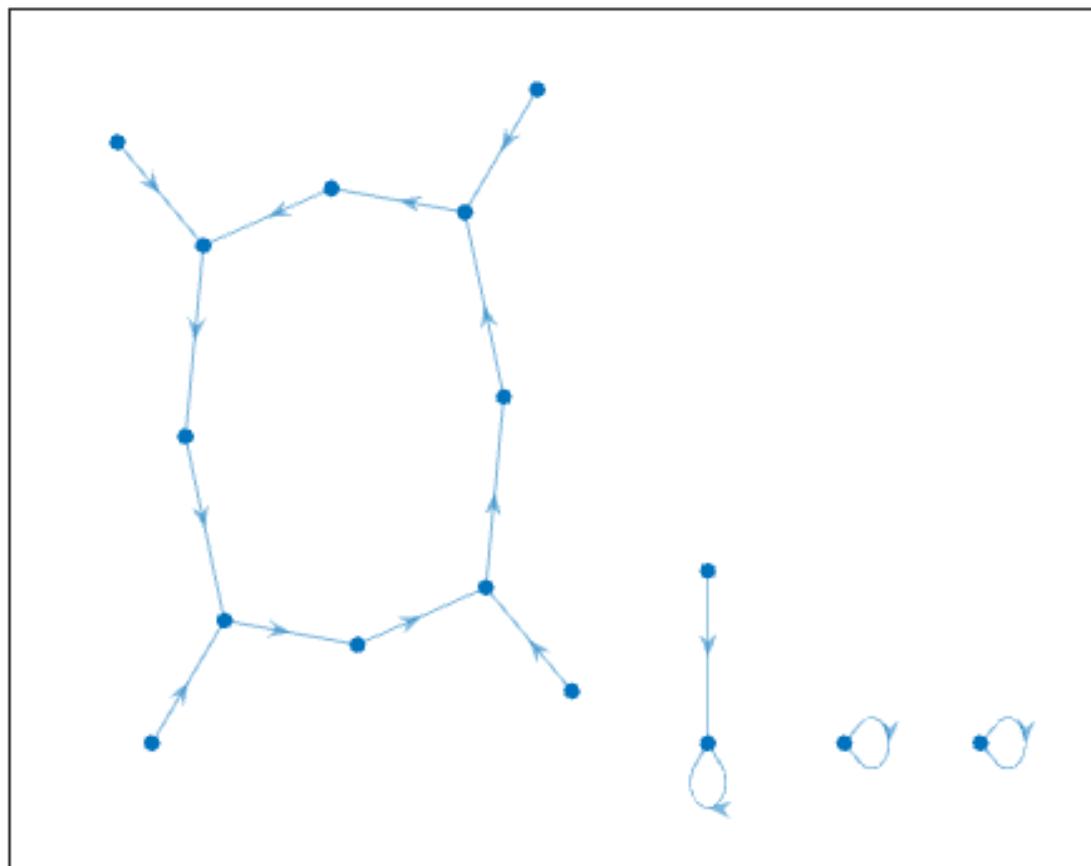


Figura 3.352: Atractor regla 30 n=4

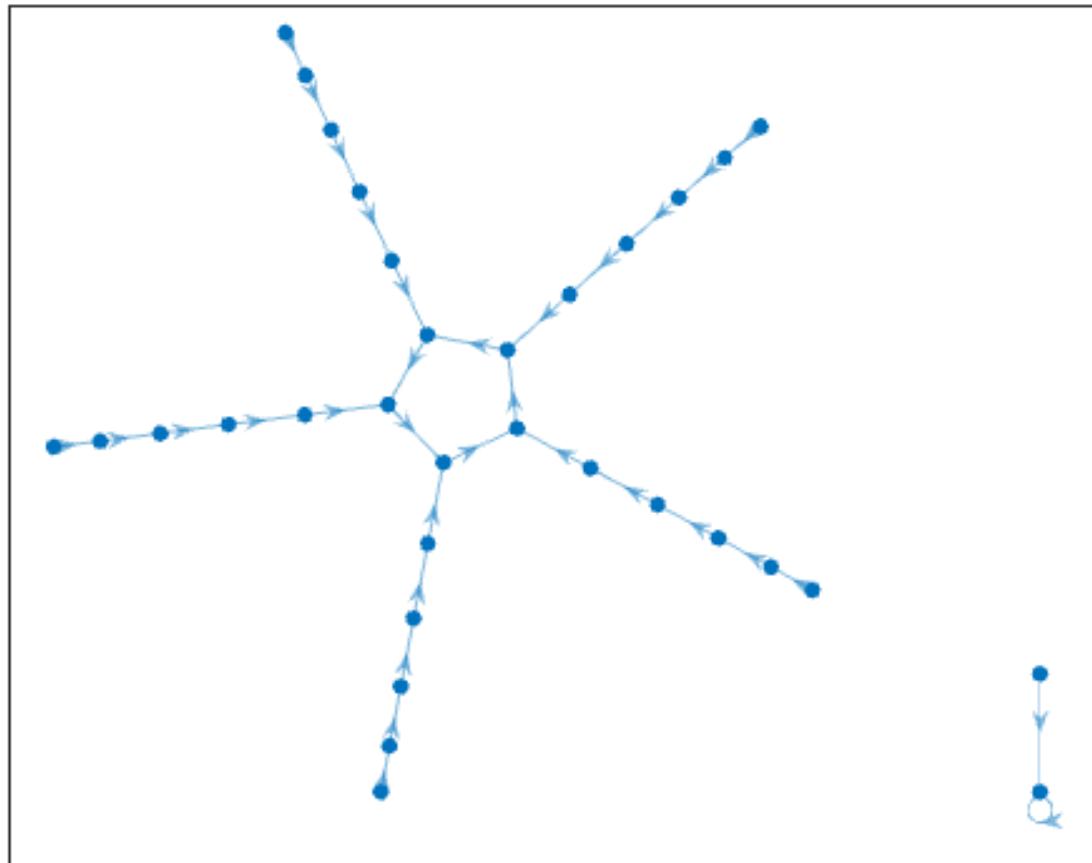


Figura 3.353: Atractor regla 30 n=5

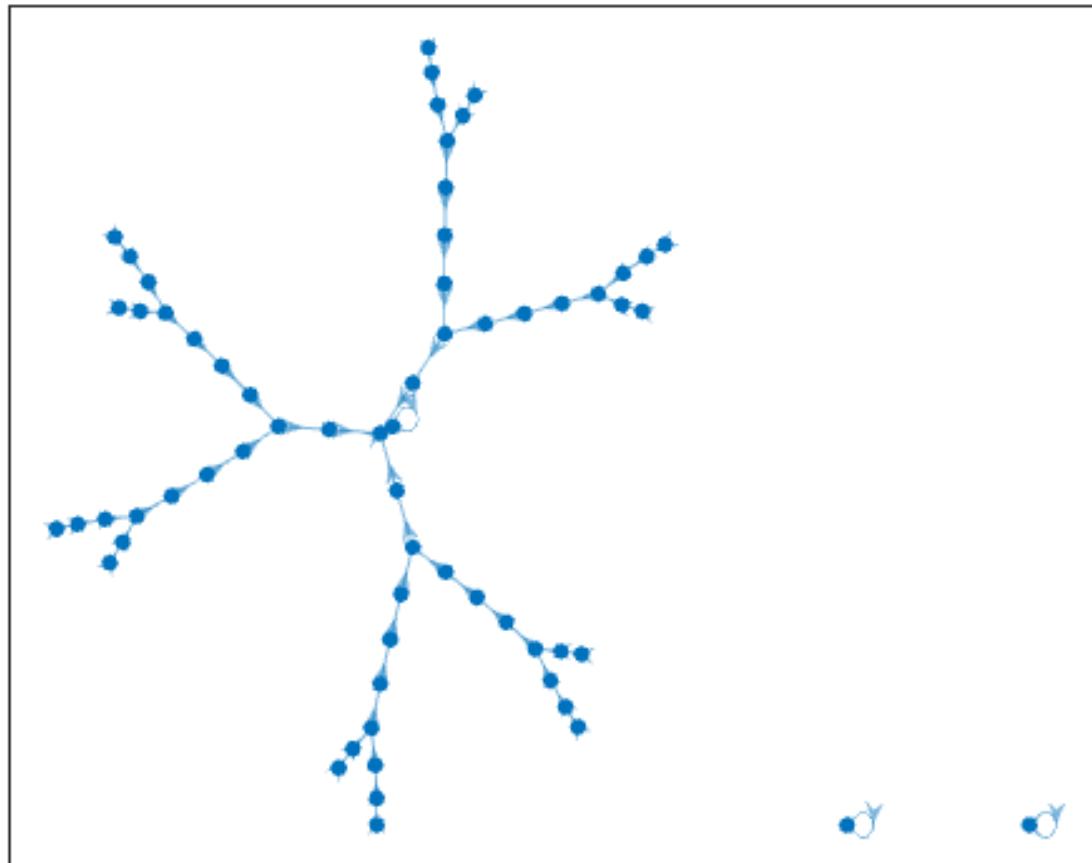


Figura 3.354: Atractor regla 30 n=6

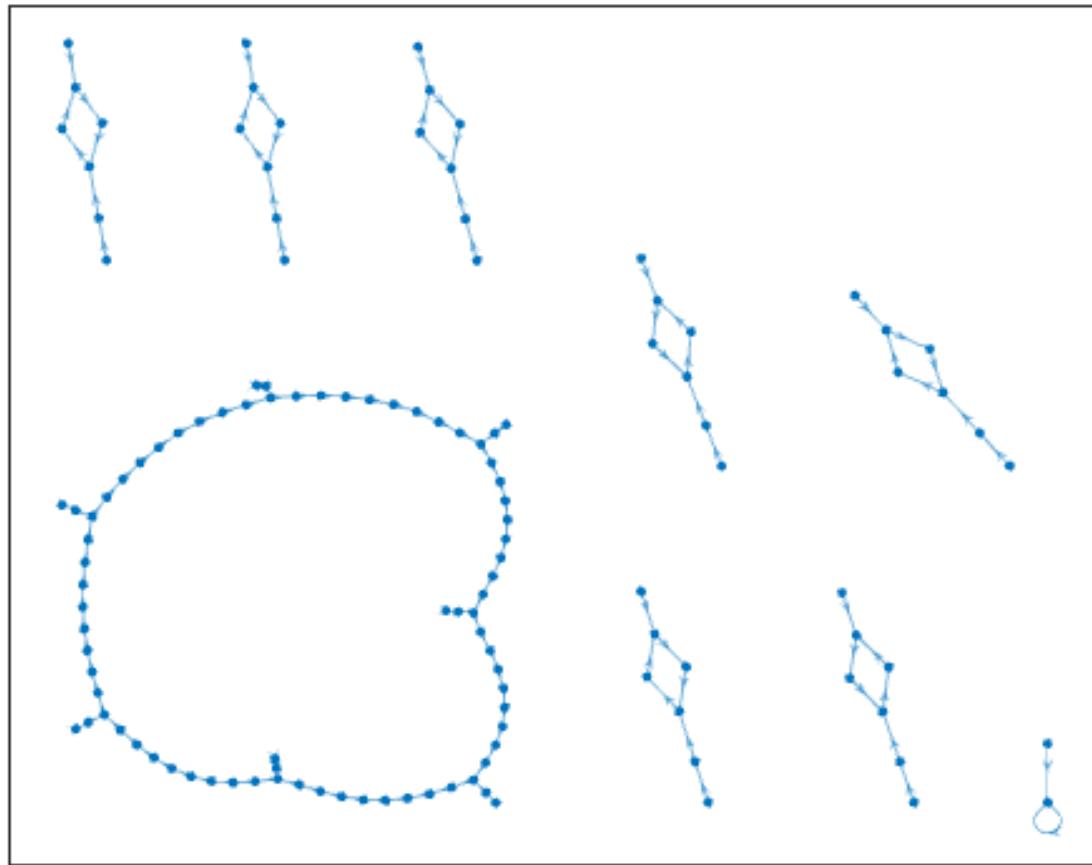


Figura 3.355: Atractor regla 30 n=7

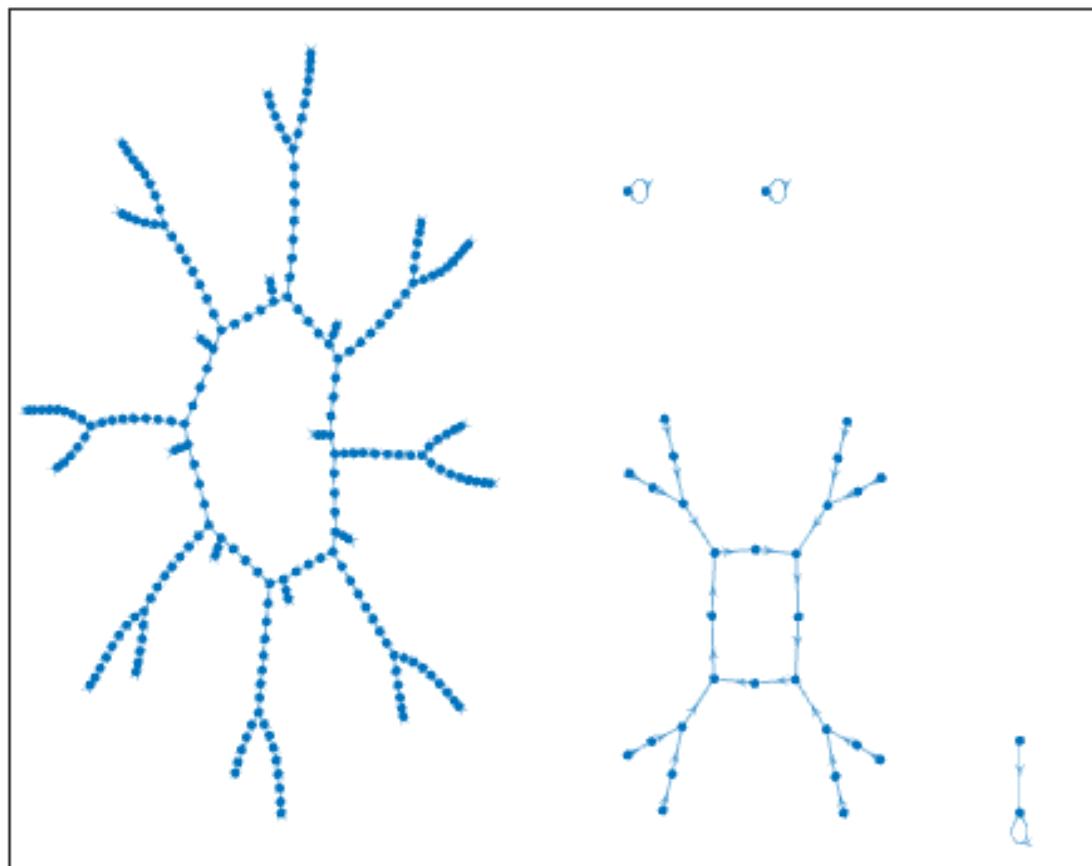


Figura 3.356: Atractor regla 30 n=8

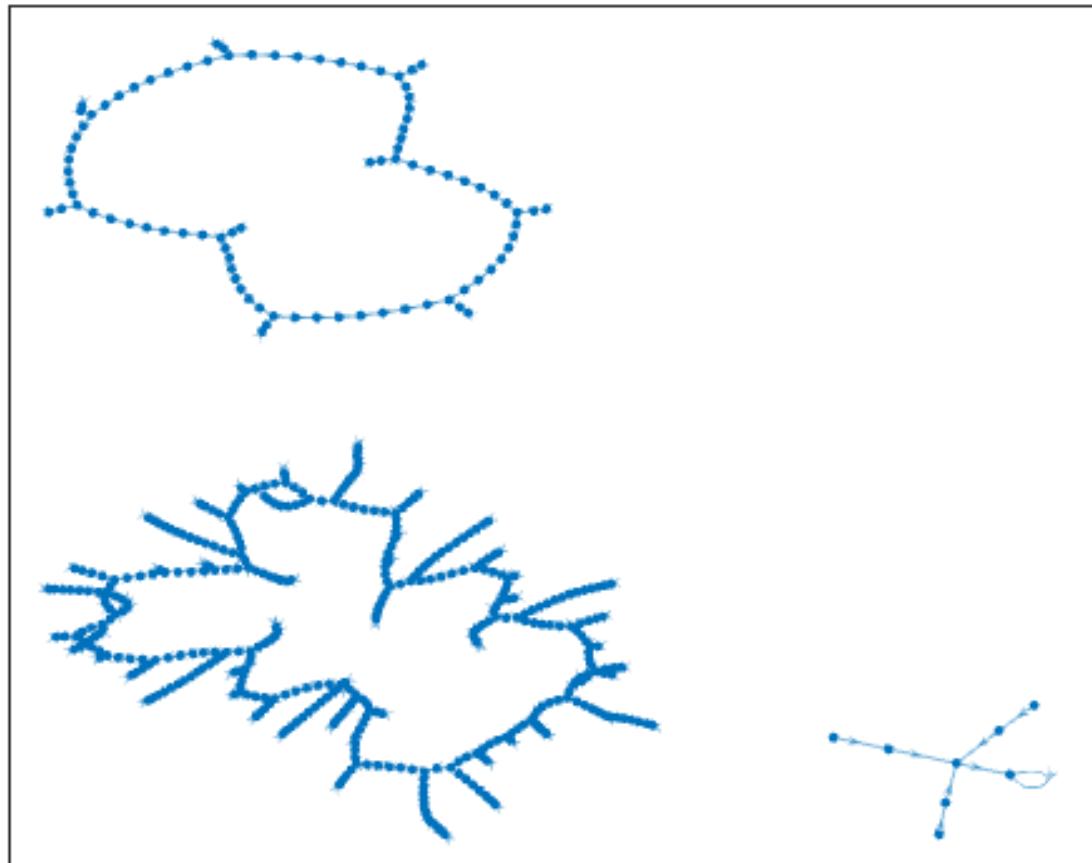


Figura 3.357: Atractor regla 30 n=9

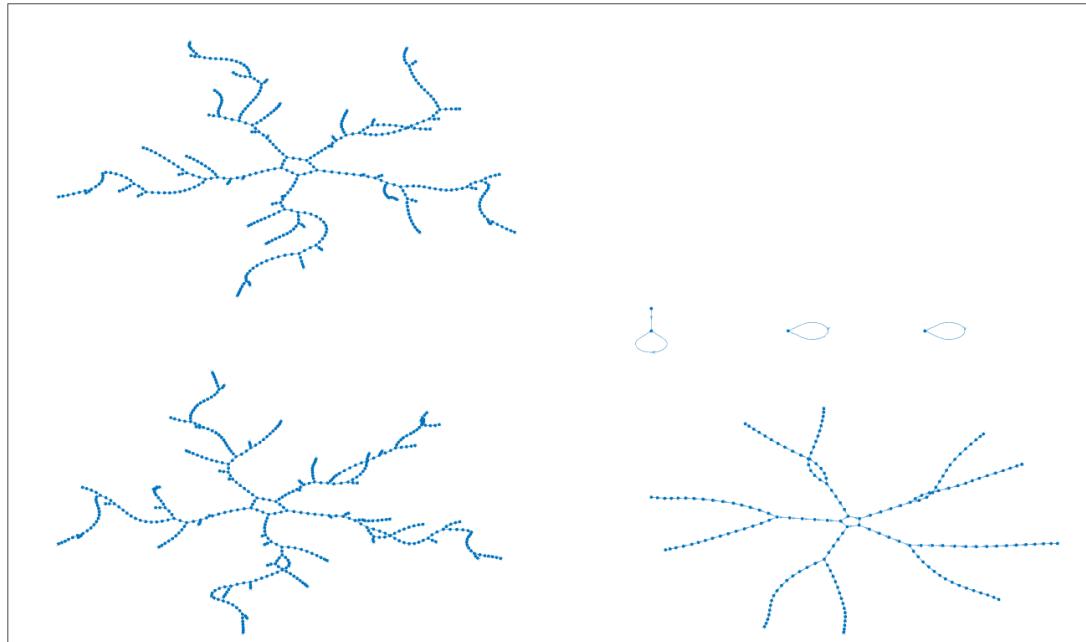


Figura 3.358: Atractor regla 30 n=10

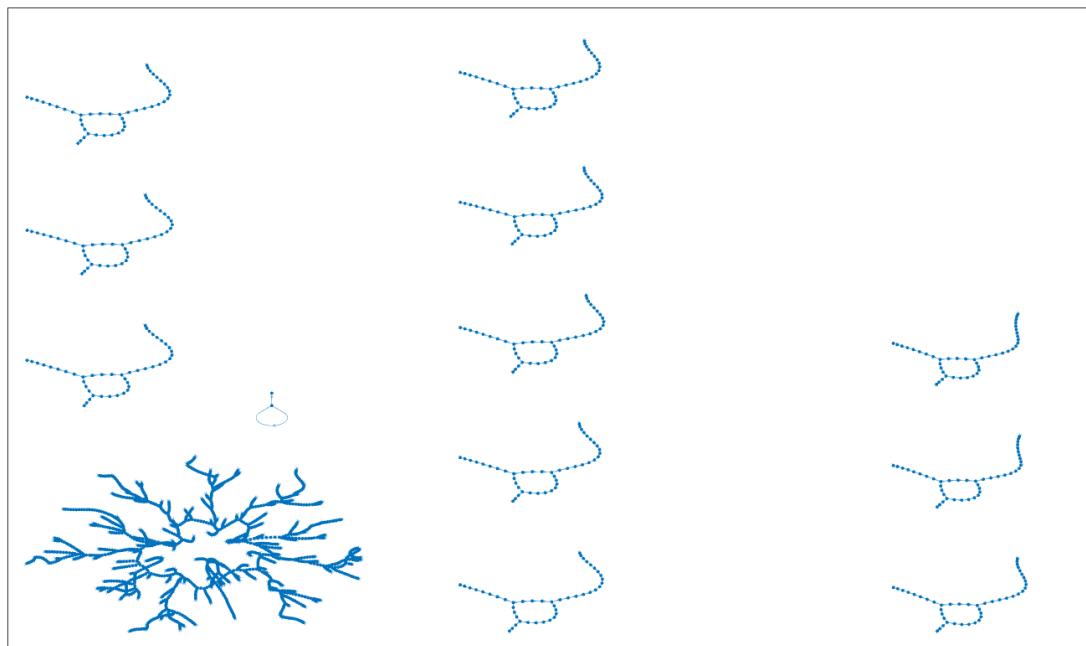
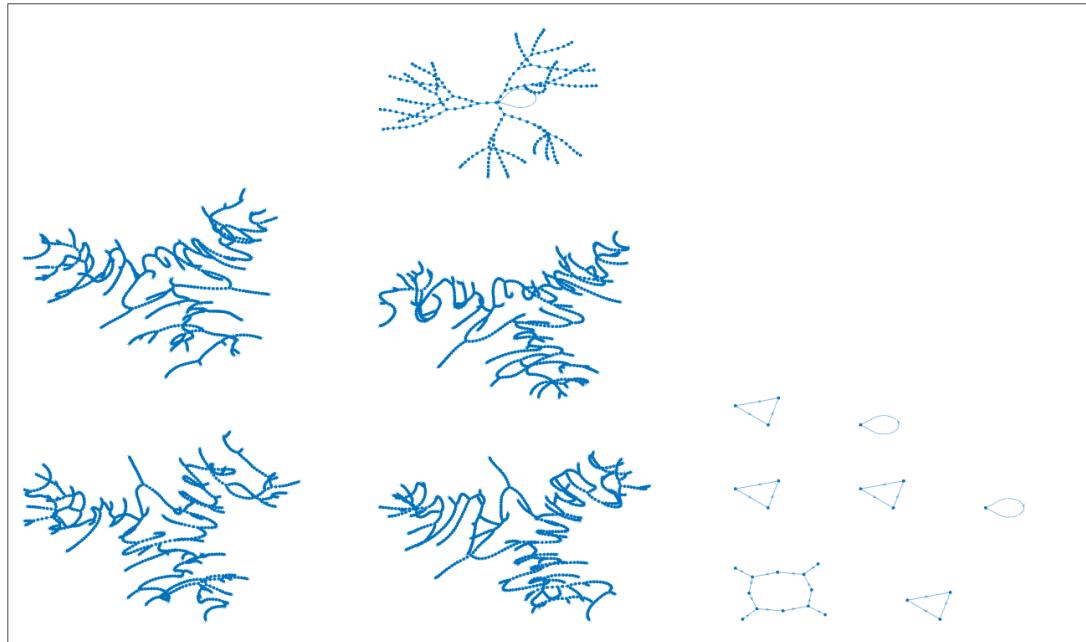
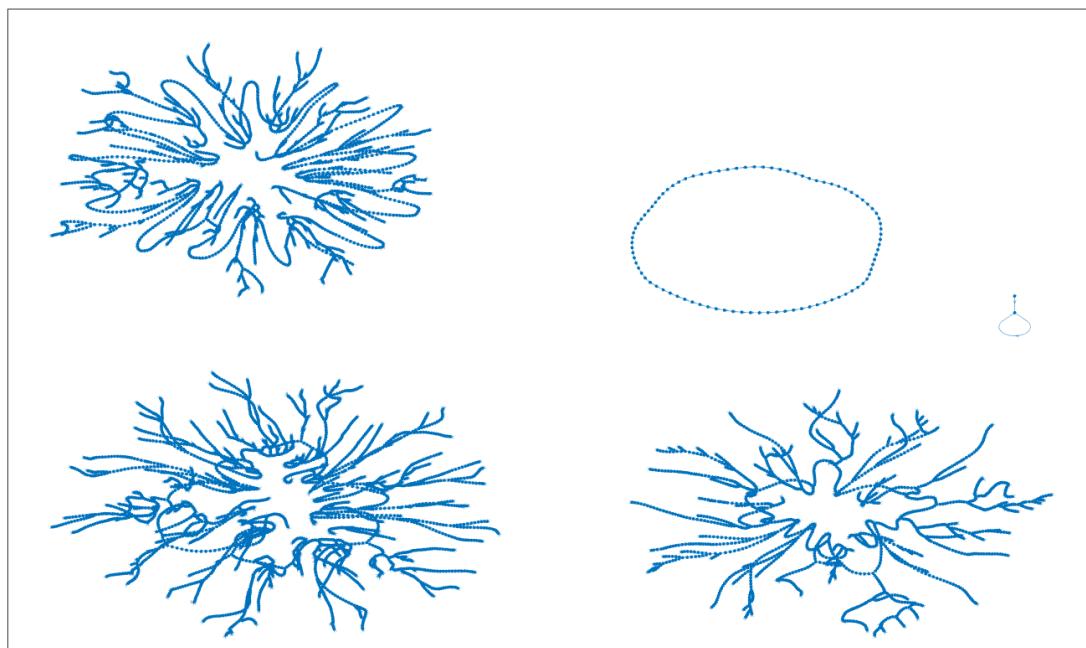


Figura 3.359: Atractor regla 30 n=11

Figura 3.360: Atractor regla 30 $n=12$ Figura 3.361: Atractor regla 30 $n=13$

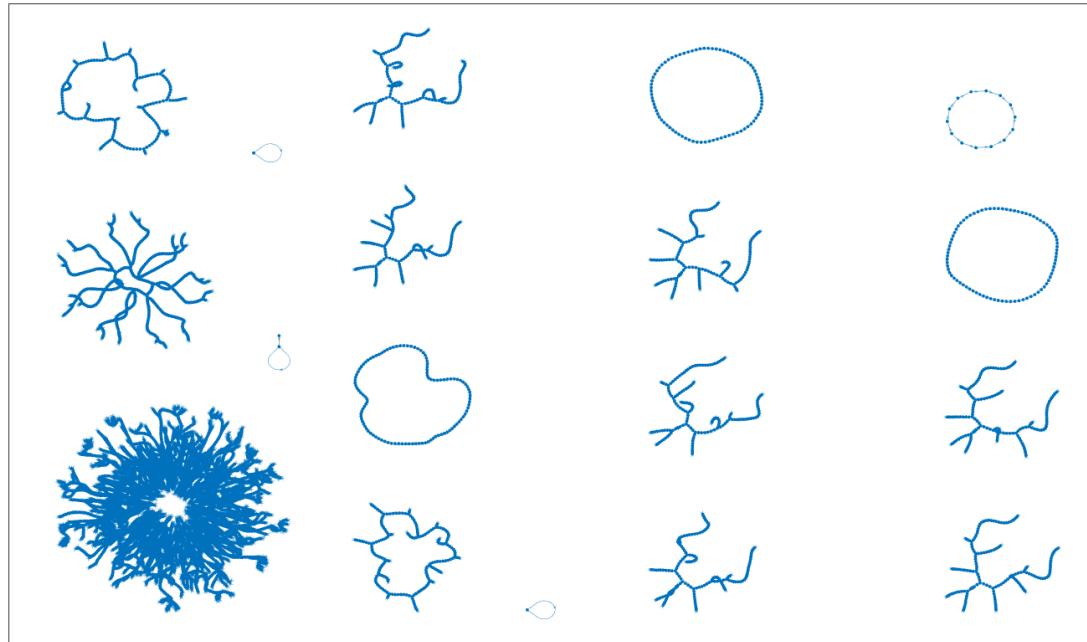


Figura 3.362: Atractor regla 30 n=14

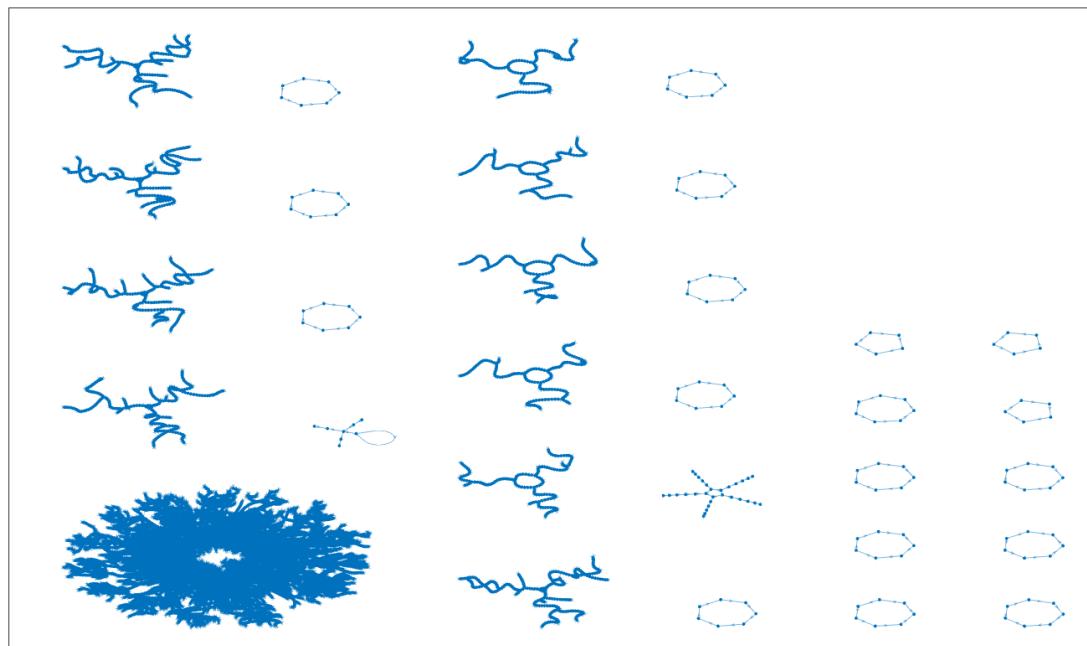


Figura 3.363: Atractor regla 30 n=15

3.28. Reglas 32,251

Respecto a la regla 32 se aprecia que mientras más grande es el tamaño de la cadena (n) se crea una estructura de tipo estrella en la cual van surgiendo nodos hoja y con una peculiaridad que en solo los n pares surgen atractores cílicos de 2 nodos, matlab los coloca en la esquina inferior derecha.

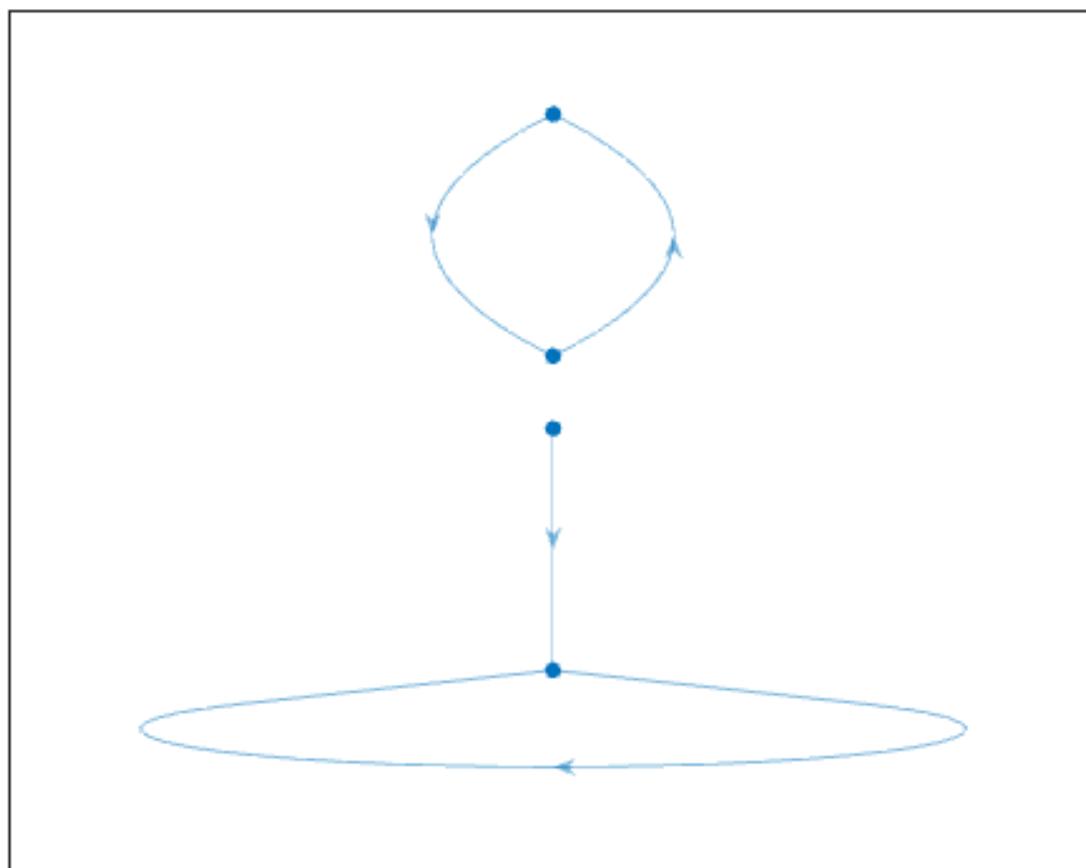


Figura 3.364: Atractor regla 32 $n=2$

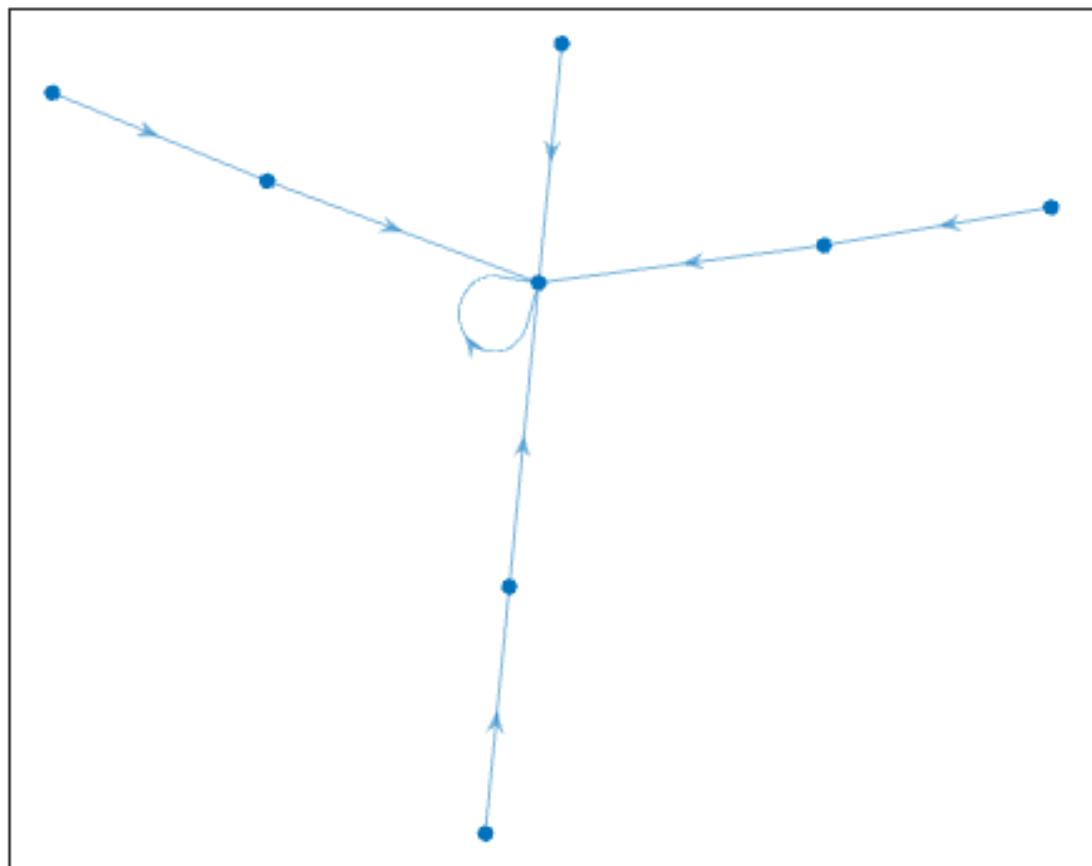


Figura 3.365: Atractor regla 32 n=3

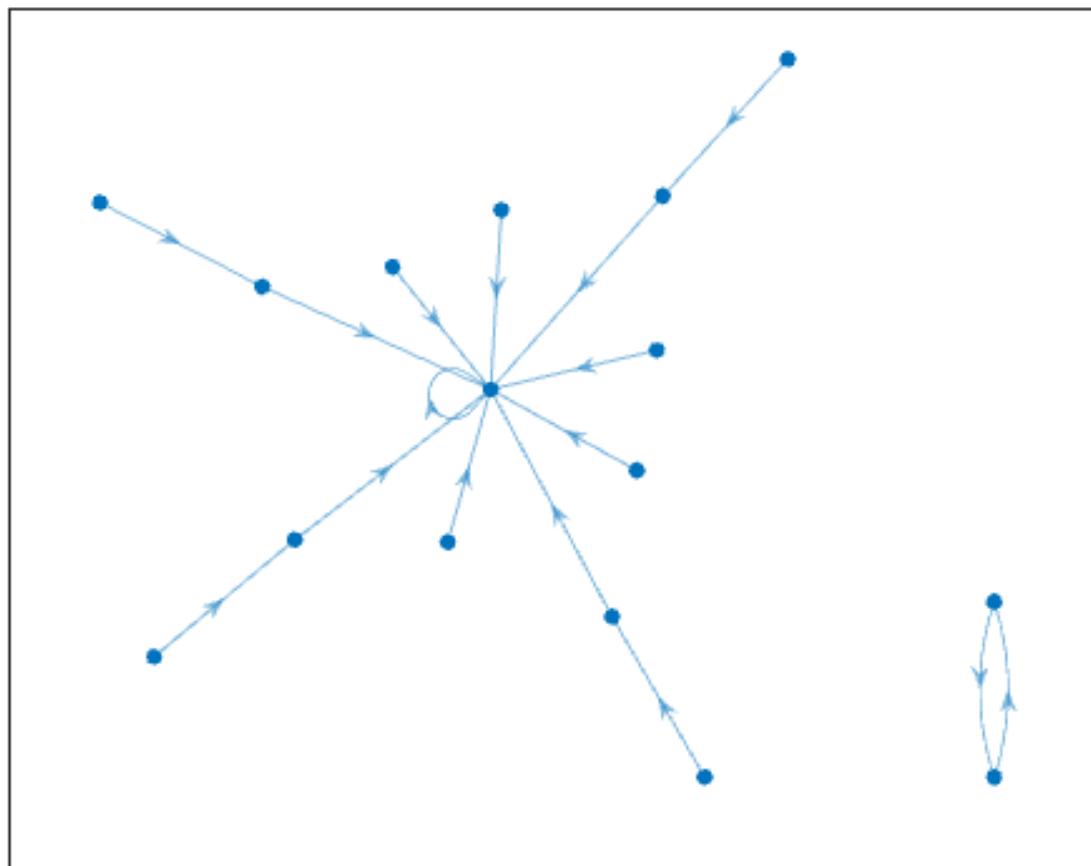


Figura 3.366: Atractor regla 32 n=4

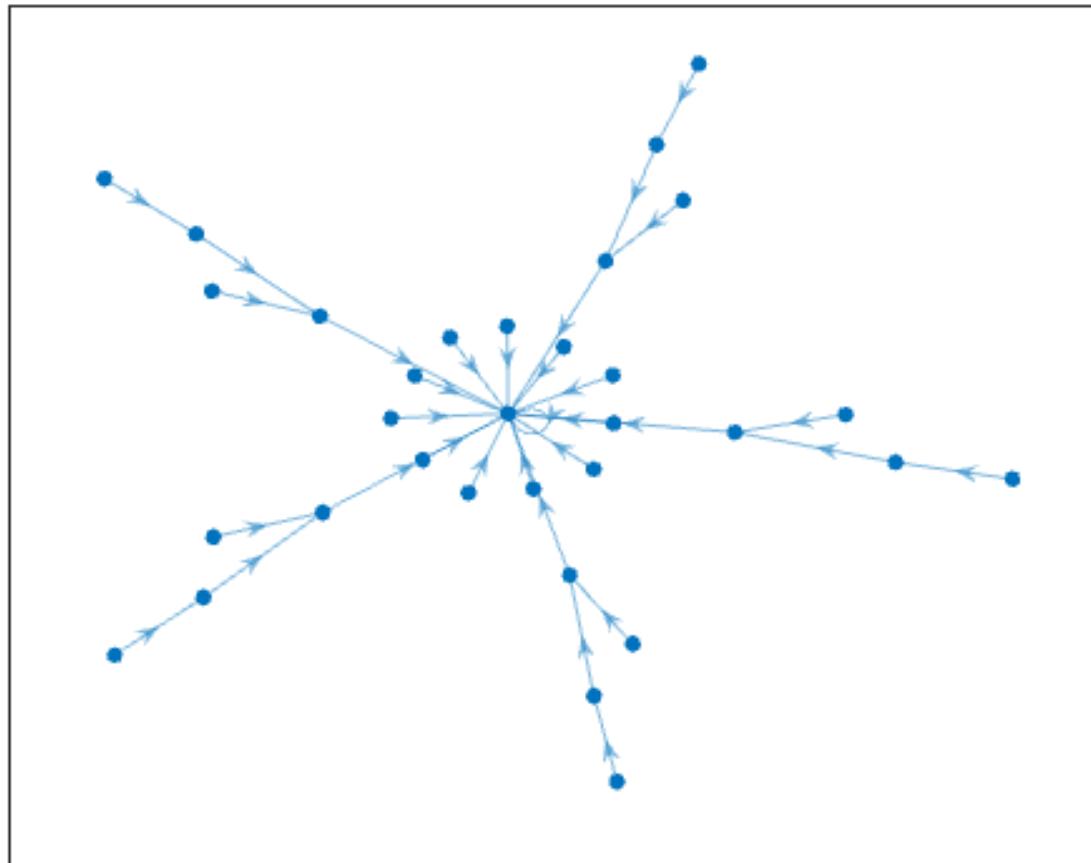


Figura 3.367: Atractor regla 32 n=5

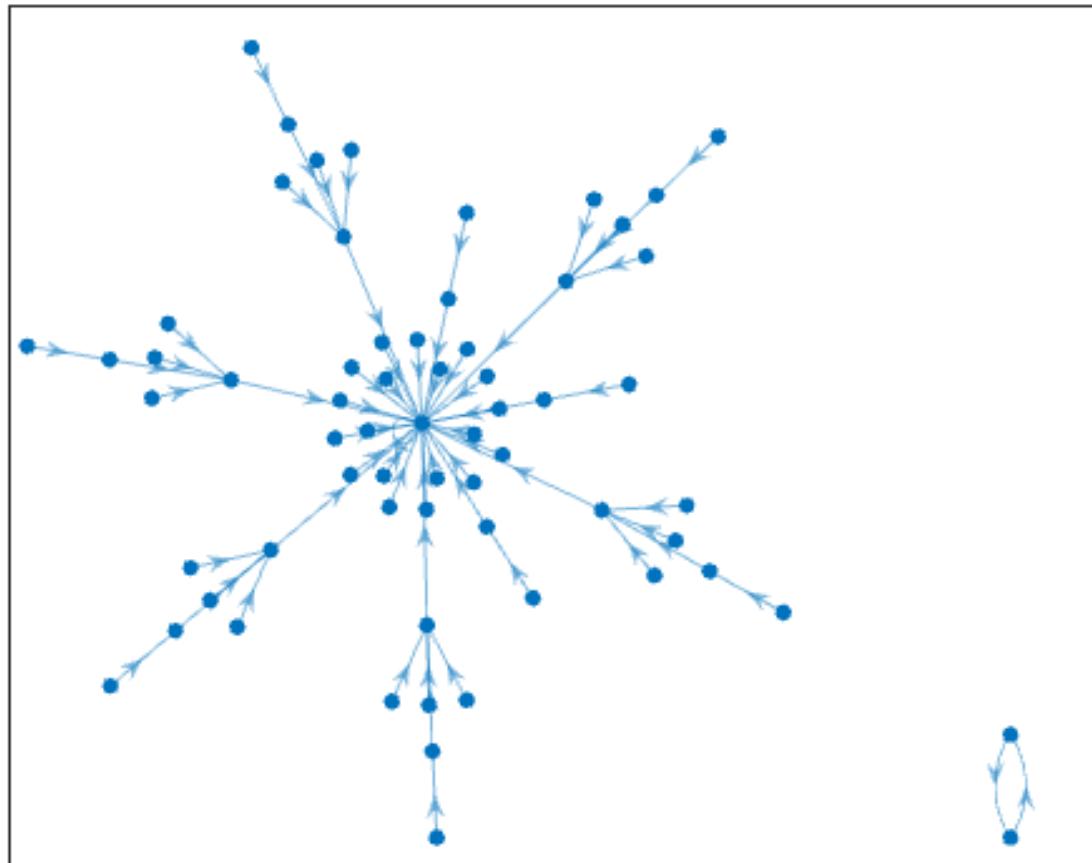


Figura 3.368: Atractor regla 32 n=6

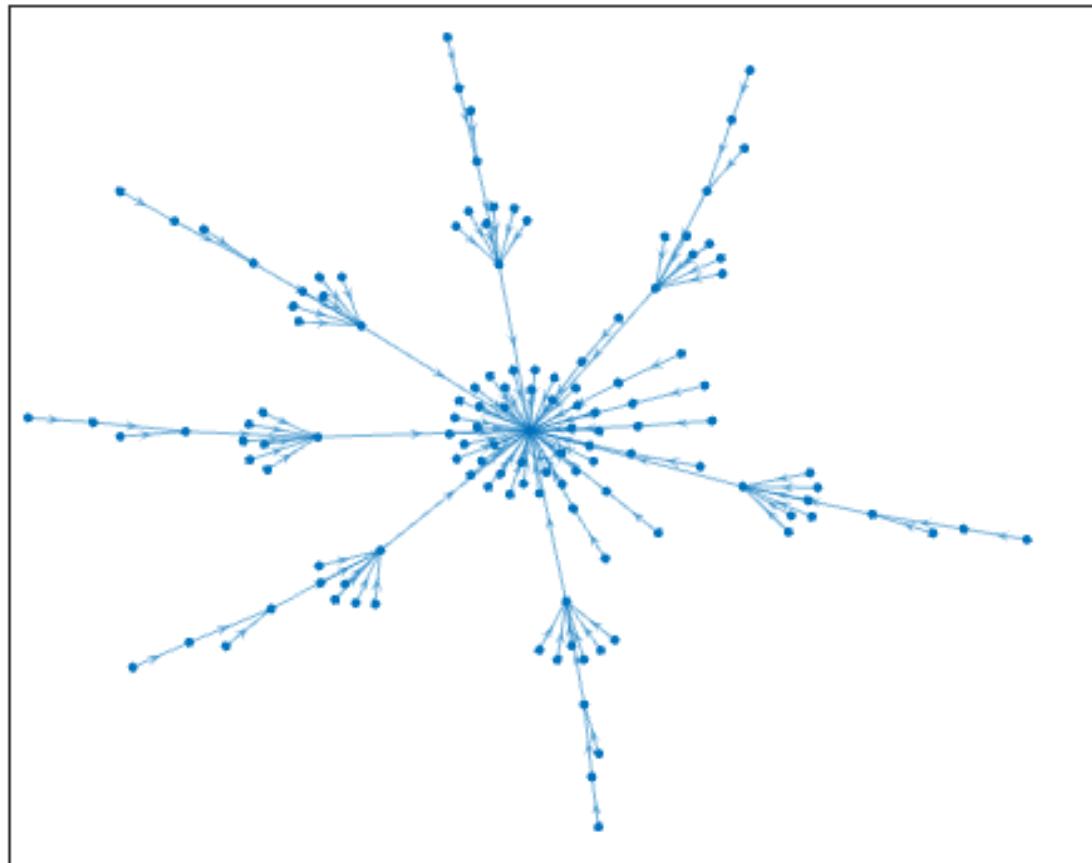


Figura 3.369: Atractor regla 32 n=7

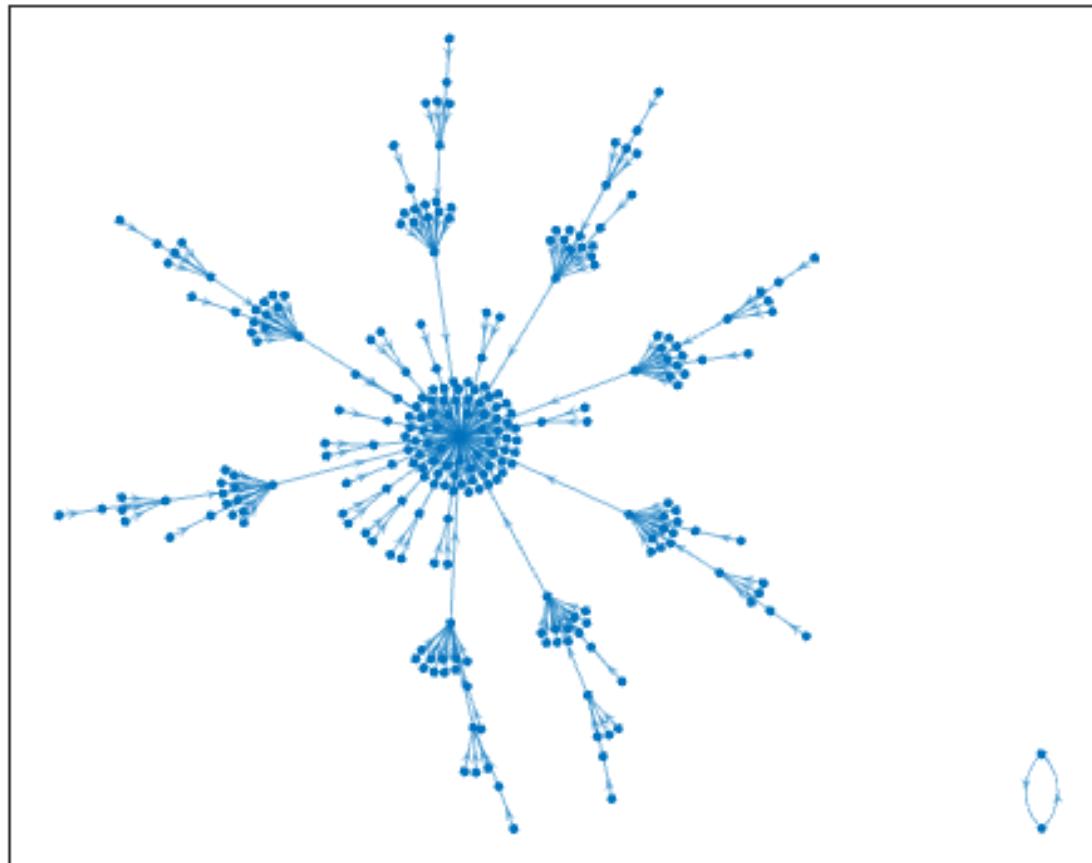


Figura 3.370: Atractor regla 32 n=8

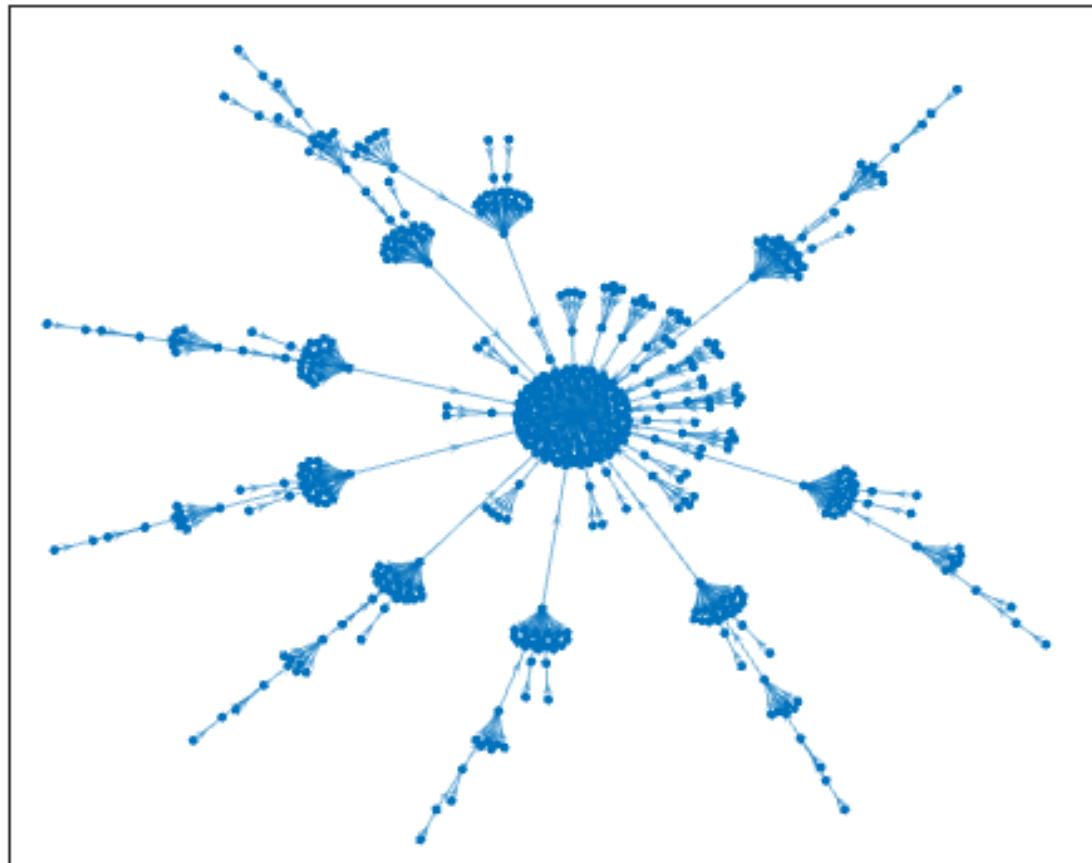


Figura 3.371: Atractor regla 32 n=9

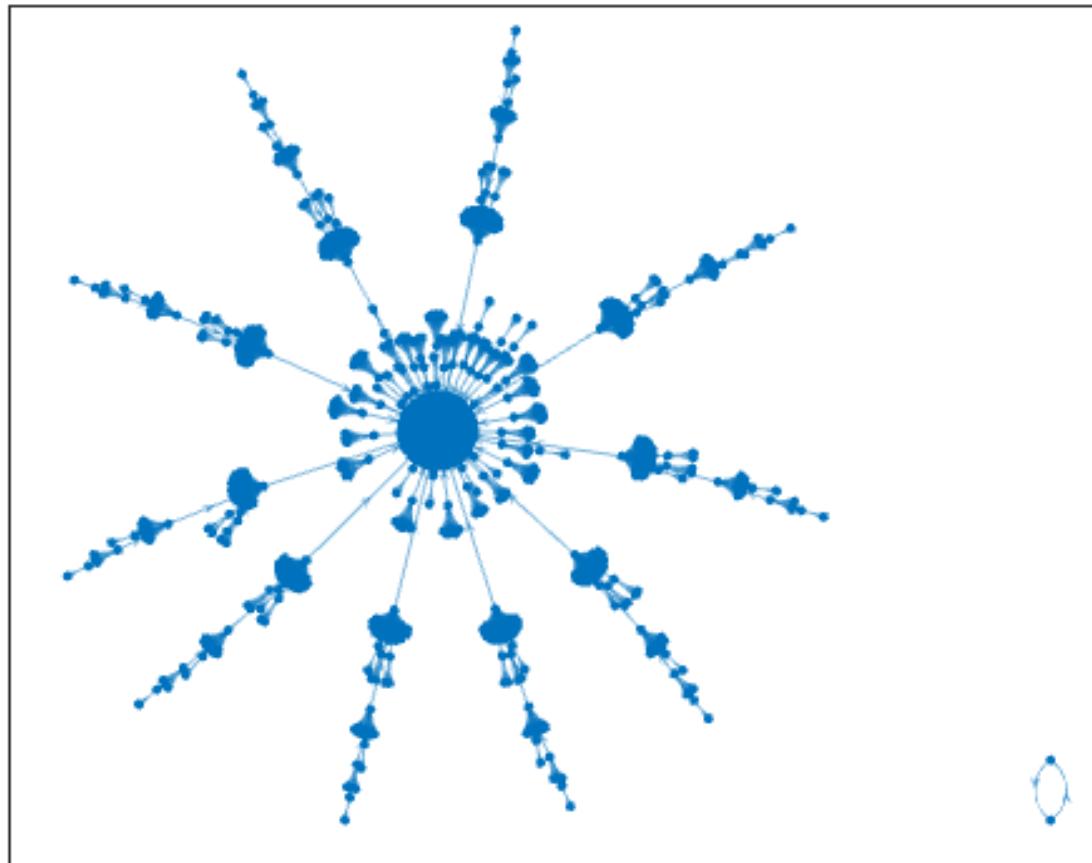


Figura 3.372: Atractor regla 32 n=10

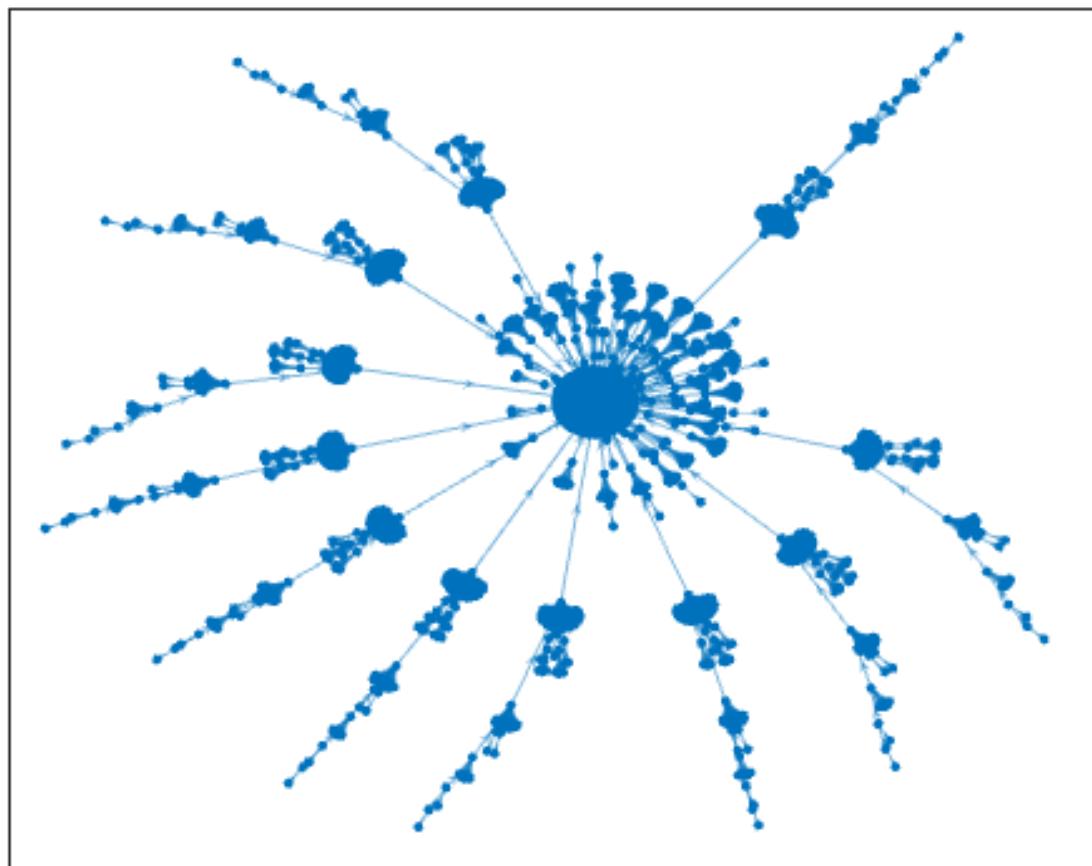


Figura 3.373: Atractor regla 32 n=11

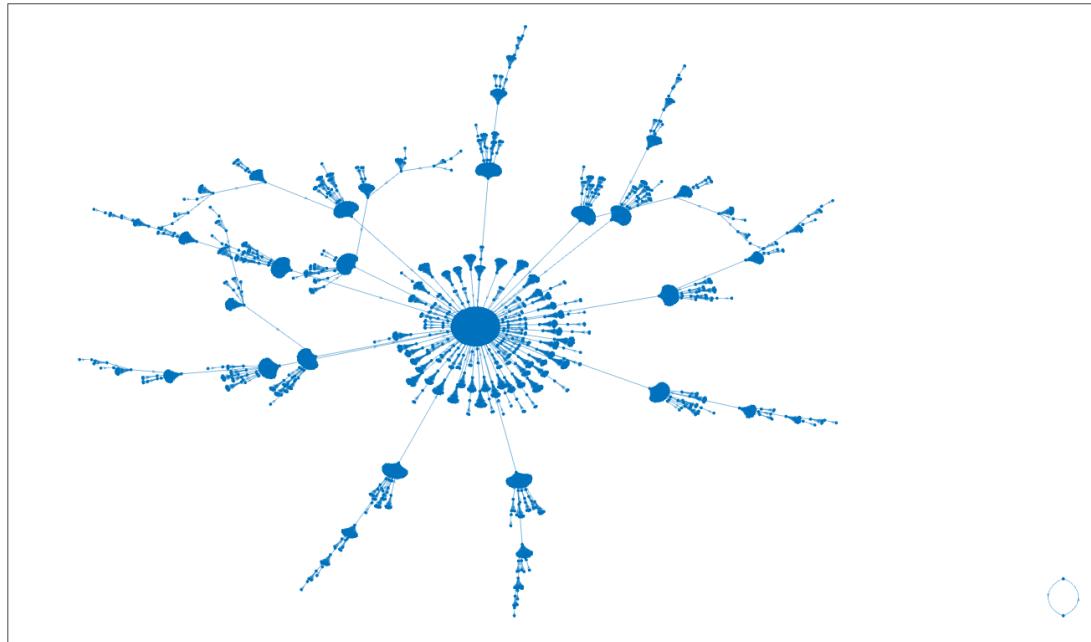


Figura 3.374: Atractor regla 32 n=12

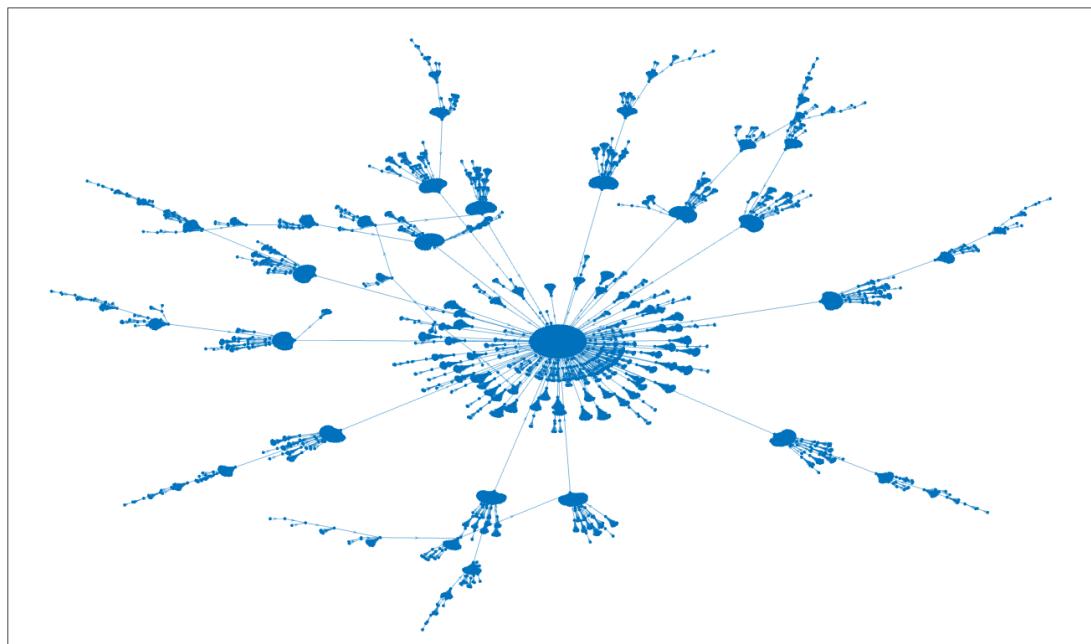


Figura 3.375: Atractor regla 32 n=13

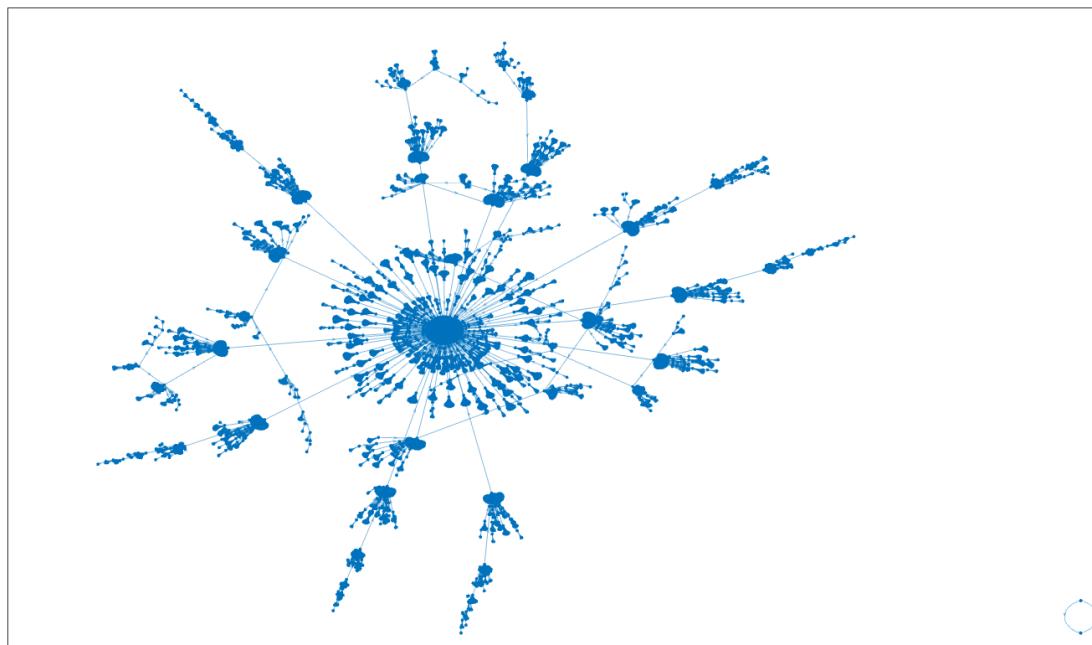


Figura 3.376: Atractor regla 32 n=14

3.29. Reglas 33,123

Respecto a la regla 33 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen bastantes nodos que en n mayores a 10 ya parece una fiesta de atractores.

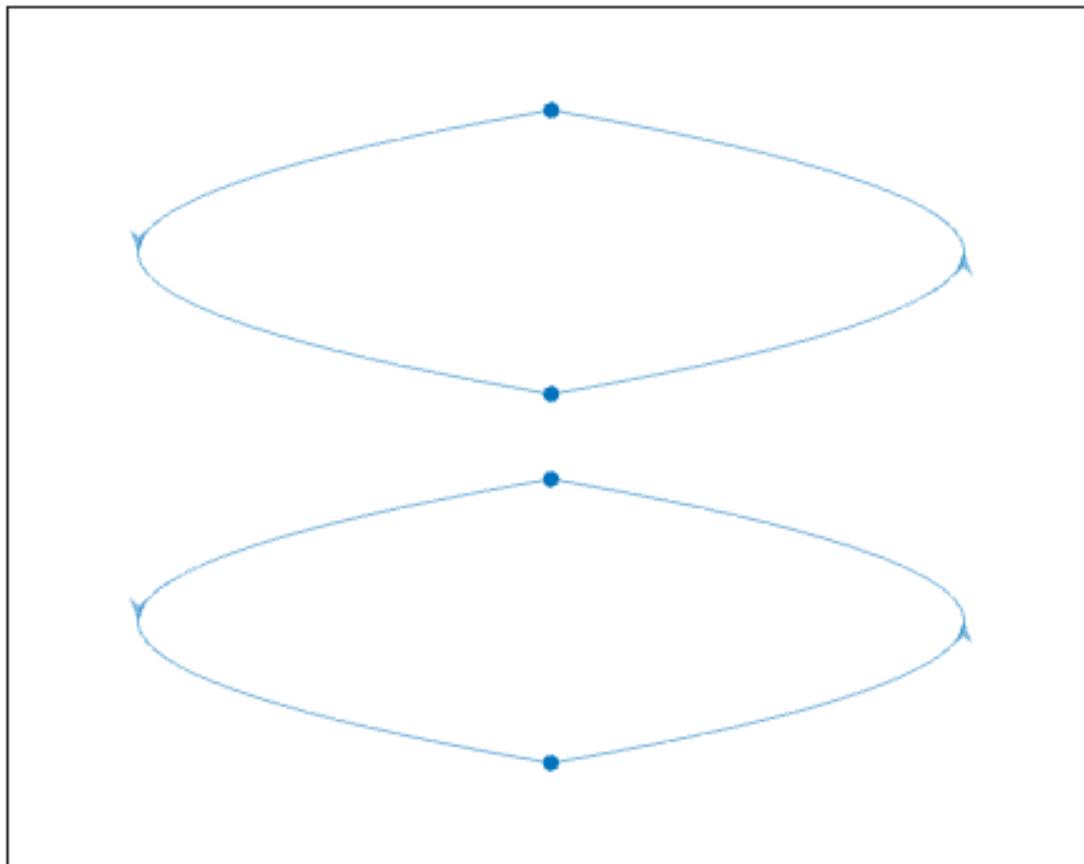


Figura 3.377: Atractor regla 33 $n=2$

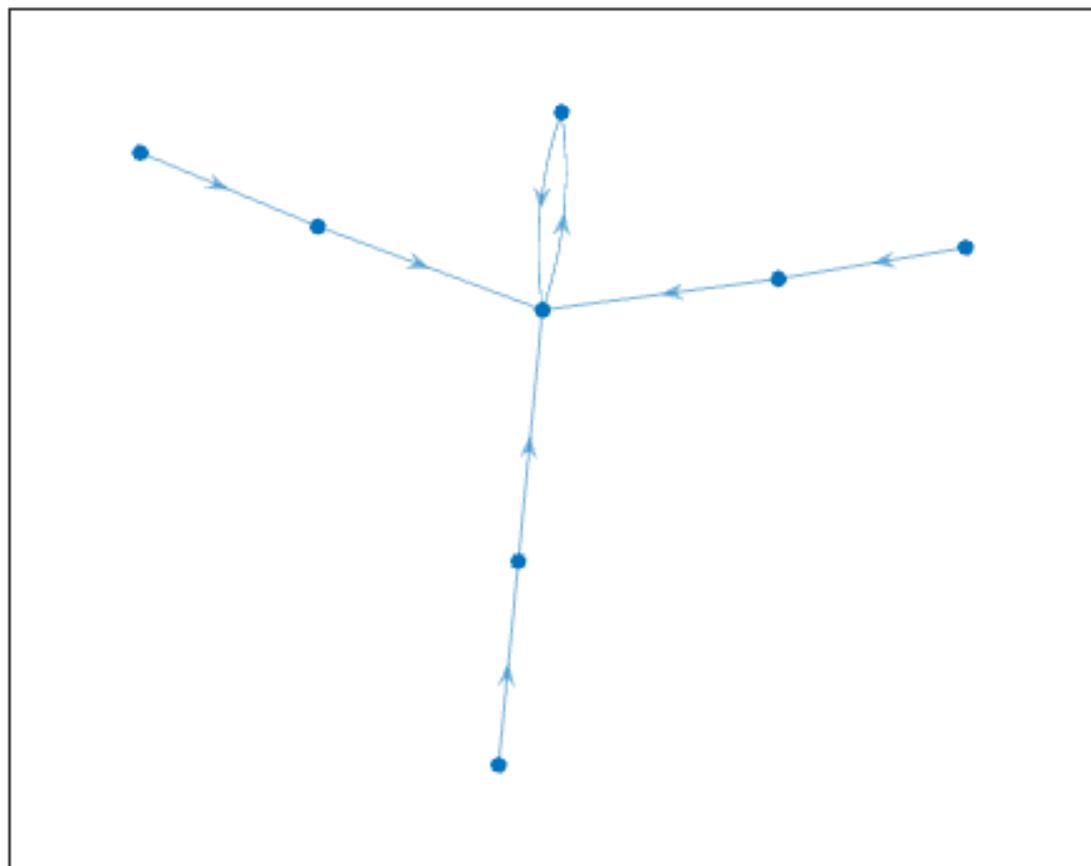


Figura 3.378: Atractor regla 33 n=3

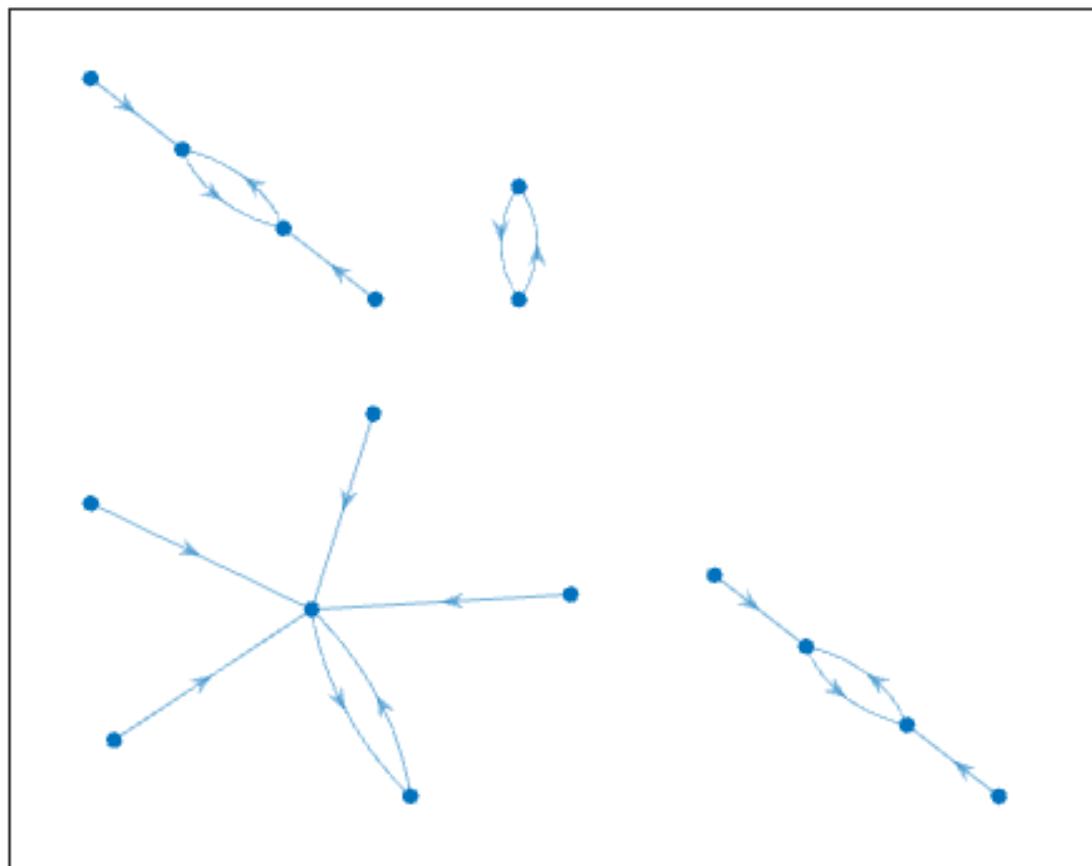


Figura 3.379: Atractor regla 33 n=4

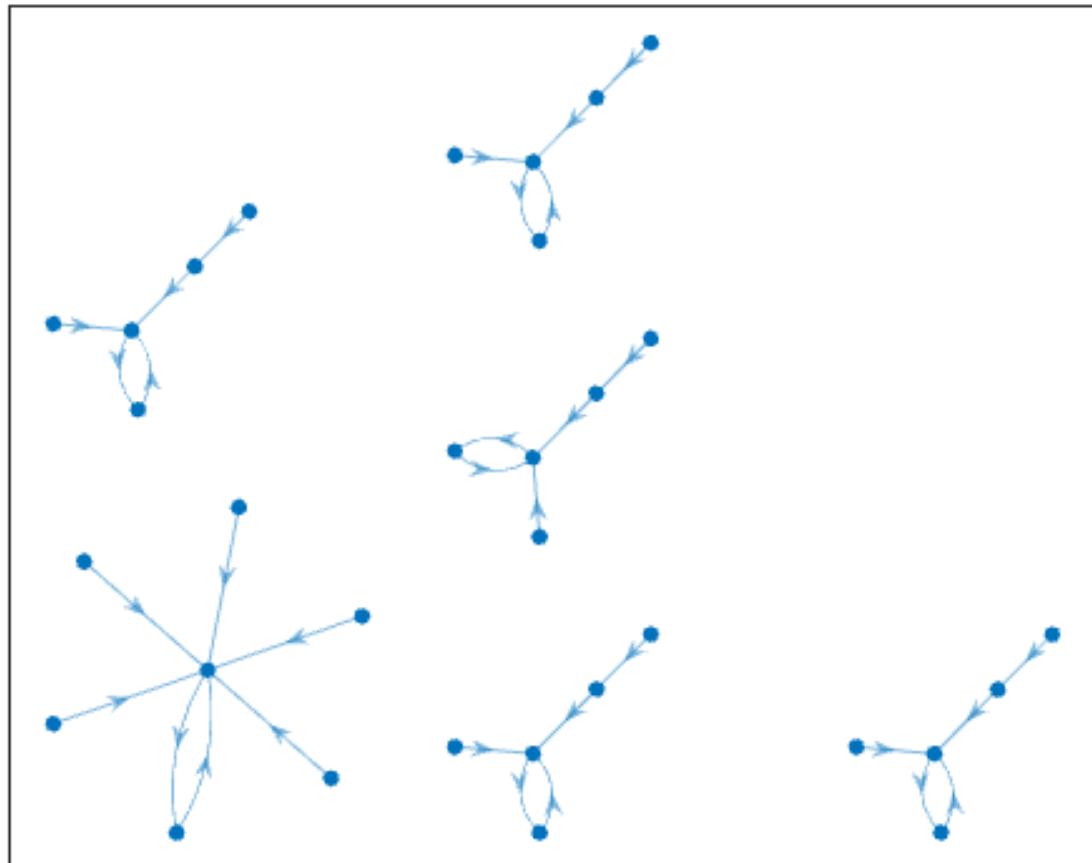


Figura 3.380: Atractor regla 33 n=5

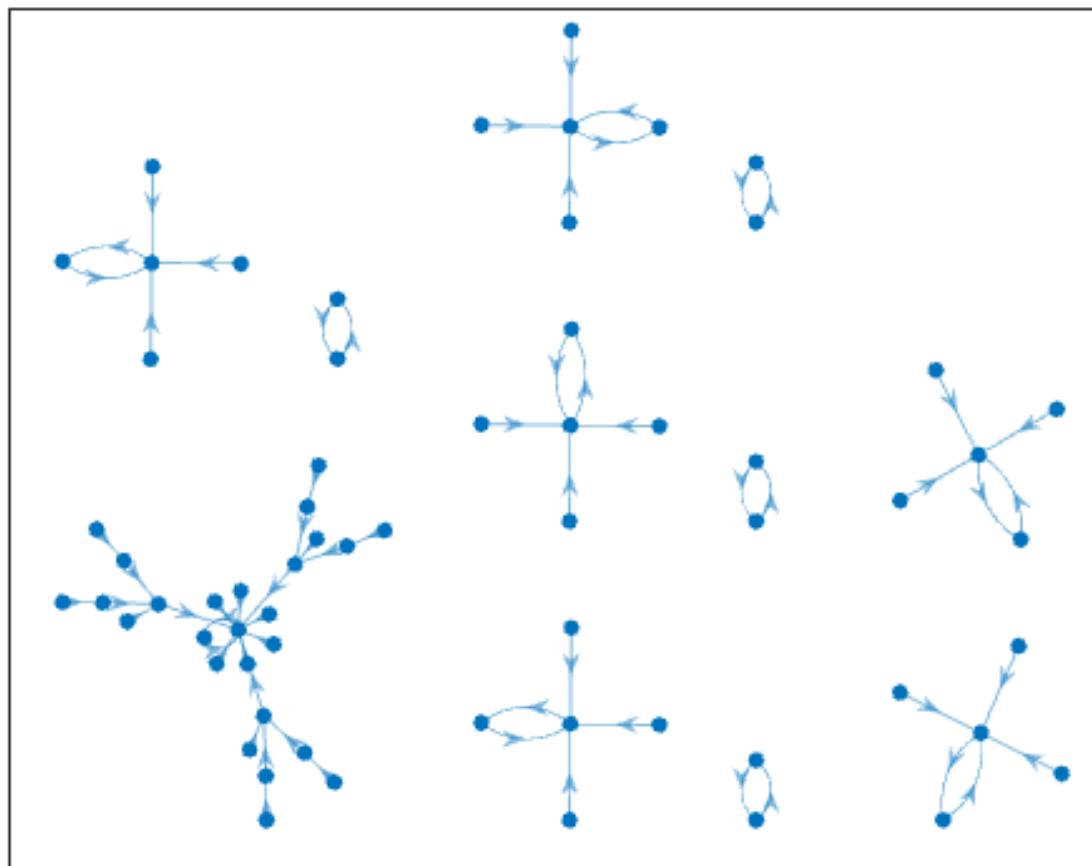


Figura 3.381: Atractor regla 33 n=6

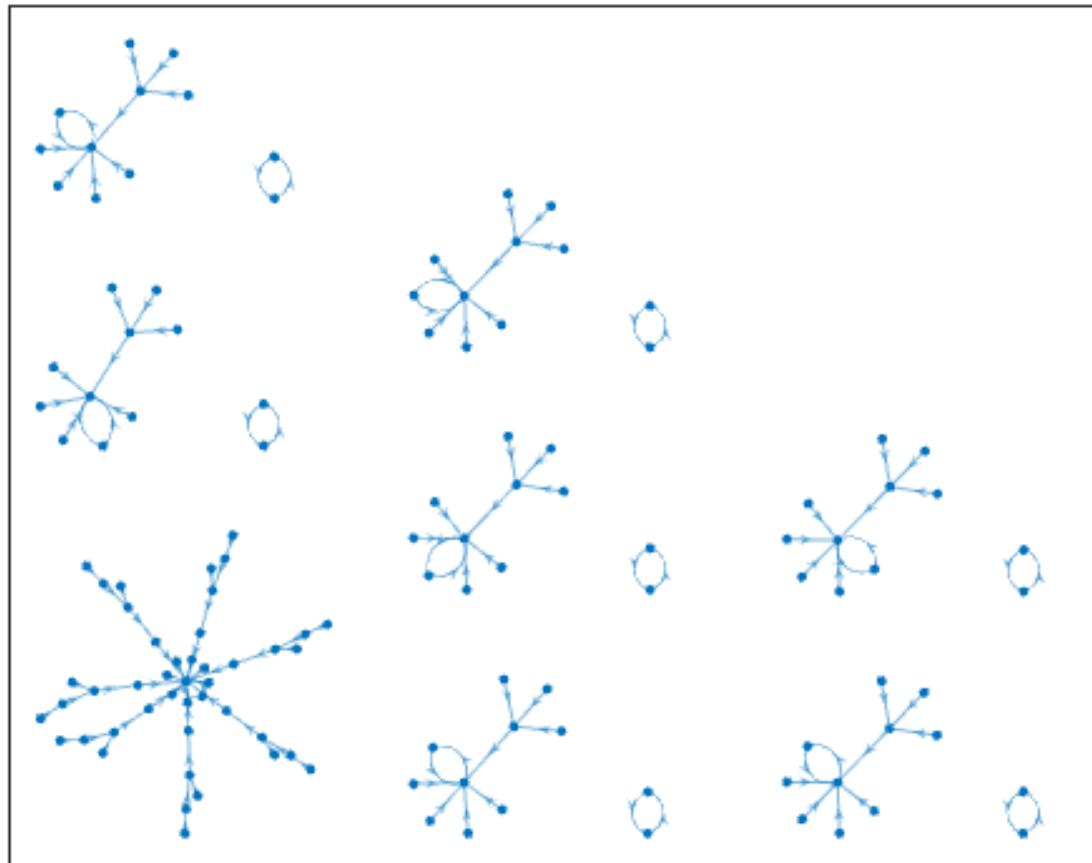


Figura 3.382: Atractor regla 33 n=7

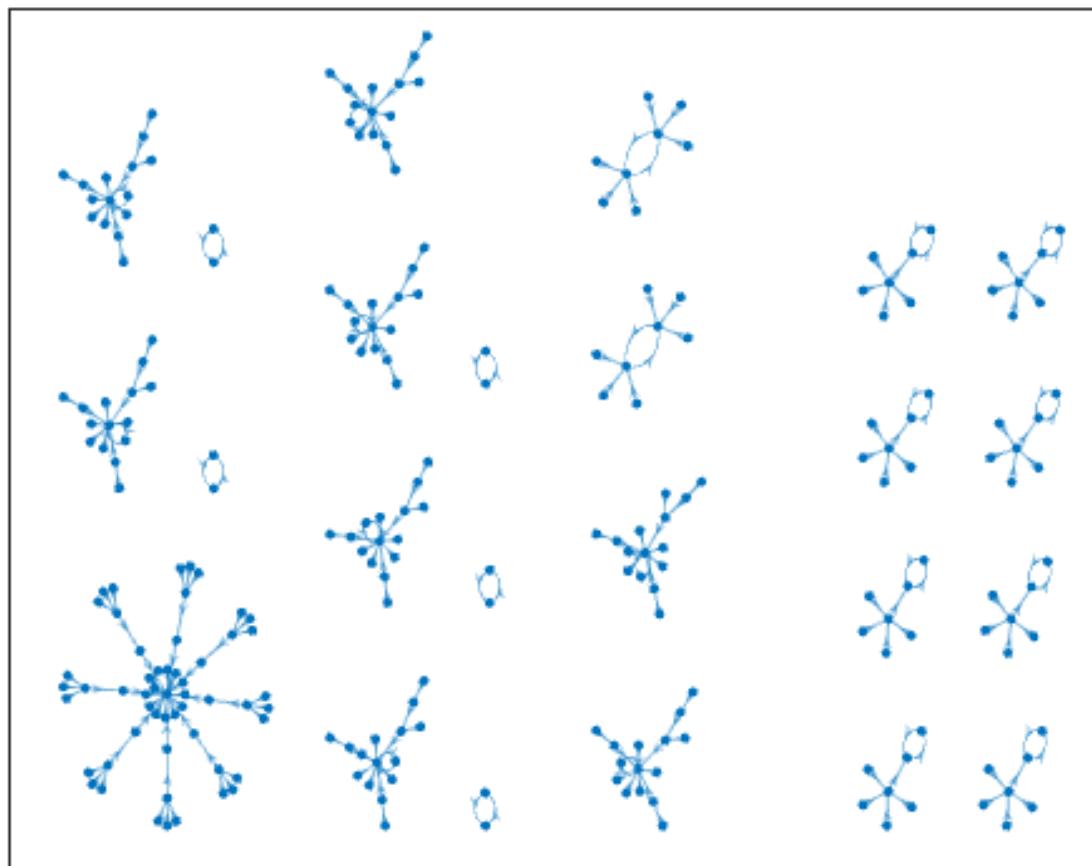


Figura 3.383: Atractor regla 33 n=8

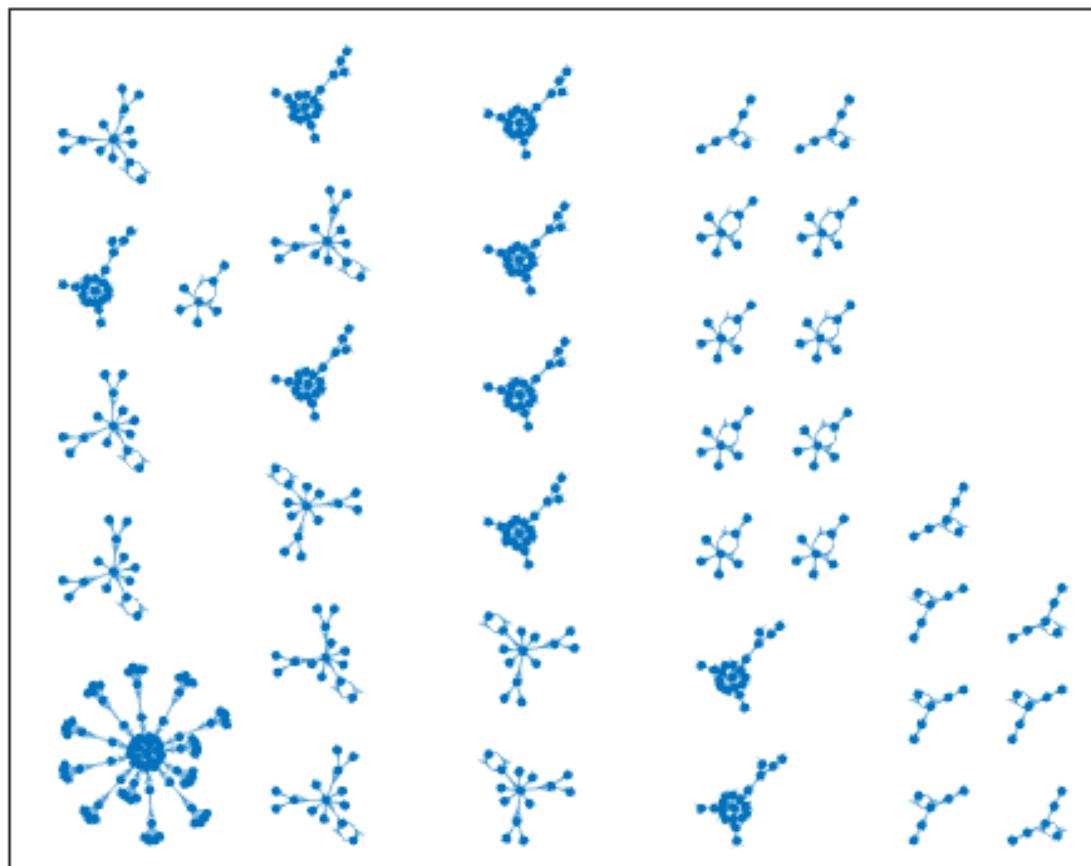


Figura 3.384: Atractor regla 33 n=9

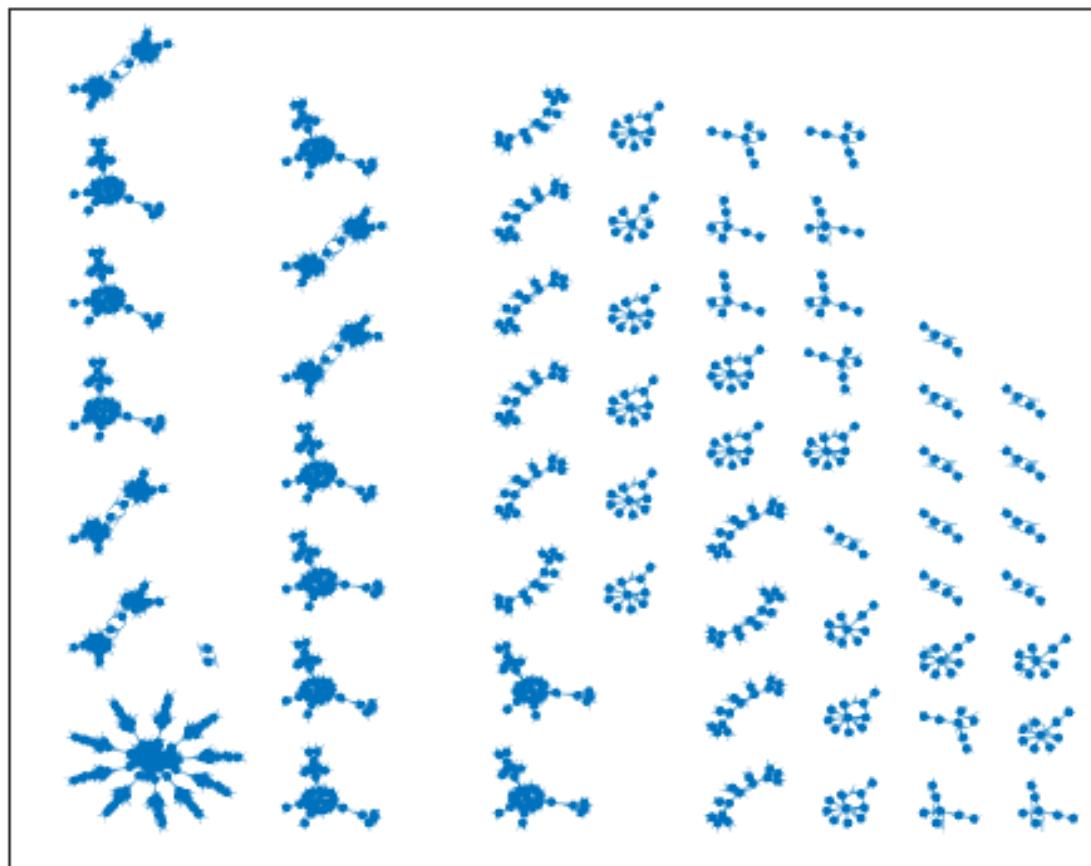


Figura 3.385: Atractor regla 33 n=10

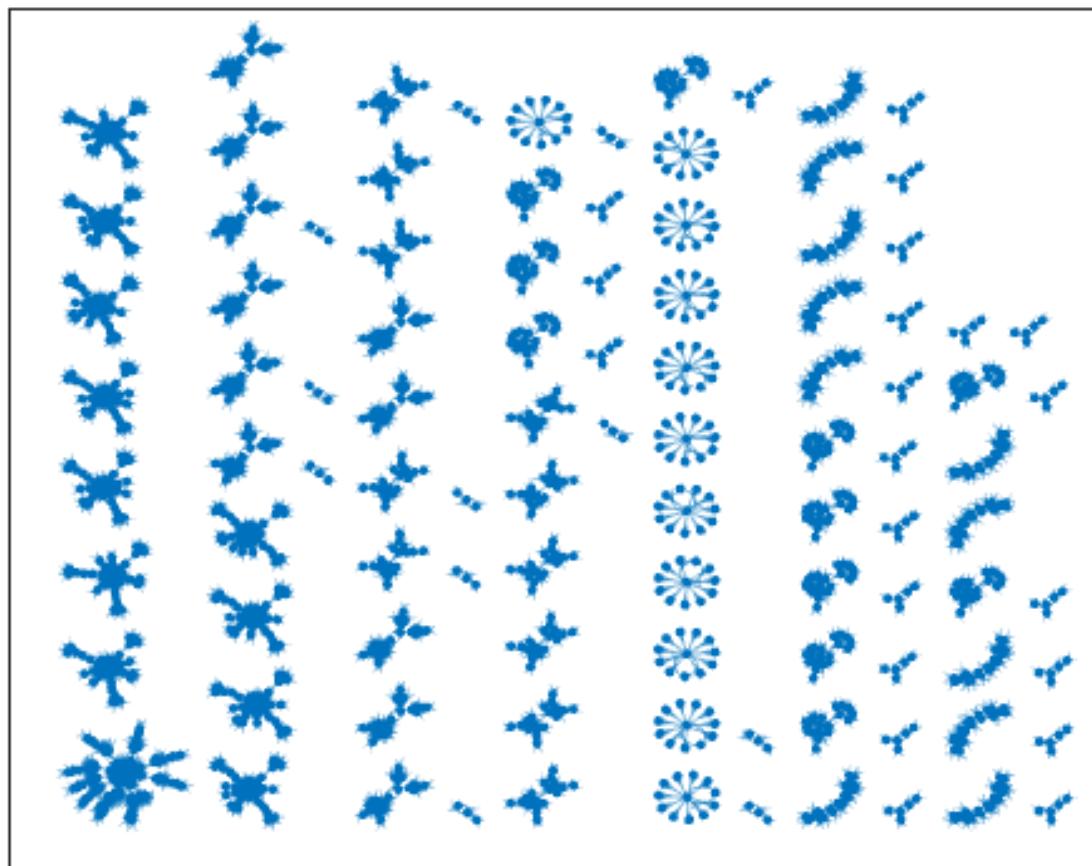


Figura 3.386: Atractor regla 33 n=11

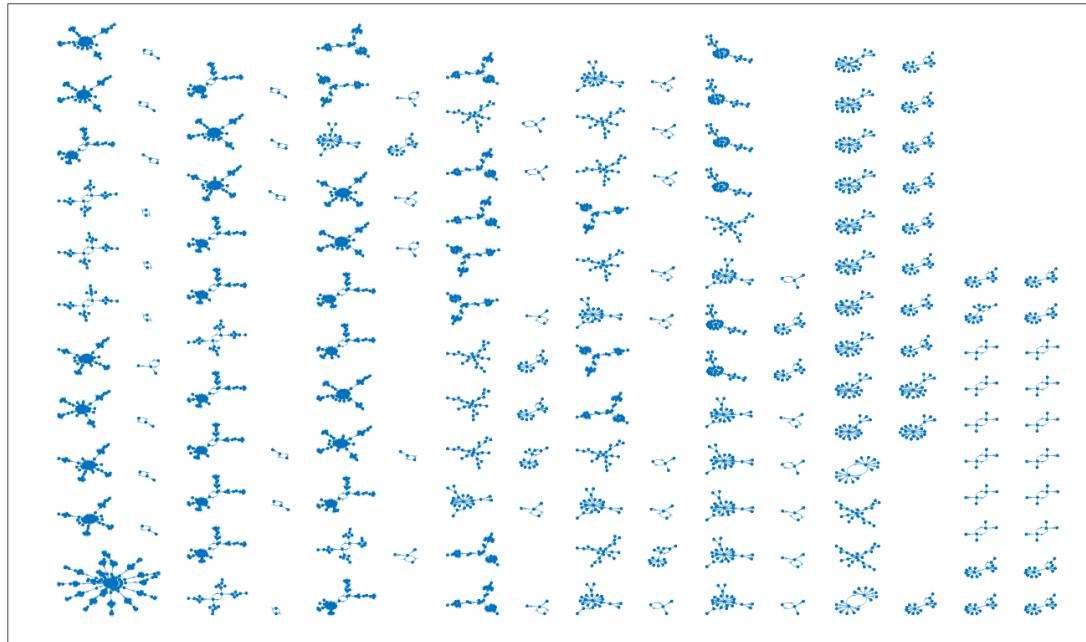


Figura 3.387: Atractor regla 33 n=12

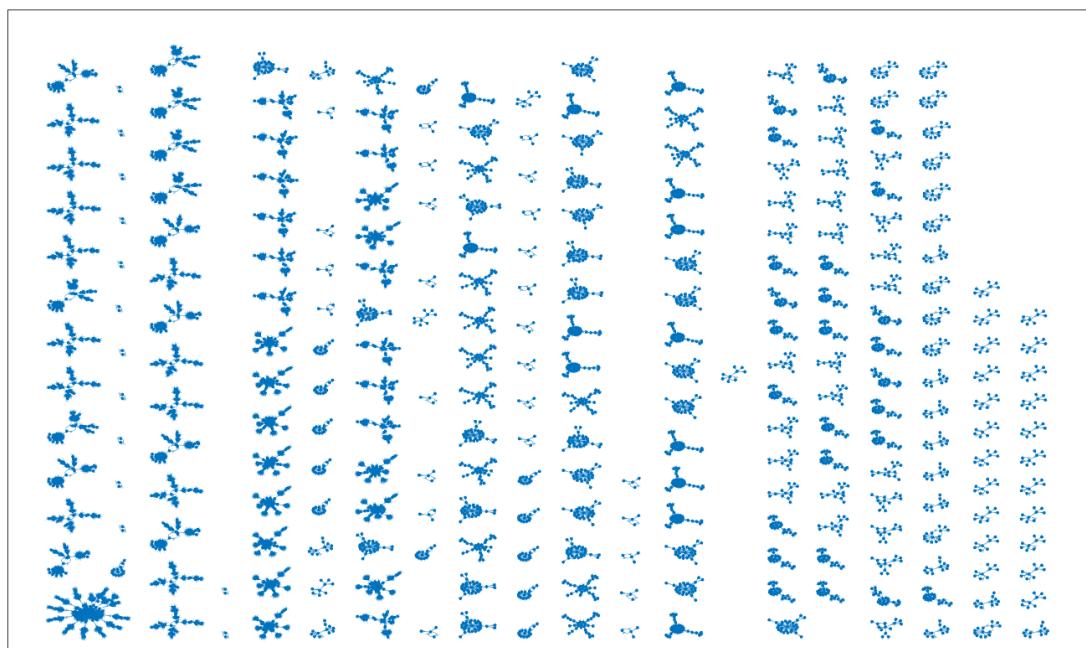


Figura 3.388: Atractor regla 33 n=13

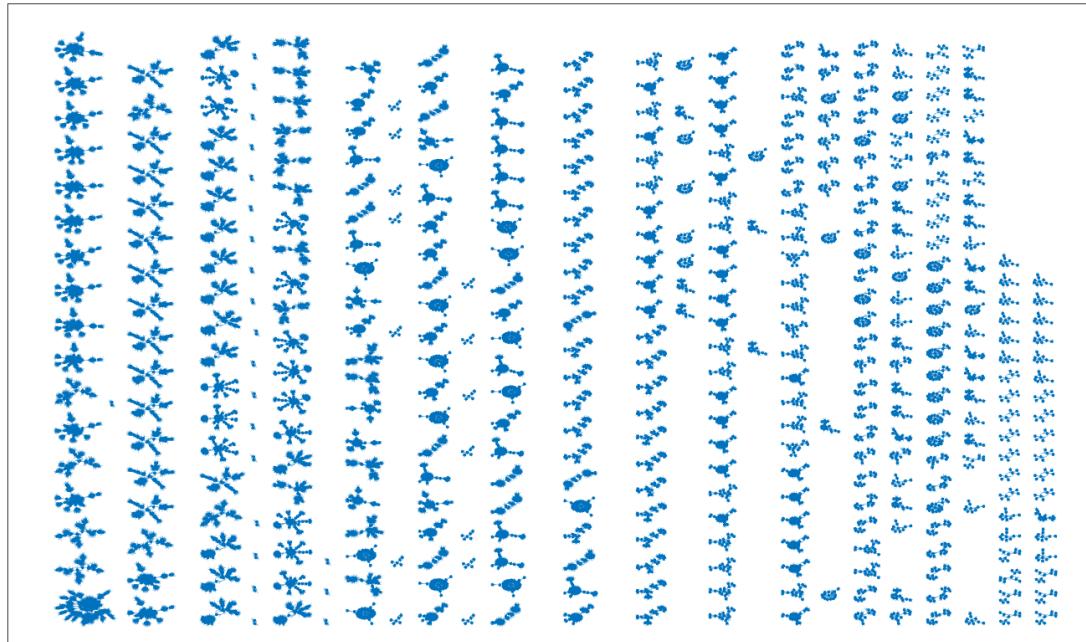


Figura 3.389: Atractor regla 33 n=14

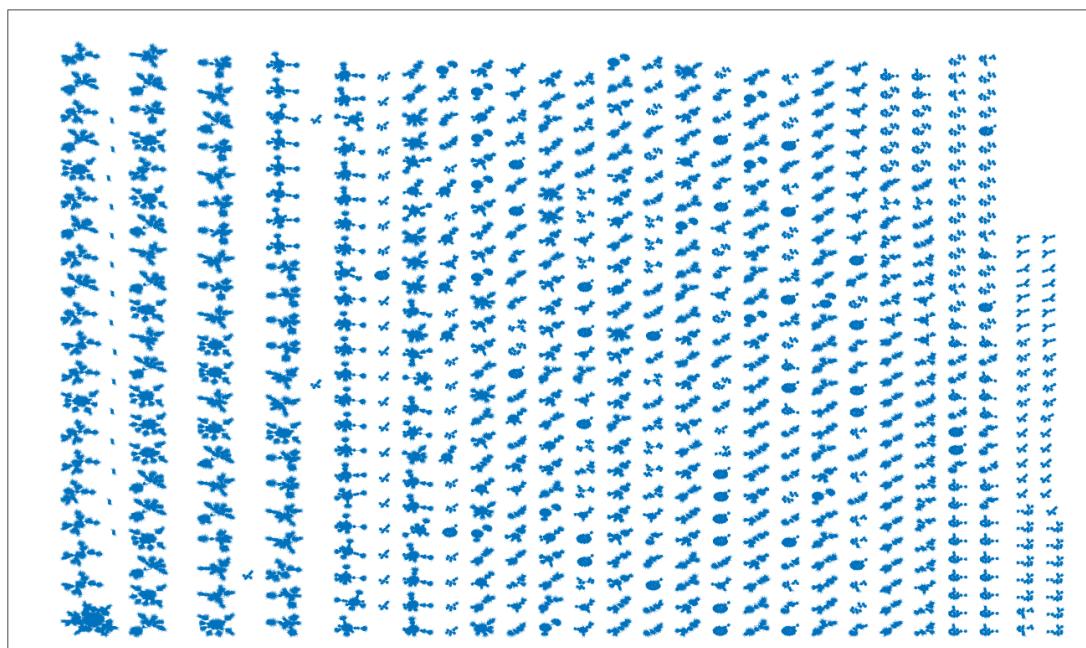


Figura 3.390: Atractor regla 33 n=15

3.30. Reglas 34,48,187,243

Respecto a la regla 34 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen atractores con forma de polígonos que en n mayores a 9 al tener tantos nodos pareciera que toman la forma de un círculo.

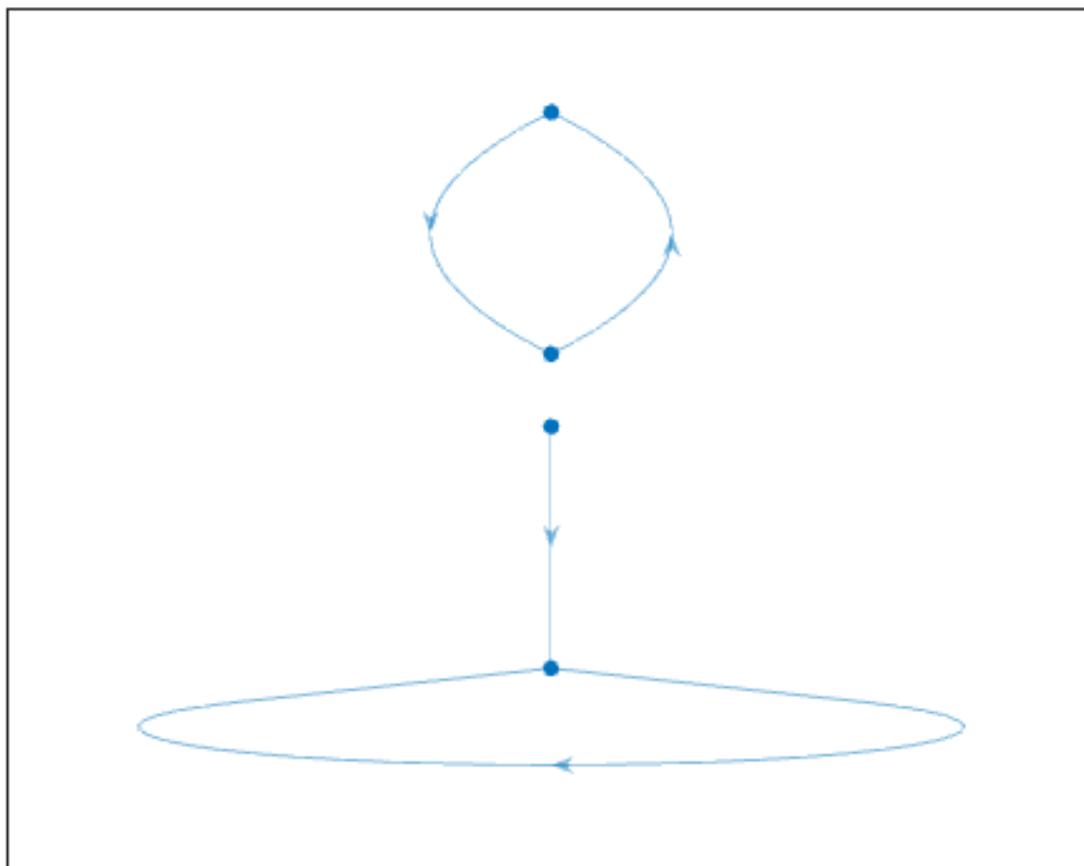


Figura 3.391: Atractor regla 34 n=2

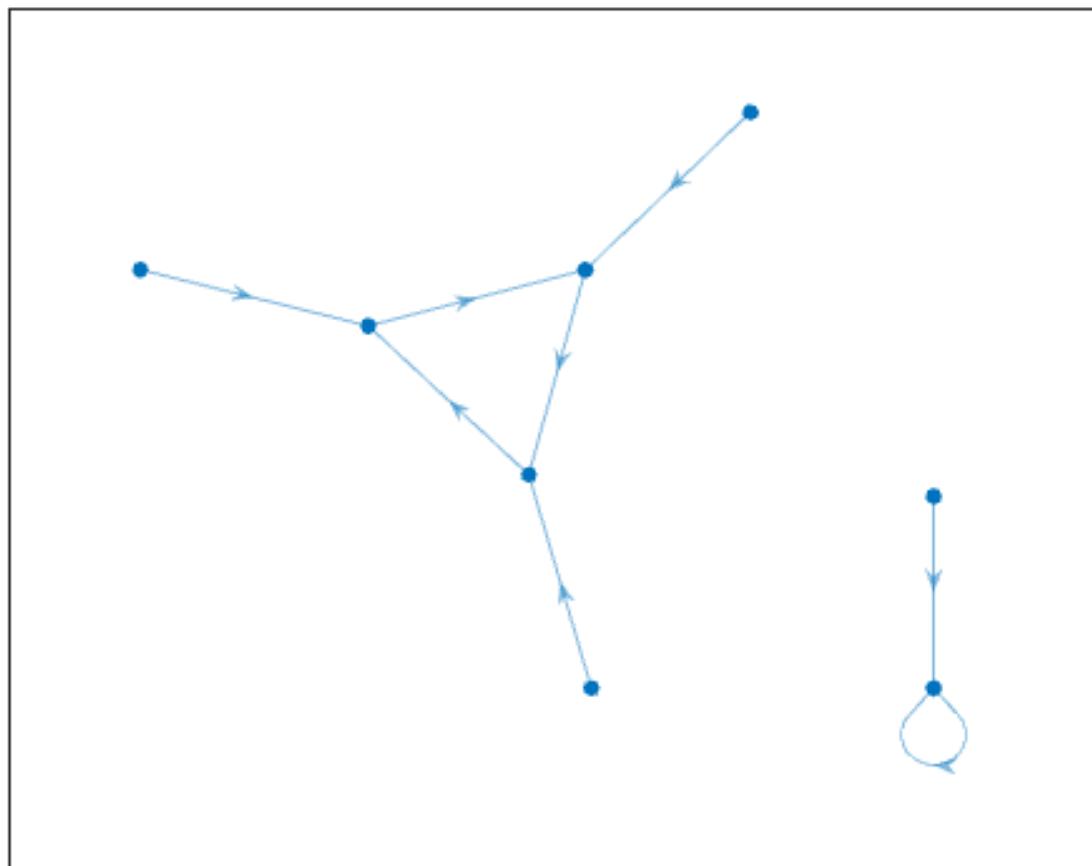


Figura 3.392: Atractor regla 34 n=3

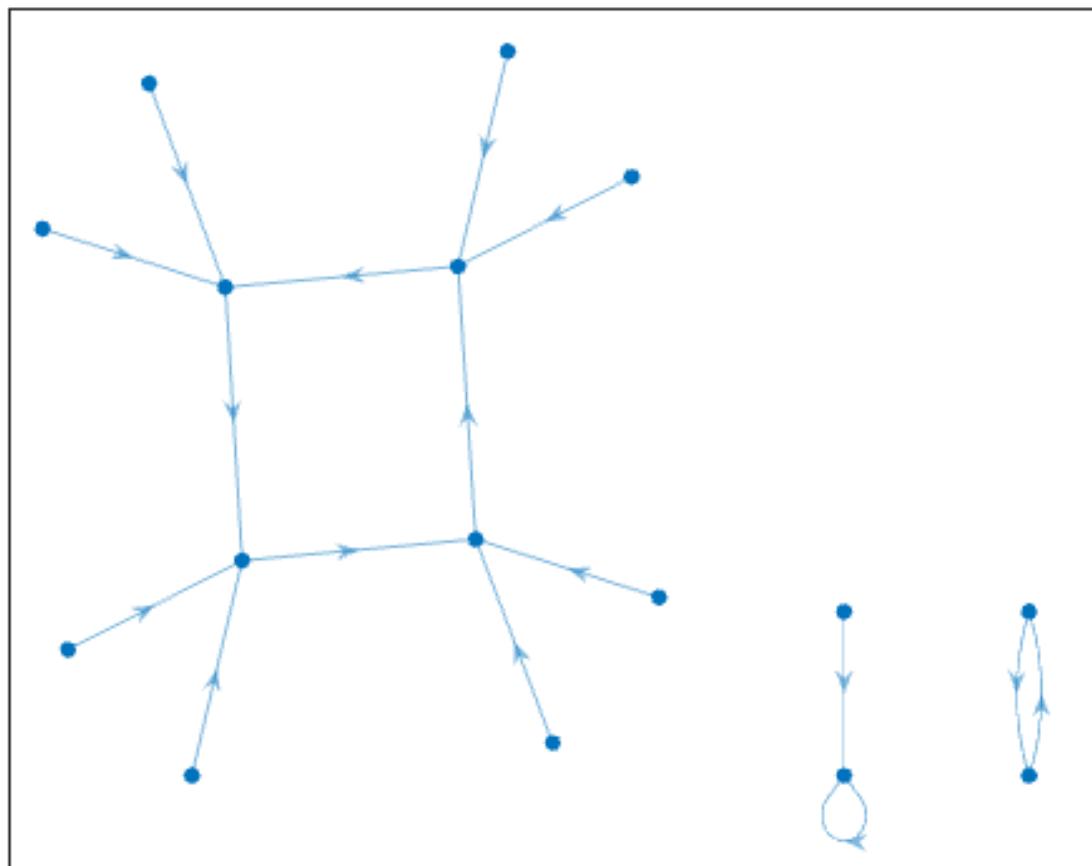


Figura 3.393: Atractor regla 34 n=4

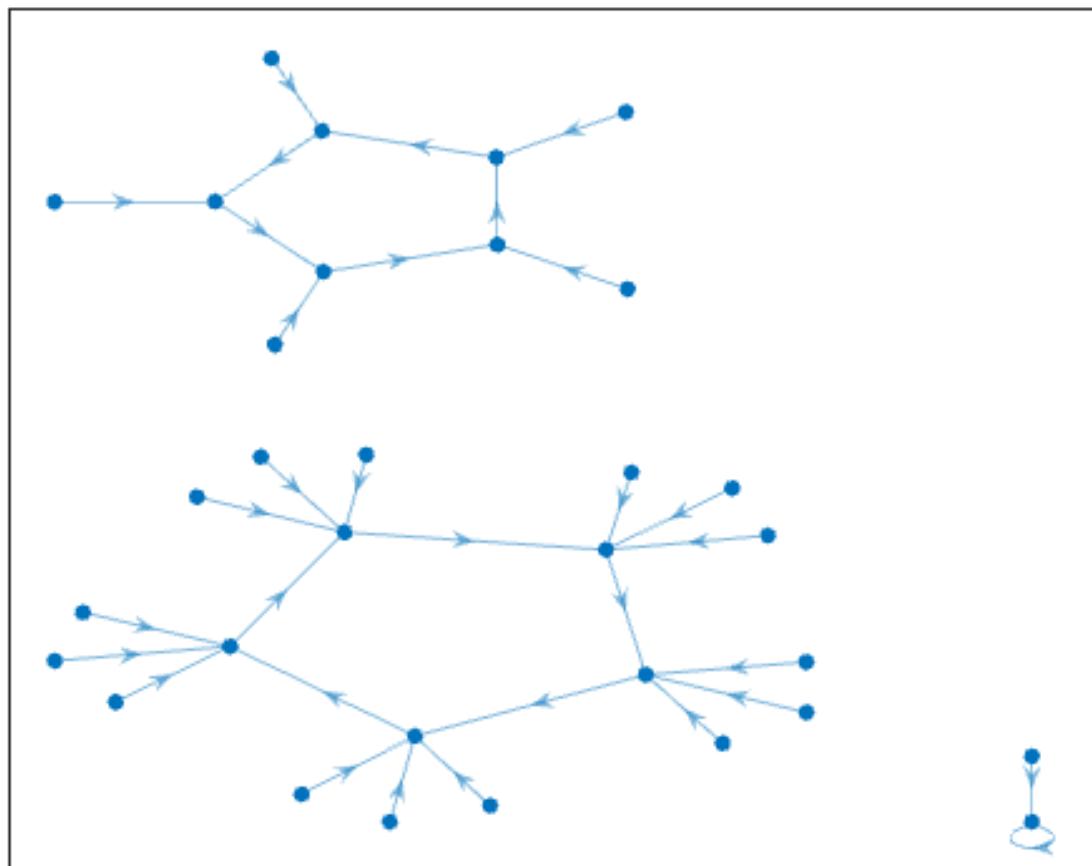


Figura 3.394: Atractor regla 34 n=5

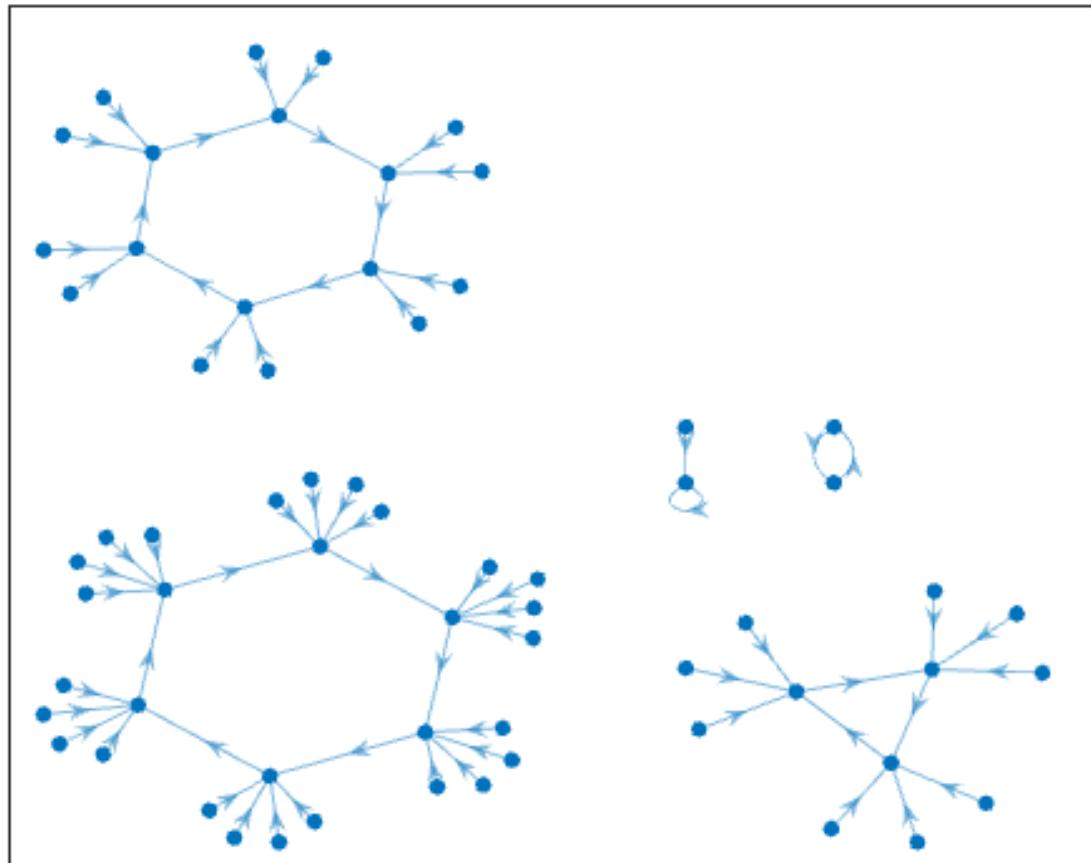


Figura 3.395: Atractor regla 34 n=6

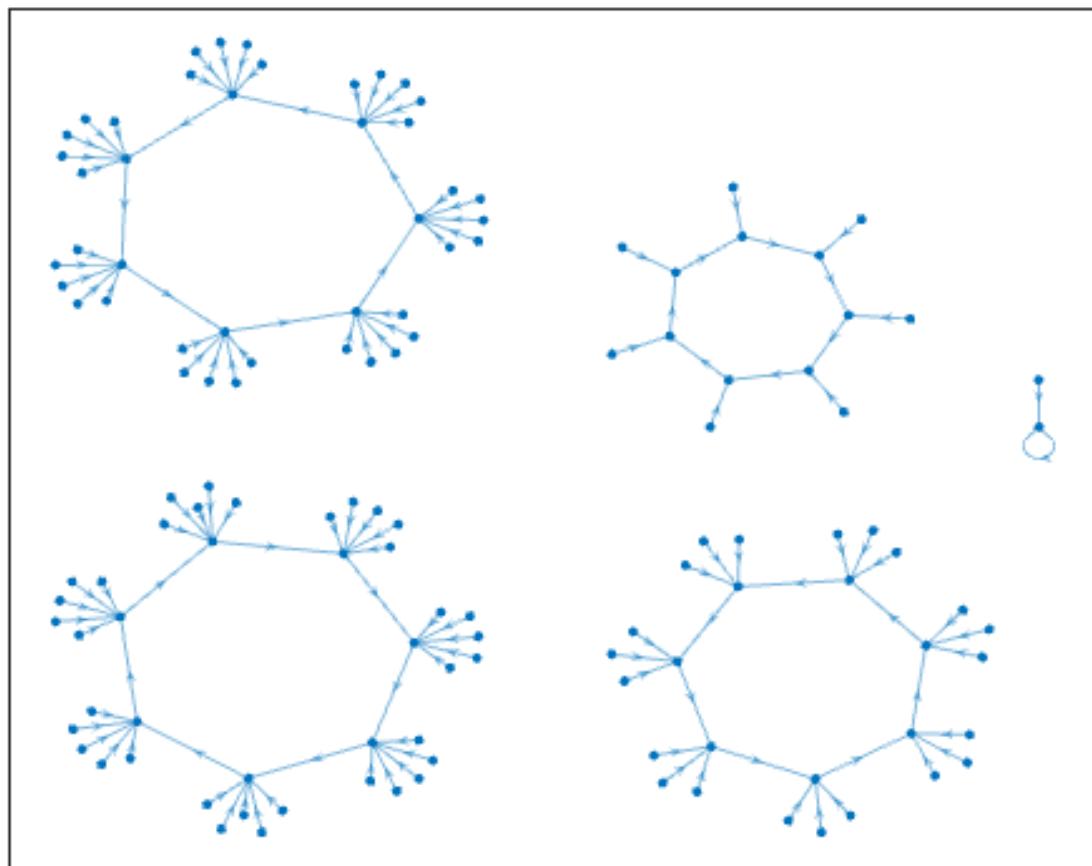


Figura 3.396: Atractor regla 34 n=7

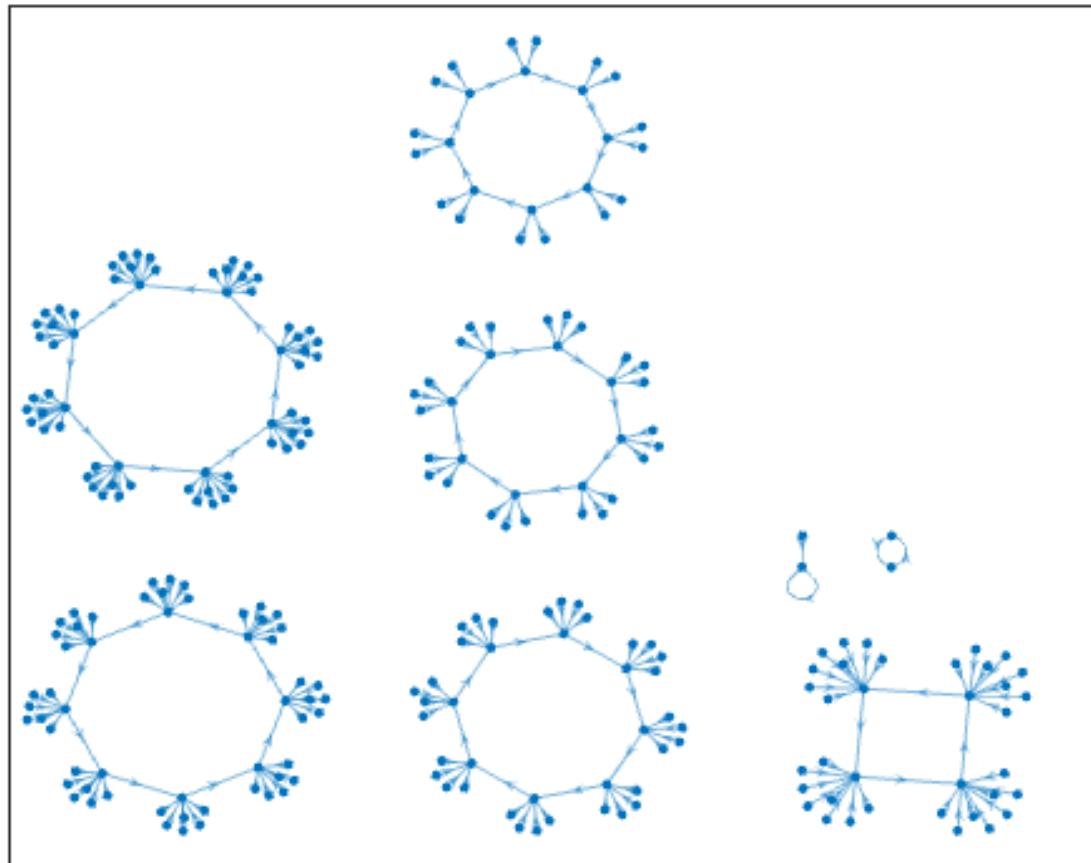


Figura 3.397: Atractor regla 34 n=8

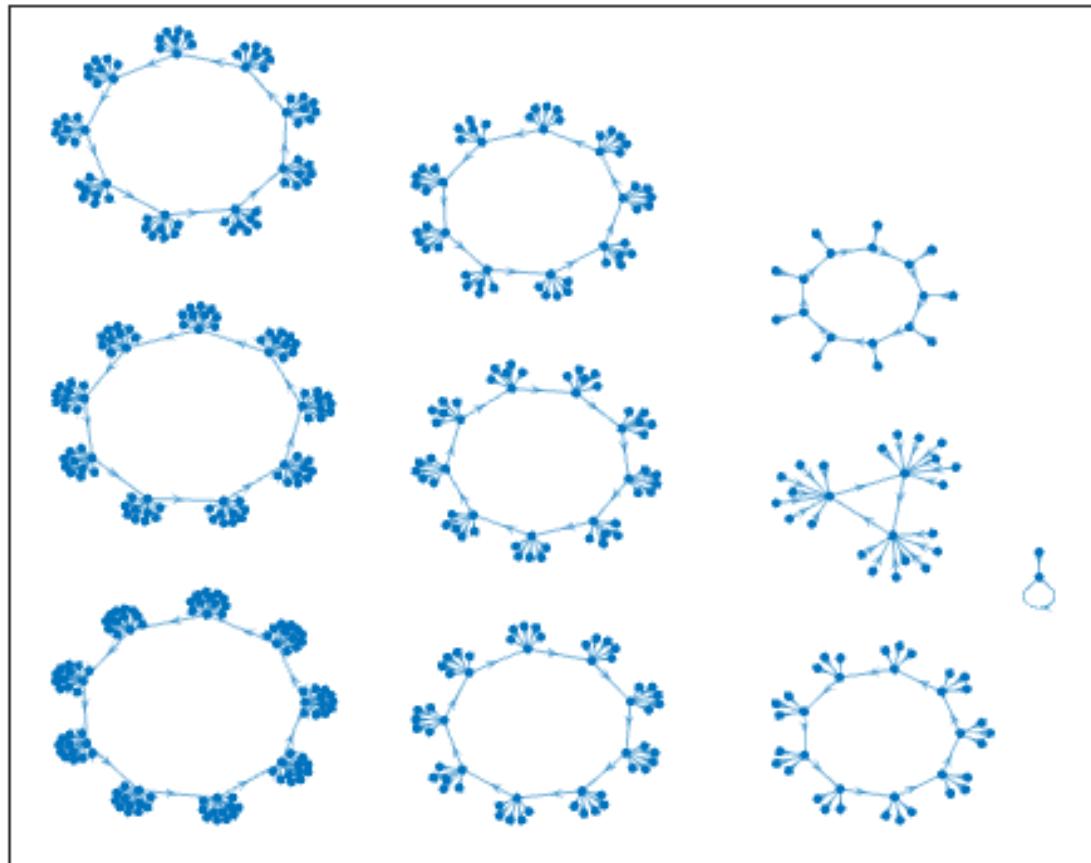


Figura 3.398: Atractor regla 34 n=9

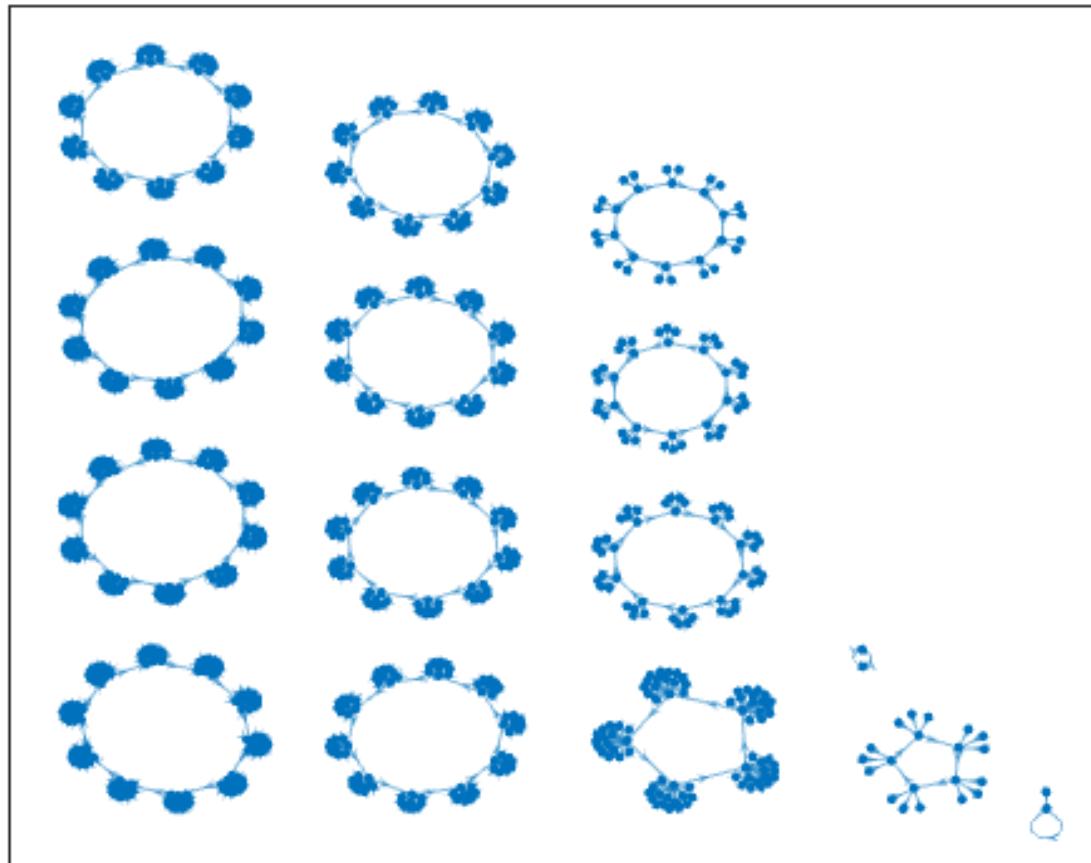


Figura 3.399: Atractor regla 34 n=10

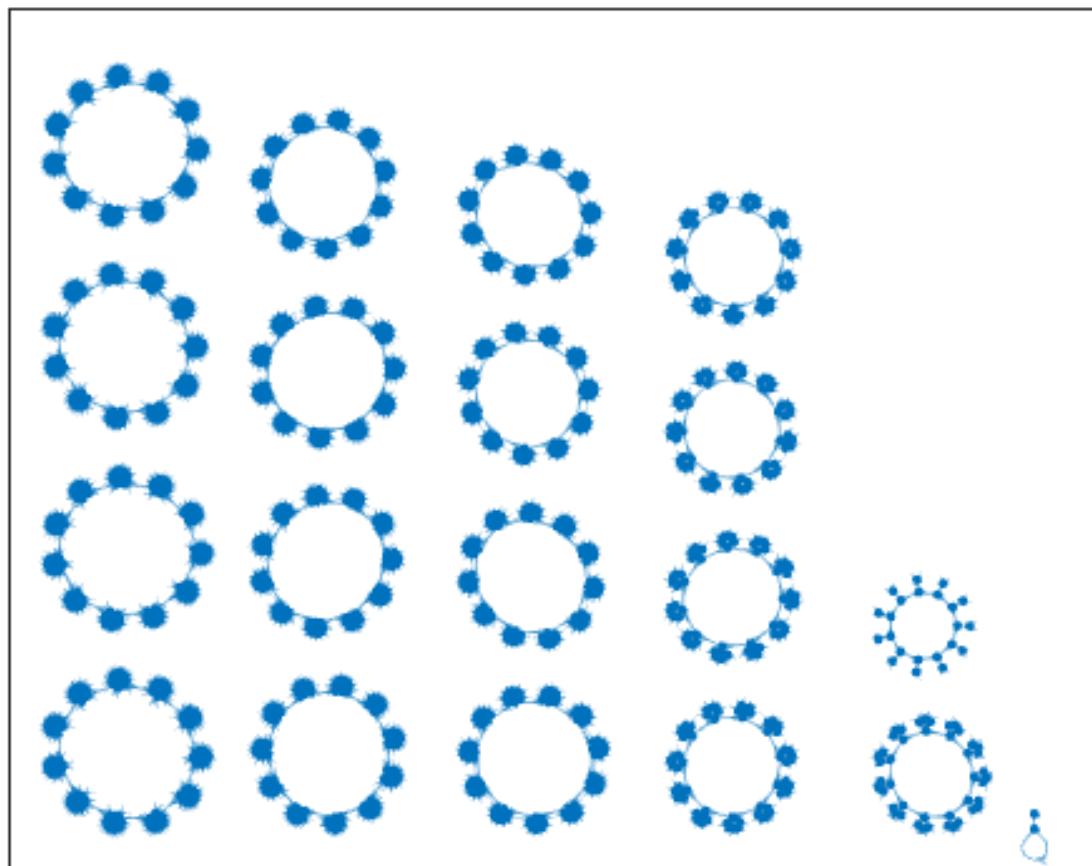


Figura 3.400: Atractor regla 34 n=11

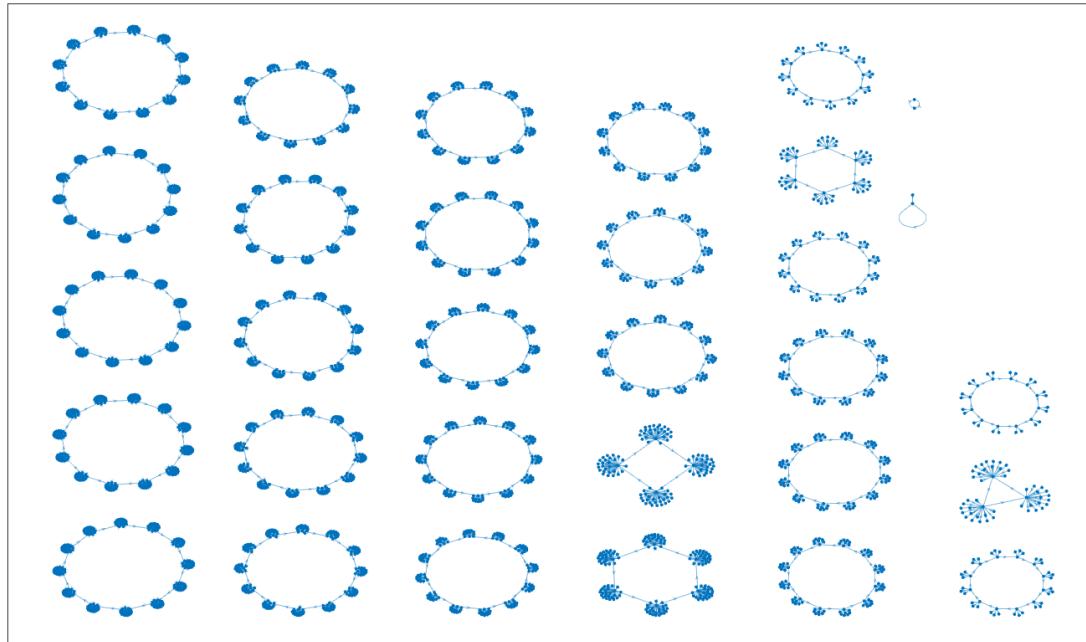


Figura 3.401: Atractor regla 34 n=12

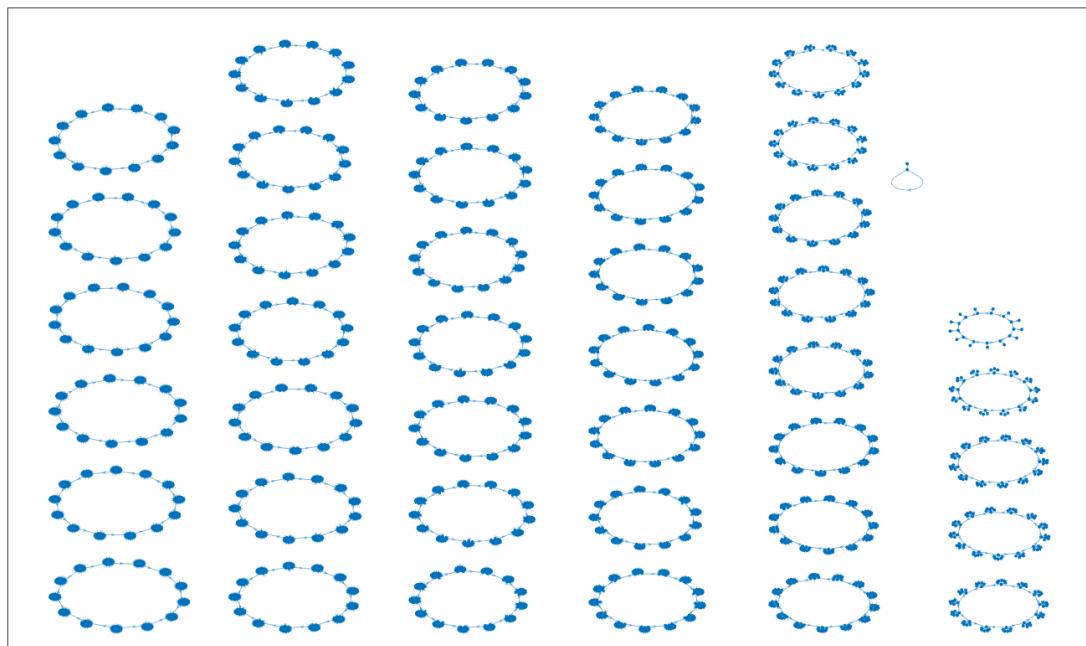


Figura 3.402: Atractor regla 34 n=13

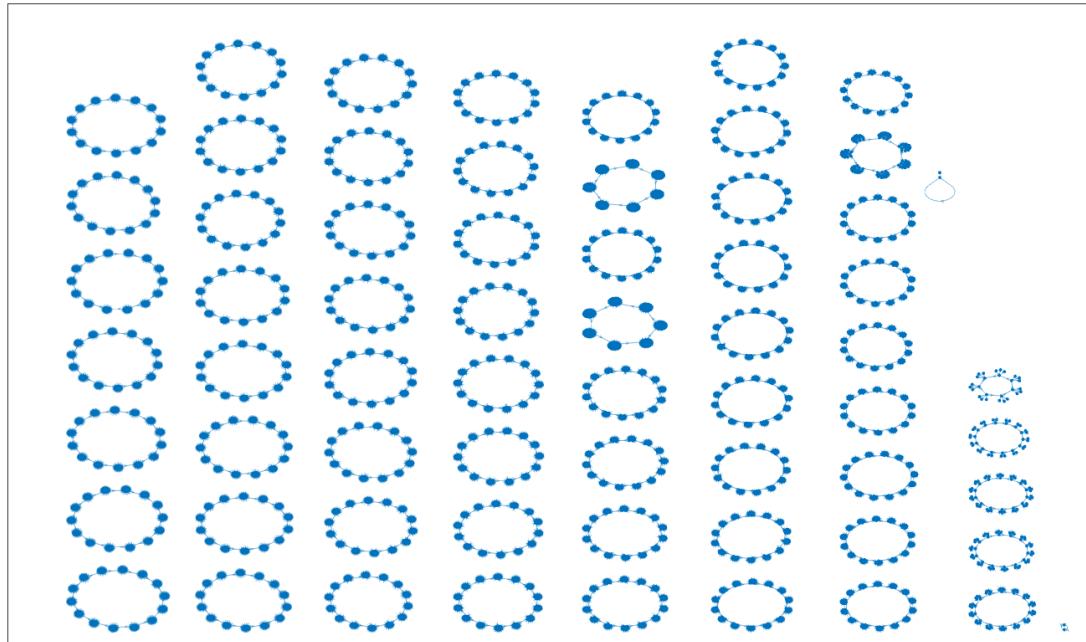


Figura 3.403: Atractor regla 34 n=14

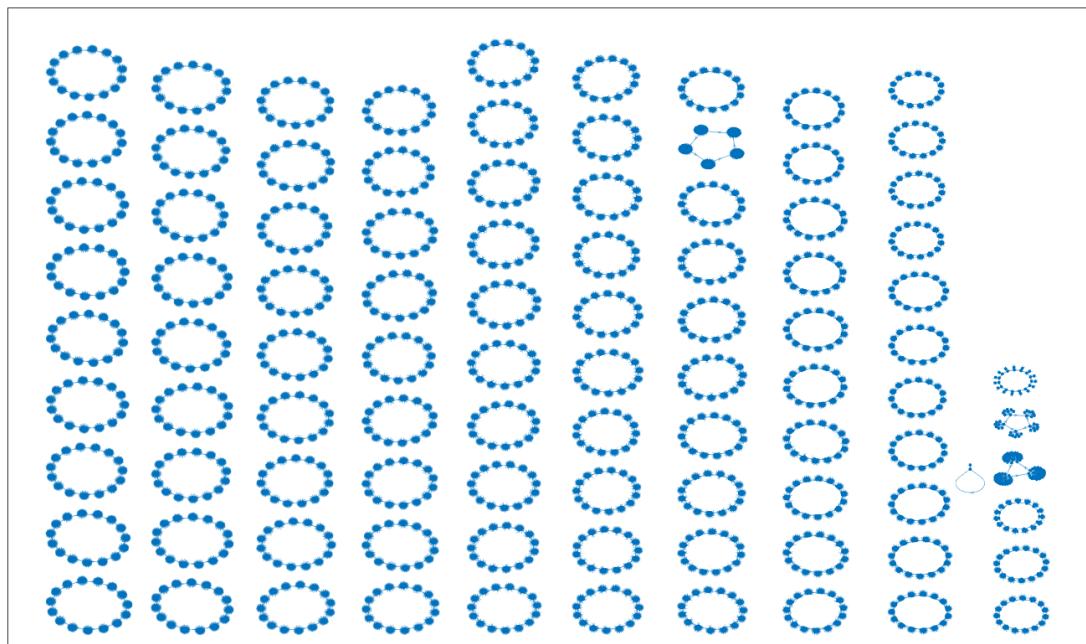


Figura 3.404: Atractor regla 34 n=15

3.31. Reglas 35,49,59,115

Respecto a la regla 35 se aprecia que mientras más grande es el tamaño de la cadena (n) matlab los ordena por antigüedad por decirlo de alguna forma, los nuevos atractores aparecen a la derecha mientras que los atractores más viejos se van haciendo hacia la izquierda y que son estos últimos los que terminan siendo los atractores más complejos.

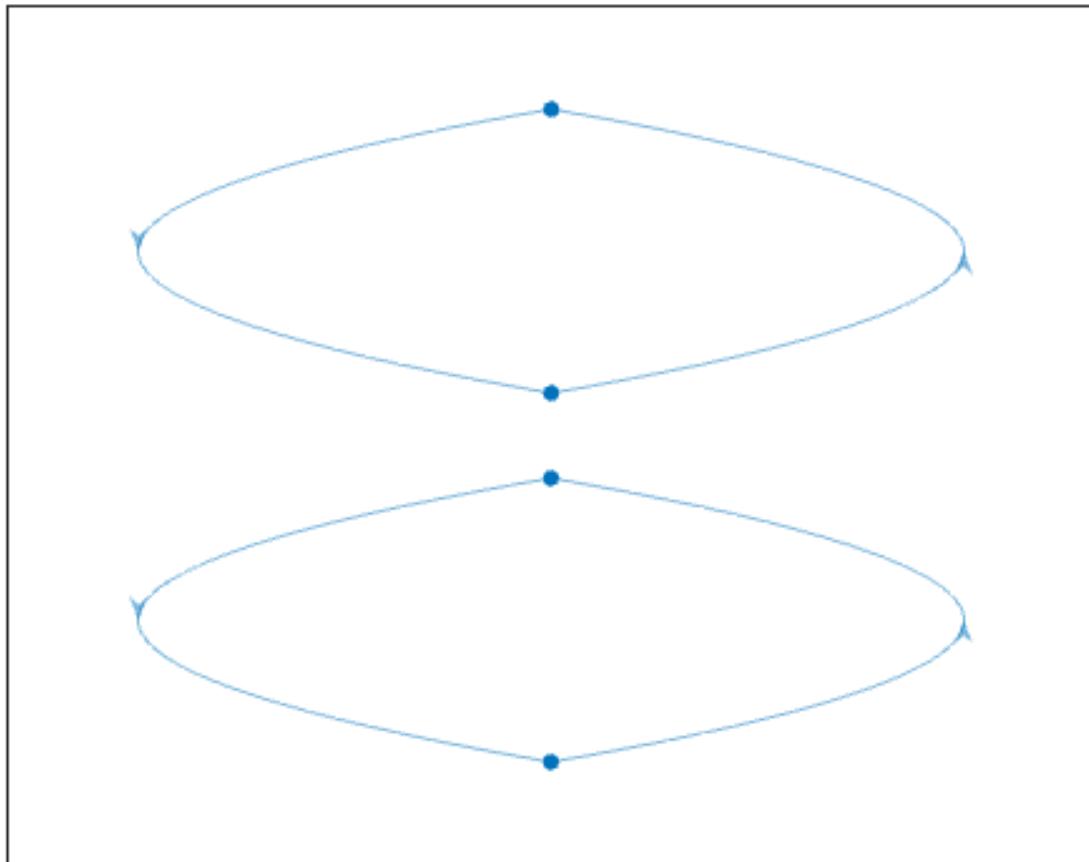


Figura 3.405: Atractor regla 35 n=2

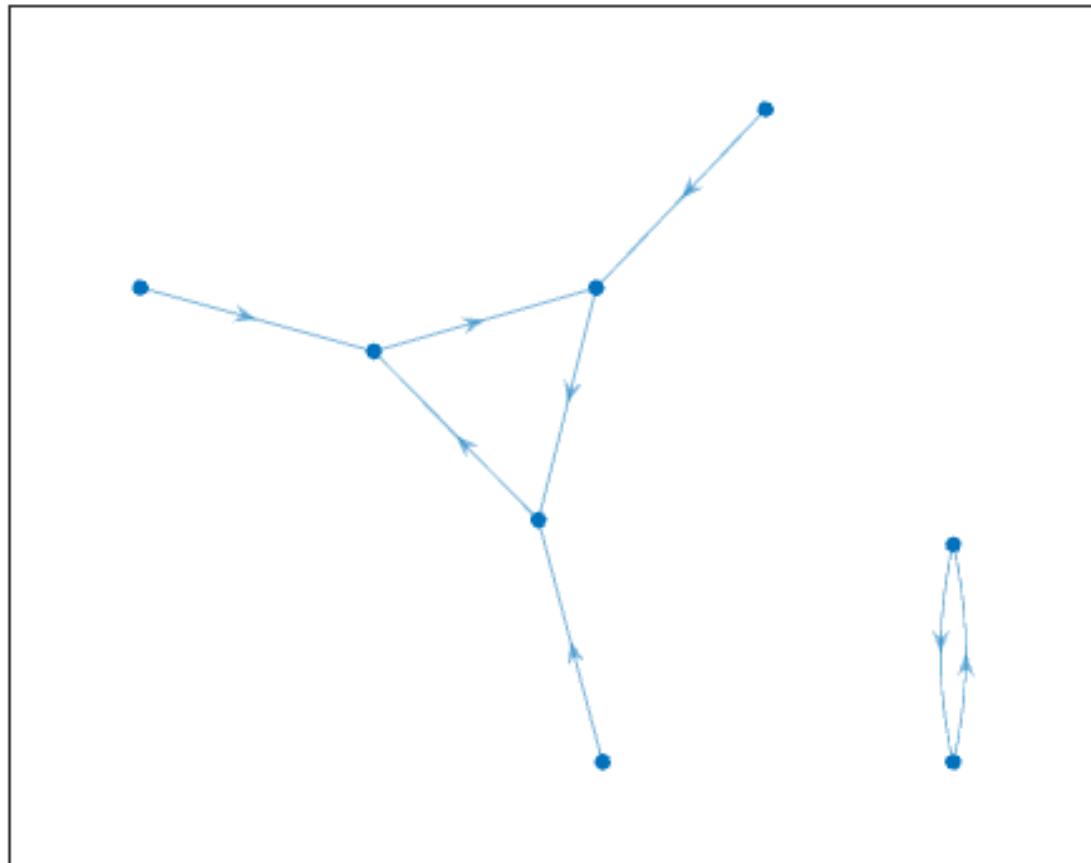


Figura 3.406: Atractor regla 35 n=3

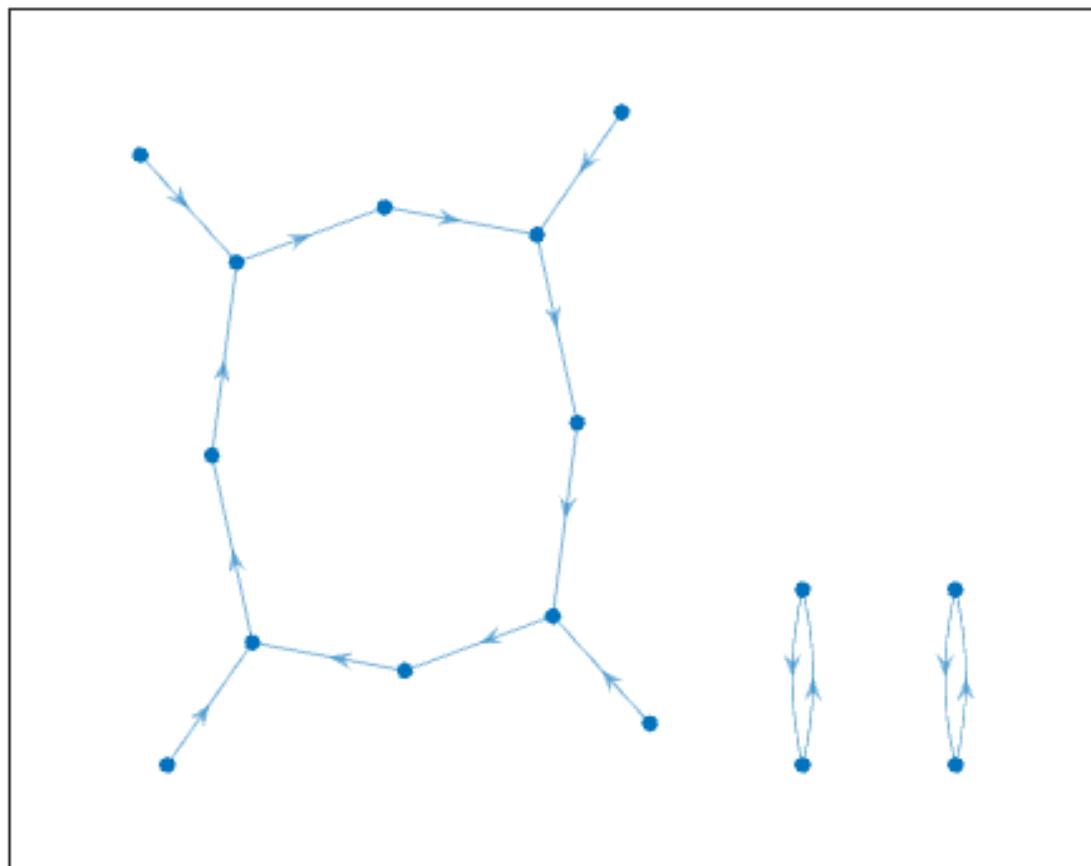


Figura 3.407: Atractor regla 35 n=4

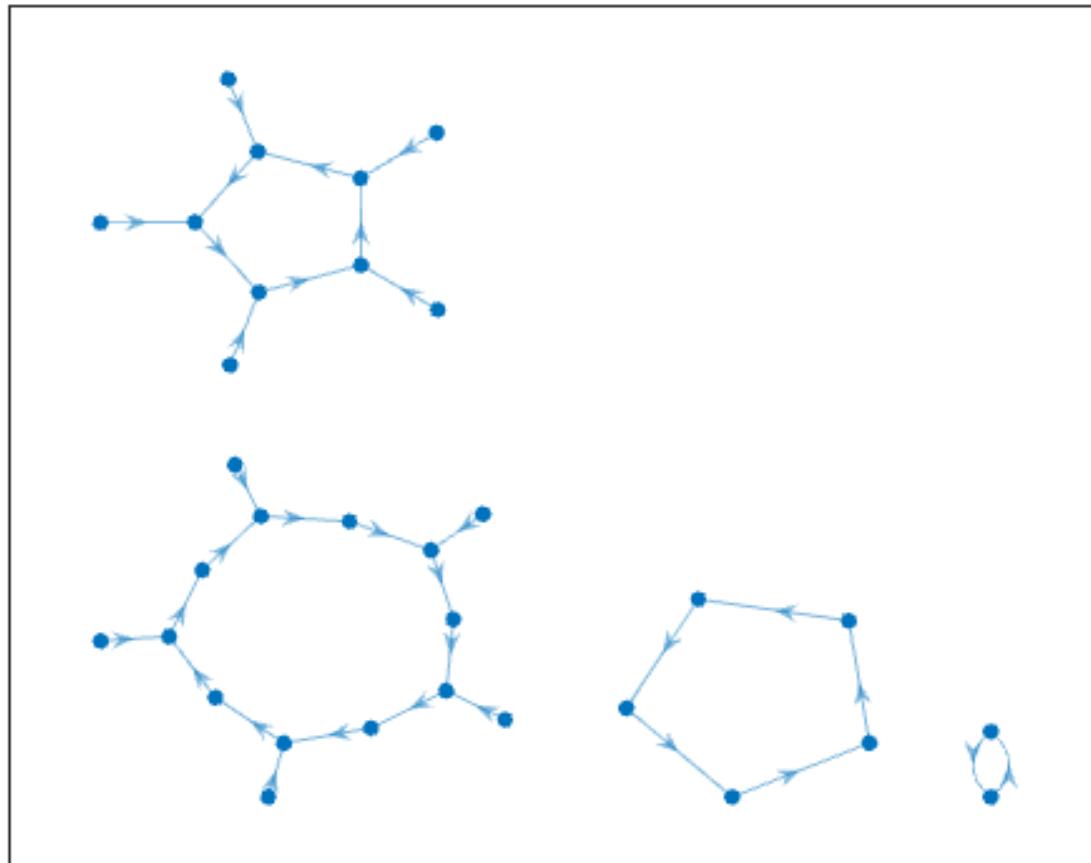


Figura 3.408: Atractor regla 35 n=5

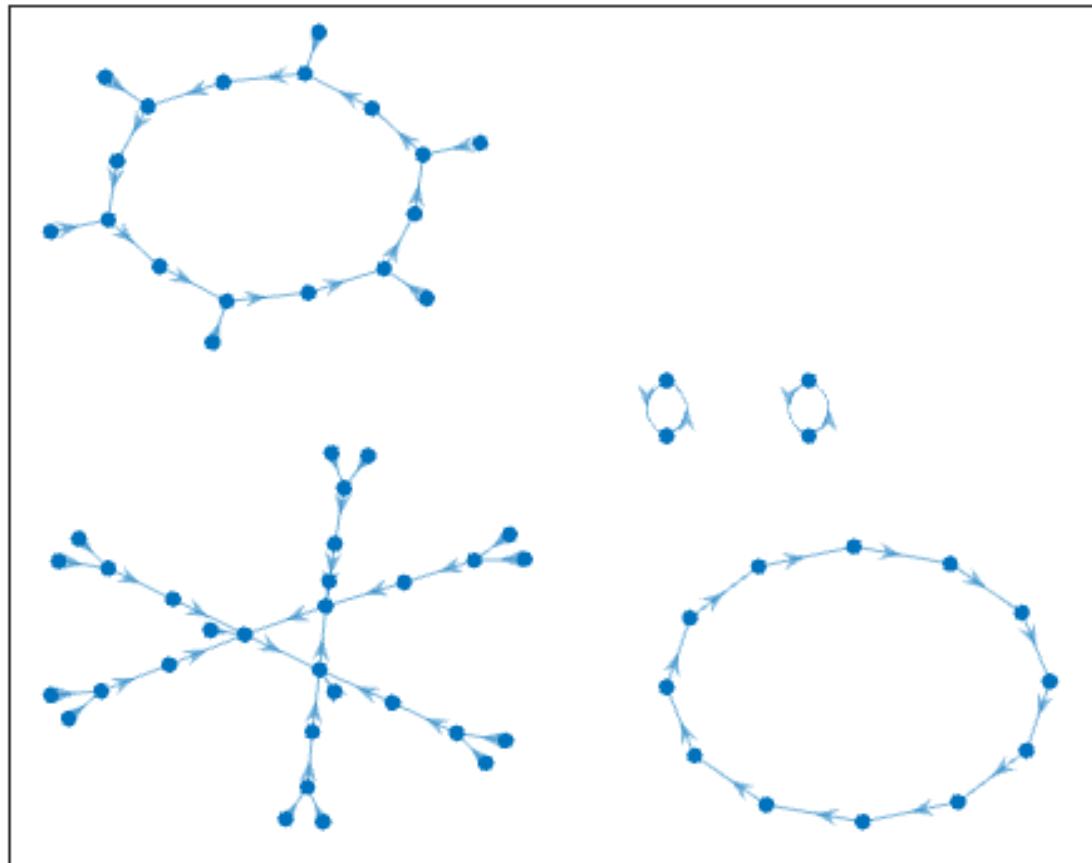
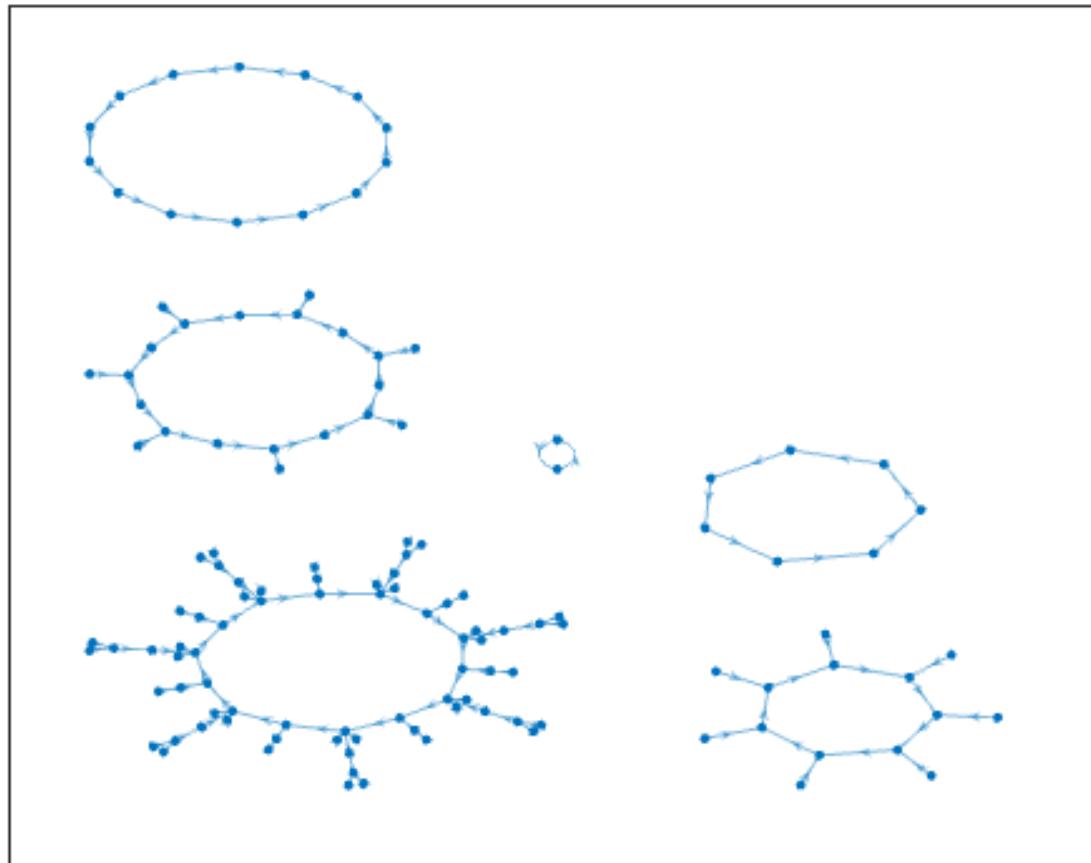
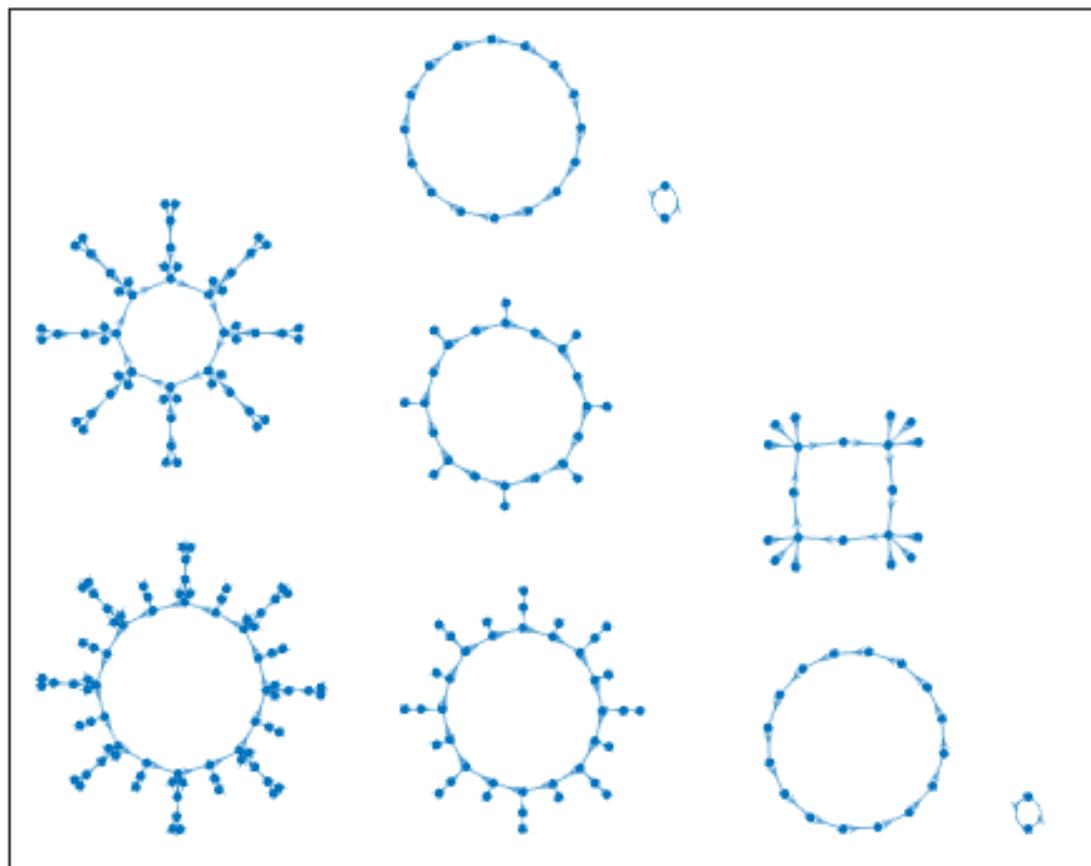


Figura 3.409: Atractor regla 35 n=6

Figura 3.410: Atractor regla 35 $n=7$

Figura 3.411: Atractor regla 35 $n=8$

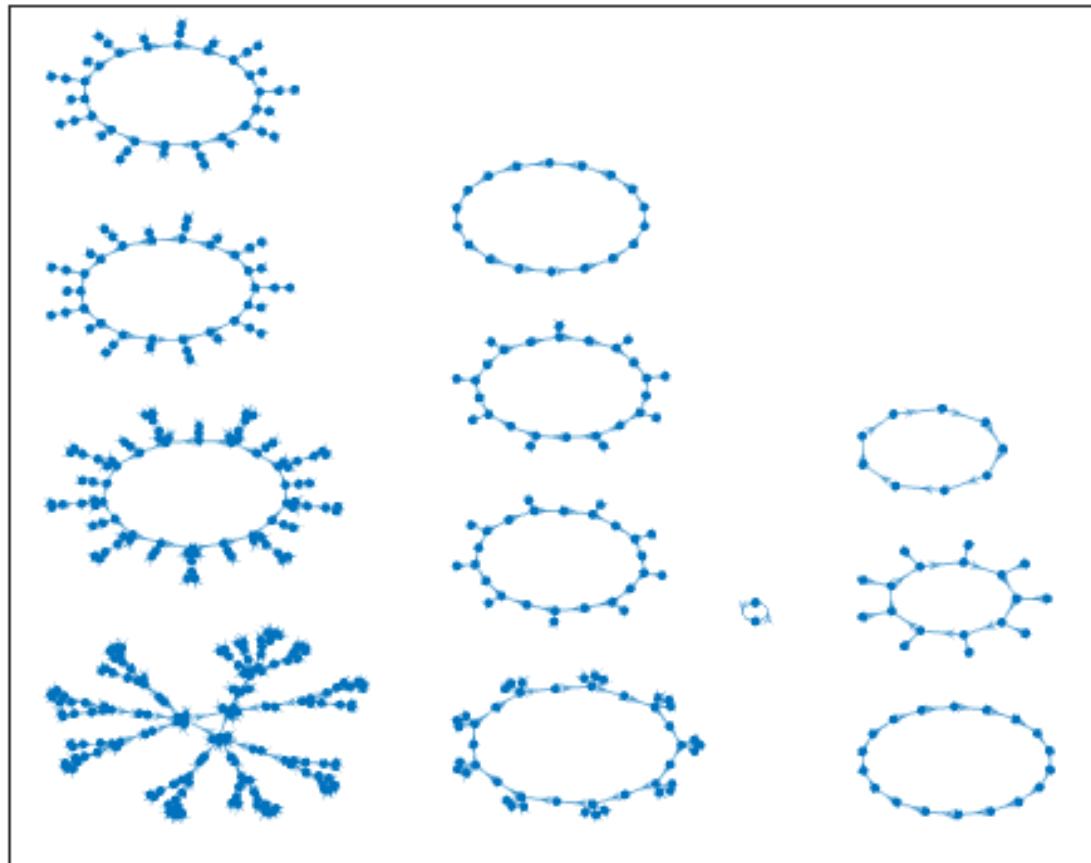


Figura 3.412: Atractor regla 35 n=9

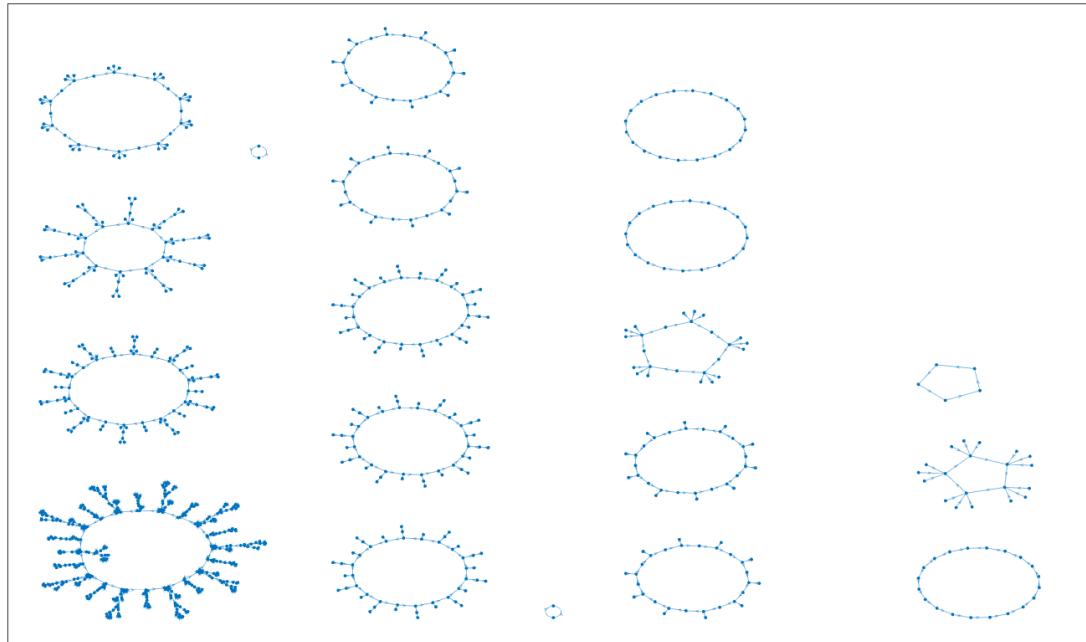


Figura 3.413: Atractor regla 35 n=10

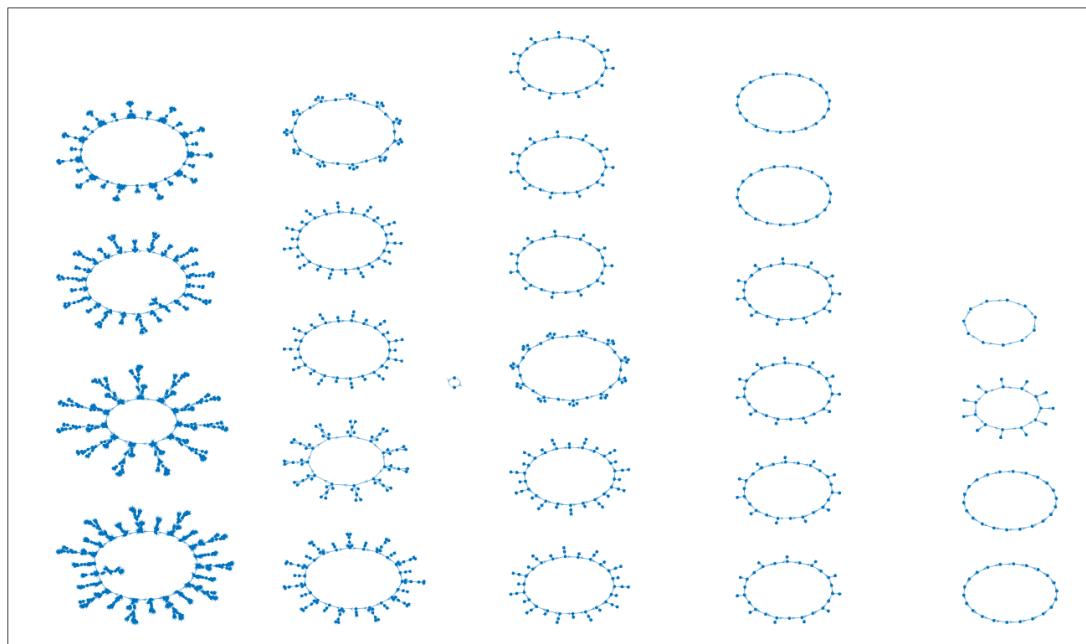


Figura 3.414: Atractor regla 35 n=11

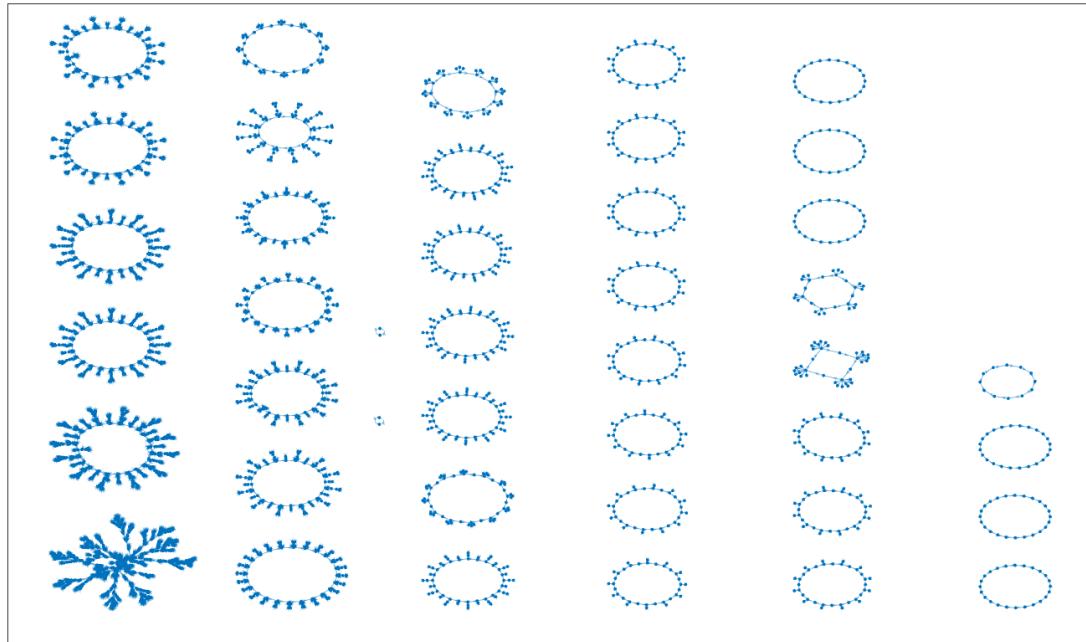


Figura 3.415: Atractor regla 35 n=12

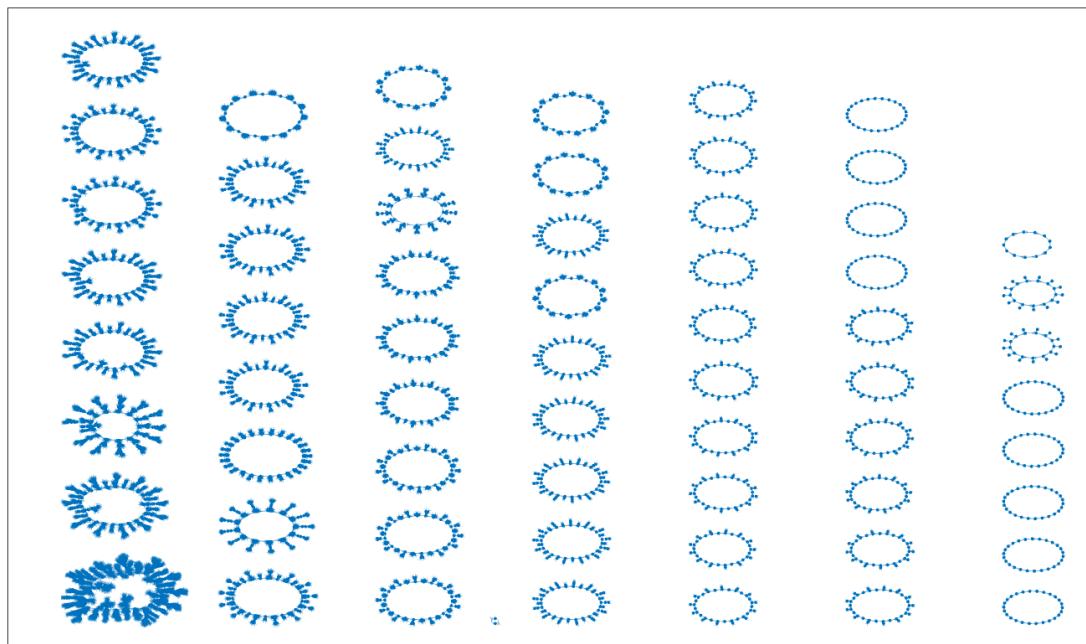


Figura 3.416: Atractor regla 35 n=13

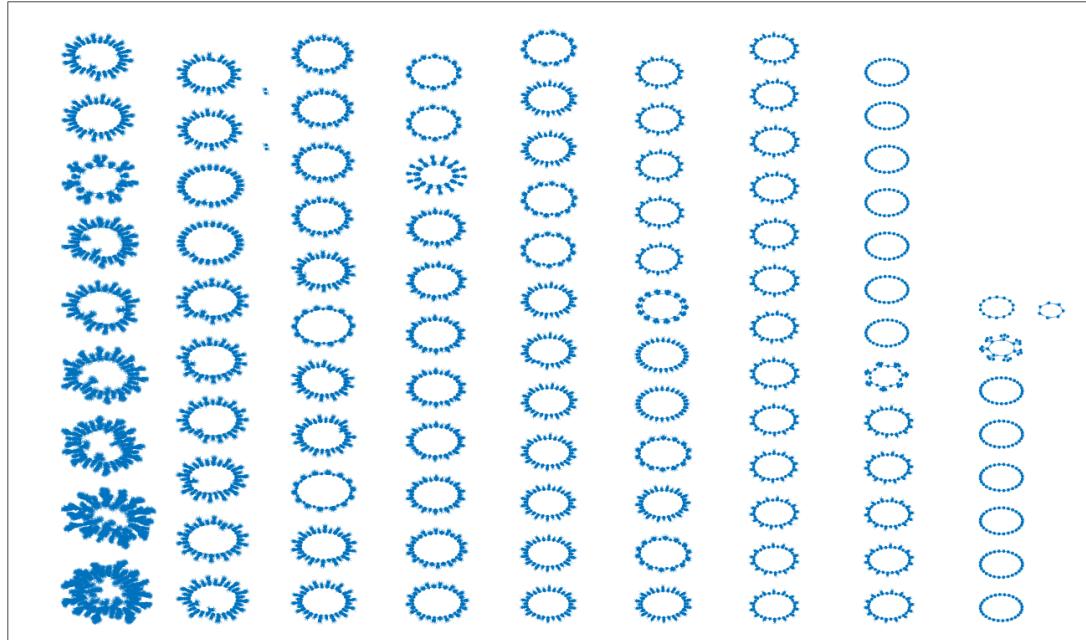


Figura 3.417: Atractor regla 35 n=14

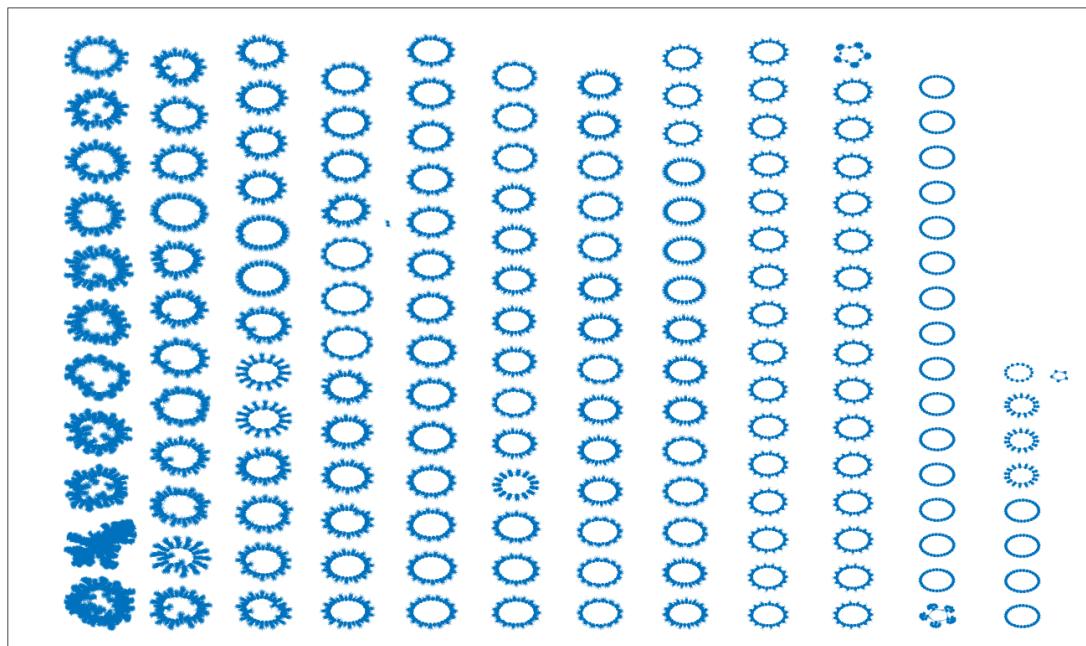


Figura 3.418: Atractor regla 35 n=15

3.32. Reglas 36,219

Respecto a la regla 36 se aprecia que mientras más grande es el tamaño de la cadena (n) el atractor que surge en la imagen 3.442 se mantiene hasta el final y solo va agregando nodos hoja, a pesar de que siguen apareciendo nuevos atractores, este atractor sigue sumando nodos.

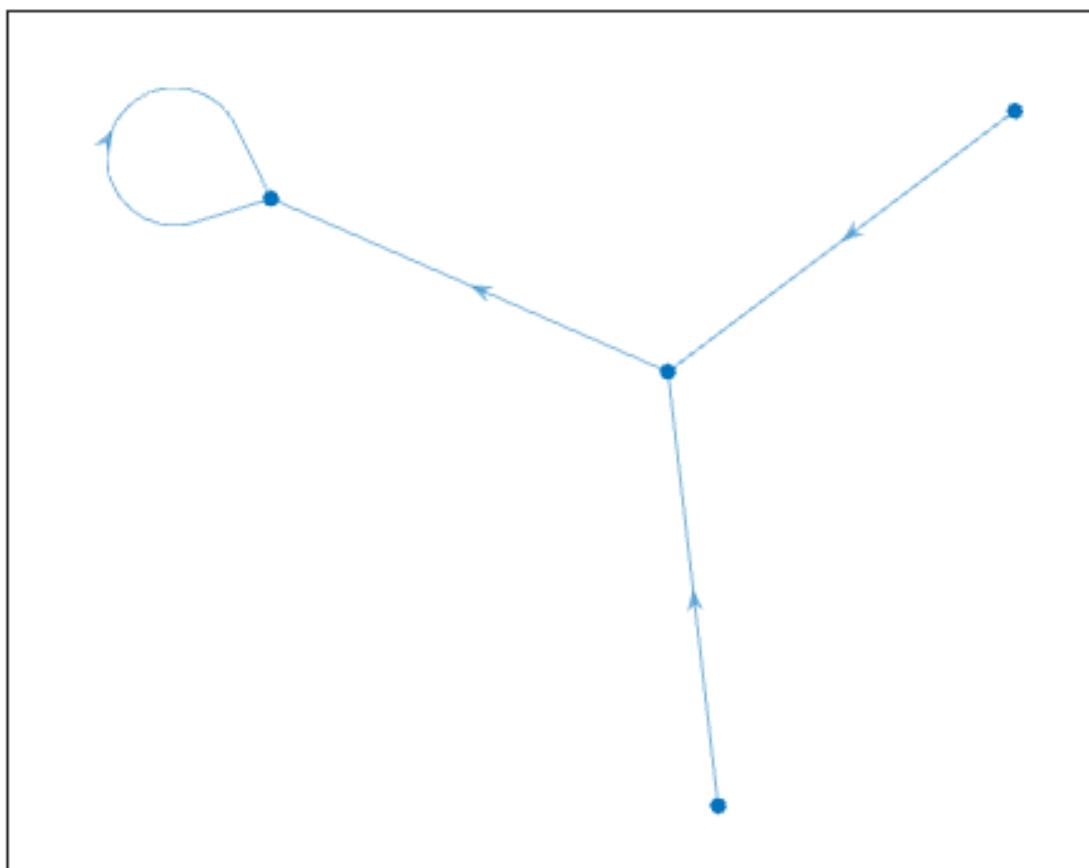


Figura 3.419: Atractor regla 36 n=2

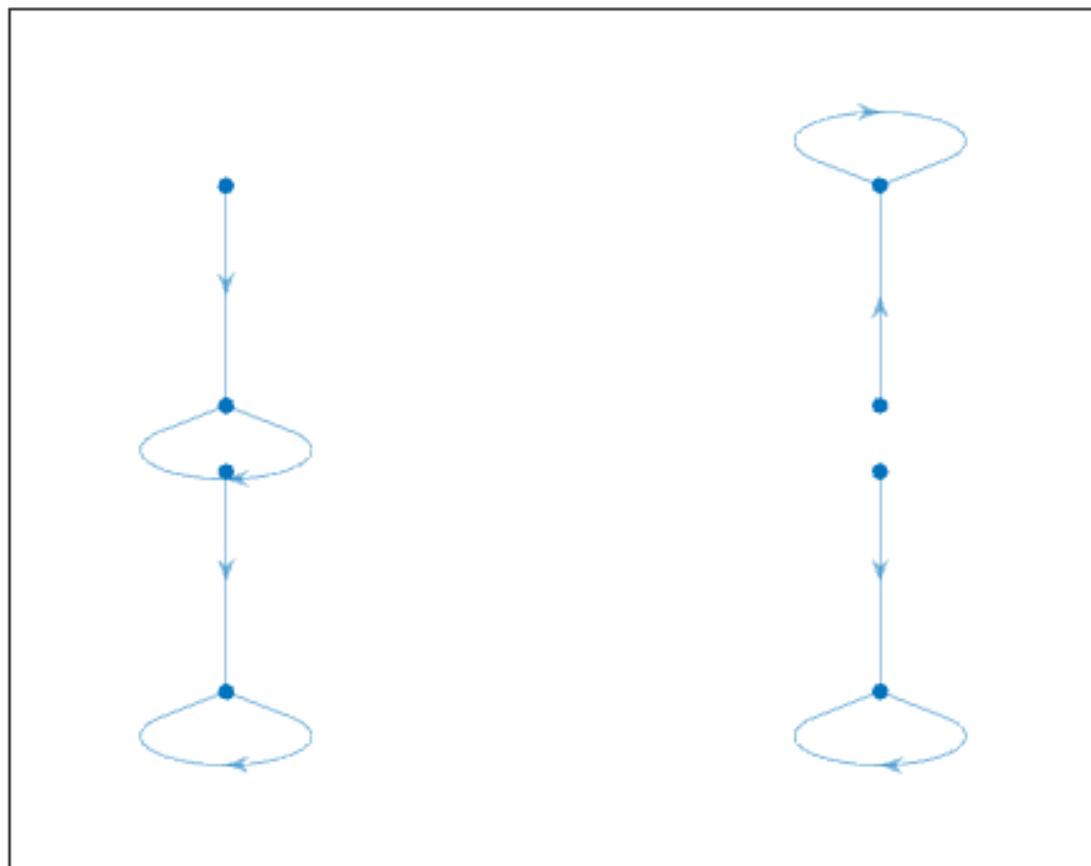
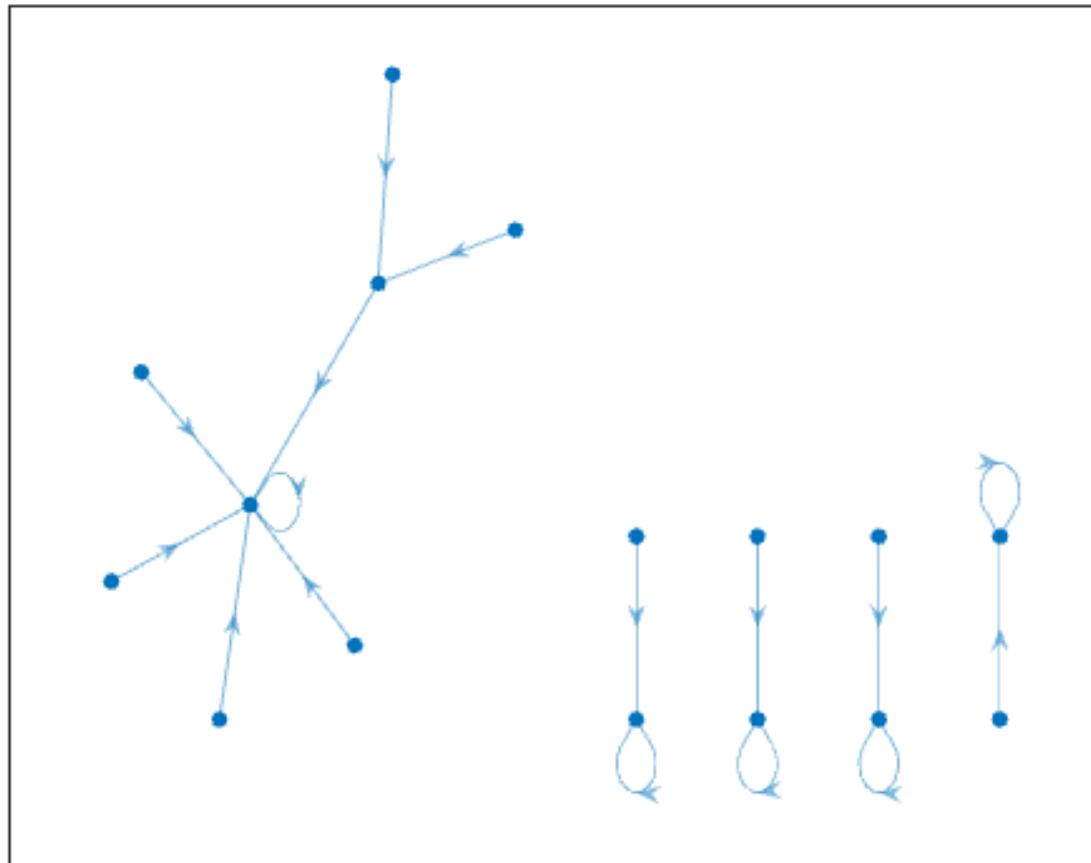


Figura 3.420: Atractor regla 36 n=3

Figura 3.421: Atractor regla 36 $n=4$

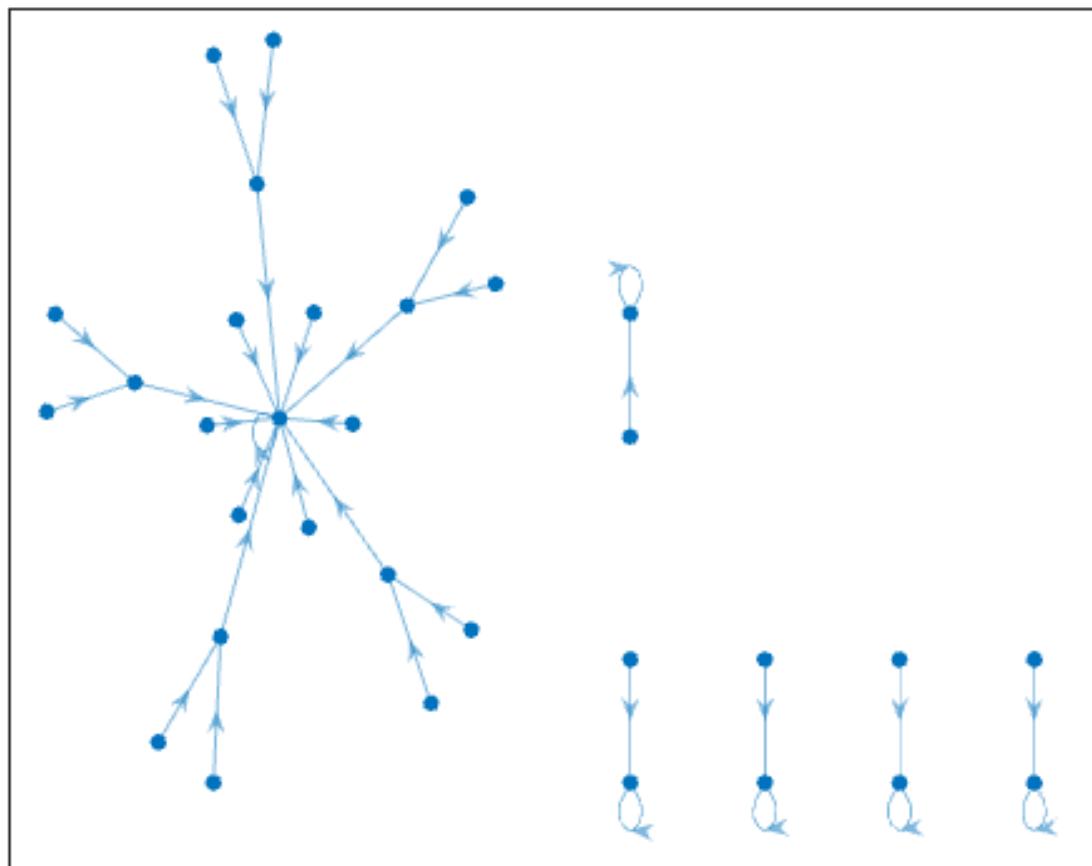


Figura 3.422: Atractor regla 36 n=5

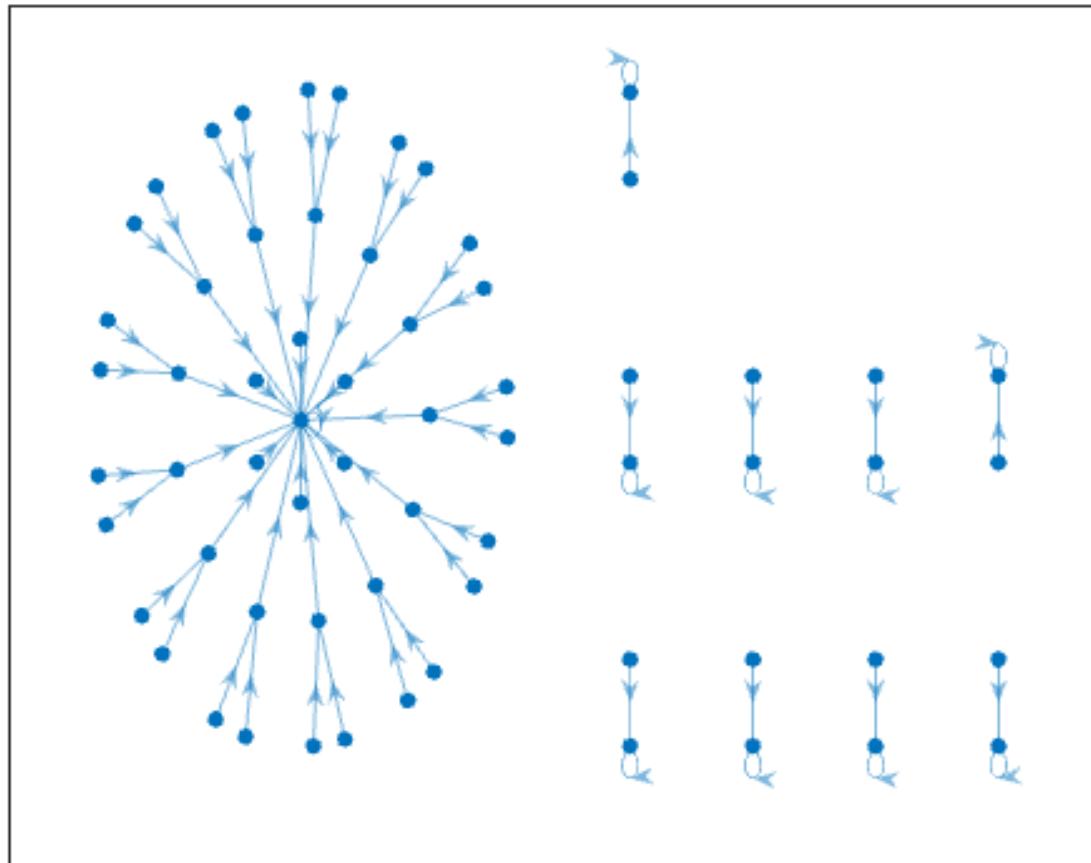


Figura 3.423: Atractor regla 36 n=6

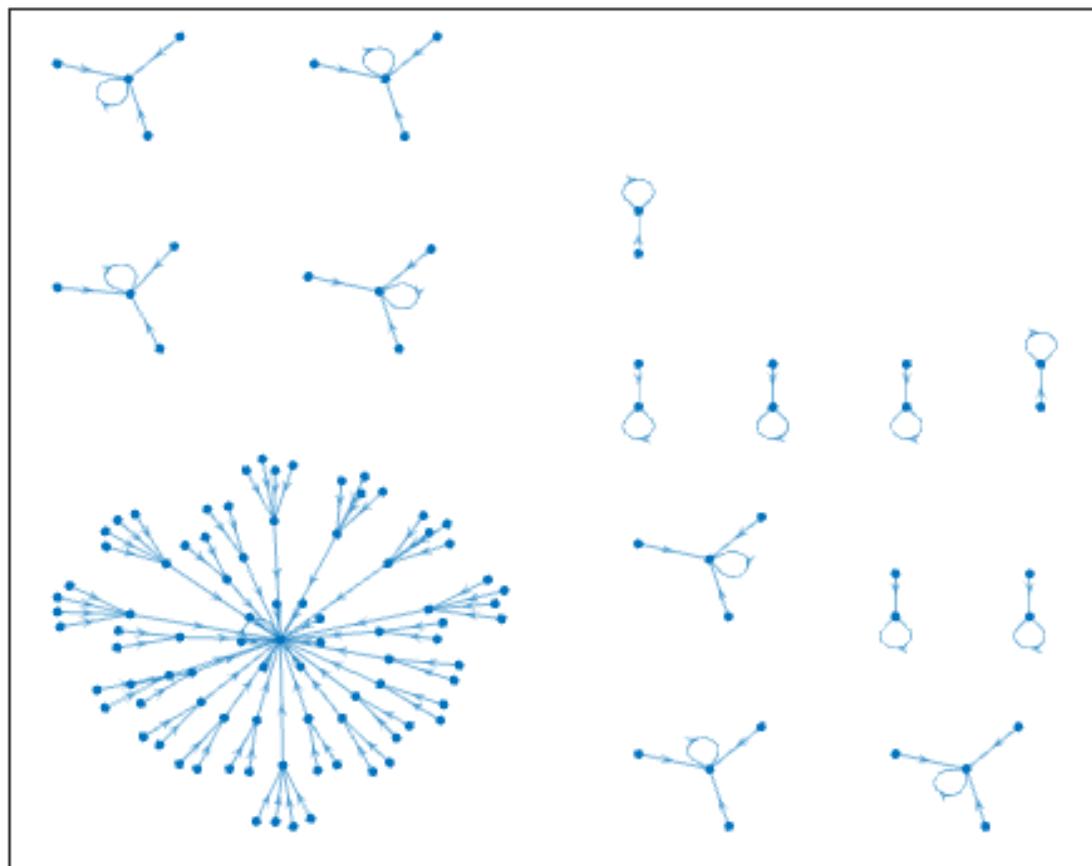


Figura 3.424: Atractor regla 36 n=7

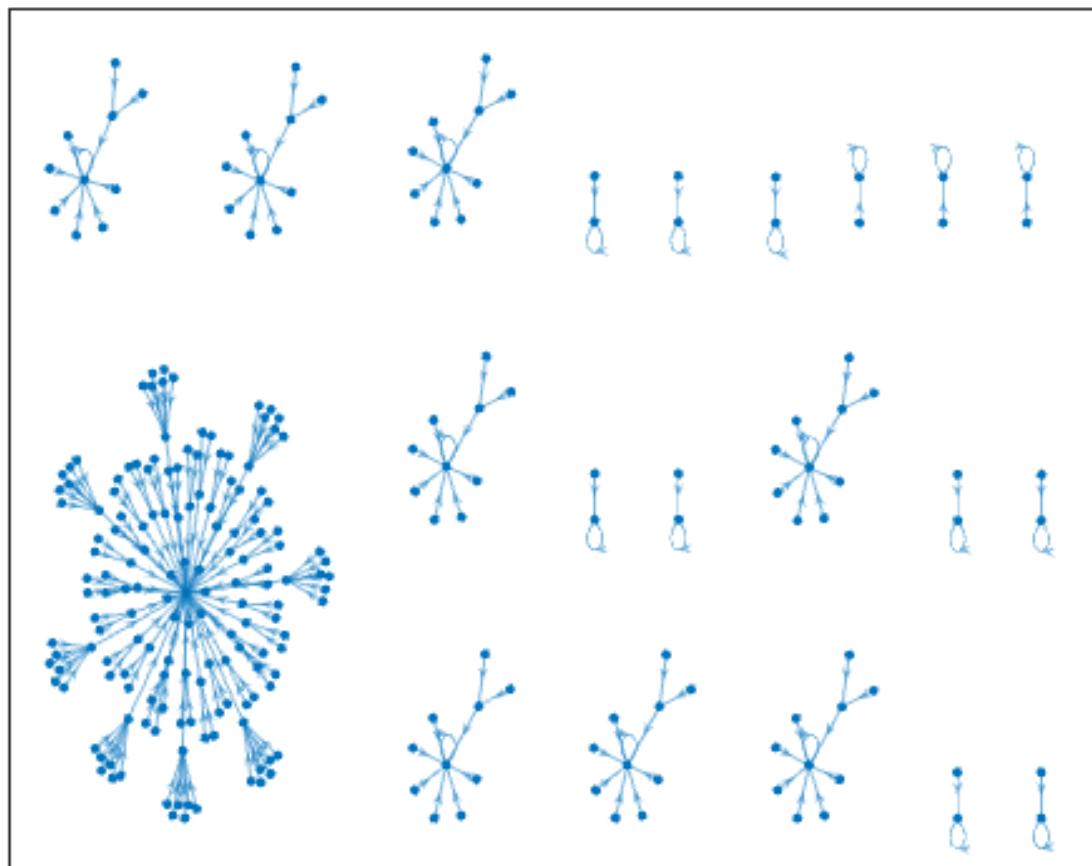


Figura 3.425: Atractor regla 36 n=8

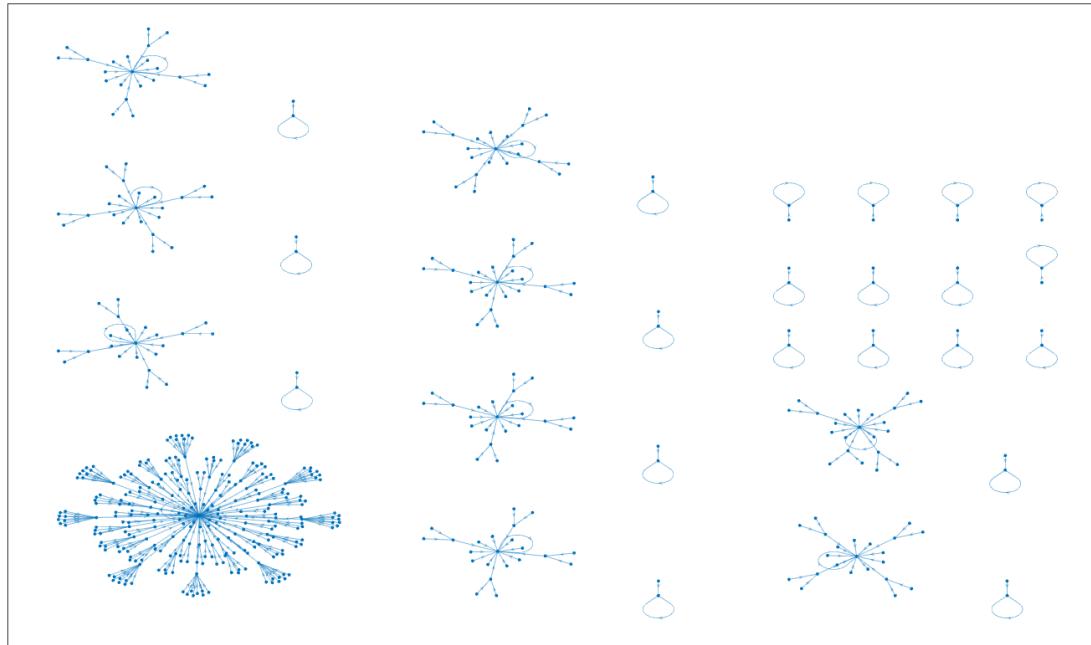


Figura 3.426: Atractor regla 36 n=9

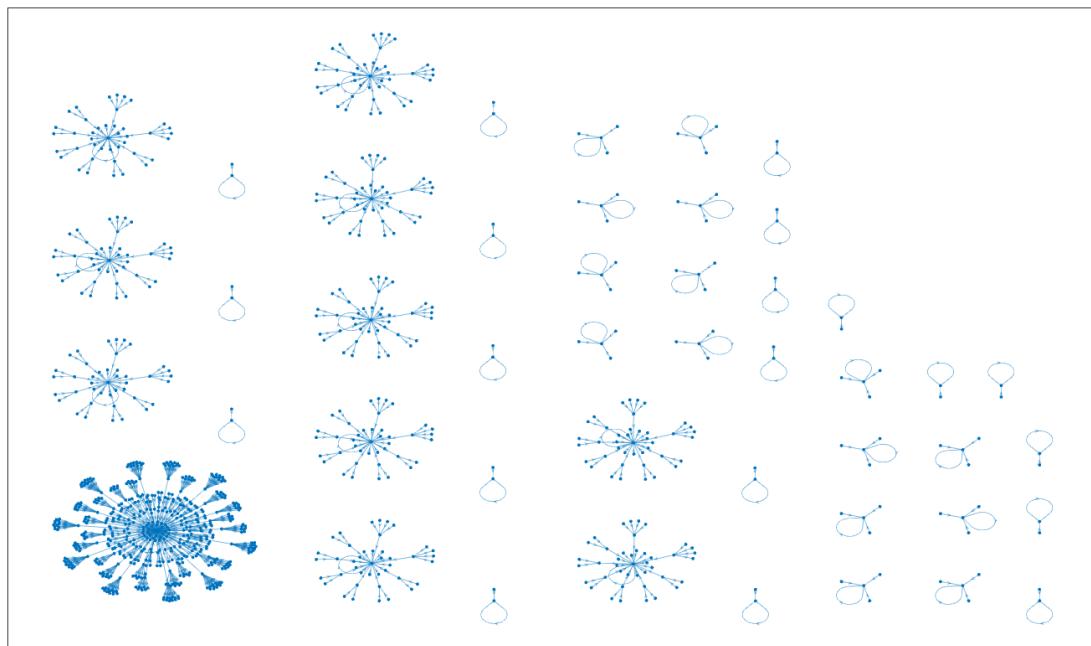


Figura 3.427: Atractor regla 36 n=10

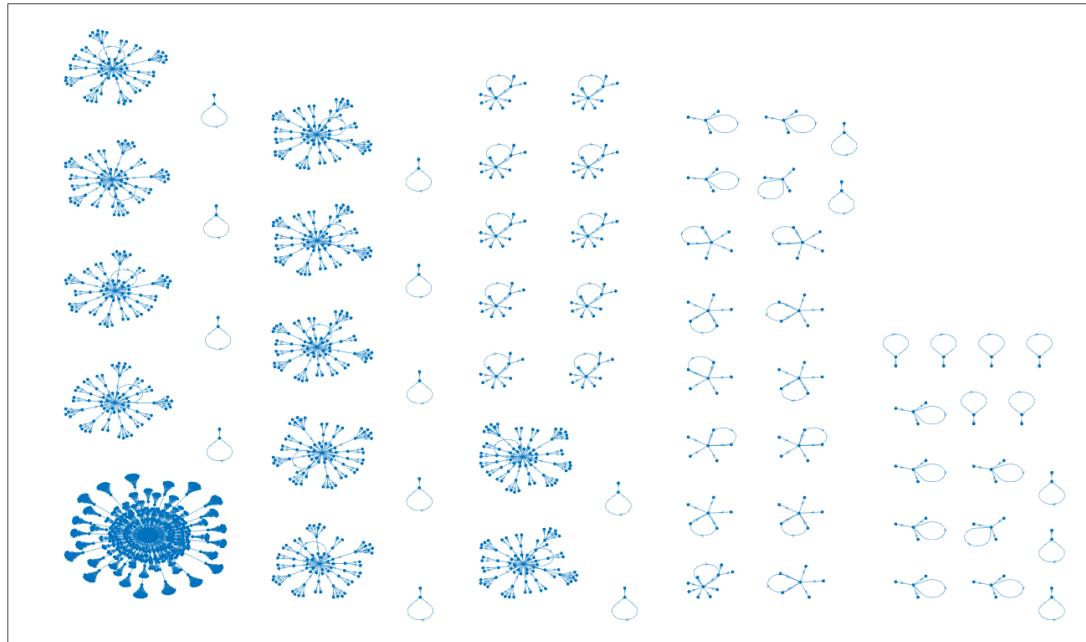


Figura 3.428: Atractor regla 36 n=11

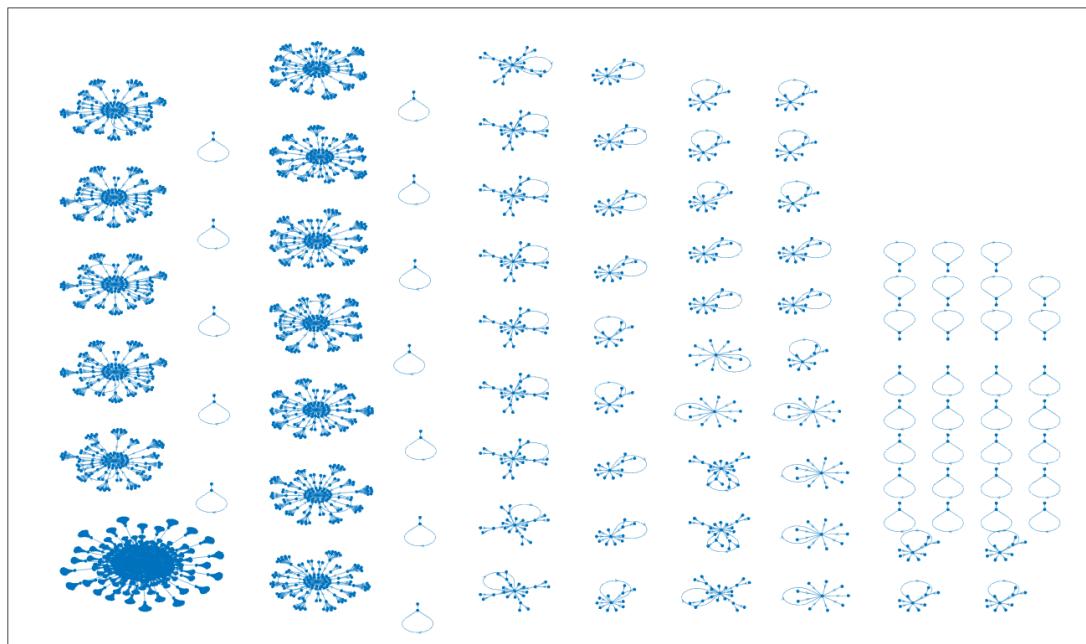


Figura 3.429: Atractor regla 36 n=12

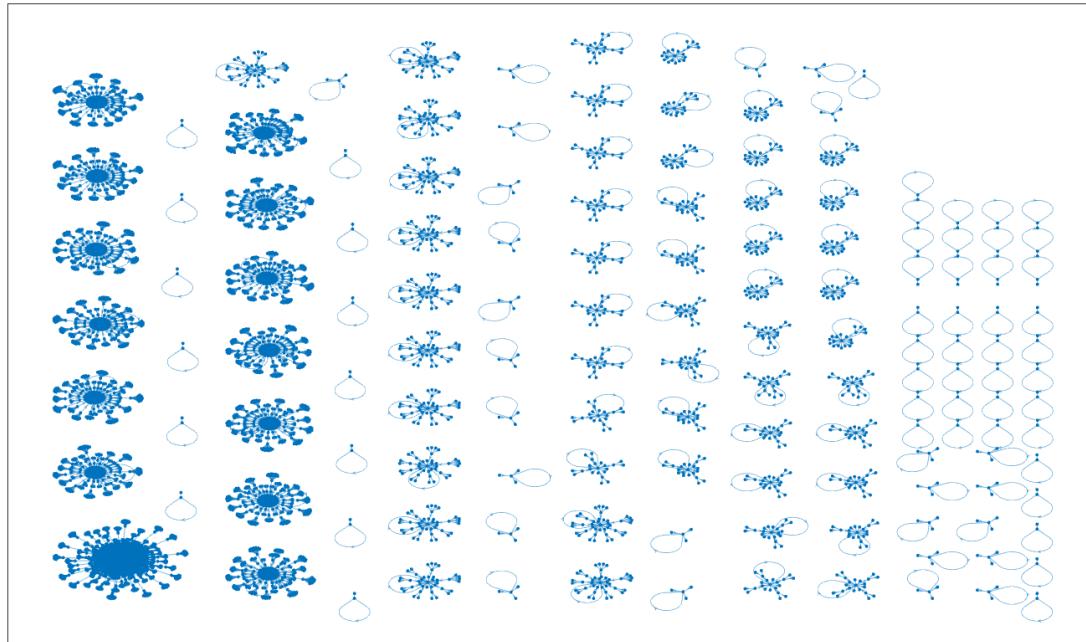


Figura 3.430: Atractor regla 36 n=13

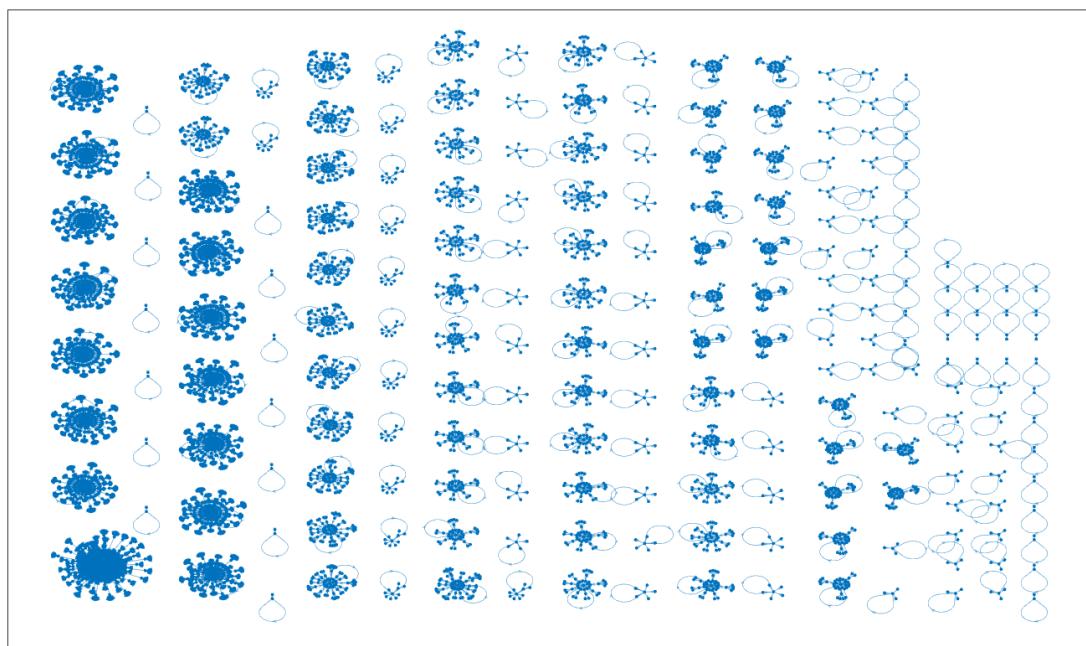


Figura 3.431: Atractor regla 36 n=14

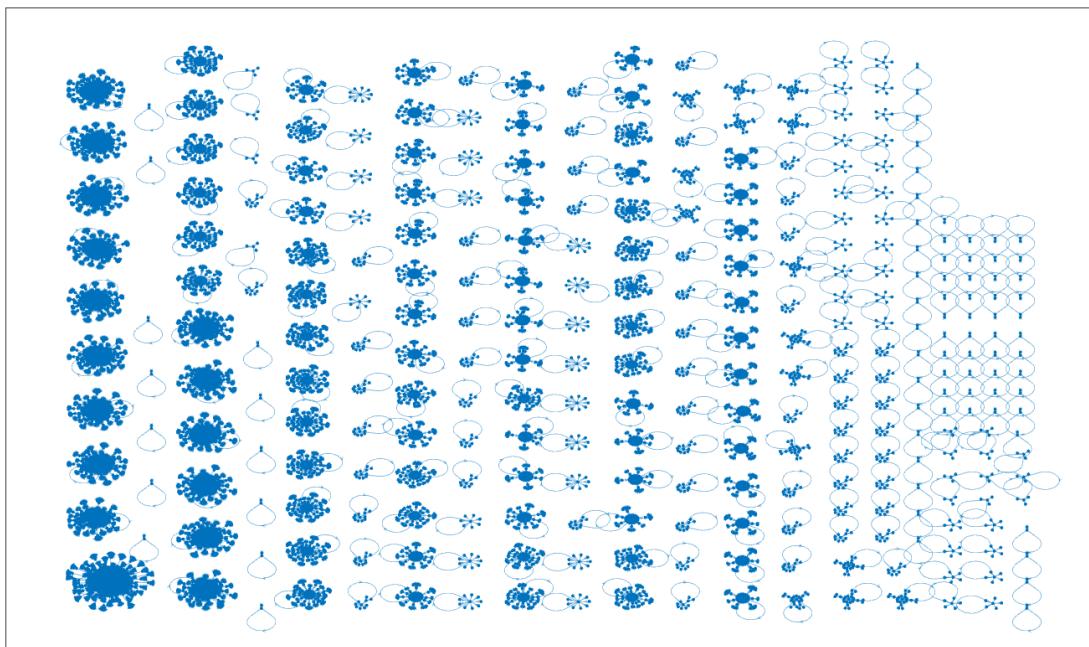


Figura 3.432: Atractor regla 36 $n=15$

3.33. Reglas 37,91

Respecto a la regla 37 se aprecia que mientras más grande es el tamaño de la cadena (n) pareciera que todo va a converger en un mismo atractor, pero de repente este atractor se fragmenta dando lugar a múltiples atractores más pequeños y a su vez surgen copias de otros atractores que terminan multiplicandose.

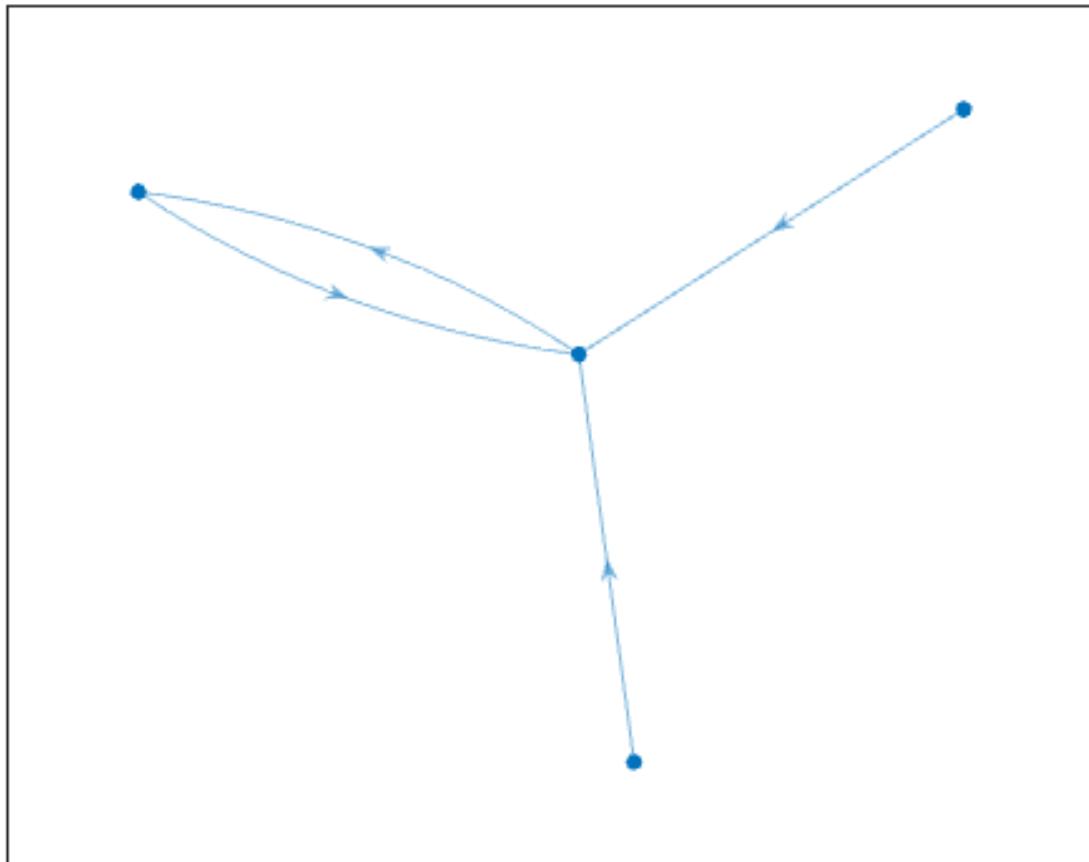


Figura 3.433: Atractor regla 37 $n=2$

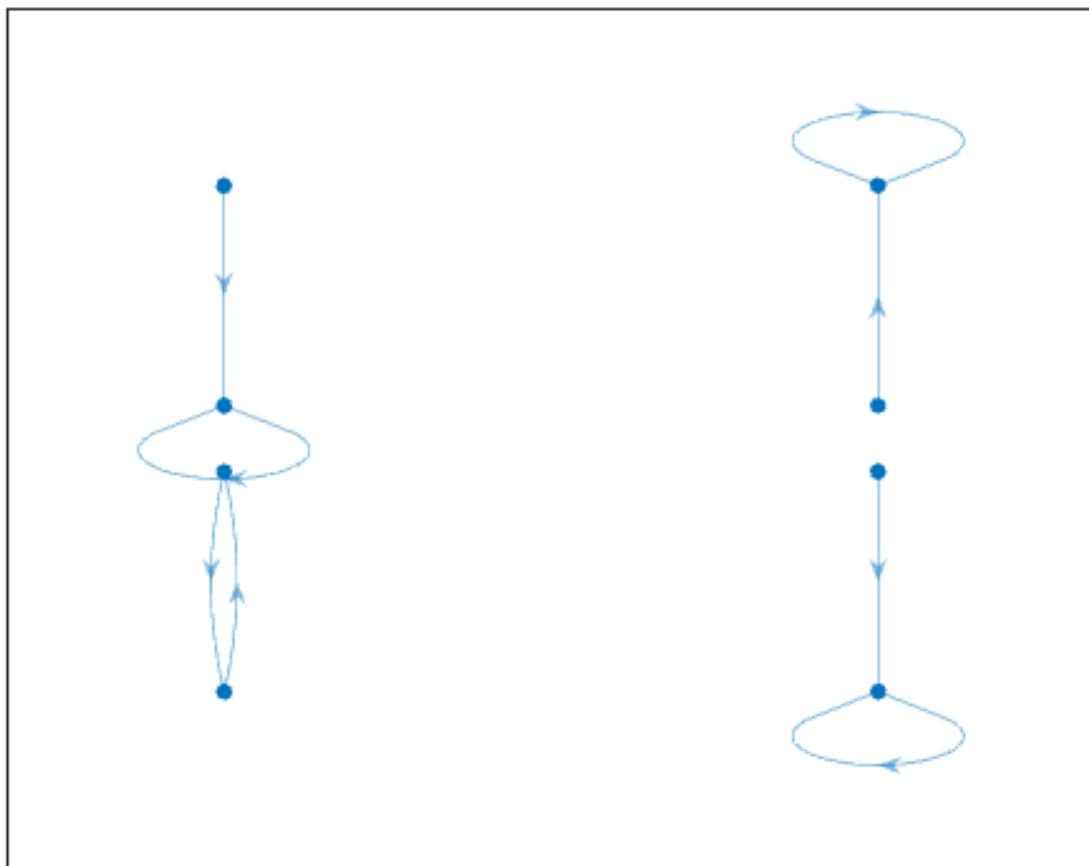


Figura 3.434: Atractor regla 37 n=3

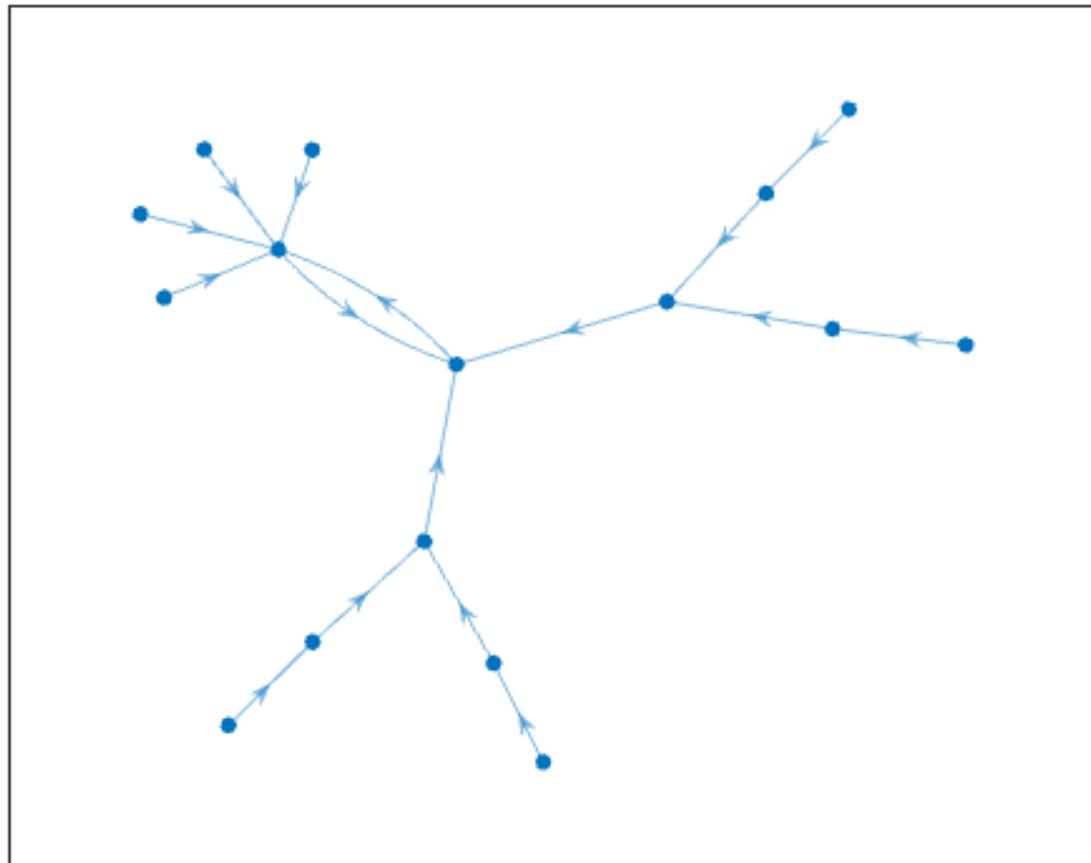


Figura 3.435: Atractor regla 37 n=4

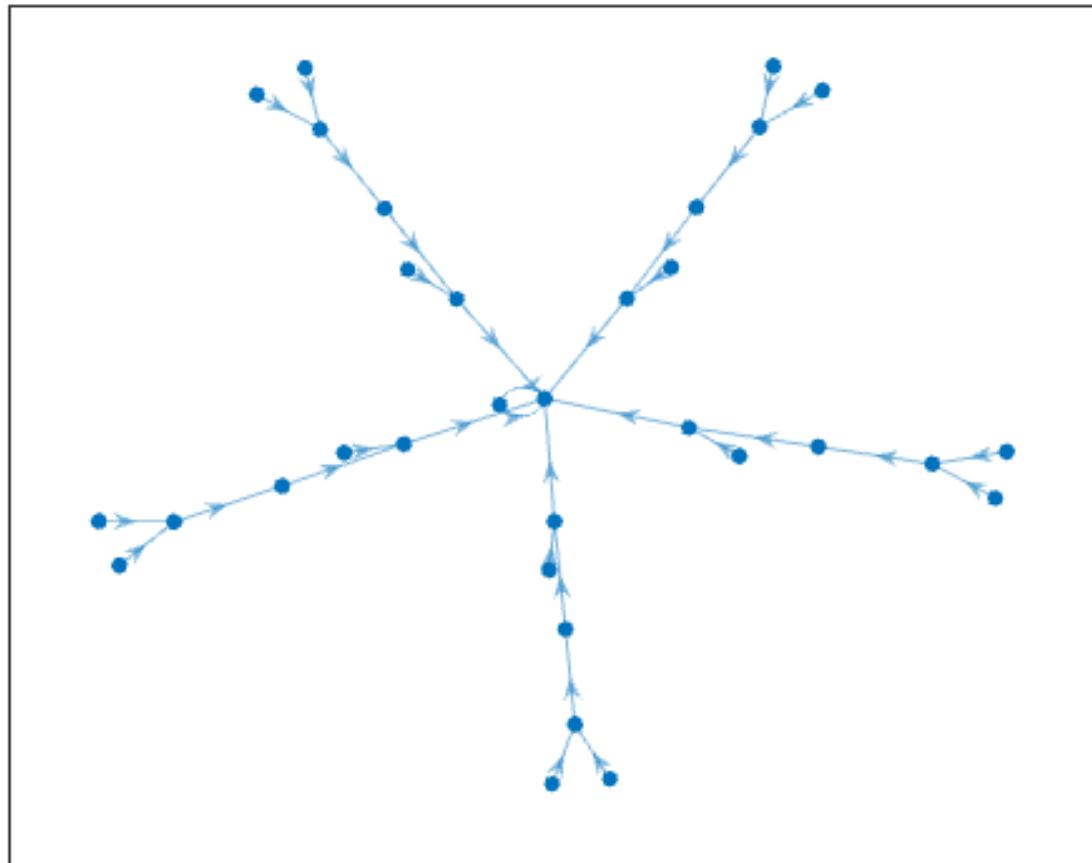


Figura 3.436: Atractor regla 37 n=5

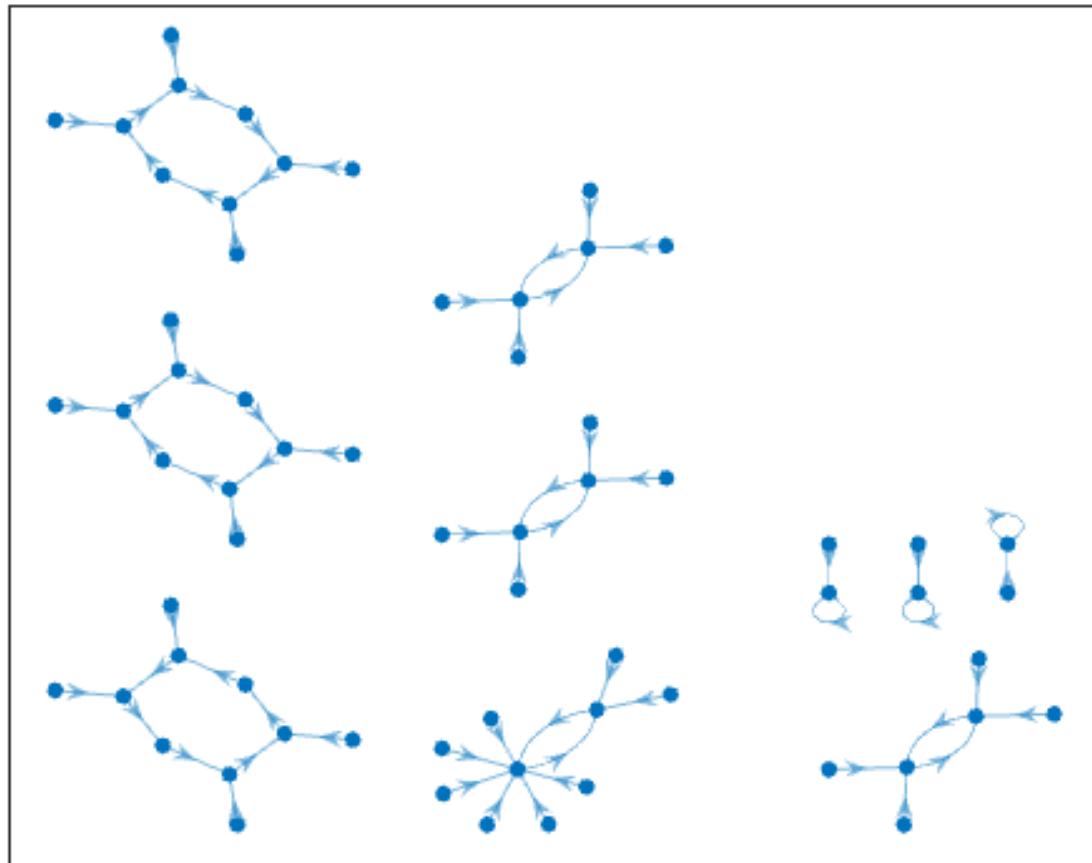
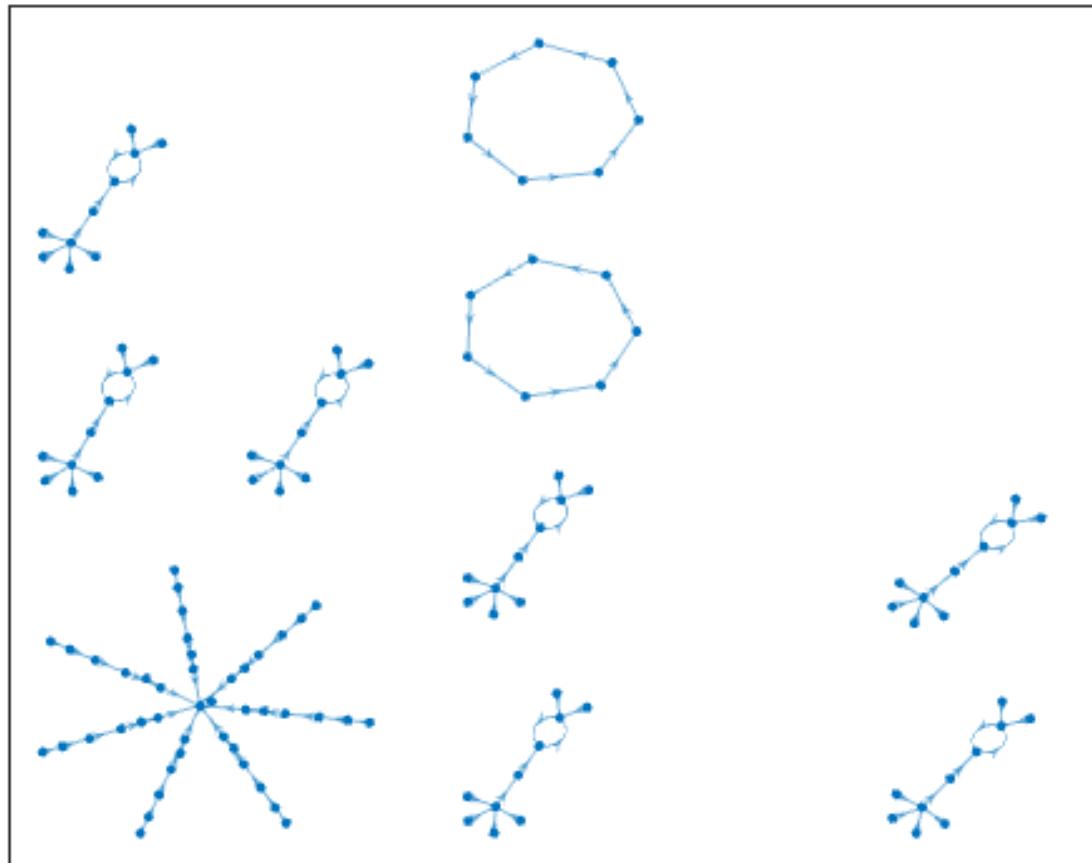


Figura 3.437: Atractor regla 37 n=6

Figura 3.438: Atractor regla 37 $n=7$

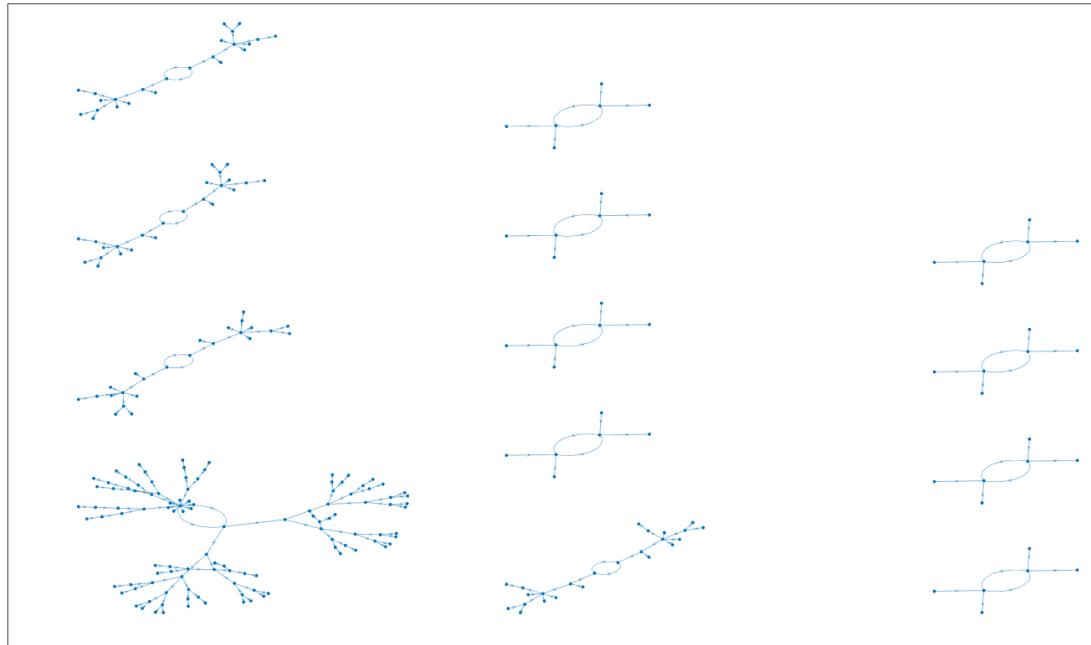


Figura 3.439: Atractor regla 37 n=8

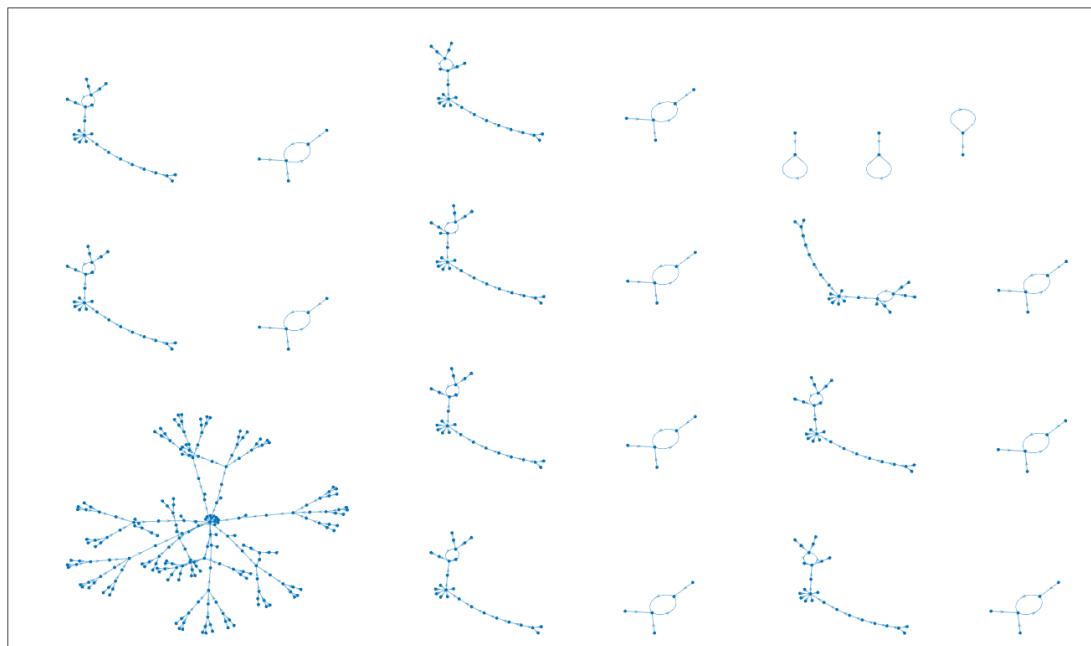
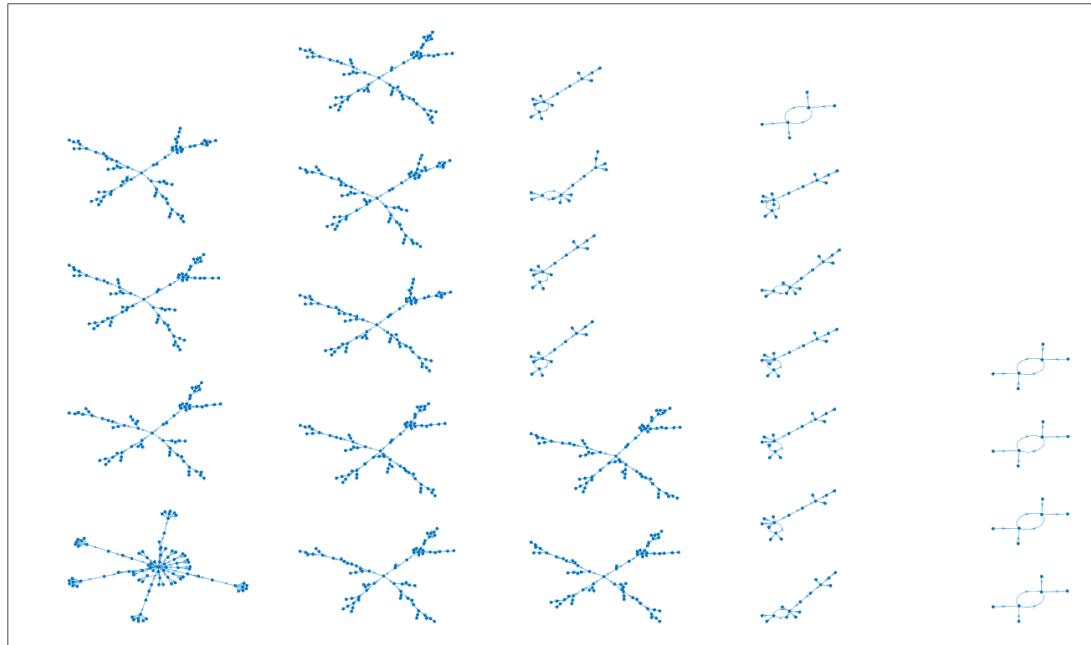
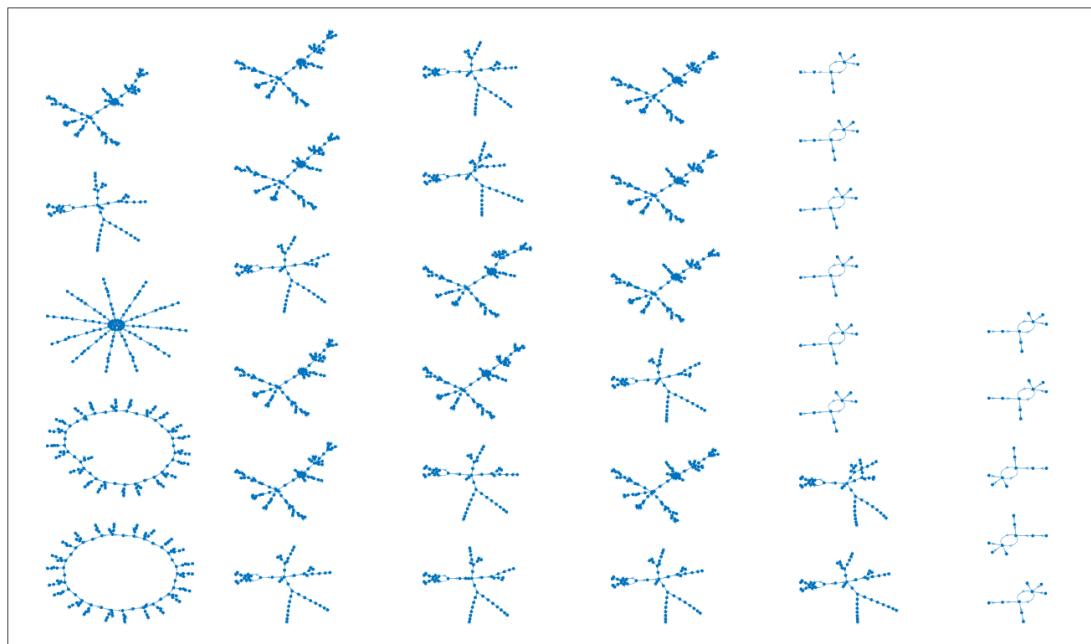


Figura 3.440: Atractor regla 37 n=9

Figura 3.441: Atractor regla 37 $n=10$ Figura 3.442: Atractor regla 37 $n=11$

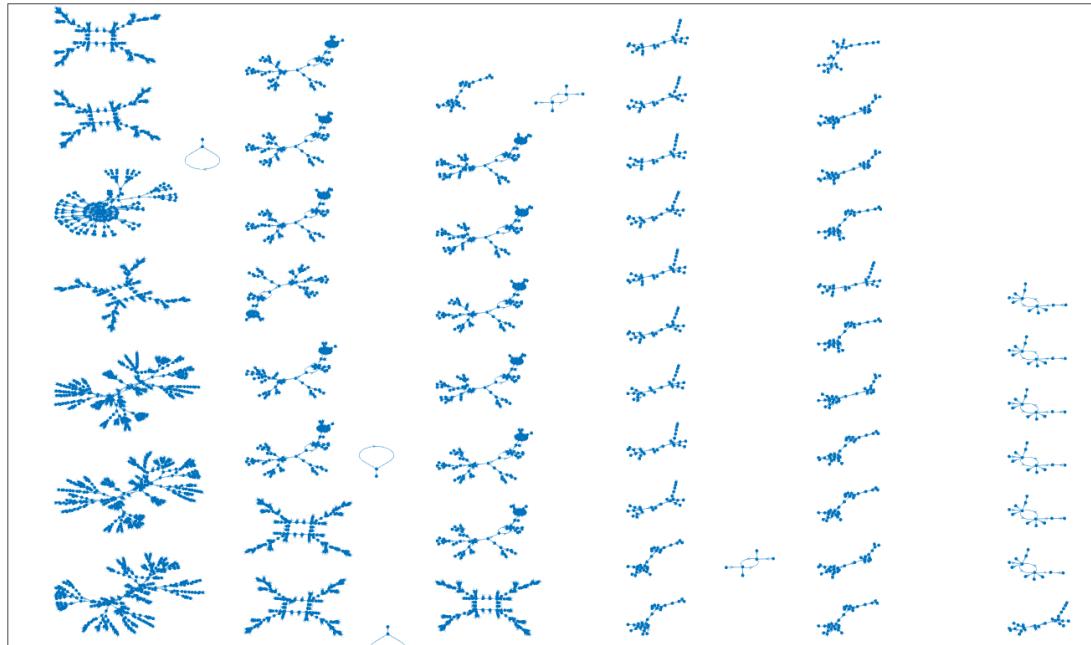


Figura 3.443: Atractor regla 37 n=12

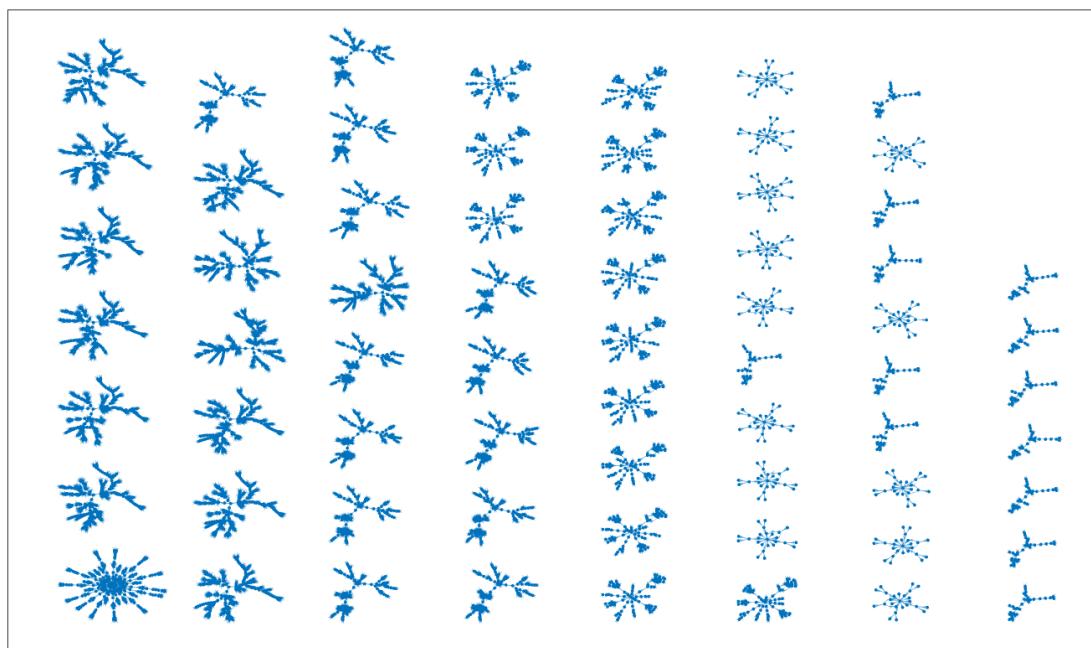
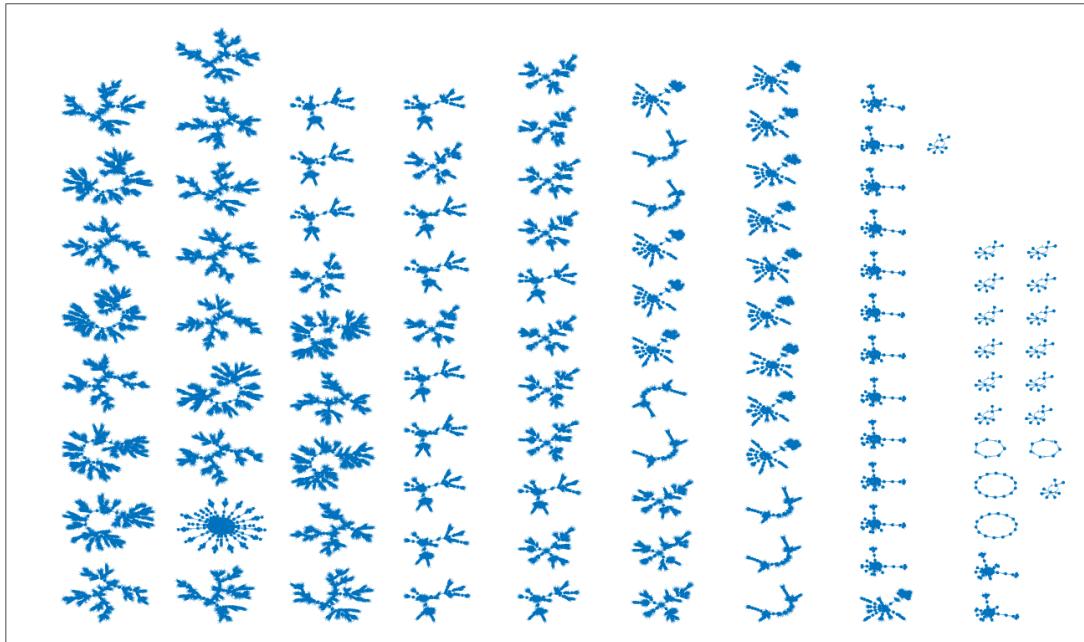
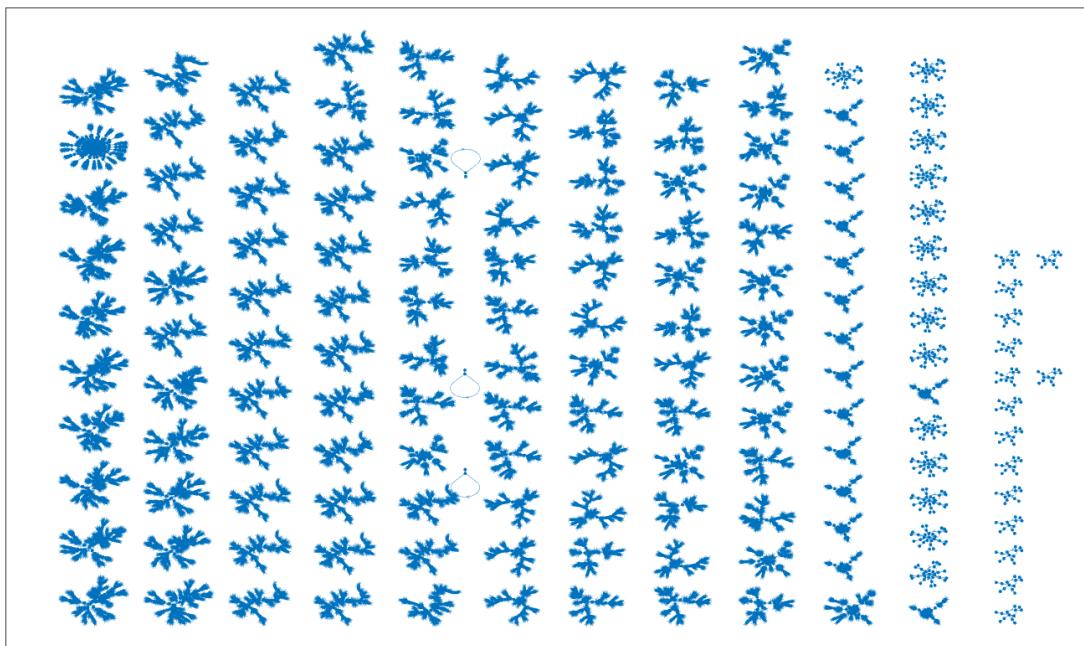


Figura 3.444: Atractor regla 37 n=13

Figura 3.445: Atractor regla 37 $n=14$ Figura 3.446: Atractor regla 37 $n=15$

3.34. Reglas 38,52,155,211

Respecto a la regla 38 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen atractores que forman polígonos que a su vez algunos tienen más nodos hoja que otros, llegando a un punto en que son tantos los nodos y atractores que algunos se deforman mostrando curvas en sus formas.

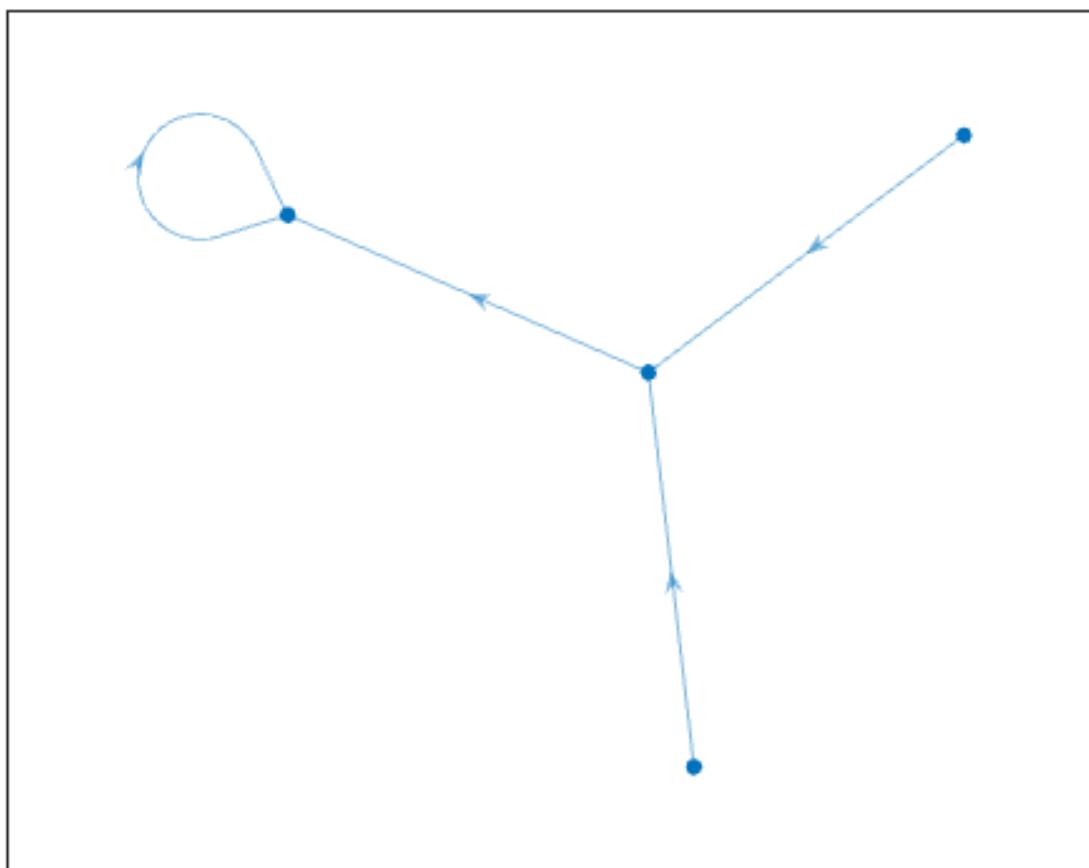


Figura 3.447: Atractor regla 38 $n=2$

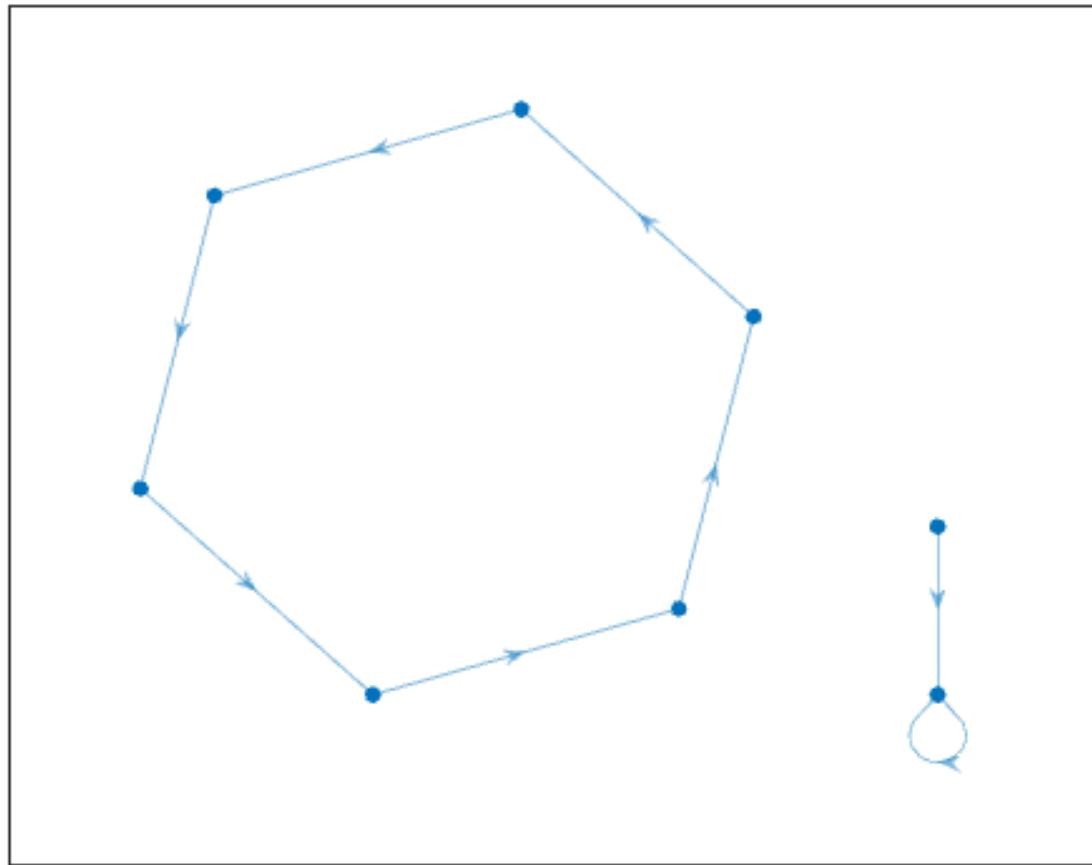


Figura 3.448: Atractor regla 38 n=3

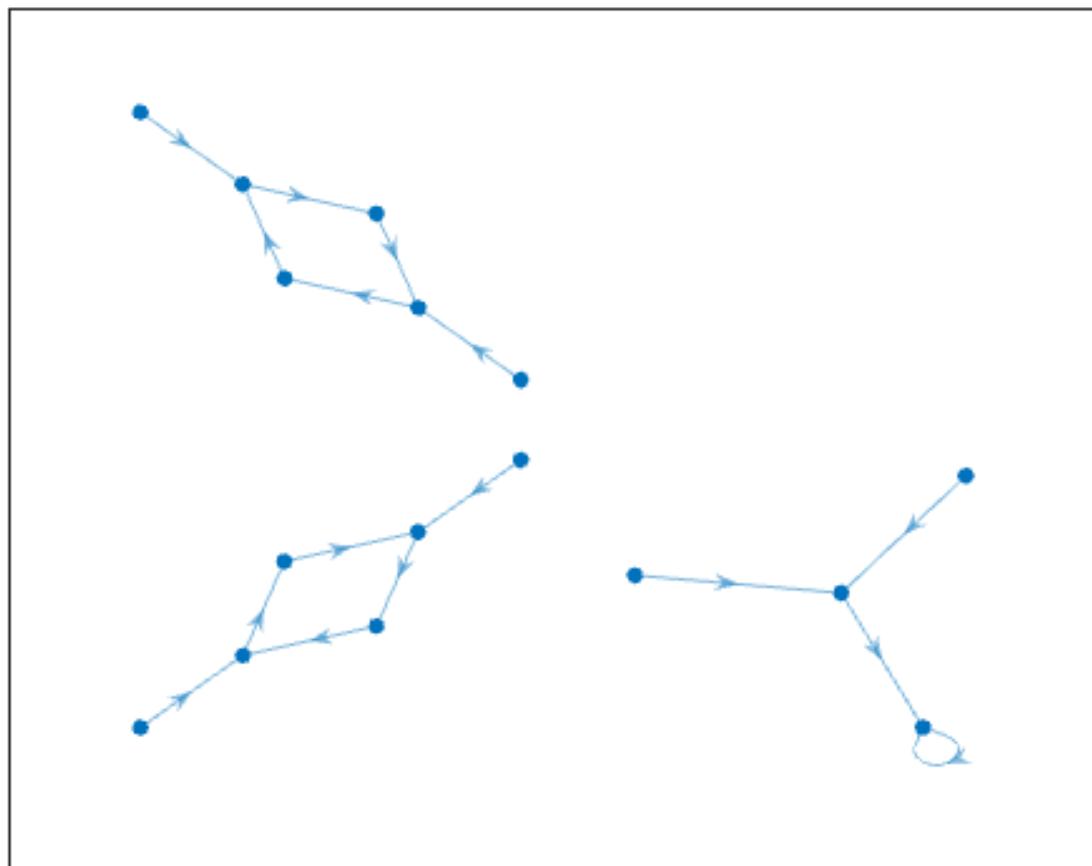


Figura 3.449: Atractor regla 38 n=4

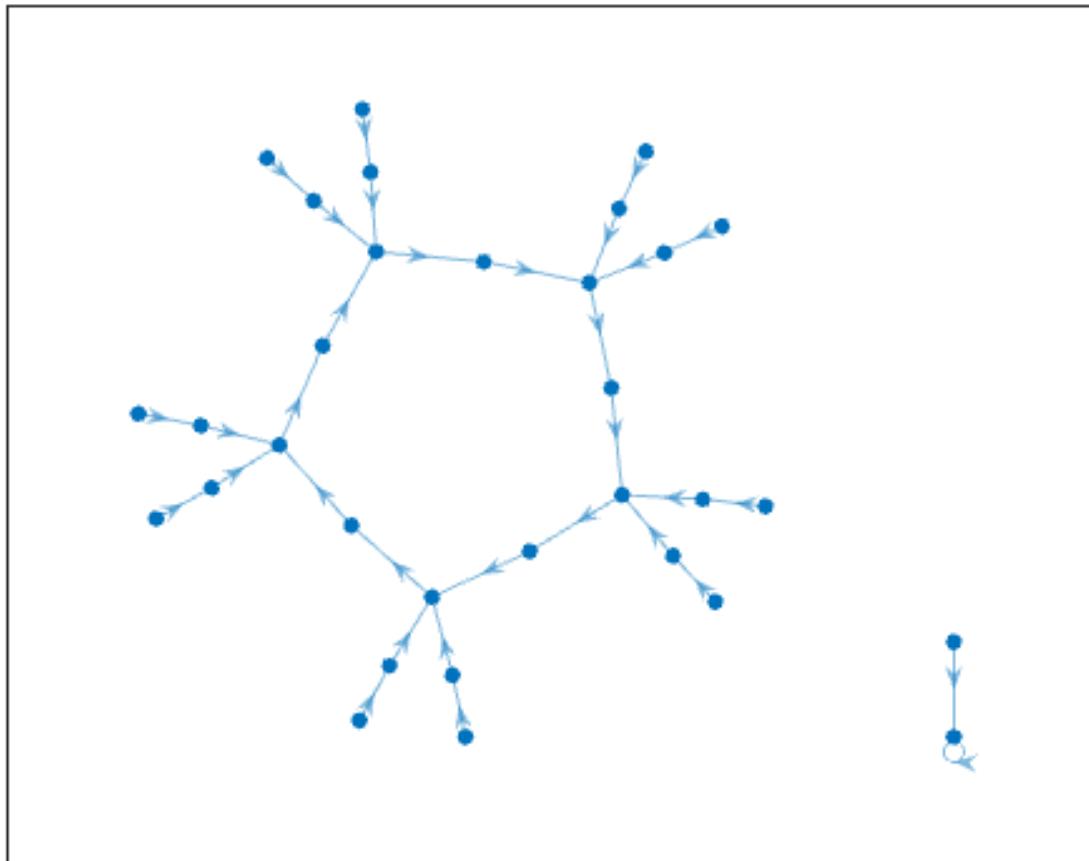
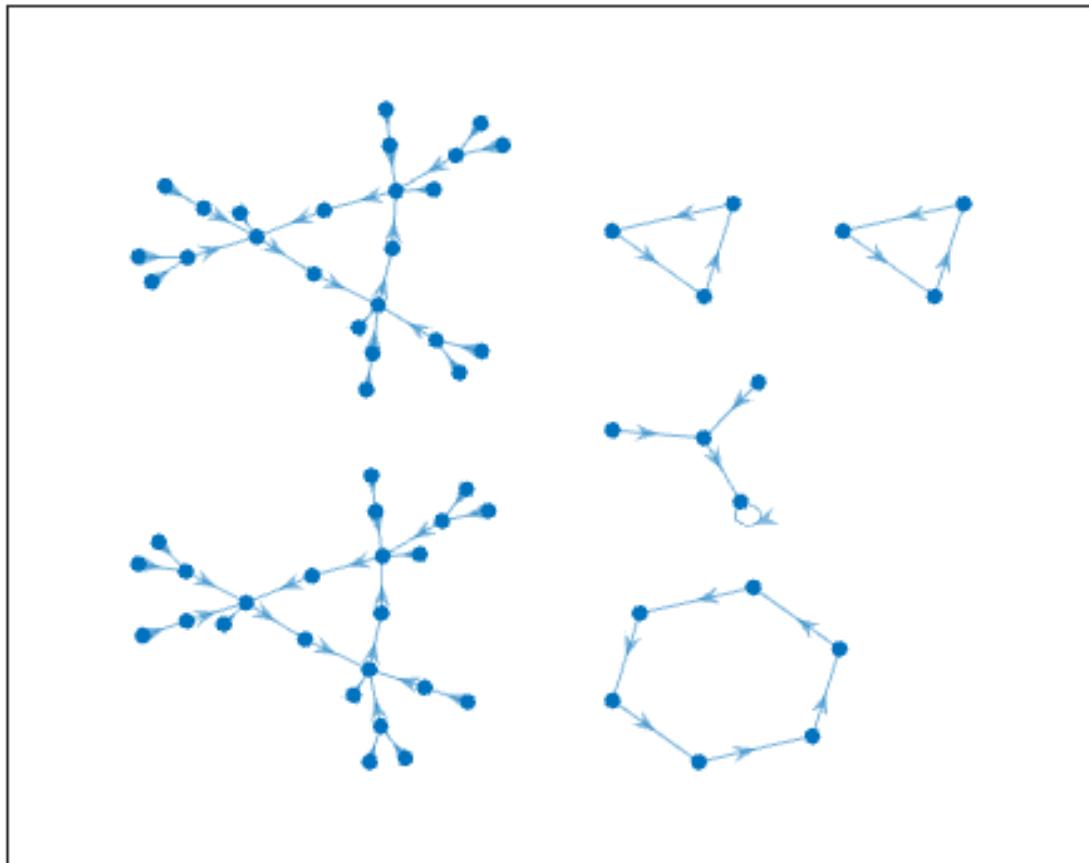


Figura 3.450: Atractor regla 38 n=5

Figura 3.451: Atractor regla 38 $n=6$

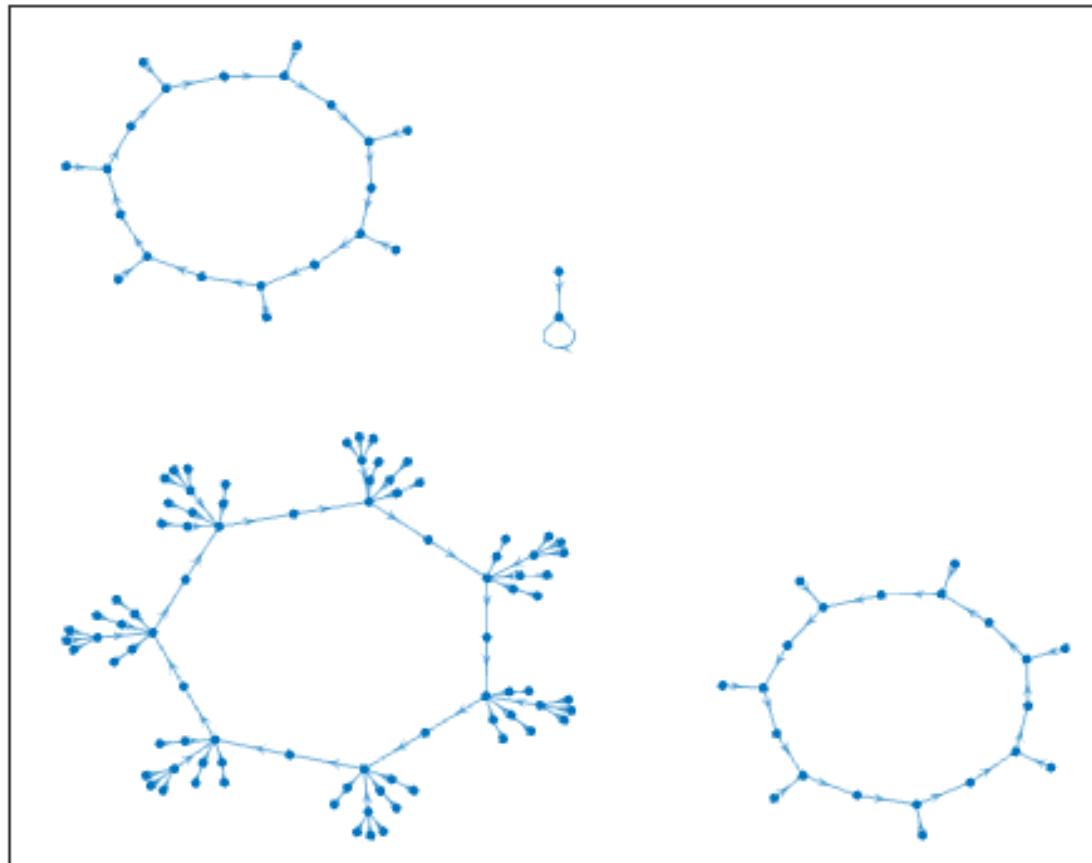


Figura 3.452: Atractor regla 38 n=7

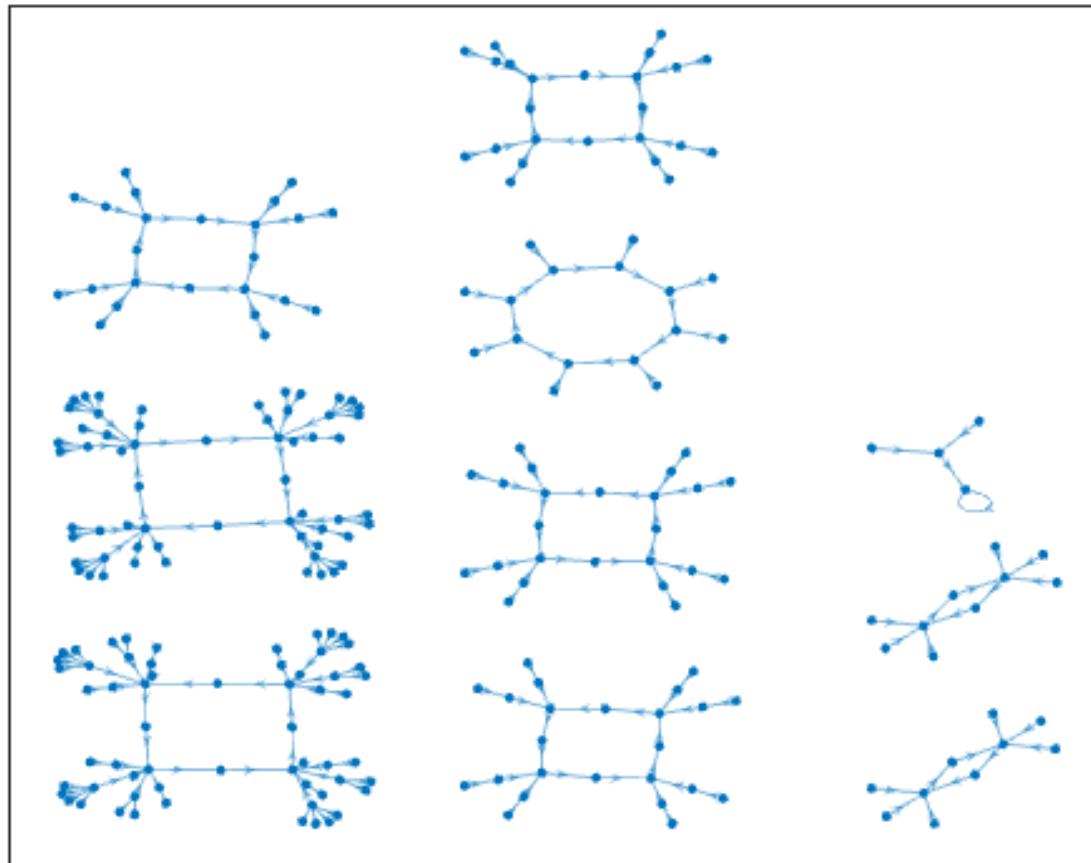
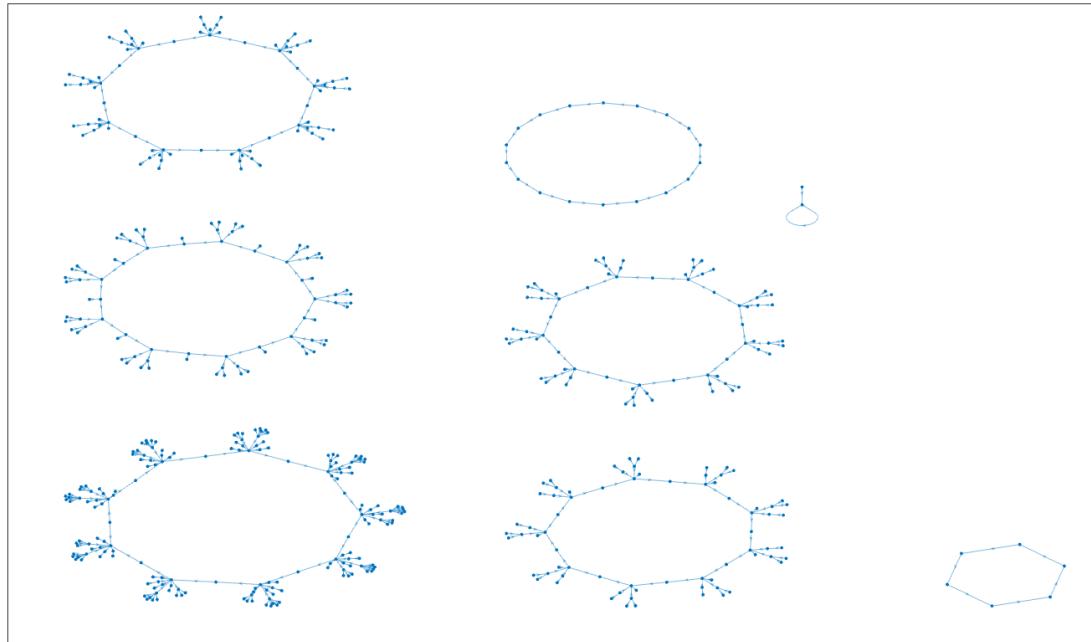
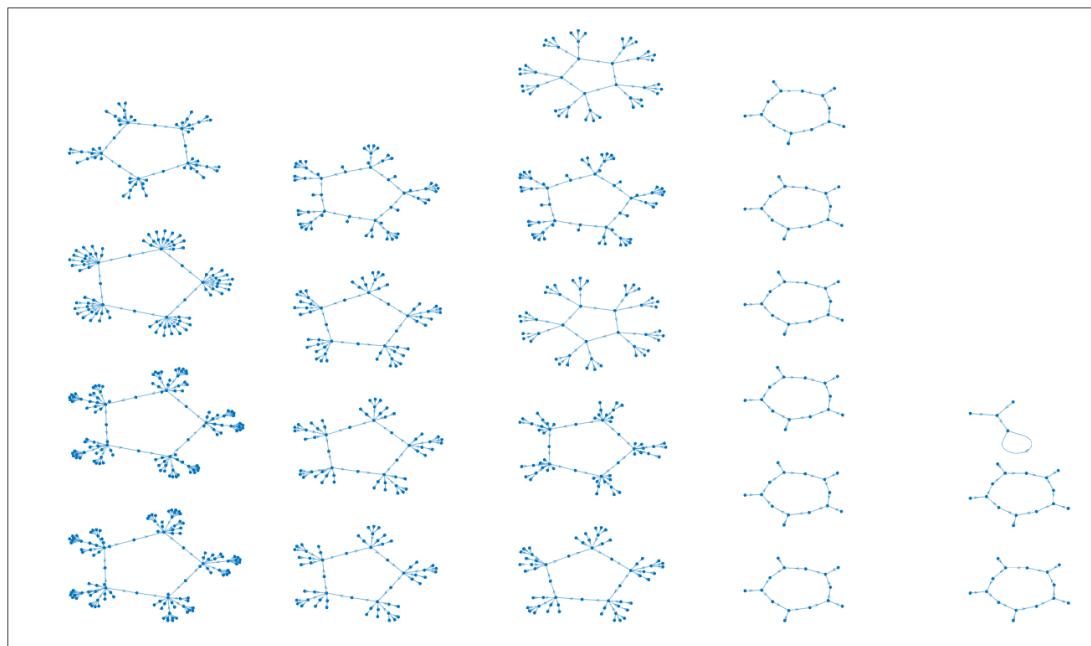


Figura 3.453: Atractor regla 38 n=8

Figura 3.454: Atractor regla 38 $n=9$ Figura 3.455: Atractor regla 38 $n=10$

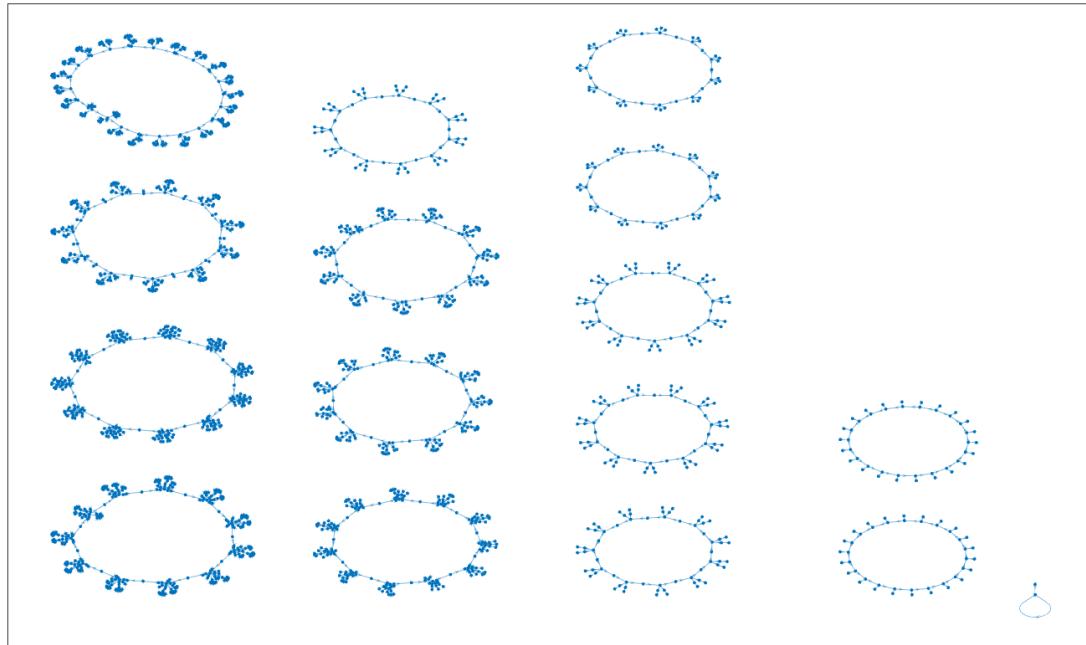


Figura 3.456: Atractor regla 38 n=11

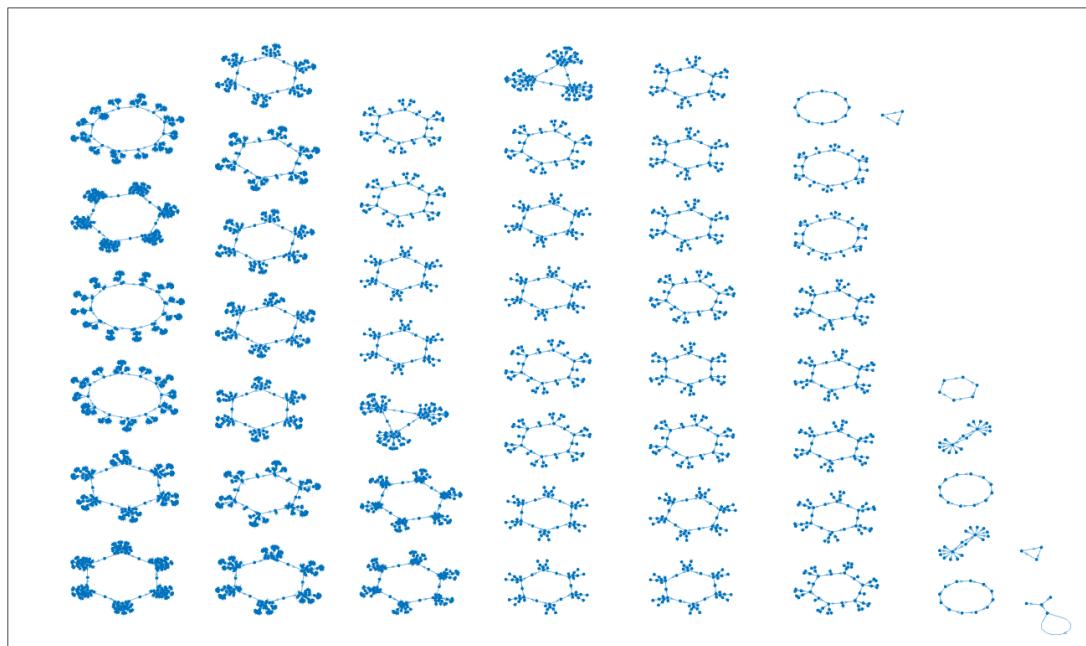


Figura 3.457: Atractor regla 38 n=12

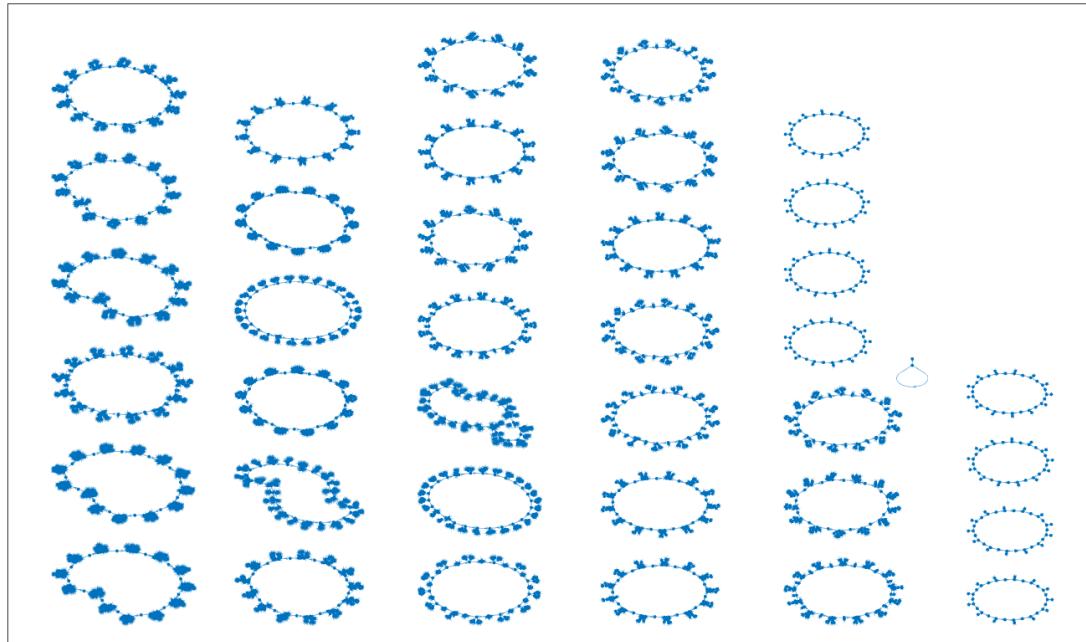


Figura 3.458: Atractor regla 38 n=13

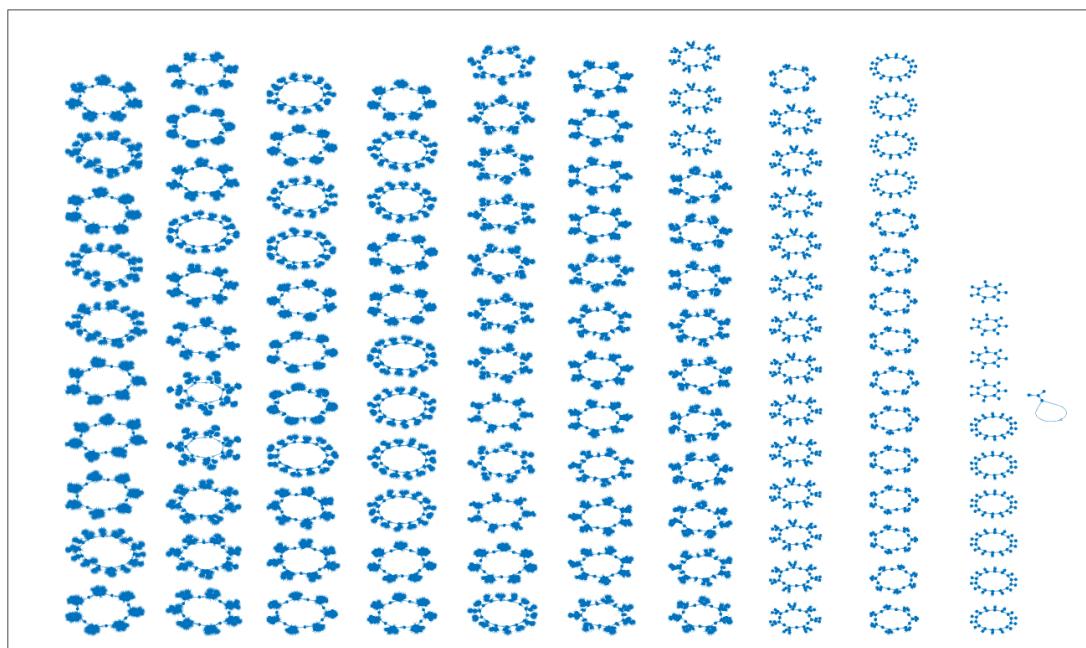


Figura 3.459: Atractor regla 38 n=14

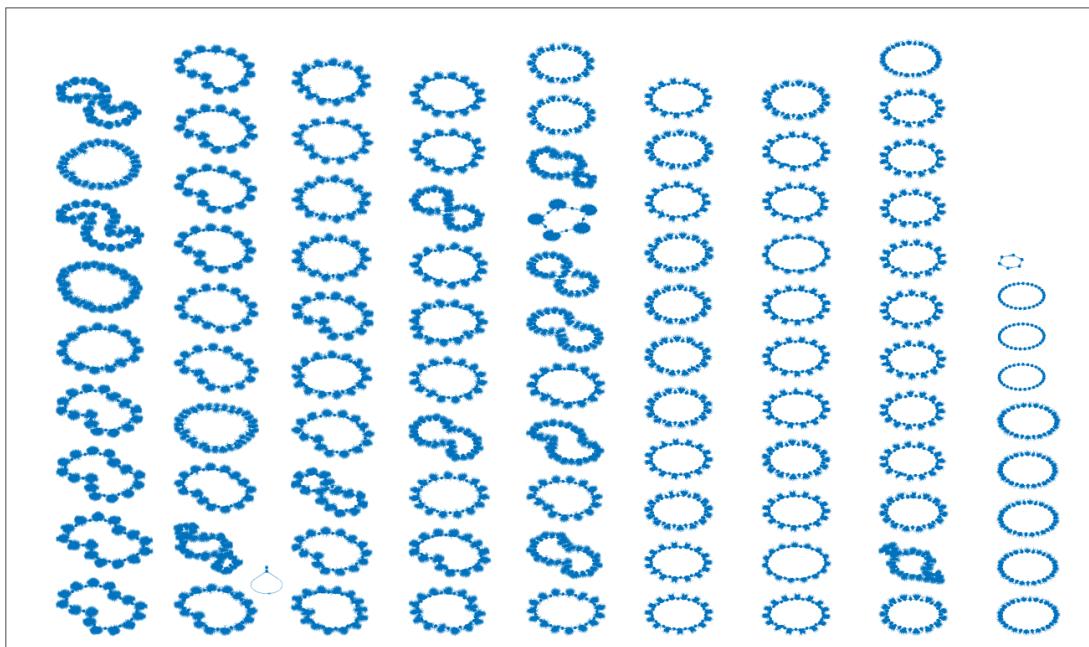


Figura 3.460: Atractor regla 38 n=15

3.35. Reglas 40,96,235,249

Respecto a la regla 40 se aprecia que mientras más grande es el tamaño de la cadena (n) el atractor que surge en la figura 3.462 se mantiene hasta el final creciendo de manera brusca sumando en cada evolución una gran cantidad de nodos dando lugar a una figura que asemeja una gota de pintura que ha caido al suelo.

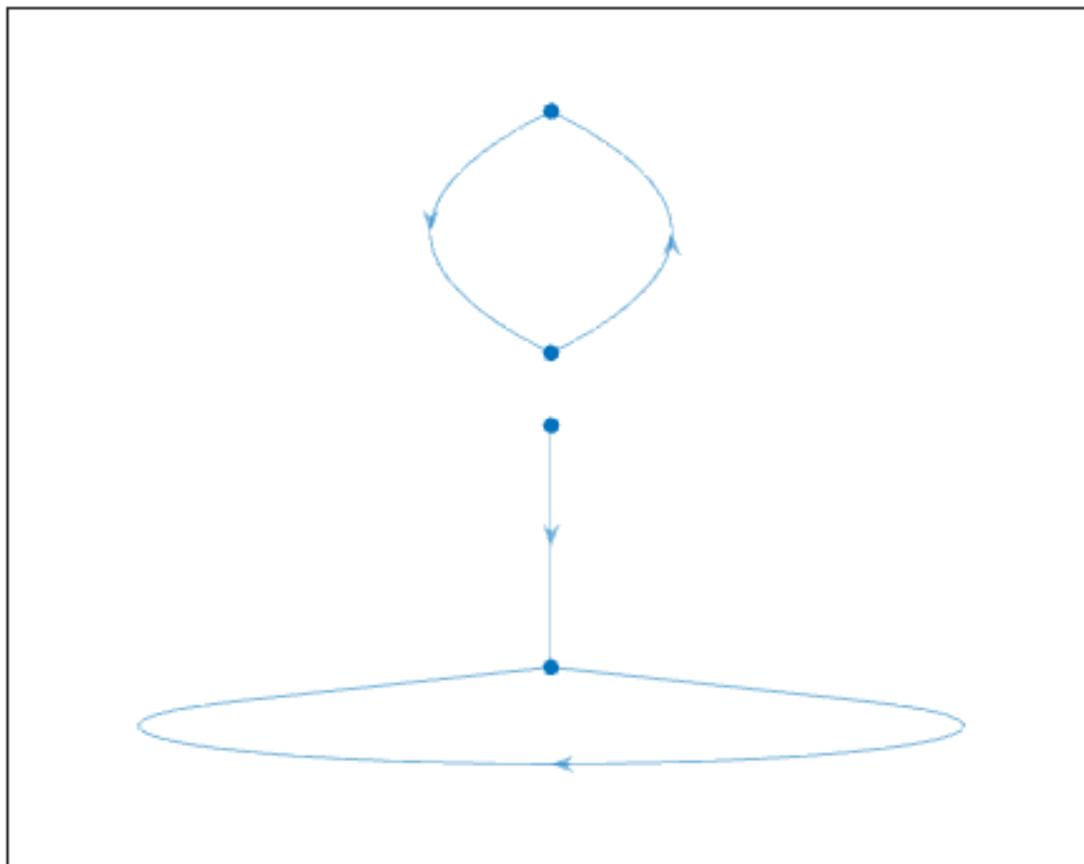
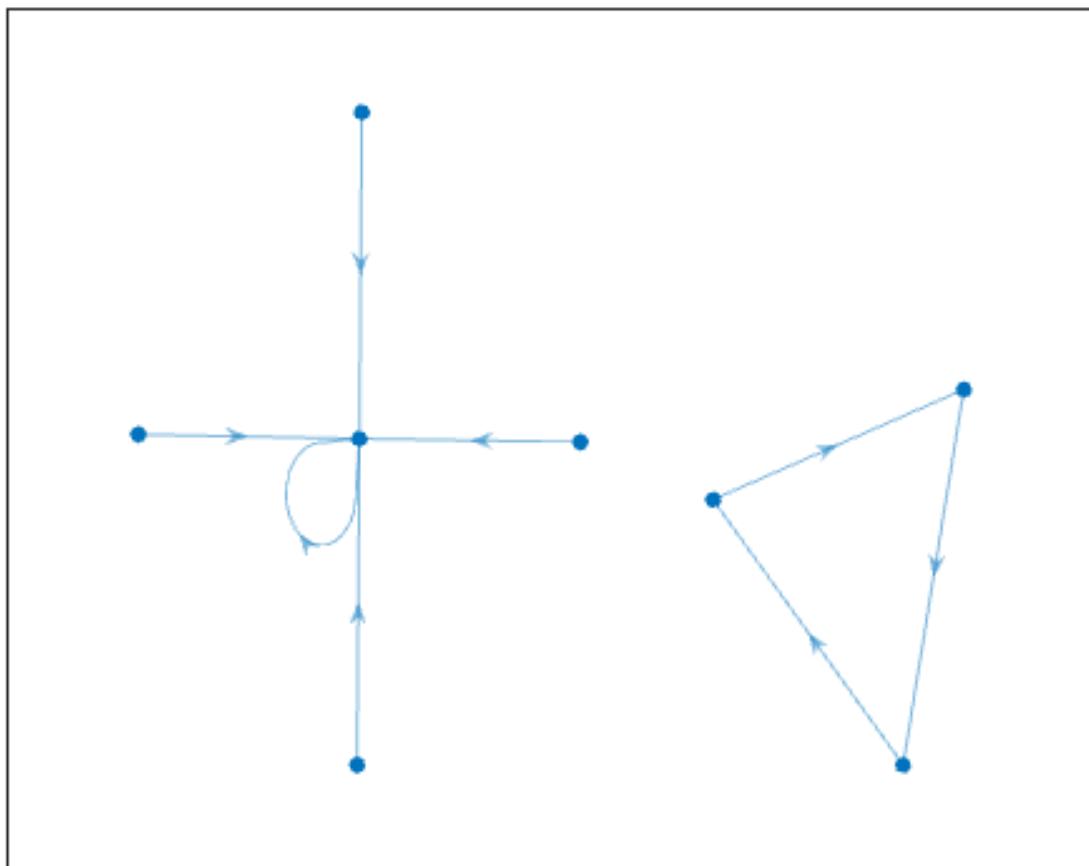


Figura 3.461: Atractor regla 40 n=2

Figura 3.462: Atractor regla 40 $n=3$

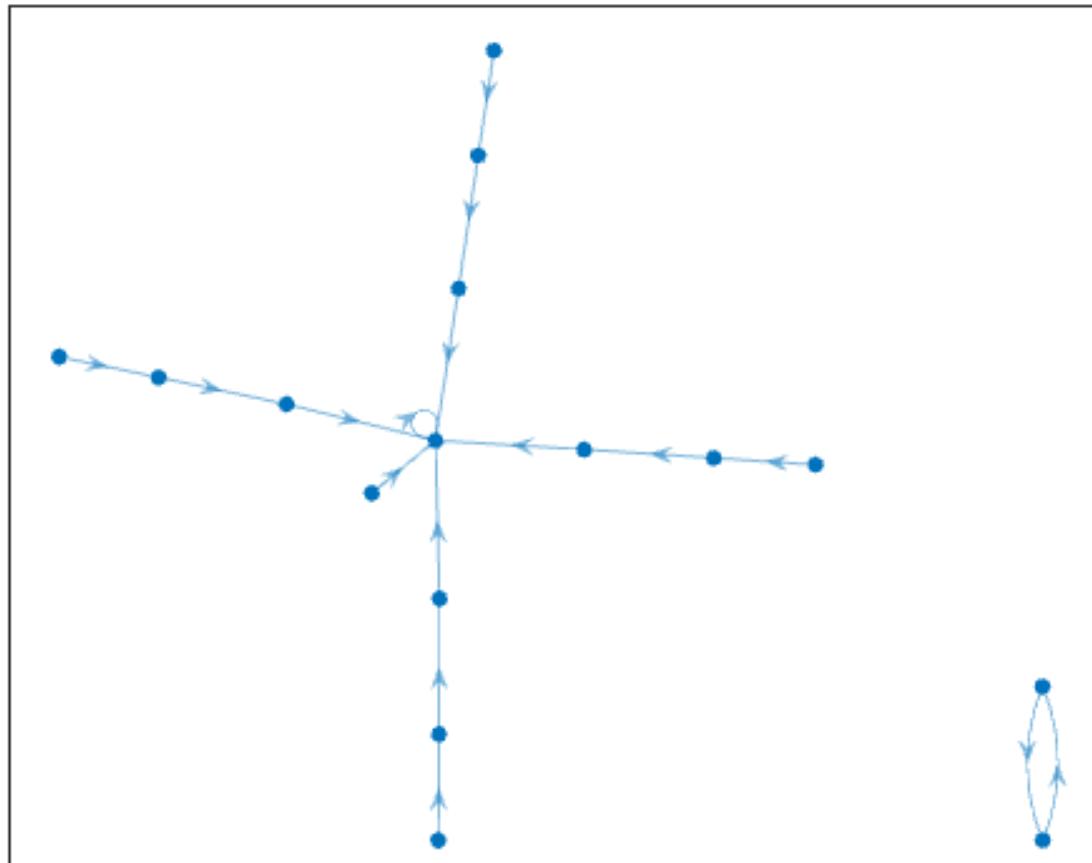


Figura 3.463: Atractor regla 40 n=4

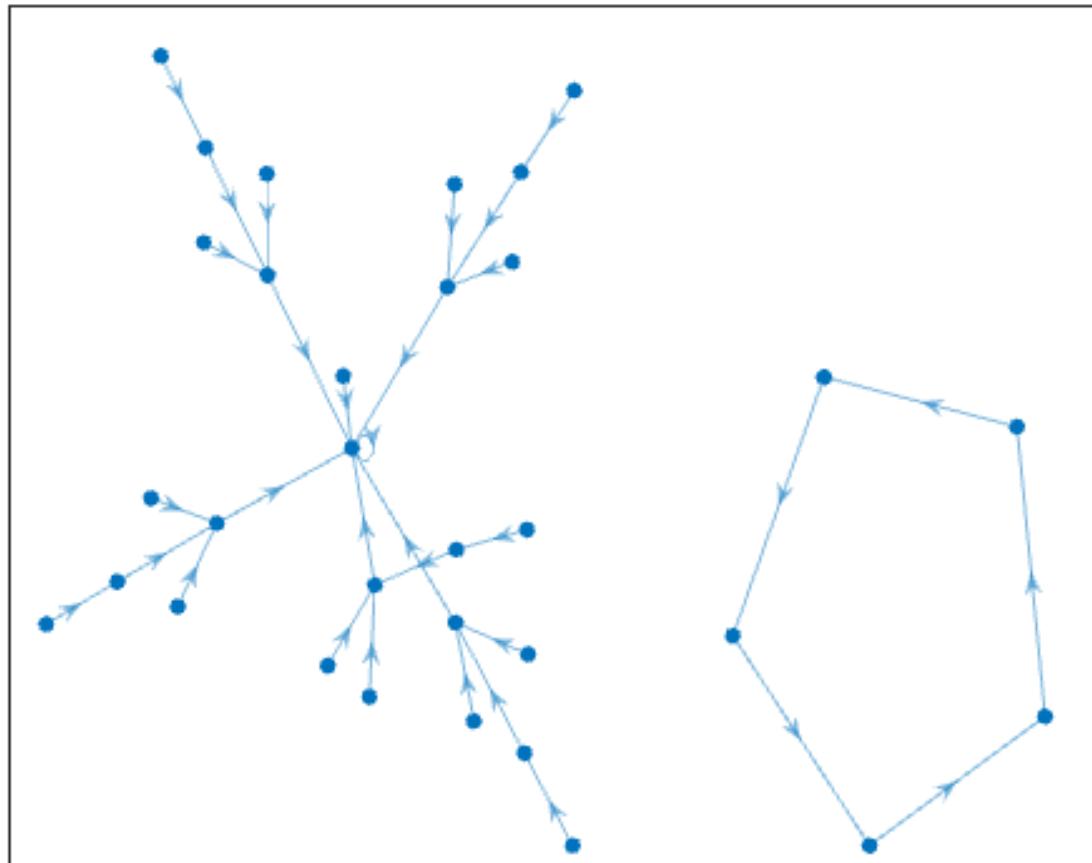


Figura 3.464: Atractor regla 40 n=5

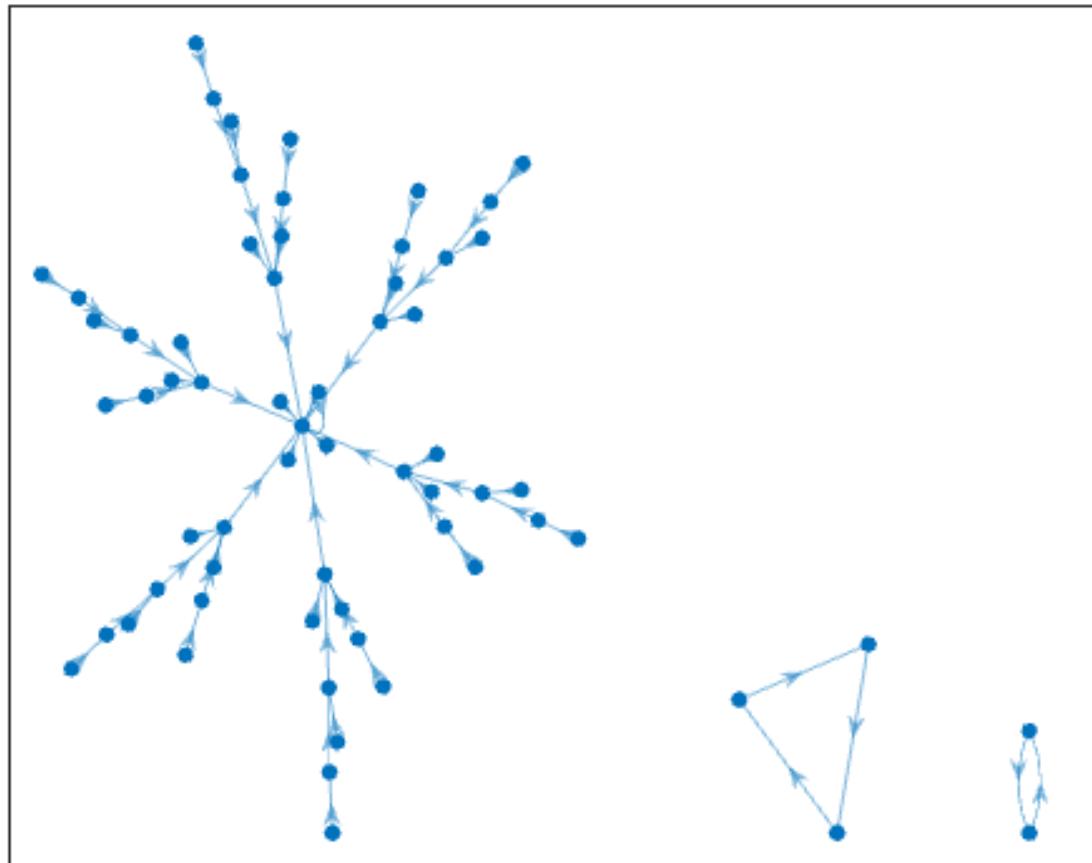


Figura 3.465: Atractor regla 40 n=6

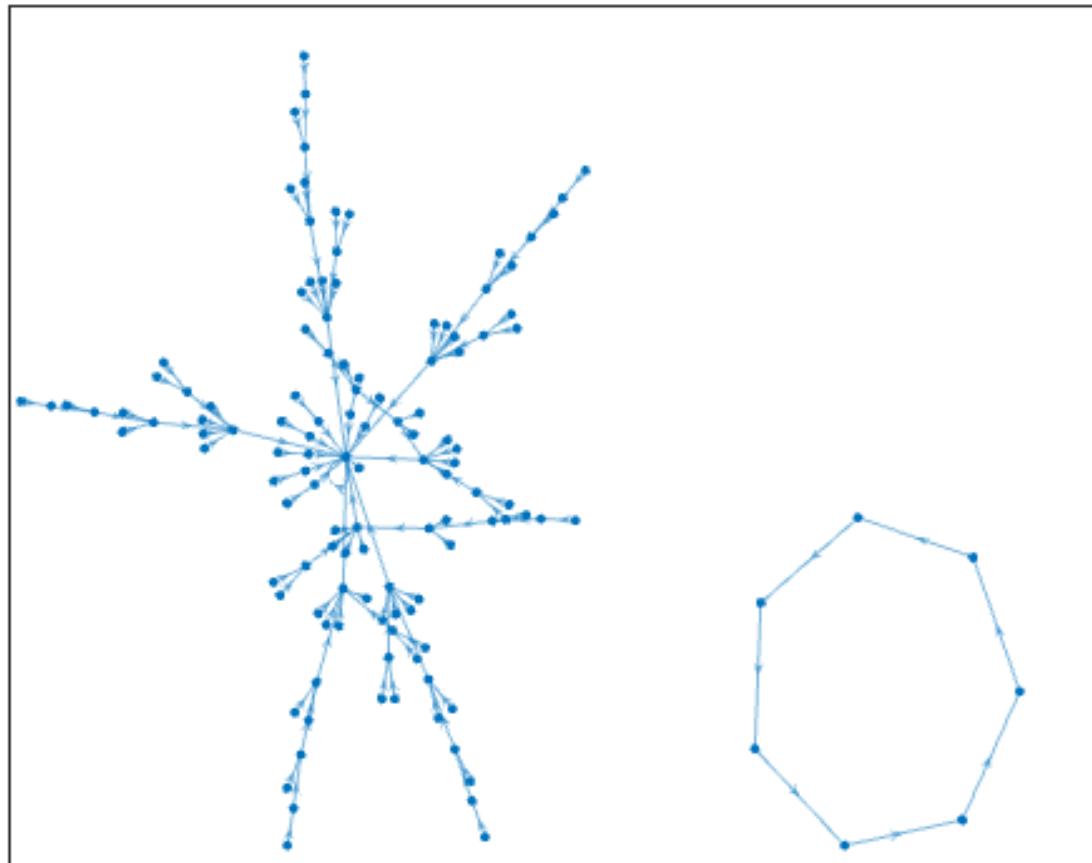


Figura 3.466: Atractor regla 40 n=7

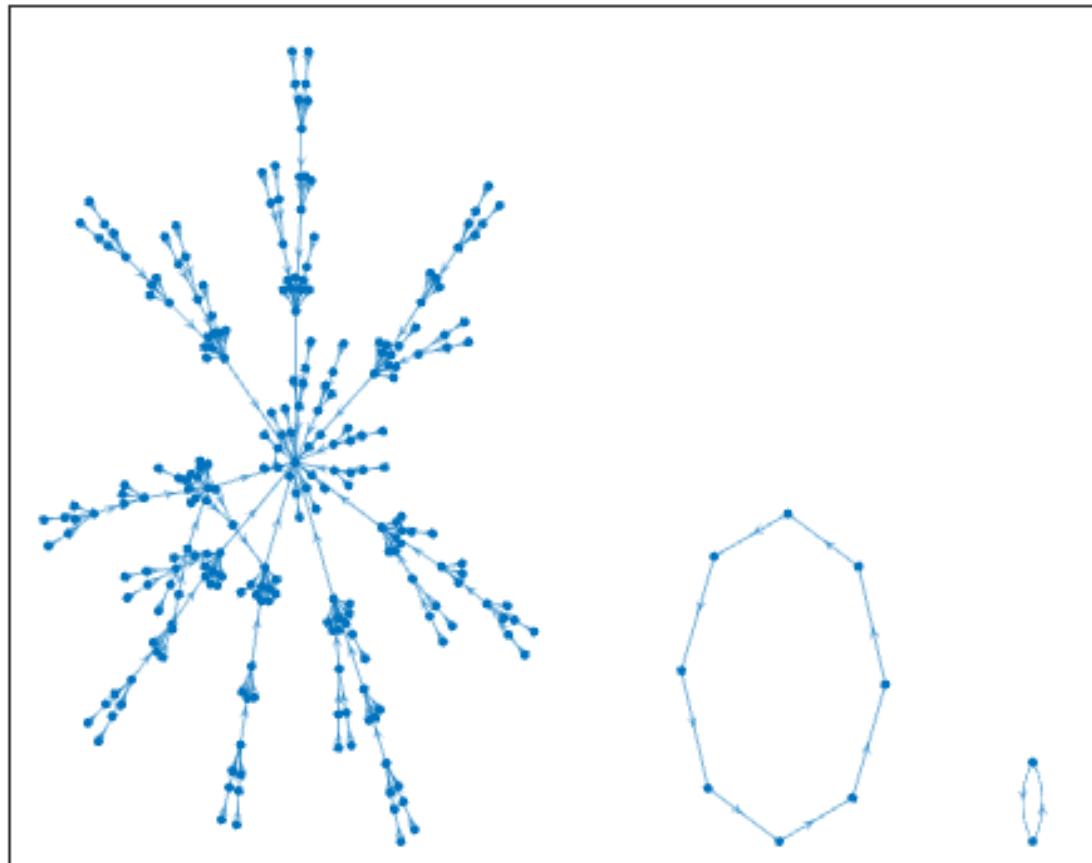
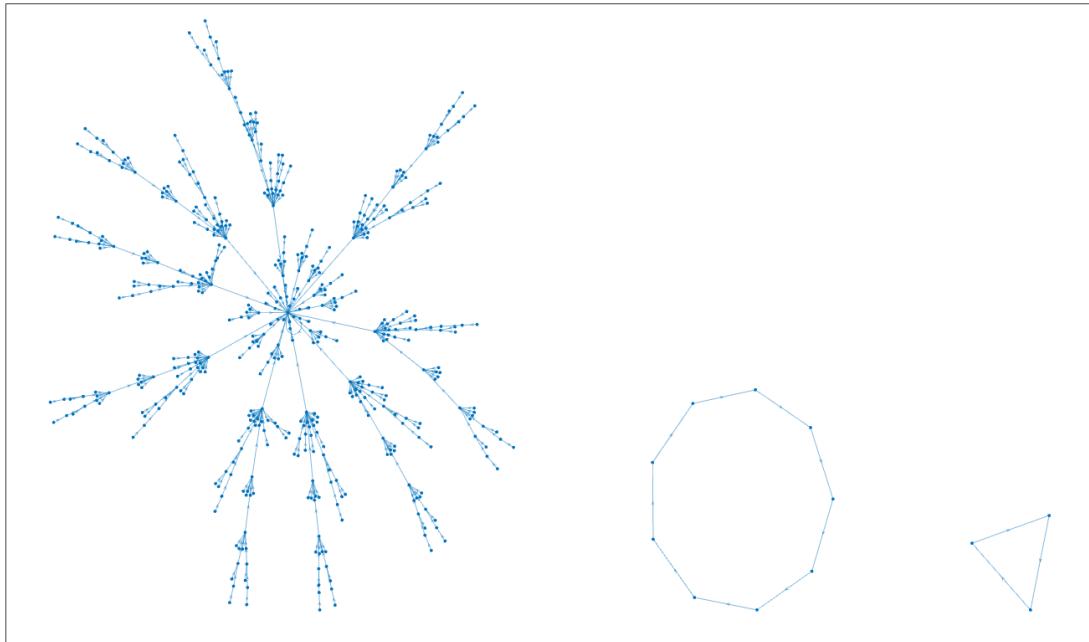
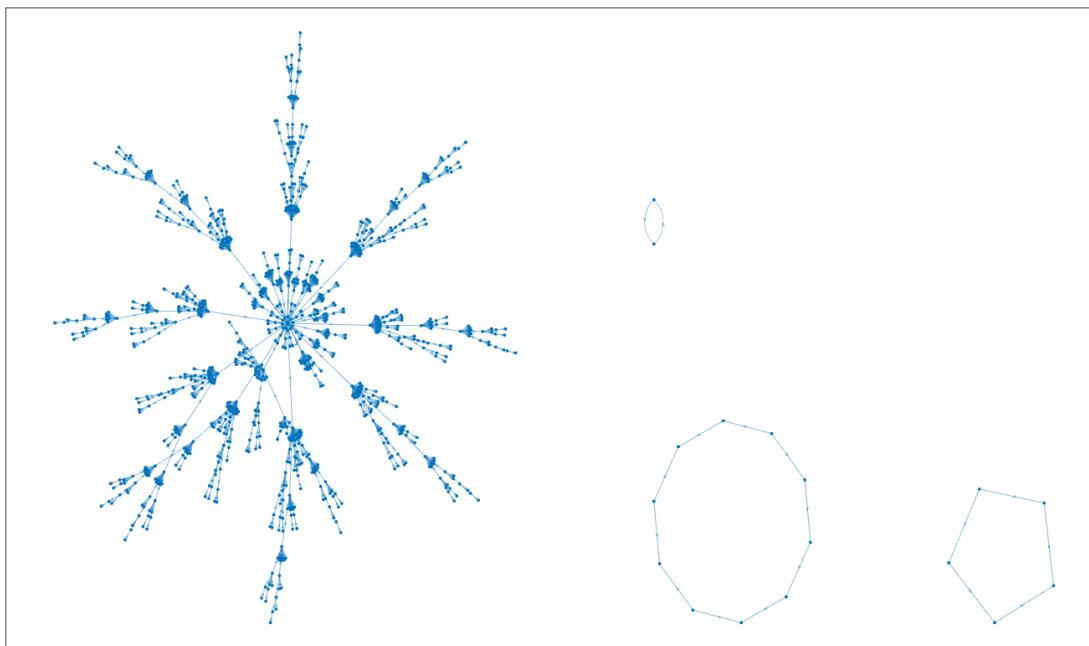


Figura 3.467: Atractor regla 40 n=8

Figura 3.468: Atractor regla 40 $n=9$ Figura 3.469: Atractor regla 40 $n=10$

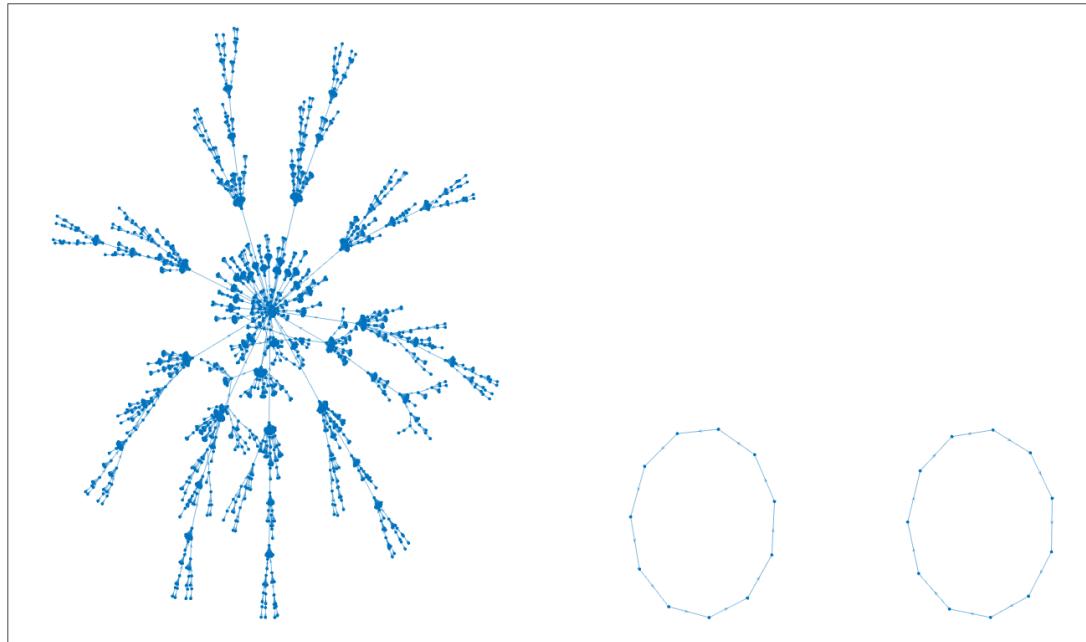


Figura 3.470: Atractor regla 40 n=11

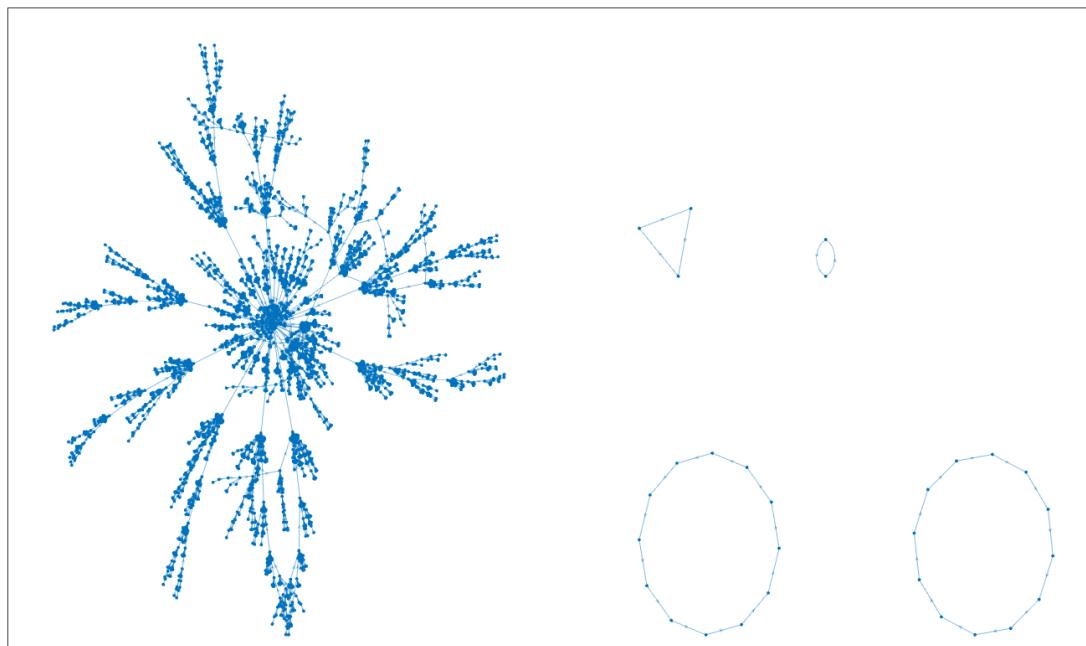


Figura 3.471: Atractor regla 40 n=12

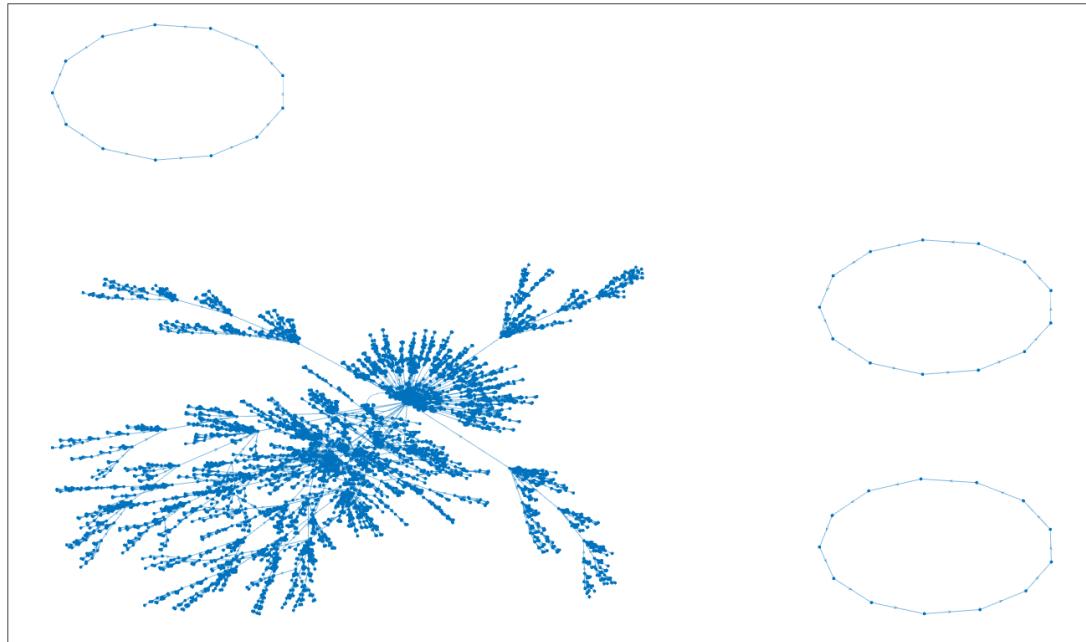


Figura 3.472: Atractor regla 40 n=13

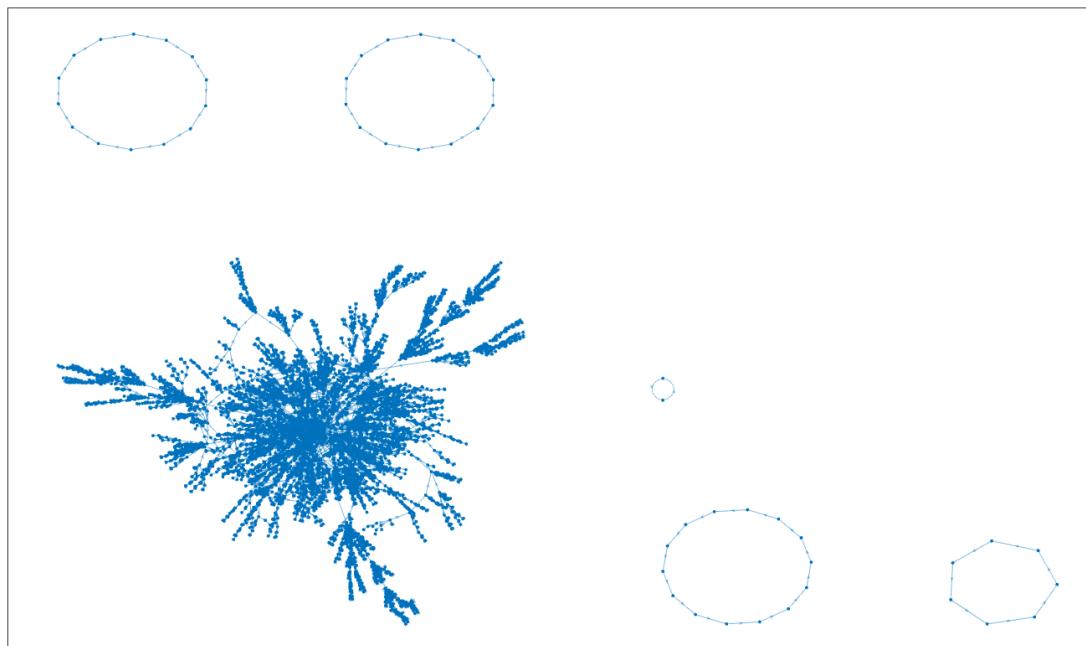


Figura 3.473: Atractor regla 40 n=14

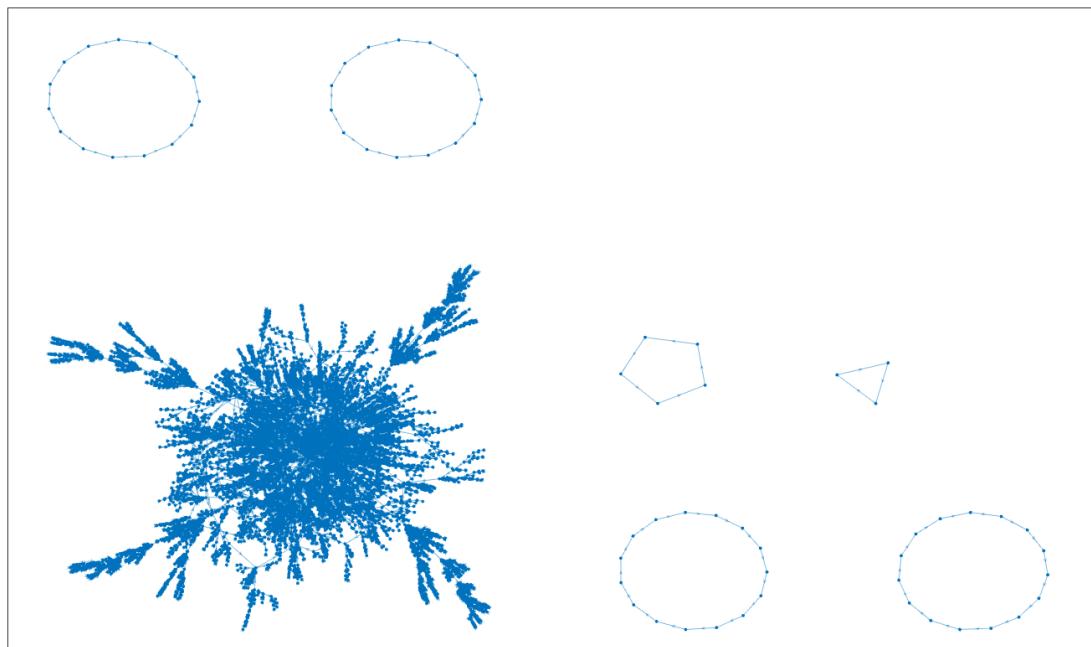


Figura 3.474: Atractor regla 40 n=15

3.36. Reglas 41,97,107,121

Respecto a la regla 41 se aprecia que mientras más grande es el tamaño de la cadena (n) surgen atractores que en un punto se fragmentan pero en n mayores a 11 surgen atractores que por su forma asemejan a una ramita de pirul.

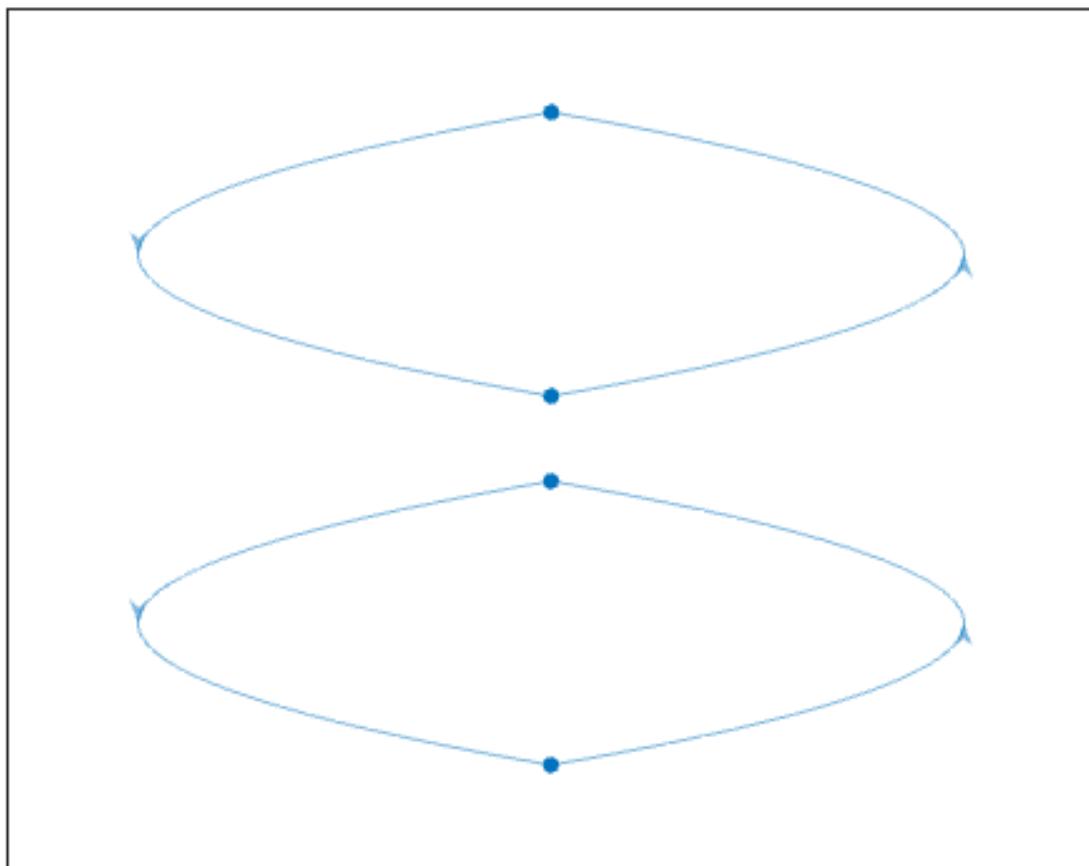


Figura 3.475: Atractor regla 41 $n=2$

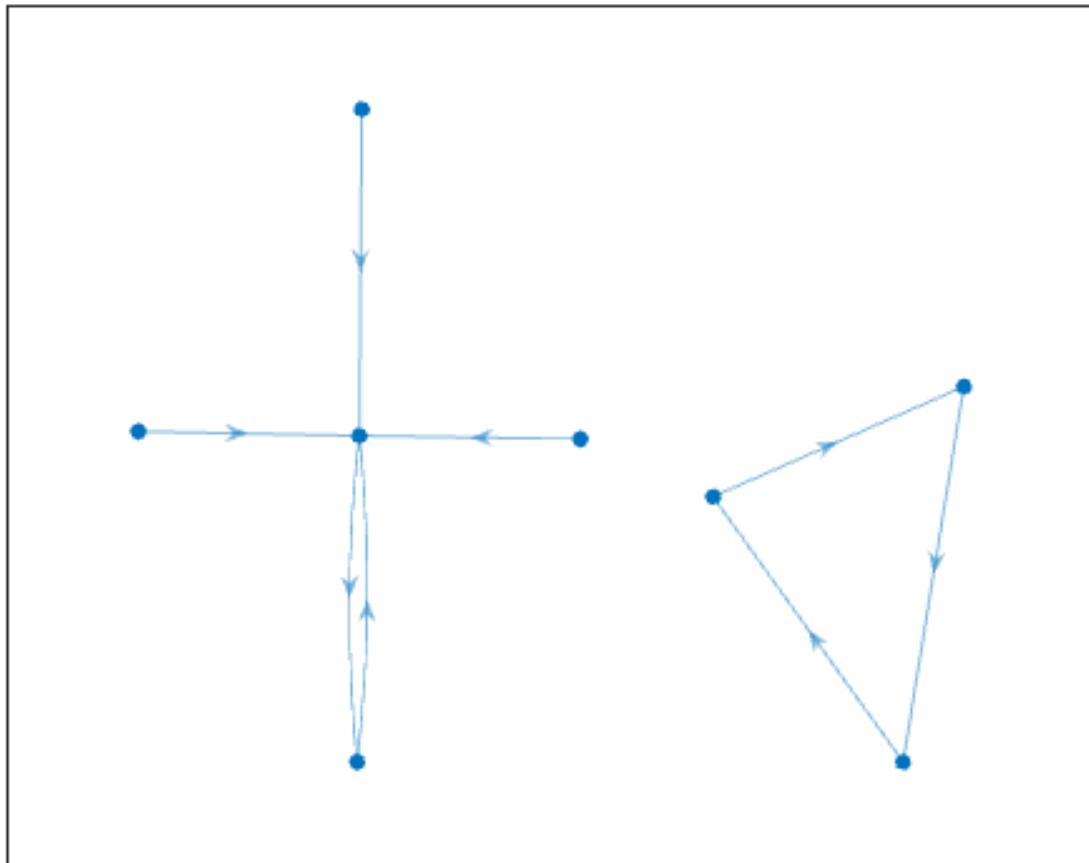


Figura 3.476: Atractor regla 41 n=3

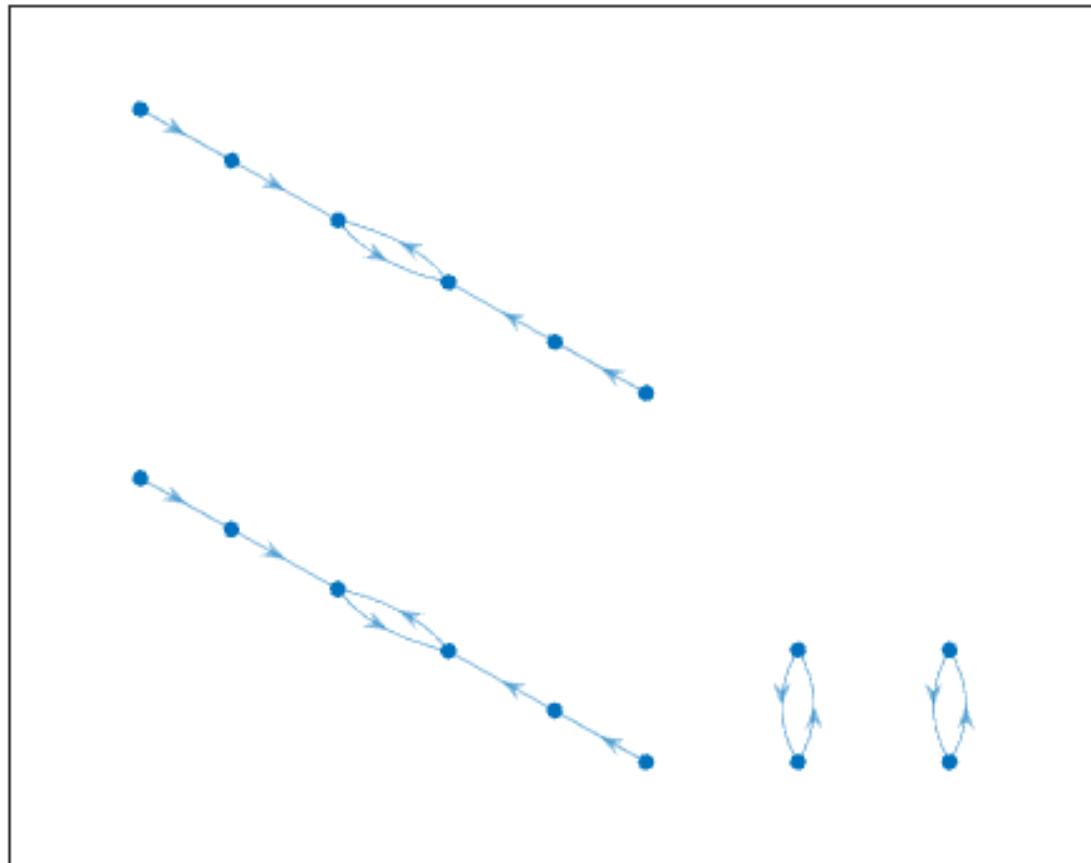


Figura 3.477: Atractor regla 41 n=4

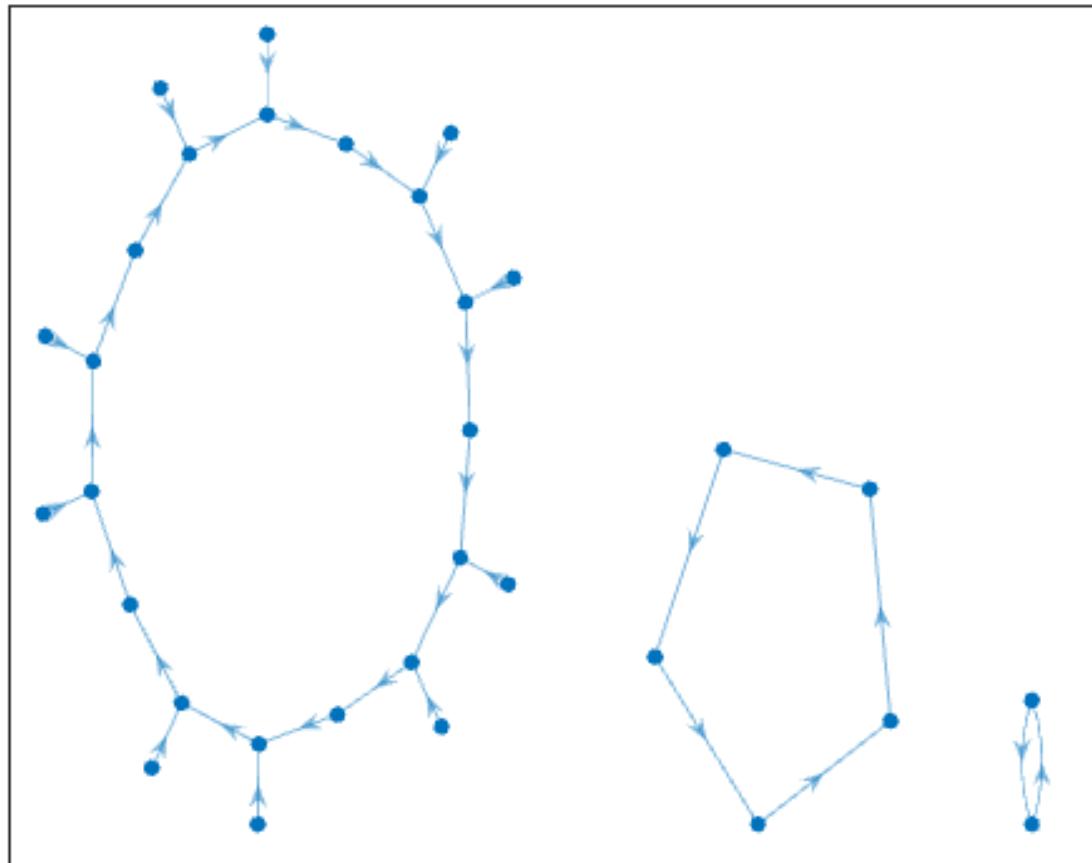


Figura 3.478: Atractor regla 41 n=5

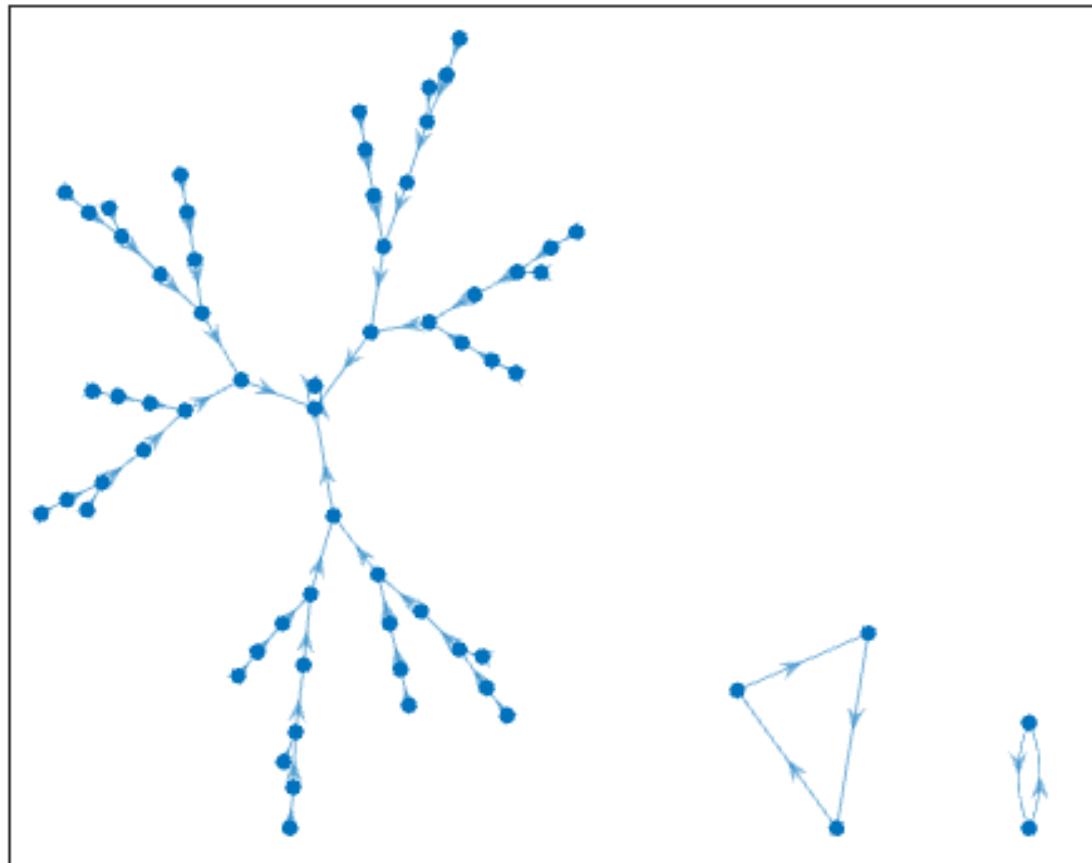


Figura 3.479: Atractor regla 41 n=6

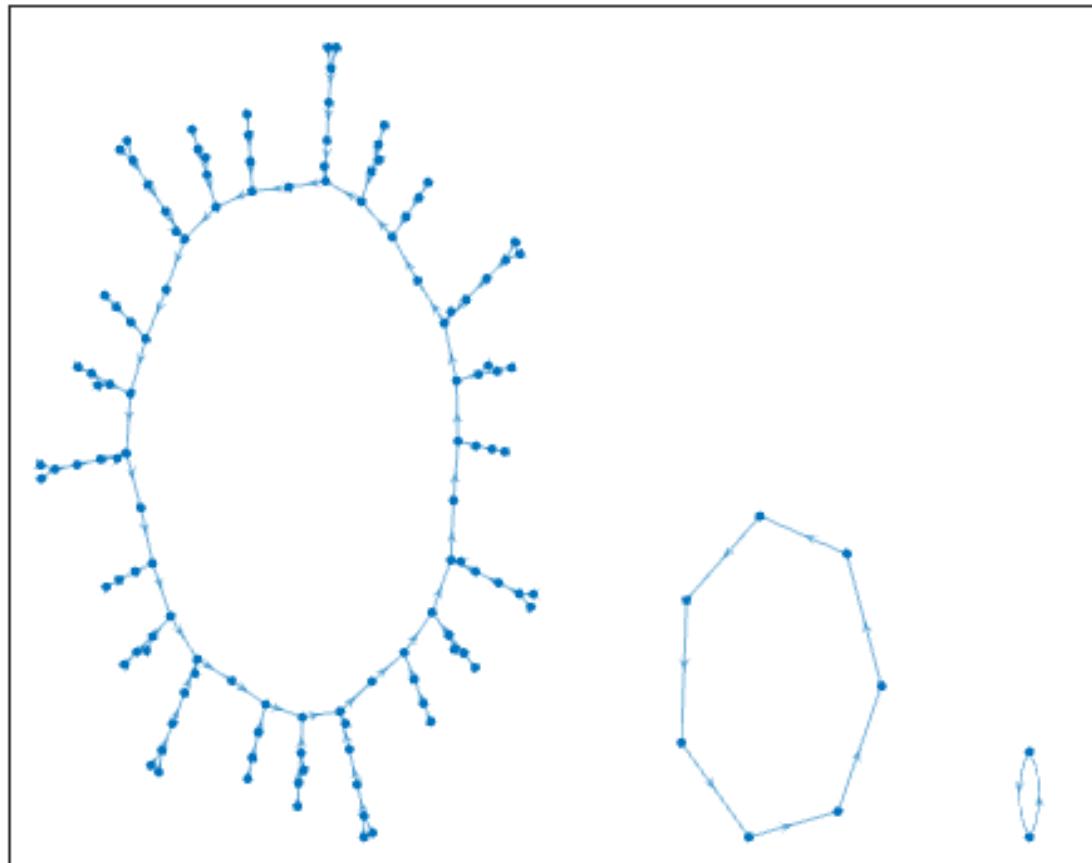


Figura 3.480: Atractor regla 41 n=7

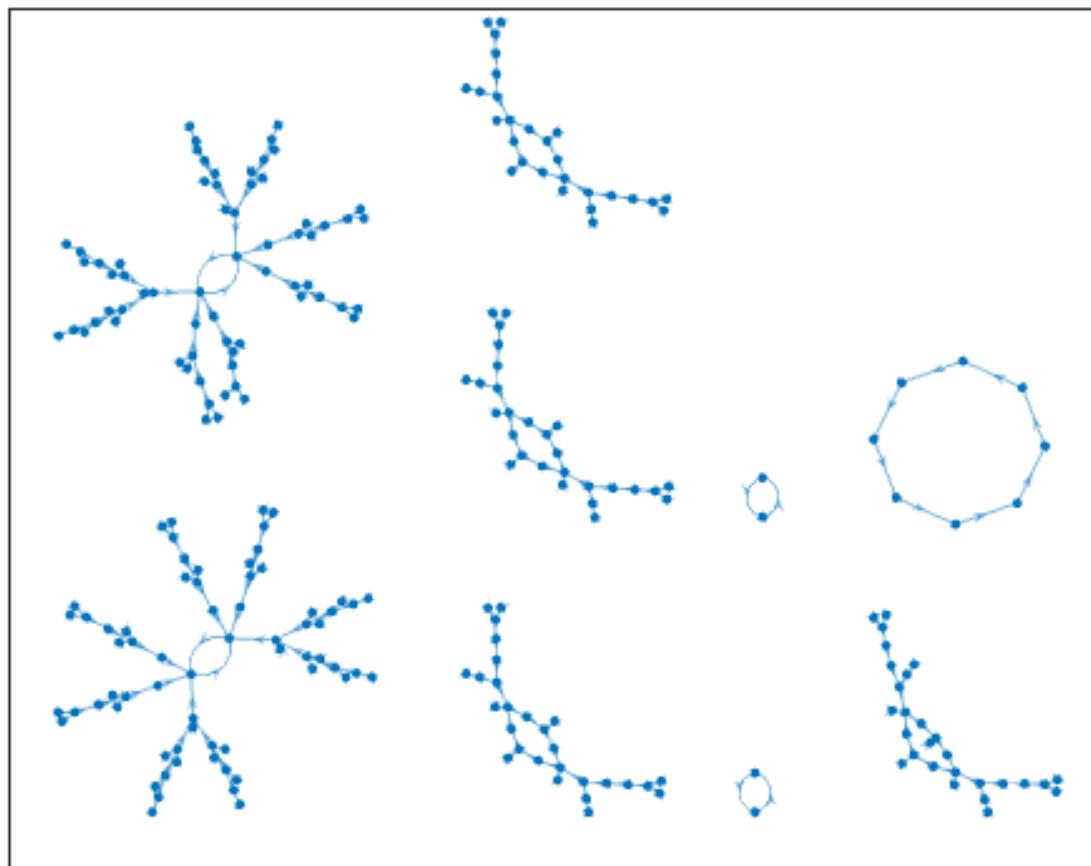
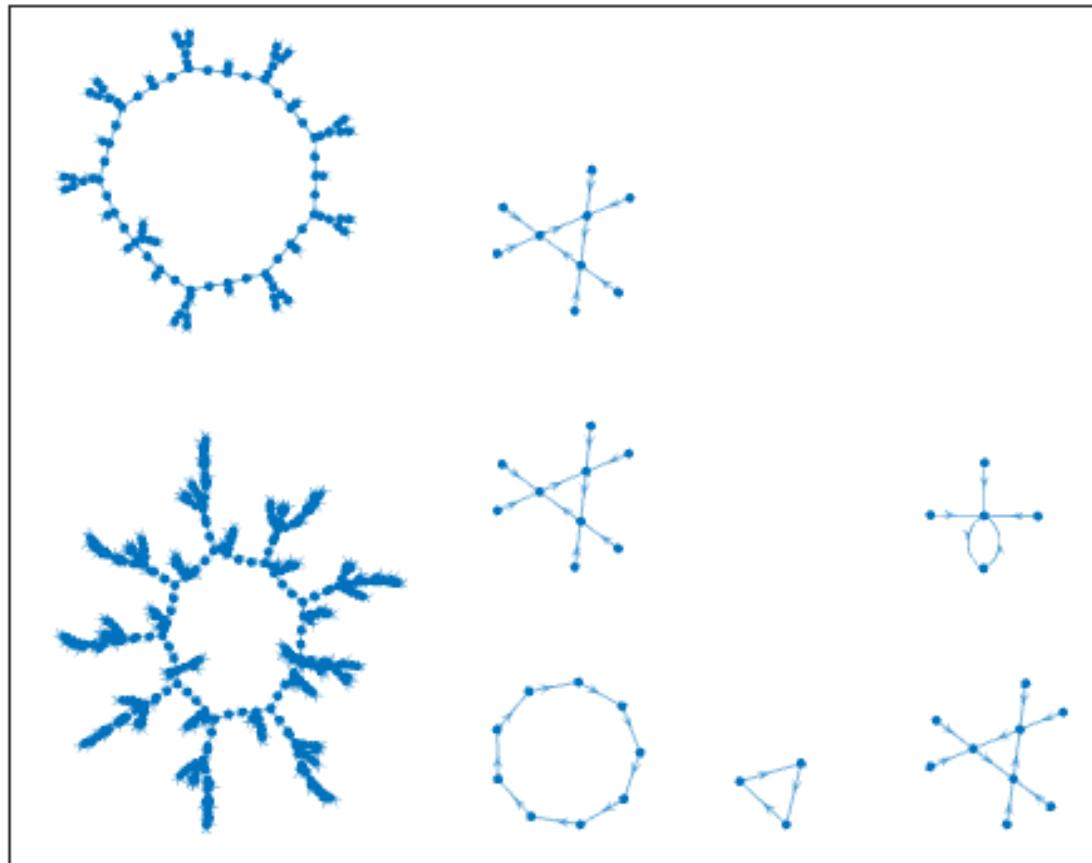


Figura 3.481: Atractor regla 41 n=8

Figura 3.482: Atractor regla 41 $n=9$

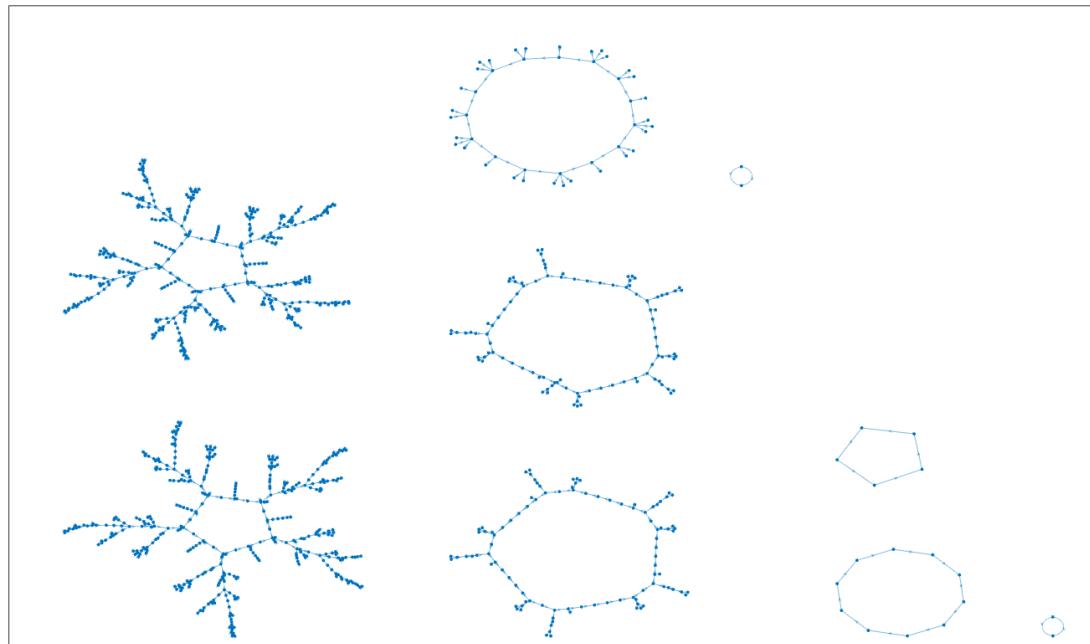


Figura 3.483: Atractor regla 41 n=10

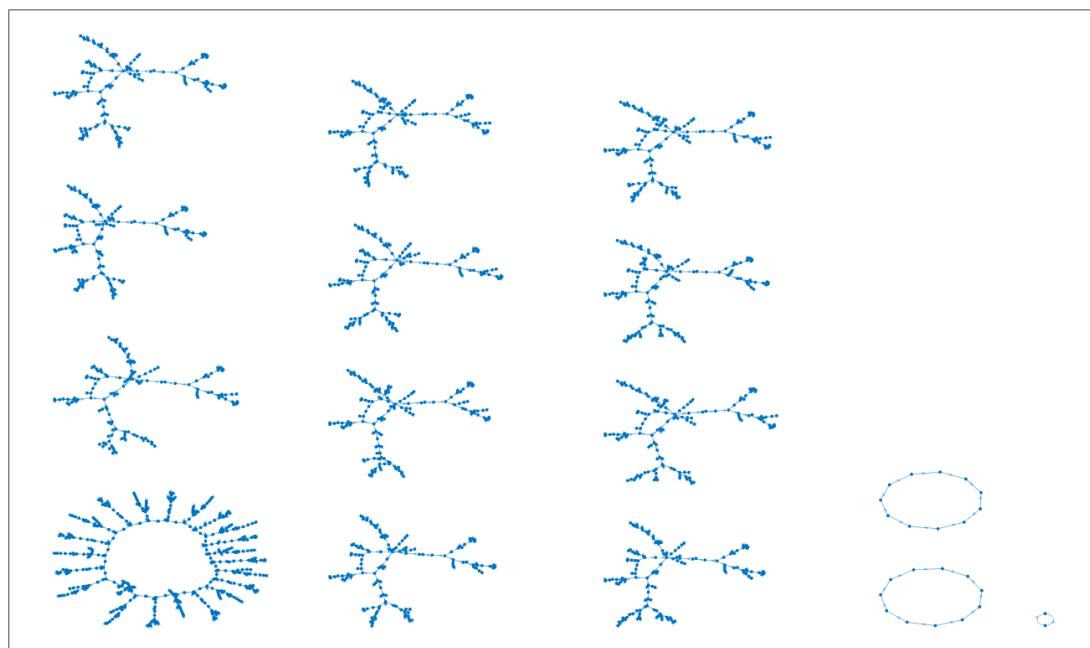


Figura 3.484: Atractor regla 41 n=11

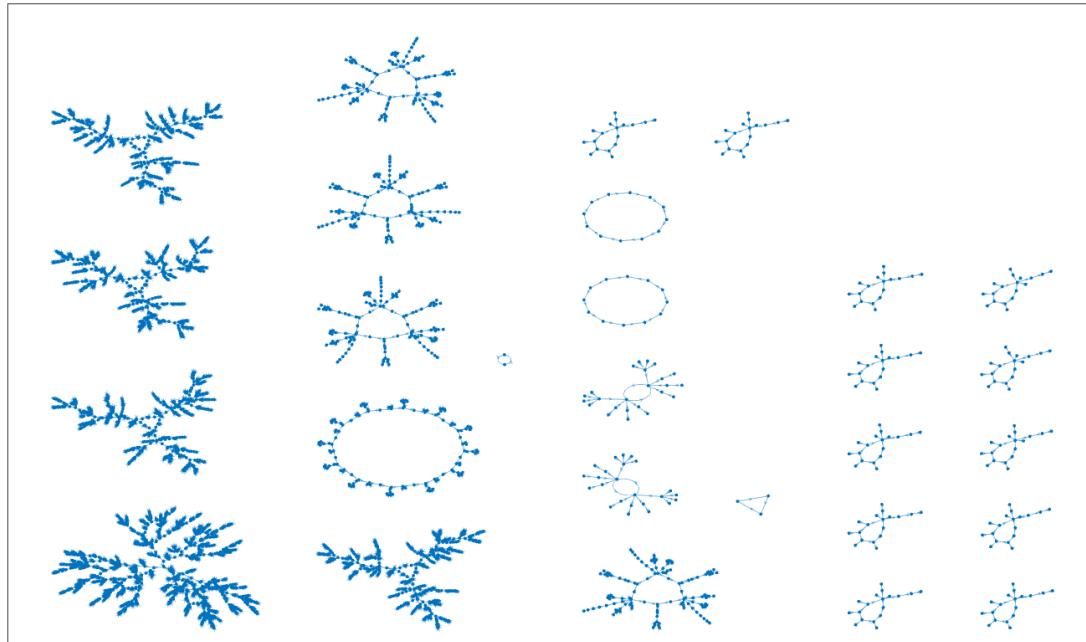


Figura 3.485: Atractor regla 41 n=12

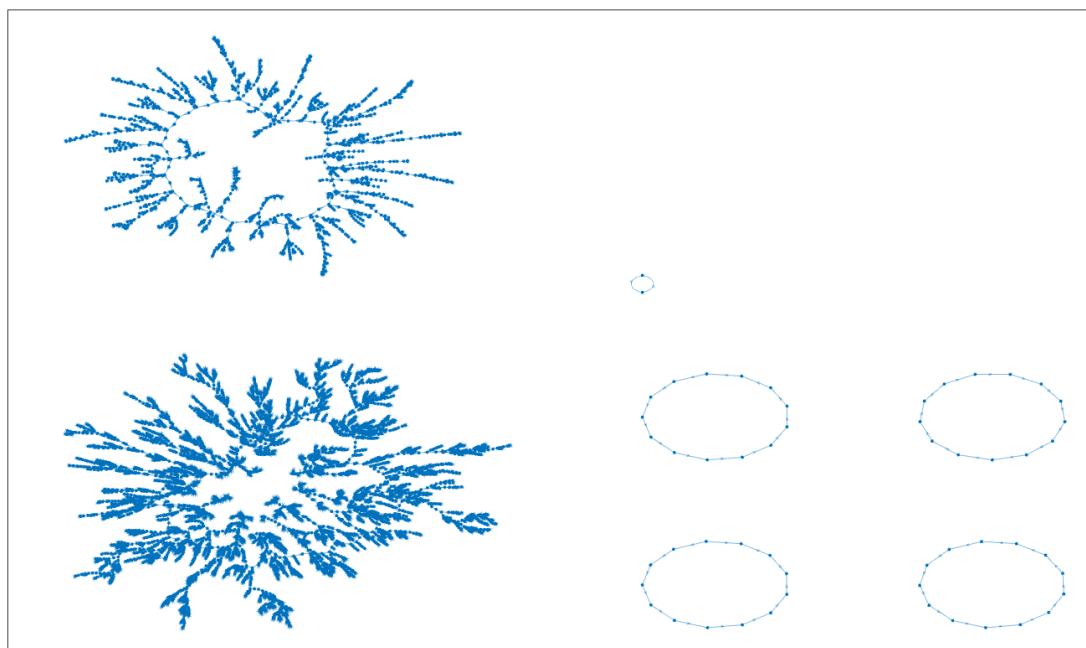


Figura 3.486: Atractor regla 41 n=13

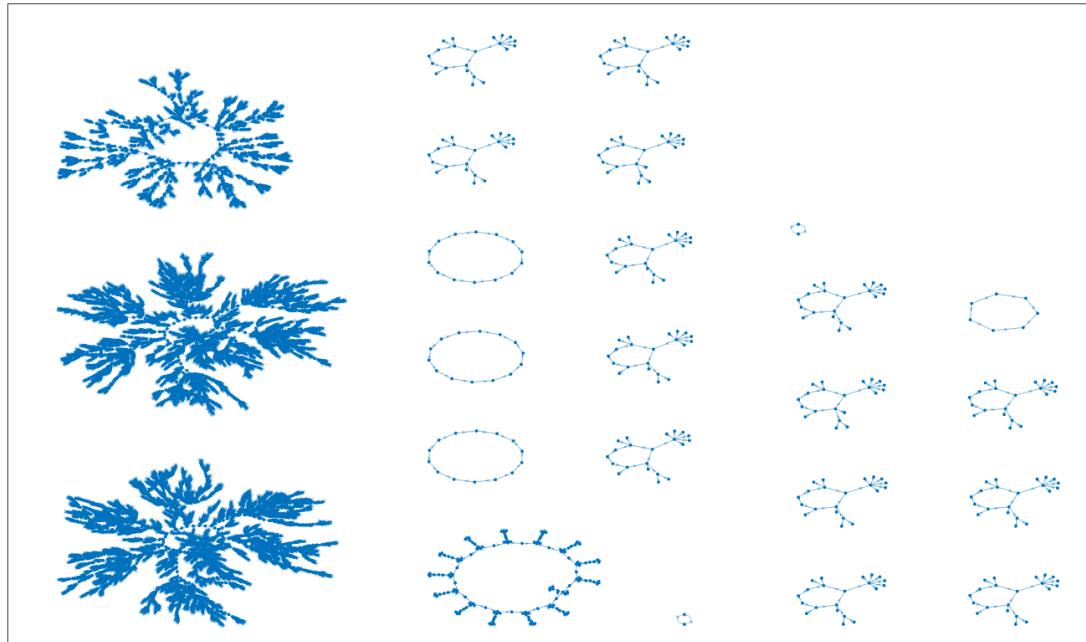


Figura 3.487: Atractor regla 41 n=14

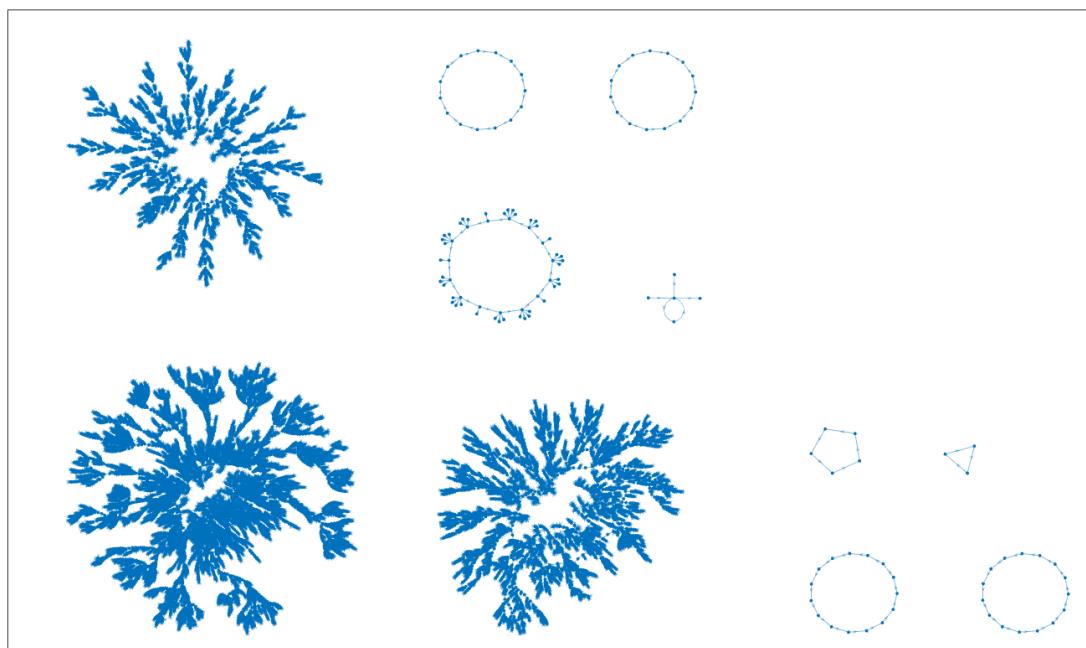


Figura 3.488: Atractor regla 41 n=15

3.37. Reglas 42,112,171,241

Respecto a la regla 42 se aprecia que mientras más grande es el tamaño de la cadena (n) la mayoría de los atractores que surgieron empiezan a tomar formas de circulo siguiendo las evoluciones de sus predecesores (los que están más abajo y a la izquierda de ellos).

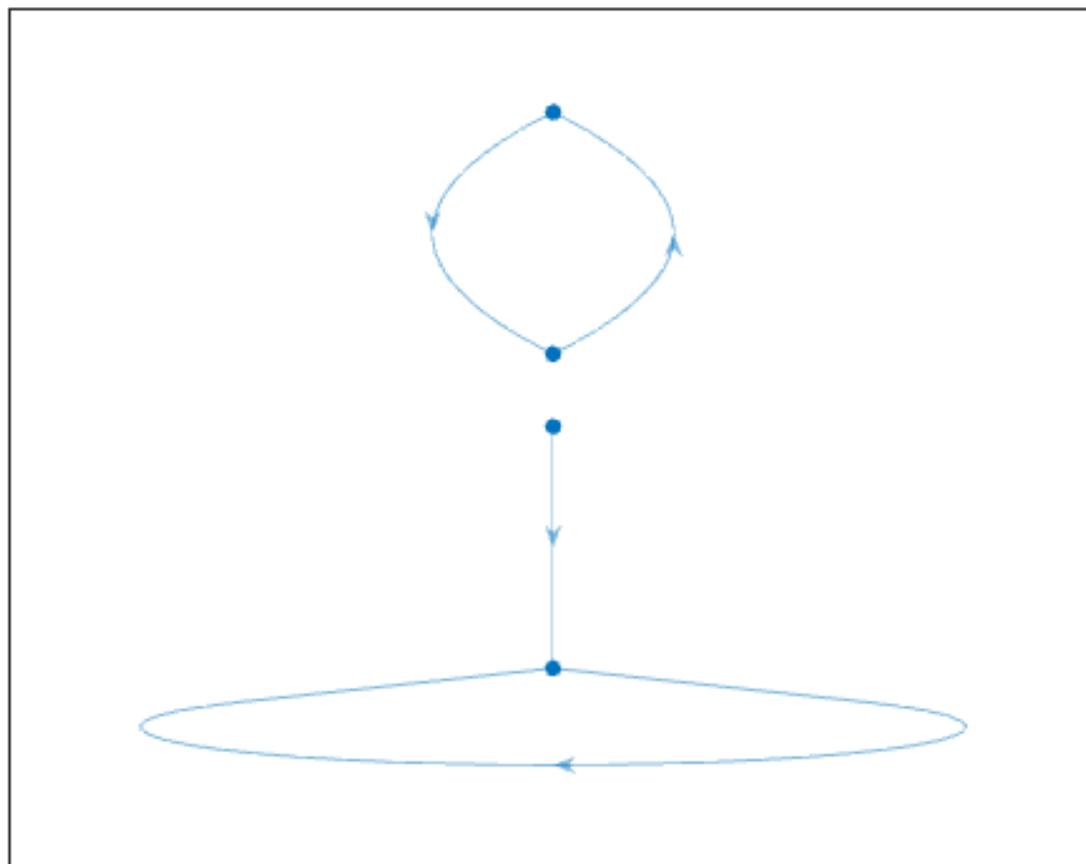


Figura 3.489: Atractor regla 42 $n=2$

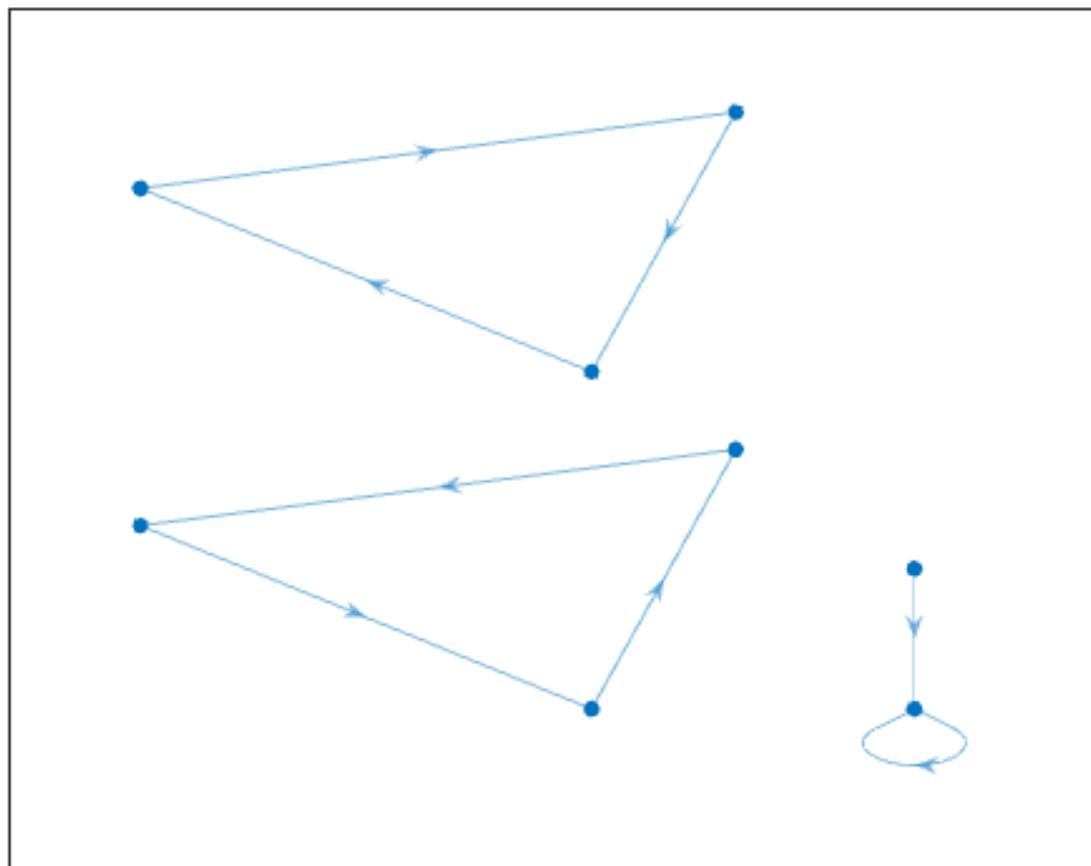
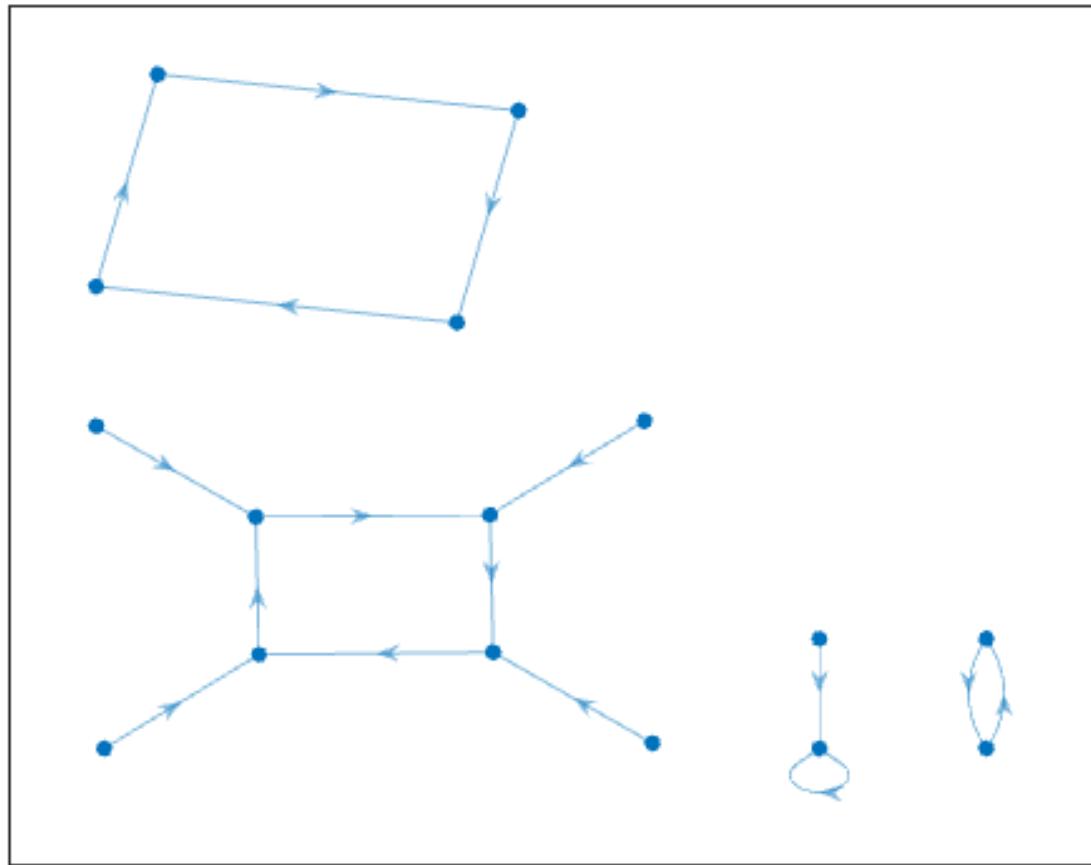
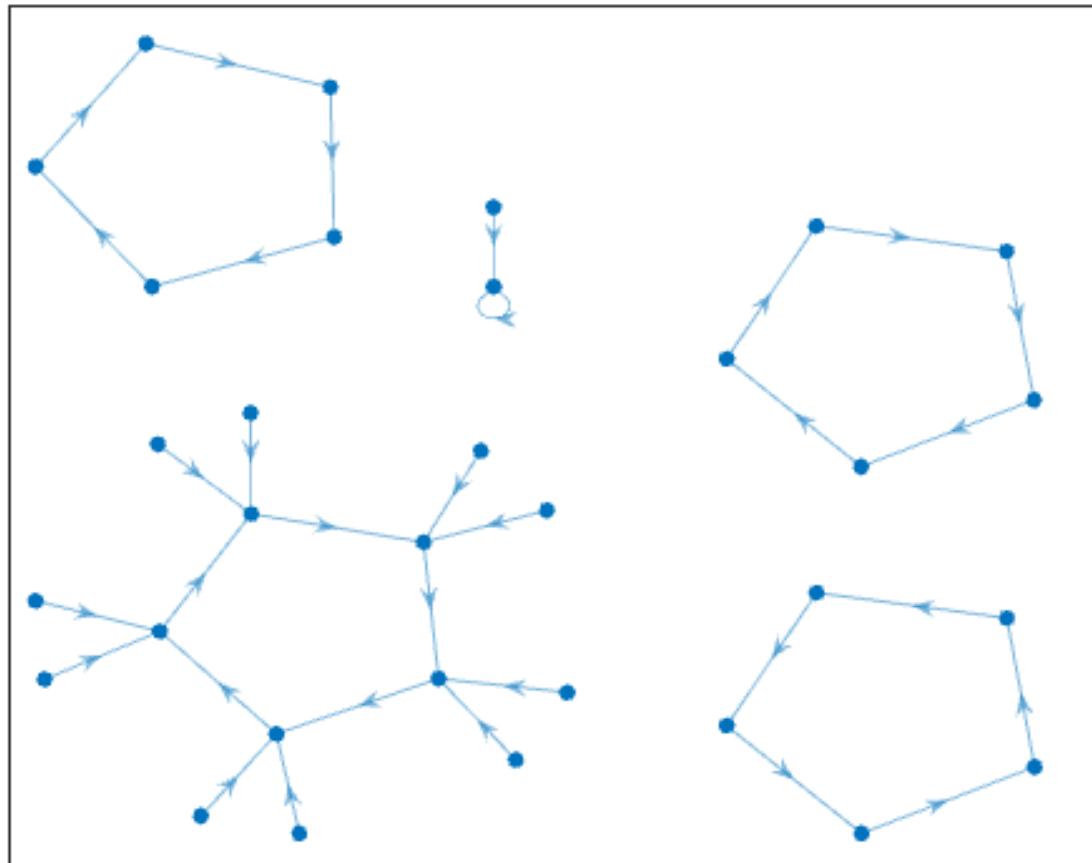


Figura 3.490: Atractor regla 42 n=3

Figura 3.491: Atractor regla 42 $n=4$

Figura 3.492: Atractor regla 42 $n=5$

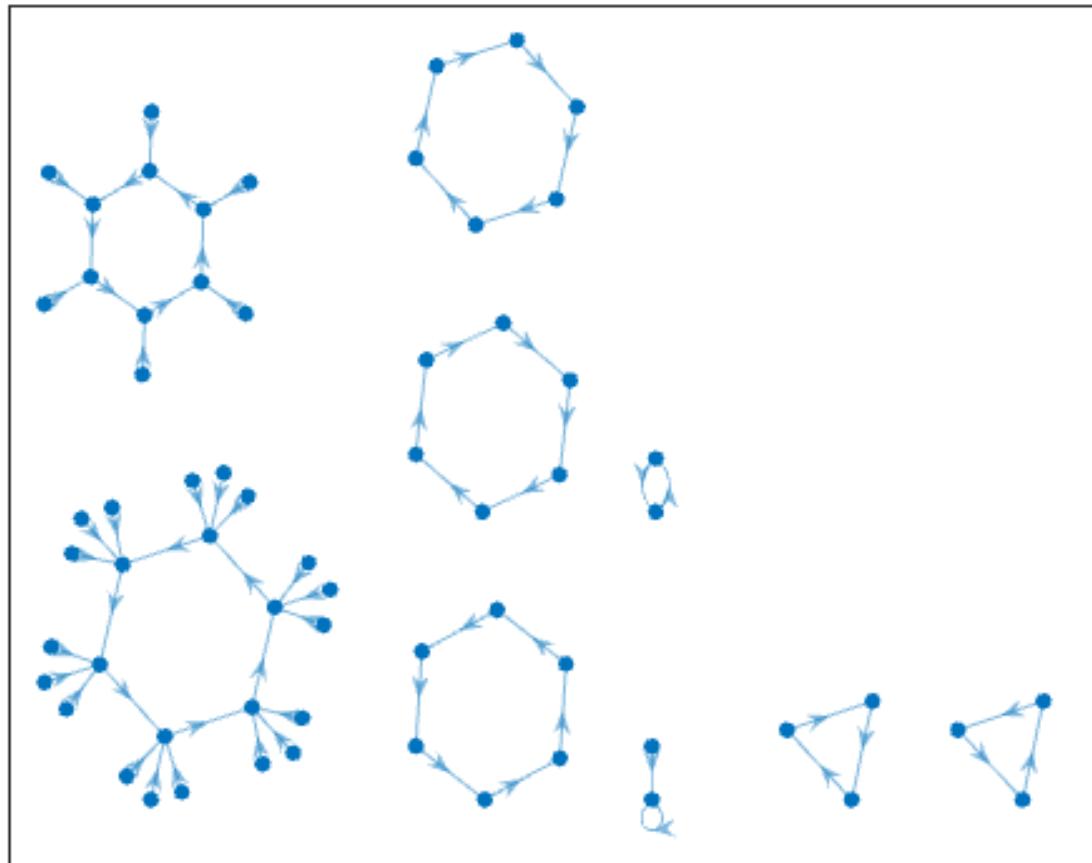


Figura 3.493: Atractor regla 42 n=6

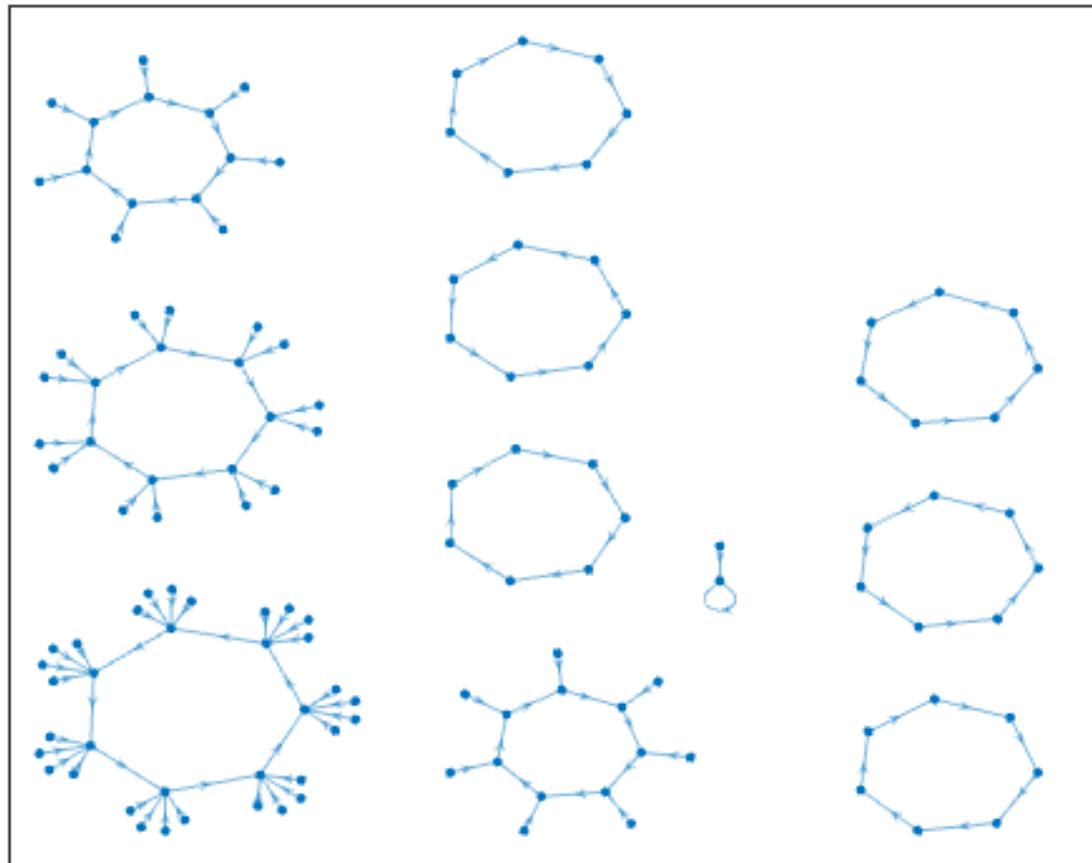


Figura 3.494: Atractor regla 42 n=7

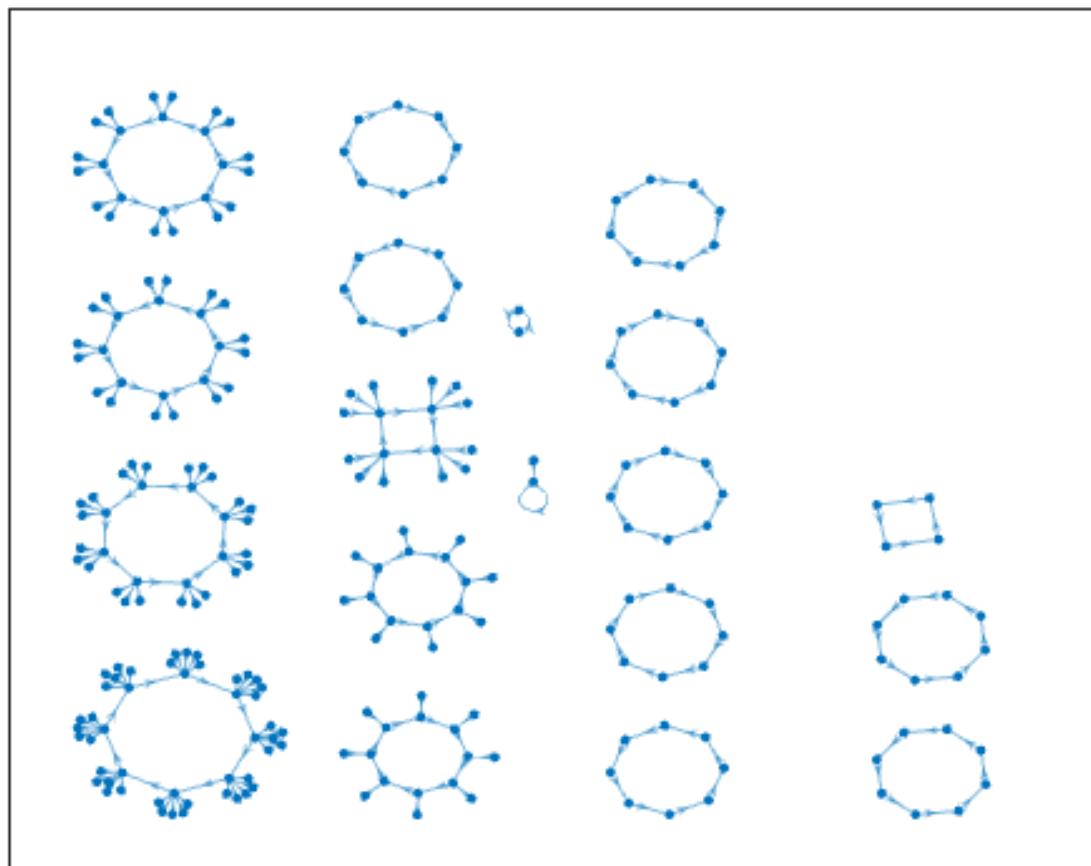


Figura 3.495: Atractor regla 42 n=8

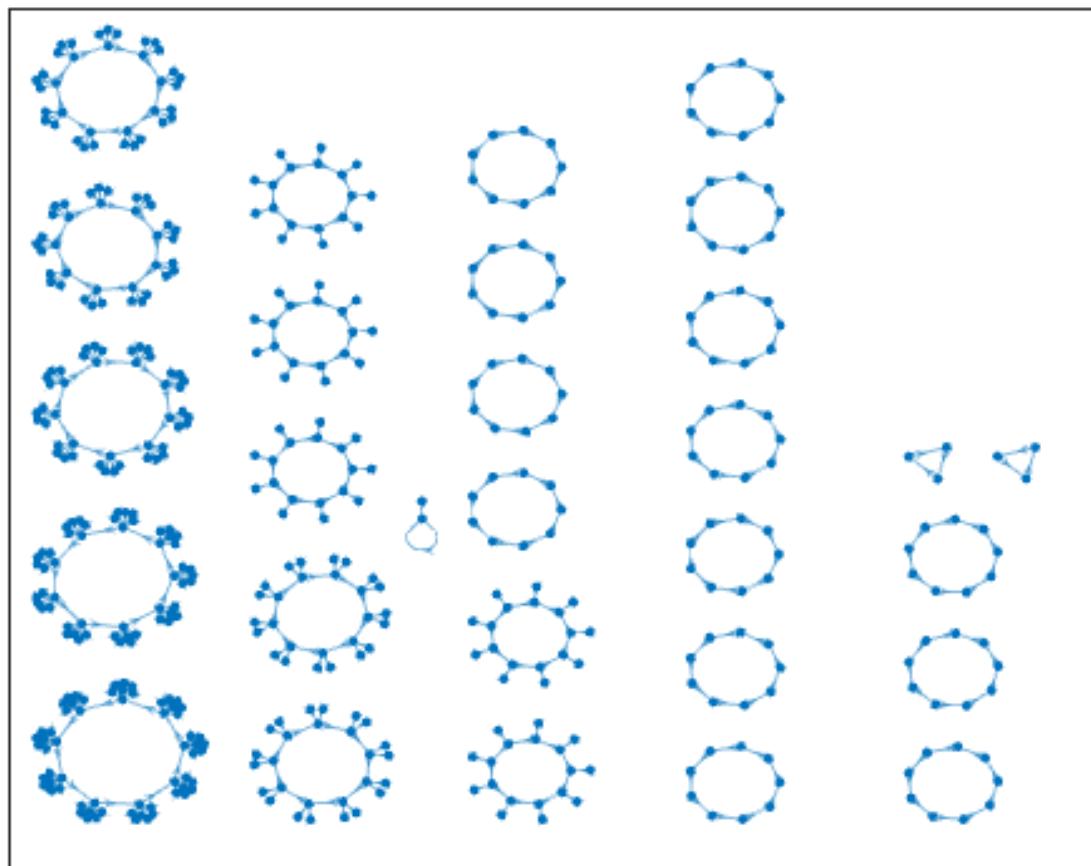


Figura 3.496: Atractor regla 42 n=9

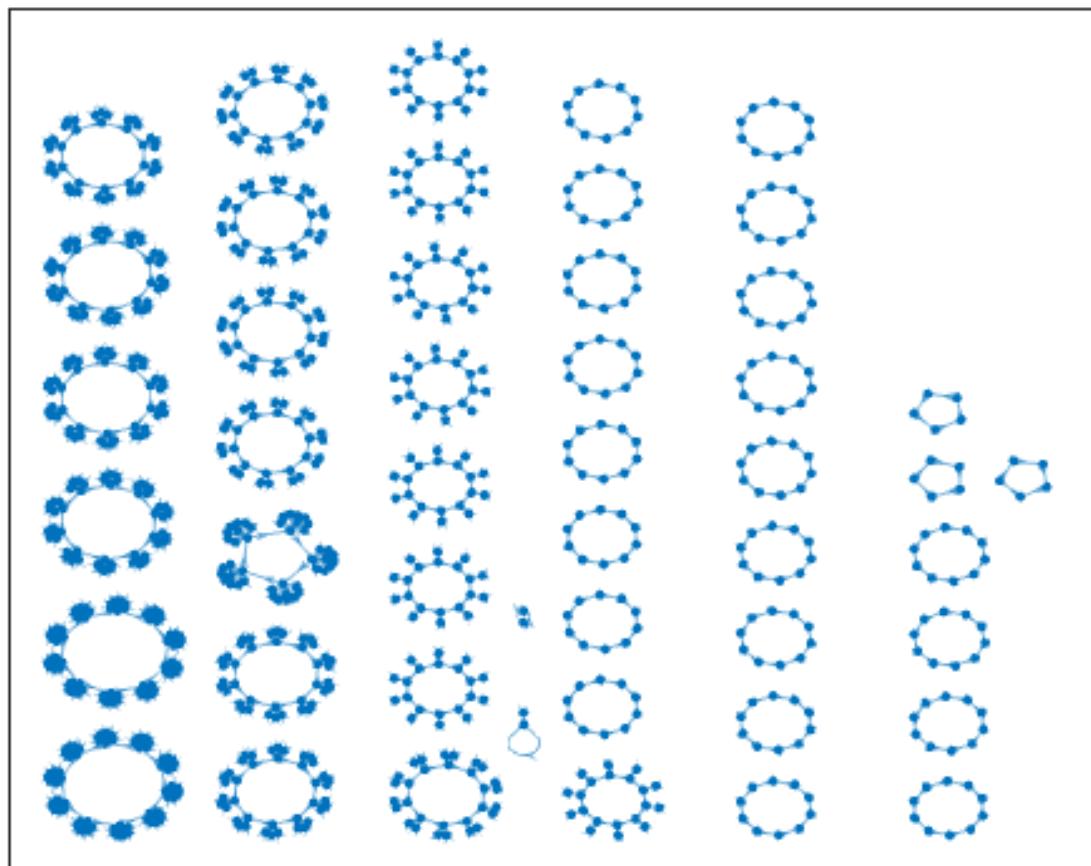


Figura 3.497: Atractor regla 42 n=10

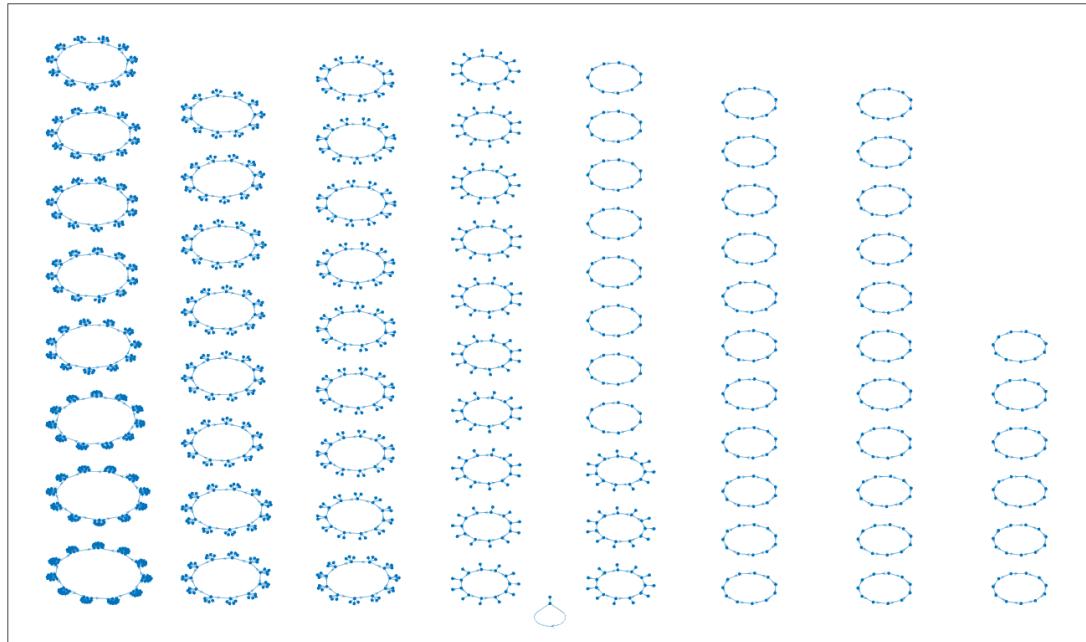


Figura 3.498: Atractor regla 42 n=11

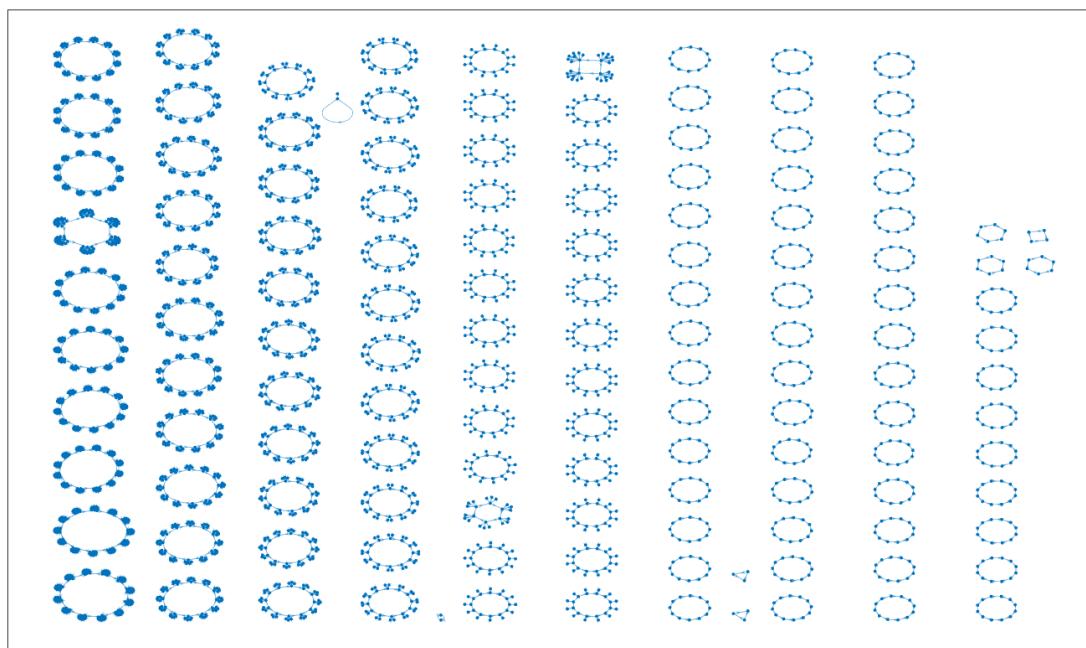


Figura 3.499: Atractor regla 42 n=12

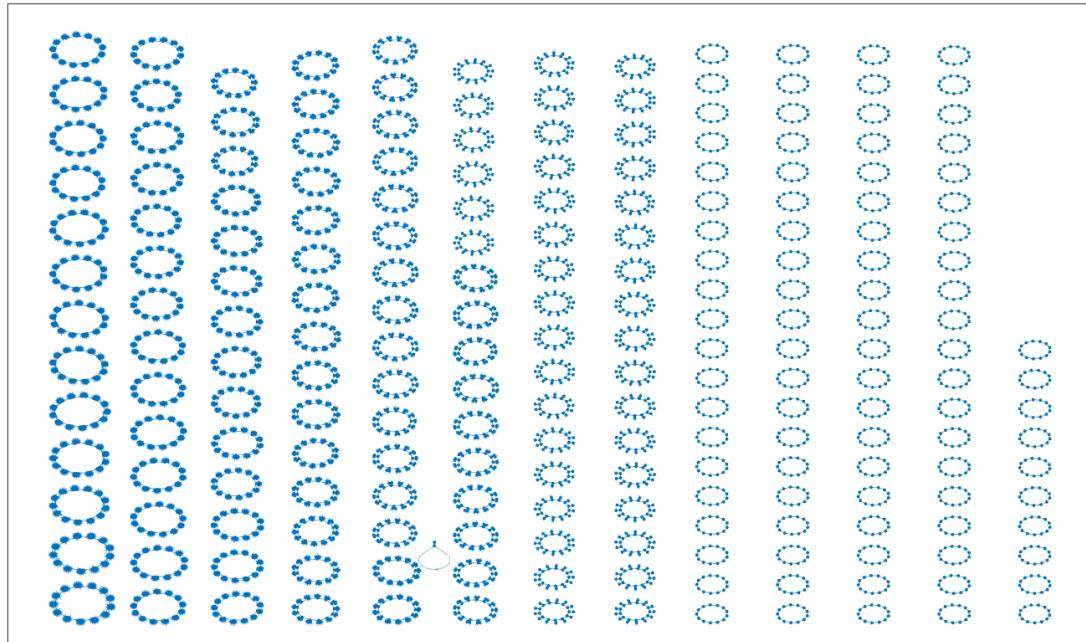


Figura 3.500: Atractor regla 42 n=13

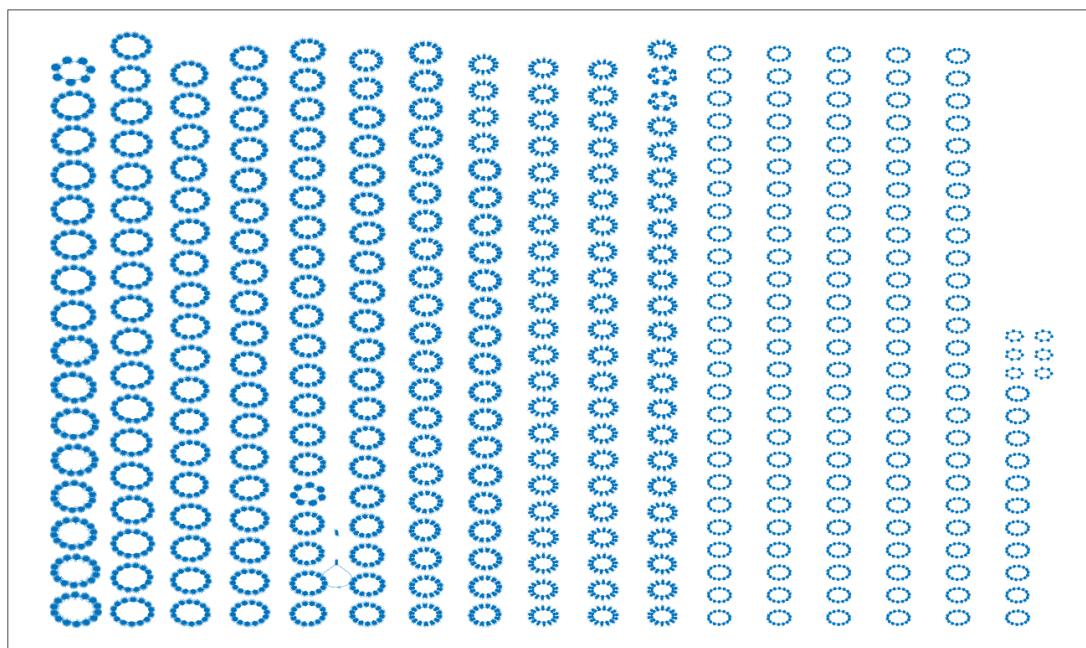


Figura 3.501: Atractor regla 42 n=14

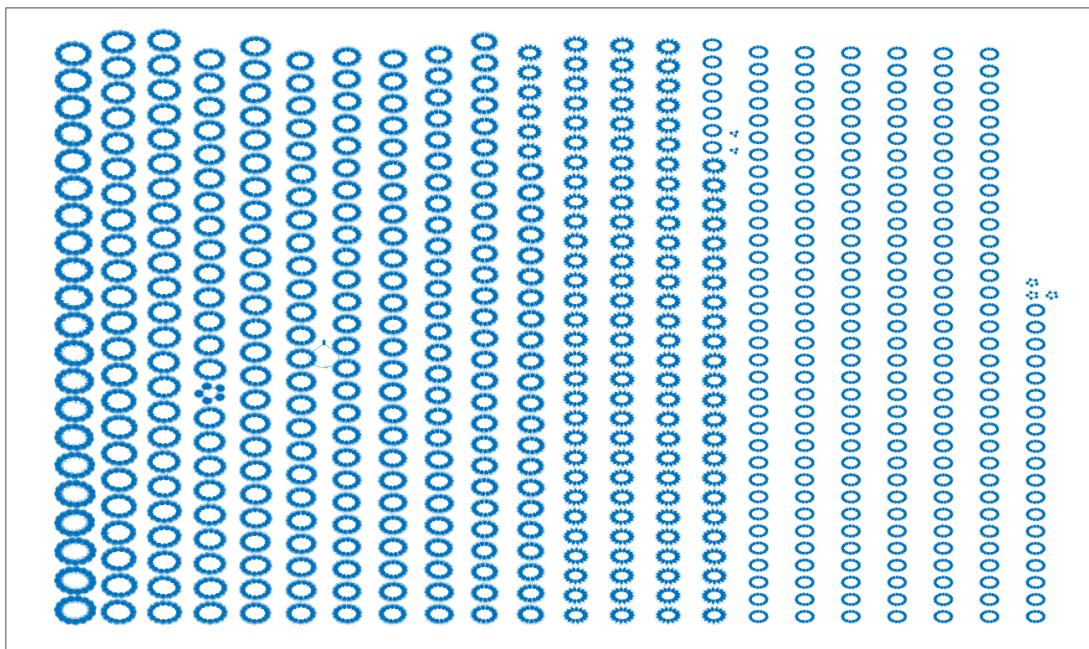


Figura 3.502: Atractor regla 42 n=15

3.38. Reglas 43,113

Respecto a la regla 43 se aprecia que mientras más grande es el tamaño de la cadena (n) al menos en cada imagen aparece una vez un atractor cíclico de 2 nodos.

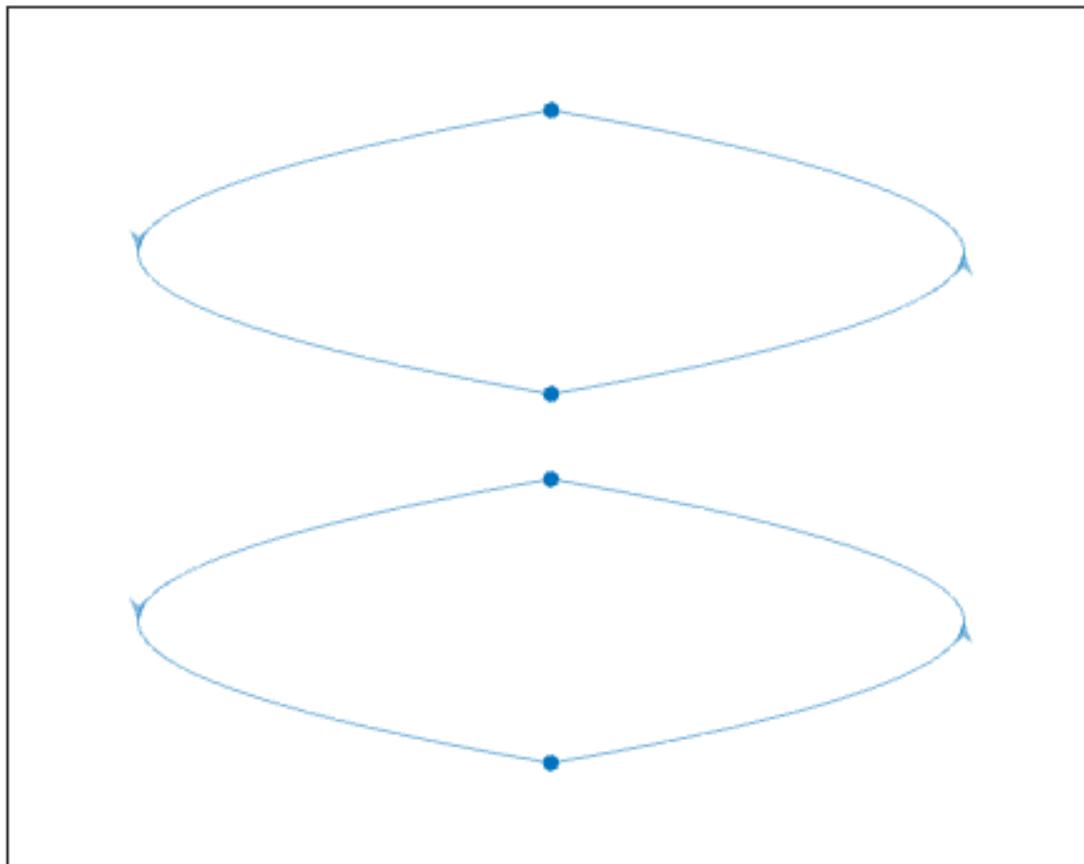


Figura 3.503: Atractor regla 43 $n=2$

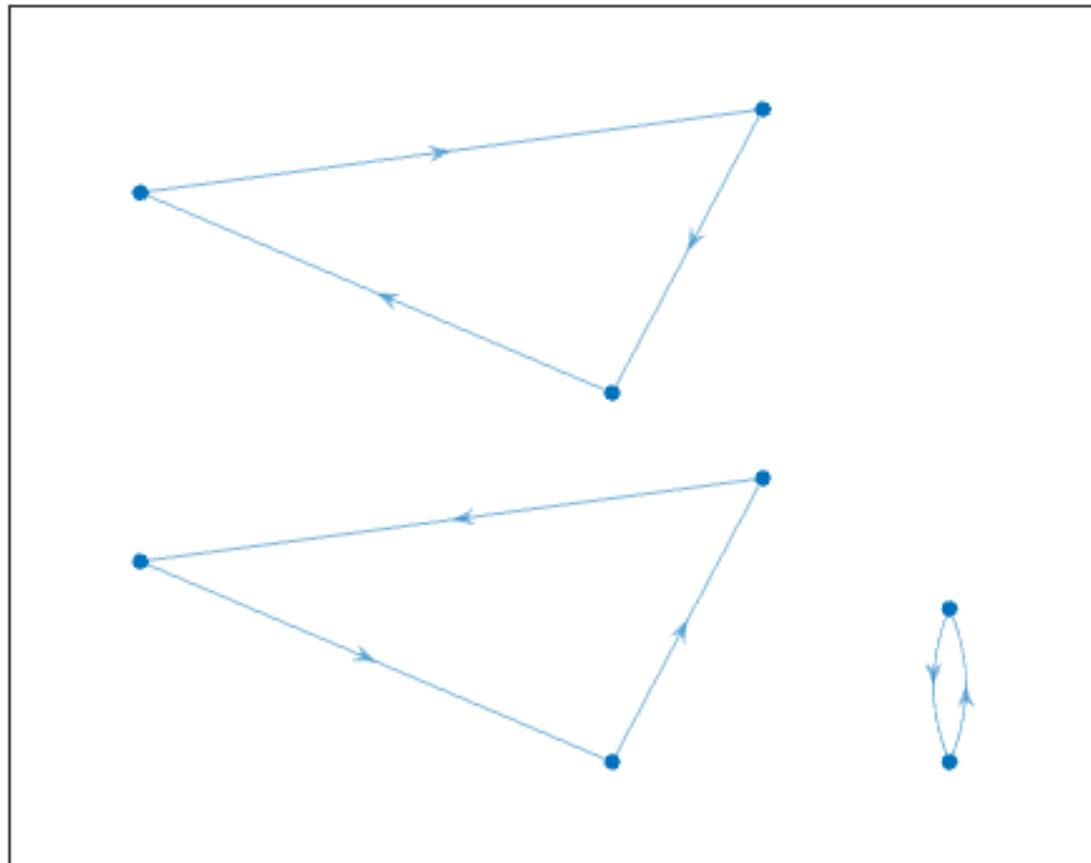


Figura 3.504: Atractor regla 43 n=3

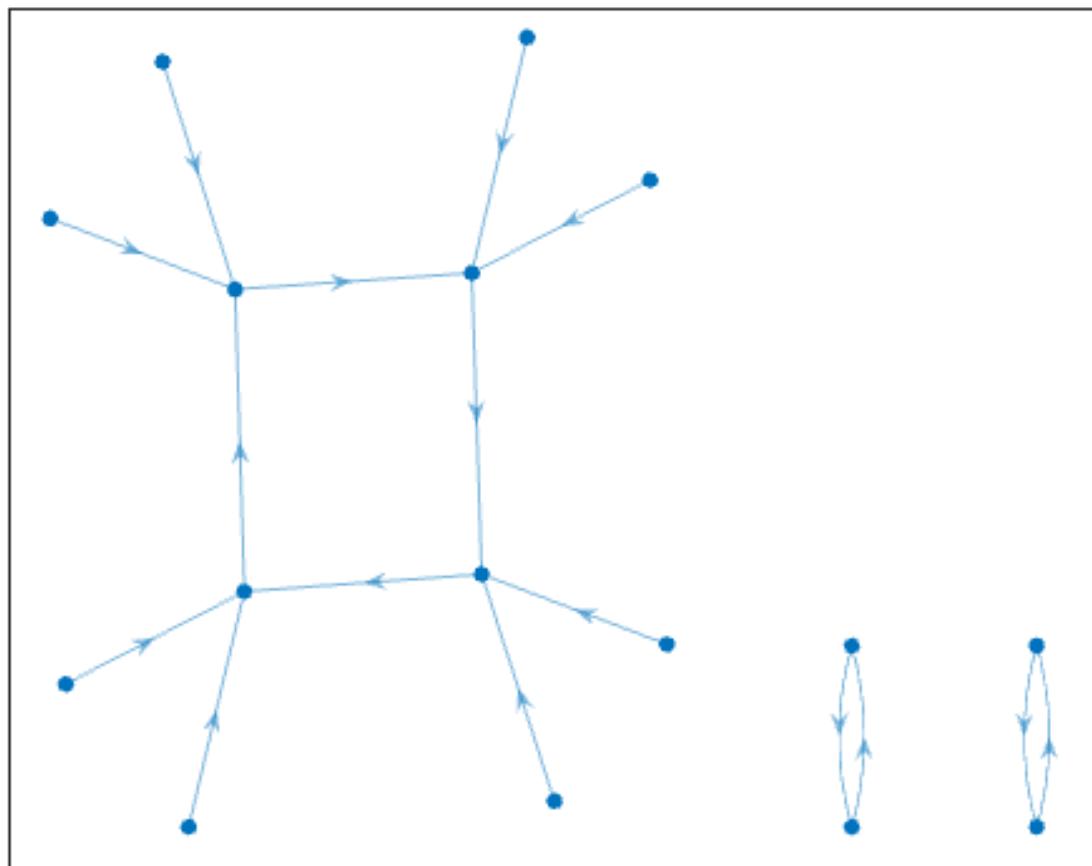
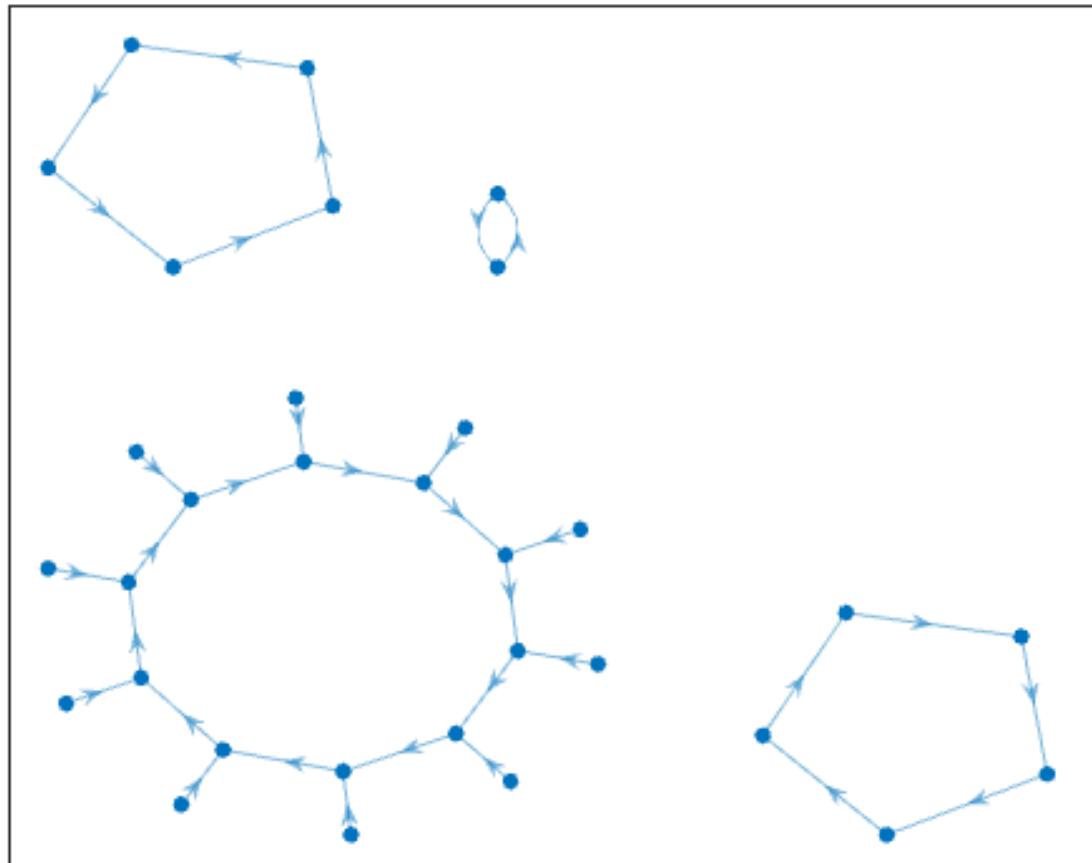
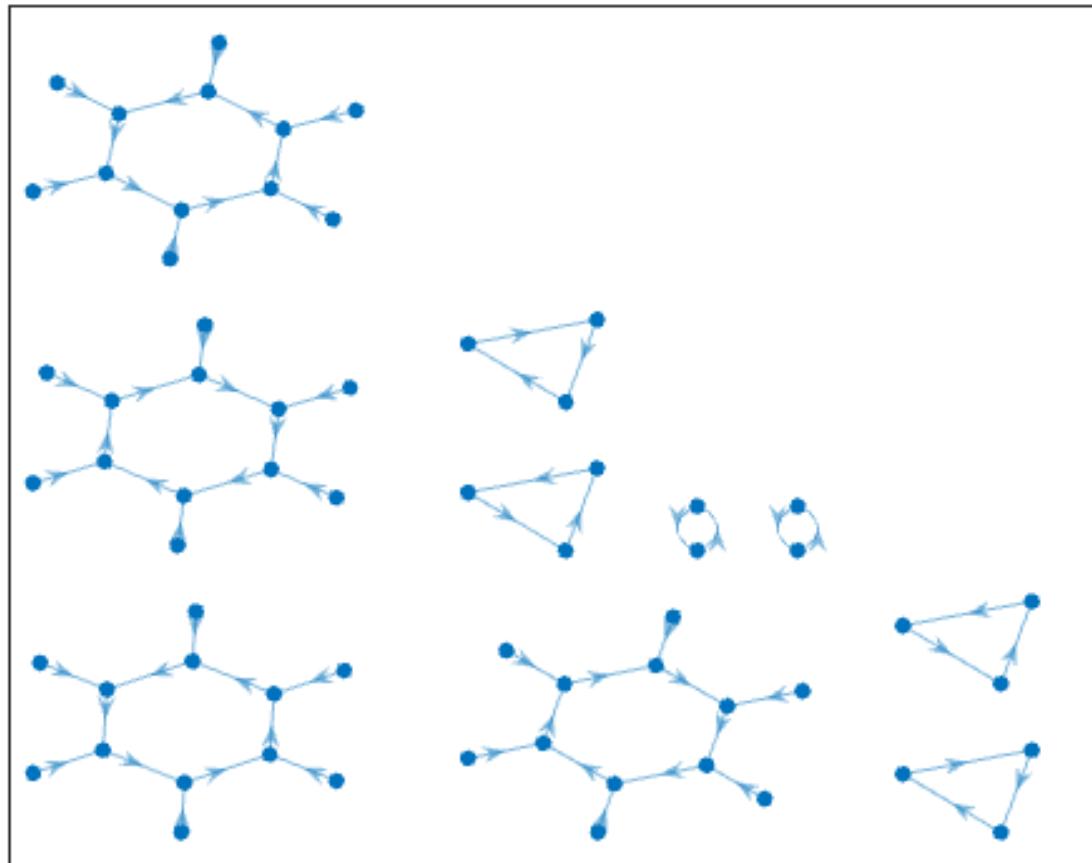


Figura 3.505: Atractor regla 43 n=4

Figura 3.506: Atractor regla 43 $n=5$

Figura 3.507: Atractor regla 43 $n=6$

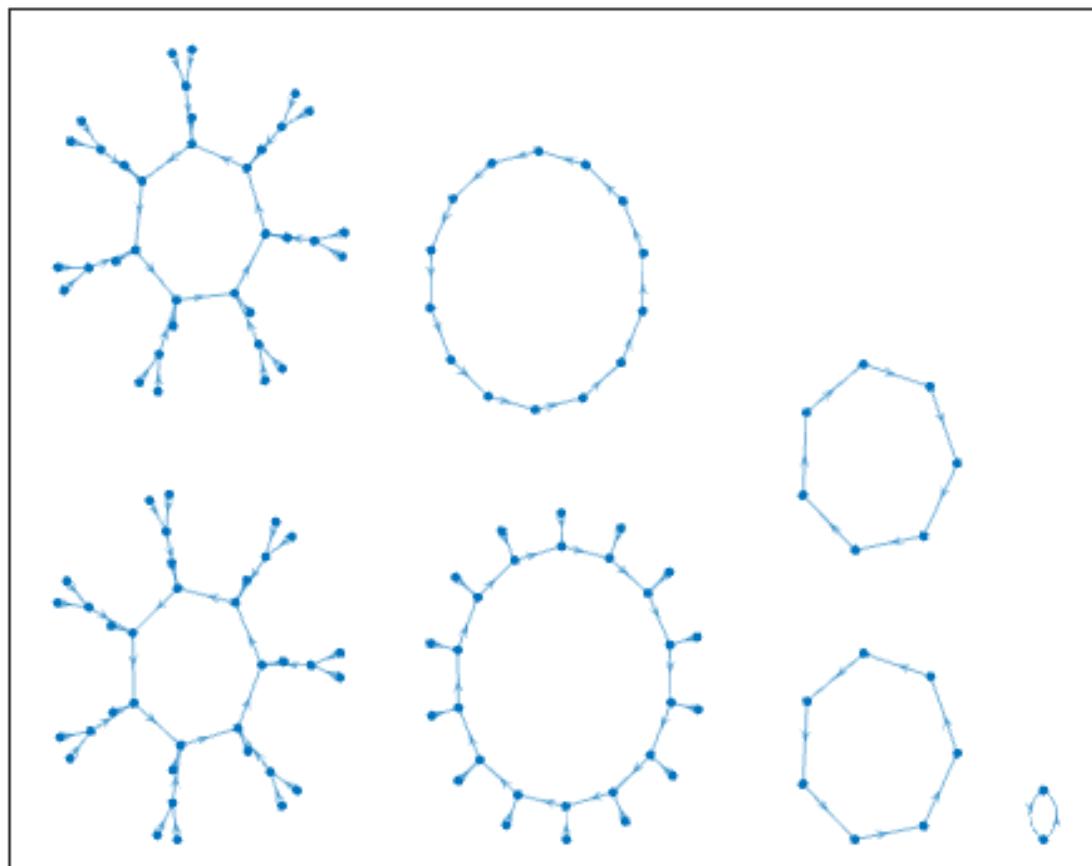
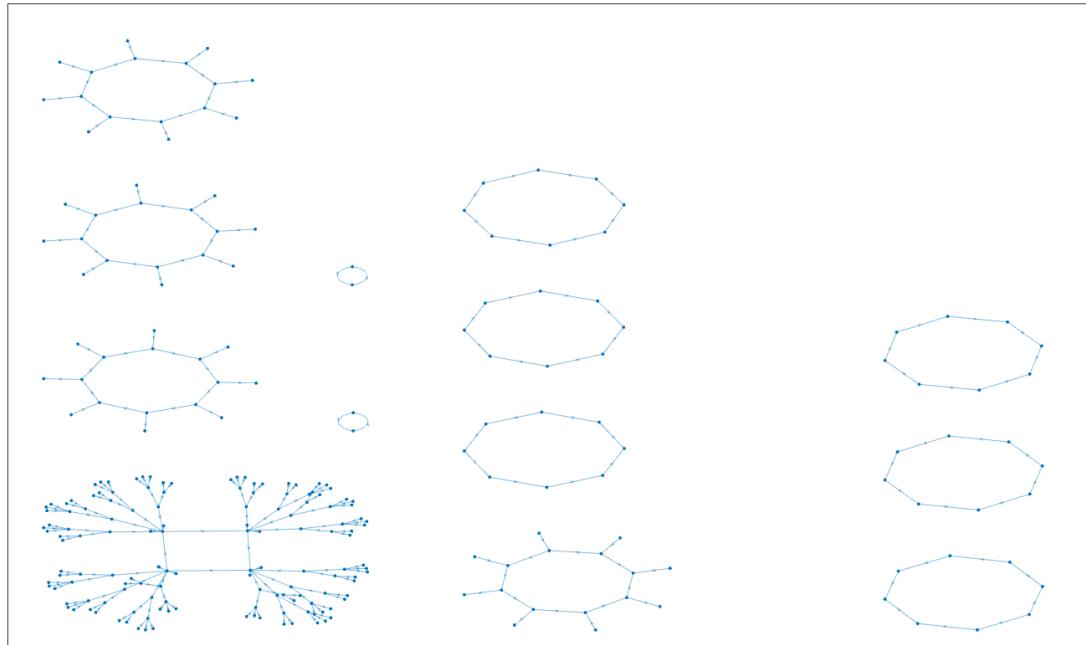
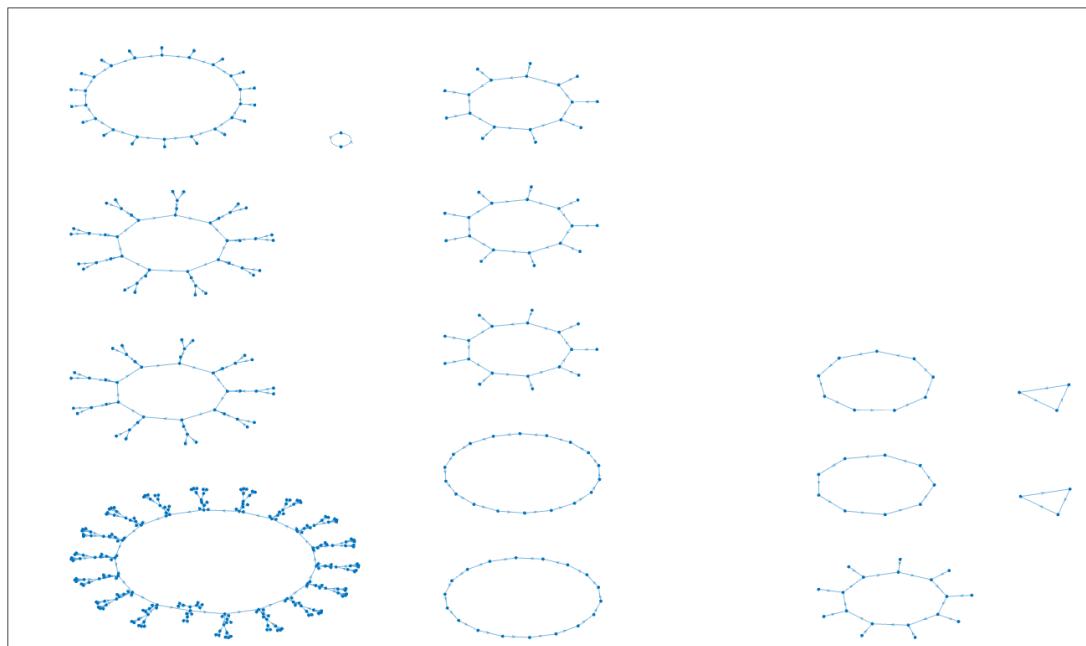


Figura 3.508: Atractor regla 43 n=7

Figura 3.509: Atractor regla 43 $n=8$ Figura 3.510: Atractor regla 43 $n=9$

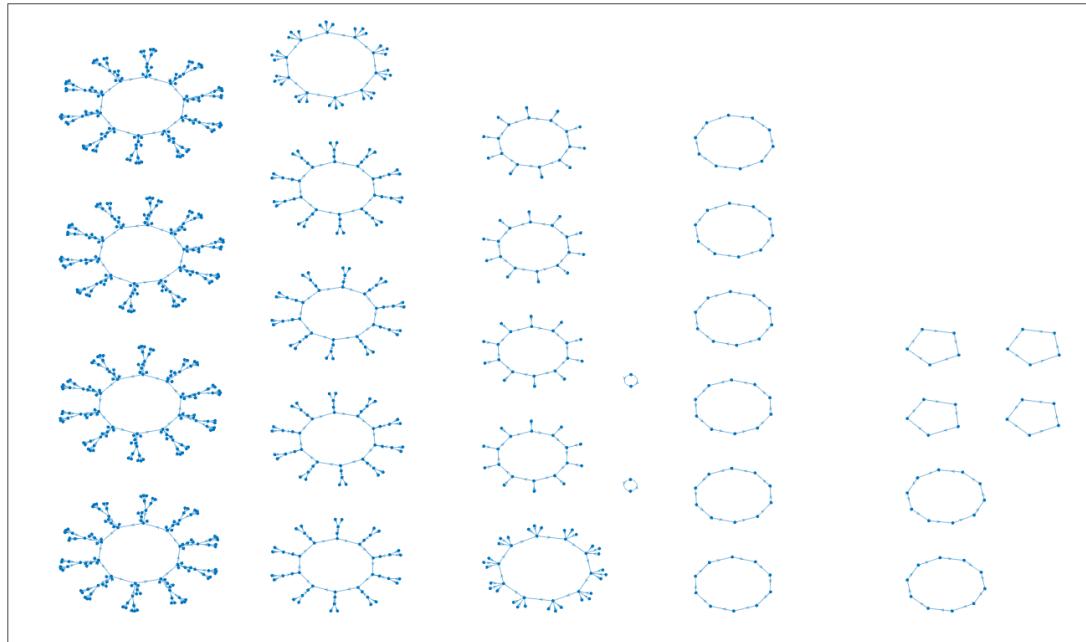


Figura 3.511: Atractor regla 43 n=10

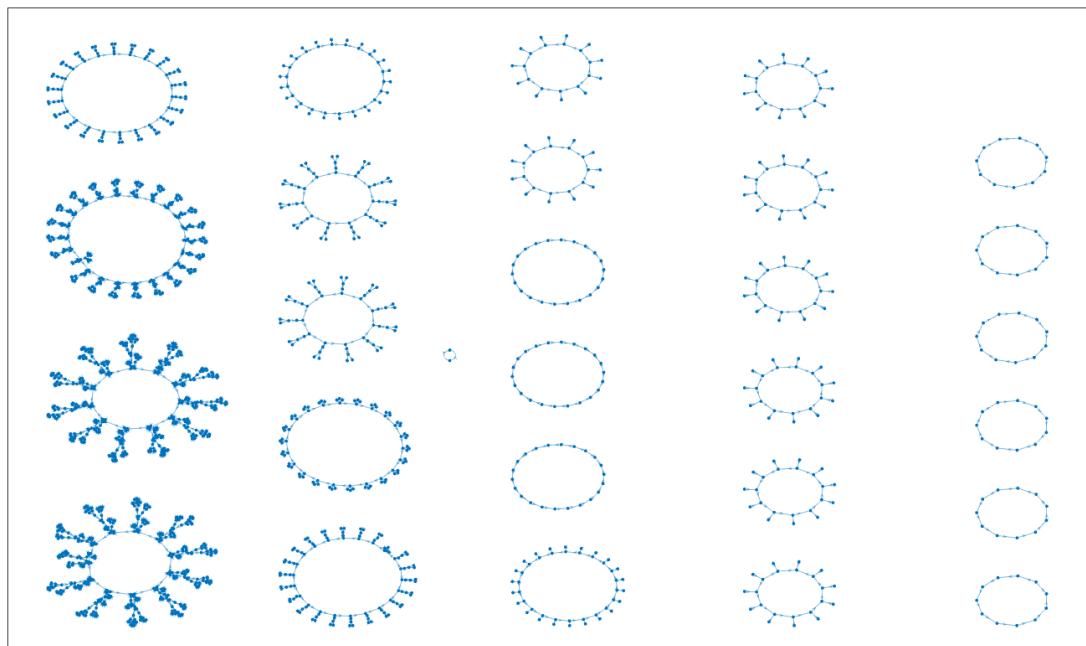


Figura 3.512: Atractor regla 43 n=11

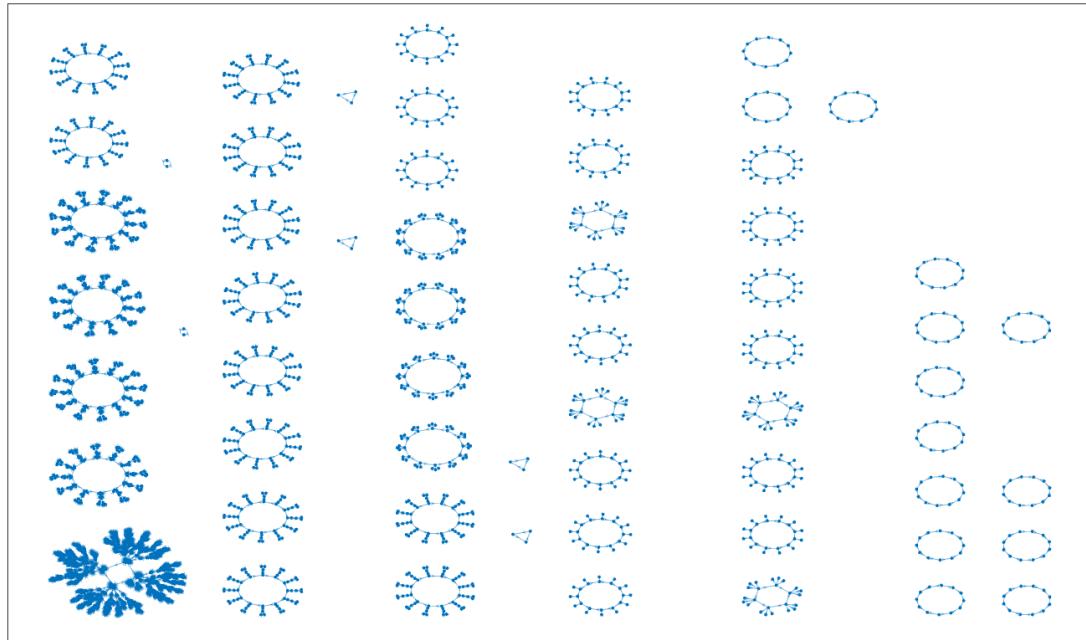


Figura 3.513: Atractor regla 43 n=12

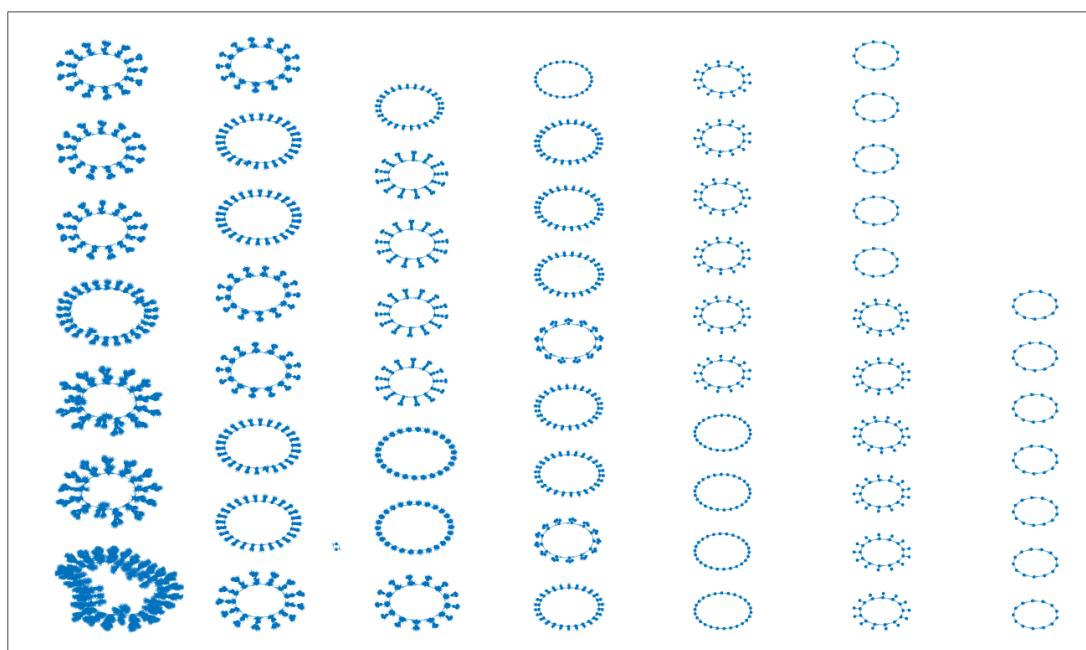


Figura 3.514: Atractor regla 43 n=13

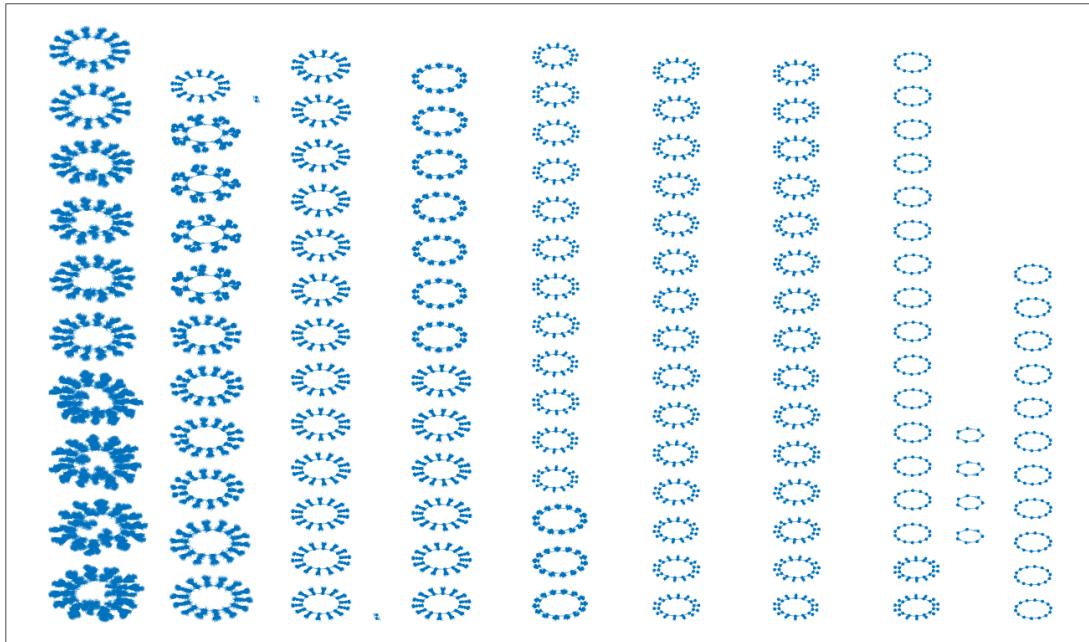


Figura 3.515: Atractor regla 43 n=14

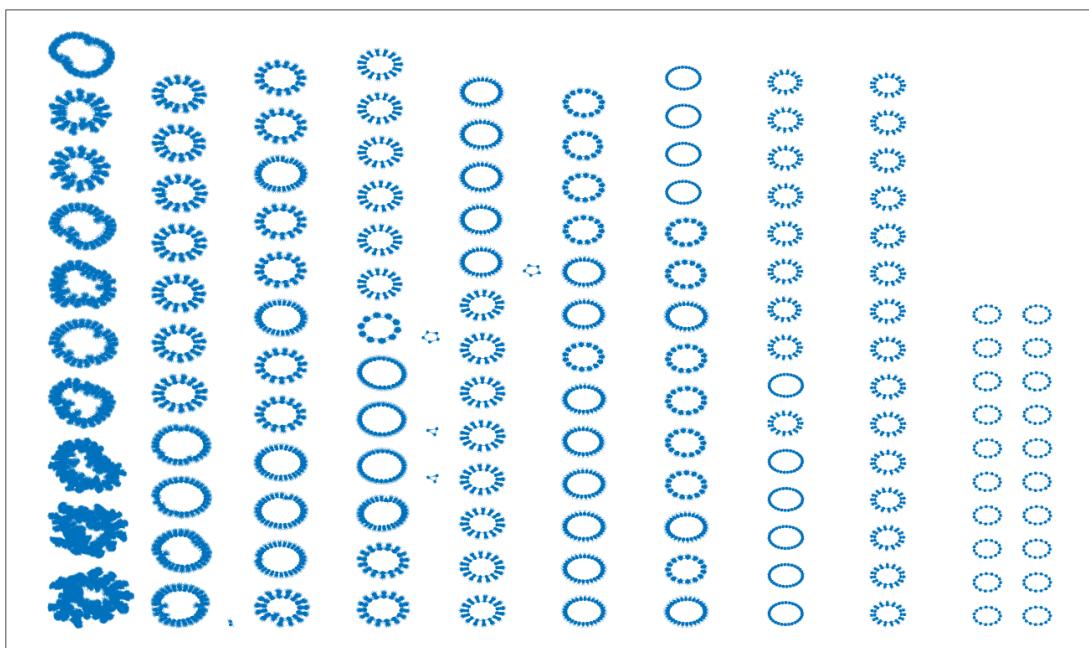


Figura 3.516: Atractor regla 43 n=15

3.39. Reglas 44,100,203,217

Respecto a la regla 44 se aprecia que mientras más grande es el tamaño de la cadena (n) en cada evolución surgen estructuras que parecieran ser copias la una de la otra en cuanto a su forma que matlab les otorga y que cada uno al evolucionar sigue siendo una copia del otro.

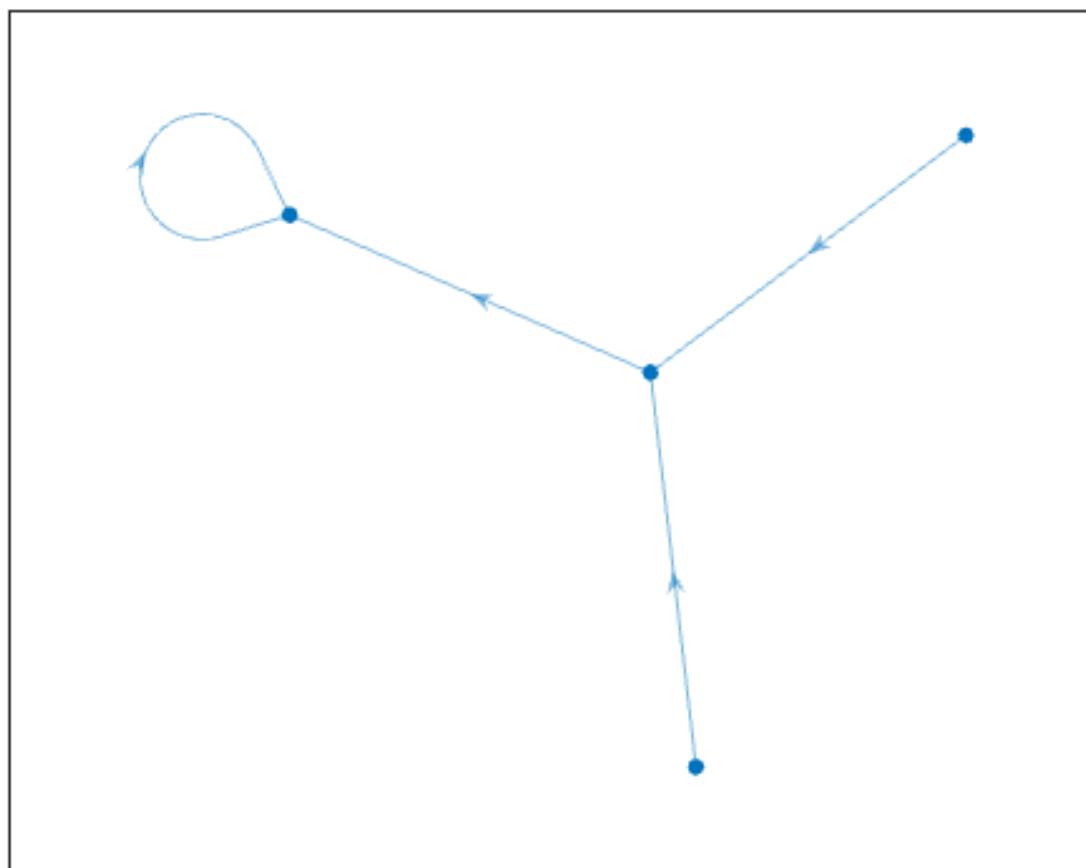


Figura 3.517: Atractor regla 44 $n=2$

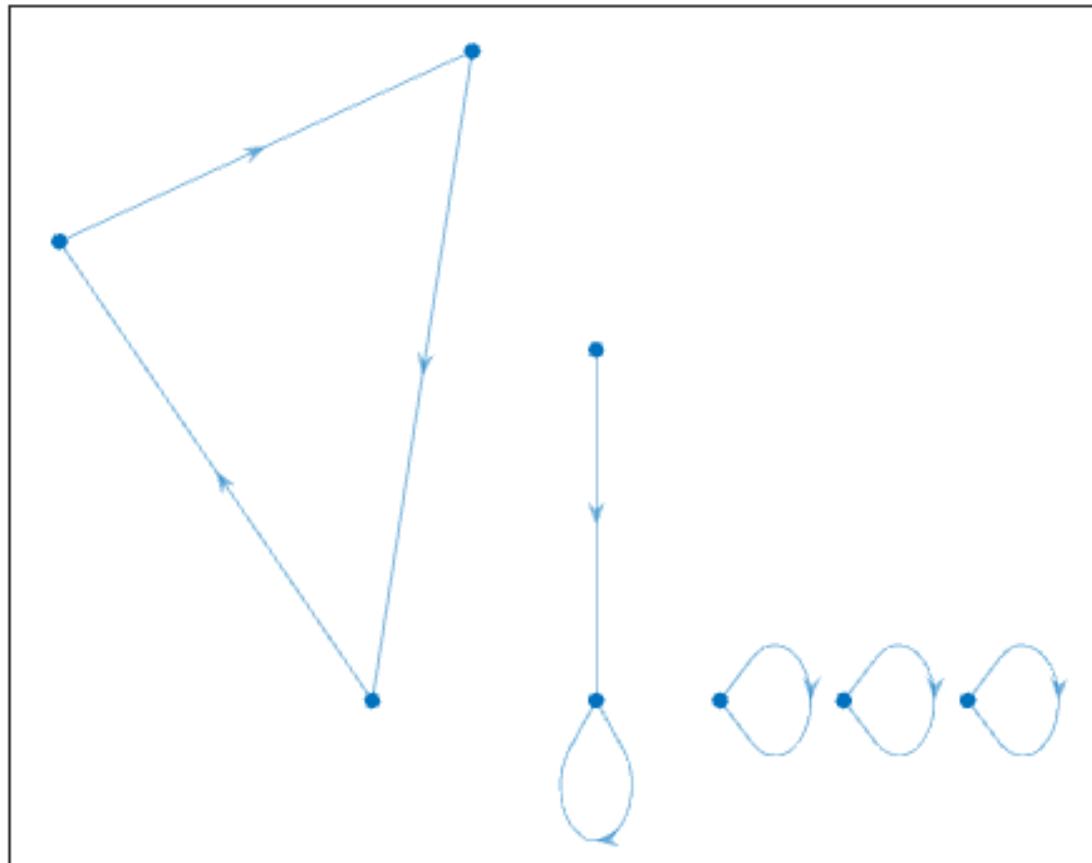


Figura 3.518: Atractor regla 44 $n=3$

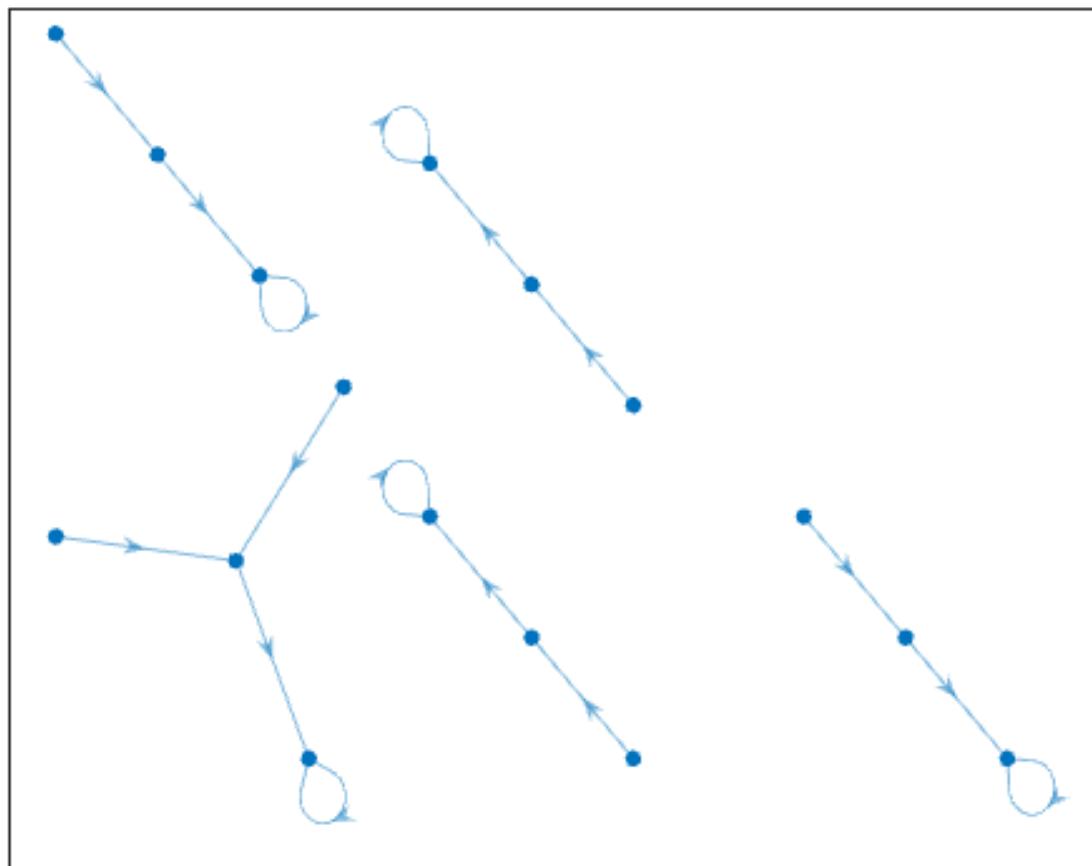


Figura 3.519: Atractor regla 44 n=4

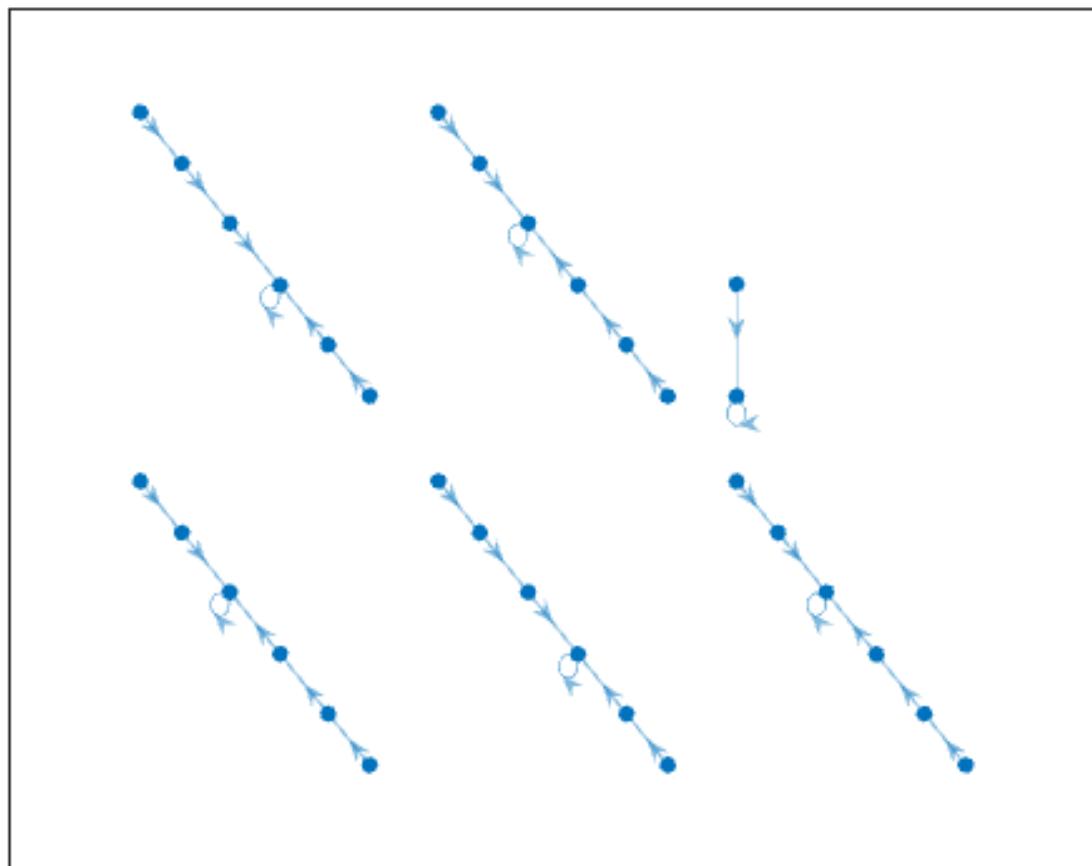


Figura 3.520: Atractor regla 44 n=5

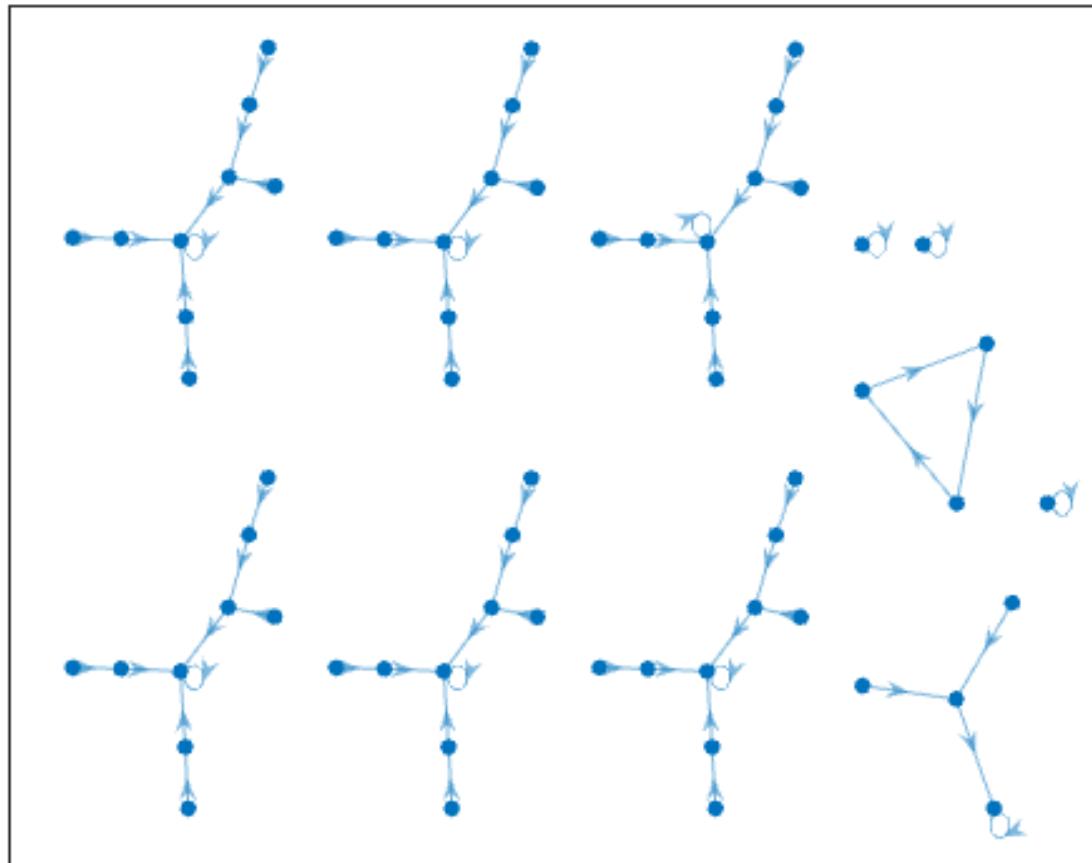


Figura 3.521: Atractor regla 44 n=6

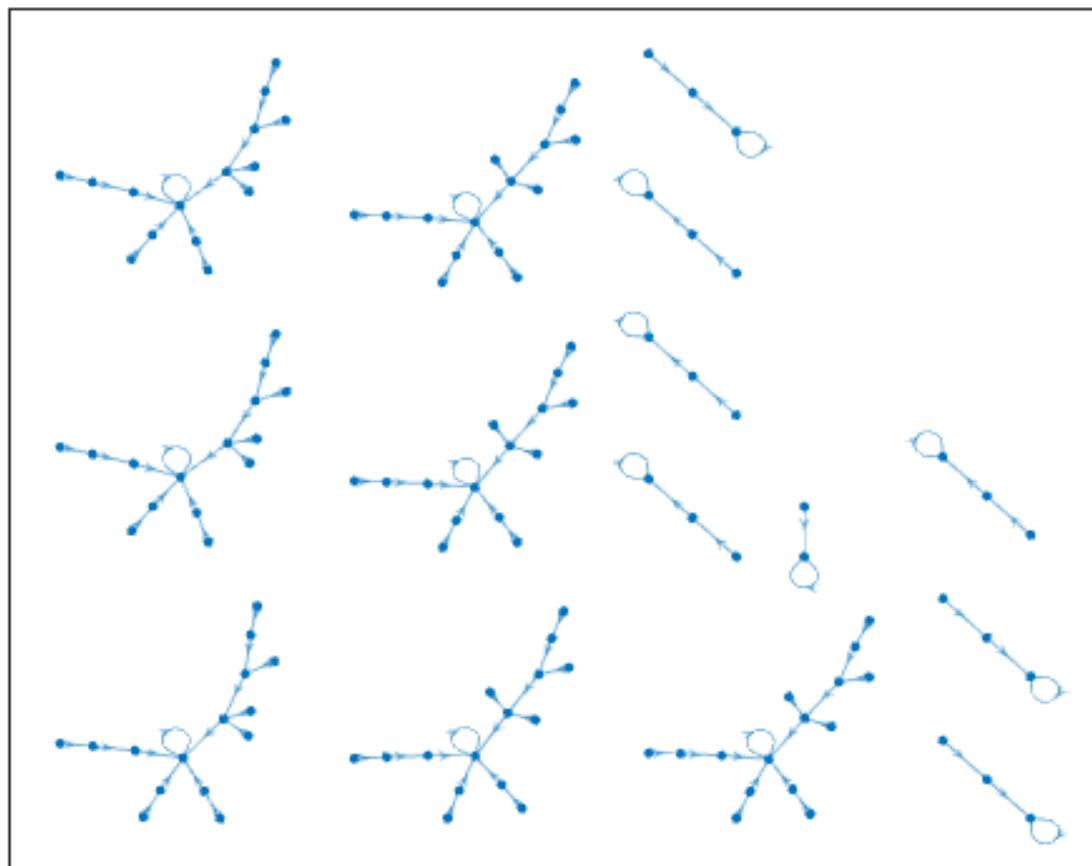


Figura 3.522: Atractor regla 44 n=7

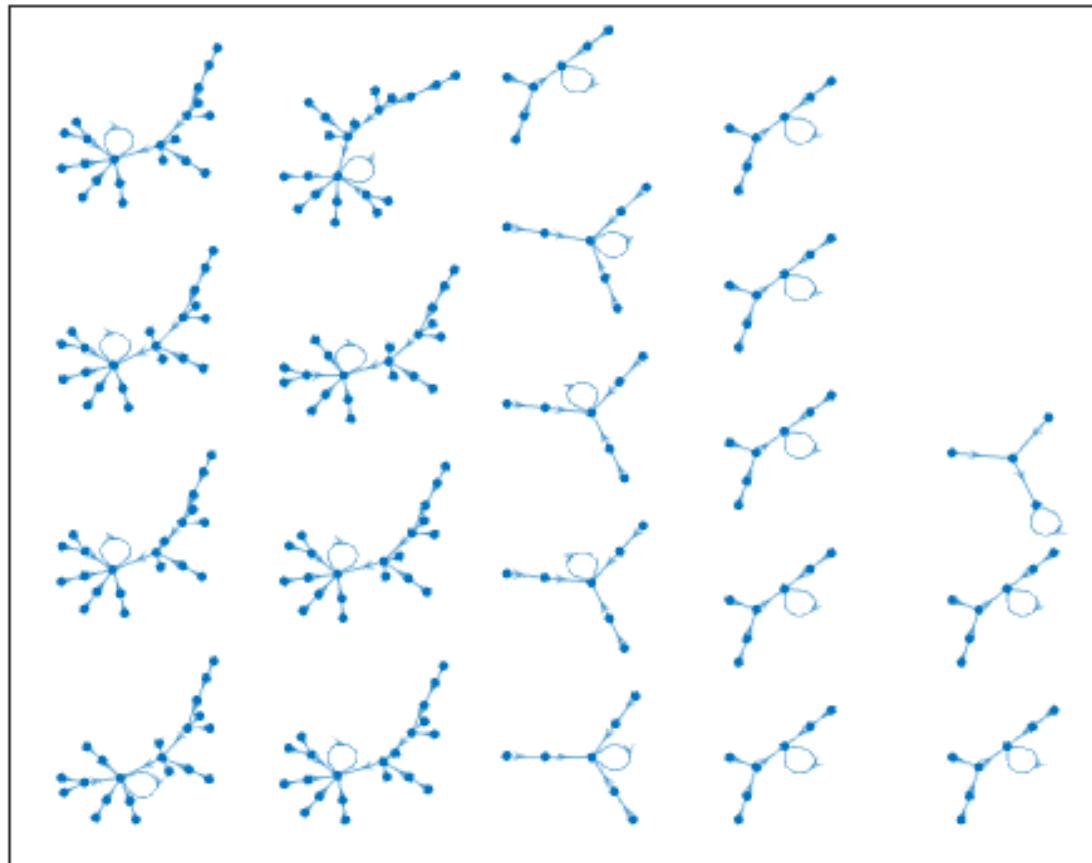


Figura 3.523: Atractor regla 44 n=8

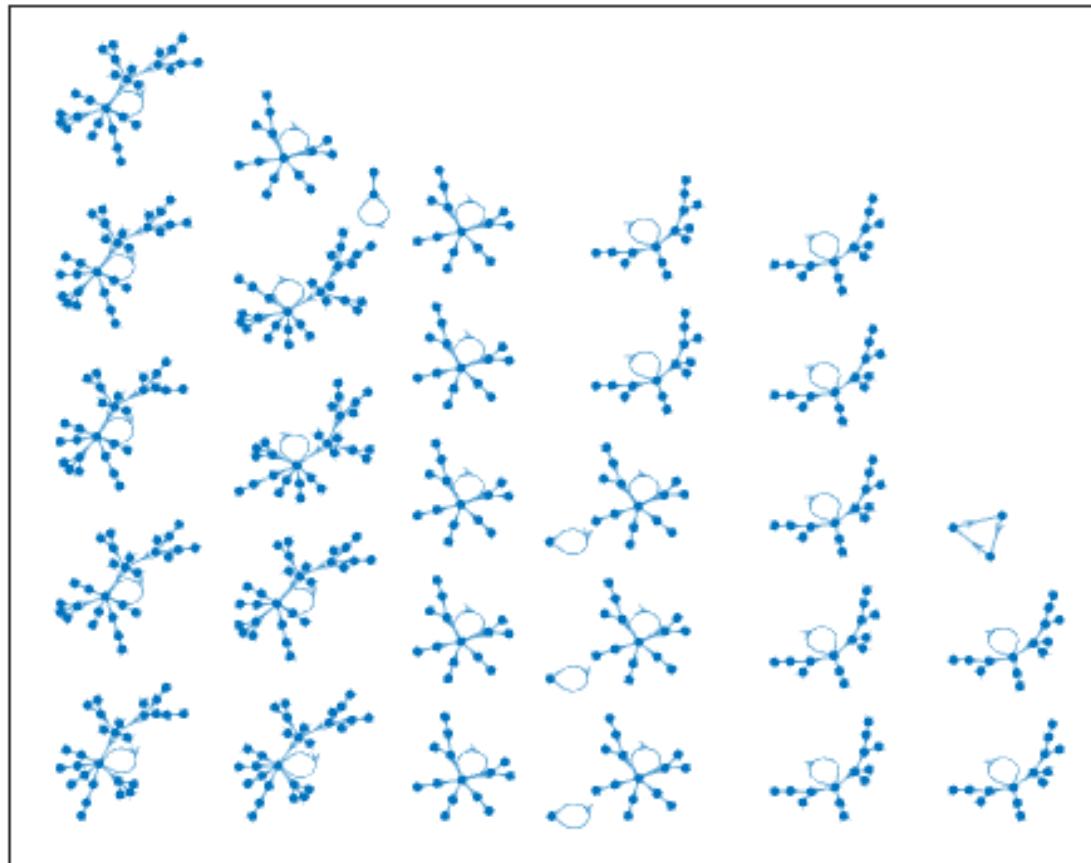


Figura 3.524: Atractor regla 44 n=9

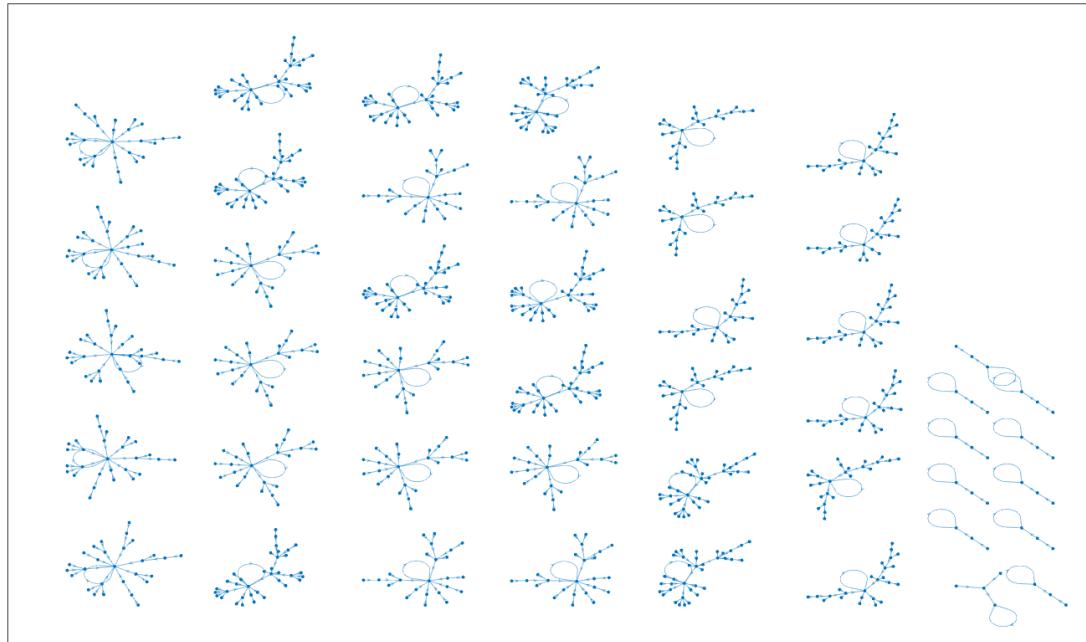


Figura 3.525: Atractor regla 44 n=10

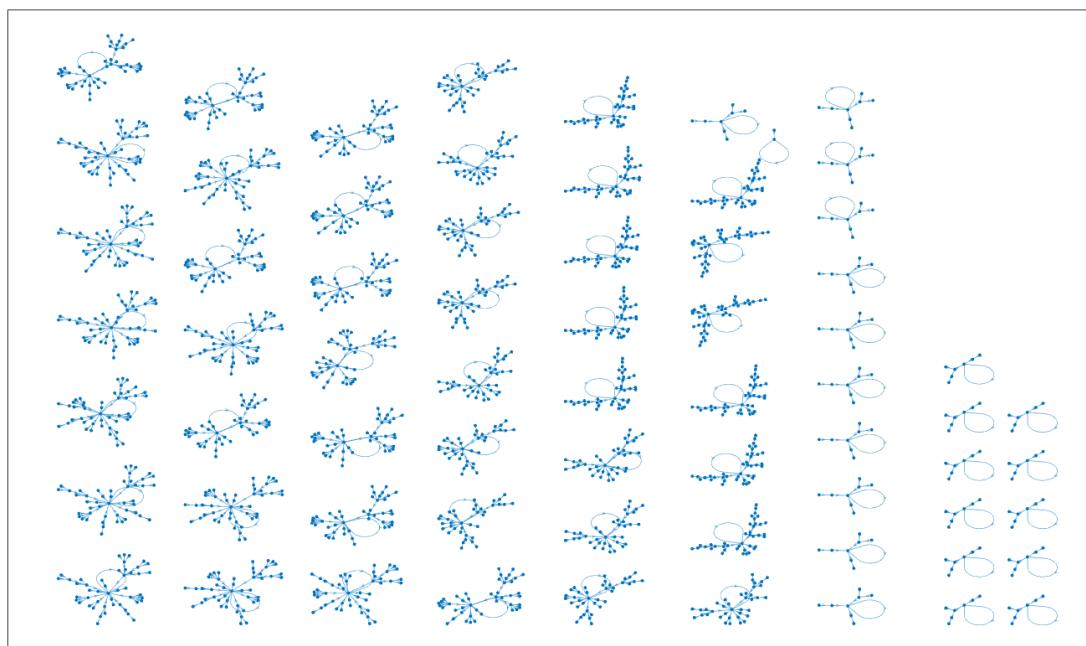


Figura 3.526: Atractor regla 44 n=11

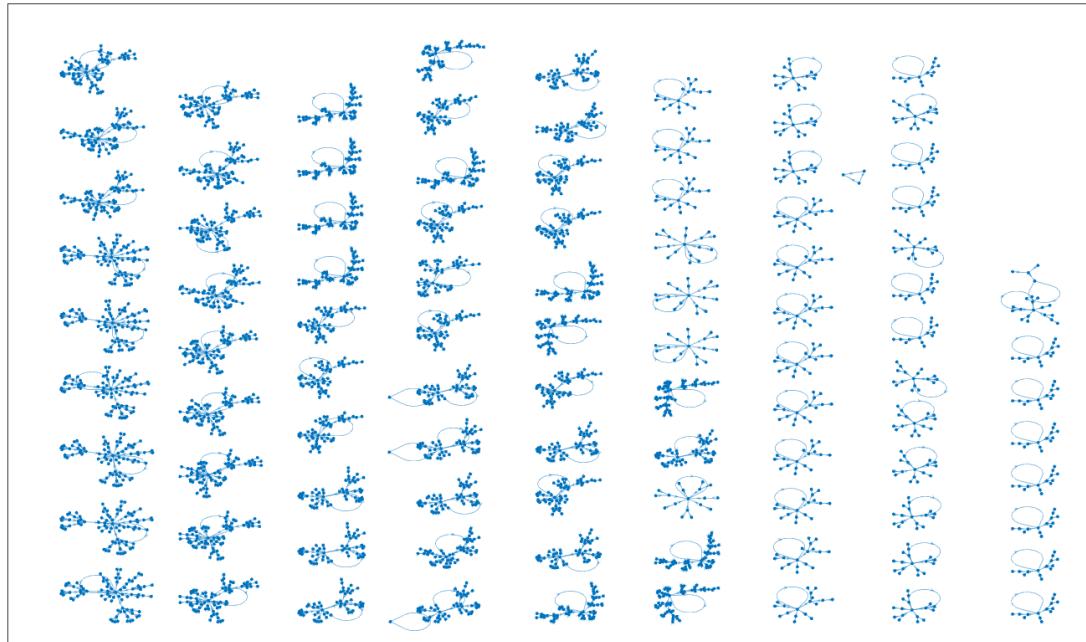


Figura 3.527: Atractor regla 44 n=12

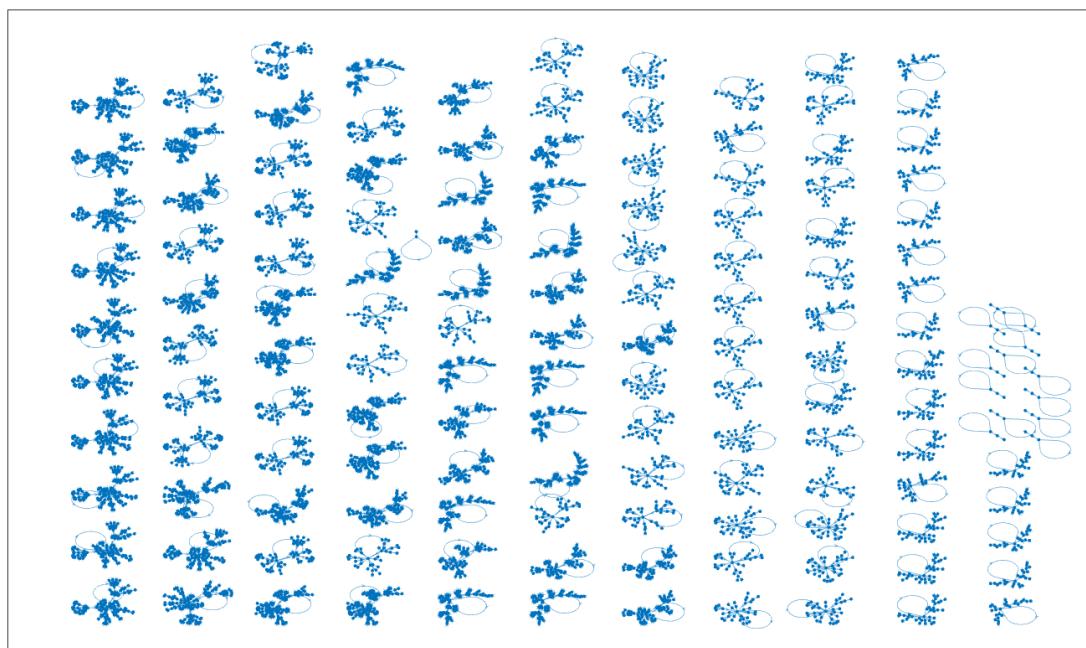


Figura 3.528: Atractor regla 44 n=13

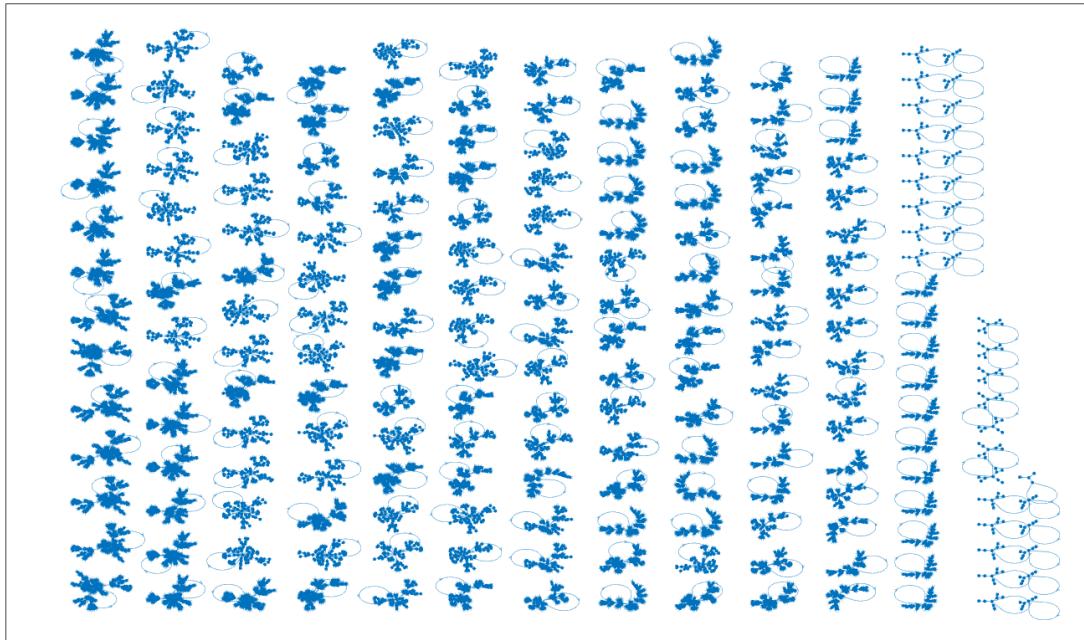


Figura 3.529: Atractor regla 44 n=14

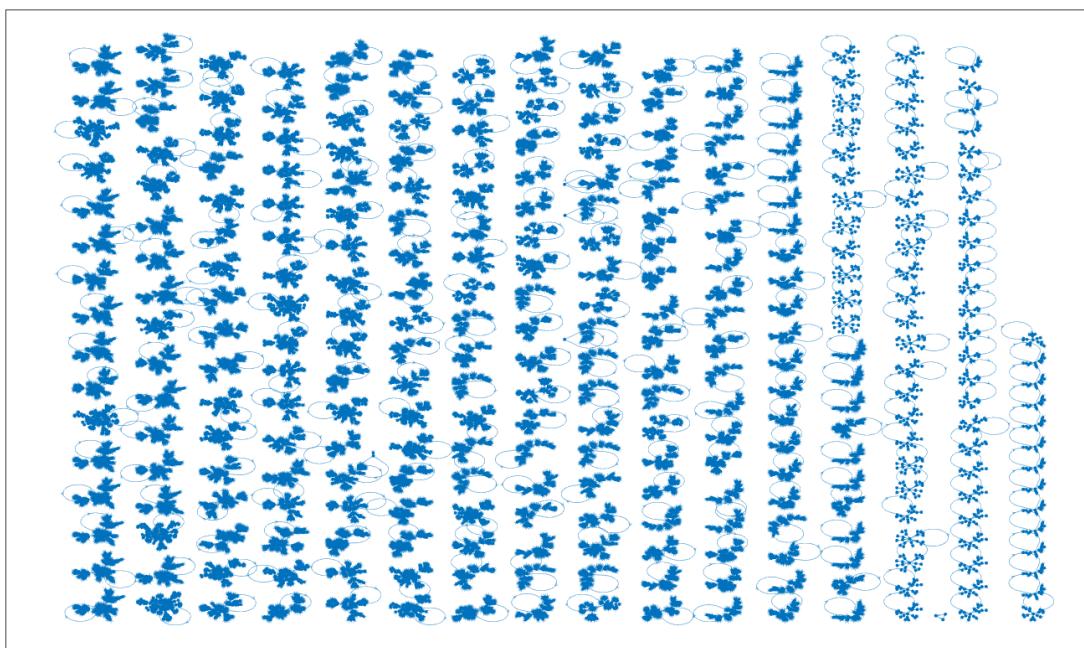


Figura 3.530: Atractor regla 44 n=15

3.40. Reglas 45,75,89,101

Respecto a la regla 45 se aprecia que mientras más grande es el tamaño de la cadena (n) particularmente en esta regla se observa que a partir de una $n=8$ (figura 3.537) surgen algunos inconvenientes con matlab, en el sentido de que las figuras que se aprecian son un tanto «raras» comparadas con las que veniamos viendo en reglas pasadas ya que presentan intersecciones entre sus mismas líneas.

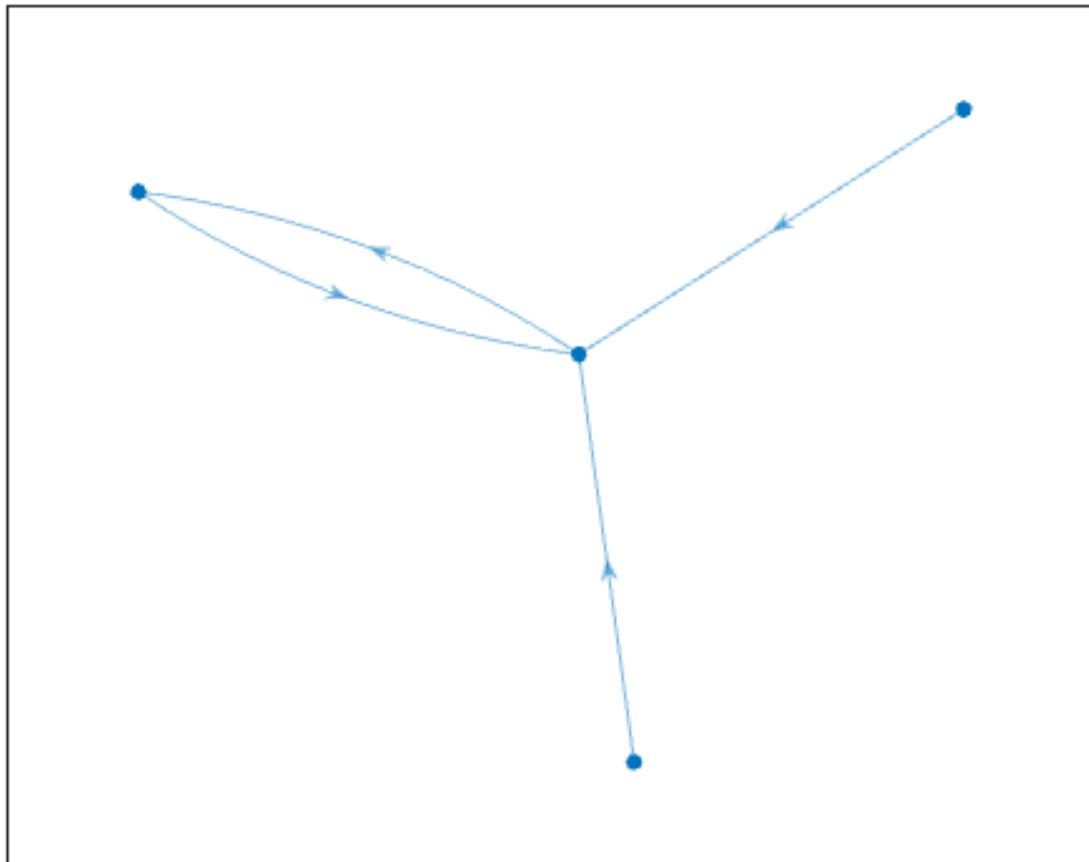


Figura 3.531: Atractor regla 45 n=2

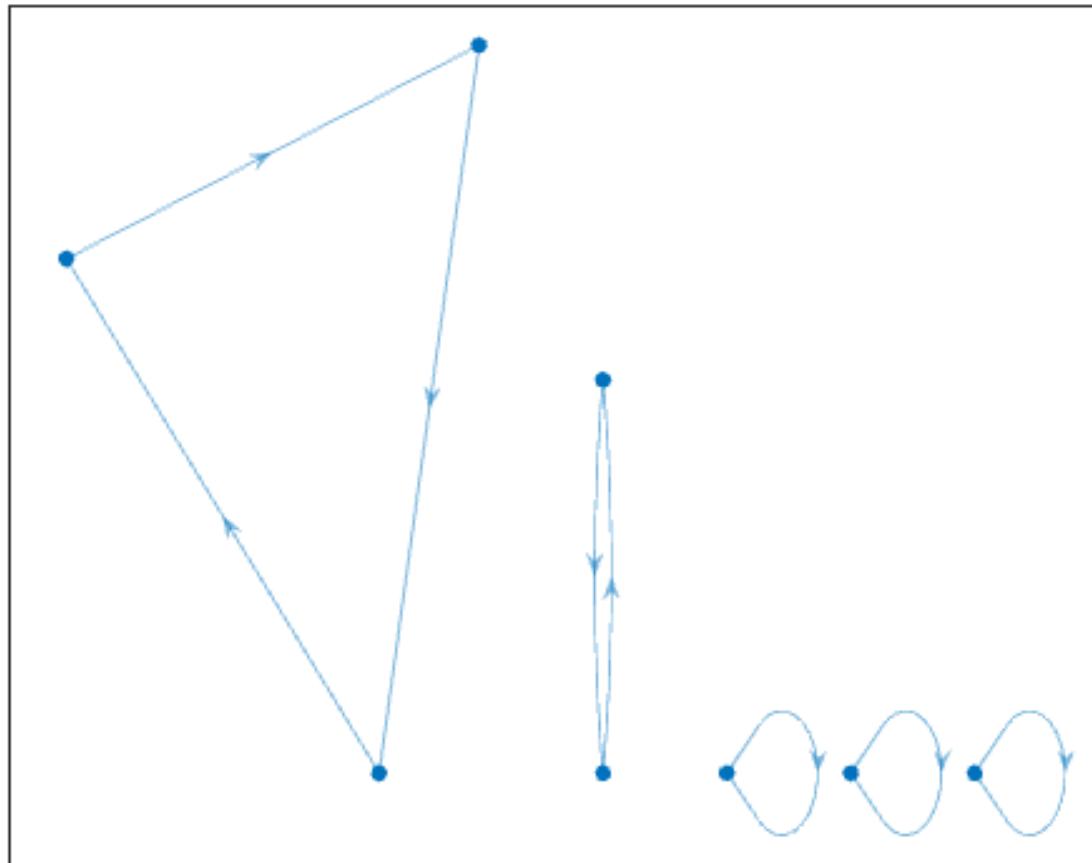


Figura 3.532: Atractor regla 45 n=3

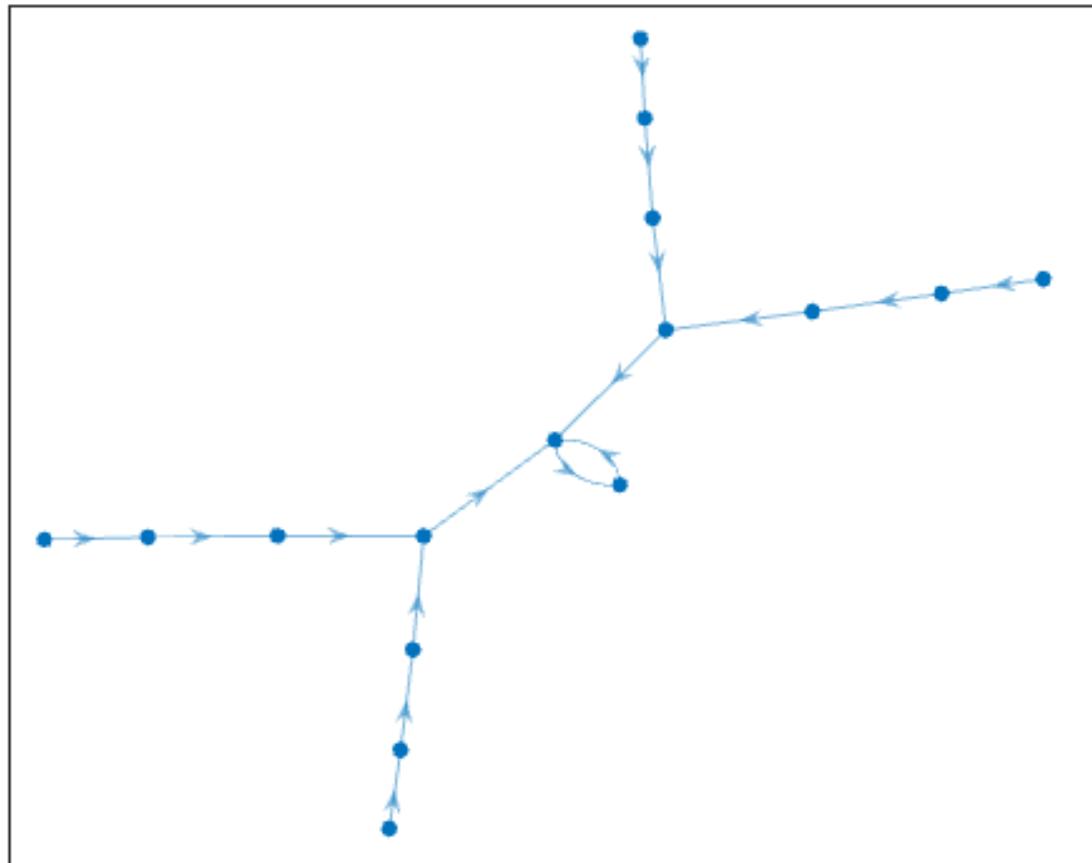


Figura 3.533: Atractor regla 45 n=4

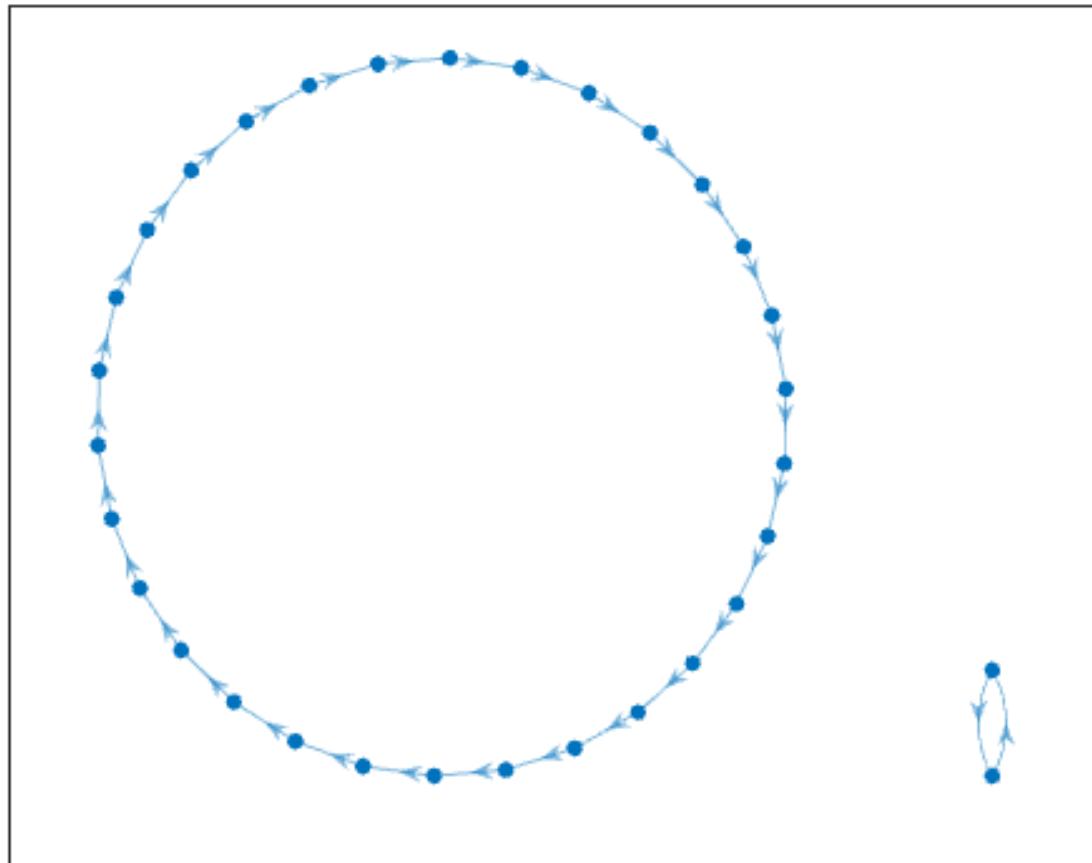


Figura 3.534: Atractor regla 45 n=5

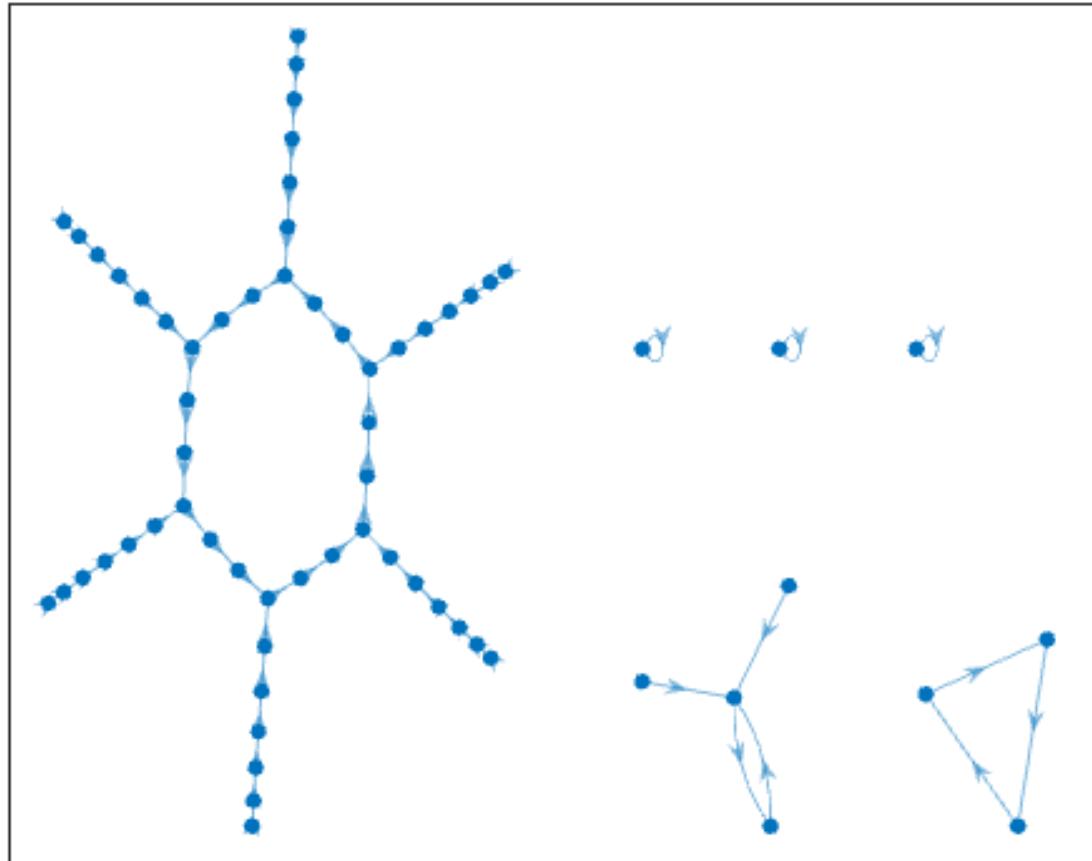


Figura 3.535: Atractor regla 45 n=6

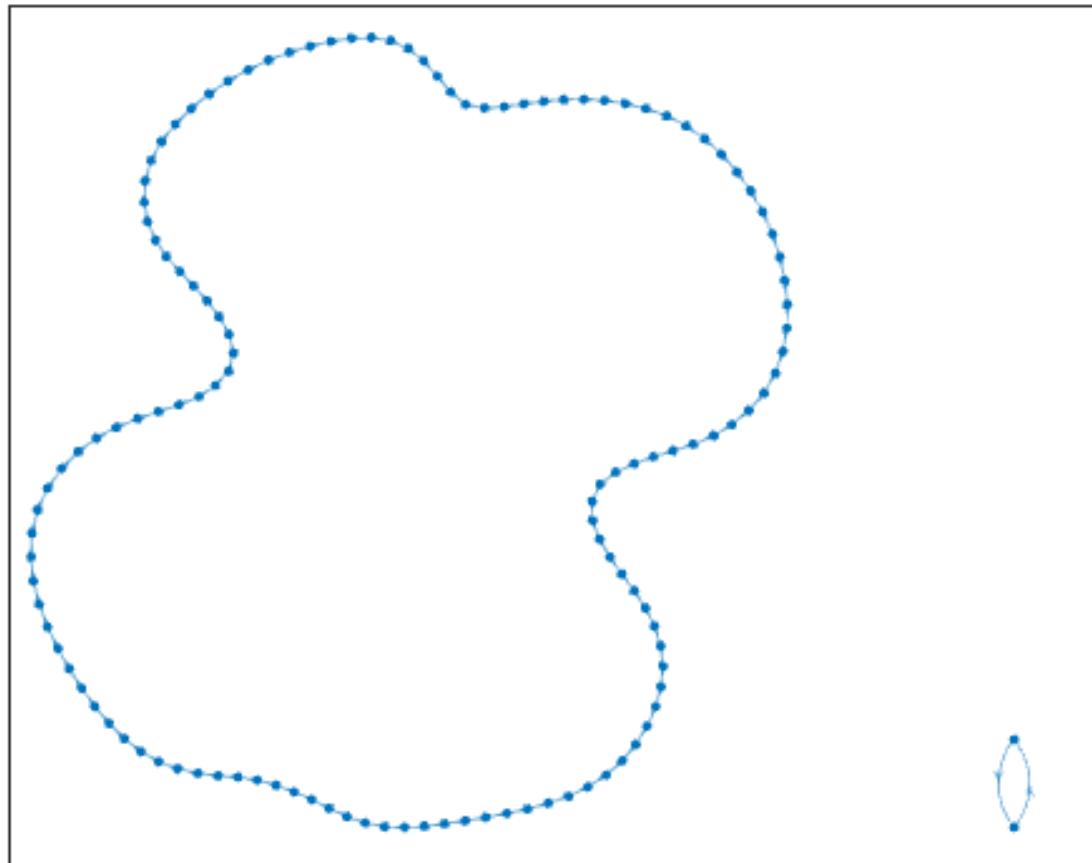


Figura 3.536: Atractor regla 45 n=7

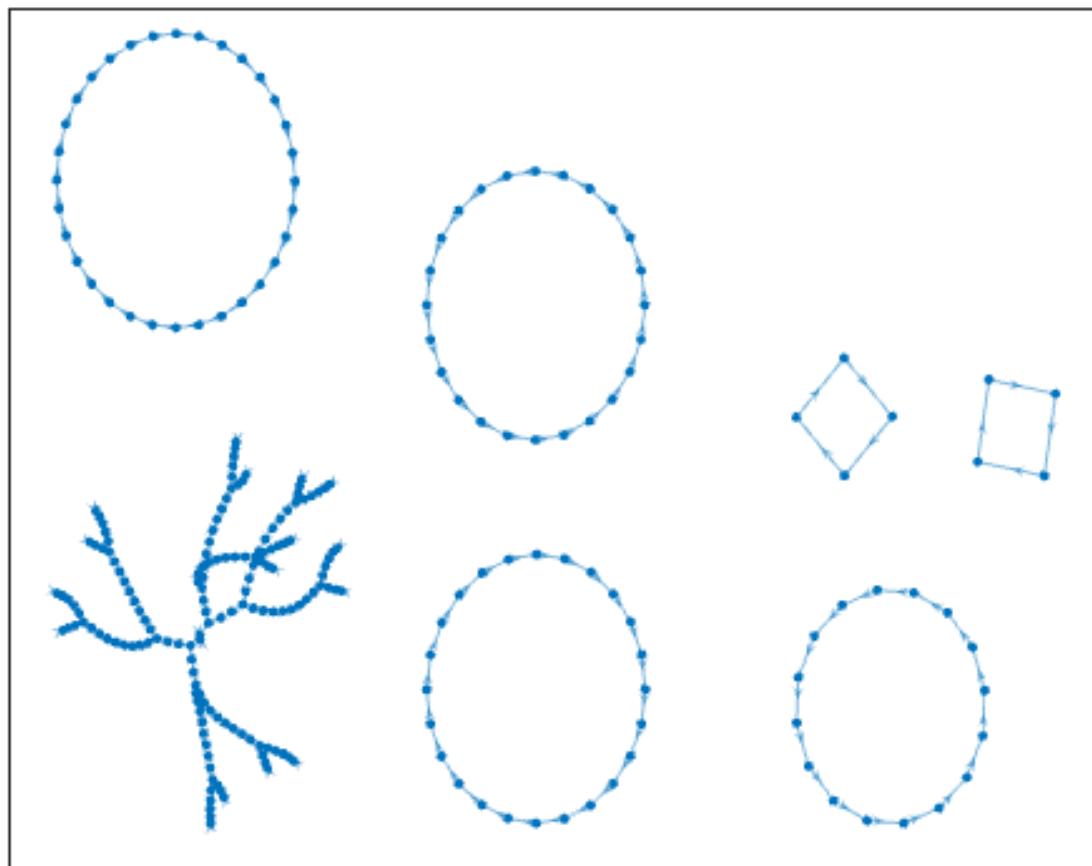


Figura 3.537: Atractor regla 45 n=8

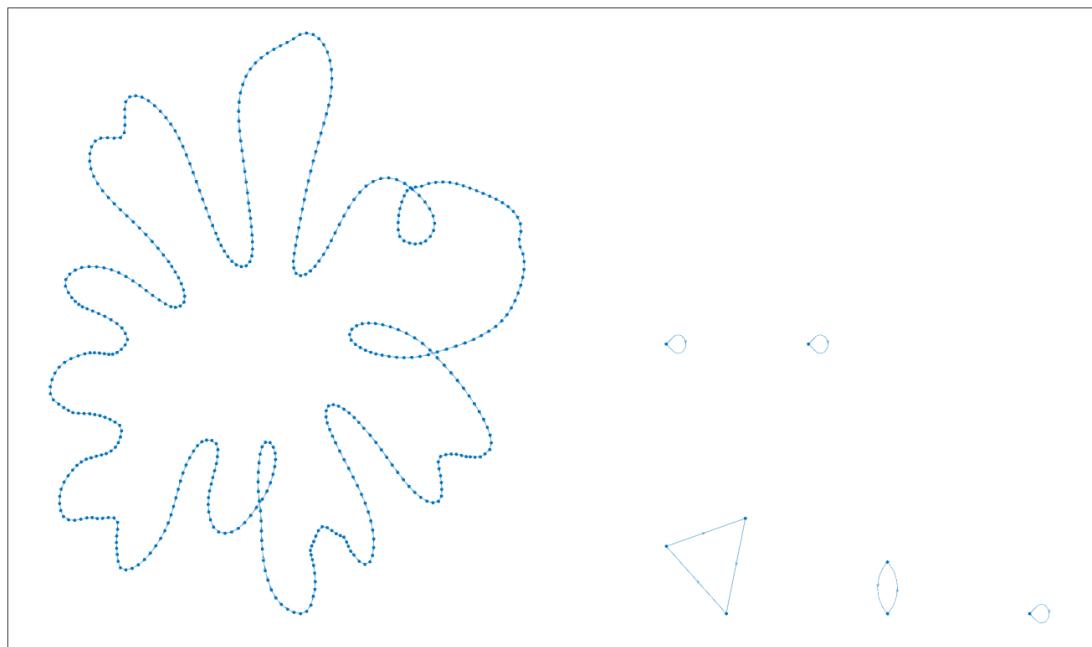


Figura 3.538: Atractor regla 45 n=9

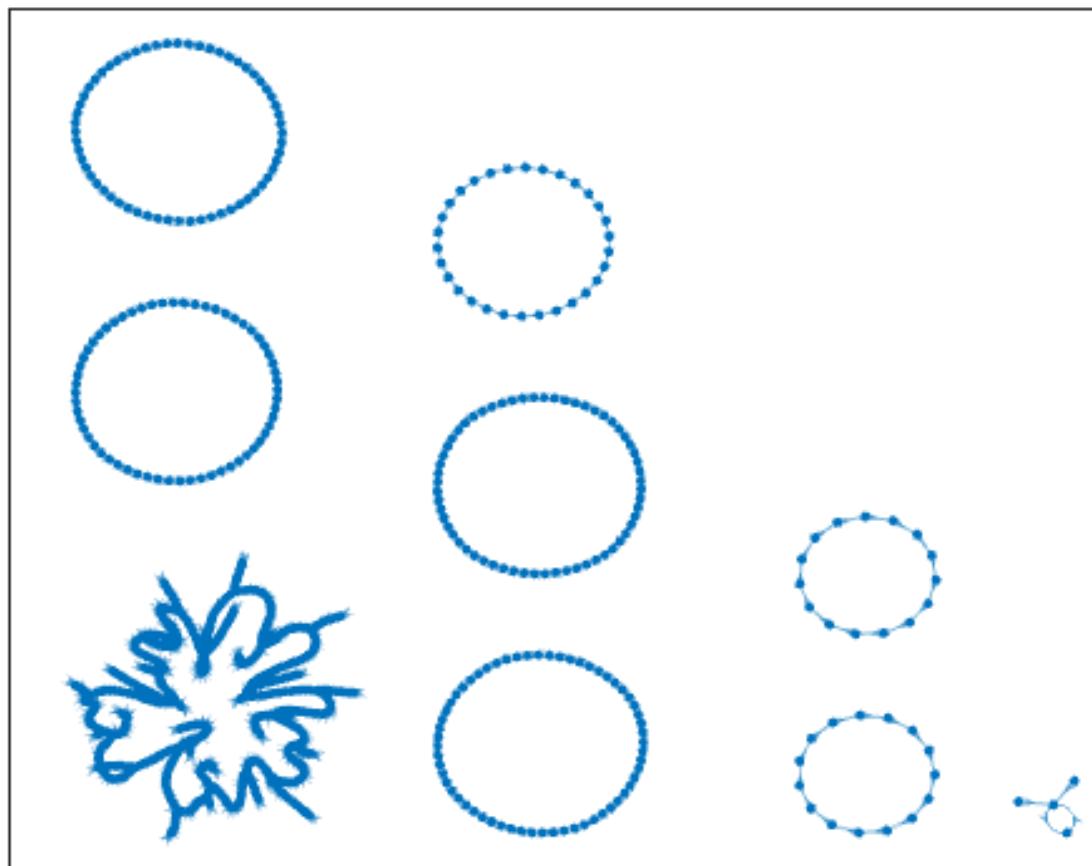


Figura 3.539: Atractor regla 45 $n=10$

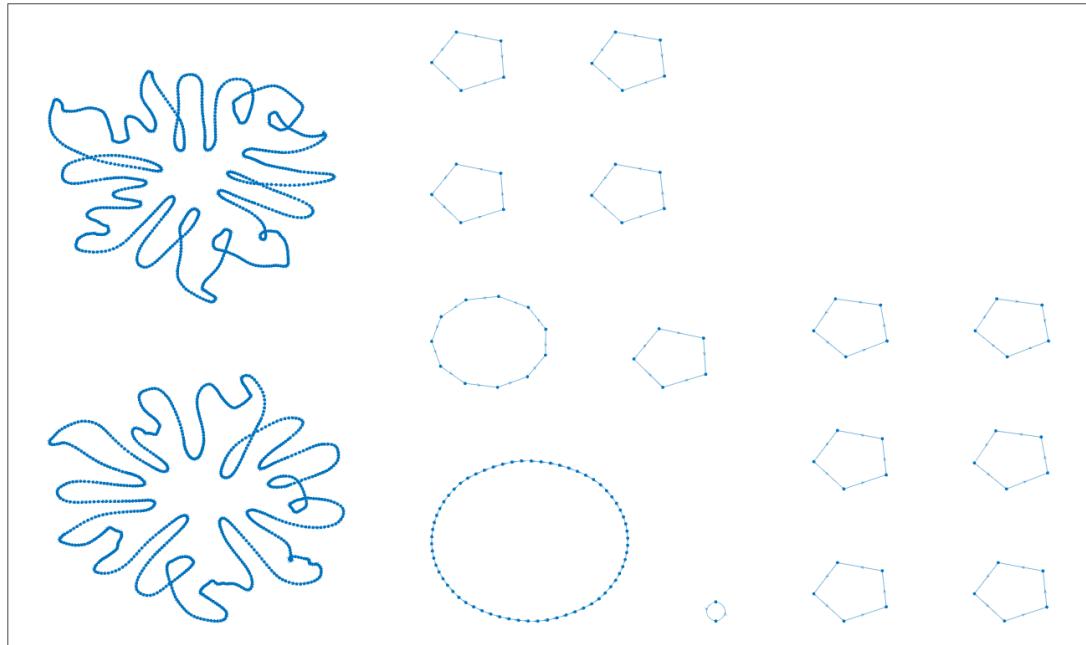


Figura 3.540: Atractor regla 45 n=11

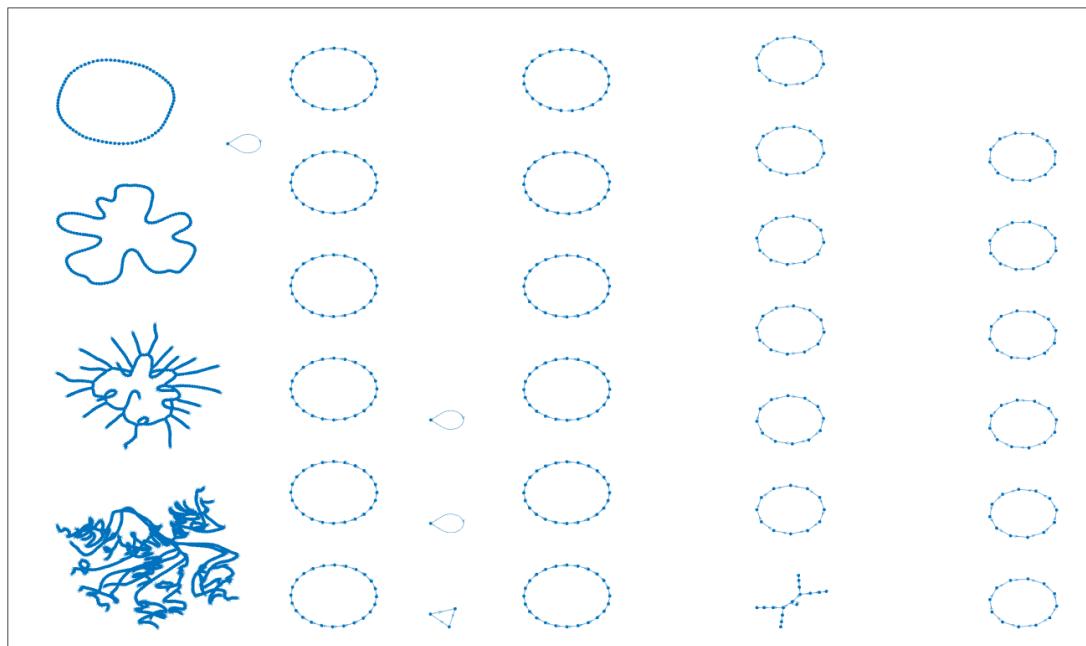


Figura 3.541: Atractor regla 45 n=12

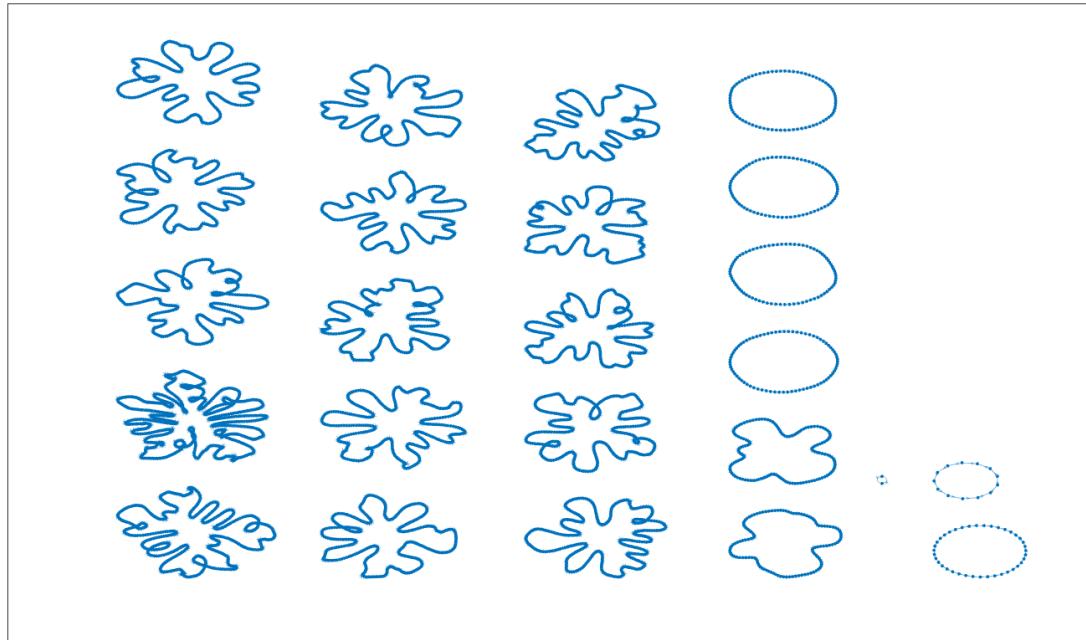


Figura 3.542: Atractor regla 45 n=13

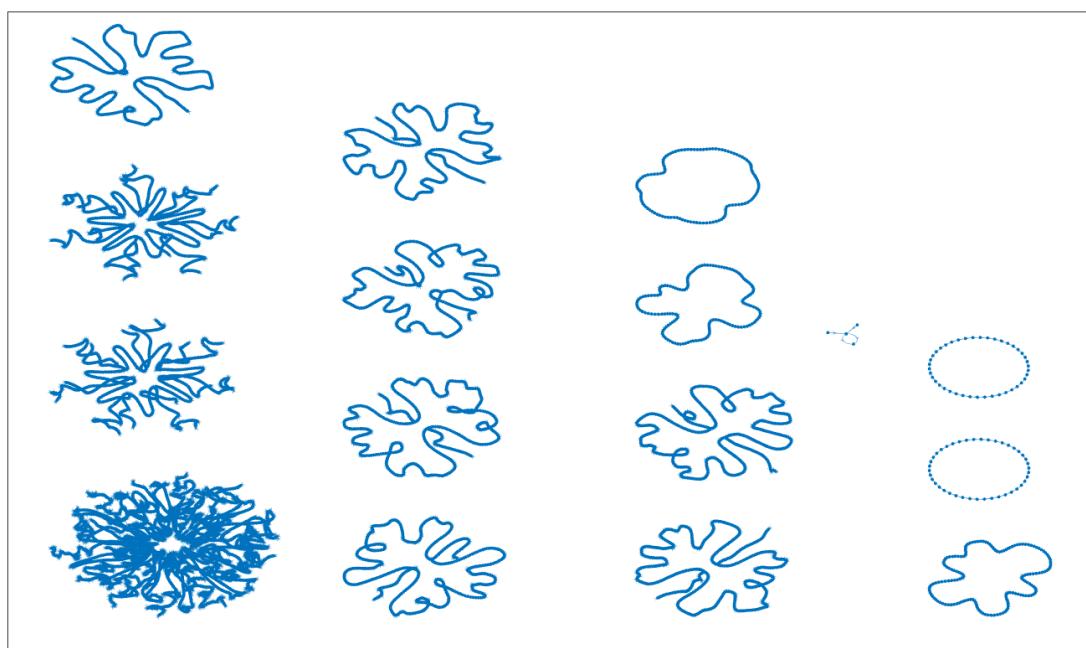


Figura 3.543: Atractor regla 45 n=14

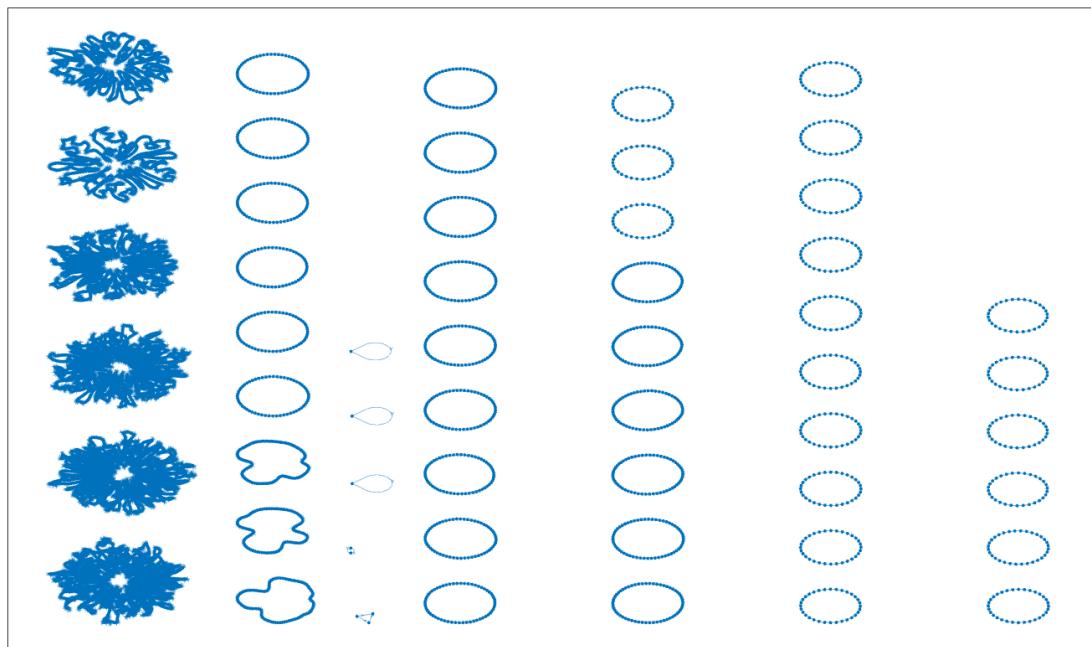


Figura 3.544: Atractor regla 45 n=15

3.41. Reglas 46,116,139,209

Respecto a la regla 46 se aprecia que mientras más grande es el tamaño de la cadena (n) en cada n par surgen estructuras que asemejan al condensador de flujo de volver al futuro.

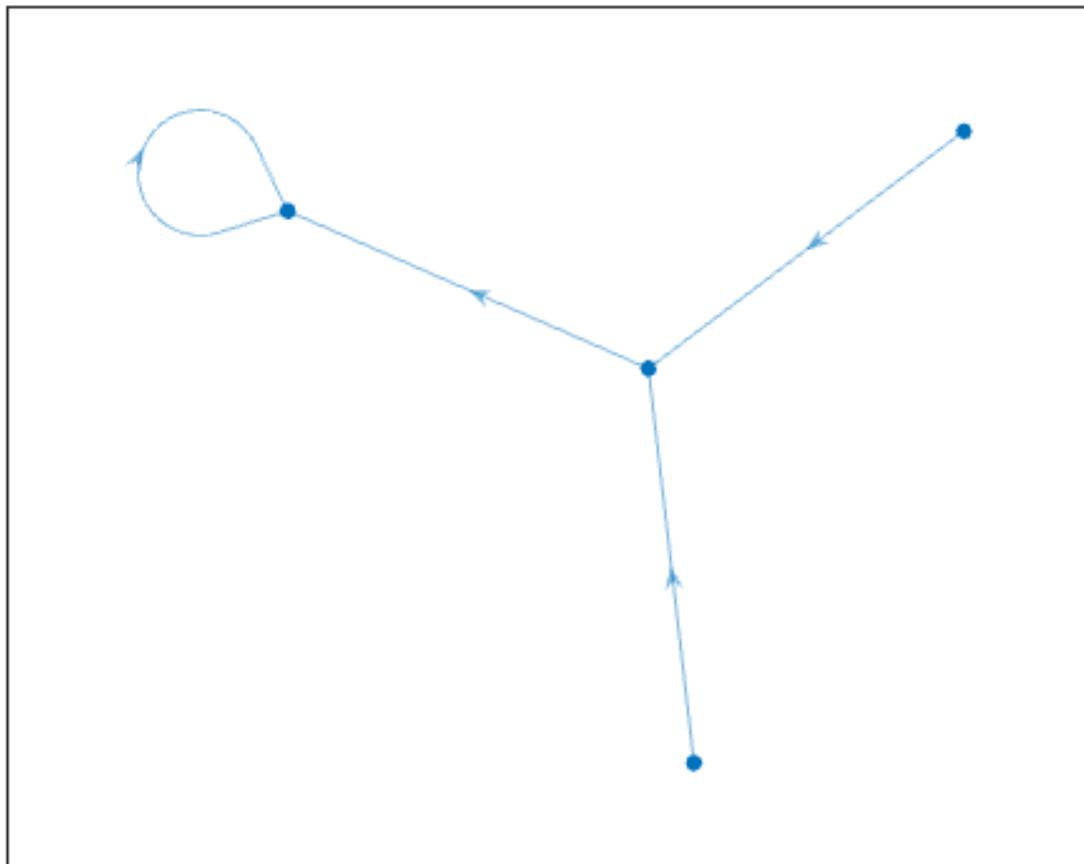


Figura 3.545: Atractor regla 46 n=2

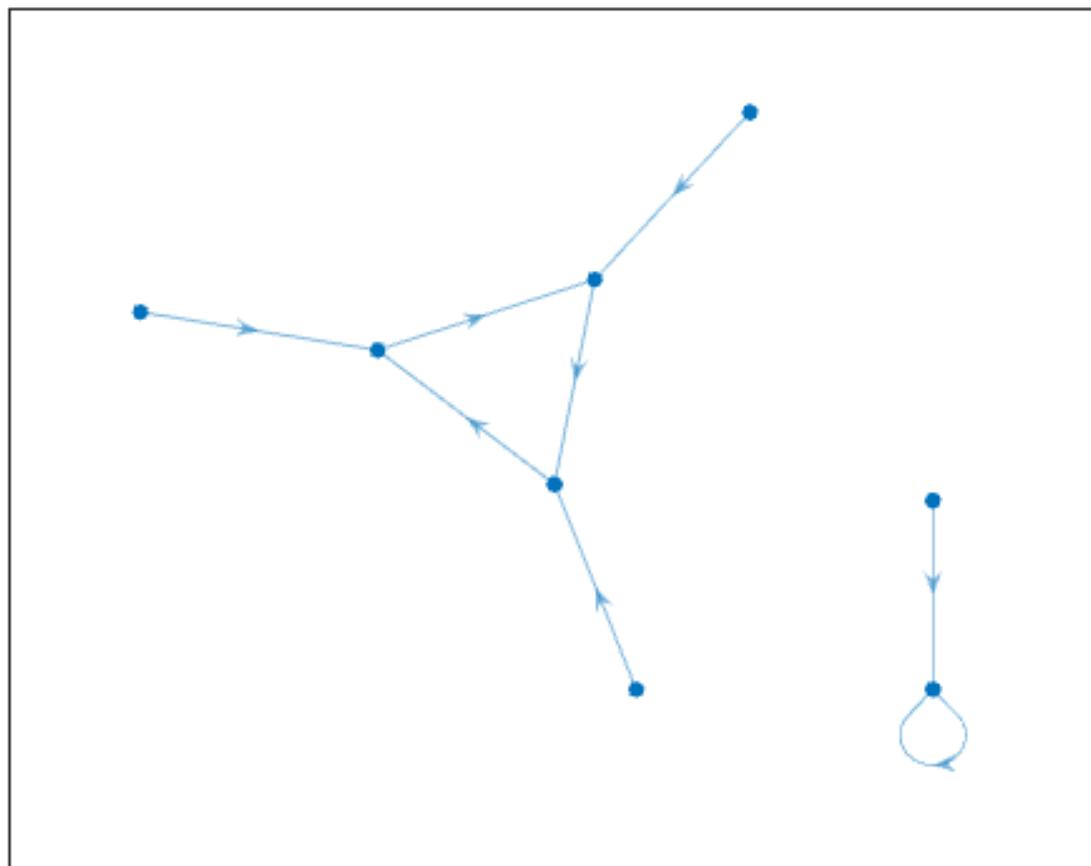


Figura 3.546: Atractor regla 46 n=3

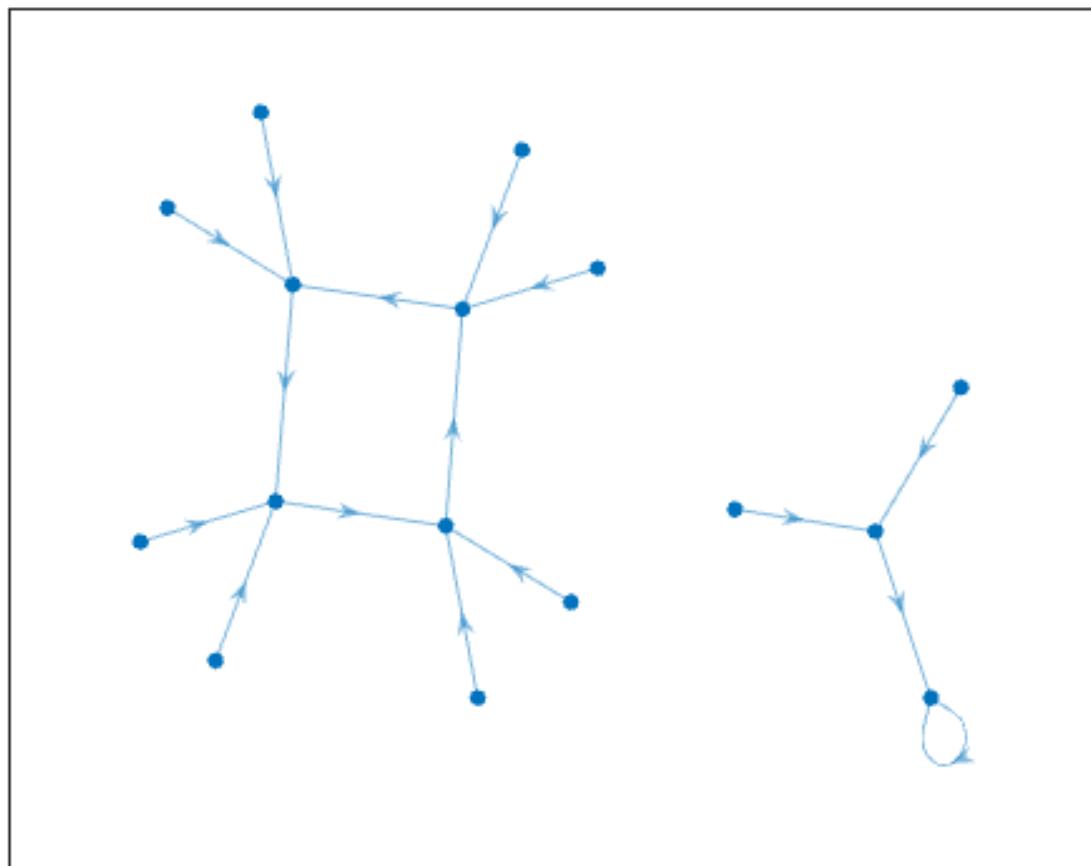
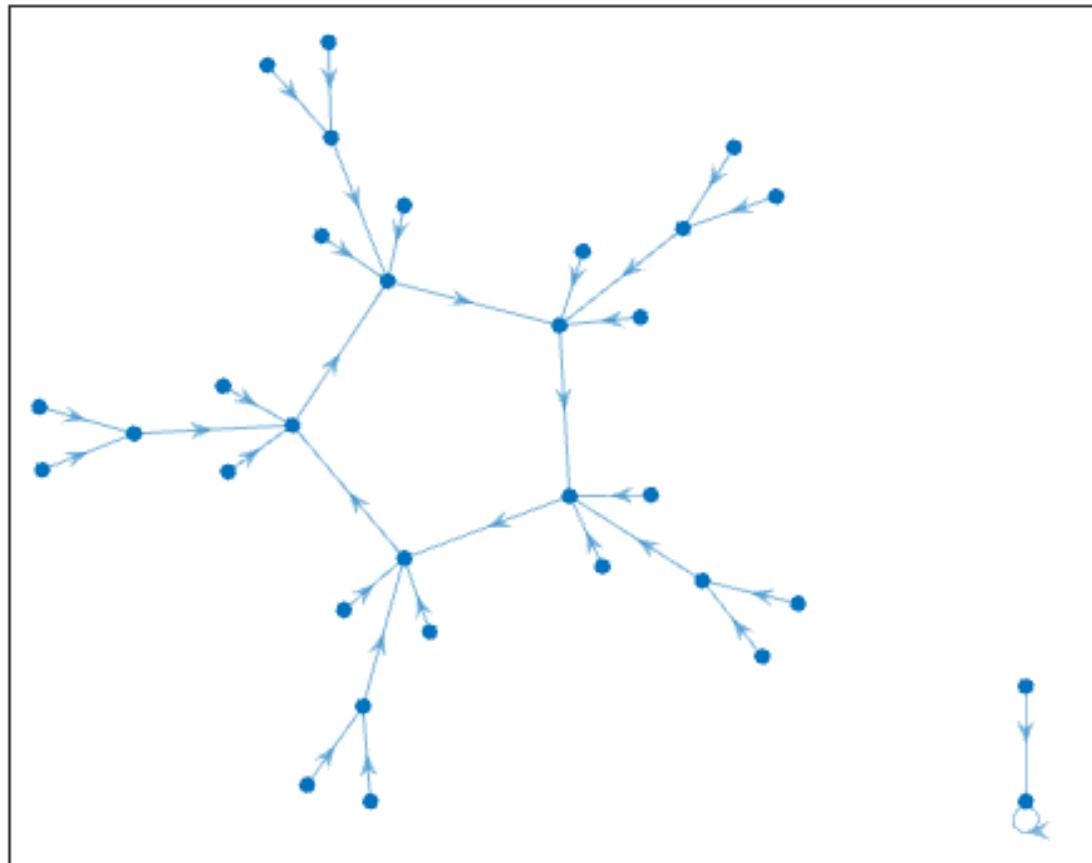


Figura 3.547: Atractor regla 46 n=4

Figura 3.548: Atractor regla 46 $n=5$

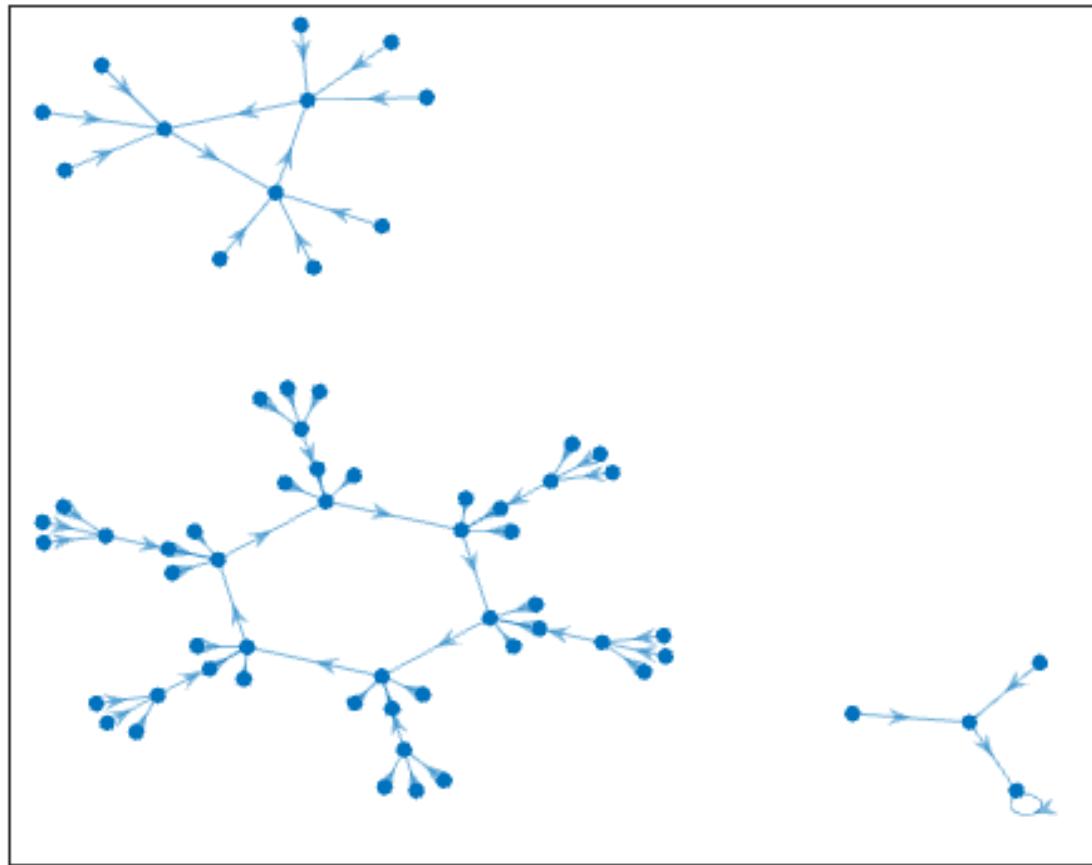


Figura 3.549: Atractor regla 46 n=6

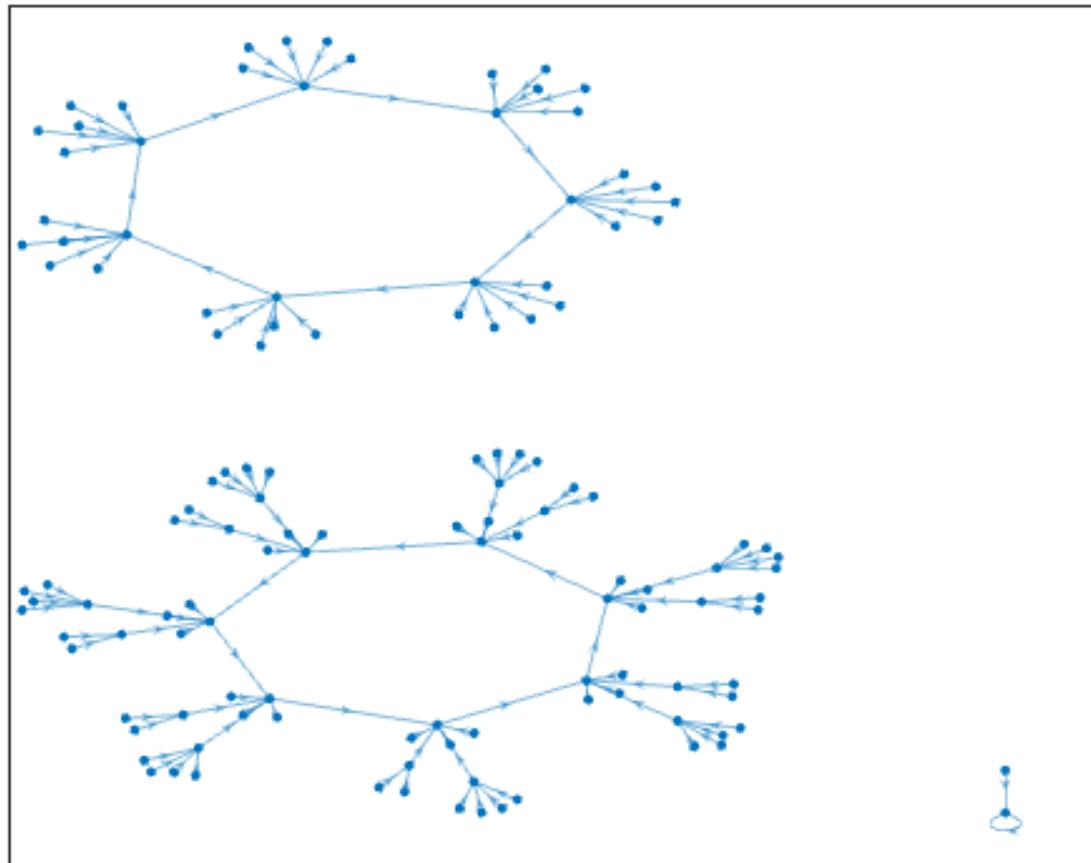
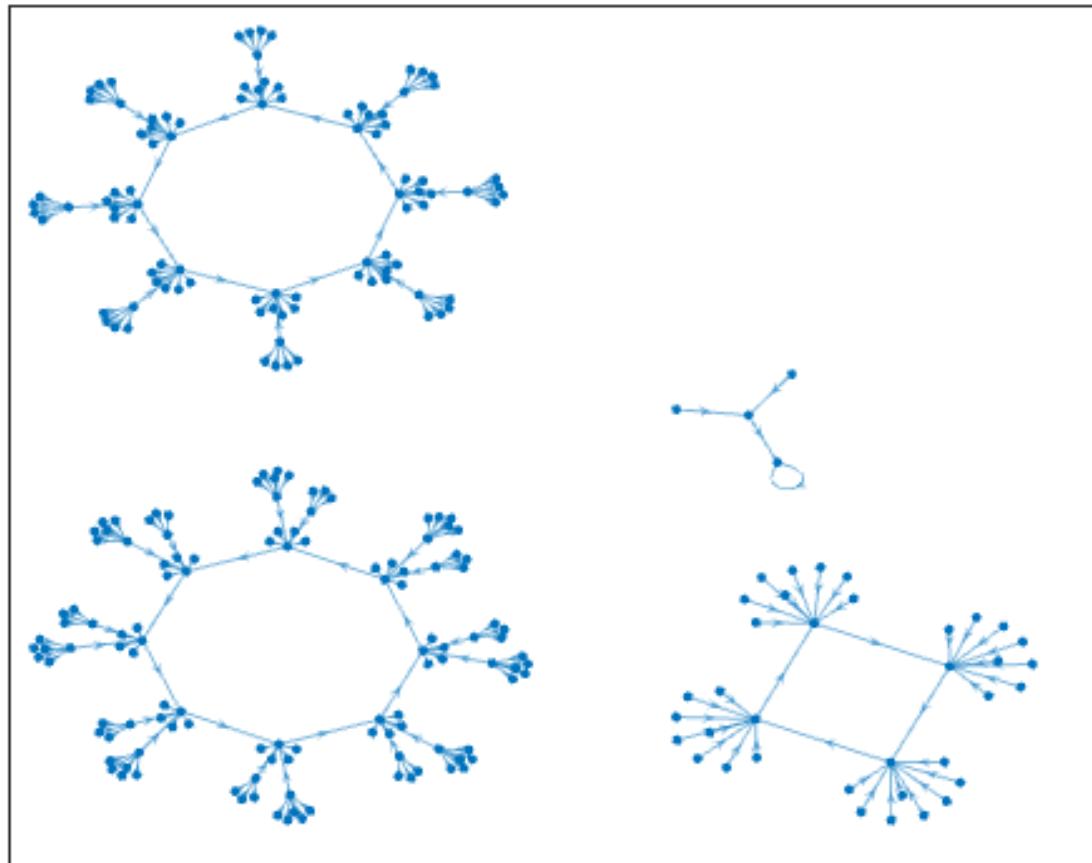
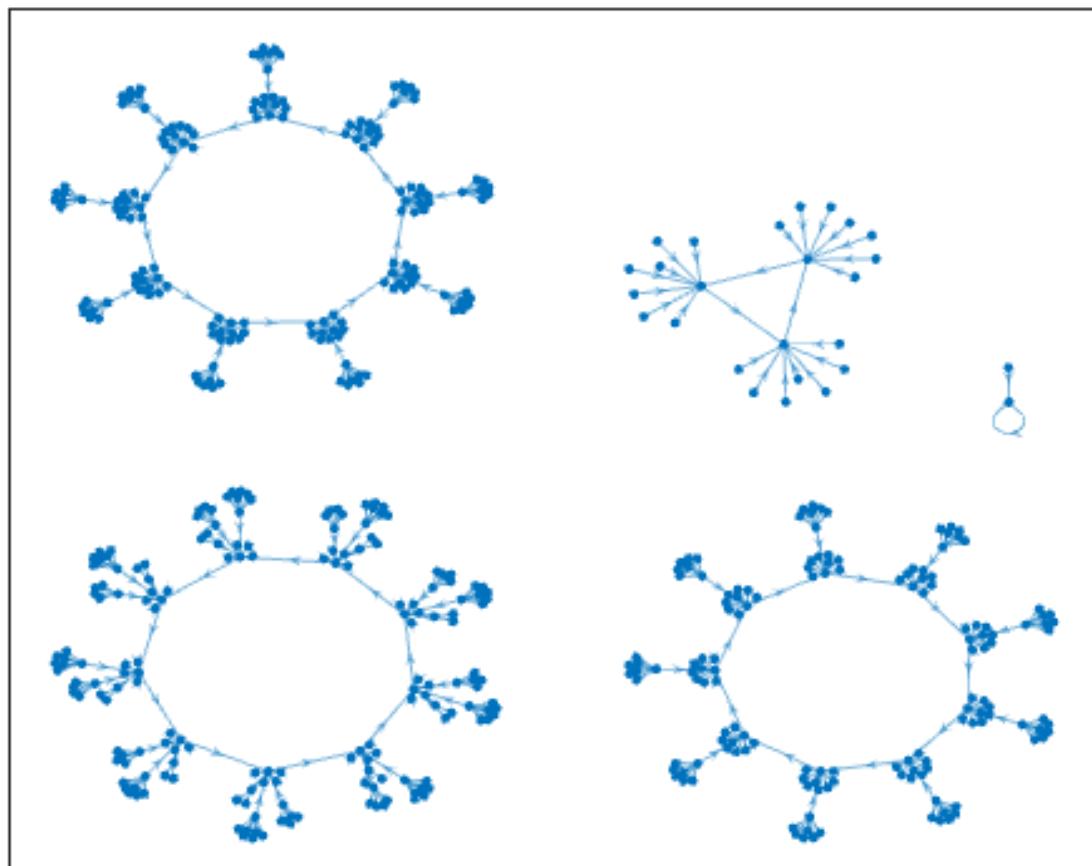


Figura 3.550: Atractor regla 46 $n=7$

Figura 3.551: Atractor regla 46 $n=8$

Figura 3.552: Atractor regla 46 $n=9$

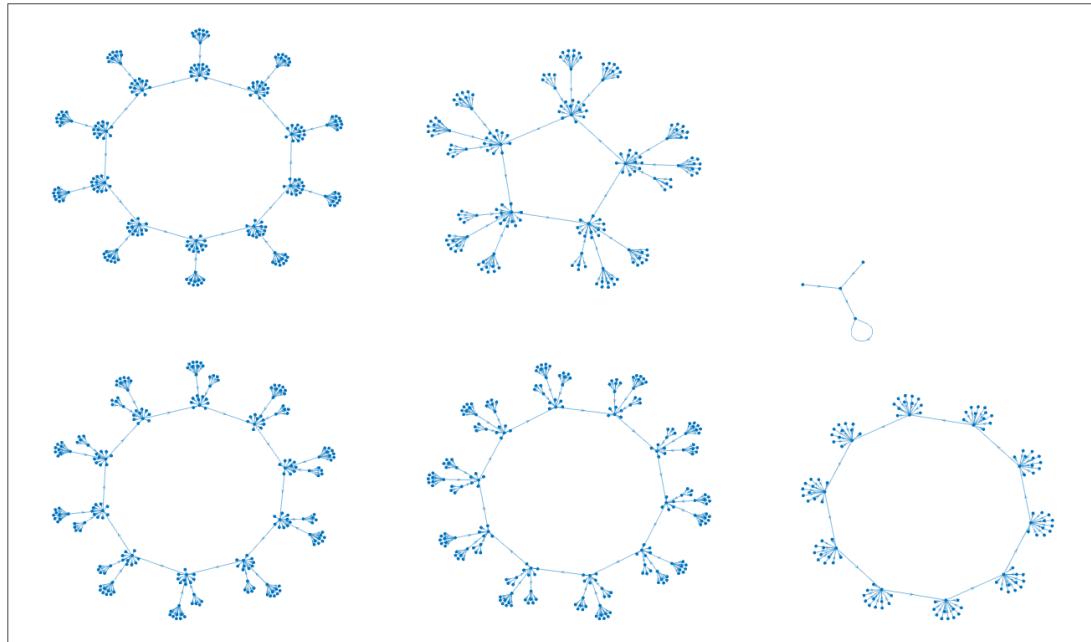


Figura 3.553: Atractor regla 46 n=10

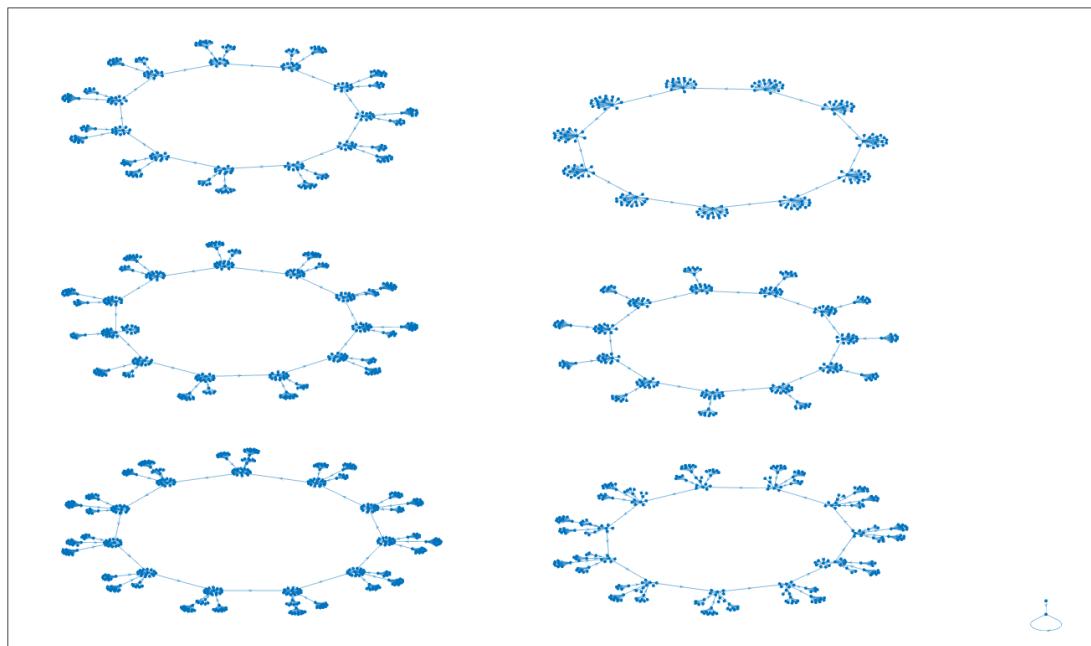
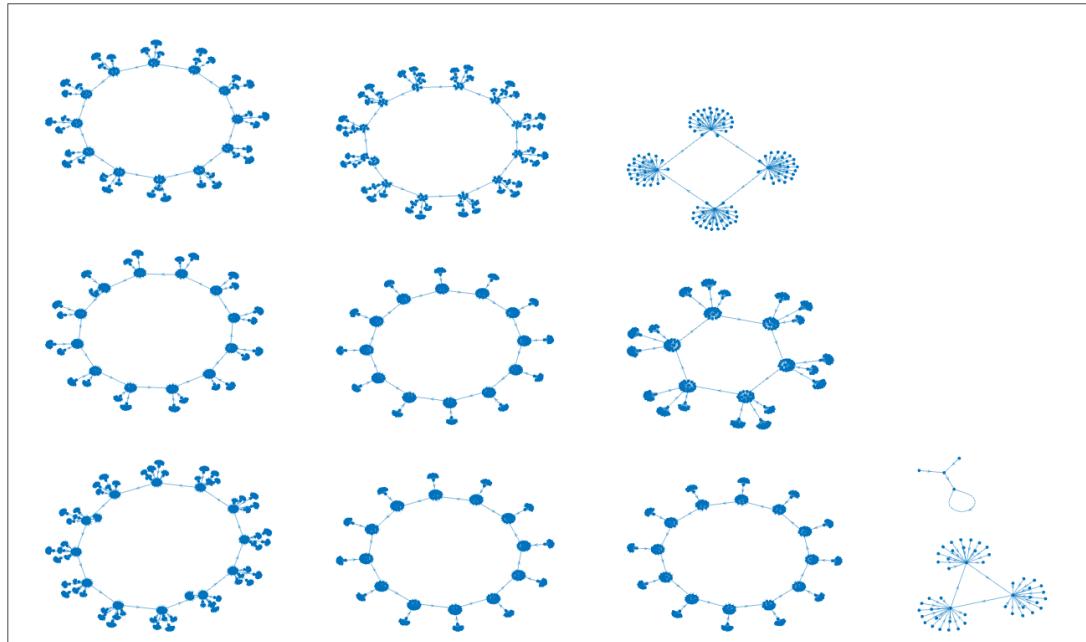
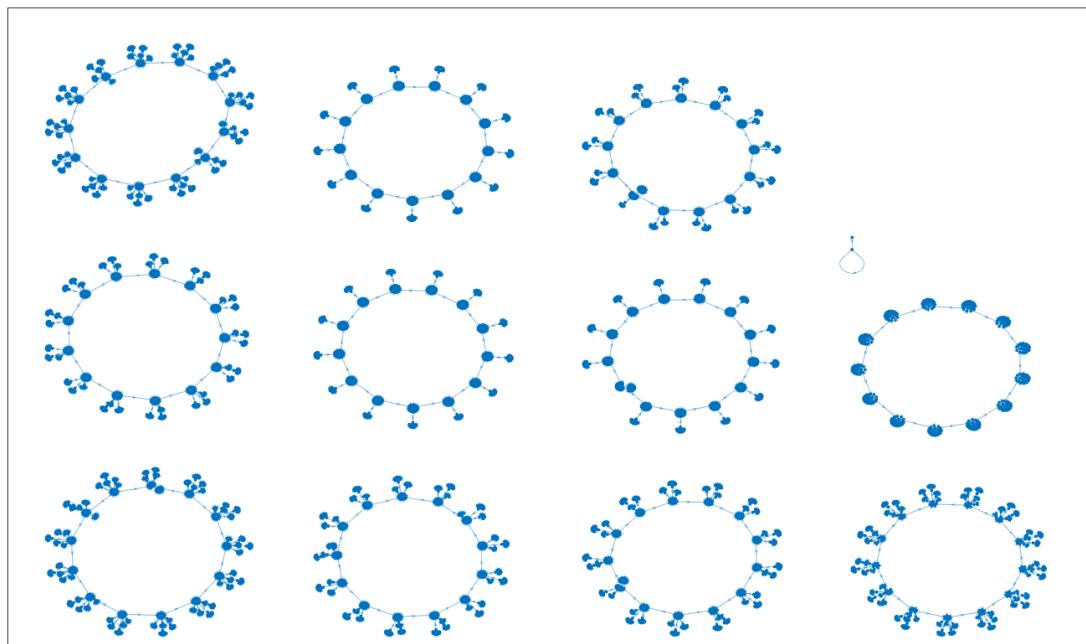


Figura 3.554: Atractor regla 46 n=11

Figura 3.555: Atractor regla 46 $n=12$ Figura 3.556: Atractor regla 46 $n=13$

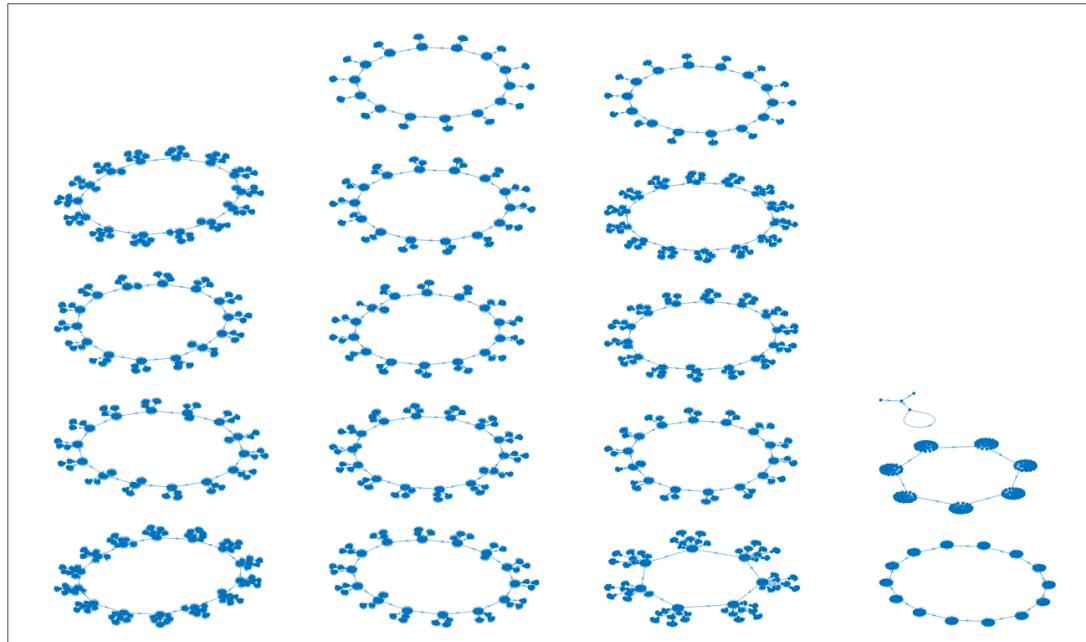


Figura 3.557: Atractor regla 46 n=14

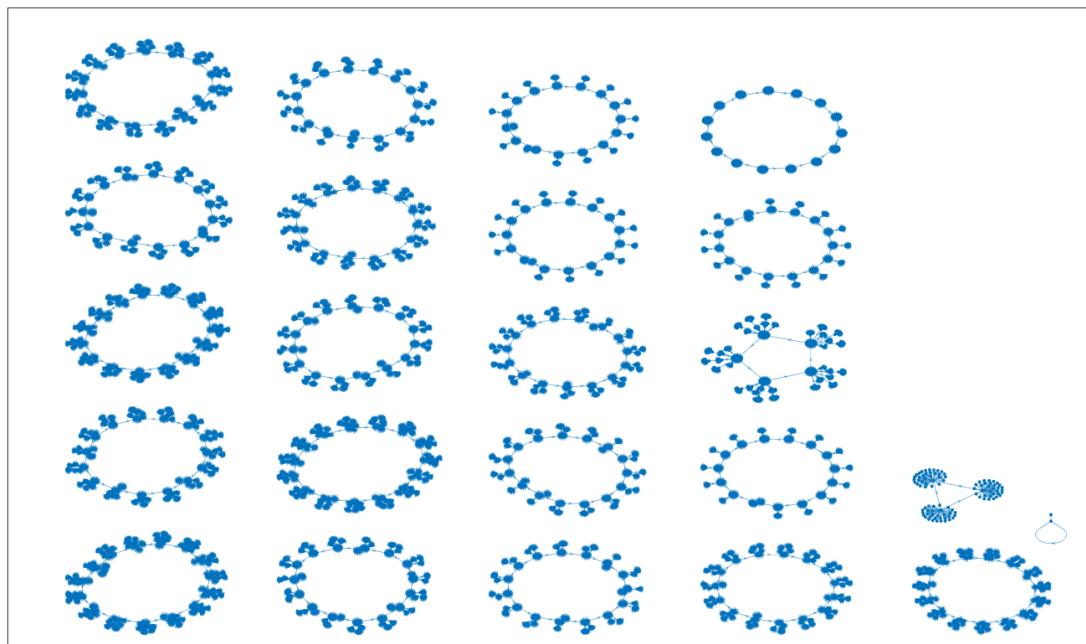


Figura 3.558: Atractor regla 46 n=15

3.42. Reglas 50,179

Respecto a la regla 50 se aprecia que mientras más grande es el tamaño de la cadena (n) siempre se mantiene presente la estructura que se crea con $n=2$, observe la figura que se encuentra abajo, esa estructura es la que siempre aparece en cada imagen, se mantiene constante.

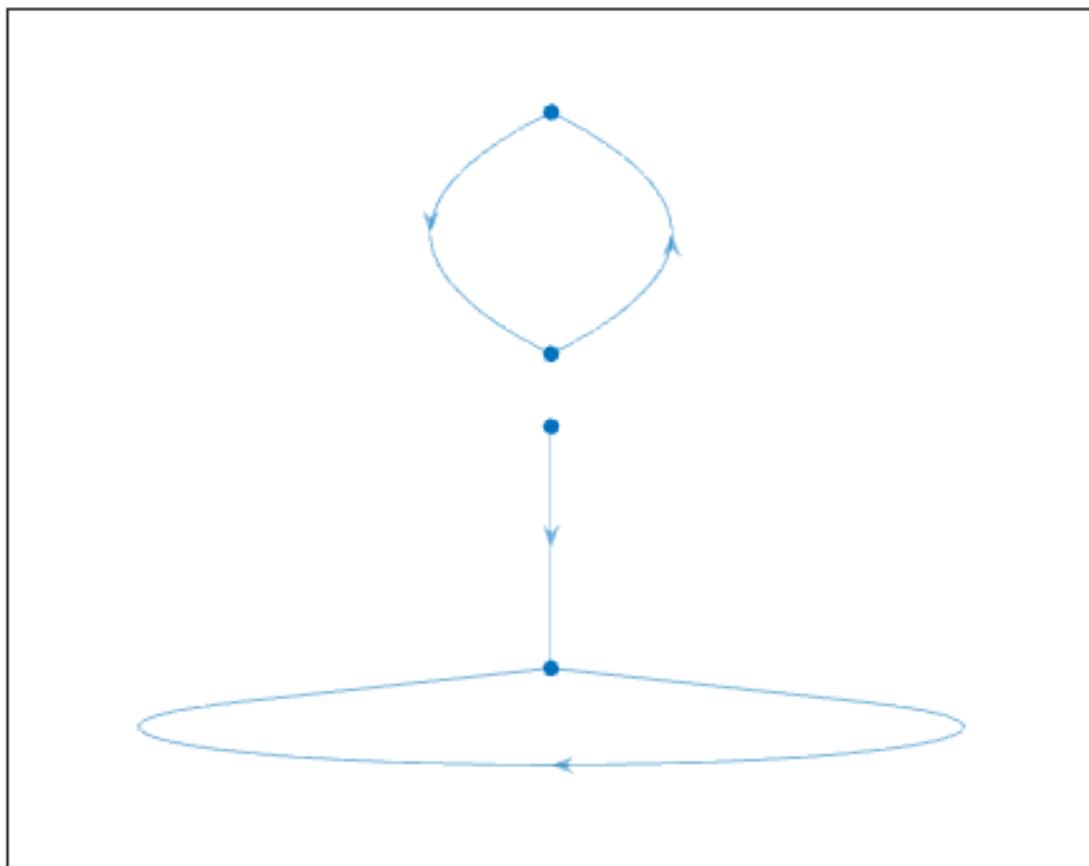


Figura 3.559: Atractor regla 50 $n=2$

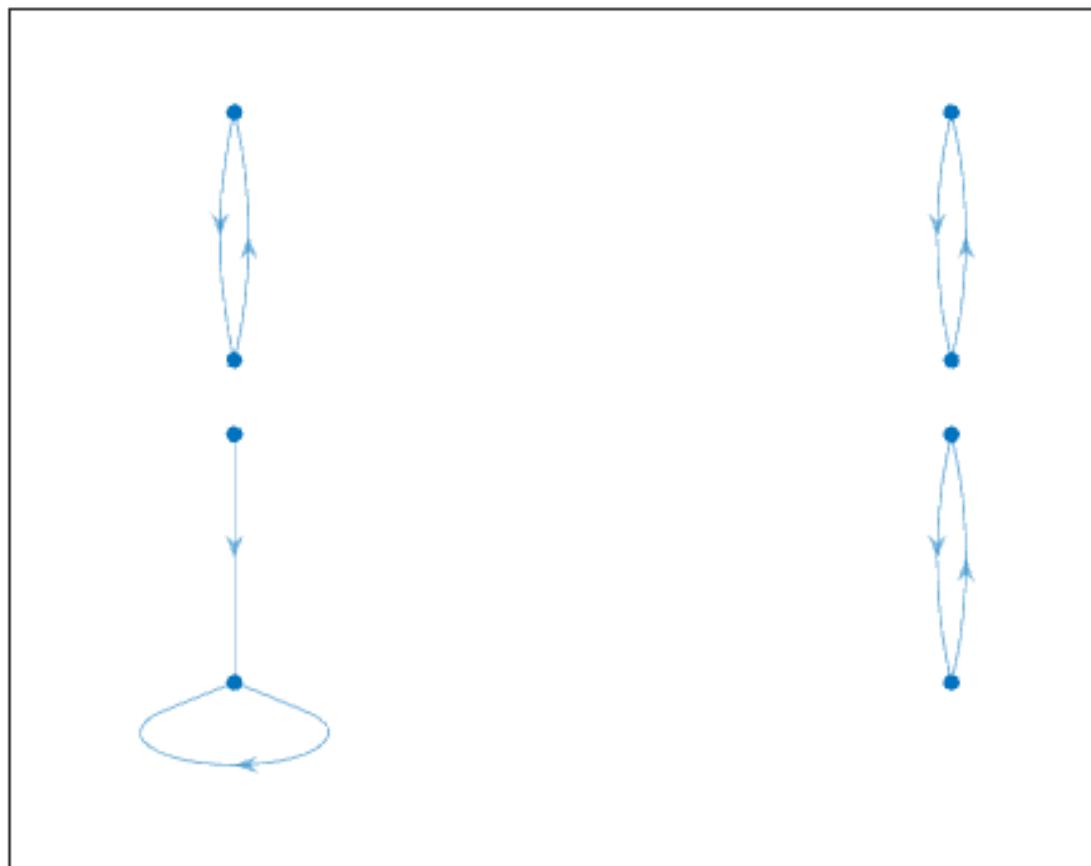


Figura 3.560: Atractor regla 50 n=3

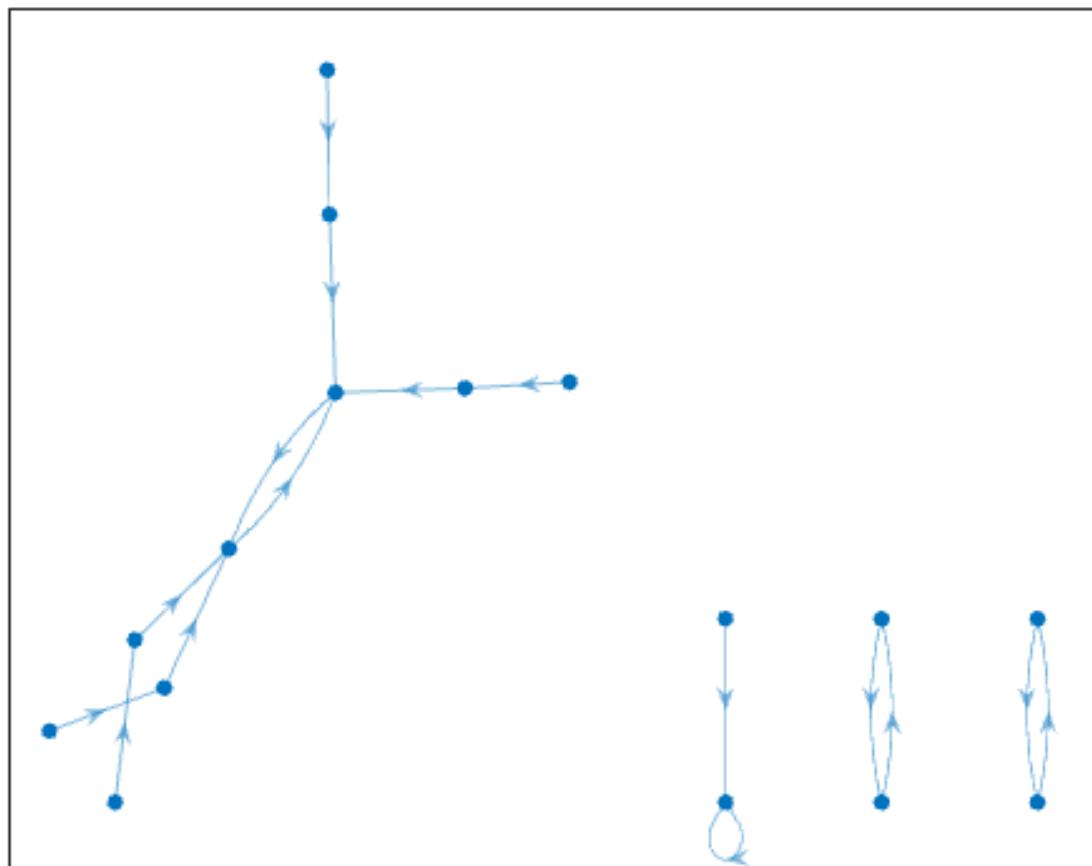


Figura 3.561: Atractor regla 50 n=4

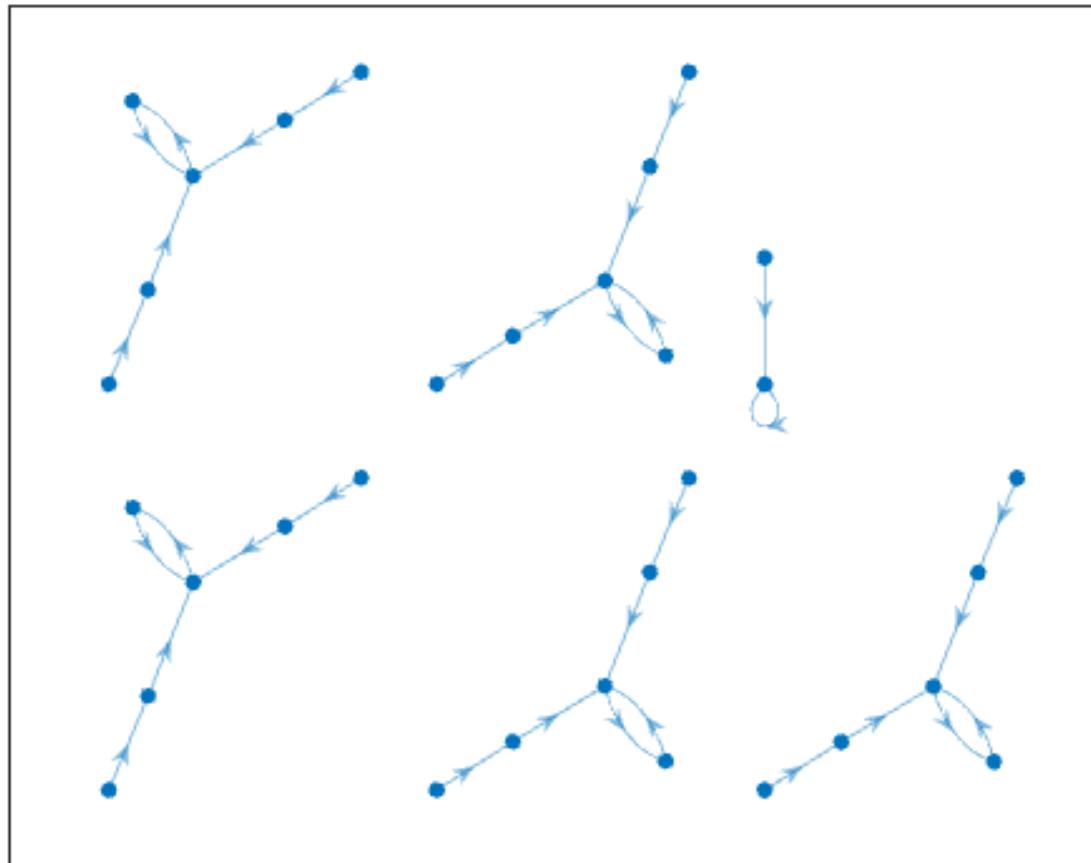


Figura 3.562: Atractor regla 50 n=5

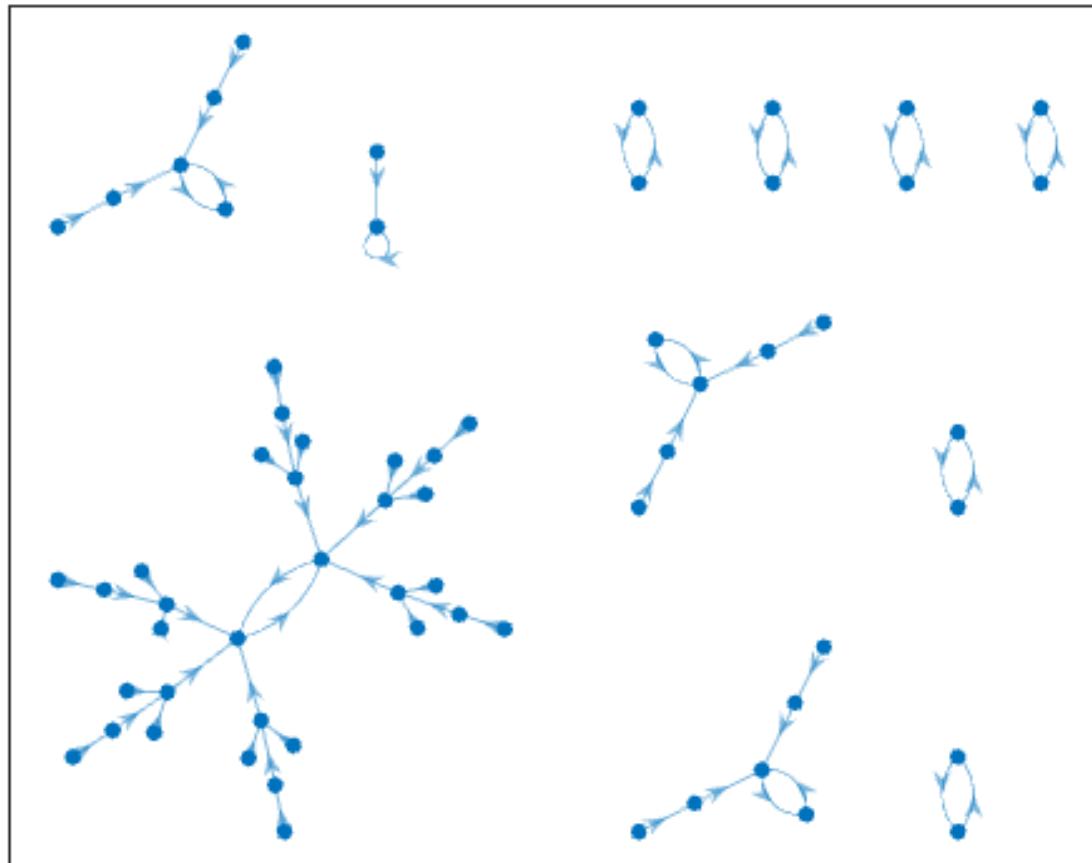


Figura 3.563: Atractor regla 50 n=6

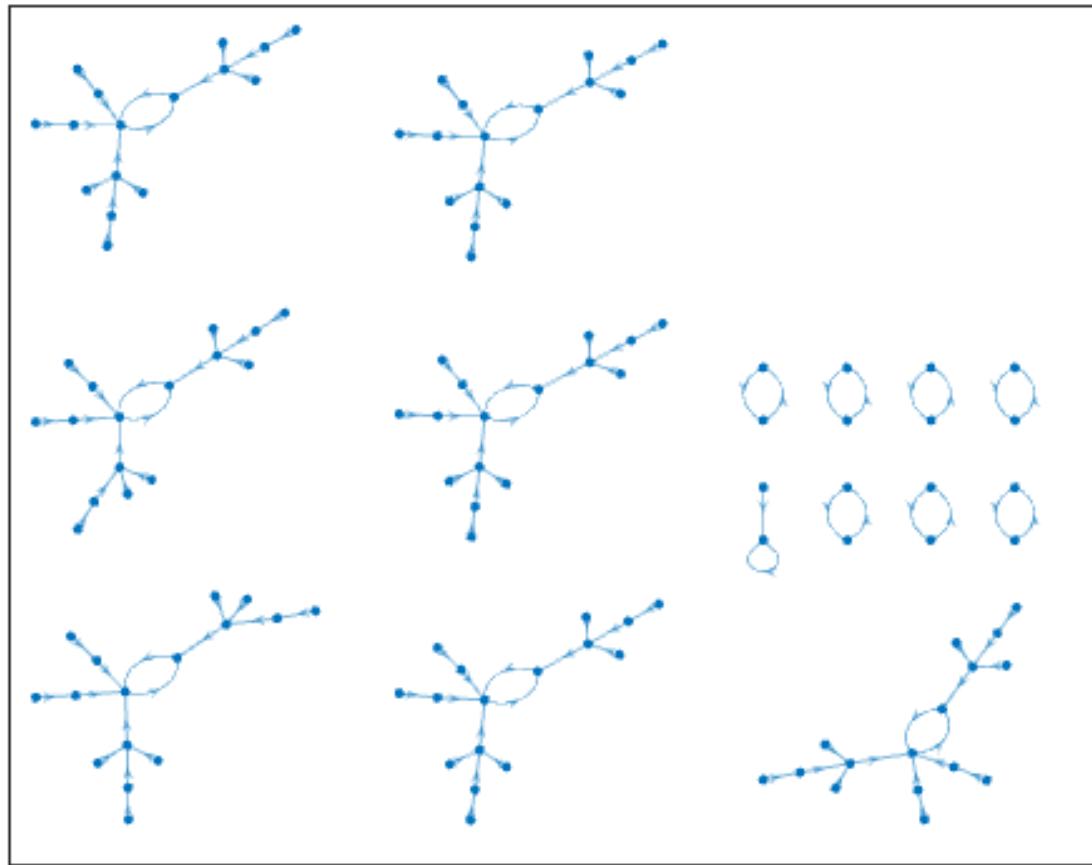


Figura 3.564: Atractor regla 50 n=7

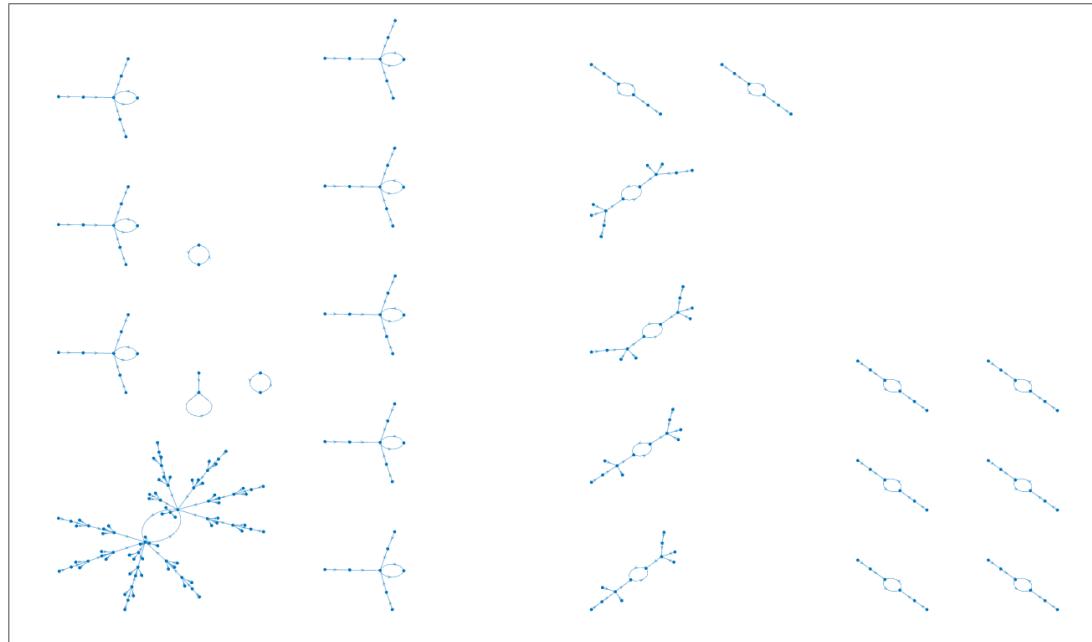


Figura 3.565: Atractor regla 50 n=8

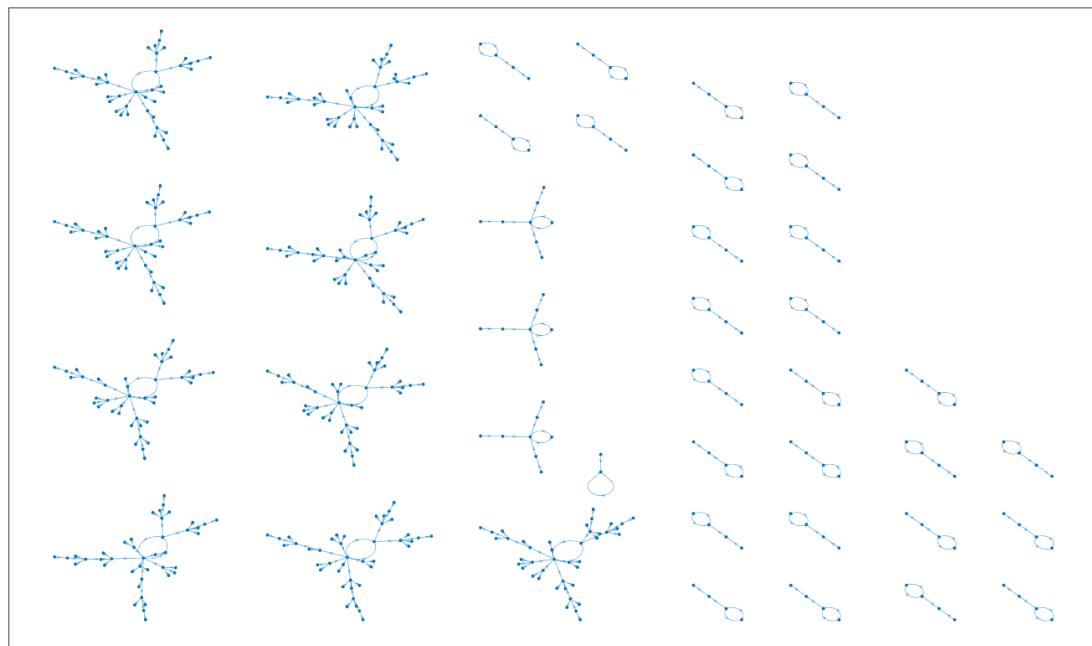


Figura 3.566: Atractor regla 50 n=9

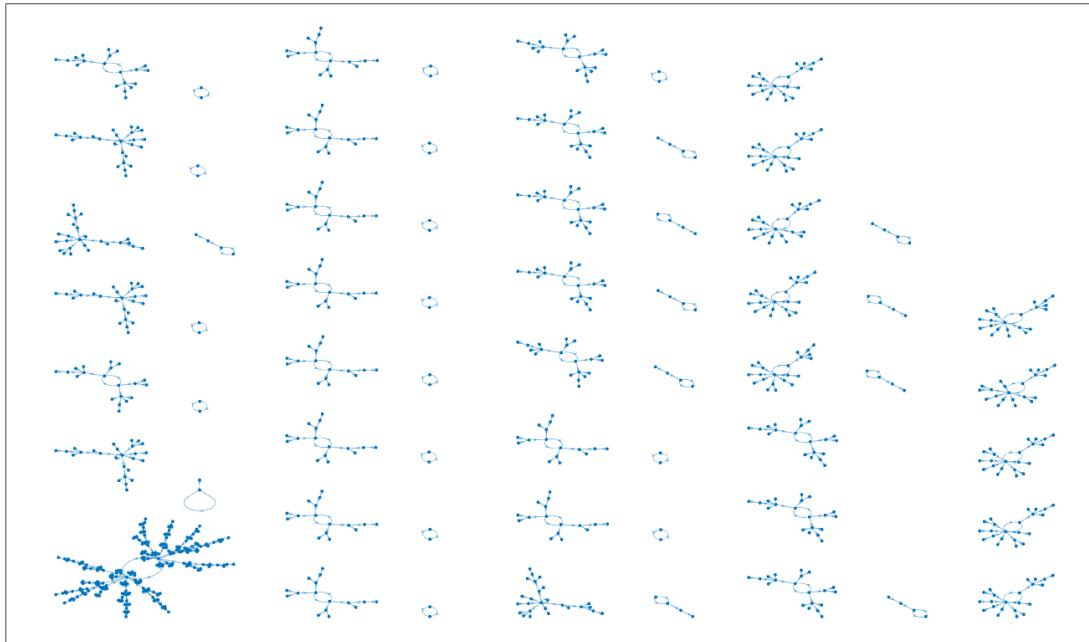


Figura 3.567: Atractor regla 50 n=10

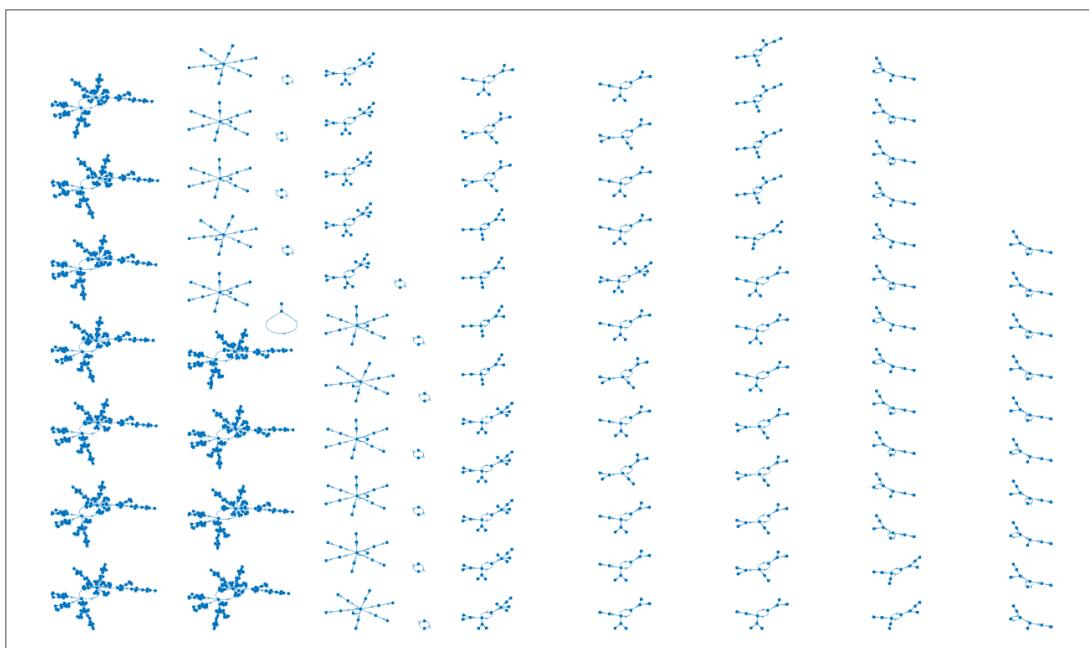


Figura 3.568: Atractor regla 50 n=11

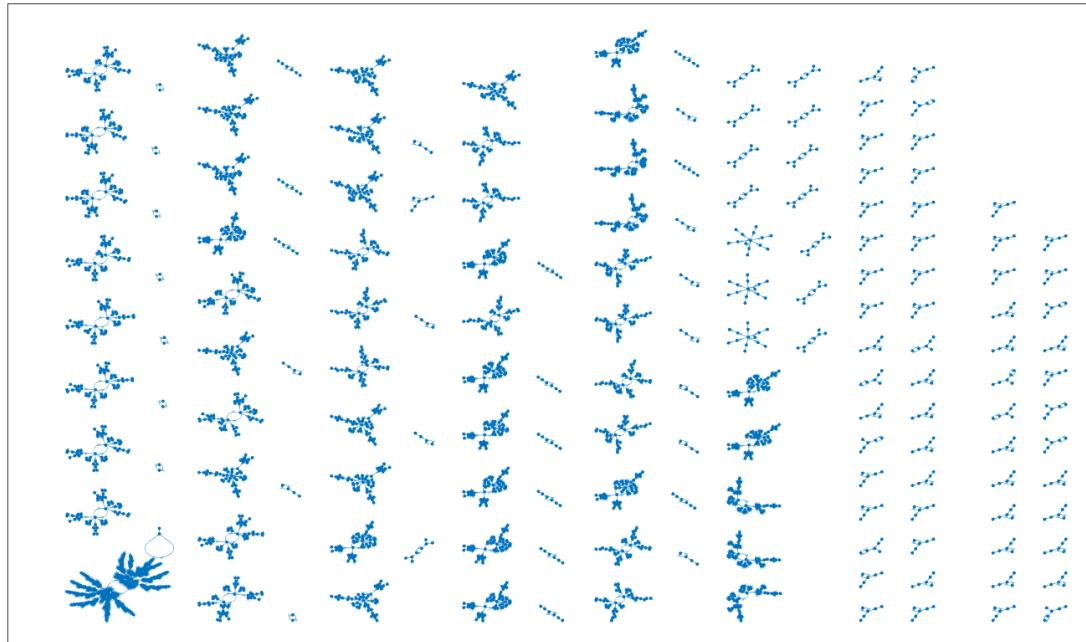


Figura 3.569: Atractor regla 50 n=12

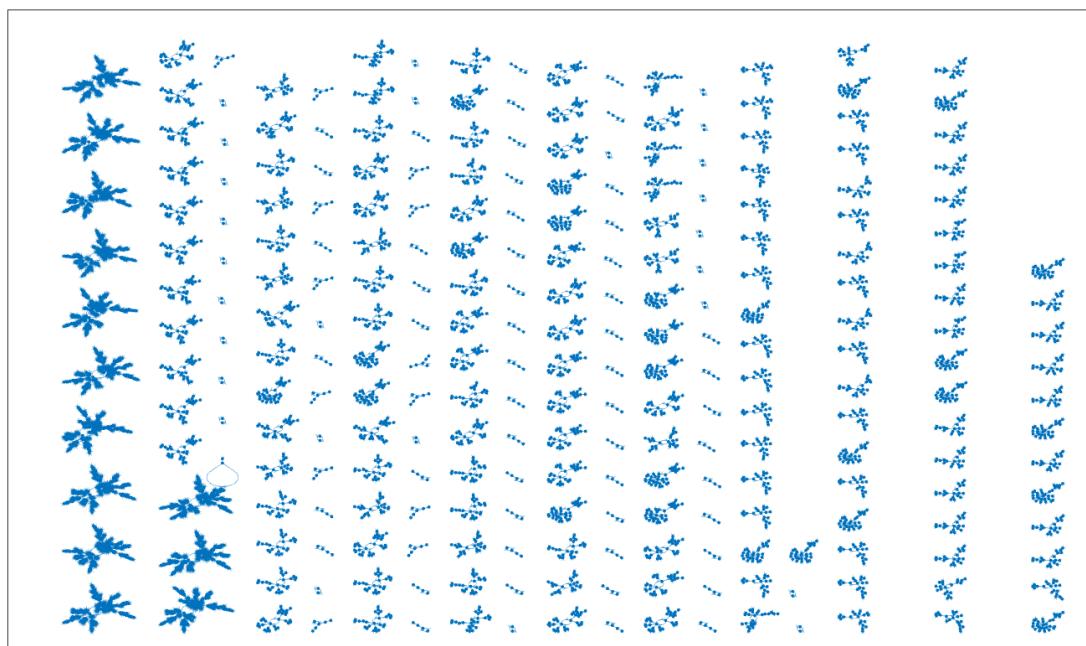


Figura 3.570: Atractor regla 50 n=13

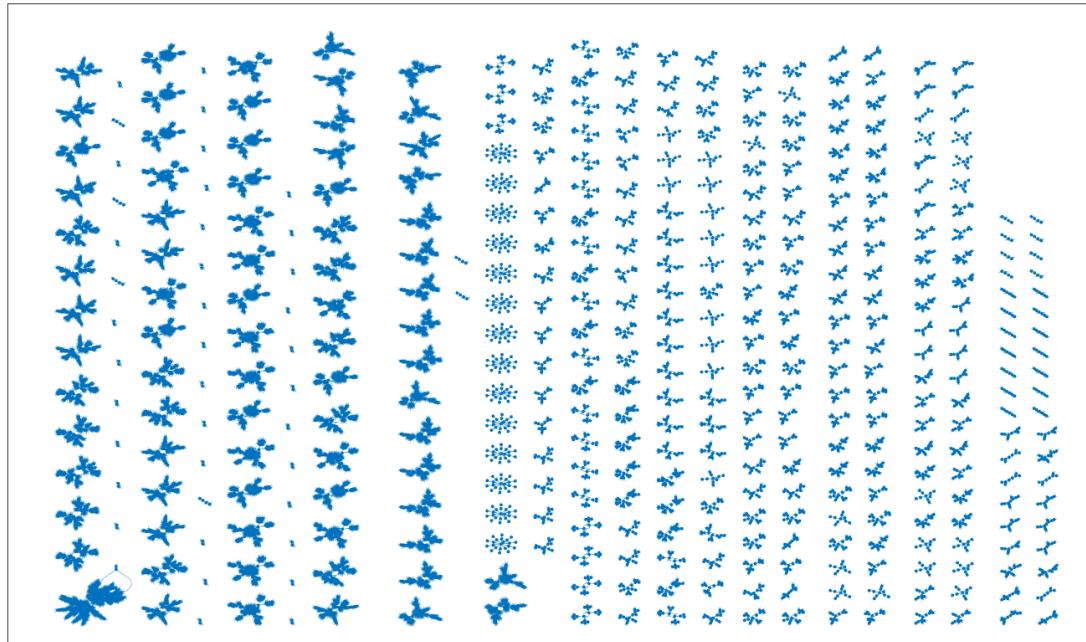


Figura 3.571: Atractor regla 50 n=14

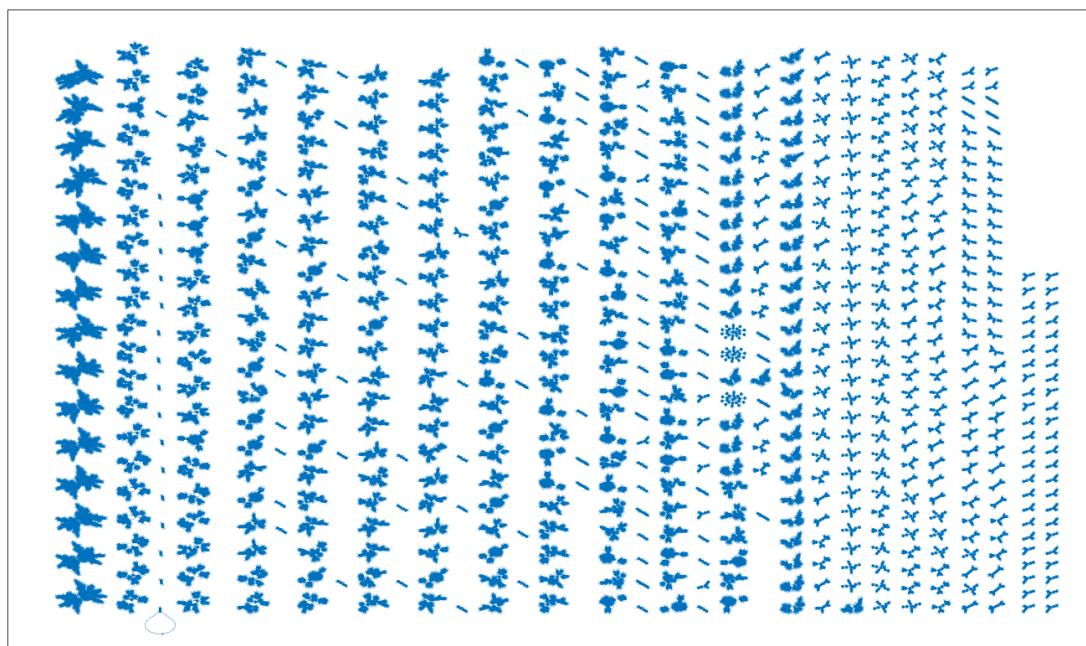


Figura 3.572: Atractor regla 50 n=15

3.43. Reglas 51

Respecto a la regla 35 se aprecia que mientras más grande es el tamaño de la cadena (n) desde le principio hasta el final solo se están creando atractores cílicos entre 2 nodos.

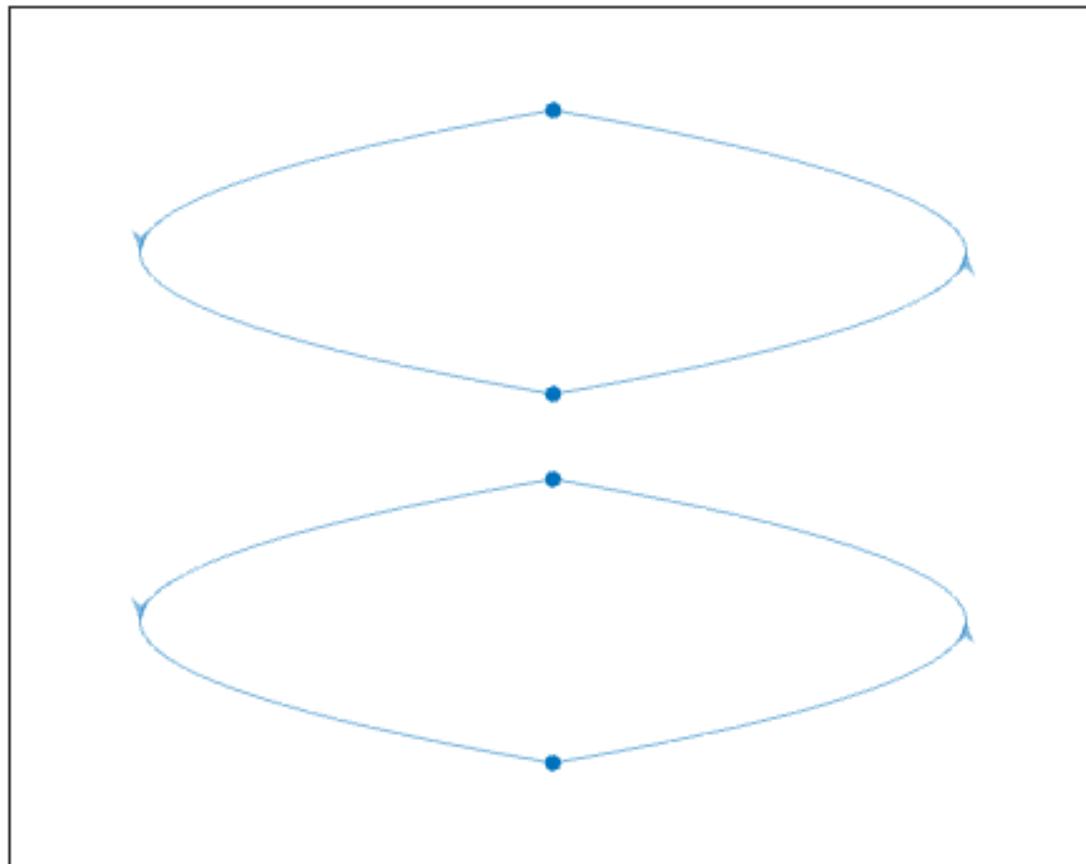


Figura 3.573: Atractor regla 51 $n=2$

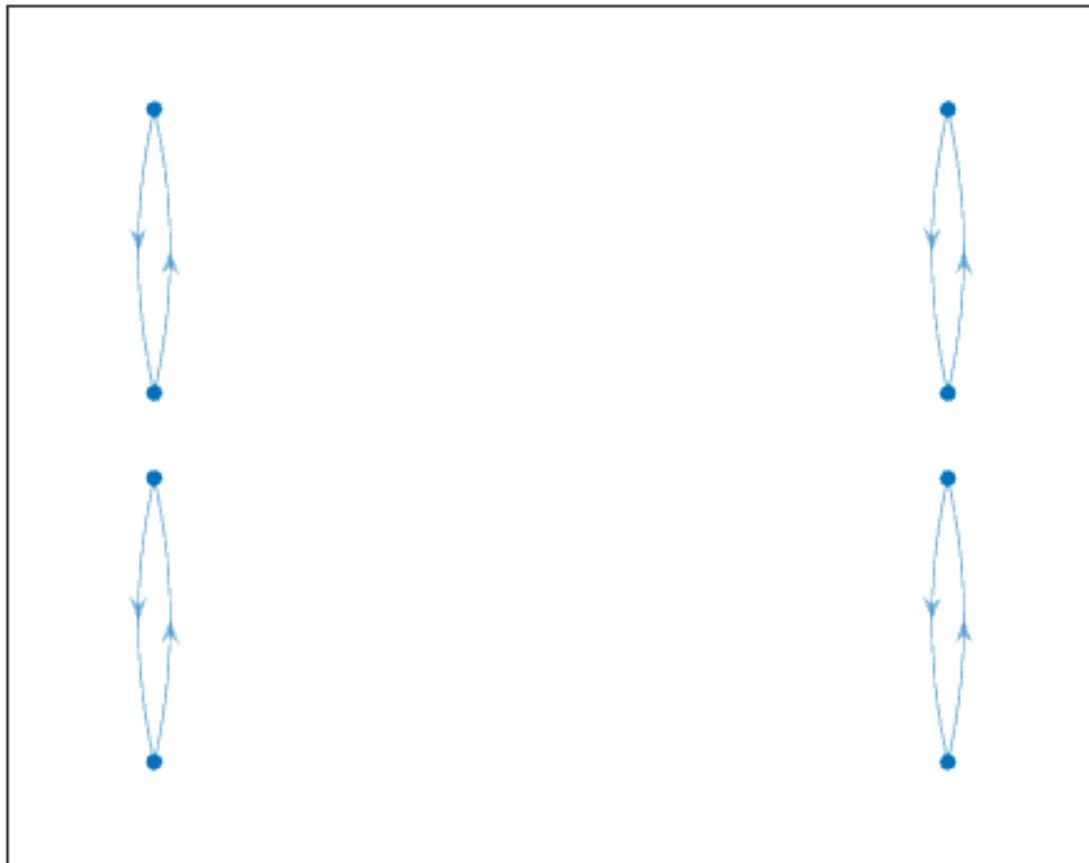


Figura 3.574: Atractor regla 51 n=3

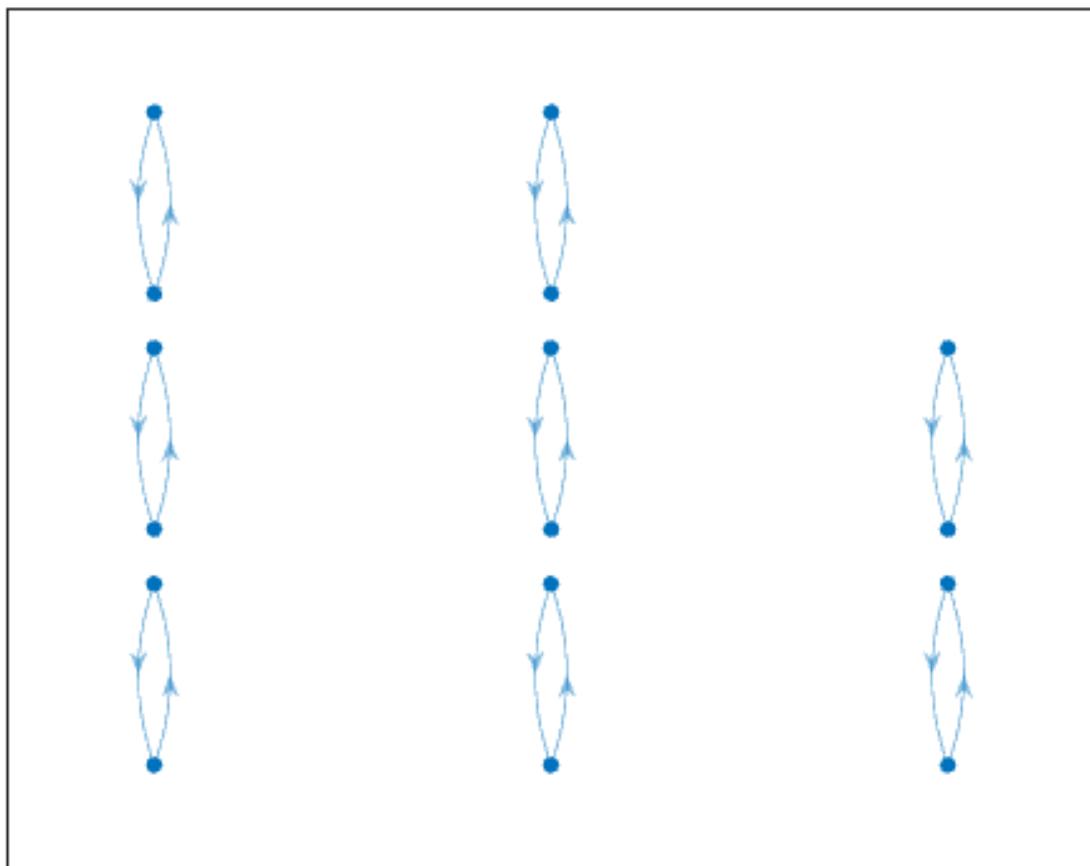


Figura 3.575: Atractor regla 51 n=4

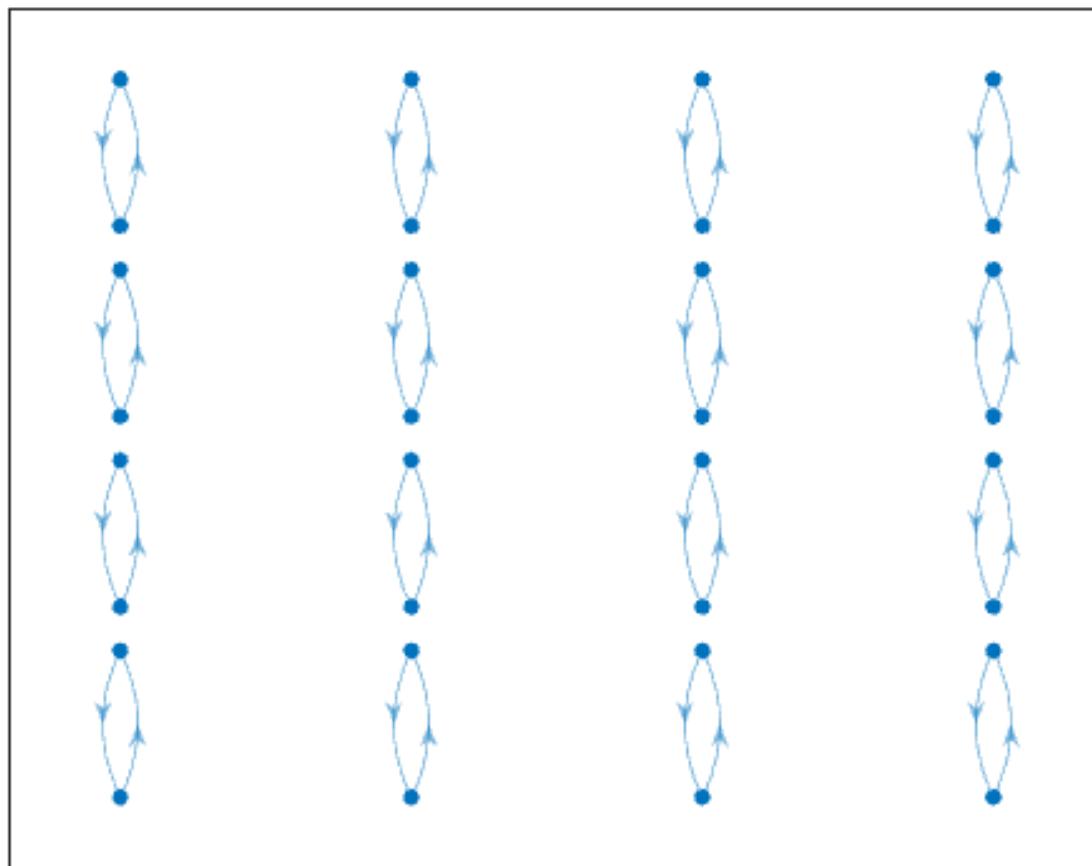


Figura 3.576: Atractor regla 51 n=5

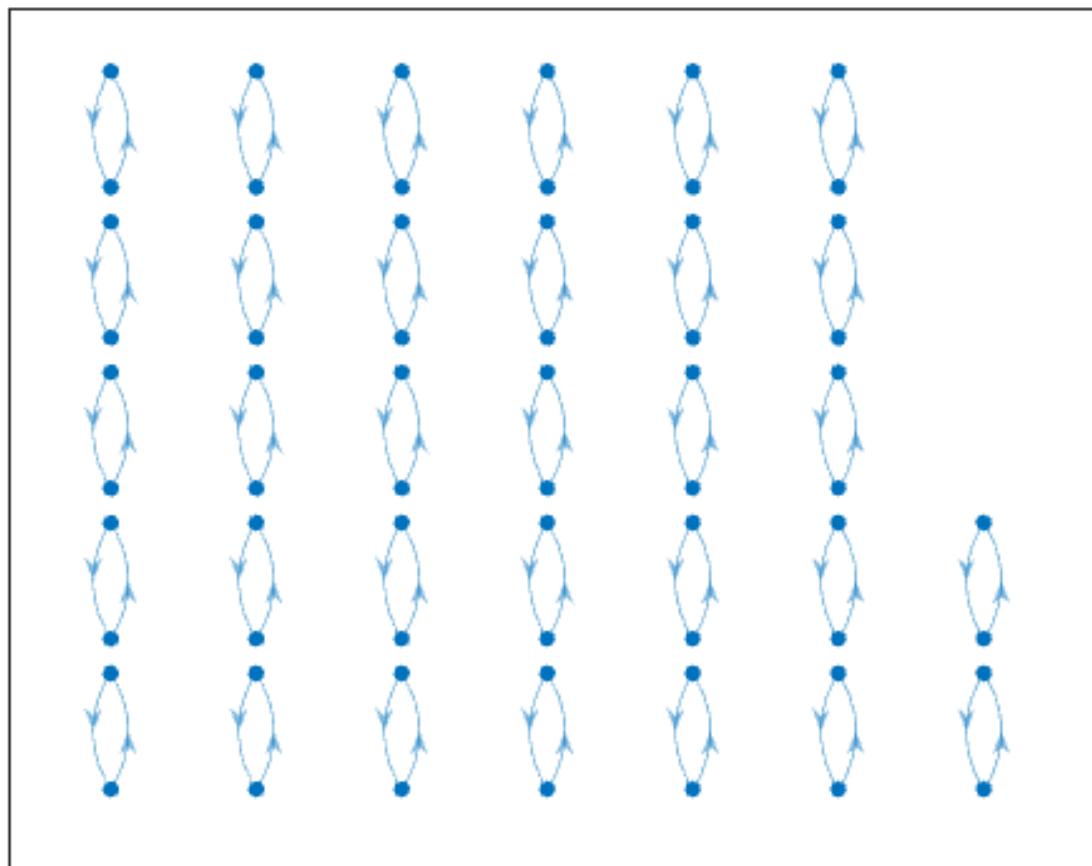


Figura 3.577: Atractor regla 51 n=6

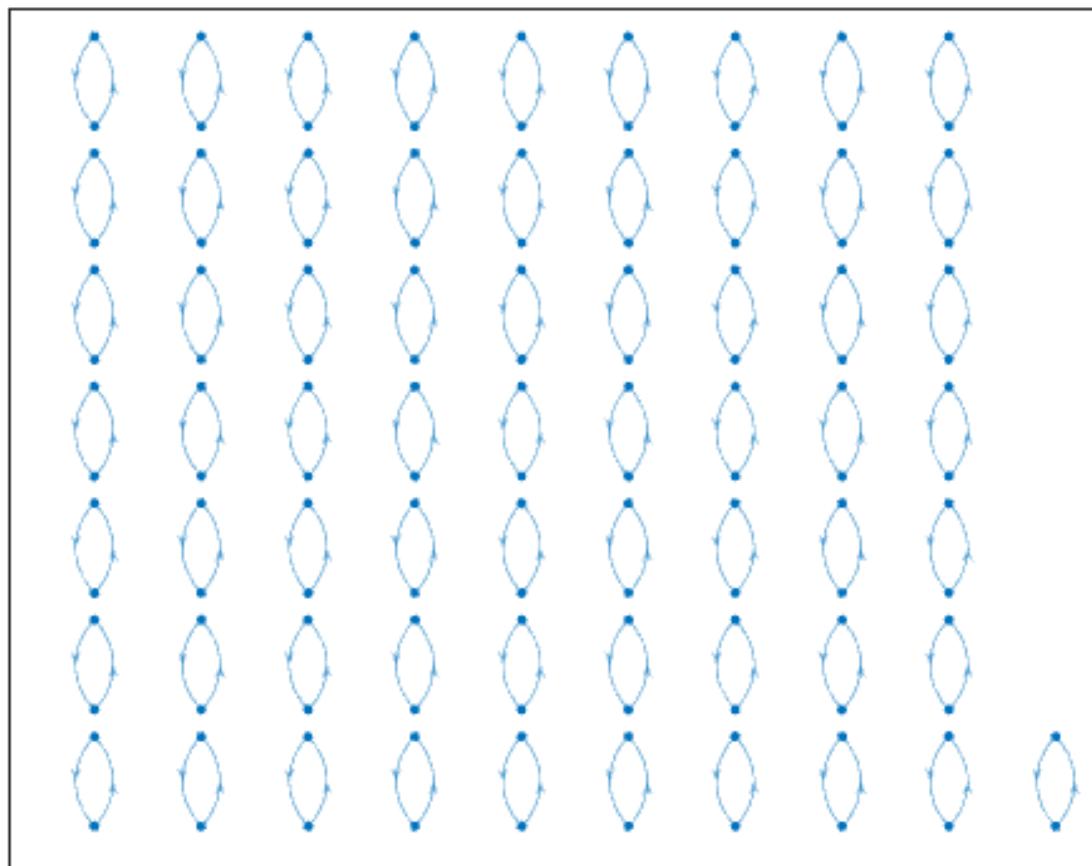


Figura 3.578: Atractor regla 51 n=7

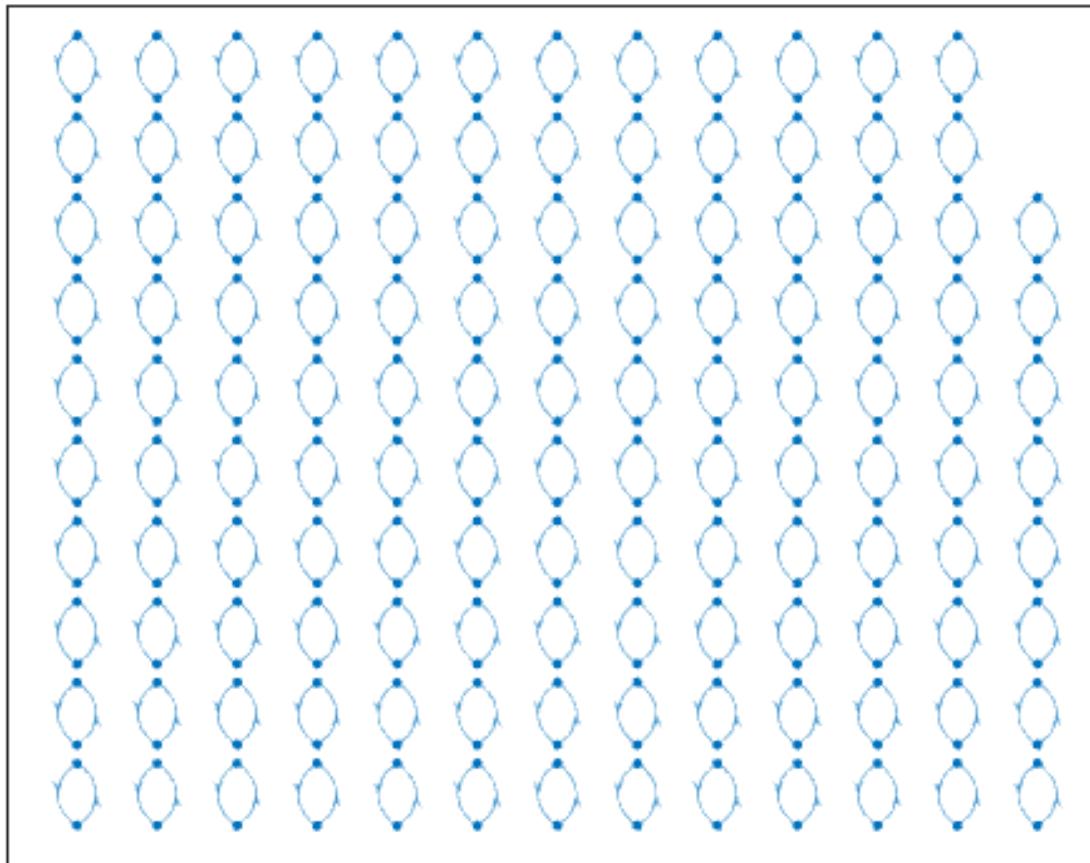


Figura 3.579: Atractor regla 51 n=8

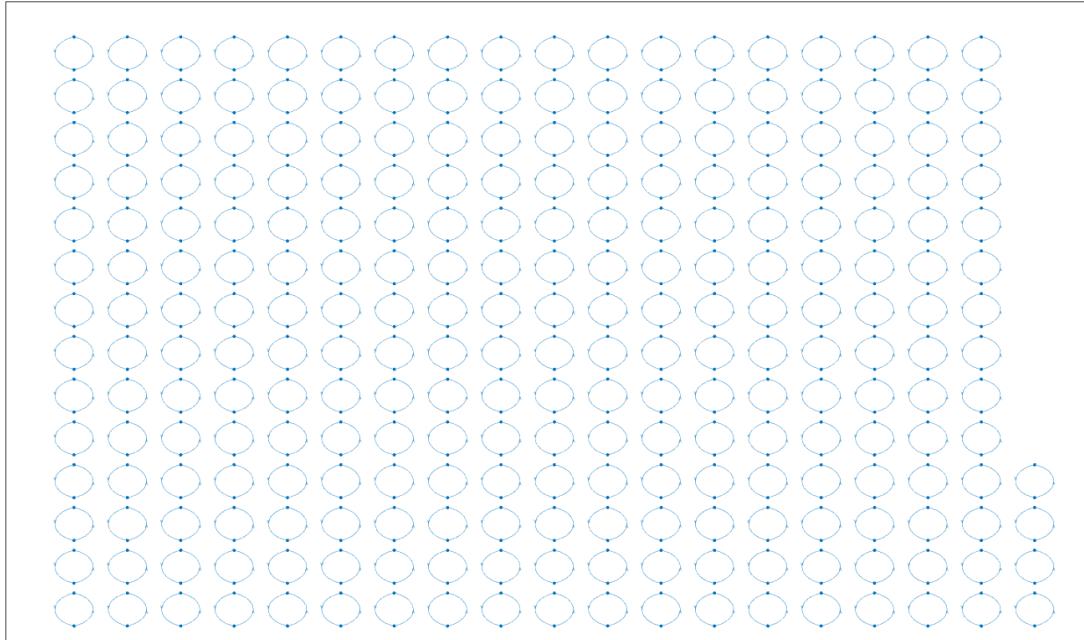


Figura 3.580: Atractor regla 51 n=9

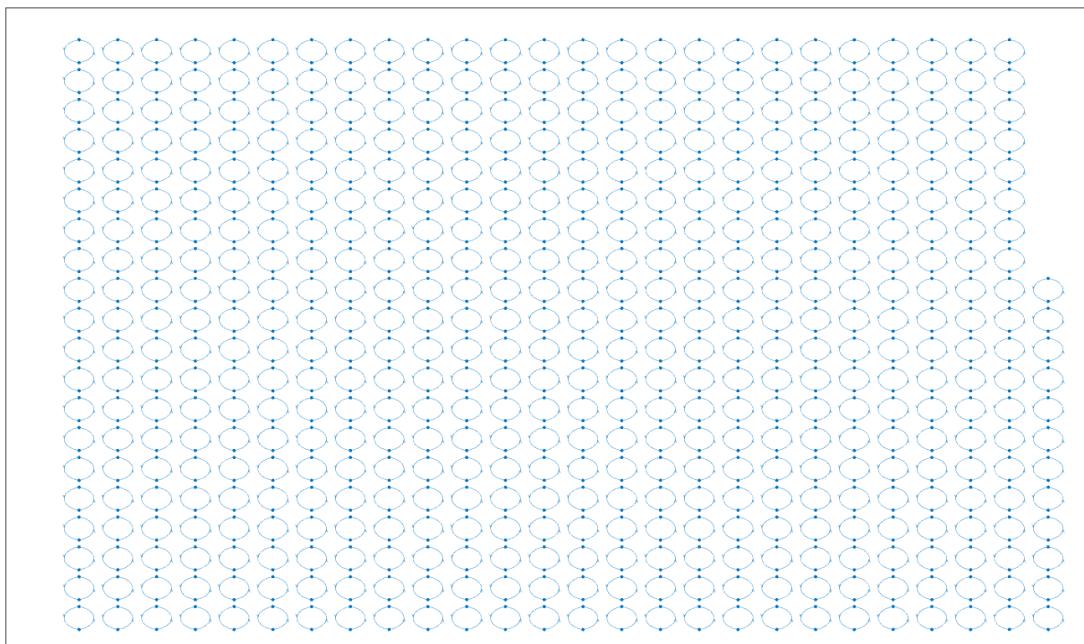


Figura 3.581: Atractor regla 51 n=10

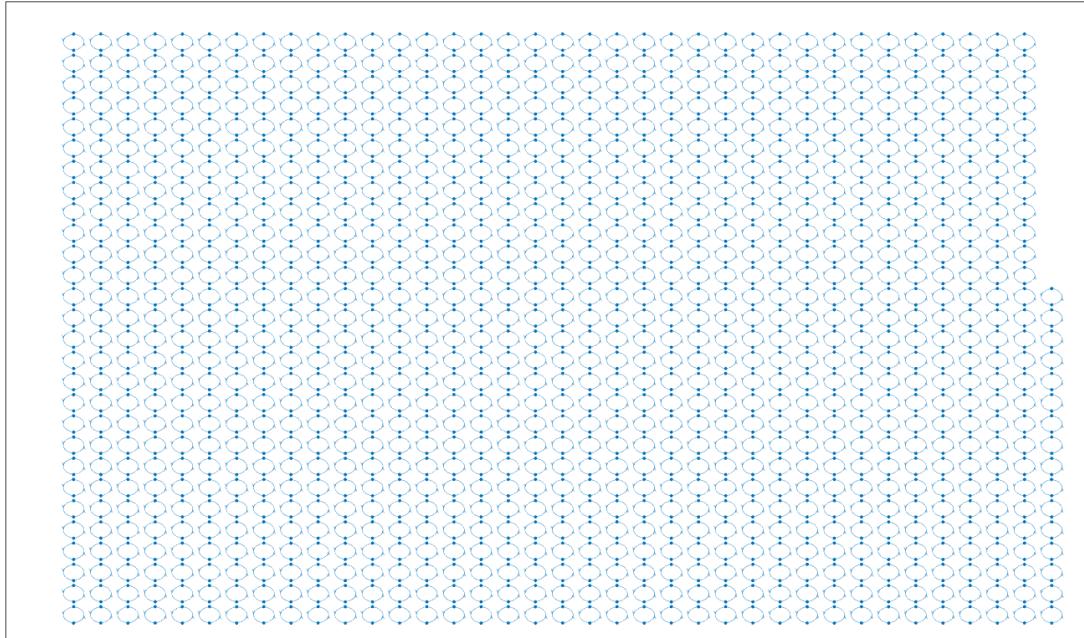


Figura 3.582: Atractor regla 51 n=11

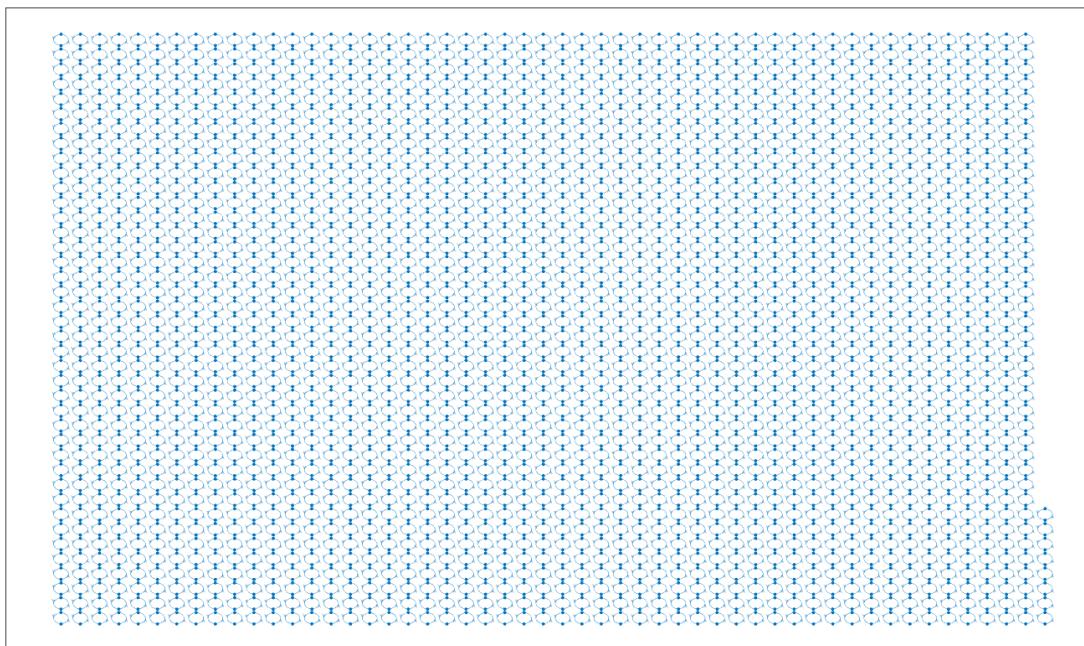


Figura 3.583: Atractor regla 51 n=12

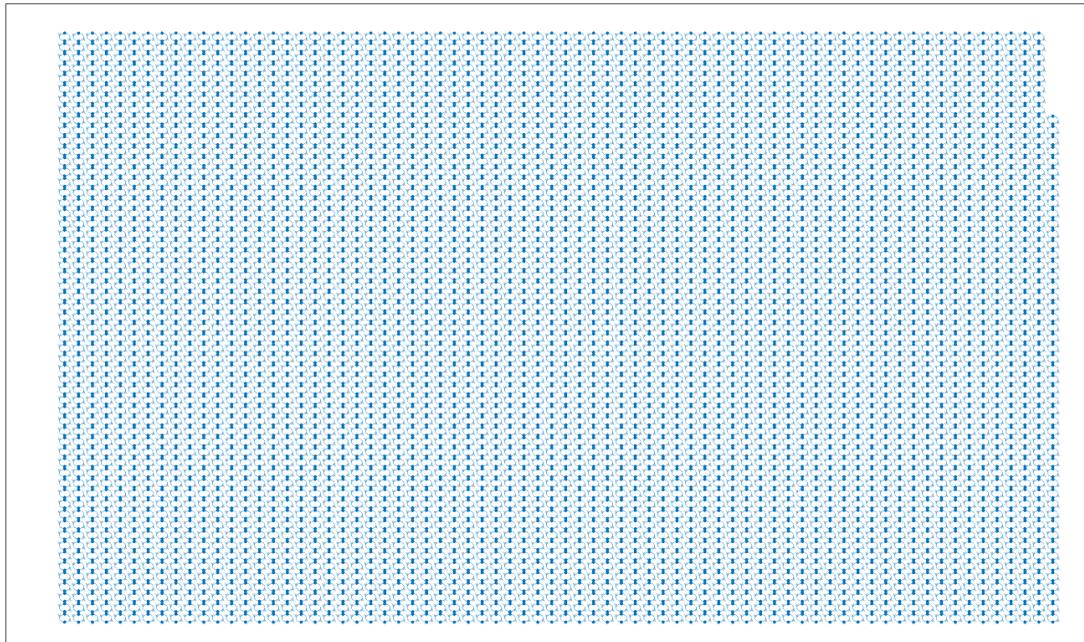


Figura 3.584: Atractor regla 51 n=13



Figura 3.585: Atractor regla 51 n=14

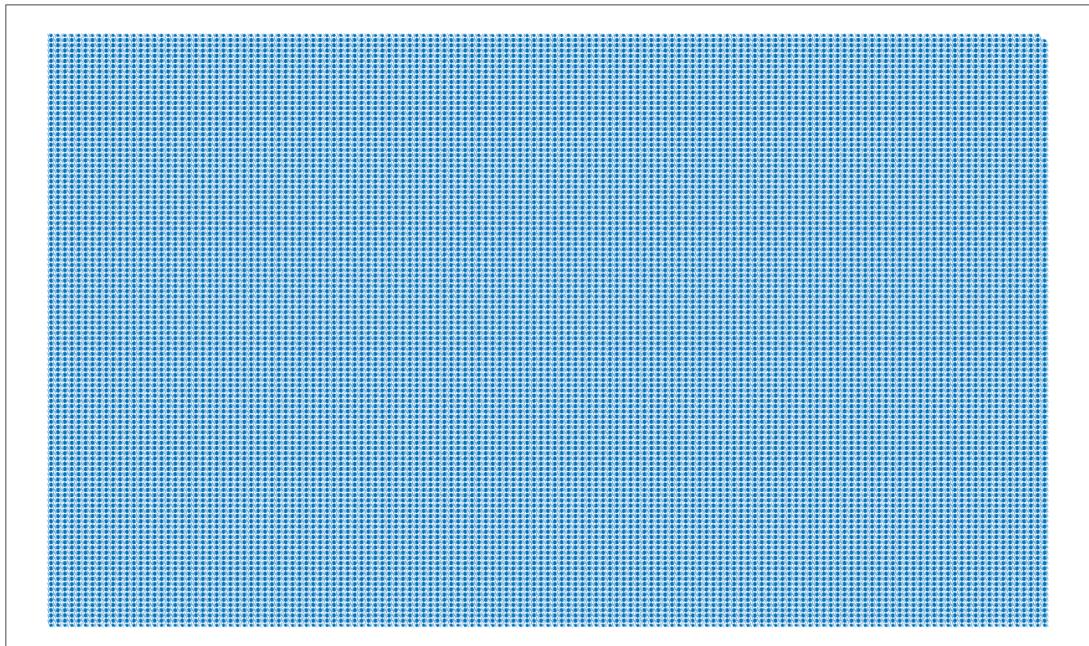


Figura 3.586: Atractor regla 51 n=15

3.44. Reglas 54,147

Respecto a la regla 54 se aprecia que mientras más grande es el tamaño de la cadena (n) observamos que, como en otras reglas se forman copias de atractores que van evolucionando a la par o que tienen el mismo comportamiento con cada incremento de n .

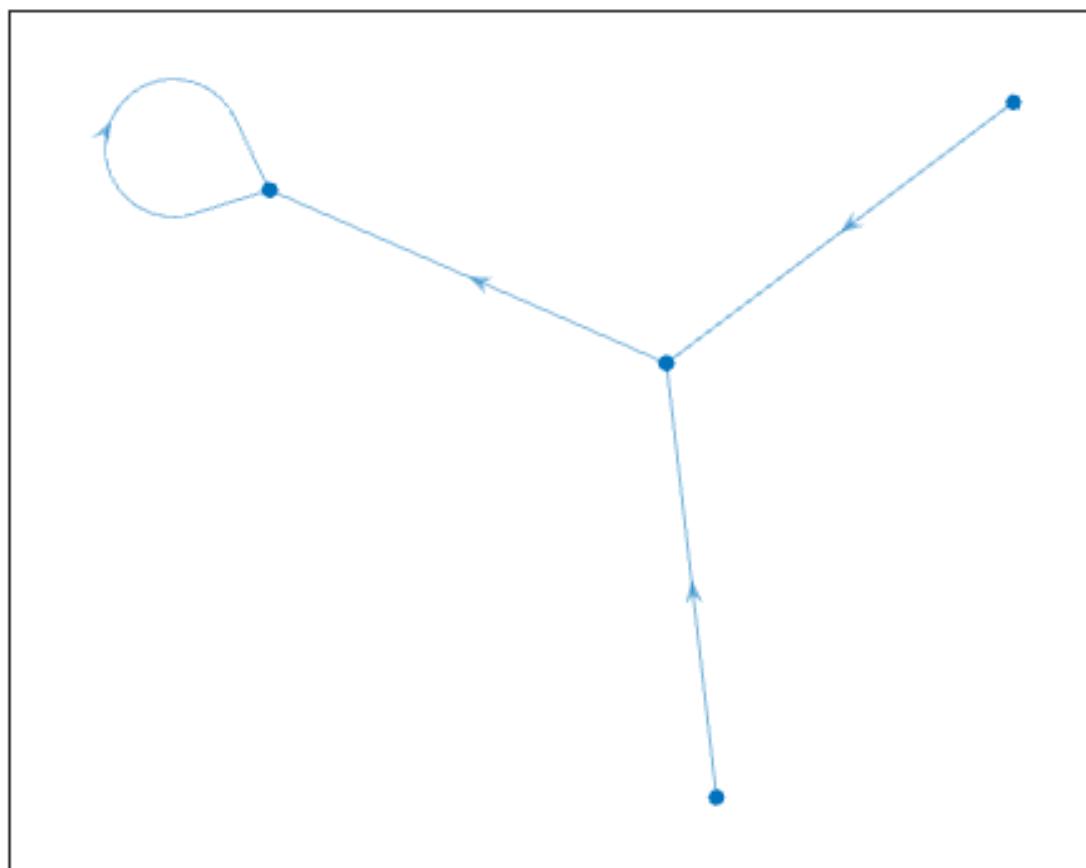


Figura 3.587: Atractor regla 54 $n=2$

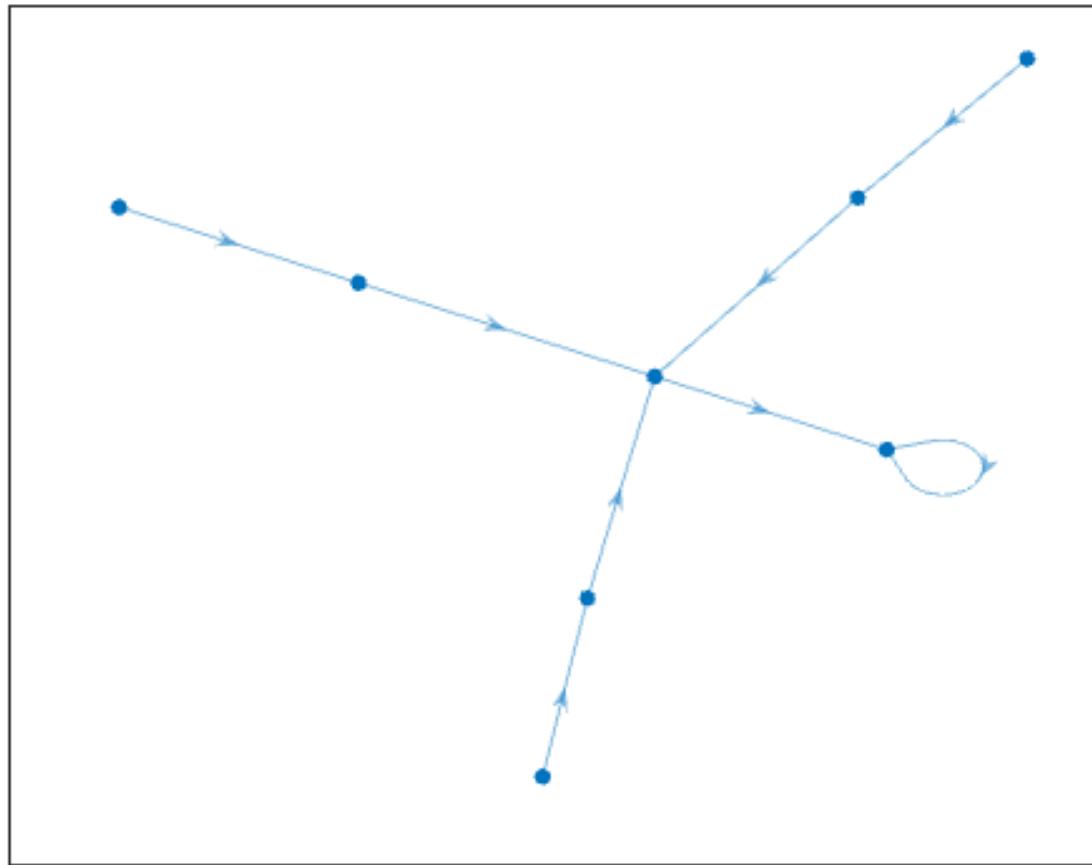


Figura 3.588: Atractor regla 54 n=3

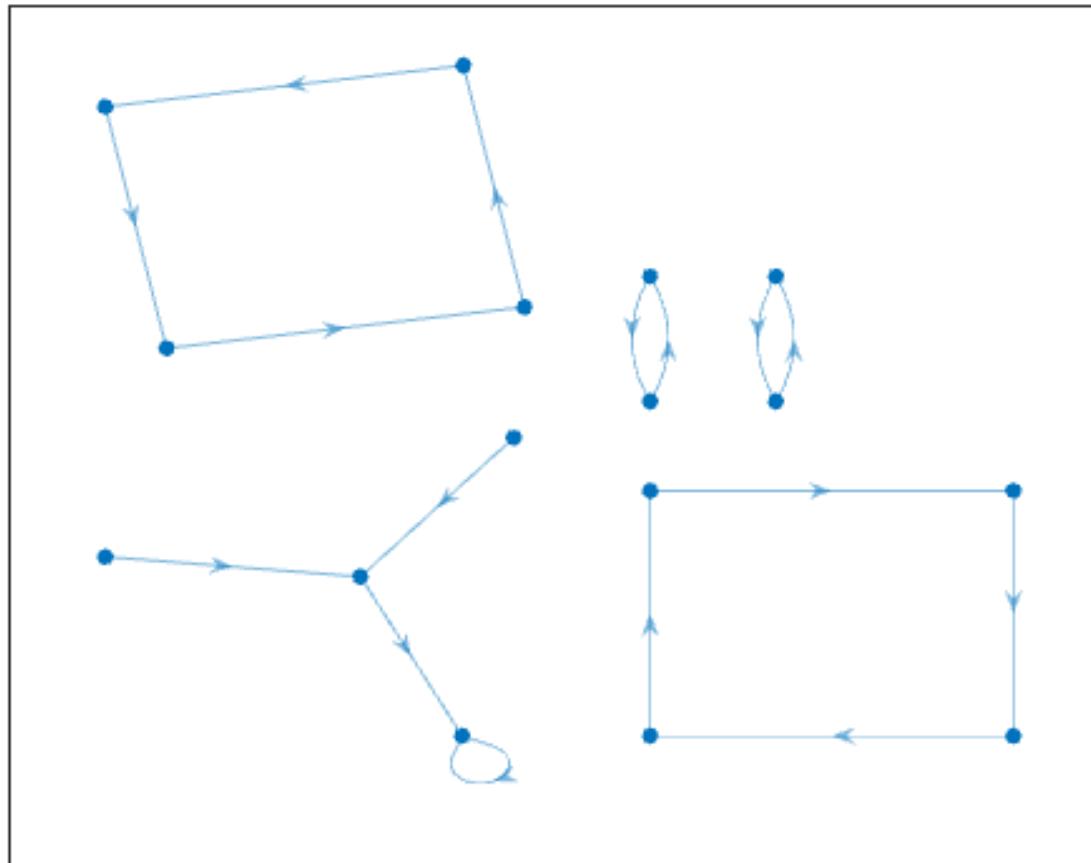


Figura 3.589: Atractor regla 54 n=4

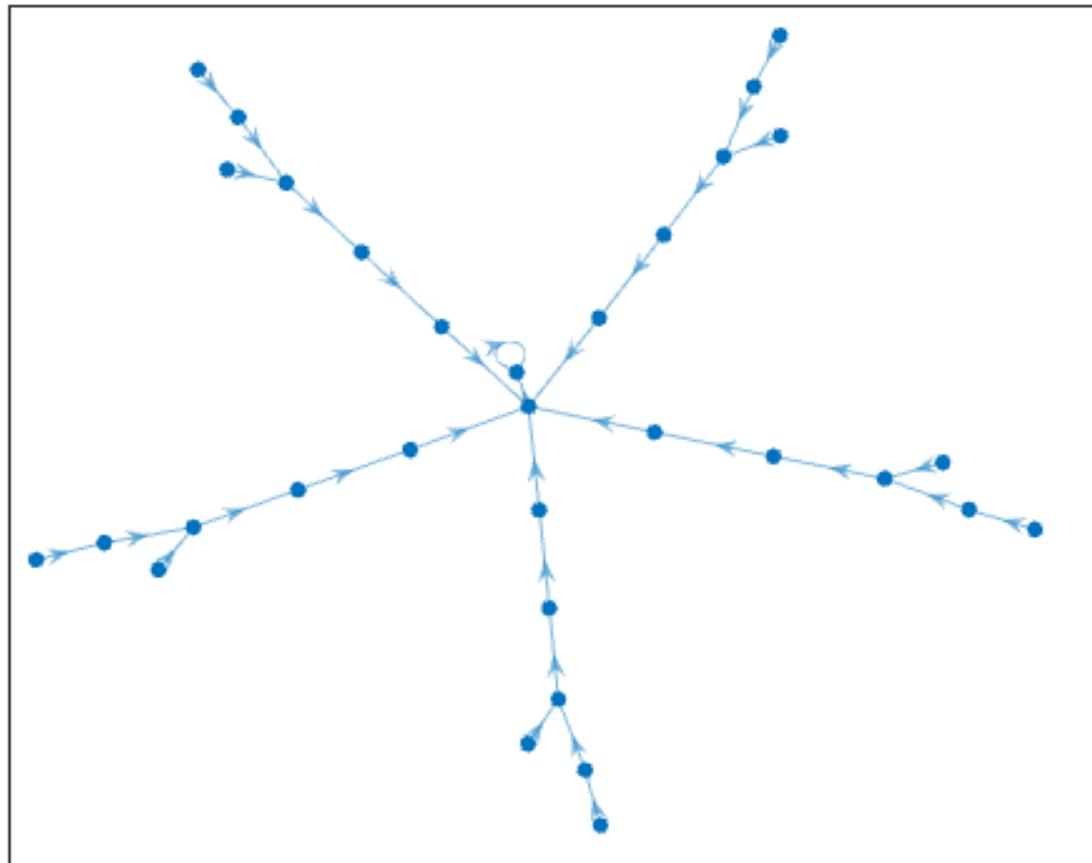


Figura 3.590: Atractor regla 54 n=5

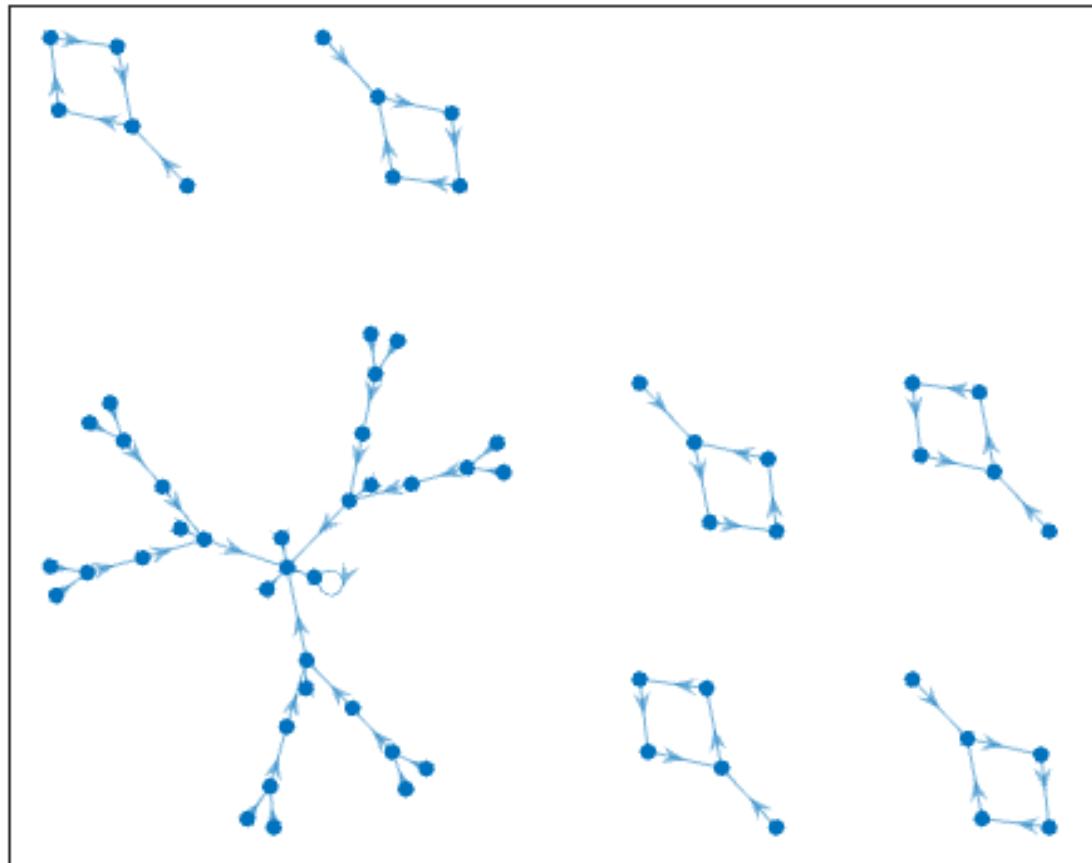


Figura 3.591: Atractor regla 54 n=6

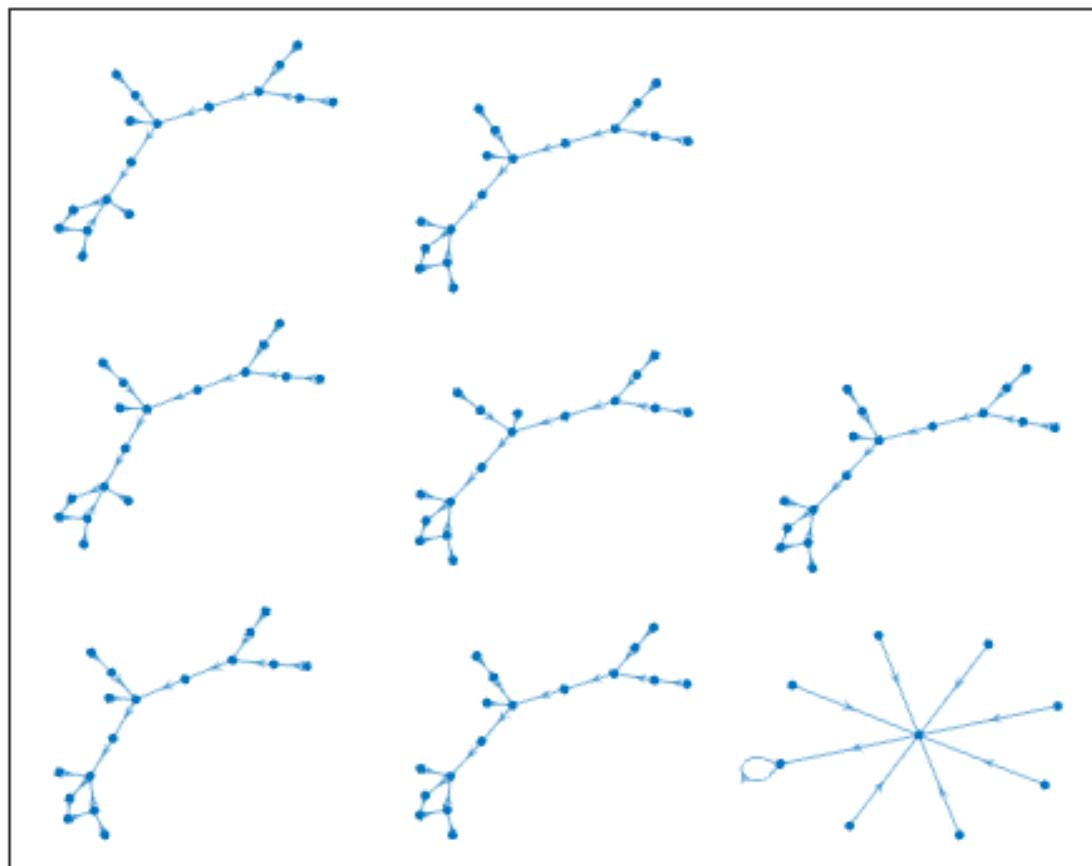


Figura 3.592: Atractor regla 54 n=7

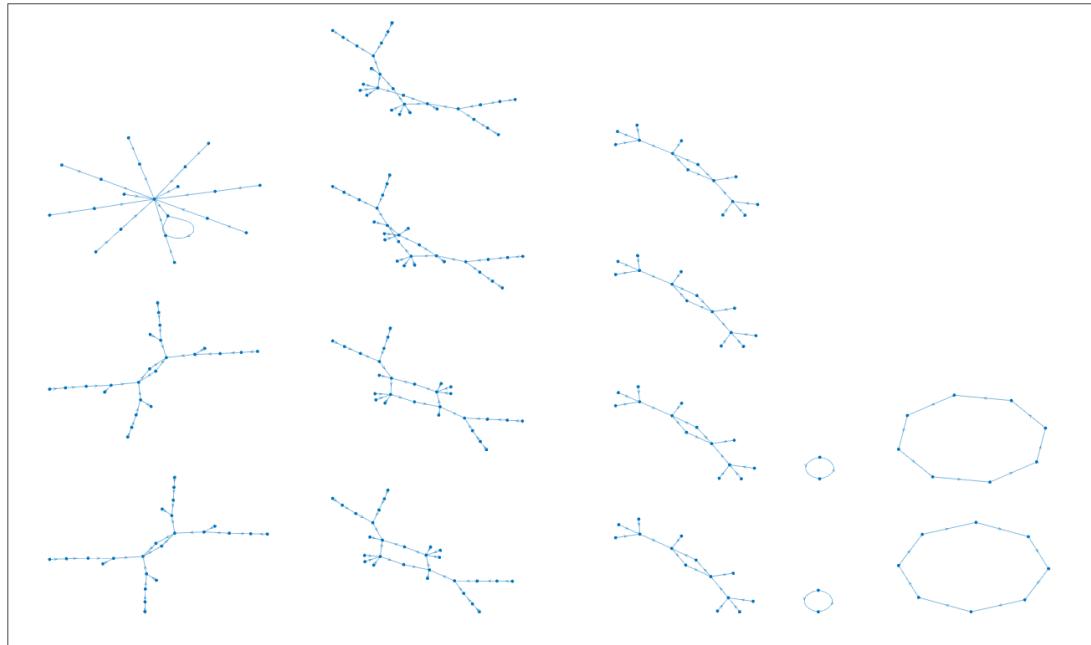


Figura 3.593: Atractor regla 54 n=8

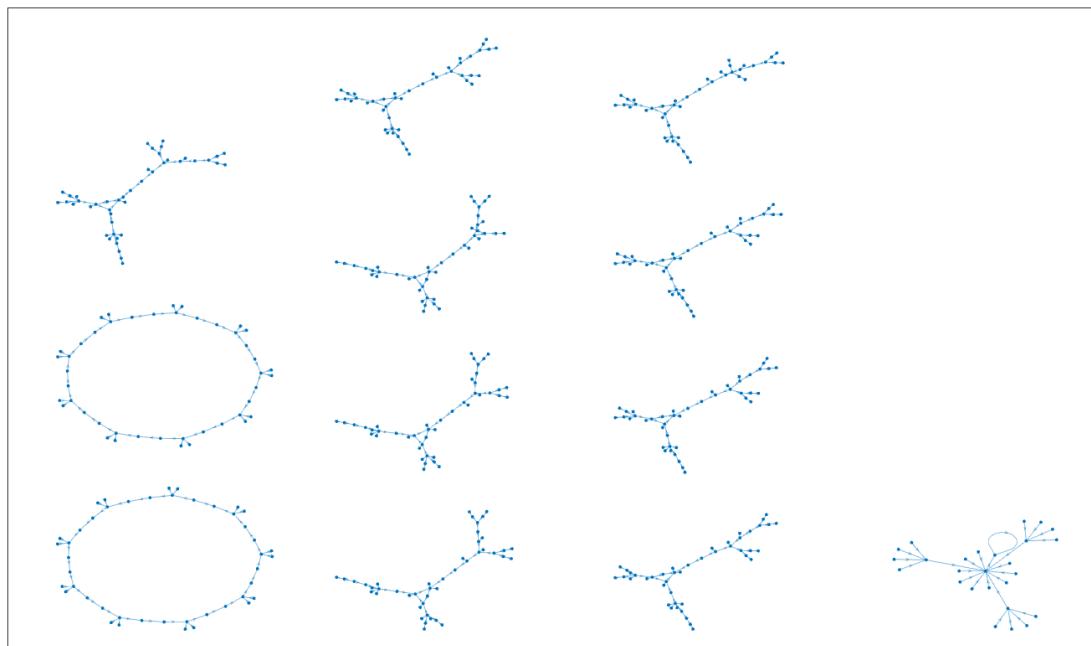


Figura 3.594: Atractor regla 54 n=9

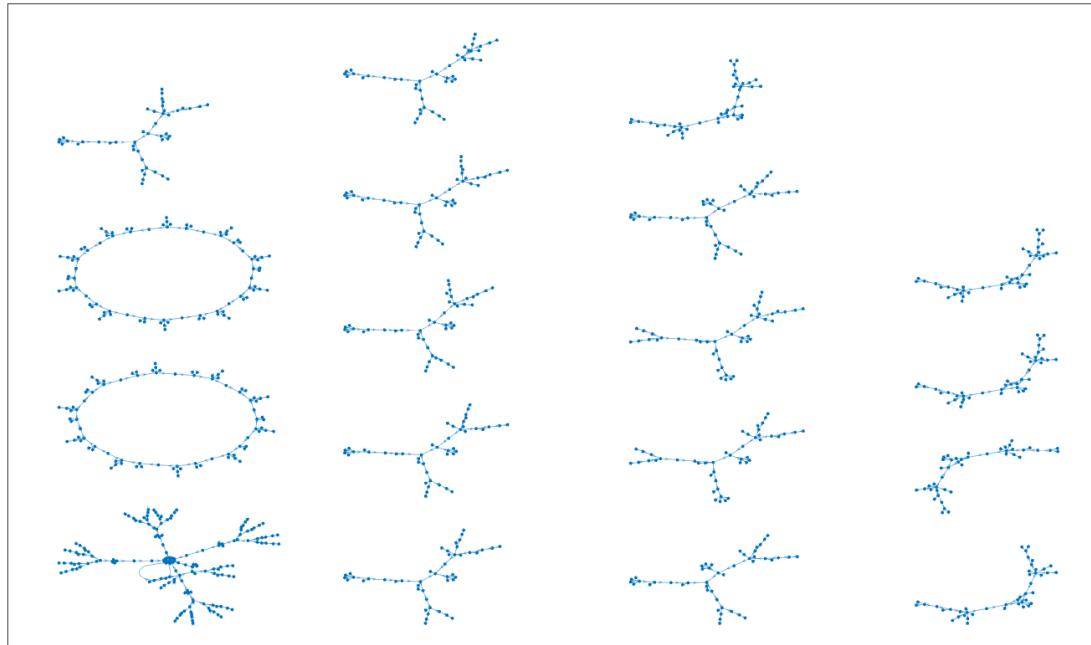


Figura 3.595: Atractor regla 54 n=10

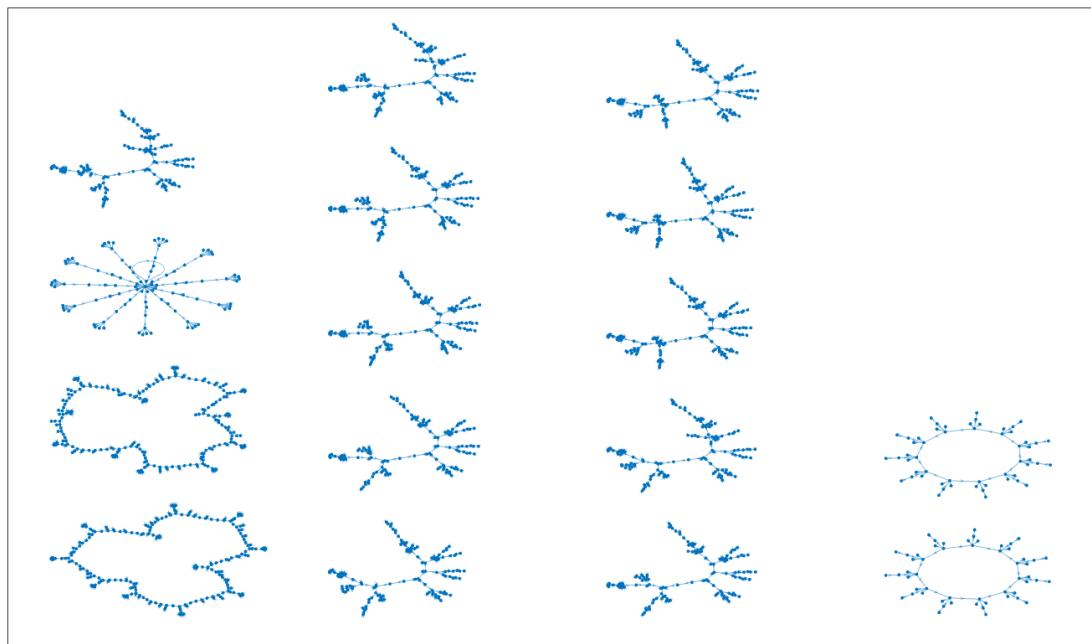
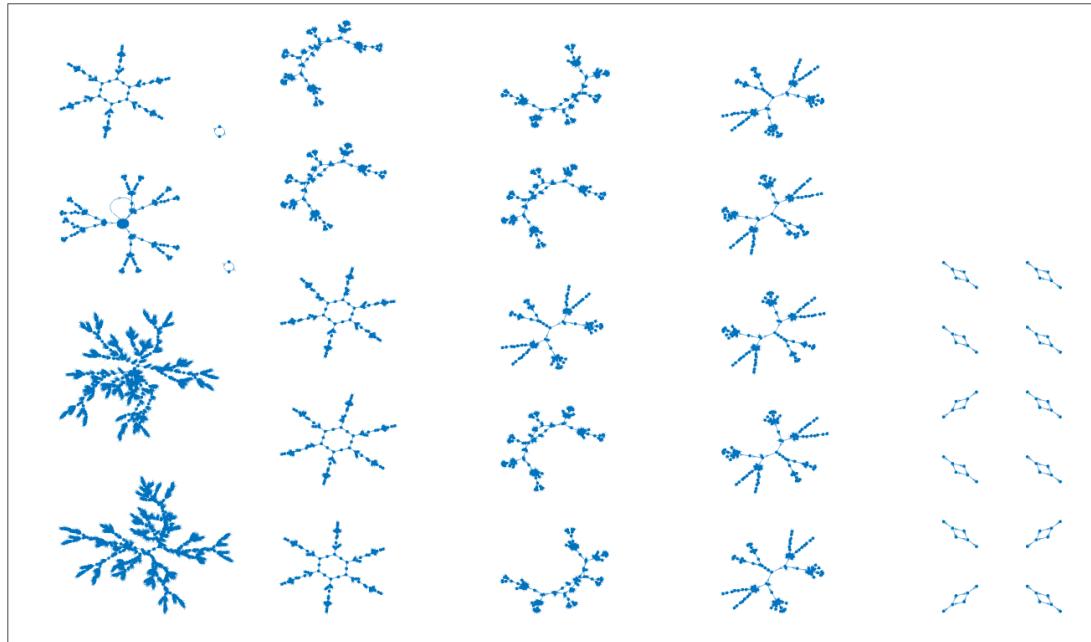
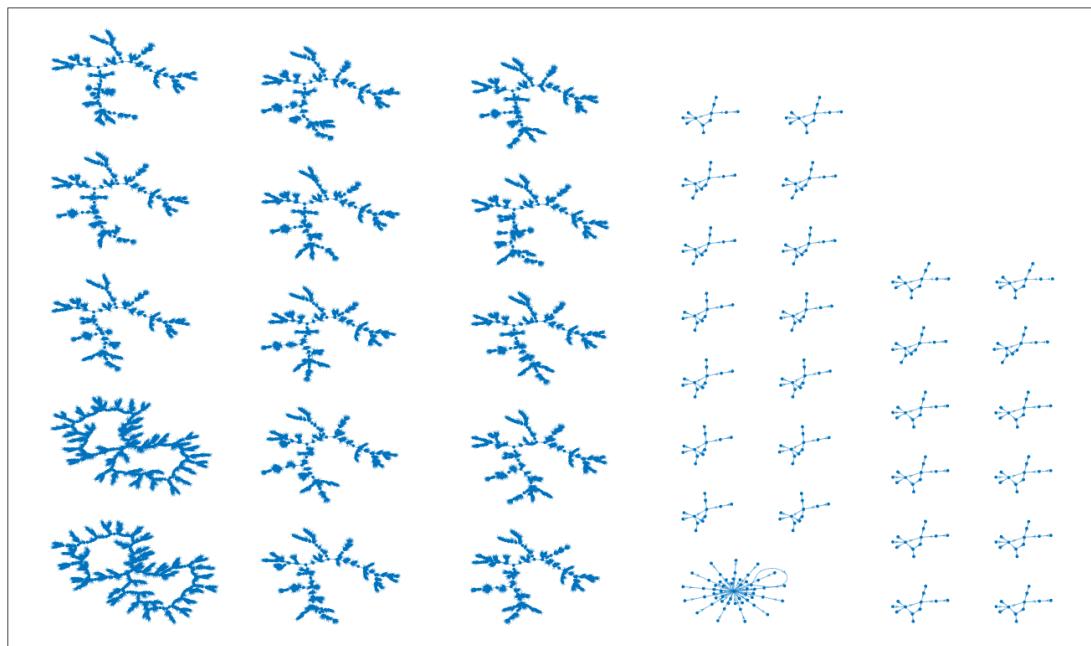


Figura 3.596: Atractor regla 54 n=11

Figura 3.597: Atractor regla 54 $n=12$ Figura 3.598: Atractor regla 54 $n=13$

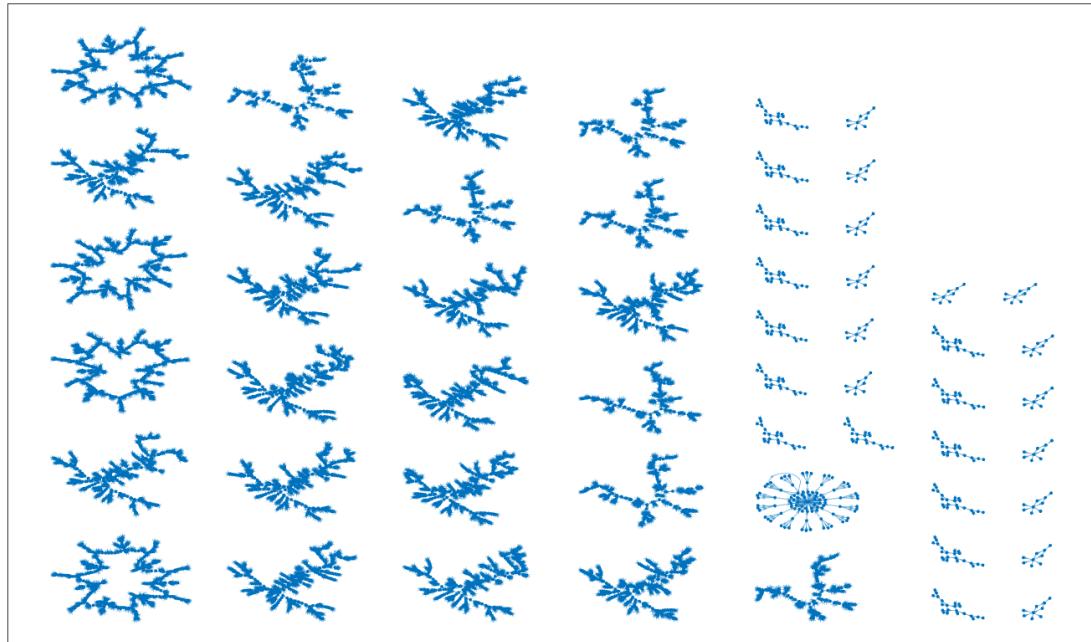


Figura 3.599: Atractor regla 54 n=14

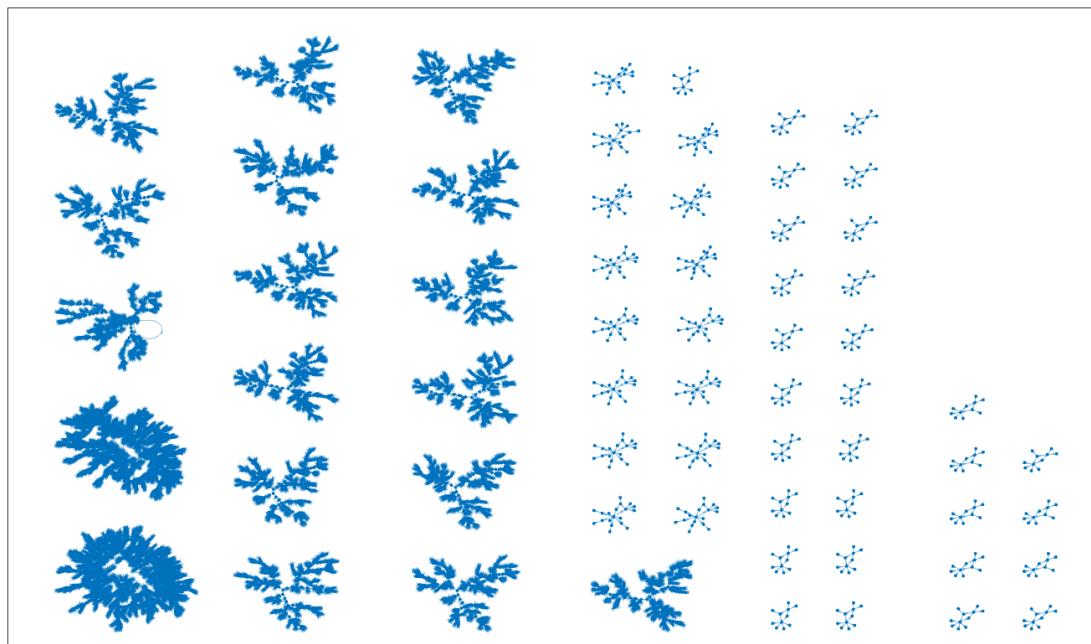


Figura 3.600: Atractor regla 54 n=15

3.45. Reglas 56,98,185,227

Respecto a la regla 54 se aprecia que mientras más grande es el tamaño de la cadena (n) sucede el mismo comportamiento que en la regla 50 que es que siempre se mantiene presente la estructura que se crea con $n=2$, observe la figura que se encuentra abajo, esa estructura es la que siempre aparece en cada imagen, se mantiene constante.

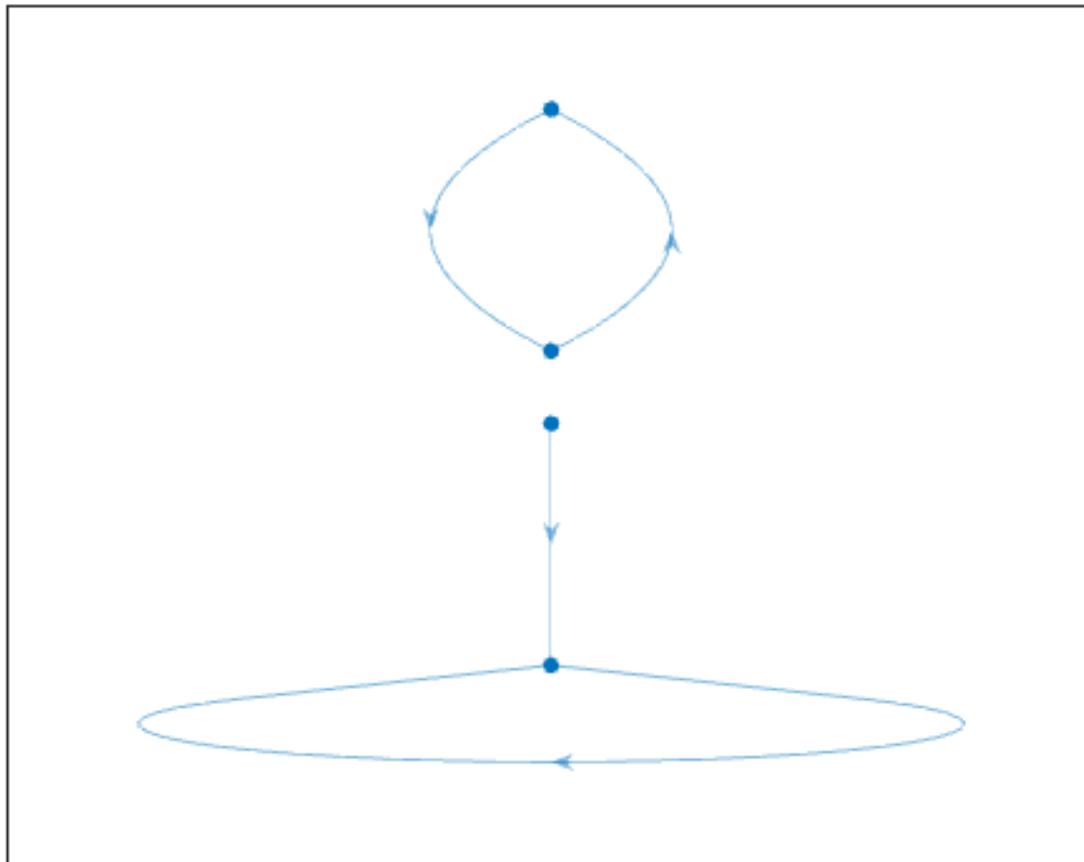
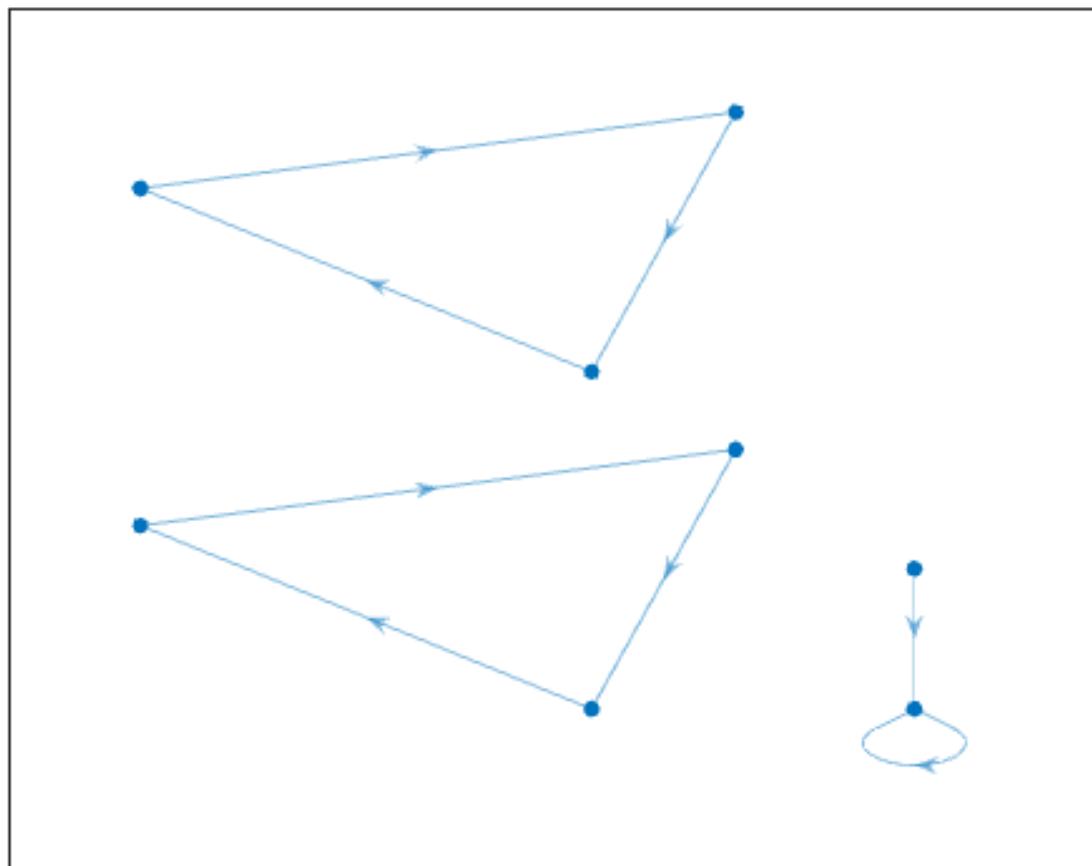


Figura 3.601: Atractor regla 56 $n=2$

Figura 3.602: Atractor regla 56 $n=3$

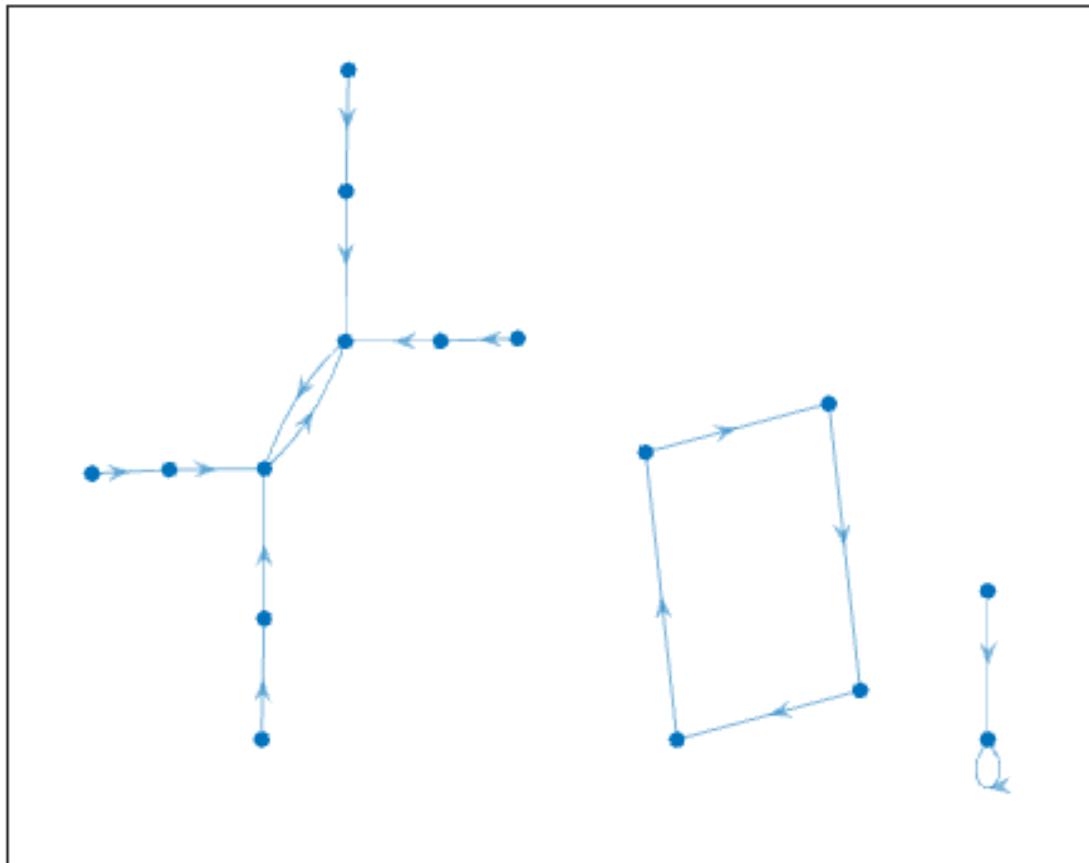


Figura 3.603: Atractor regla 56 n=4

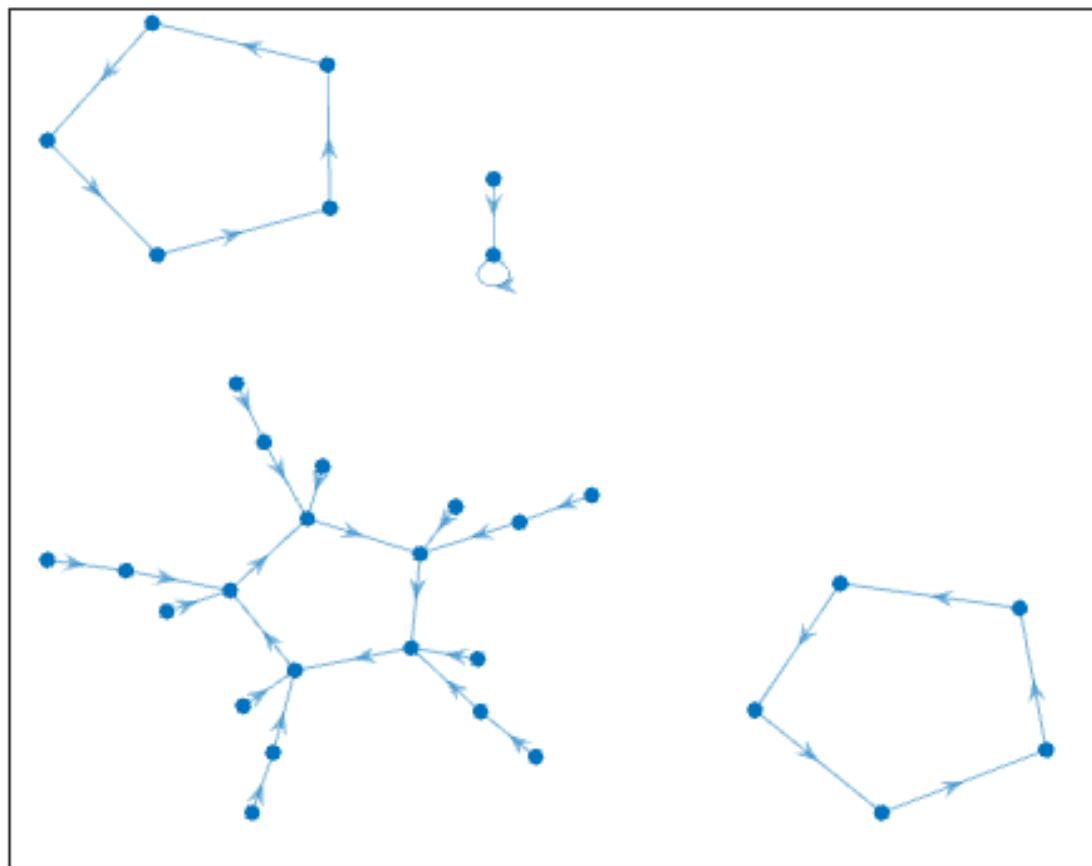
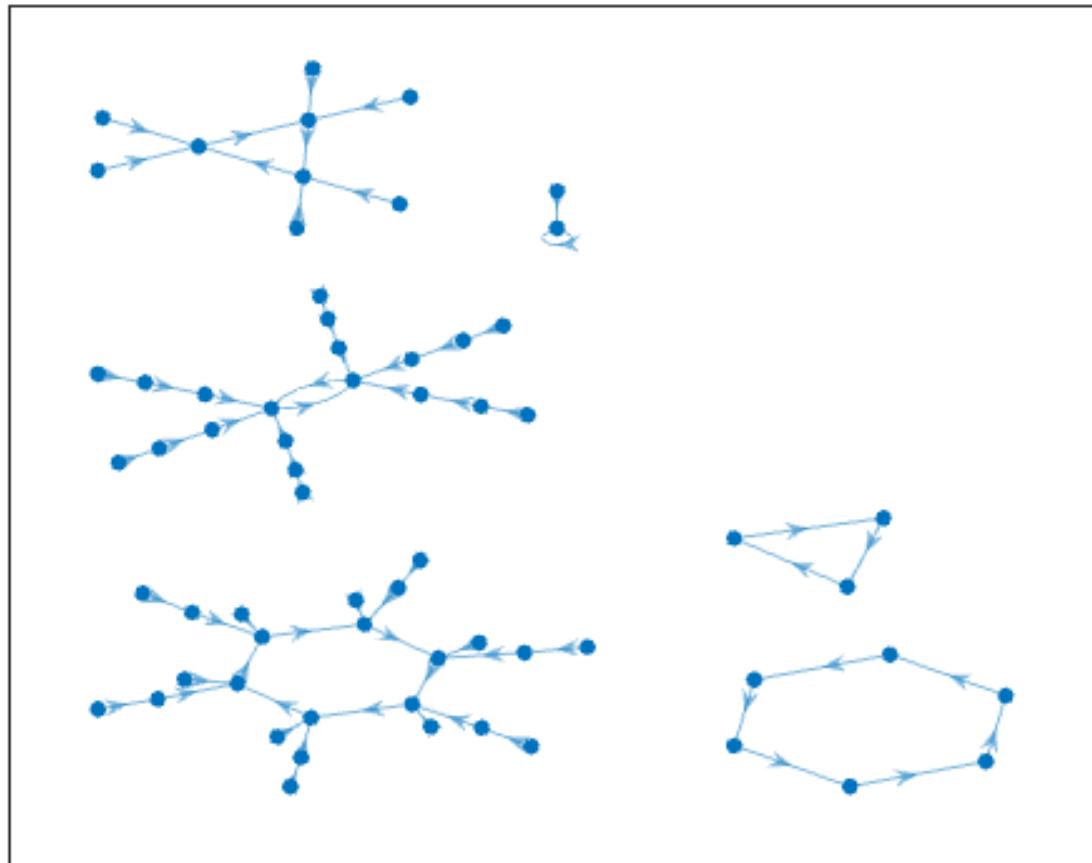
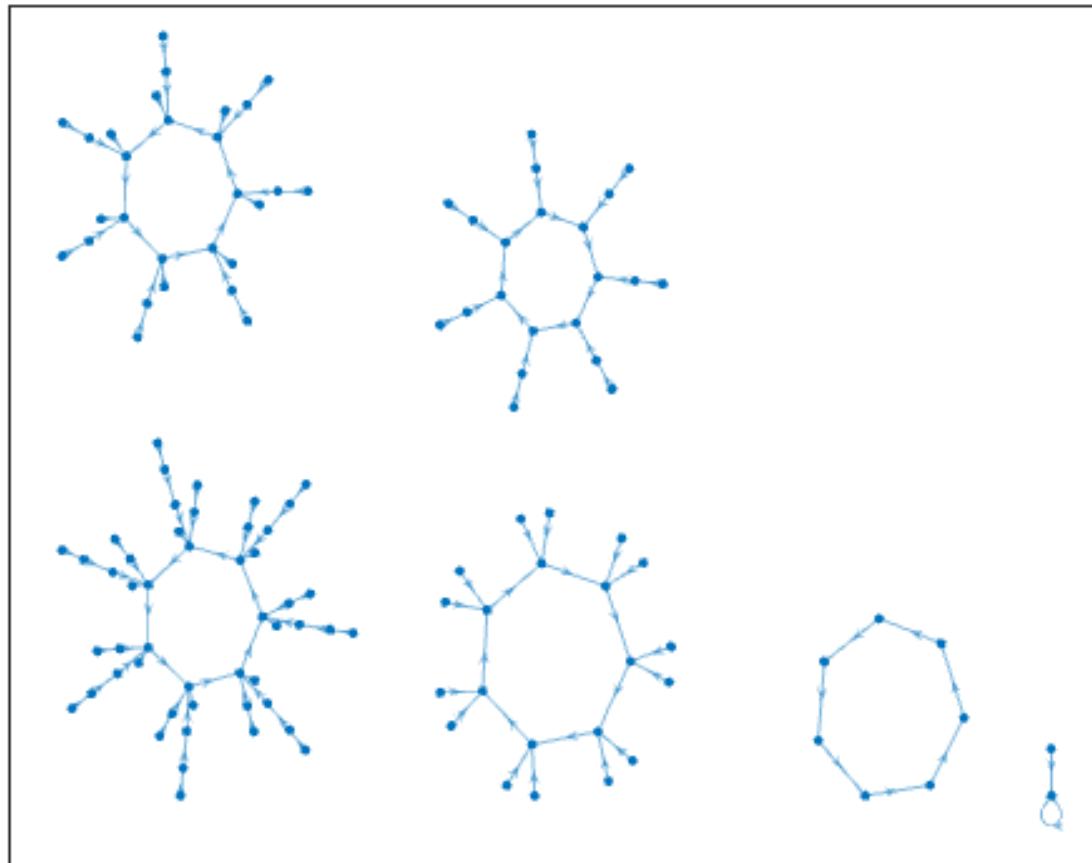


Figura 3.604: Atractor regla 56 n=5

Figura 3.605: Atractor regla 56 $n=6$

Figura 3.606: Atractor regla 56 $n=7$

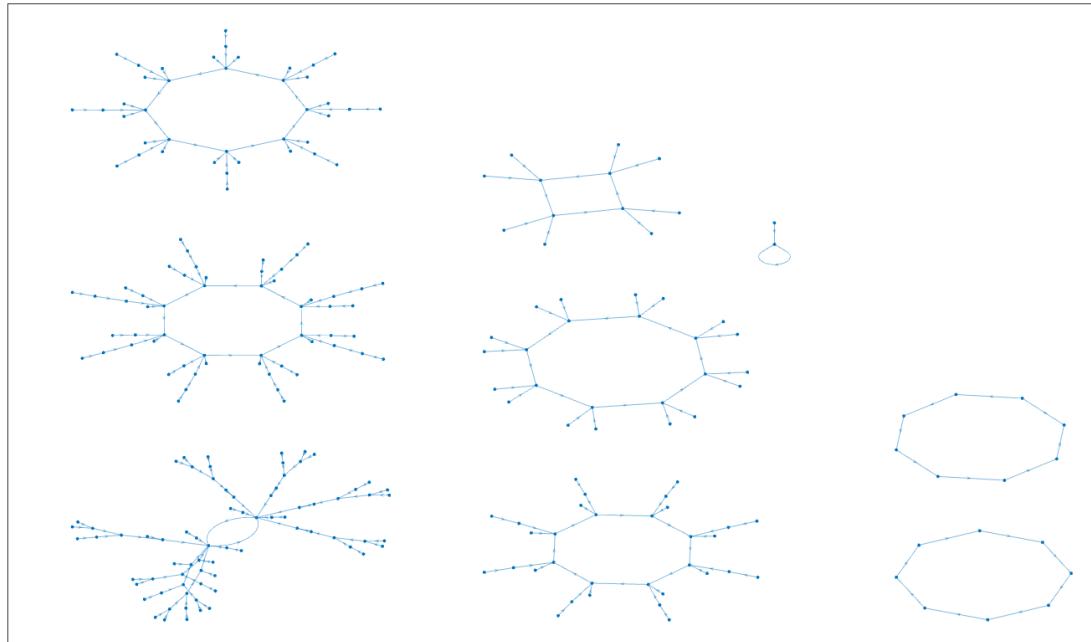


Figura 3.607: Atractor regla 56 n=8

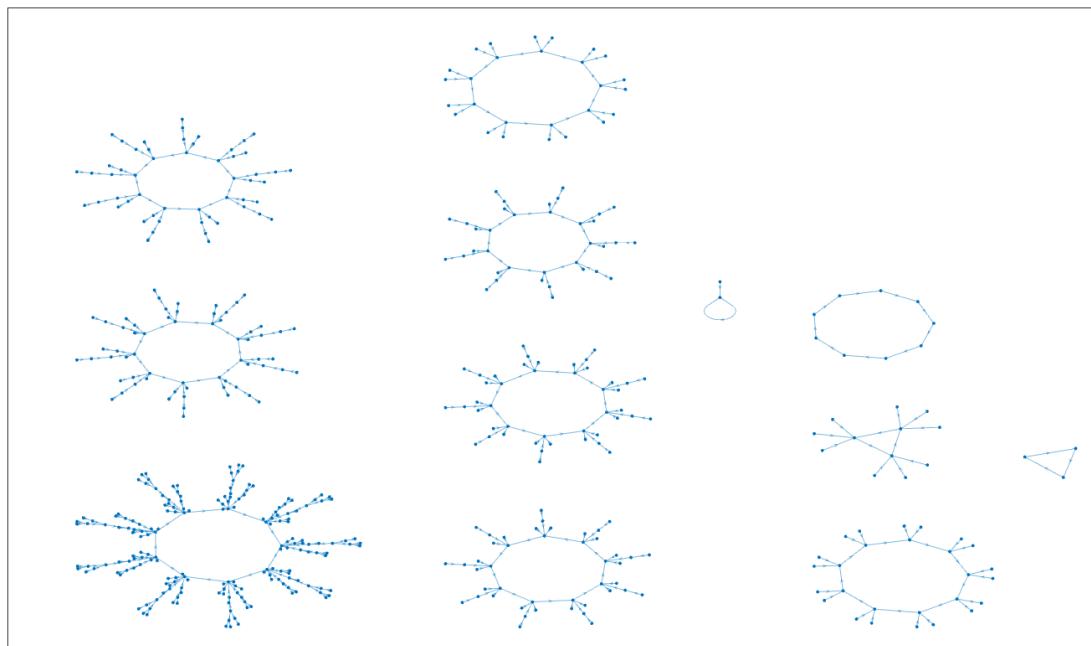


Figura 3.608: Atractor regla 56 n=9

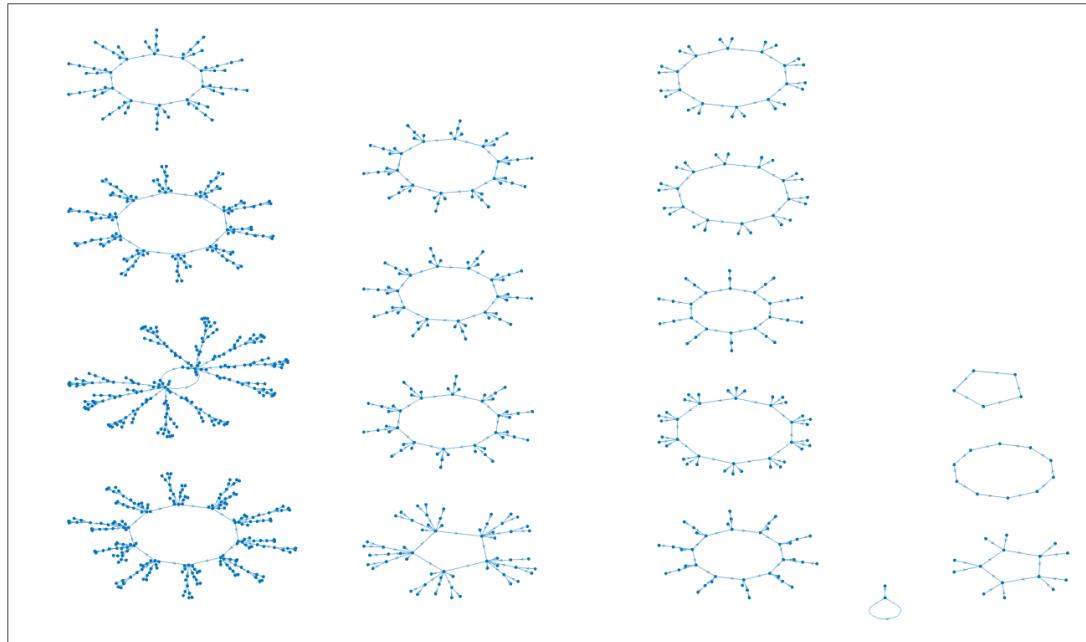


Figura 3.609: Atractor regla 56 n=10

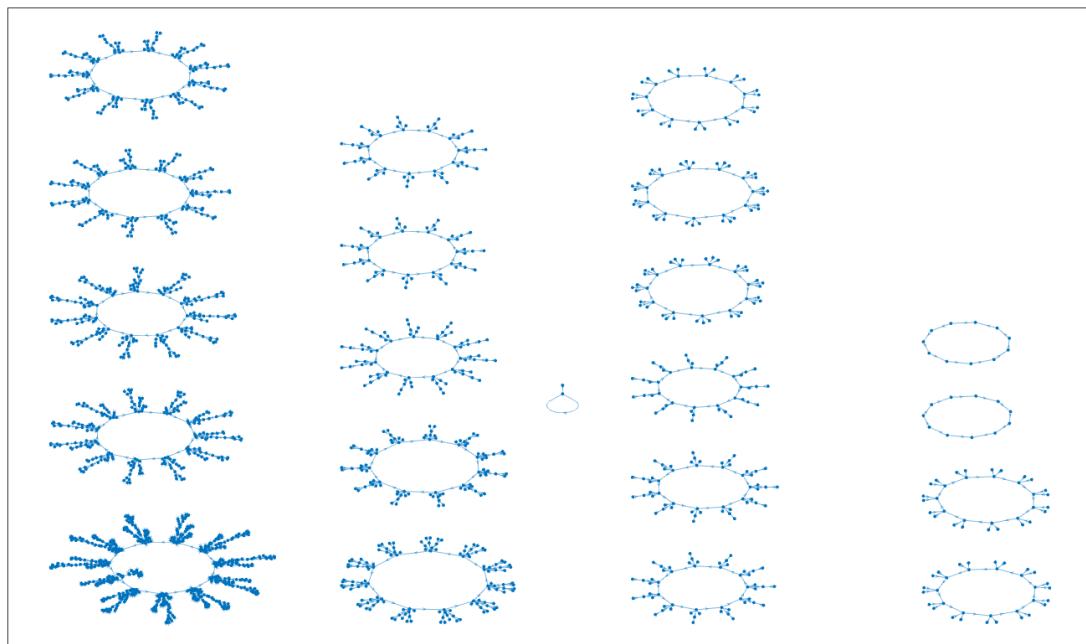


Figura 3.610: Atractor regla 56 n=11

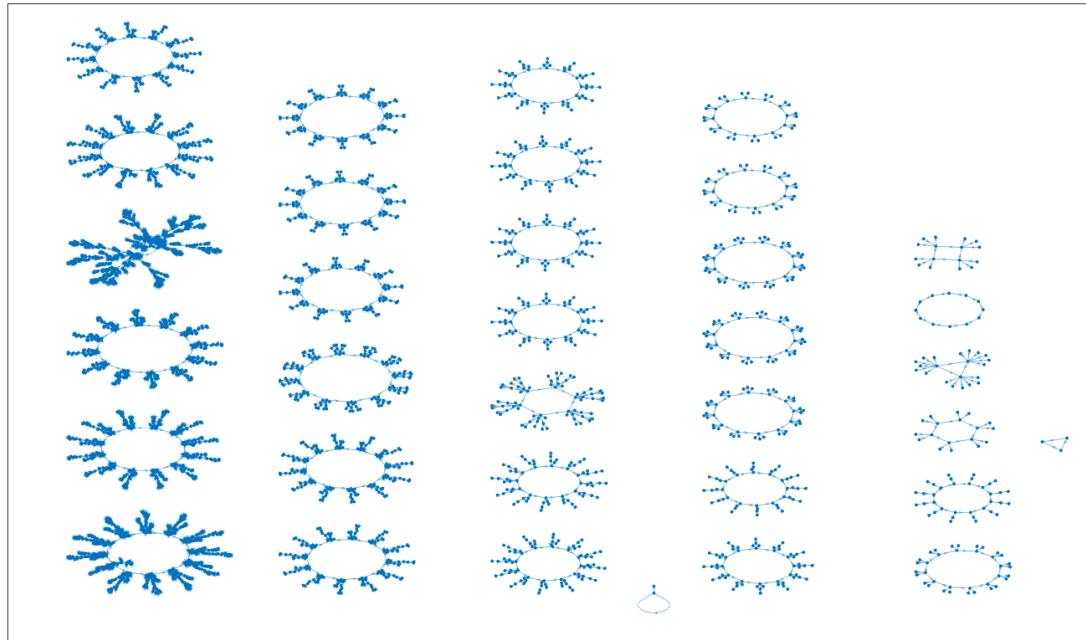


Figura 3.611: Atractor regla 56 n=12

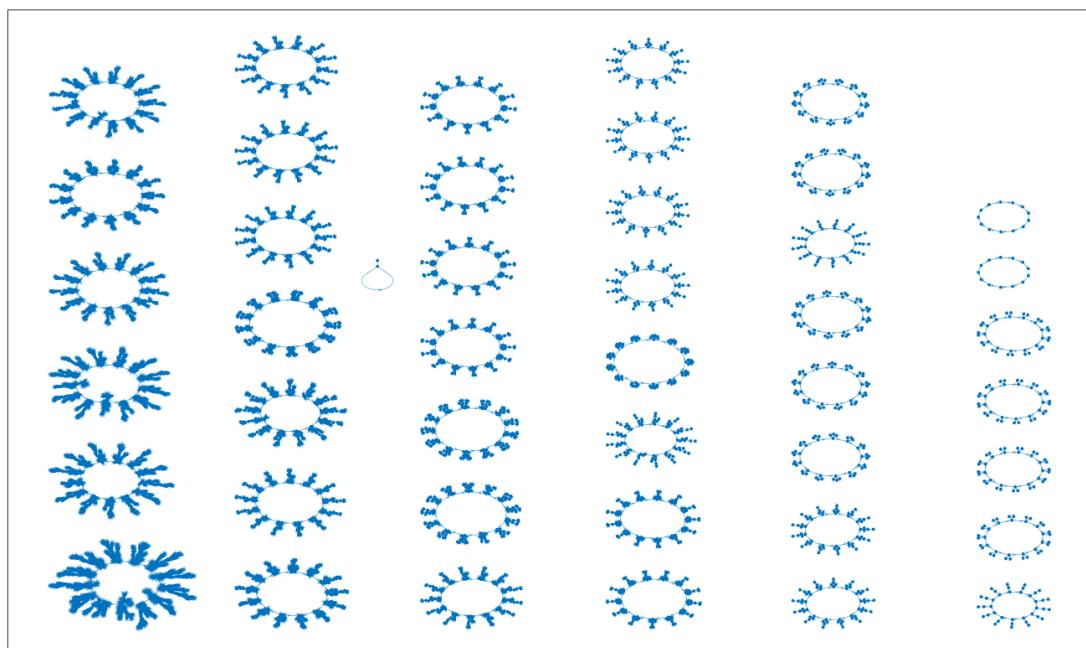


Figura 3.612: Atractor regla 56 n=13

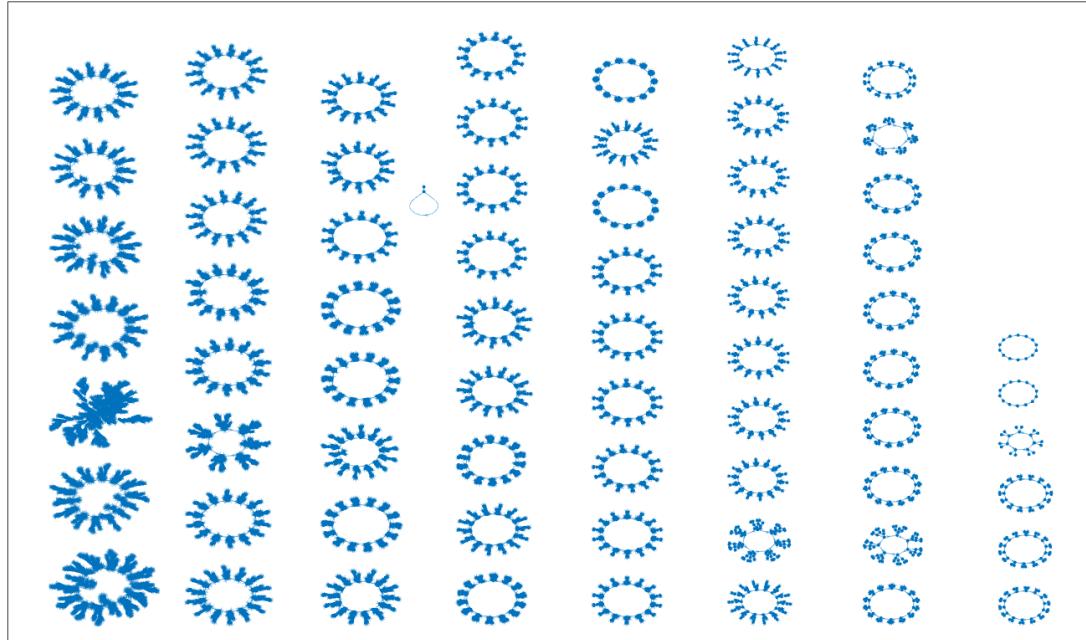


Figura 3.613: Atractor regla 56 n=14

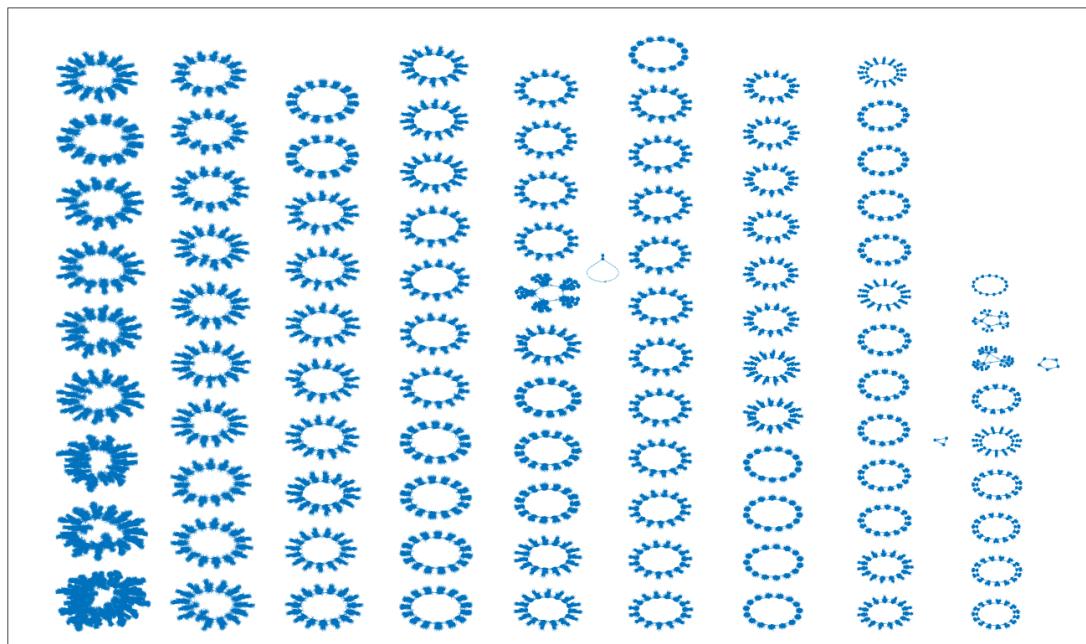


Figura 3.614: Atractor regla 56 n=15

3.46. Reglas 57,99

Respecto a la regla 57 se aprecia que mientras más grande es el tamaño de la cadena (n) y en particular en el salto de $n=6$ a $n=7$ los atractores dan un salto brusco en cuanto a su figura y también mencionar que el atractor cíclico entre 2 nodos se presenta sin falta en cada imagen.

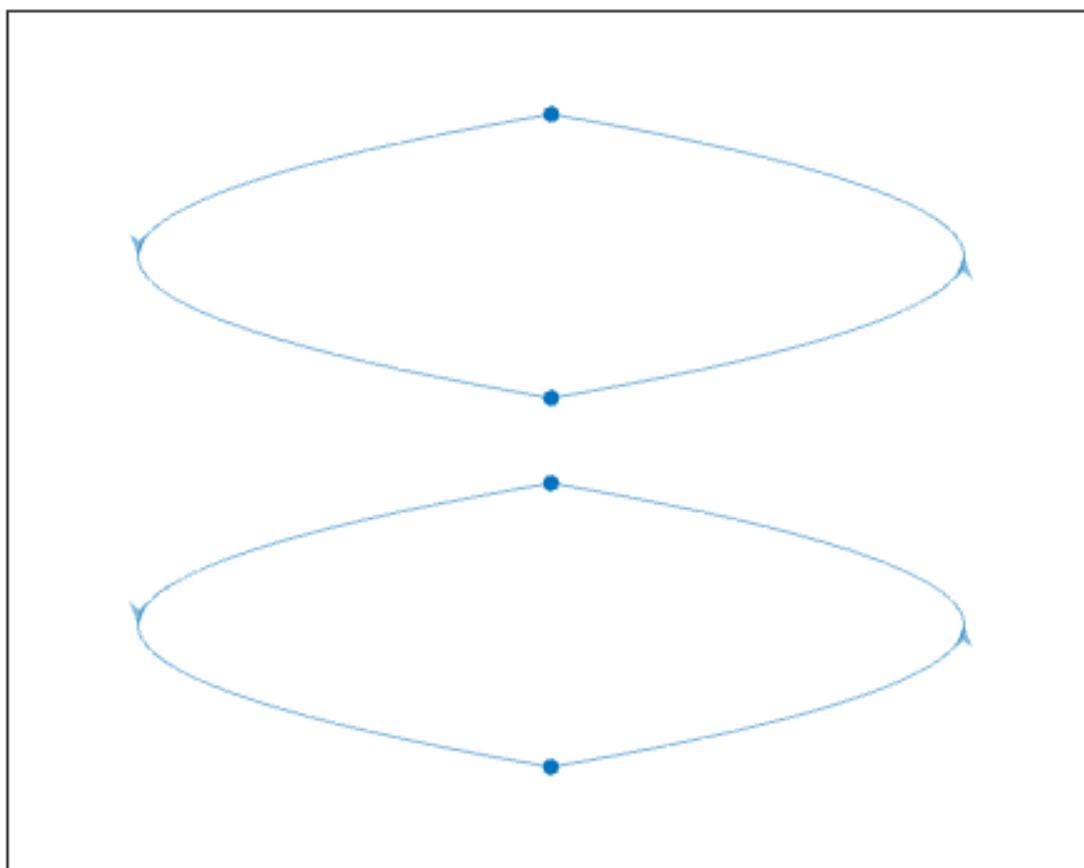
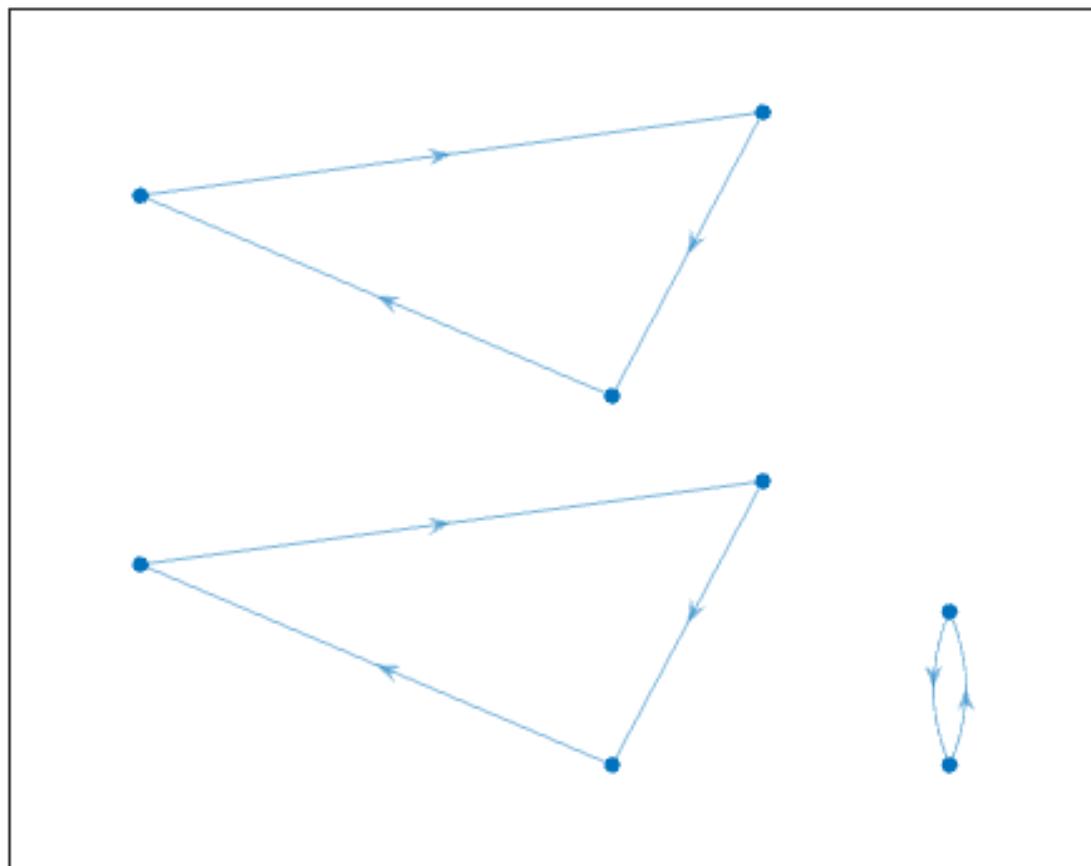


Figura 3.615: Atractor regla 57 $n=2$

Figura 3.616: Atractor regla 57 $n=3$

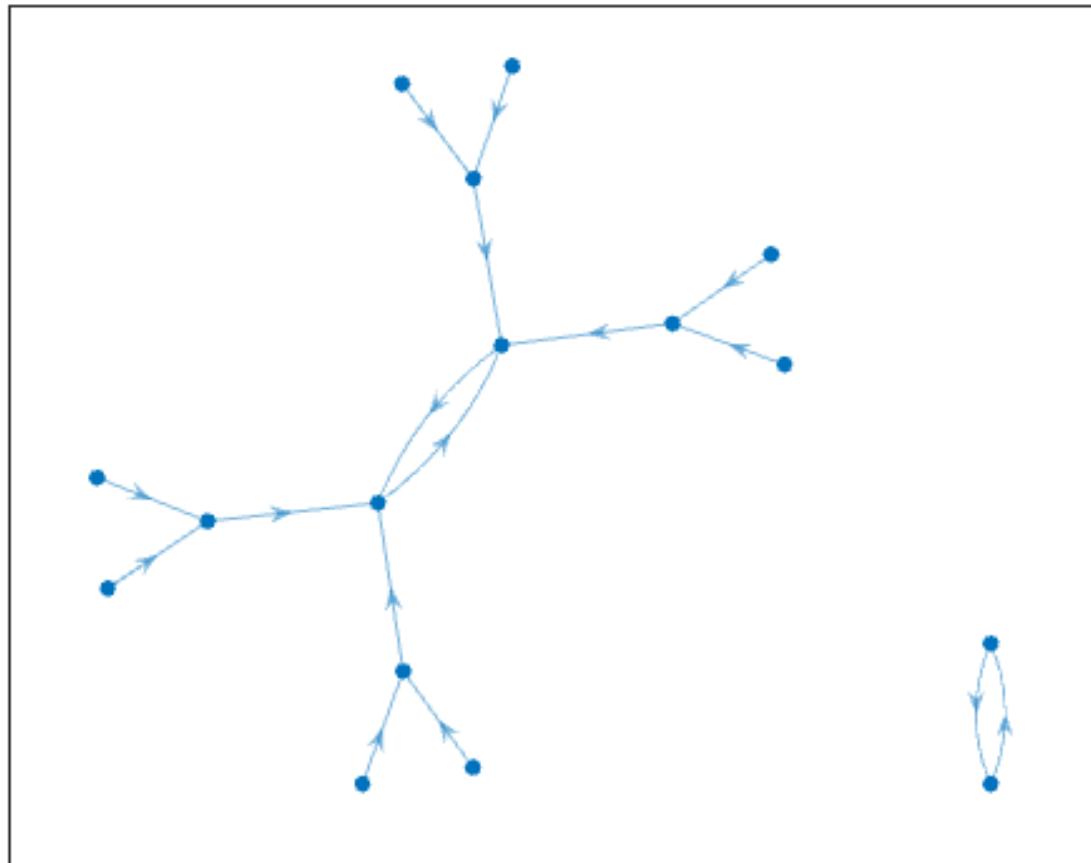
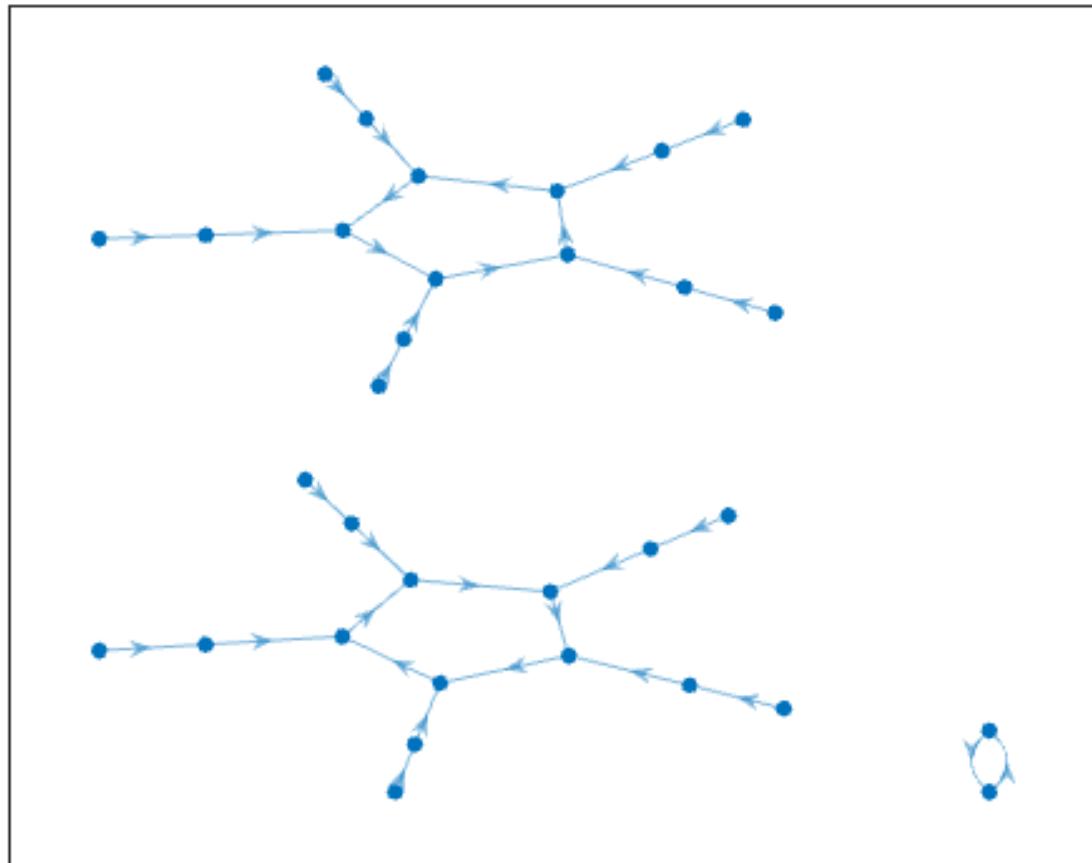


Figura 3.617: Atractor regla 57 n=4

Figura 3.618: Atractor regla 57 $n=5$

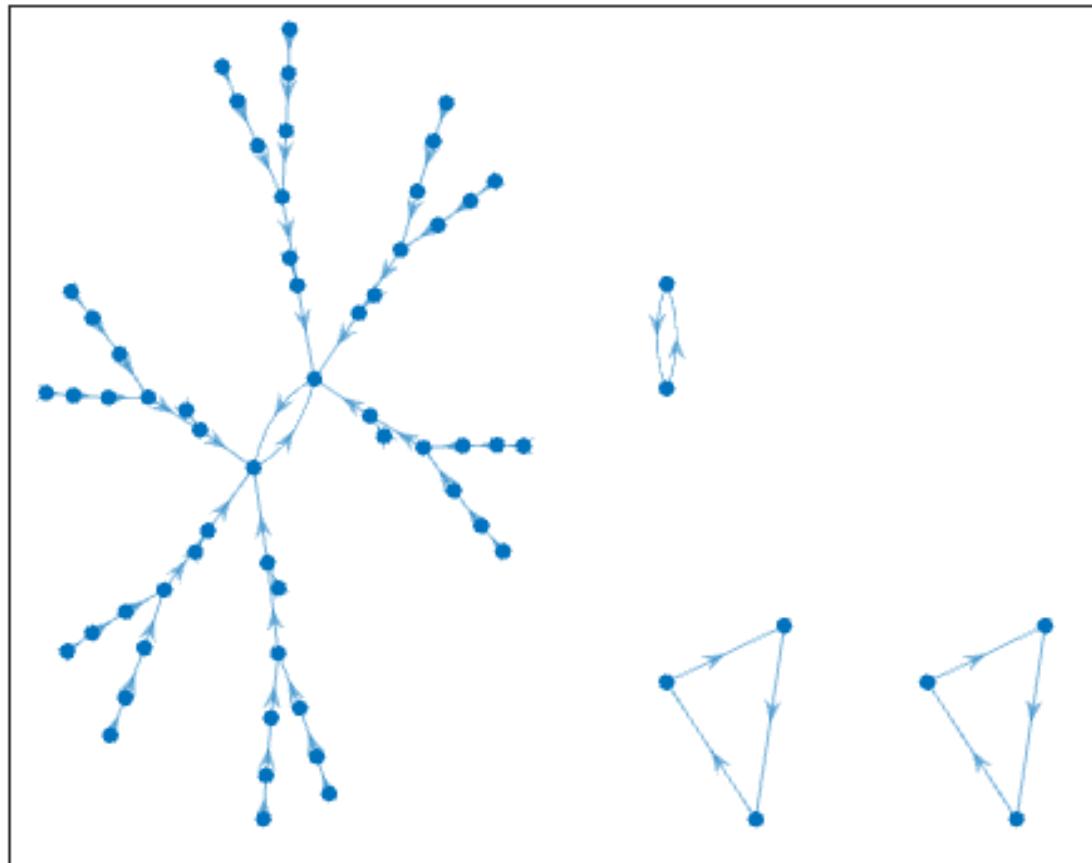


Figura 3.619: Atractor regla 57 n=6

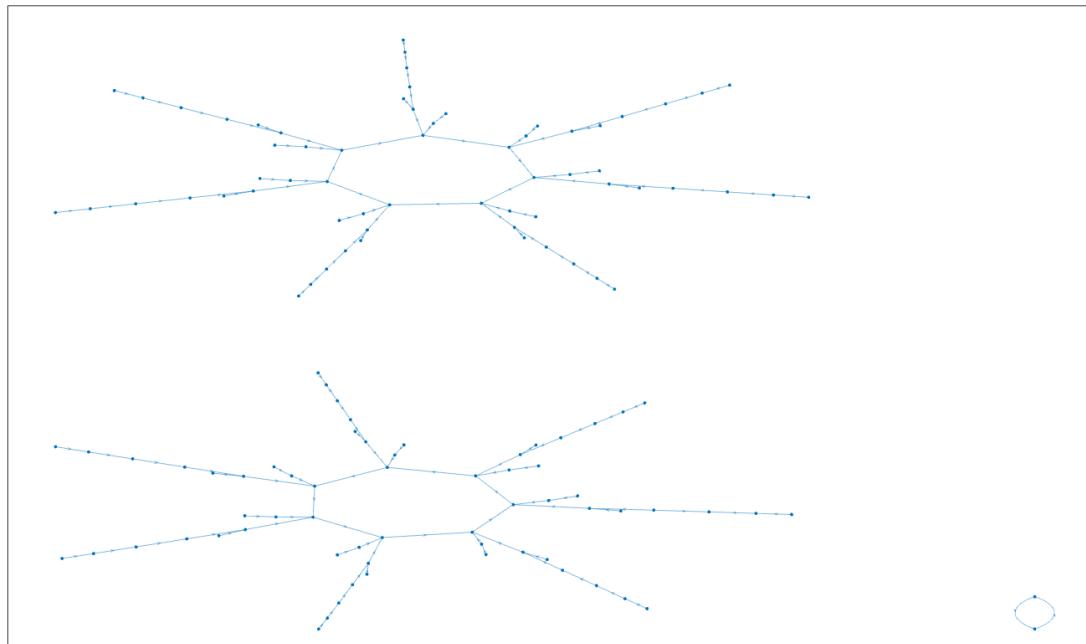


Figura 3.620: Atractor regla 57 n=7

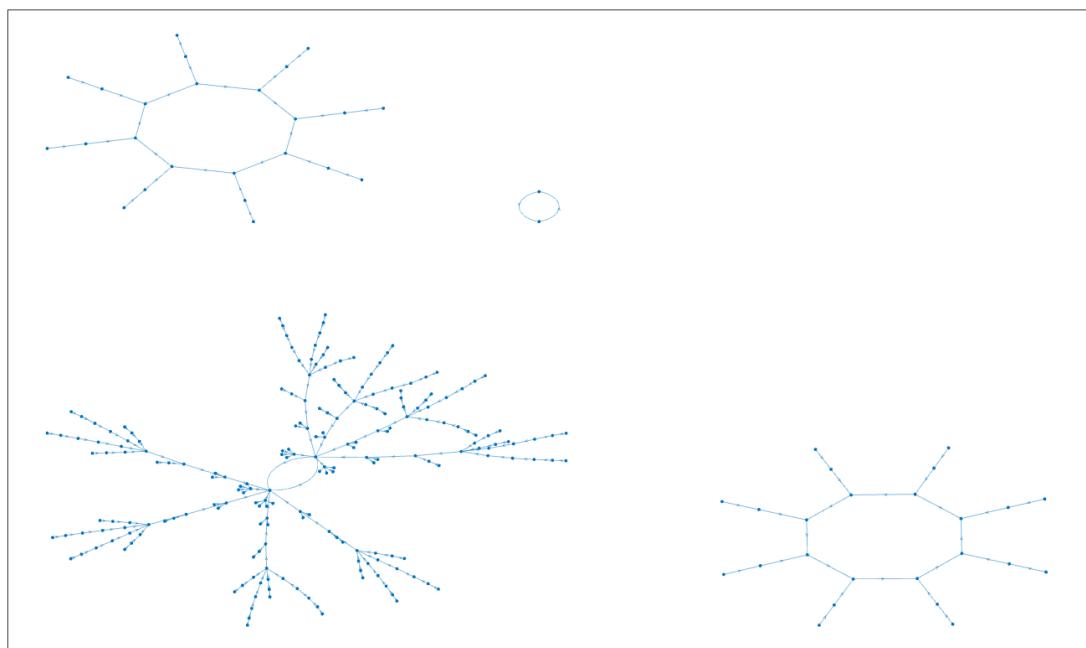


Figura 3.621: Atractor regla 57 n=8

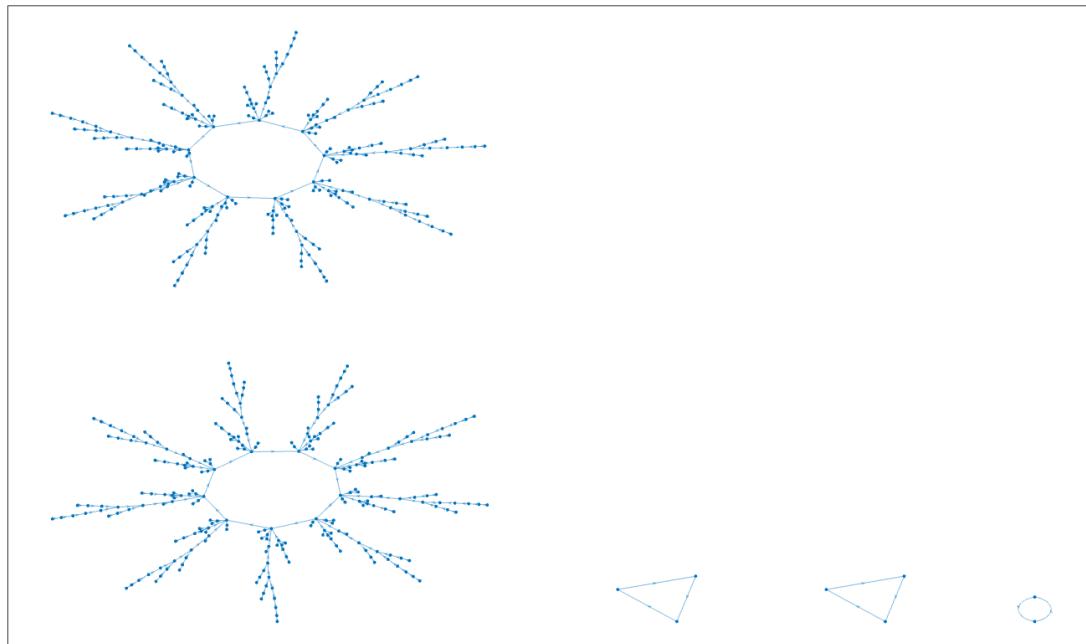


Figura 3.622: Atractor regla 57 n=9

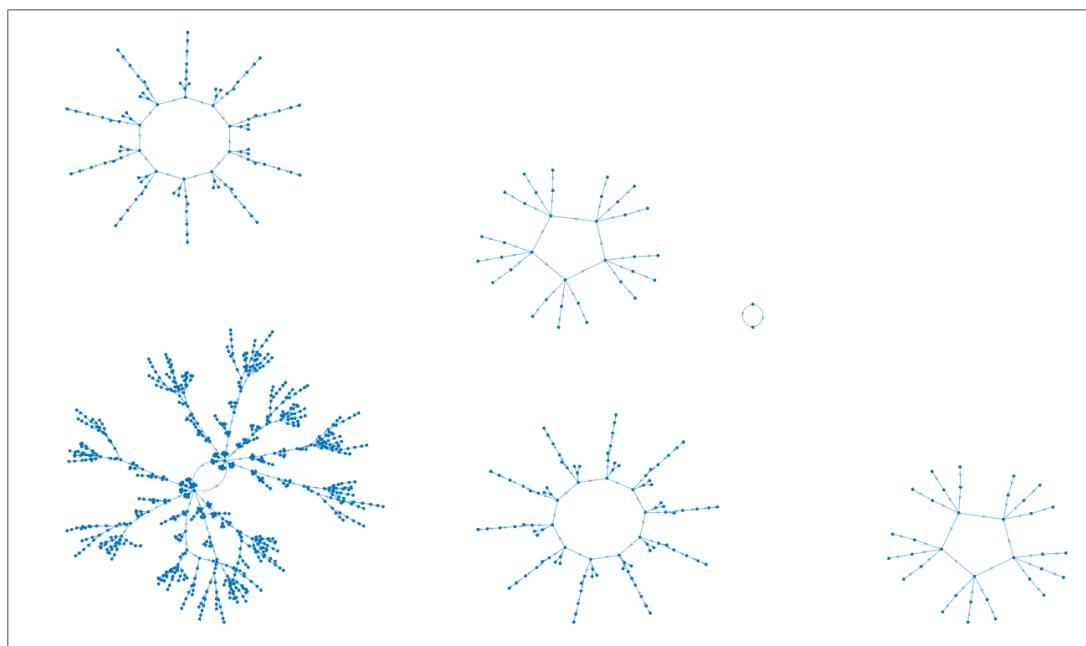
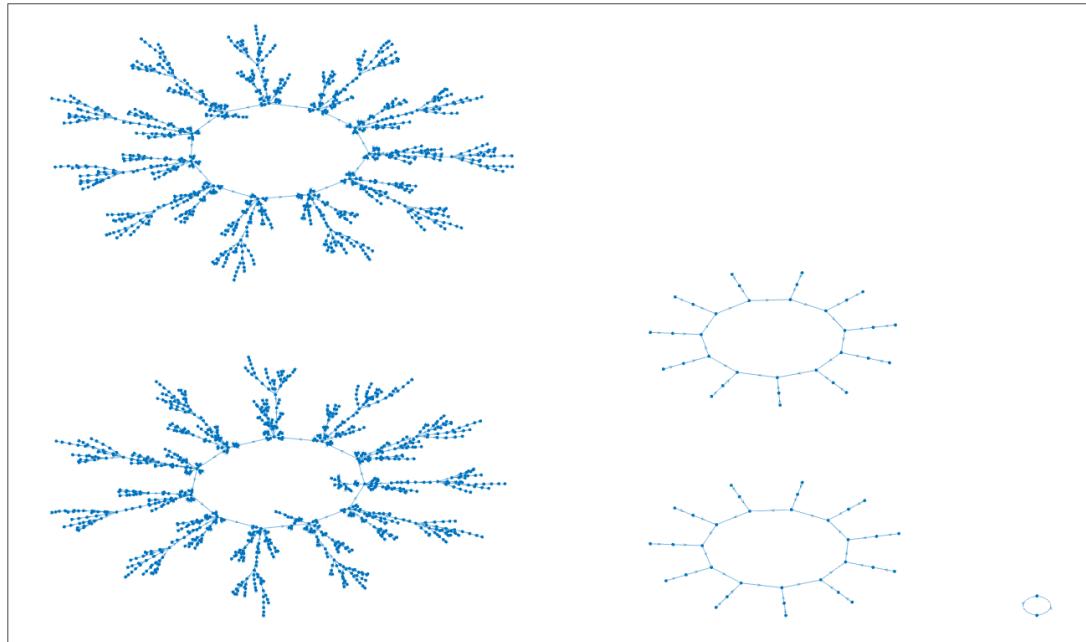
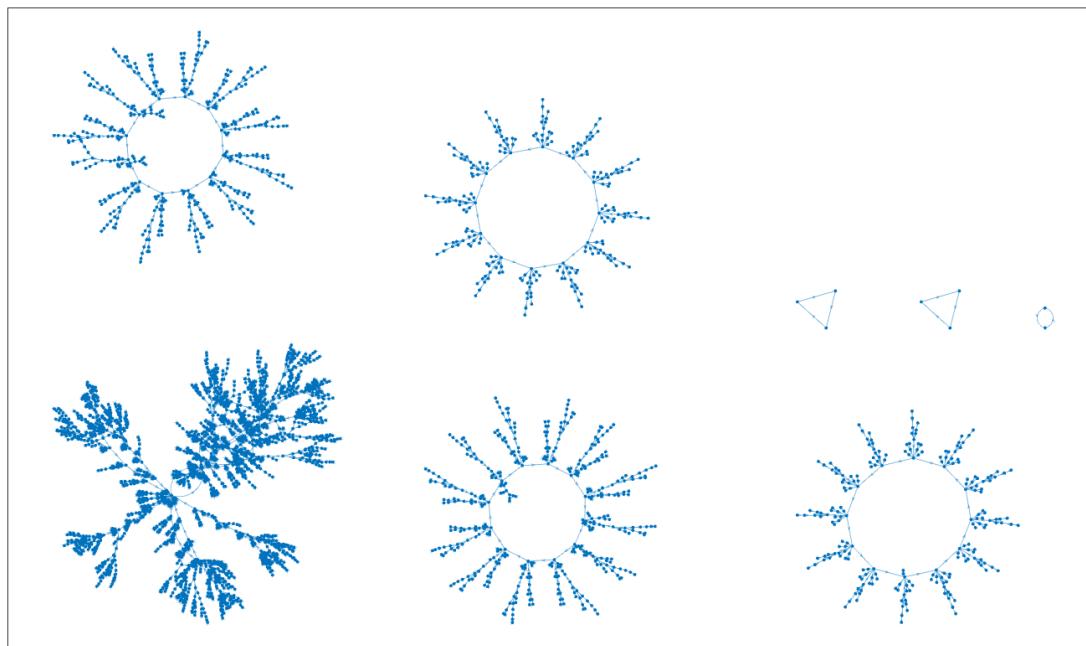
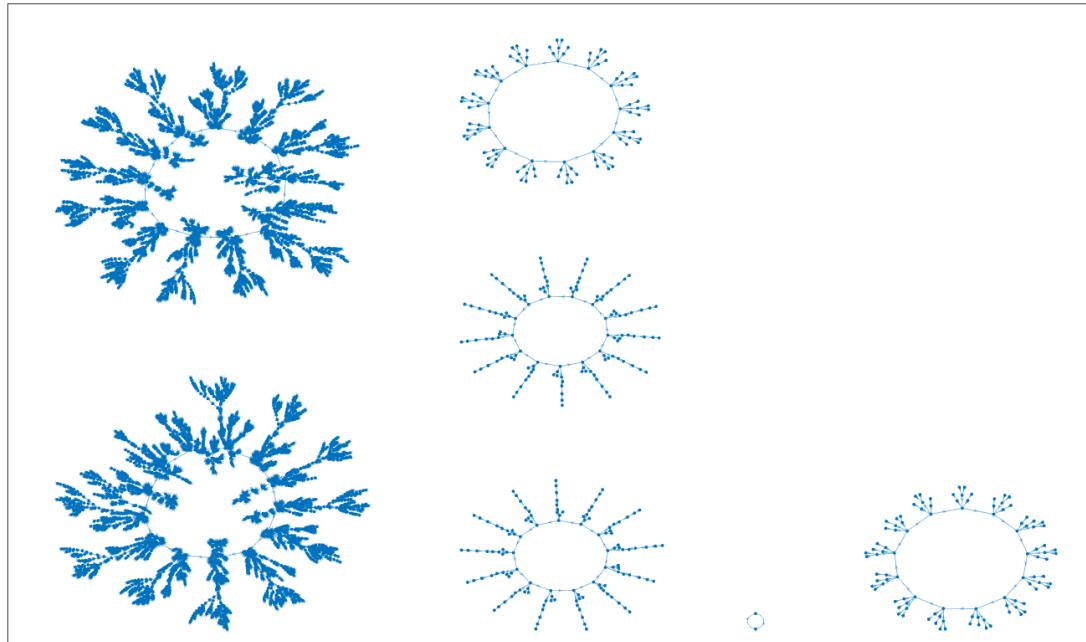
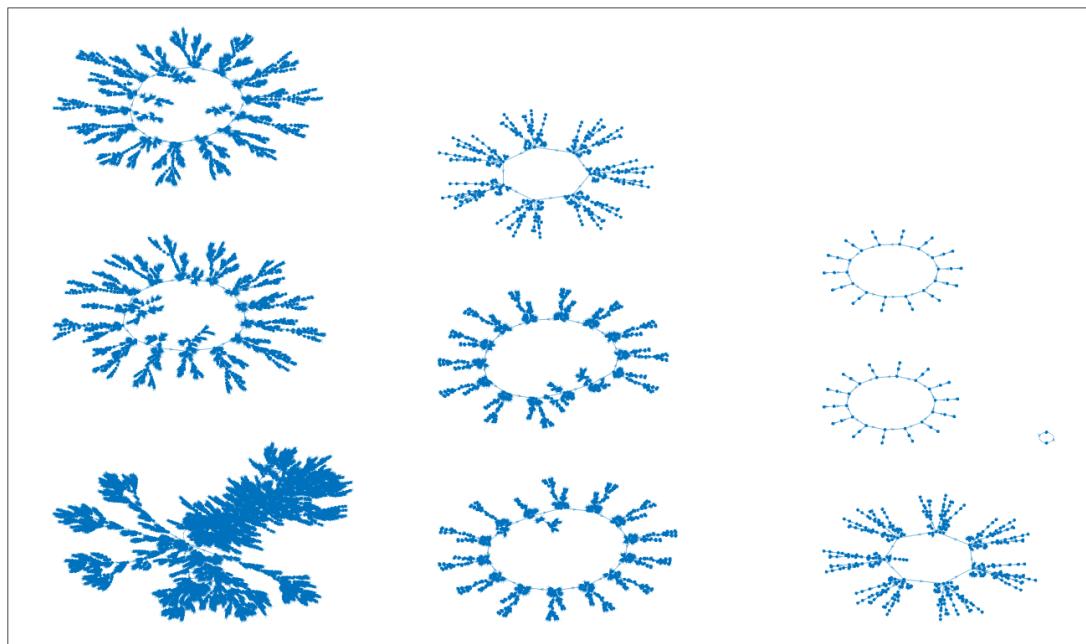
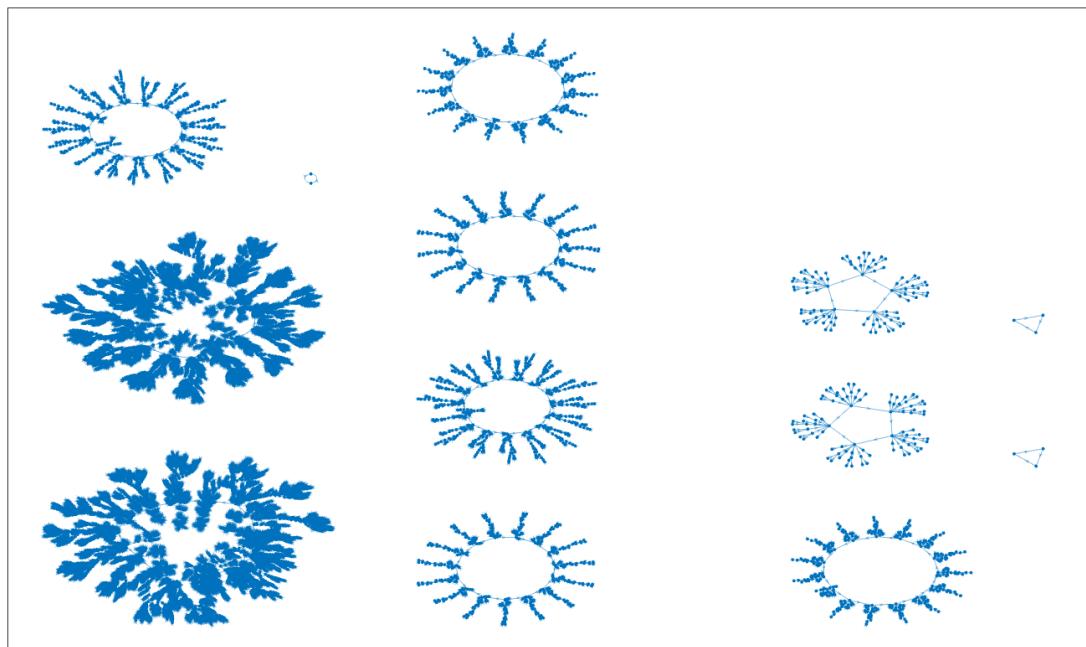


Figura 3.623: Atractor regla 57 n=10

Figura 3.624: Atractor regla 57 $n=11$ Figura 3.625: Atractor regla 57 $n=12$

Figura 3.626: Atractor regla 57 $n=13$ Figura 3.627: Atractor regla 57 $n=14$

Figura 3.628: Atractor regla 57 $n=15$

3.47. Reglas 58,114,163,177

Respecto a la regla 58 se aprecia que mientras más grande es el tamaño de la cadena (n) sucede el mismo comportamiento que en la regla 50 y 56 que es que siempre se mantiene presente la estructura que se crea con $n=2$, observe la figura que se encuentra abajo, esa estructura es la que siempre aparece en cada imagen, se mantiene constante.

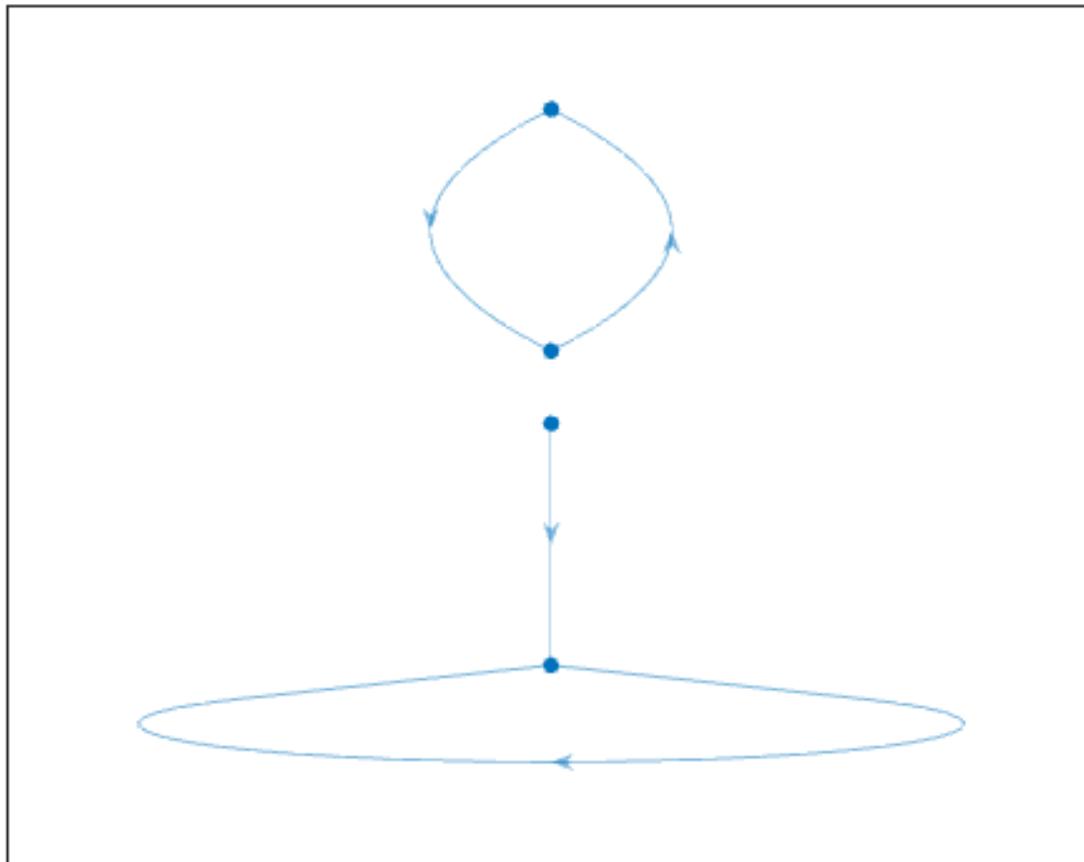


Figura 3.629: Atractor regla 58 $n=2$

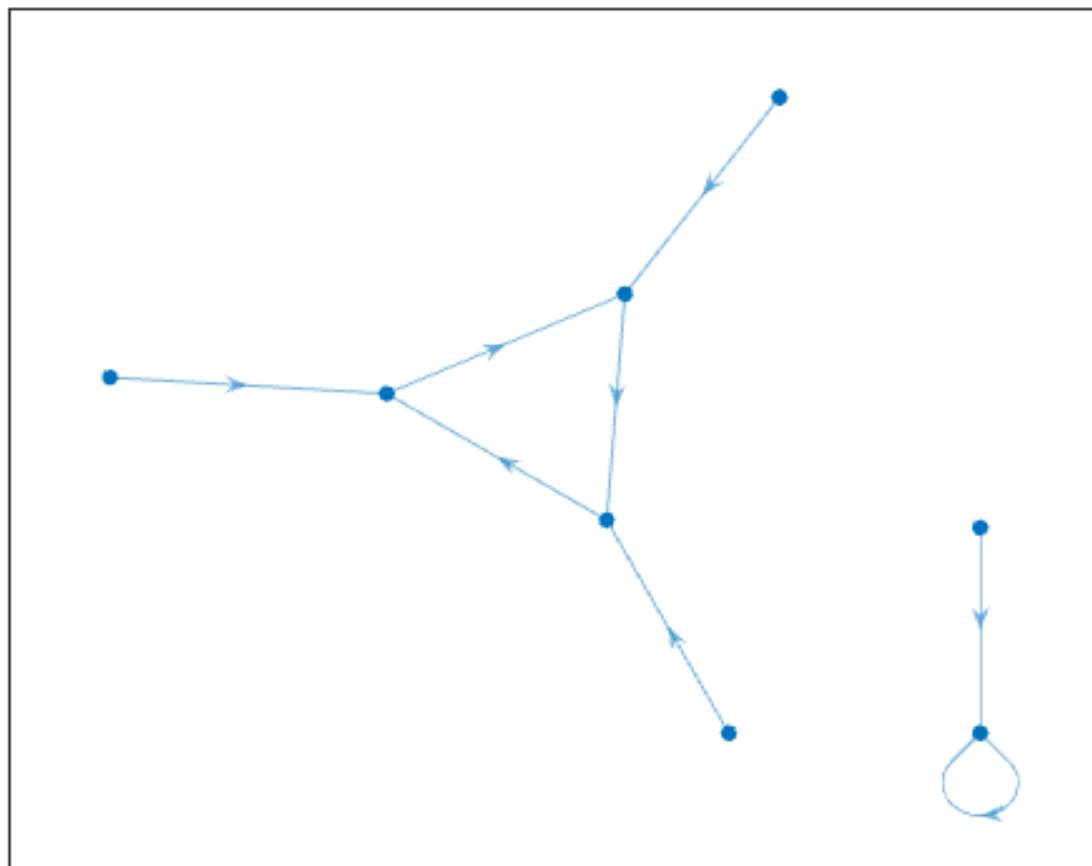


Figura 3.630: Atractor regla 58 n=3

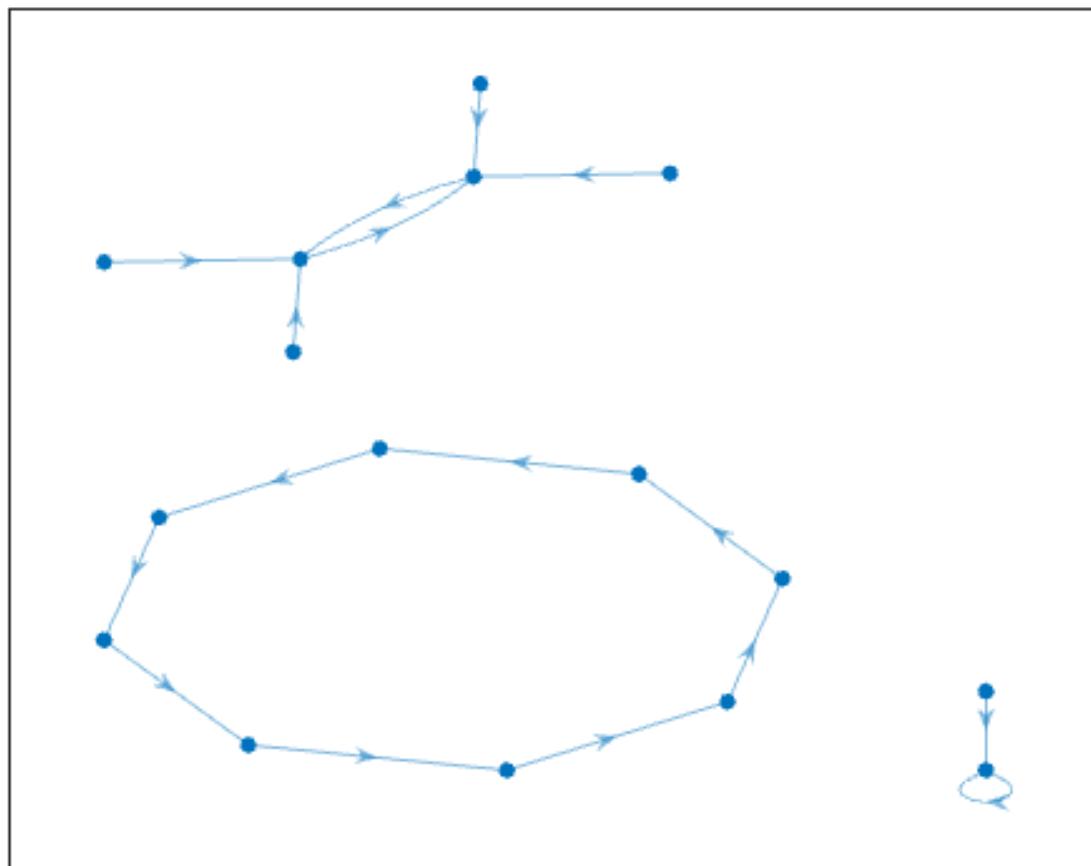


Figura 3.631: Atractor regla 58 n=4

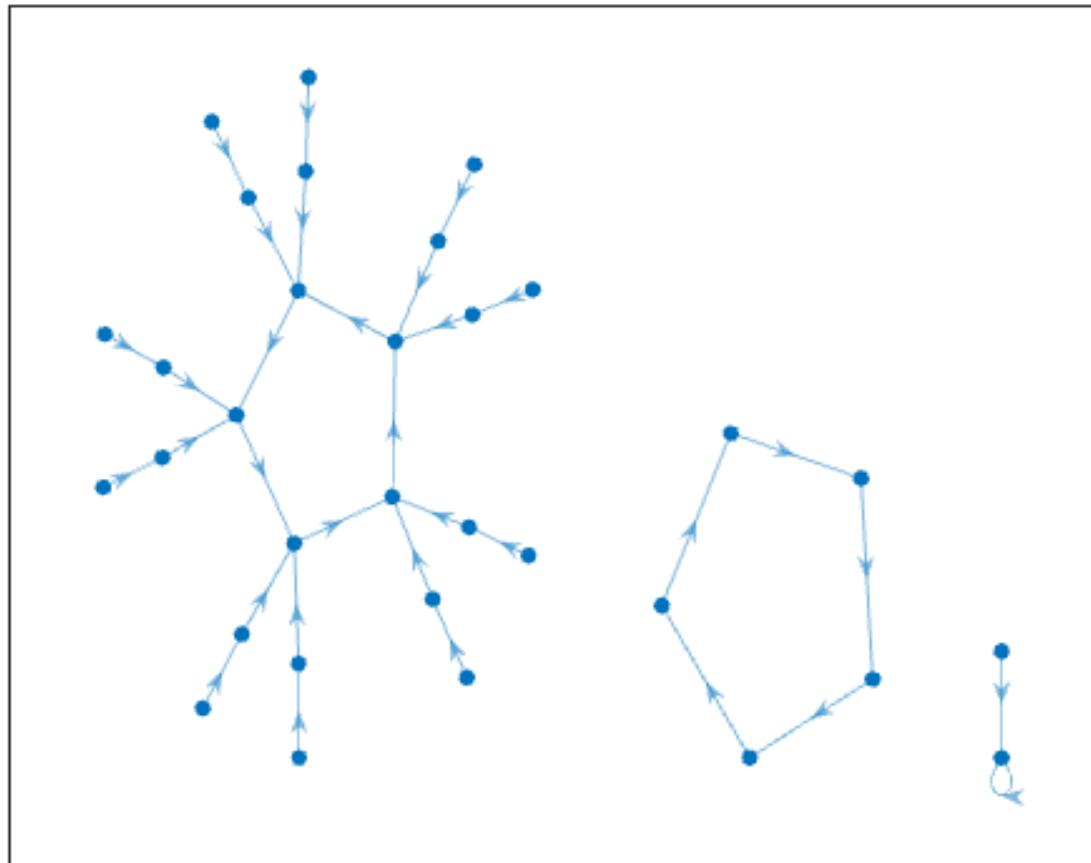


Figura 3.632: Atractor regla 58 n=5

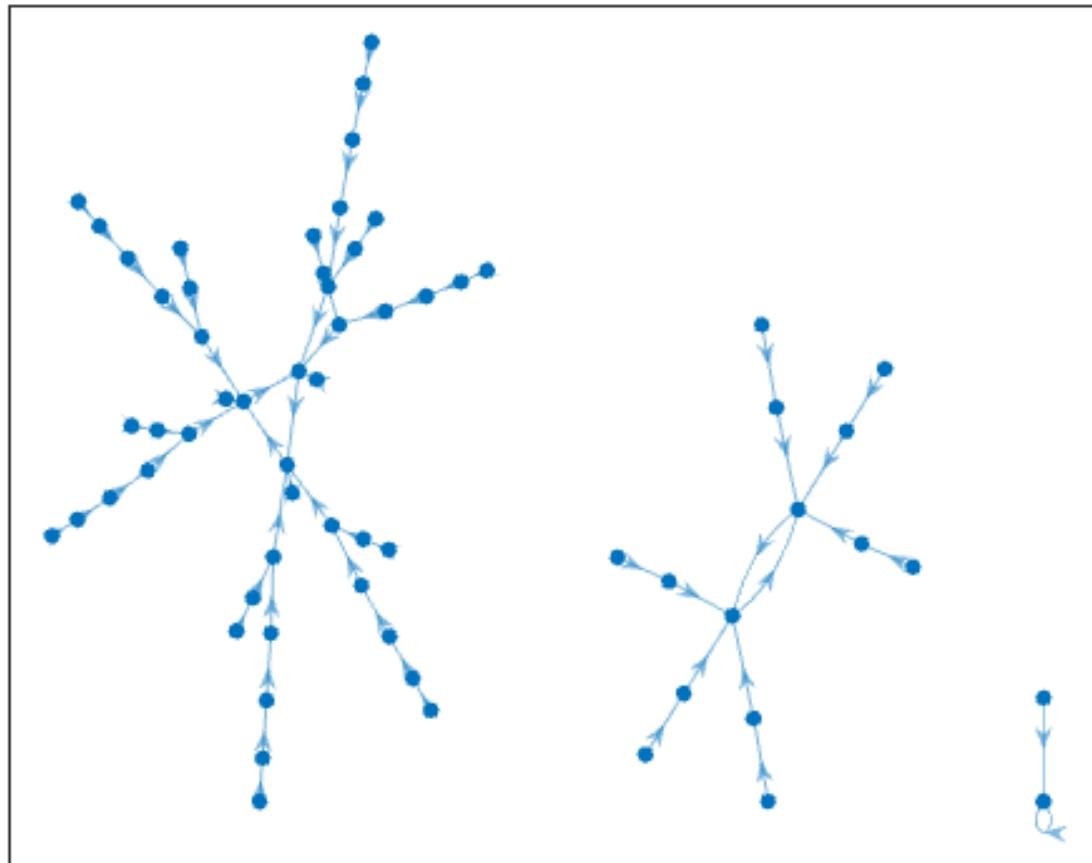


Figura 3.633: Atractor regla 58 n=6

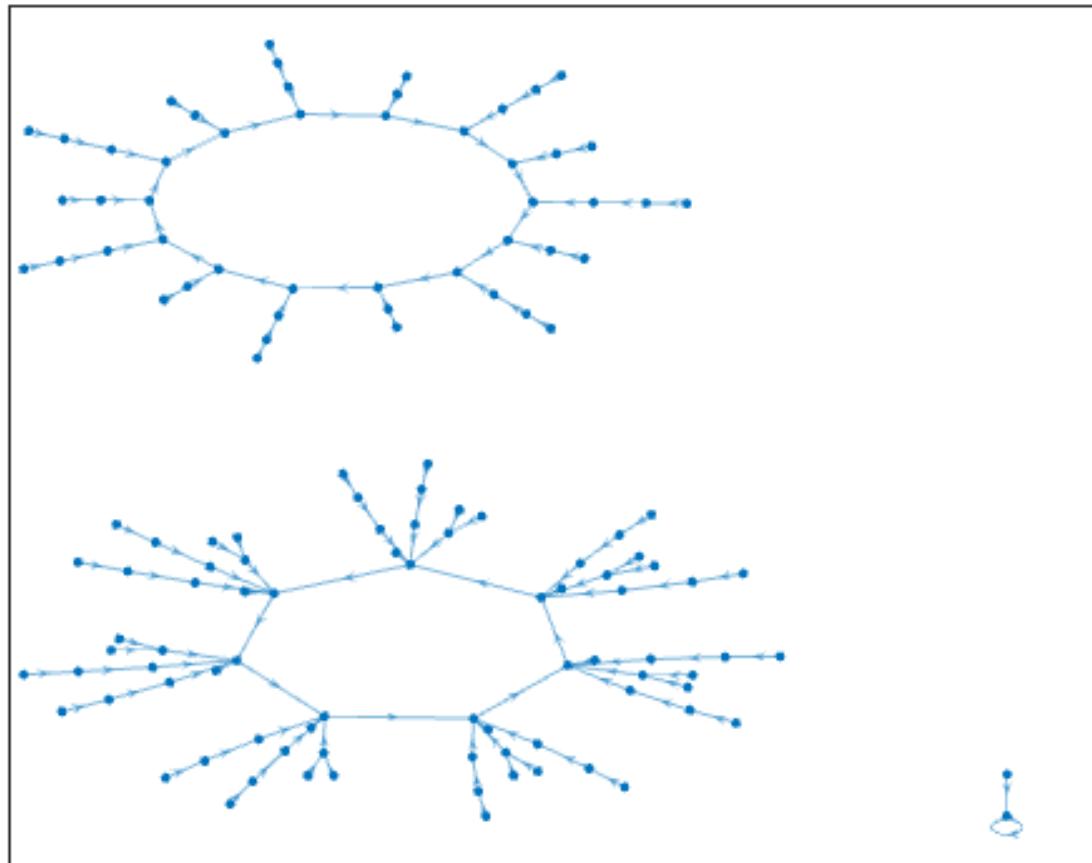


Figura 3.634: Atractor regla 58 n=7

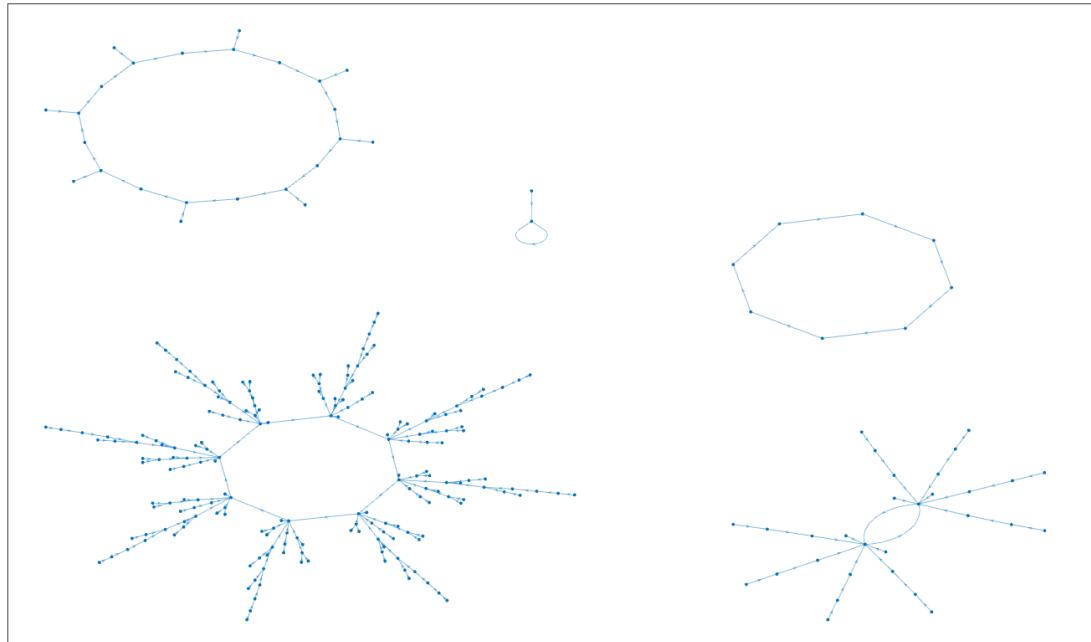


Figura 3.635: Atractor regla 58 n=8

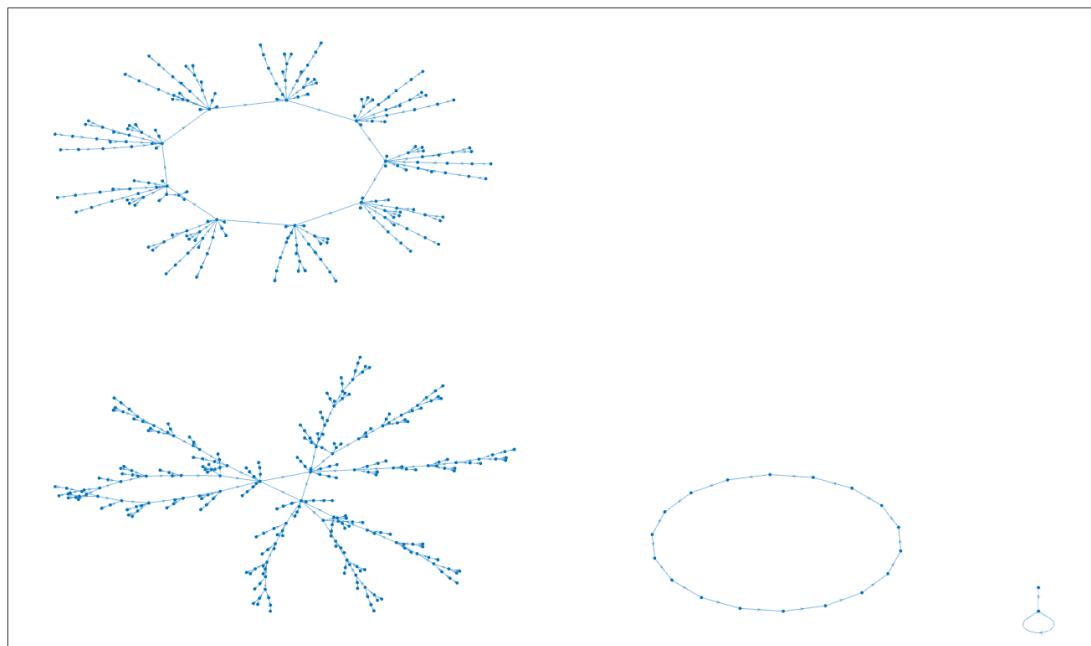


Figura 3.636: Atractor regla 58 n=9

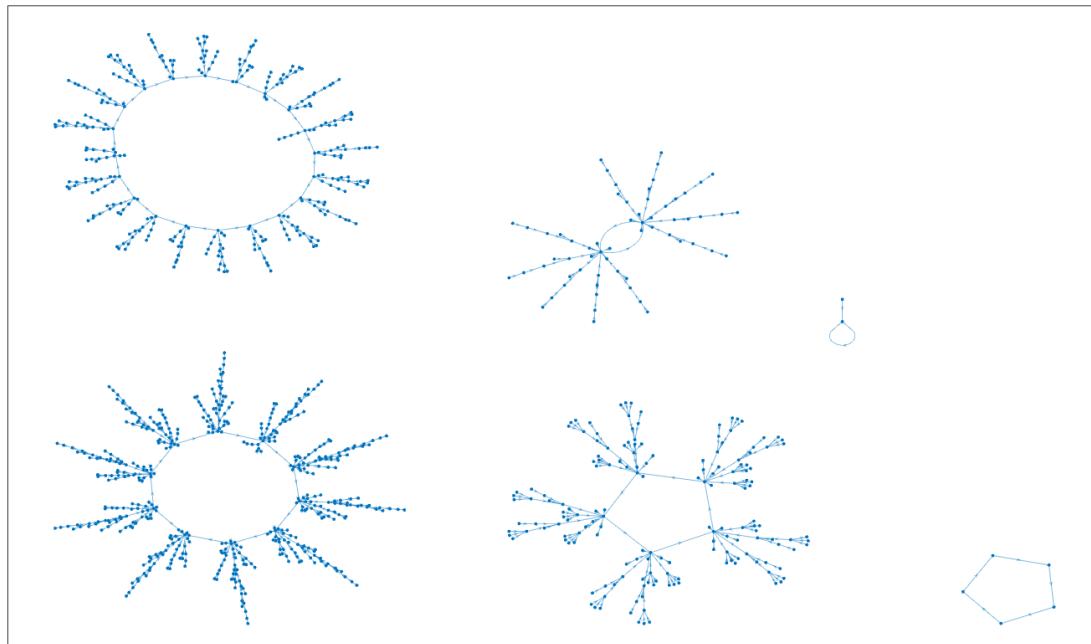


Figura 3.637: Atractor regla 58 n=10

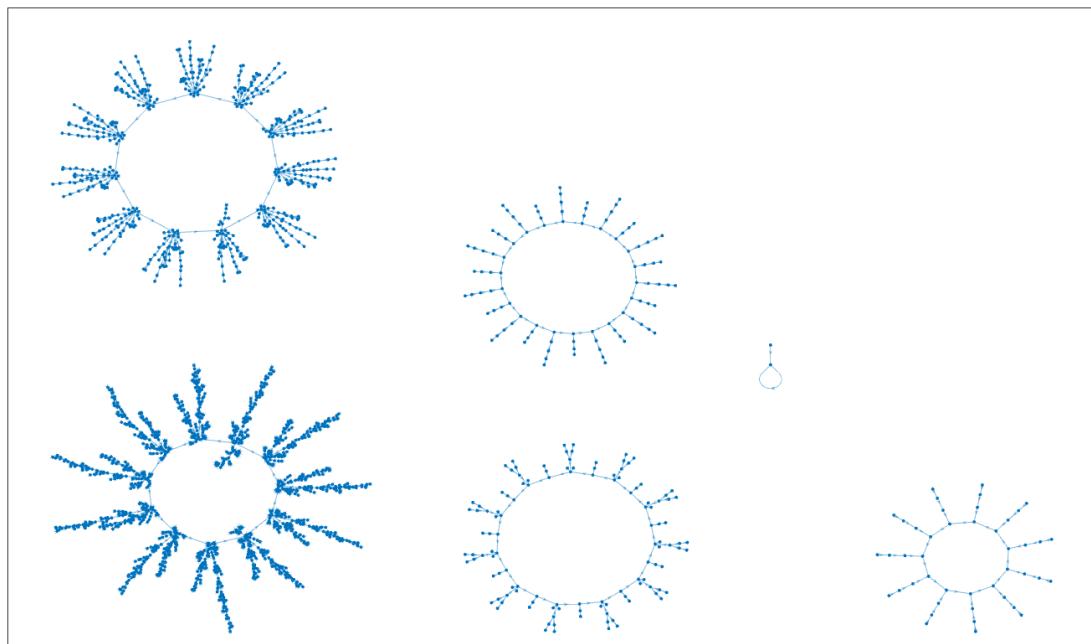
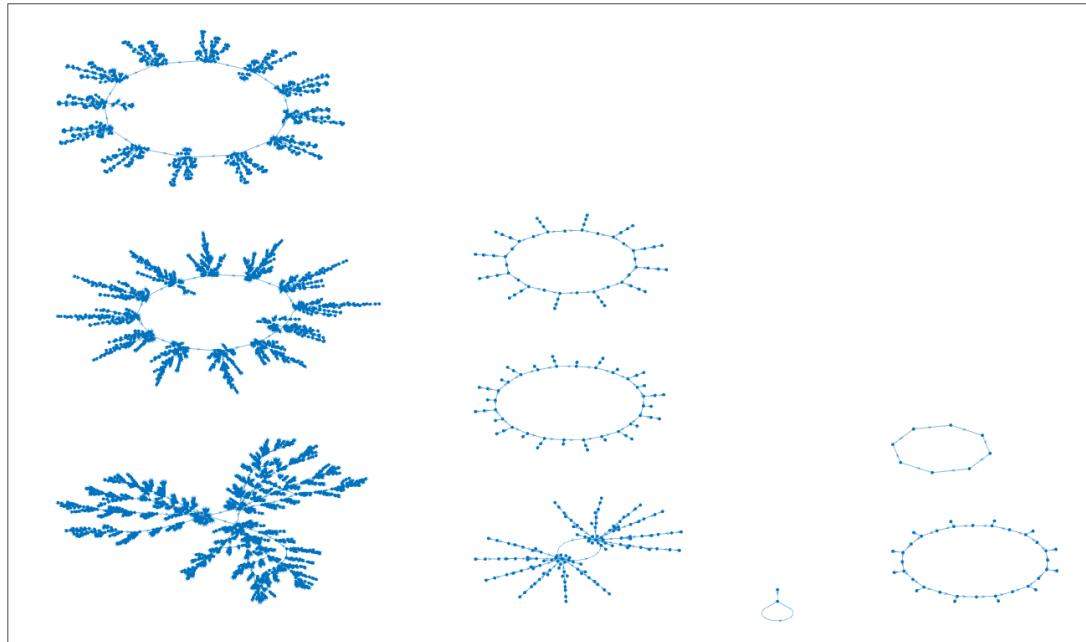
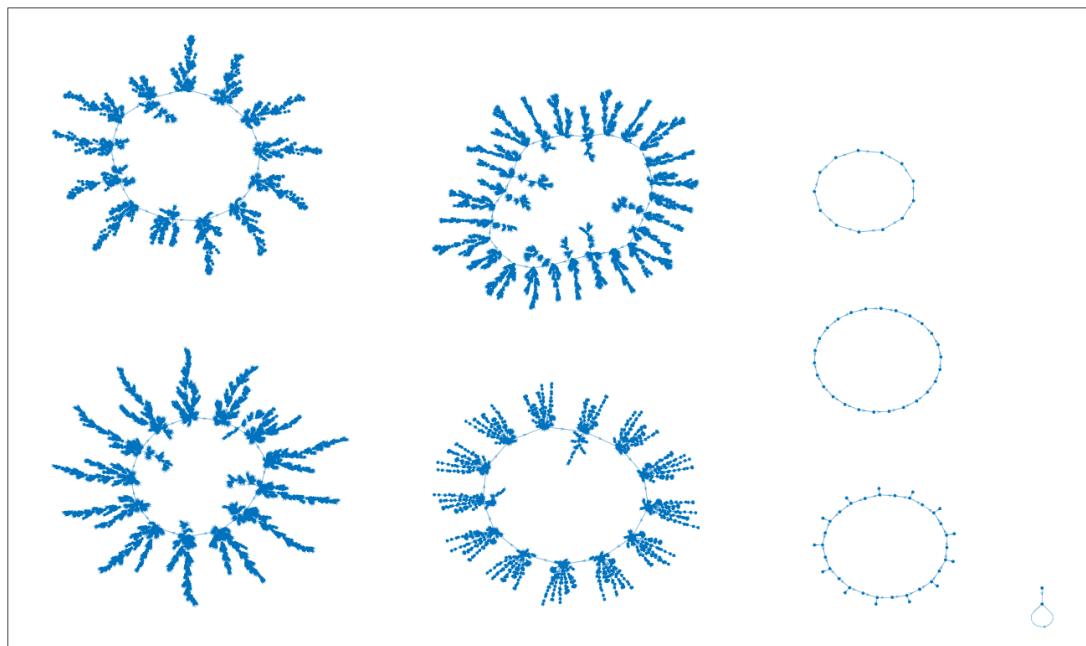


Figura 3.638: Atractor regla 58 n=11

Figura 3.639: Atractor regla 58 $n=12$ Figura 3.640: Atractor regla 58 $n=13$

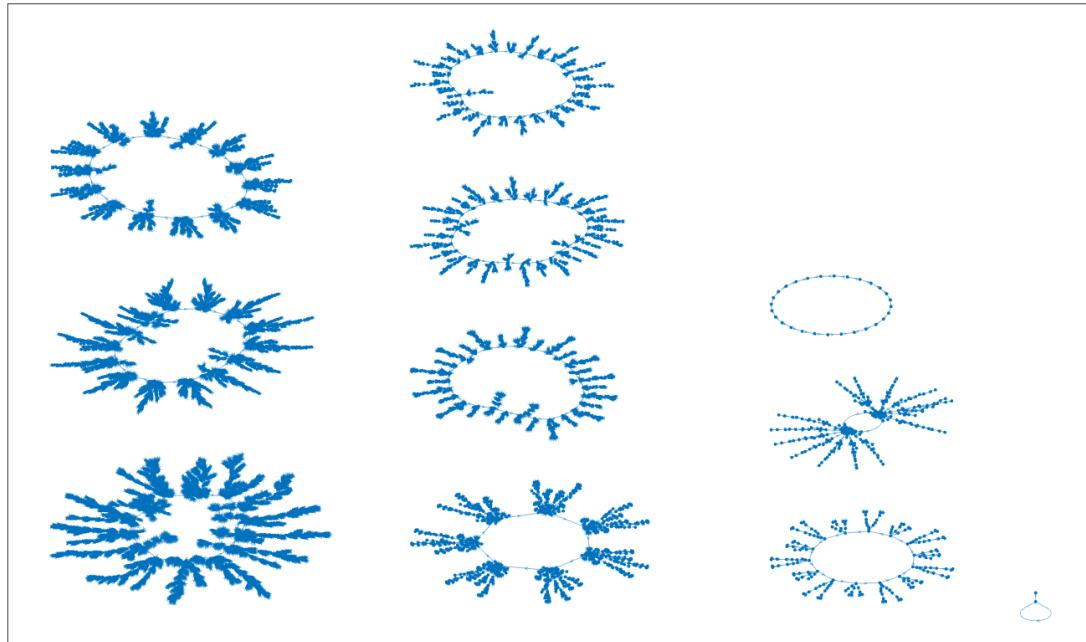


Figura 3.641: Atractor regla 58 n=14

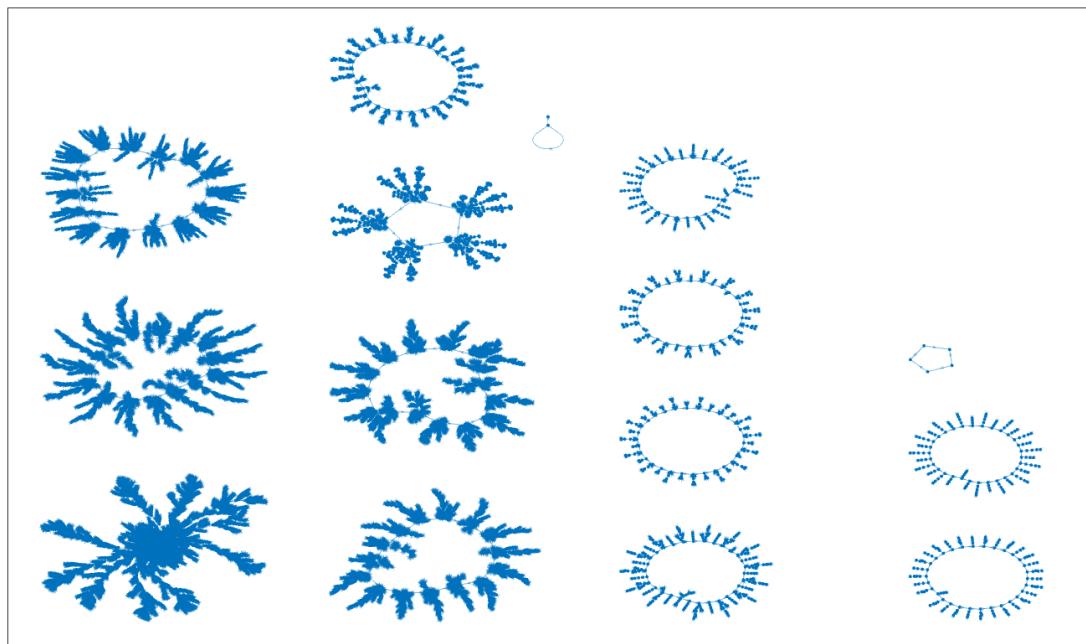


Figura 3.642: Atractor regla 58 n=15

3.48. Reglas 60,102,153,195

Respecto a la regla 60 se aprecia que hay un salto brusco en la configuración del atractor en $n=7$ (figura 3.648) a $n=8$ (figura 4.649) y mencionar que una estructura se mantiene siempre constante, ya sea unida a un atractor o separada y ella siendo por sí misma un atractor.

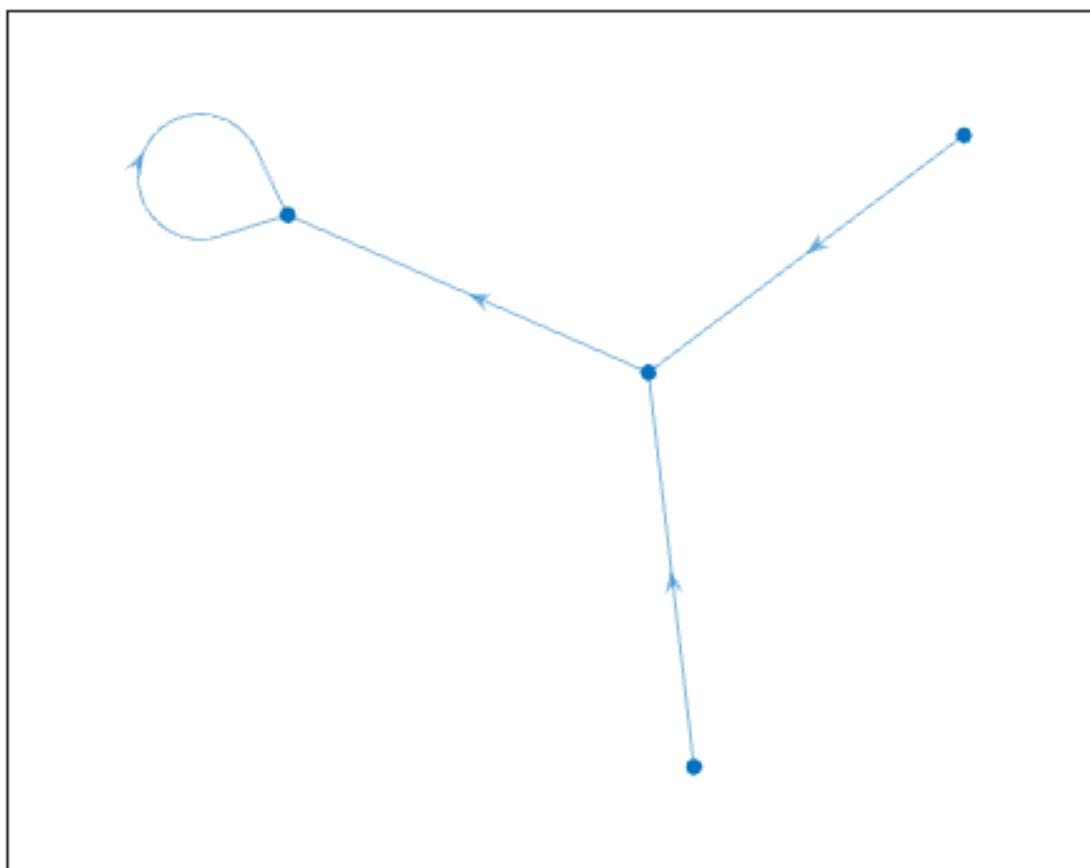


Figura 3.643: Atractor regla 60 $n=2$

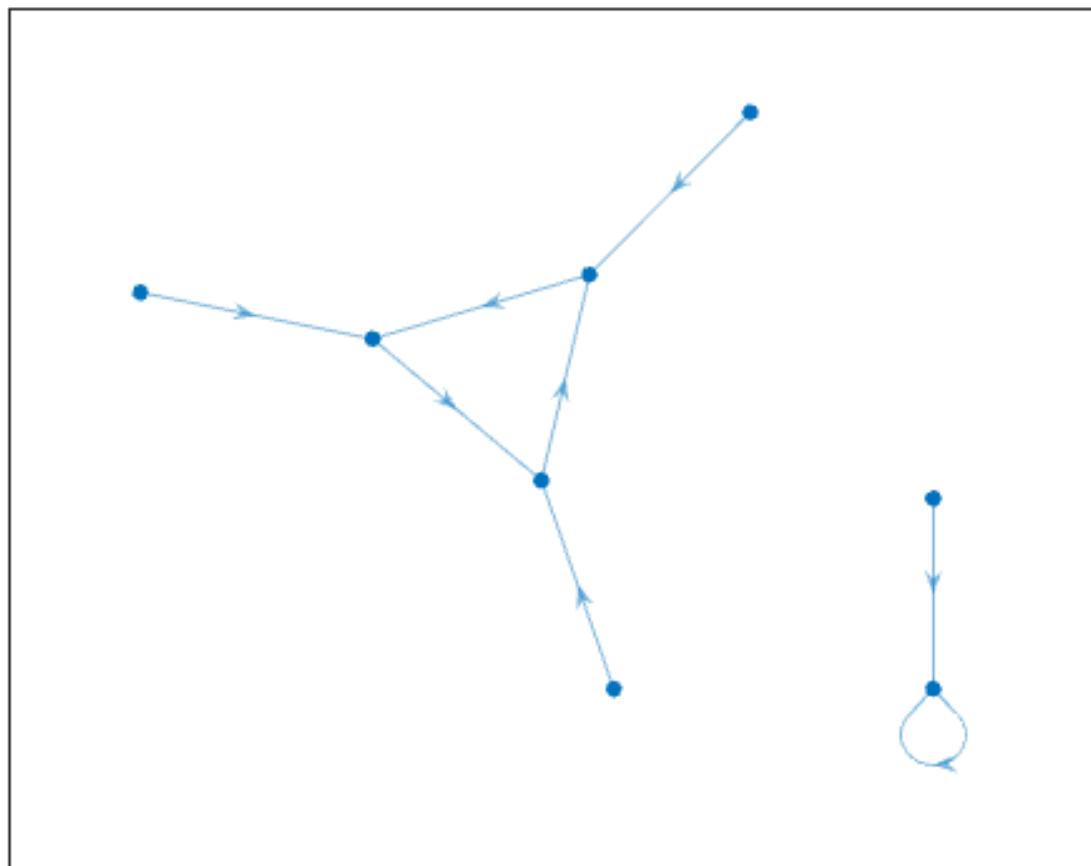


Figura 3.644: Atractor regla 60 n=3

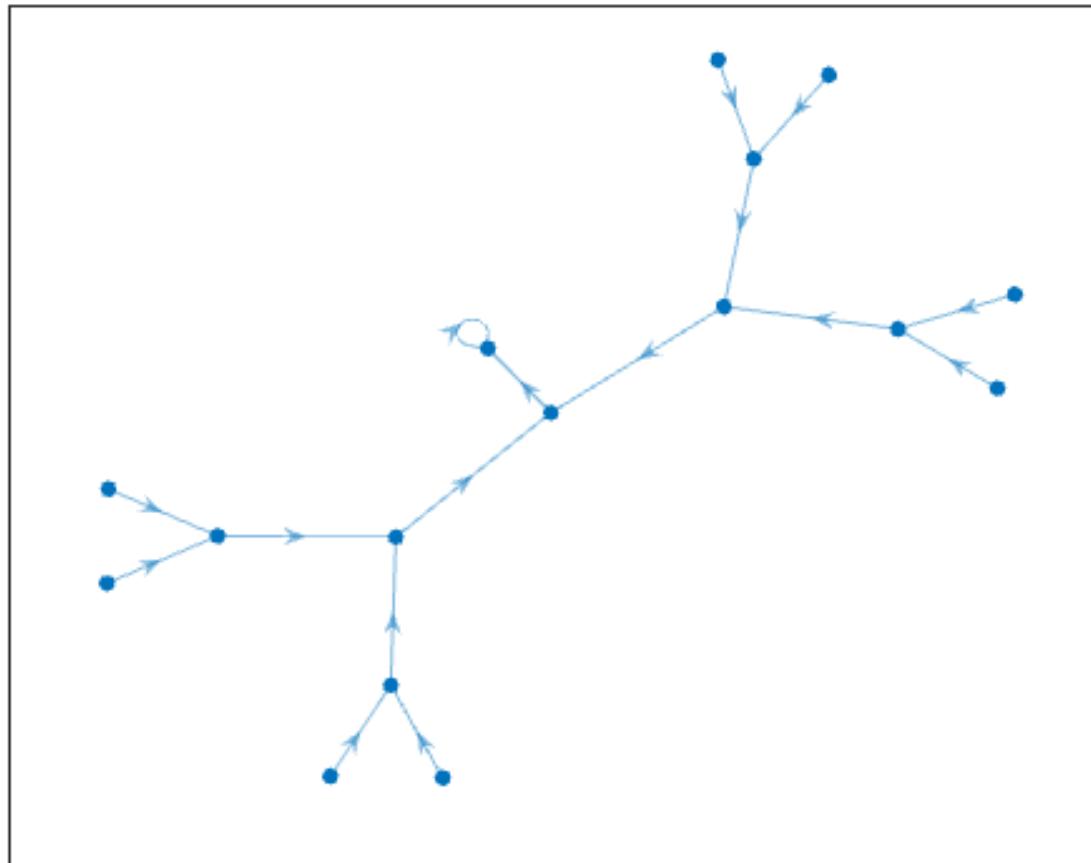


Figura 3.645: Atractor regla 60 n=4

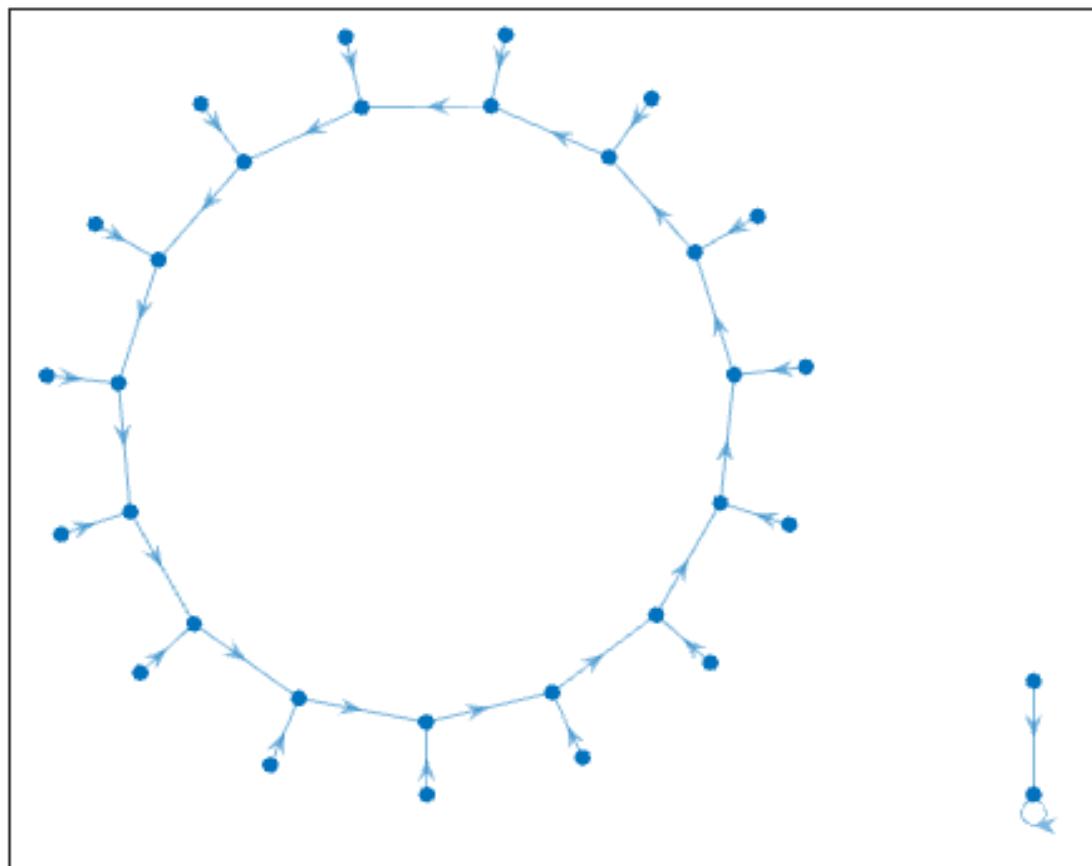


Figura 3.646: Atractor regla 60 n=5

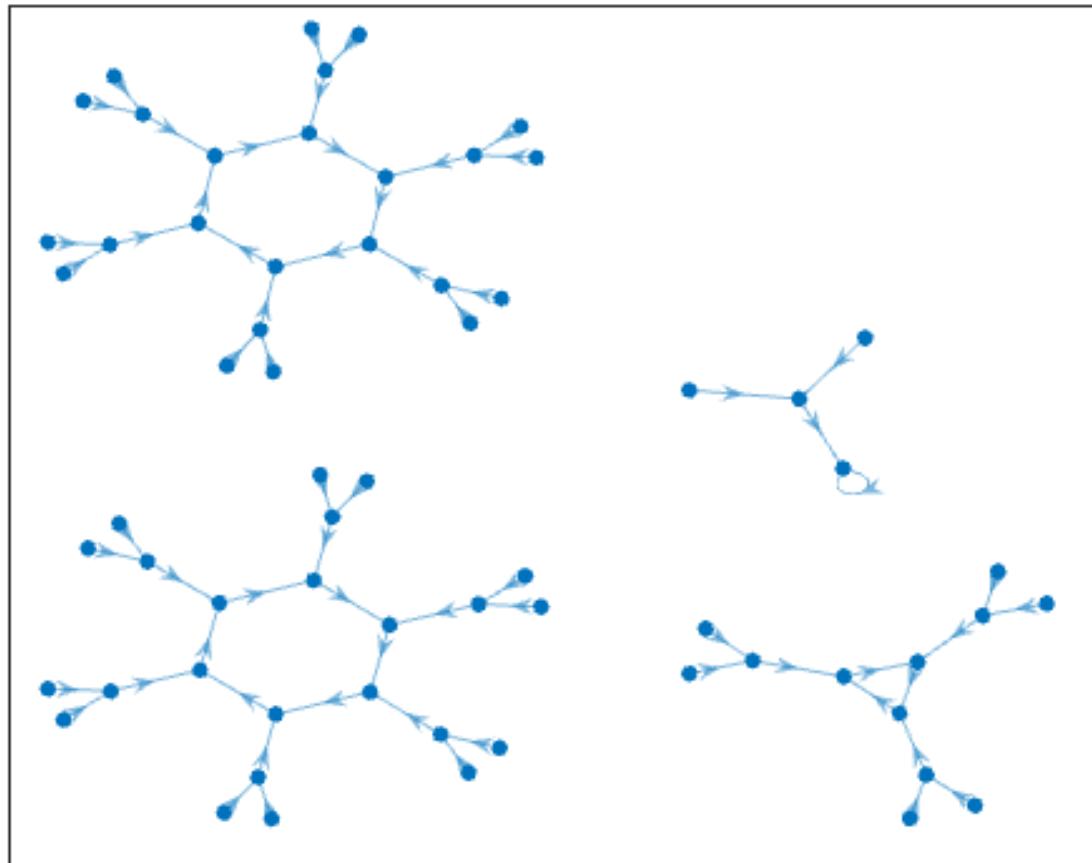


Figura 3.647: Atractor regla 60 n=6

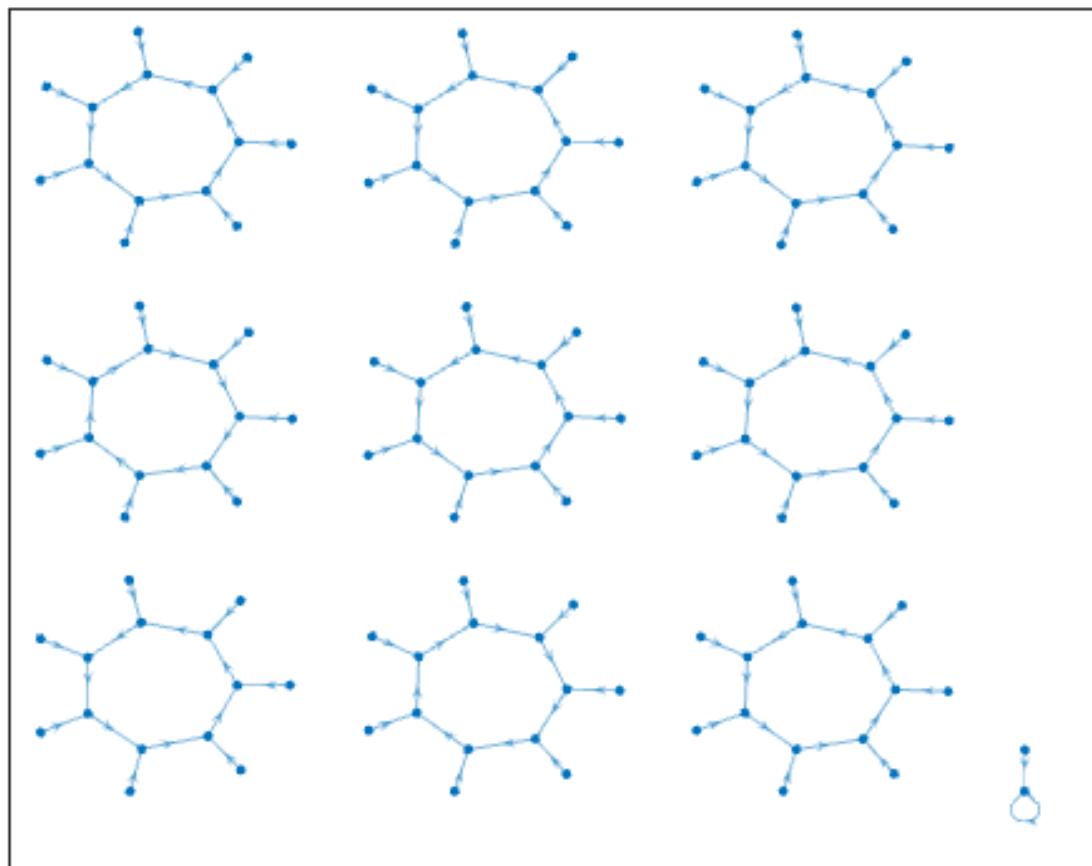


Figura 3.648: Atractor regla 60 n=7

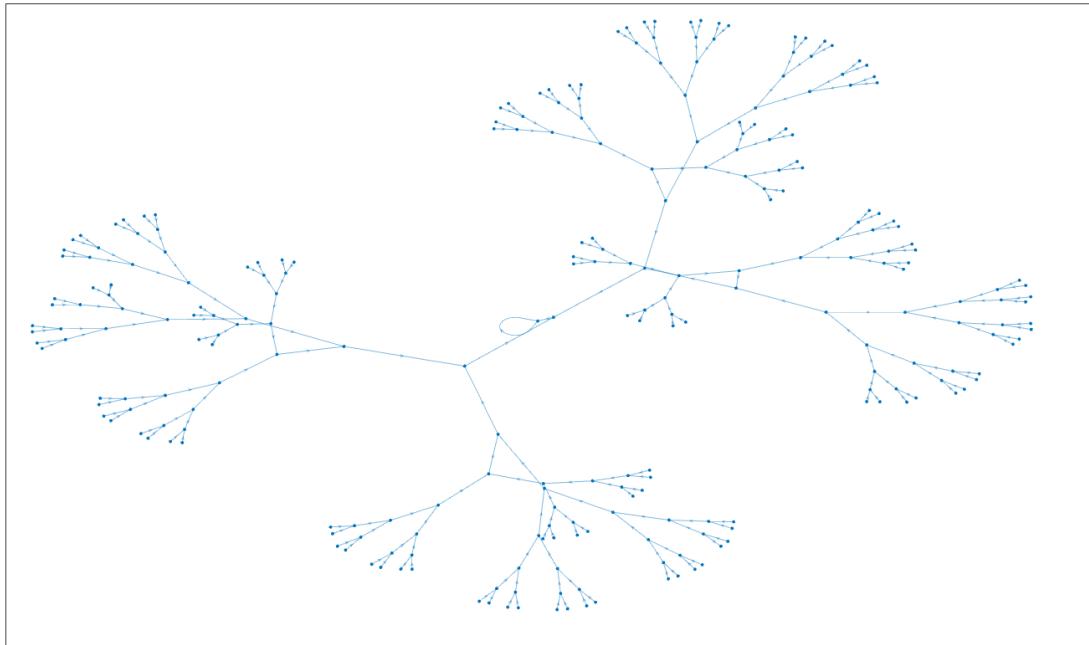


Figura 3.649: Atractor regla 60 n=8

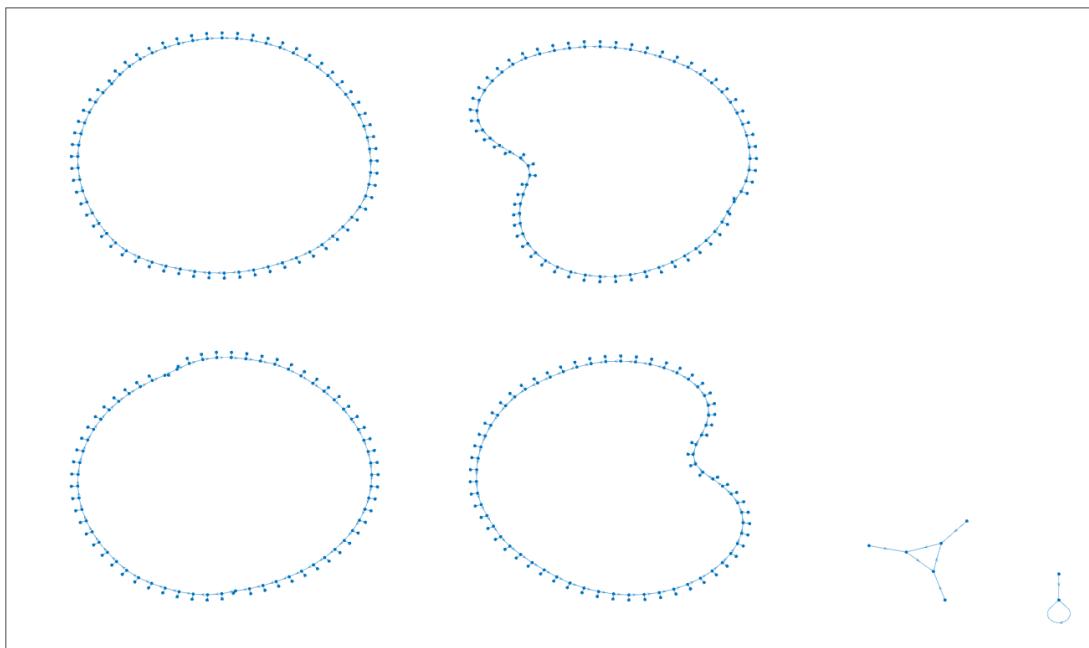


Figura 3.650: Atractor regla 60 n=9

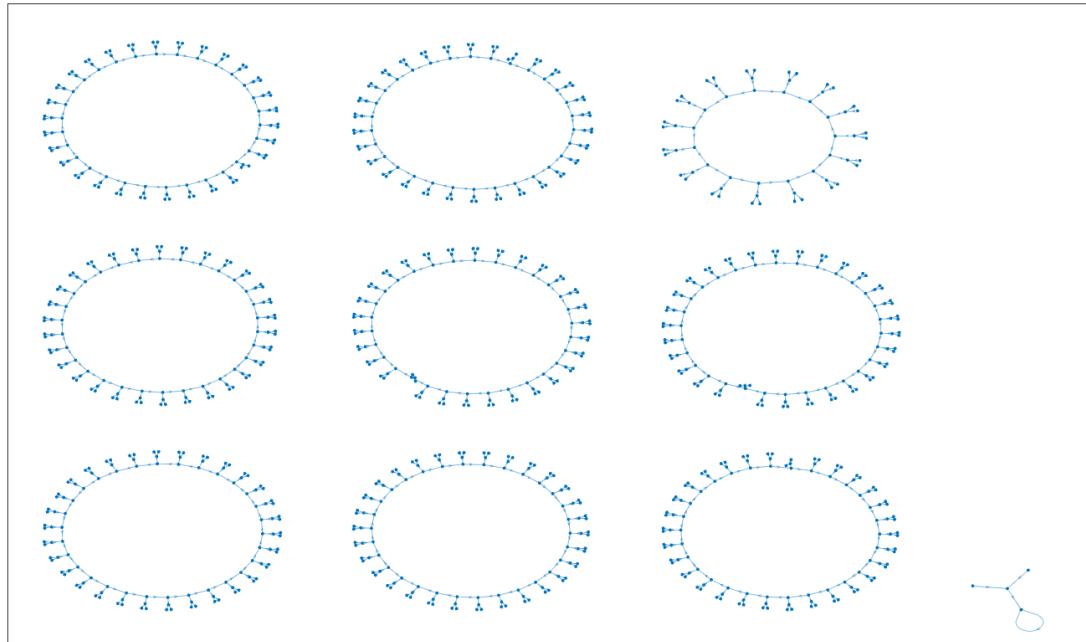


Figura 3.651: Atractor regla 60 n=10

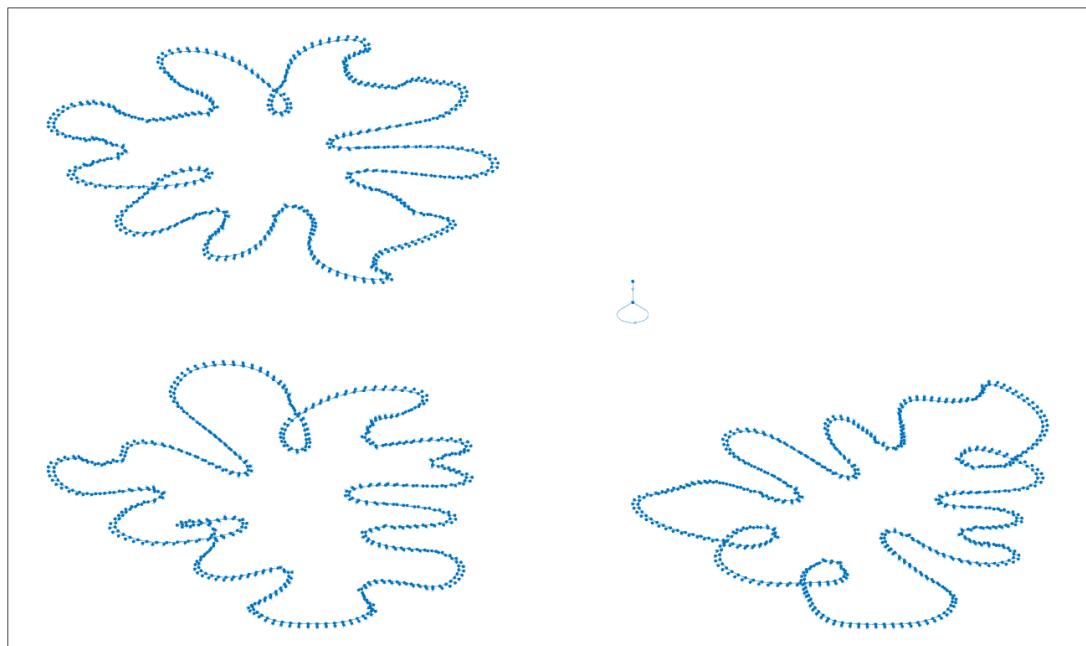


Figura 3.652: Atractor regla 60 n=11

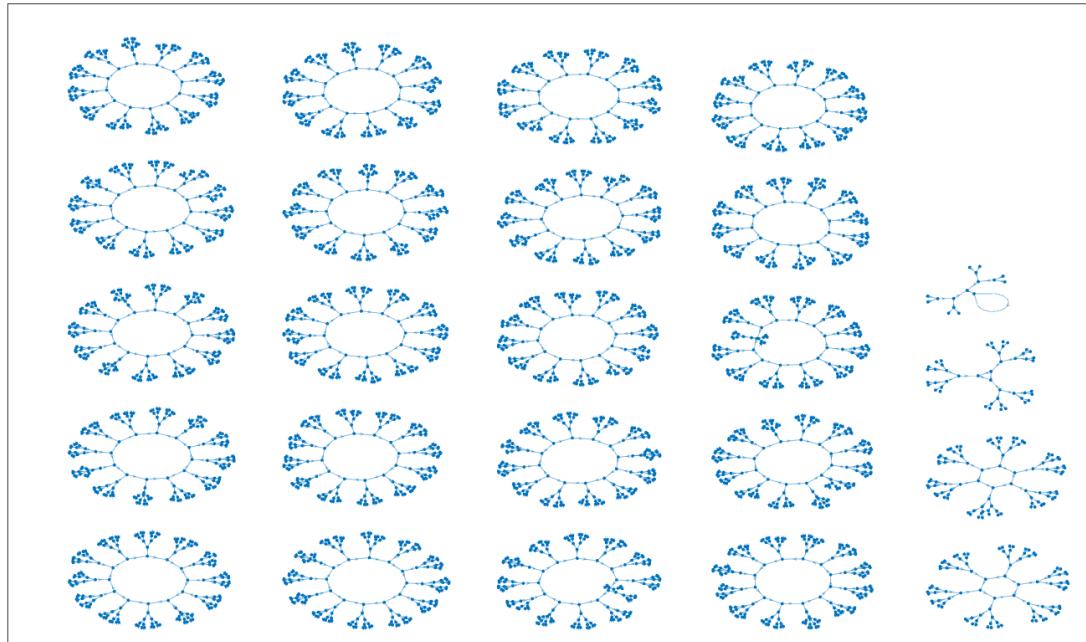


Figura 3.653: Atractor regla 60 n=12

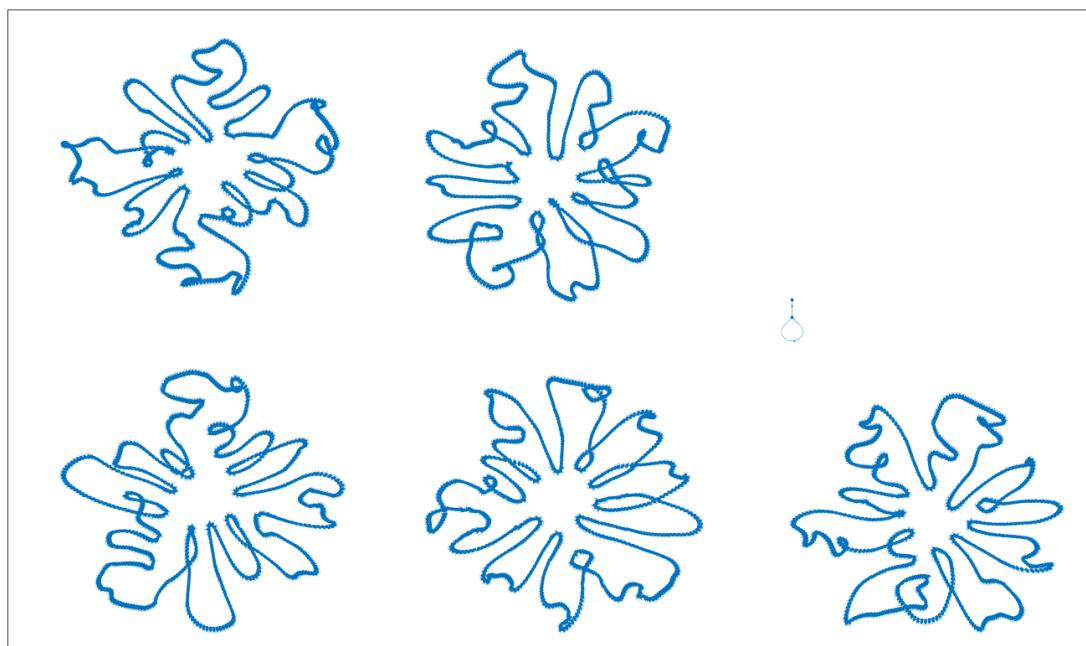


Figura 3.654: Atractor regla 60 n=13

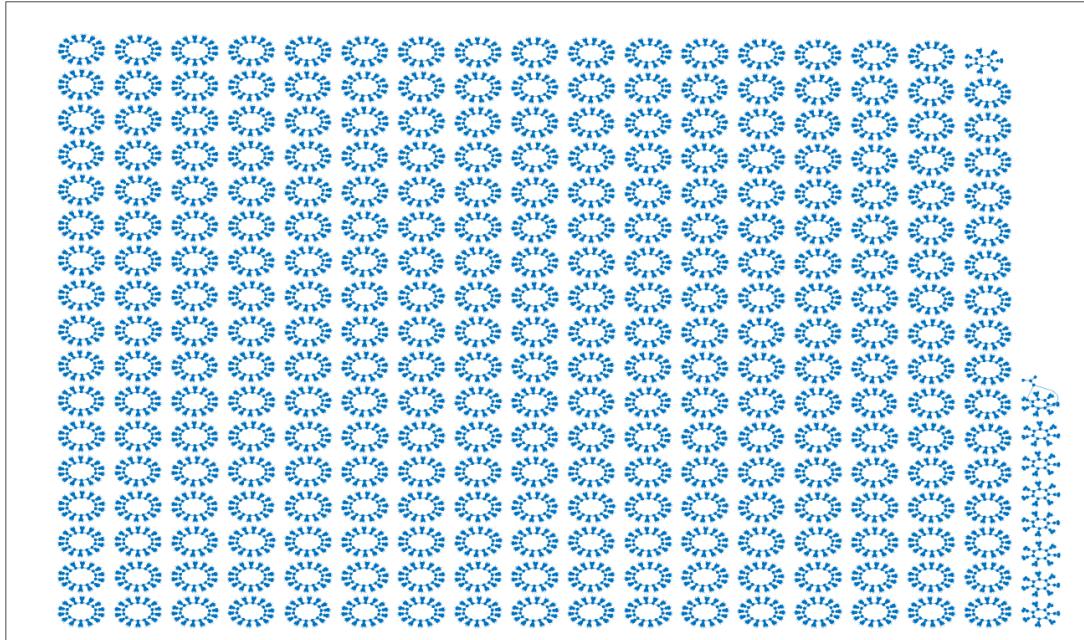


Figura 3.655: Atractor regla 60 n=14

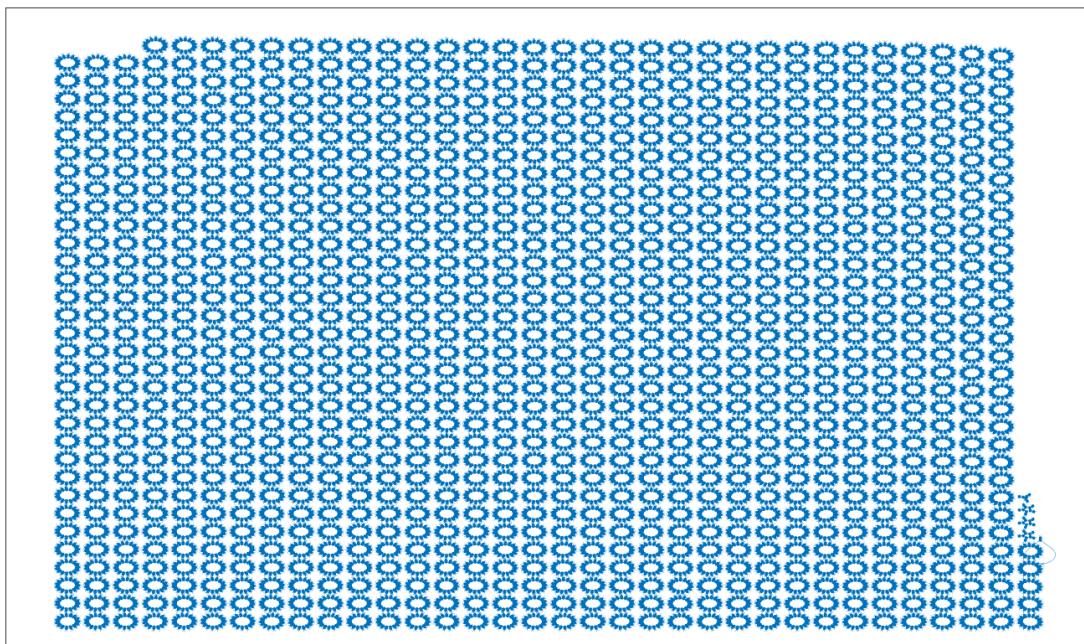


Figura 3.656: Atractor regla 60 n=15

3.49. Reglas 62,118,131,145

Respecto a la regla 62 se aprecia que mientras más grande es el tamaño de la cadena (n) a partir de $n=3$ siempre aparecen atractores con estructura de triángulo, a pesar de que unos evolucionan en otras estructuras aparece un nuevo atractor con estructura de triángulo que tomará su lugar.

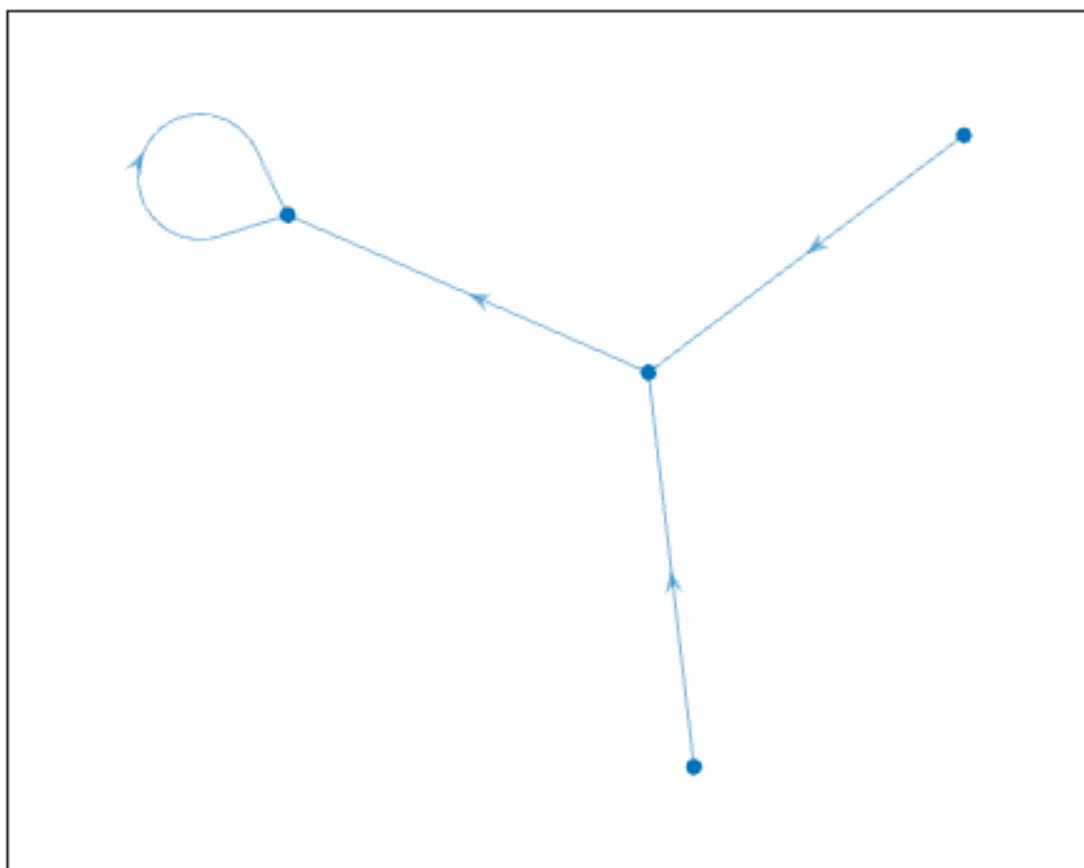
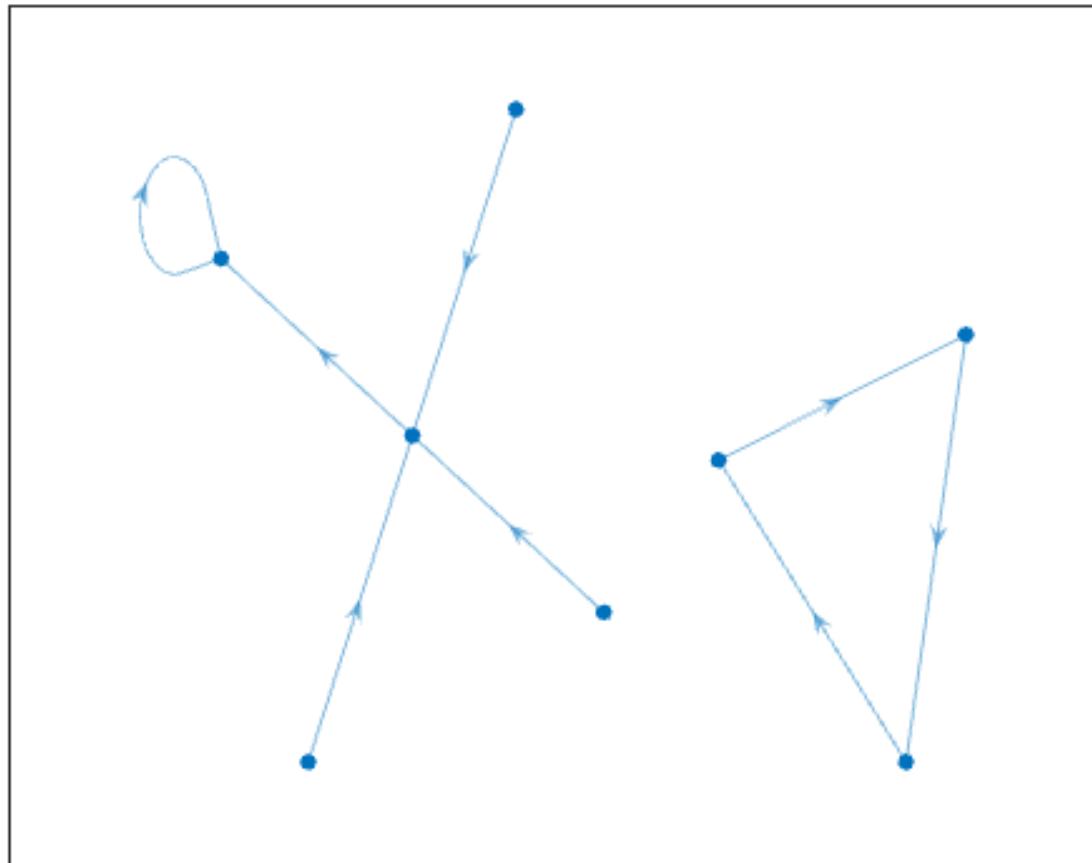


Figura 3.657: Atractor regla 62 $n=2$

Figura 3.658: Atractor regla 62 $n=3$

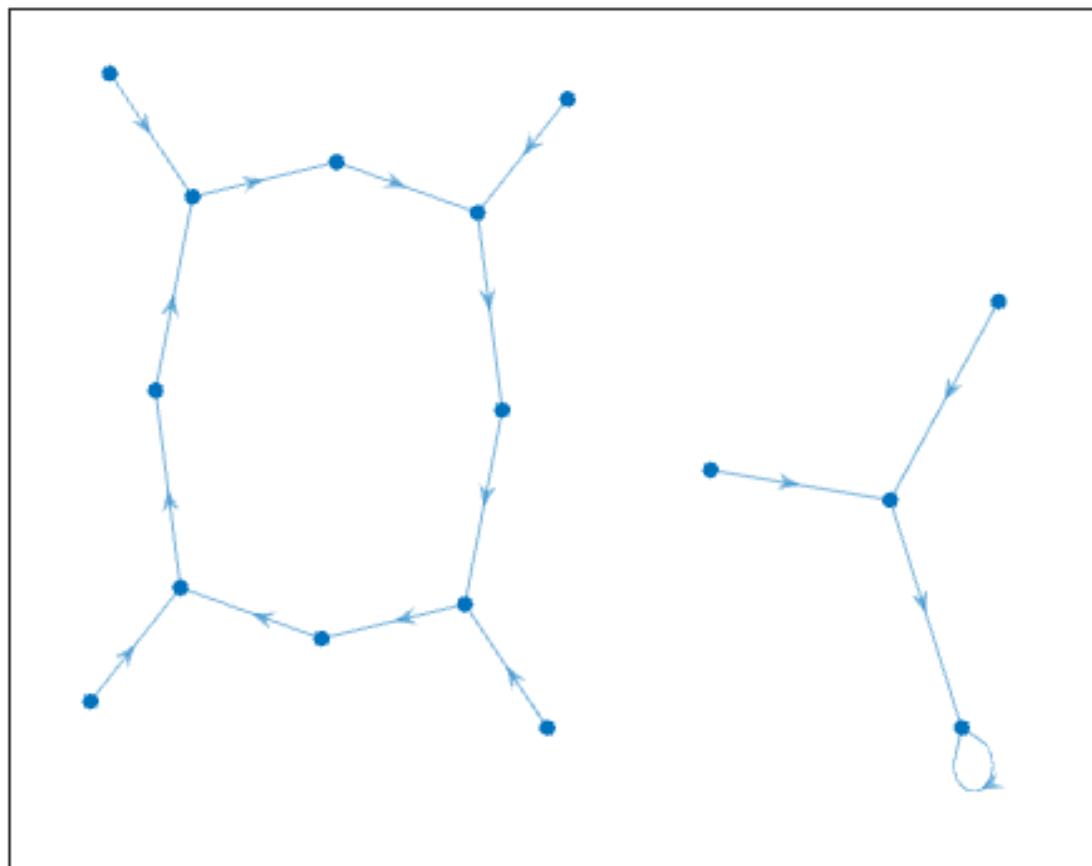


Figura 3.659: Atractor regla 62 n=4

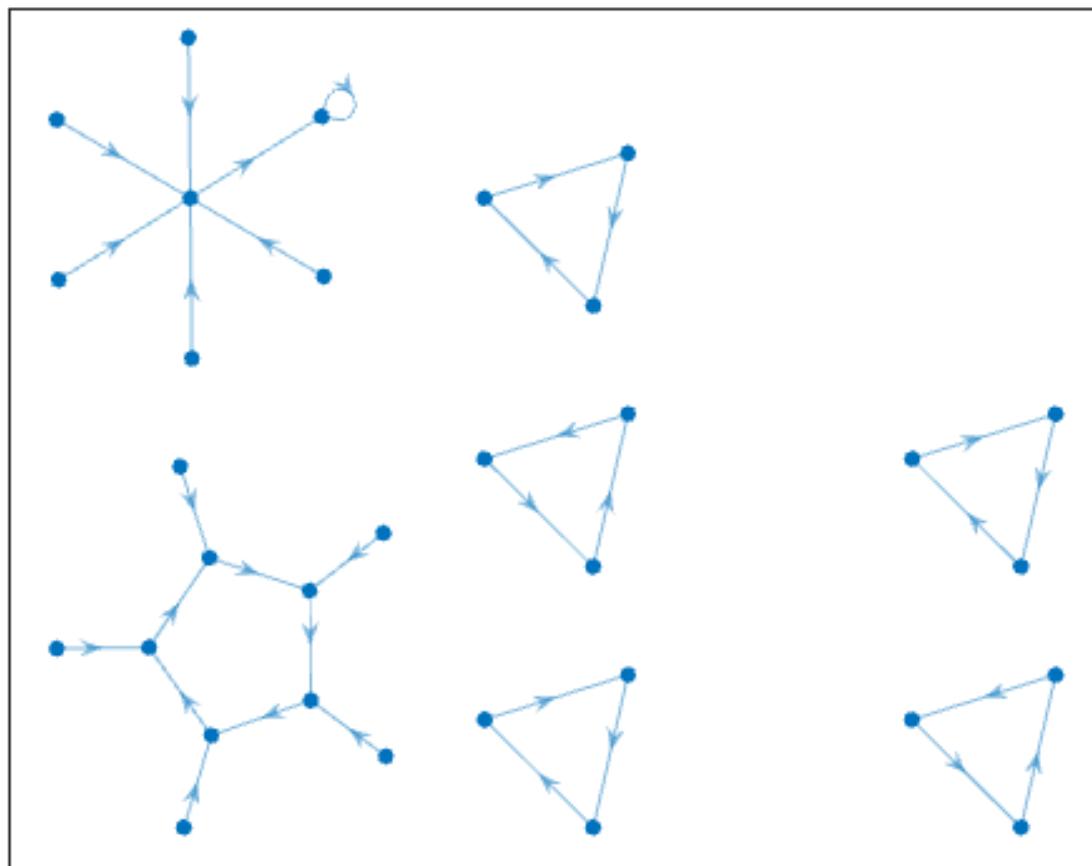


Figura 3.660: Atractor regla 62 n=5

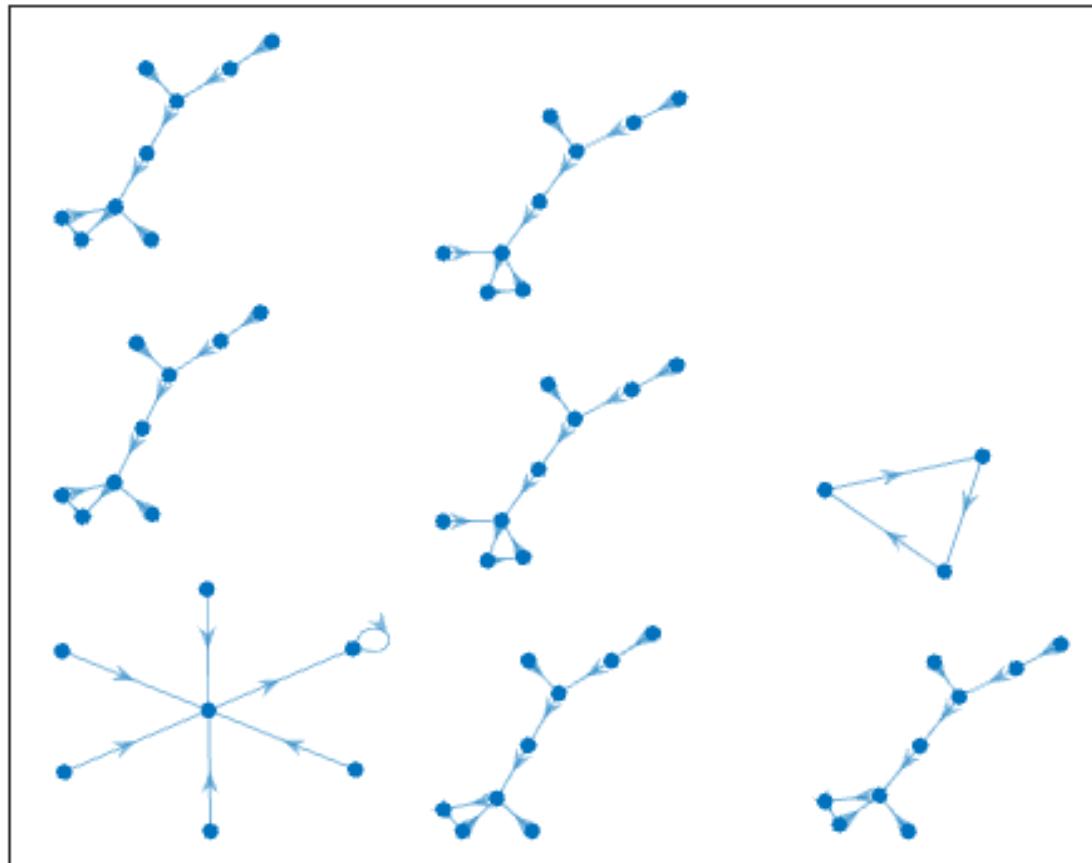
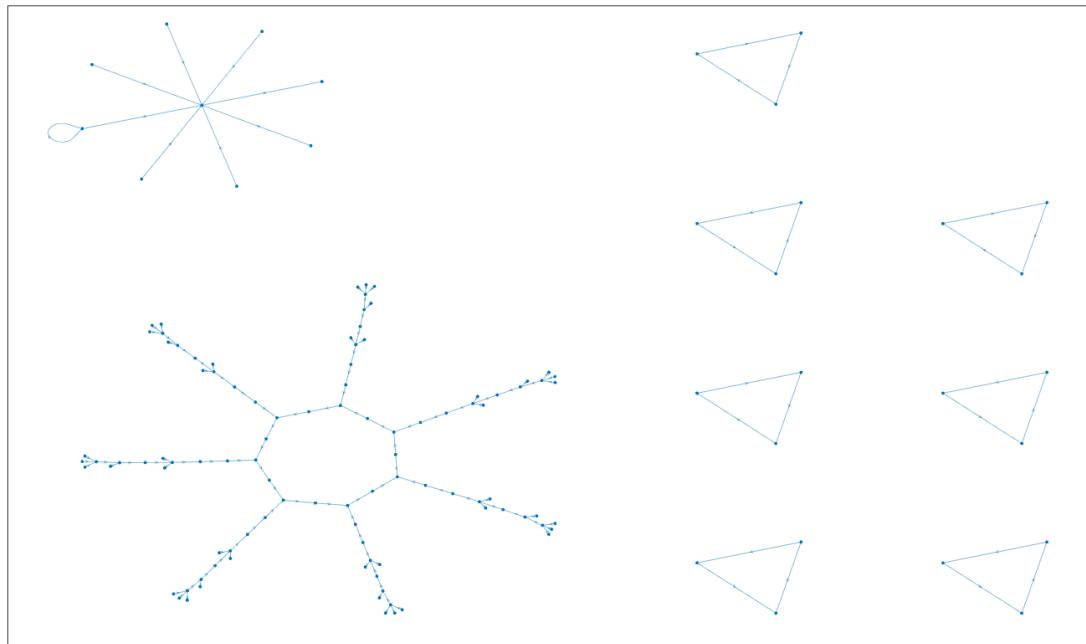
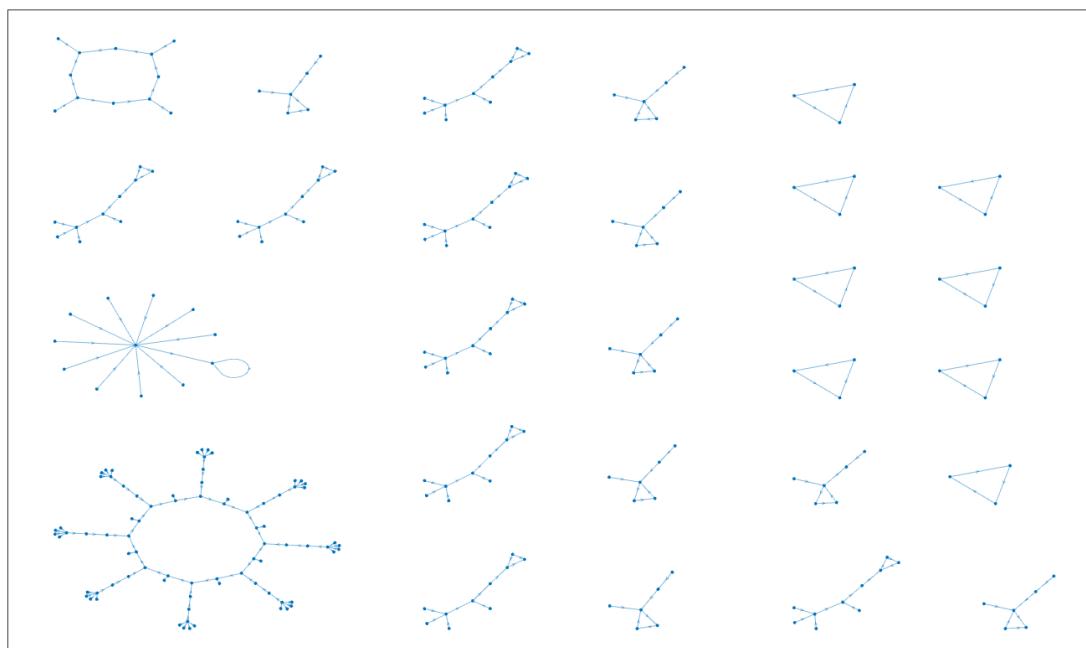


Figura 3.661: Atractor regla 62 n=6

Figura 3.662: Atractor regla 62 $n=7$ Figura 3.663: Atractor regla 62 $n=8$

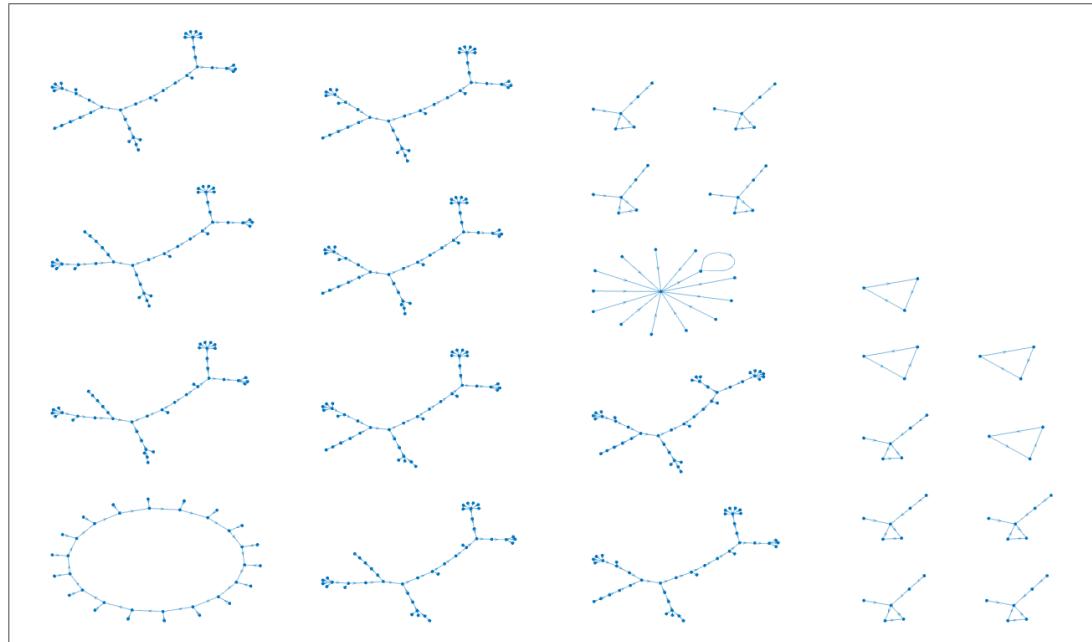


Figura 3.664: Atractor regla 62 n=9

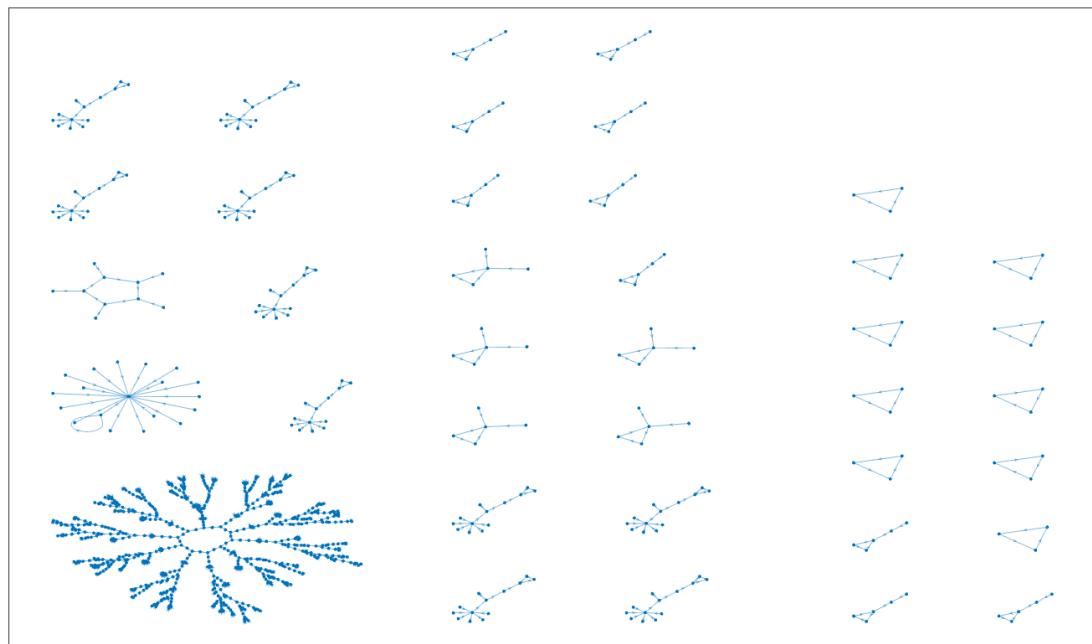


Figura 3.665: Atractor regla 62 n=10

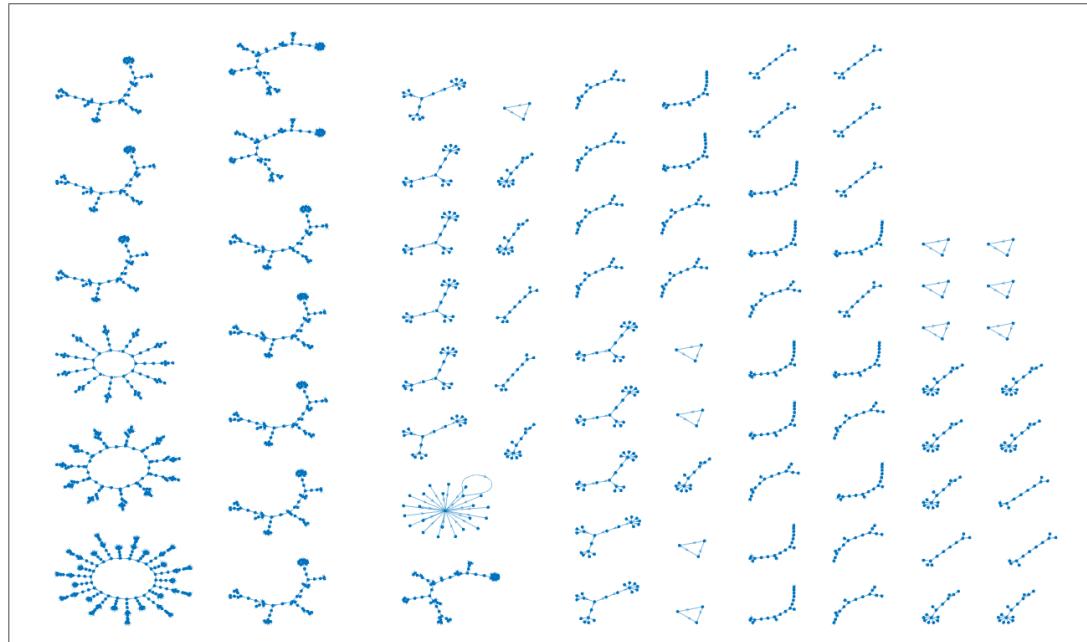


Figura 3.666: Atractor regla 62 n=11

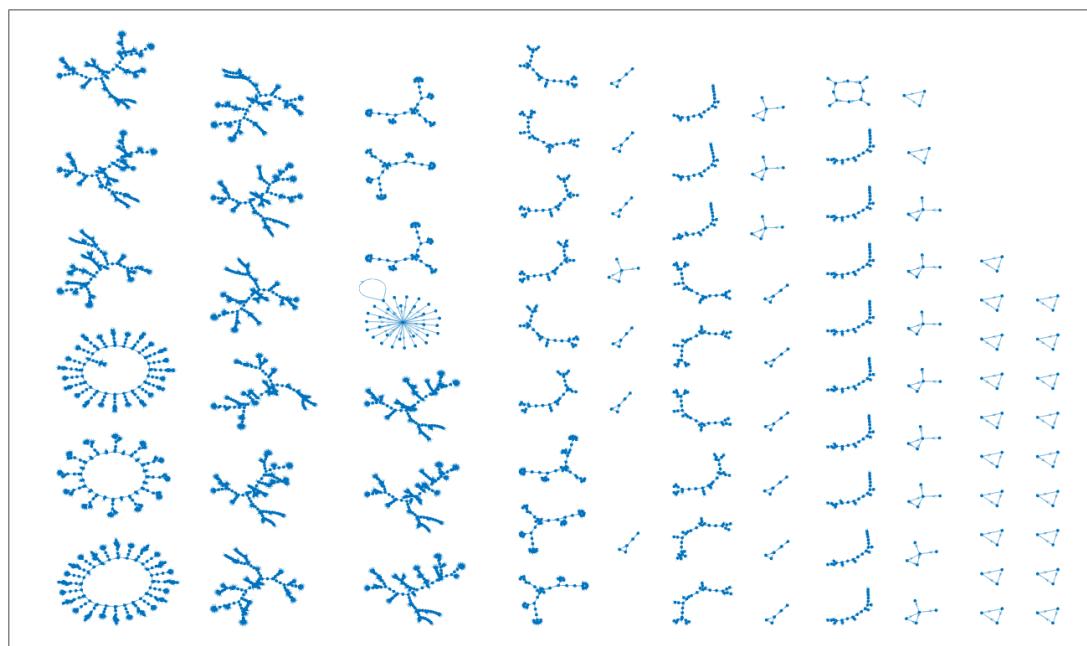


Figura 3.667: Atractor regla 62 n=12

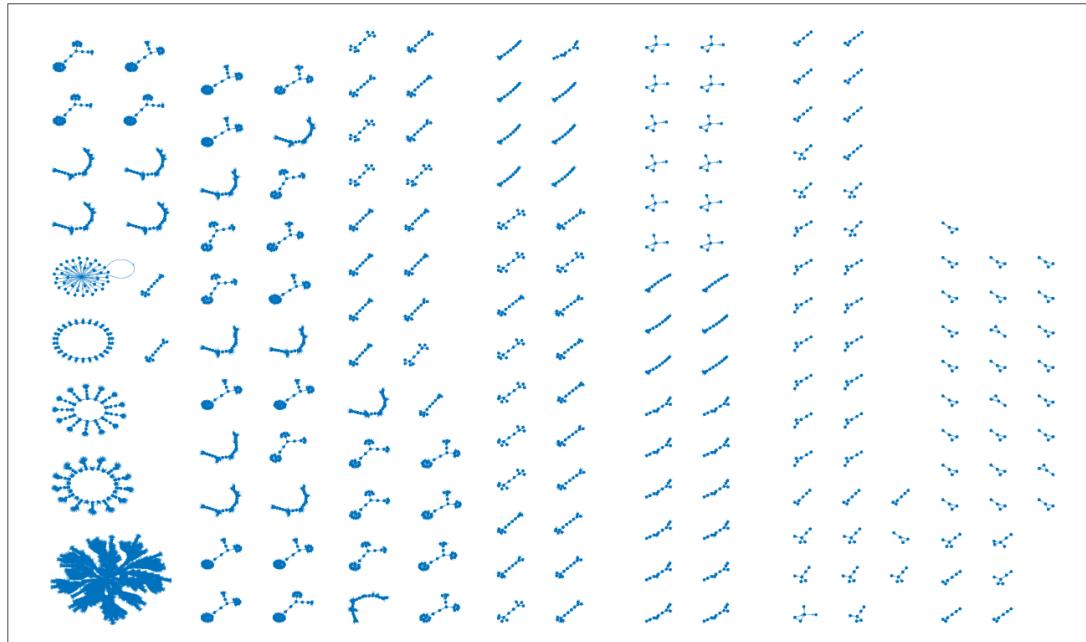


Figura 3.668: Atractor regla 62 n=13

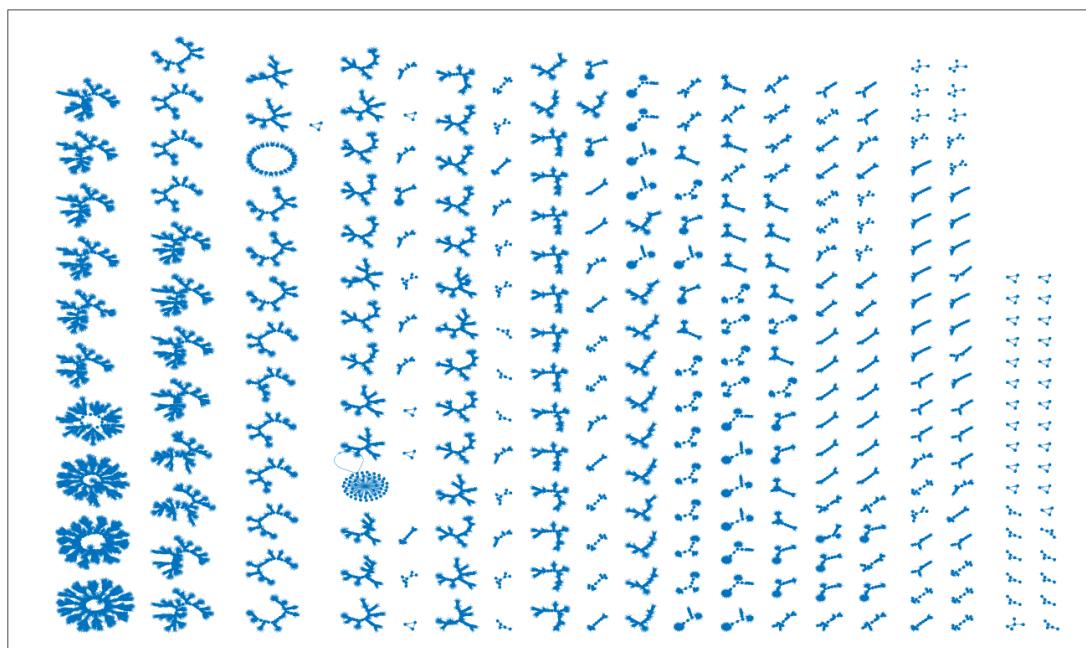


Figura 3.669: Atractor regla 62 n=14

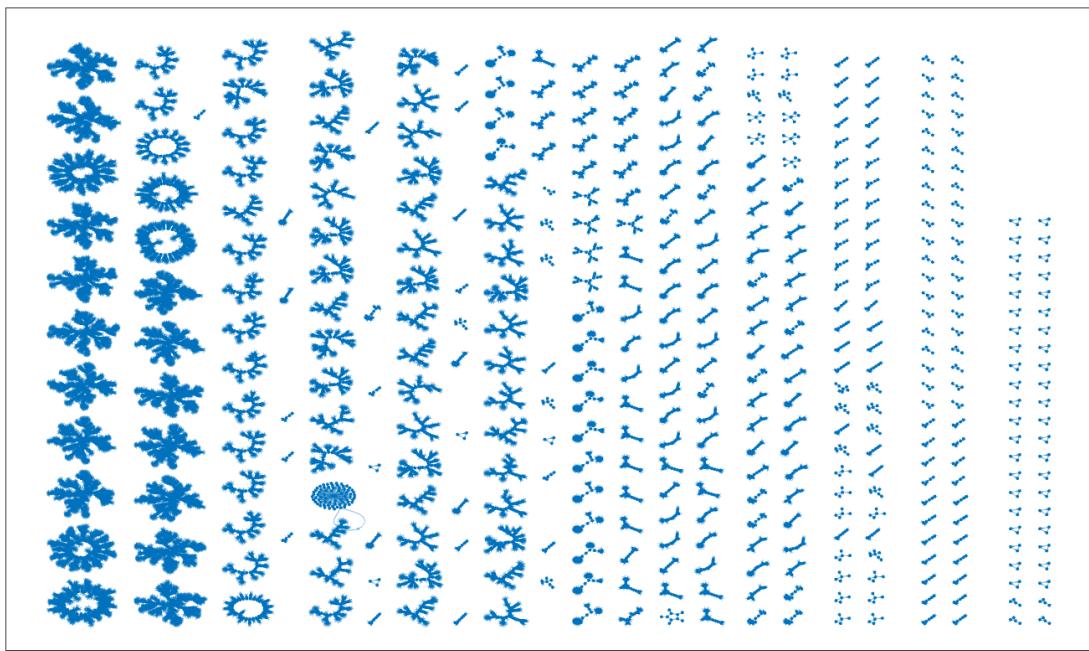


Figura 3.670: Atractor regla 62 n=15

3.50. Reglas 72,237

Respecto a la regla 72 se aprecia que en $n=15$ (figura 3.684) se presentan todas las configuraciones que fueron surgiendo en cada evolución desde $n=2$ hasta $n=15$.

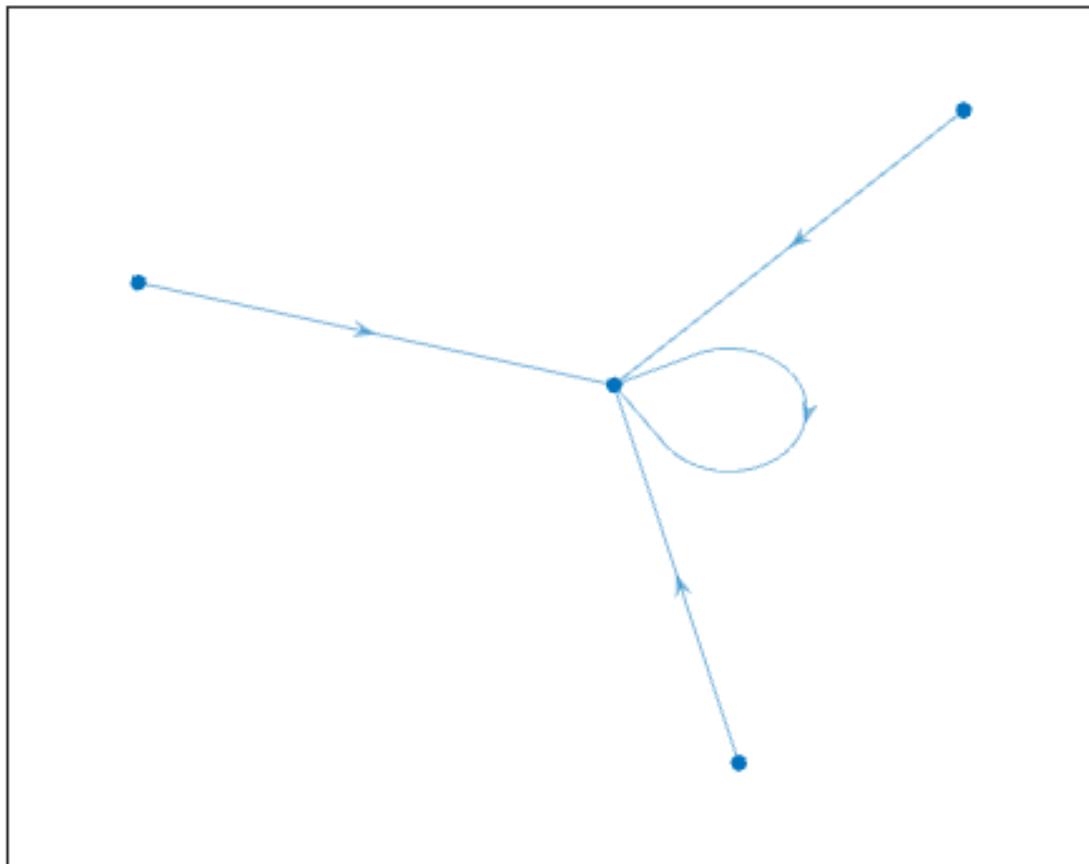


Figura 3.671: Atractor regla 72 $n=2$

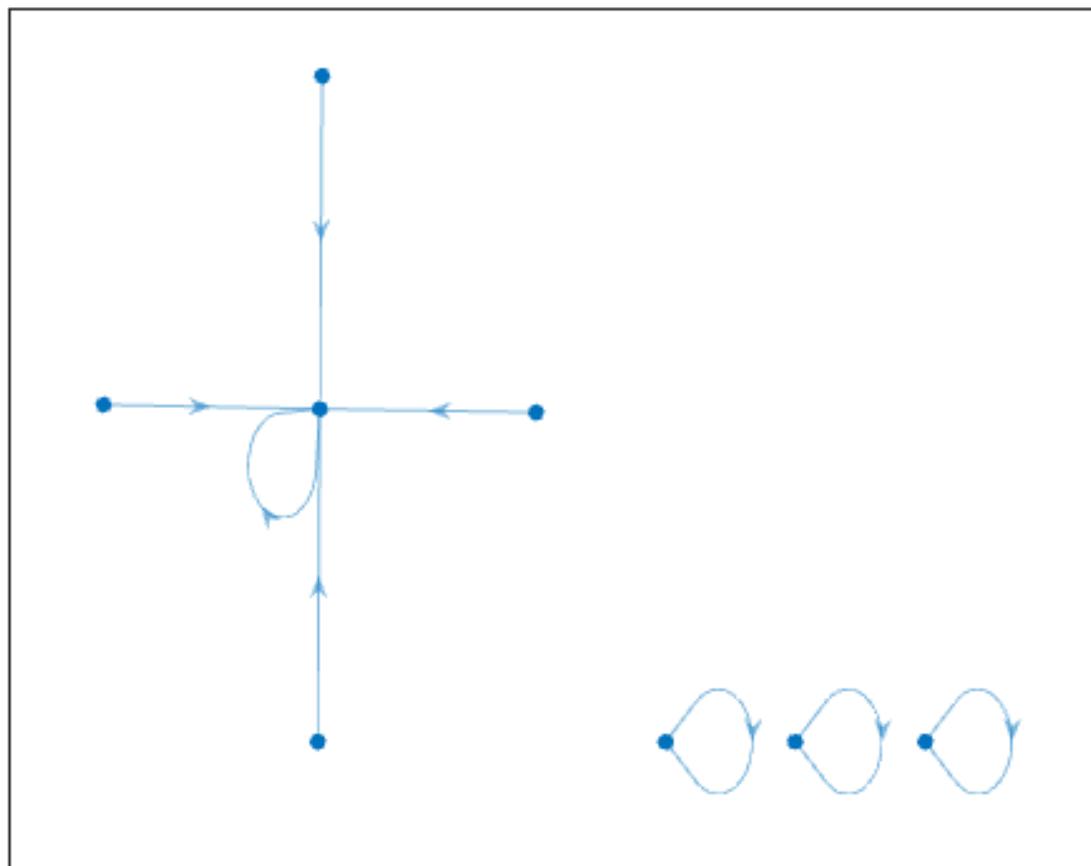


Figura 3.672: Atractor regla 72 n=3

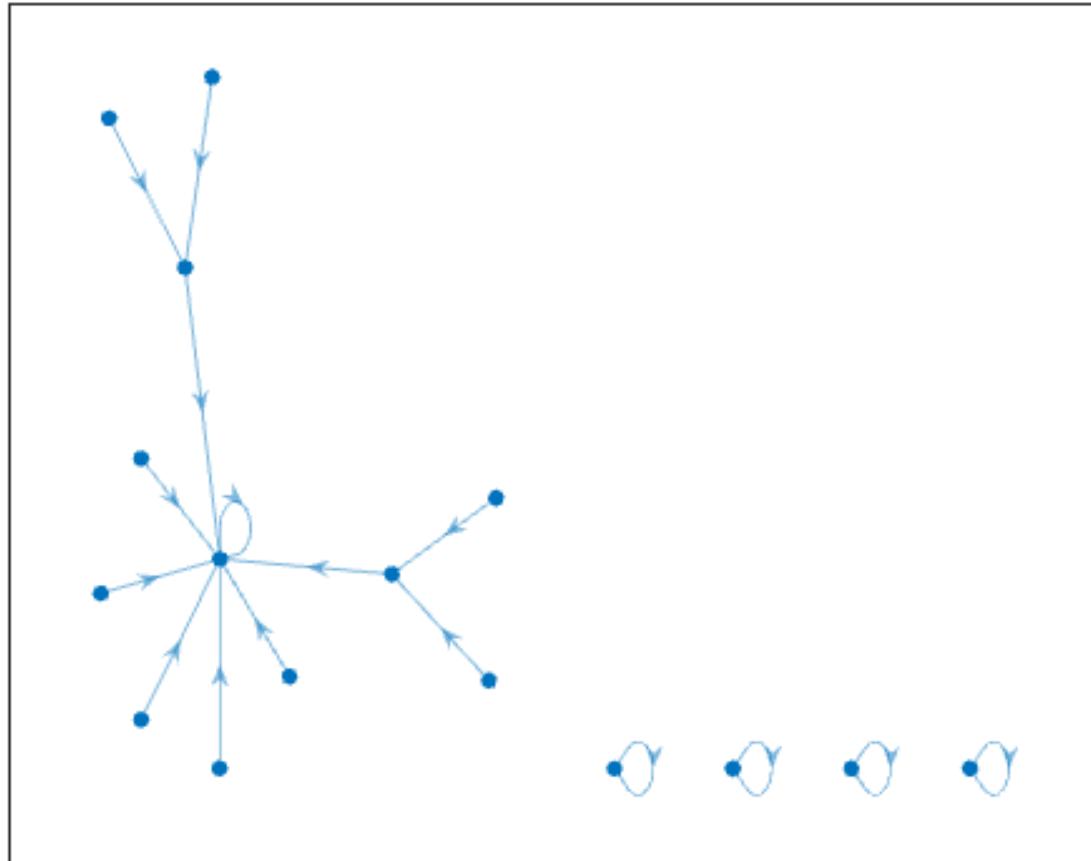


Figura 3.673: Atractor regla 72 n=4

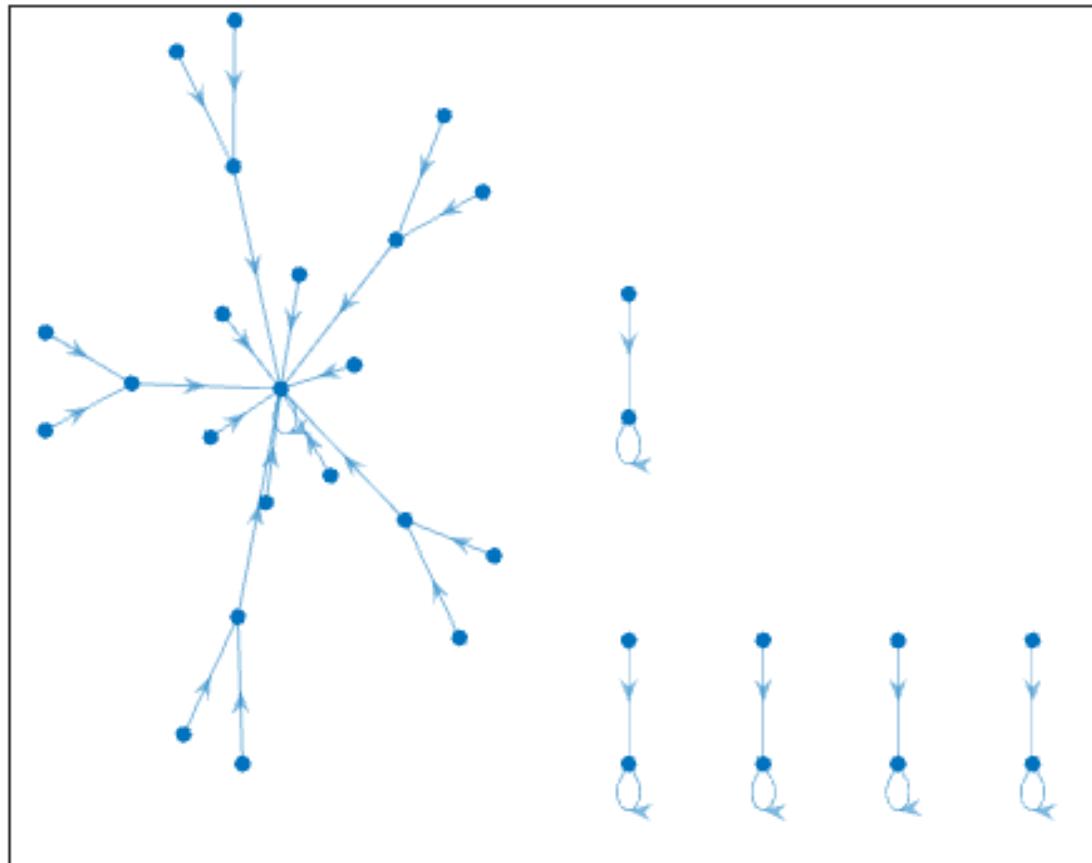


Figura 3.674: Atractor regla 72 n=5

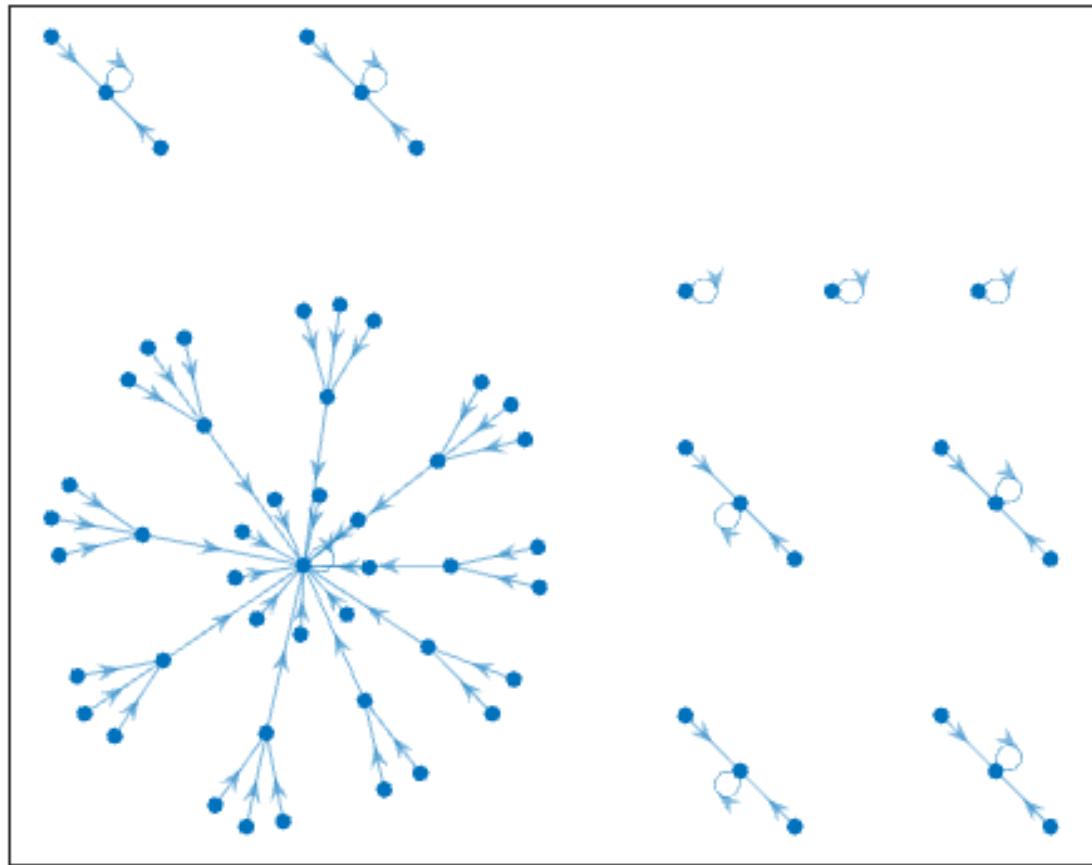


Figura 3.675: Atractor regla 72 n=6

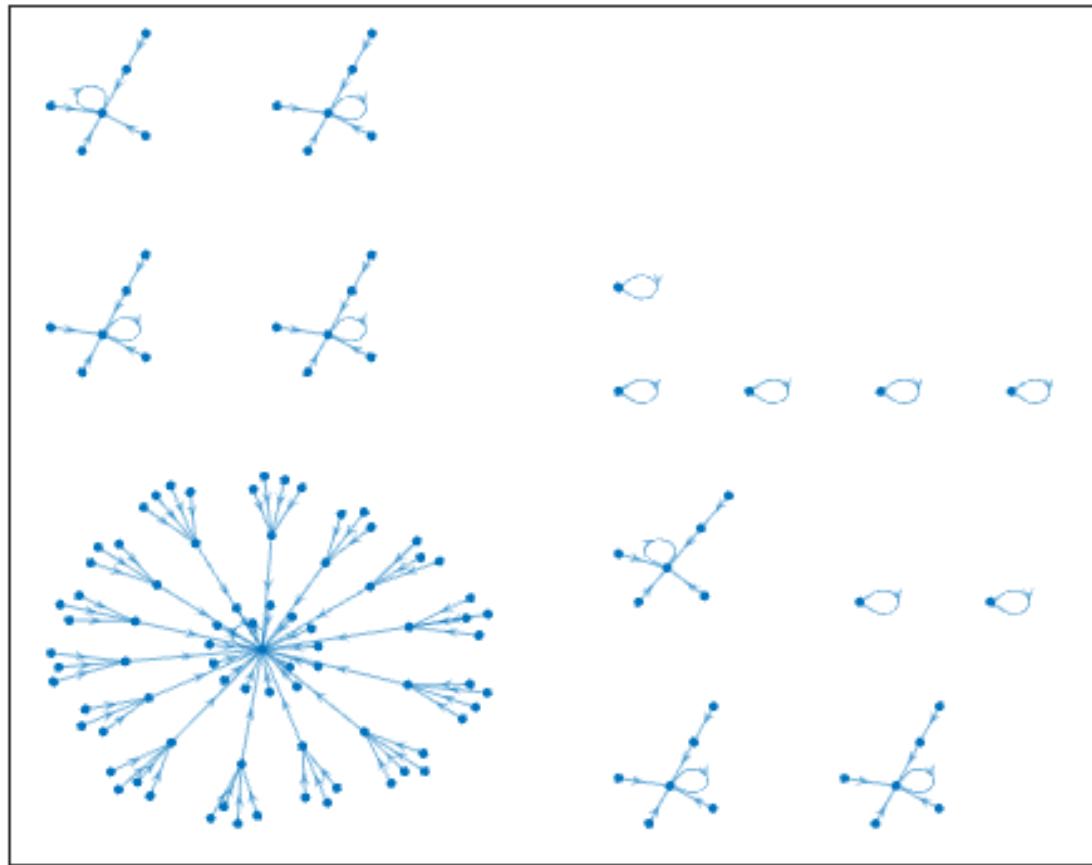


Figura 3.676: Atractor regla 72 n=7

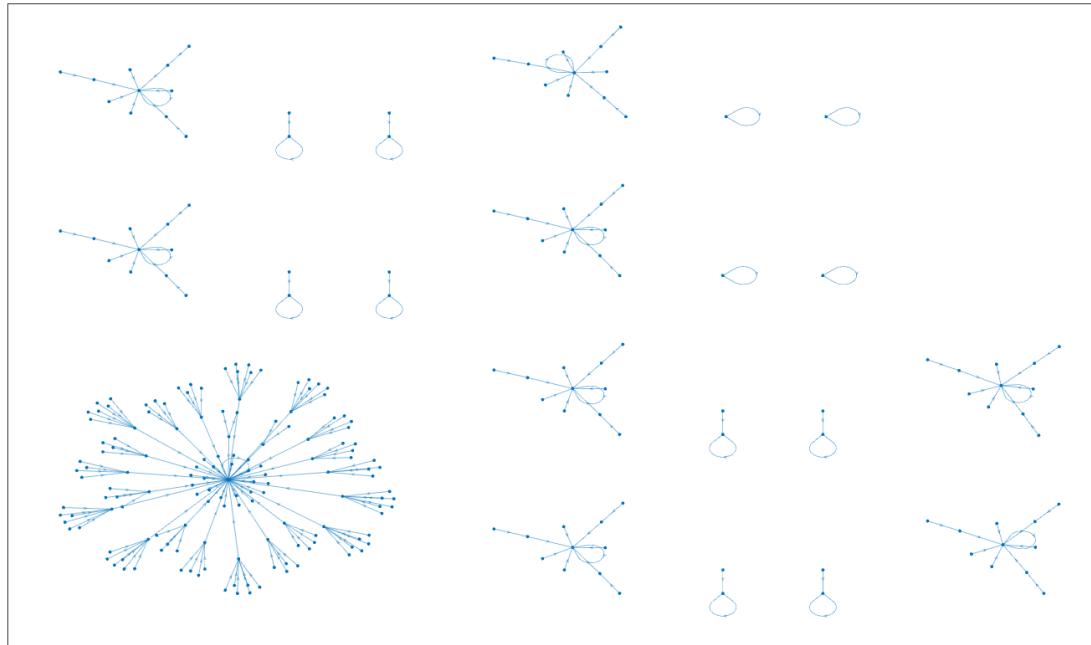


Figura 3.677: Atractor regla 72 n=8

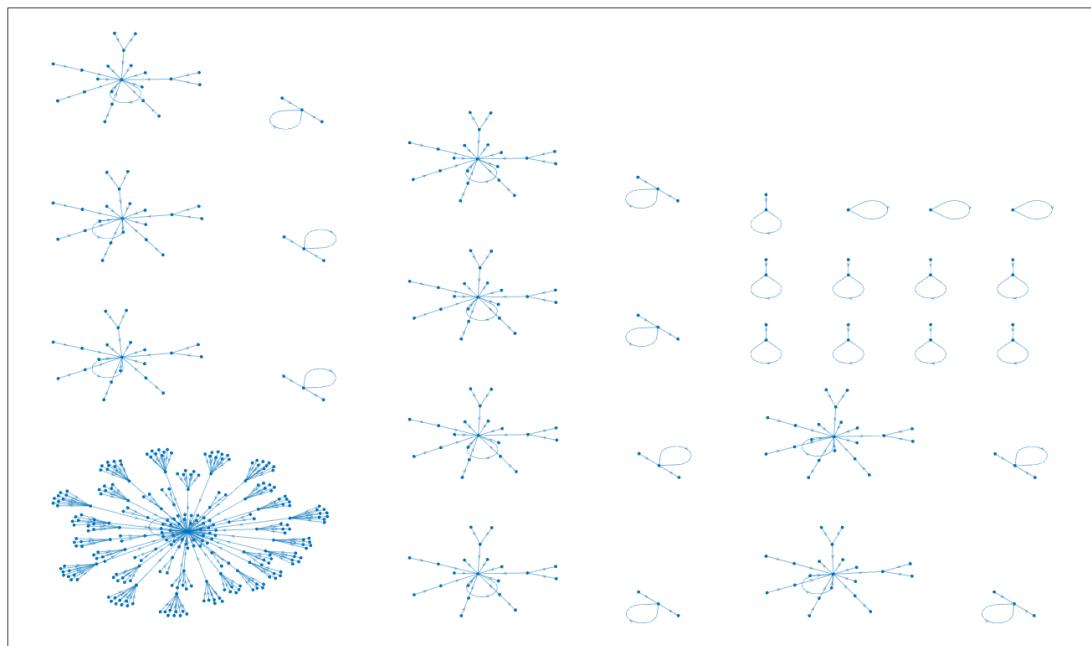


Figura 3.678: Atractor regla 72 n=9

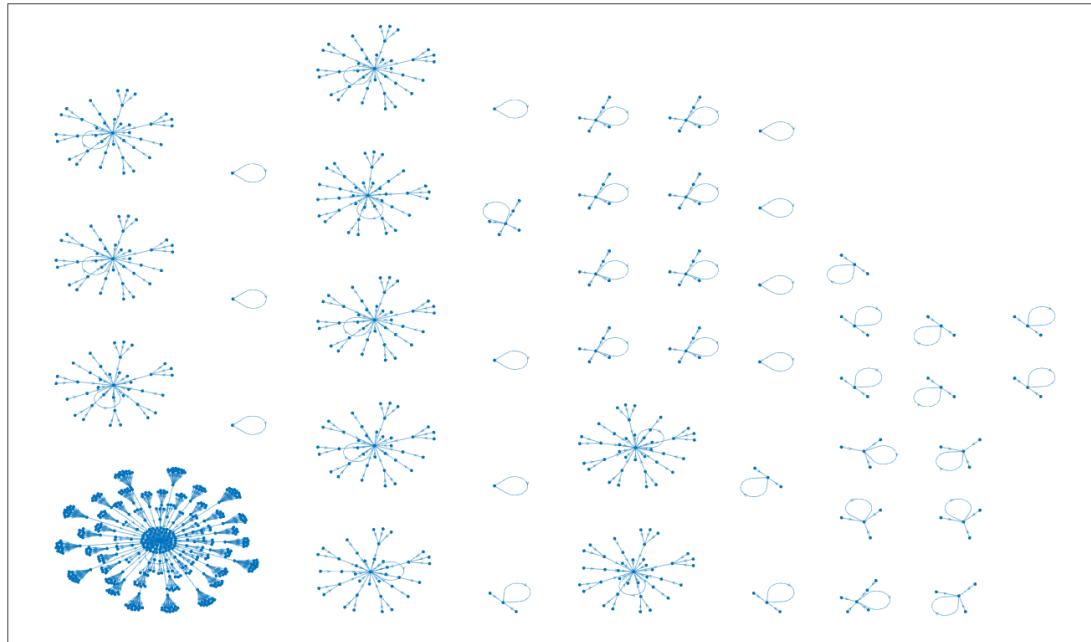


Figura 3.679: Atractor regla 72 n=10

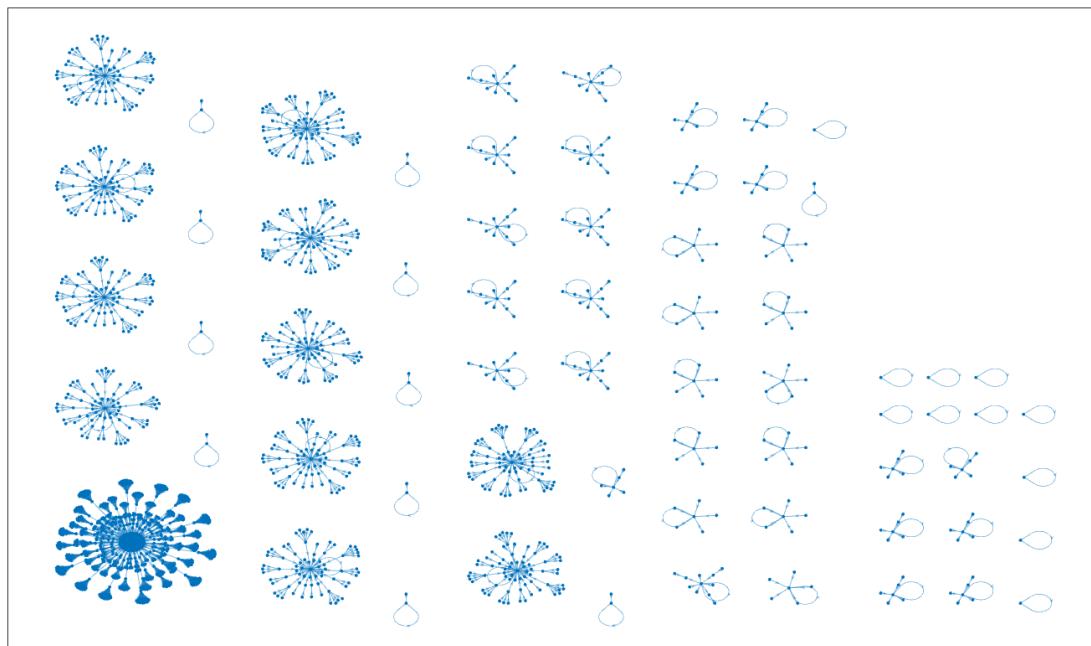


Figura 3.680: Atractor regla 72 n=11

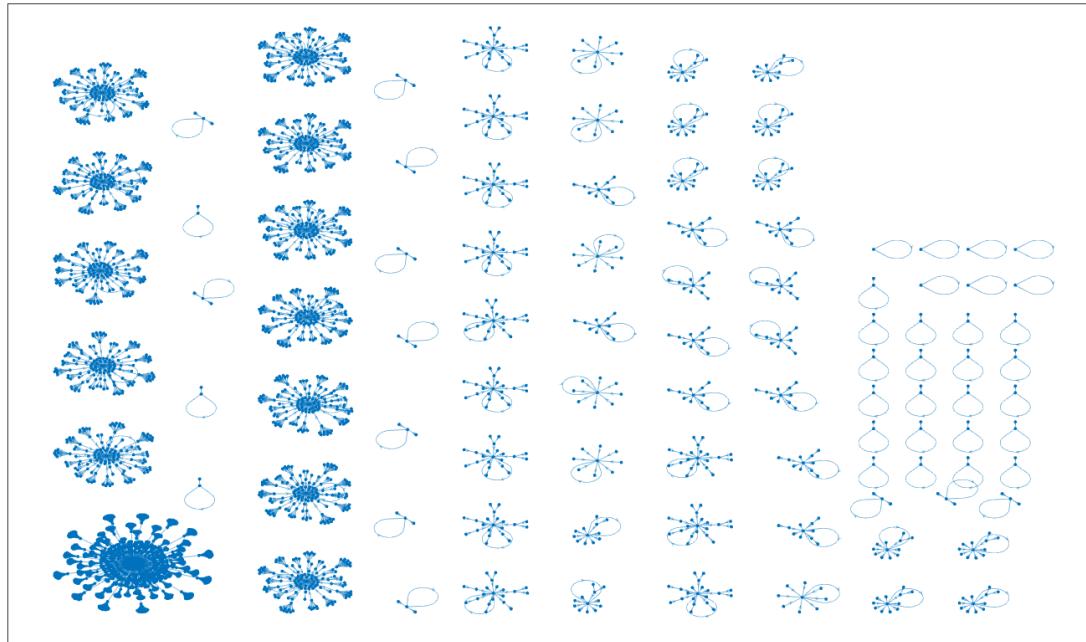


Figura 3.681: Atractor regla 72 n=12

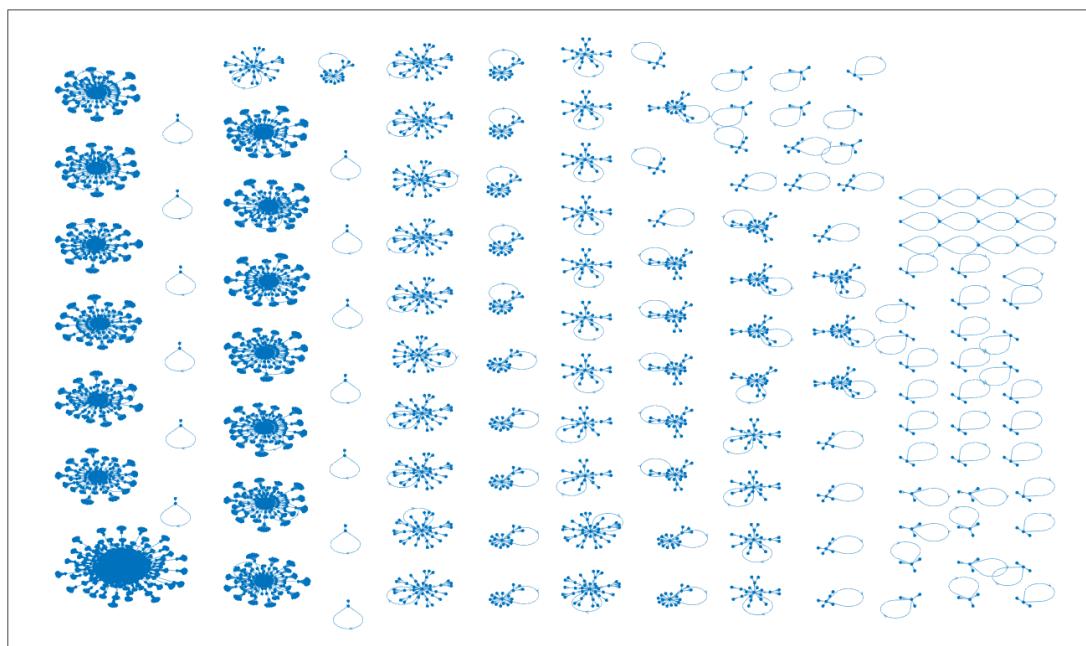


Figura 3.682: Atractor regla 72 n=13

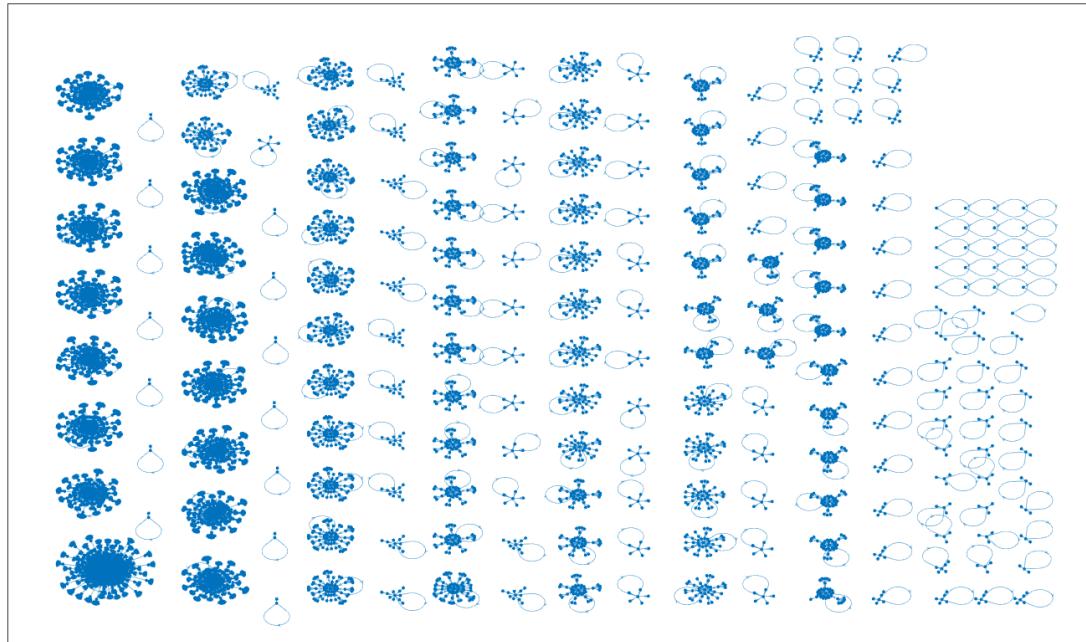


Figura 3.683: Atractor regla 72 n=14

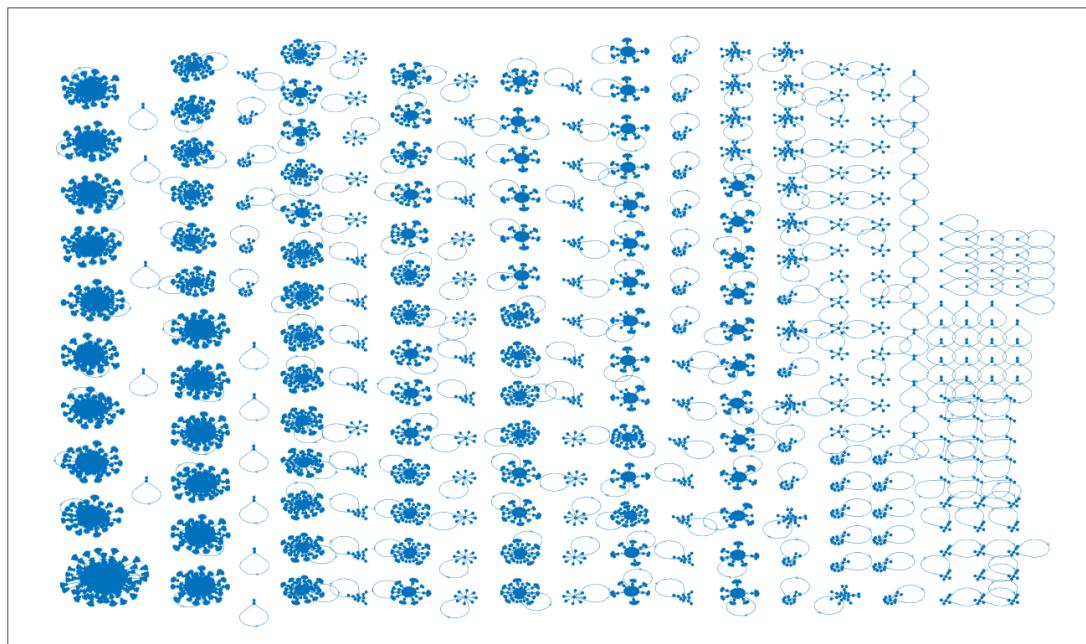


Figura 3.684: Atractor regla 72 n=15

3.51. Reglas 73,109

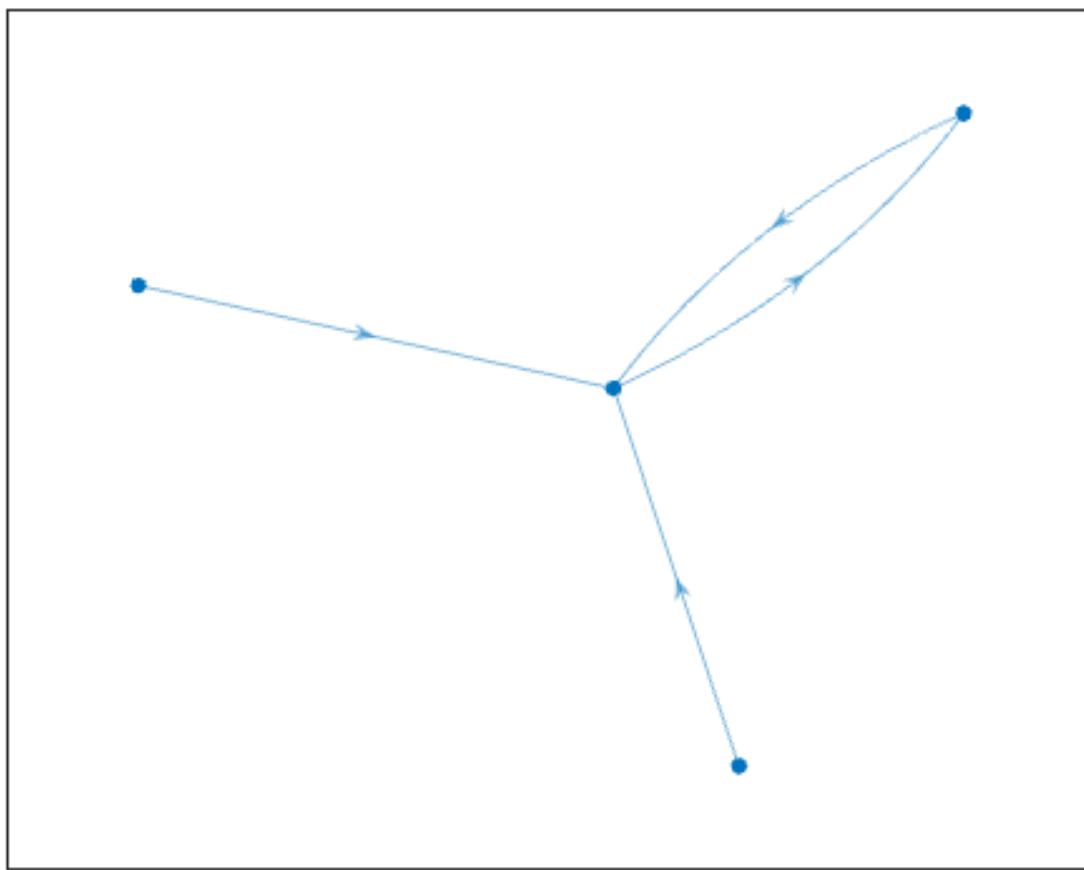


Figura 3.685: Atractor regla 73 n=2

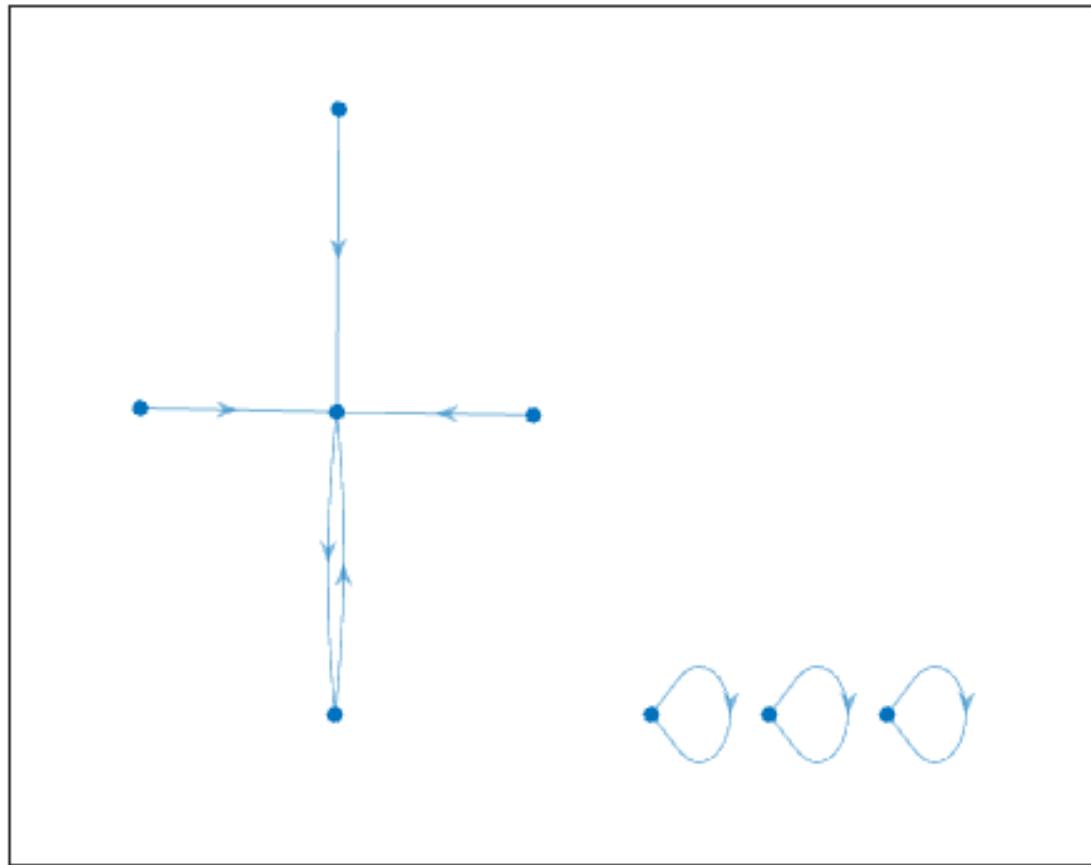


Figura 3.686: Atractor regla 73 n=3

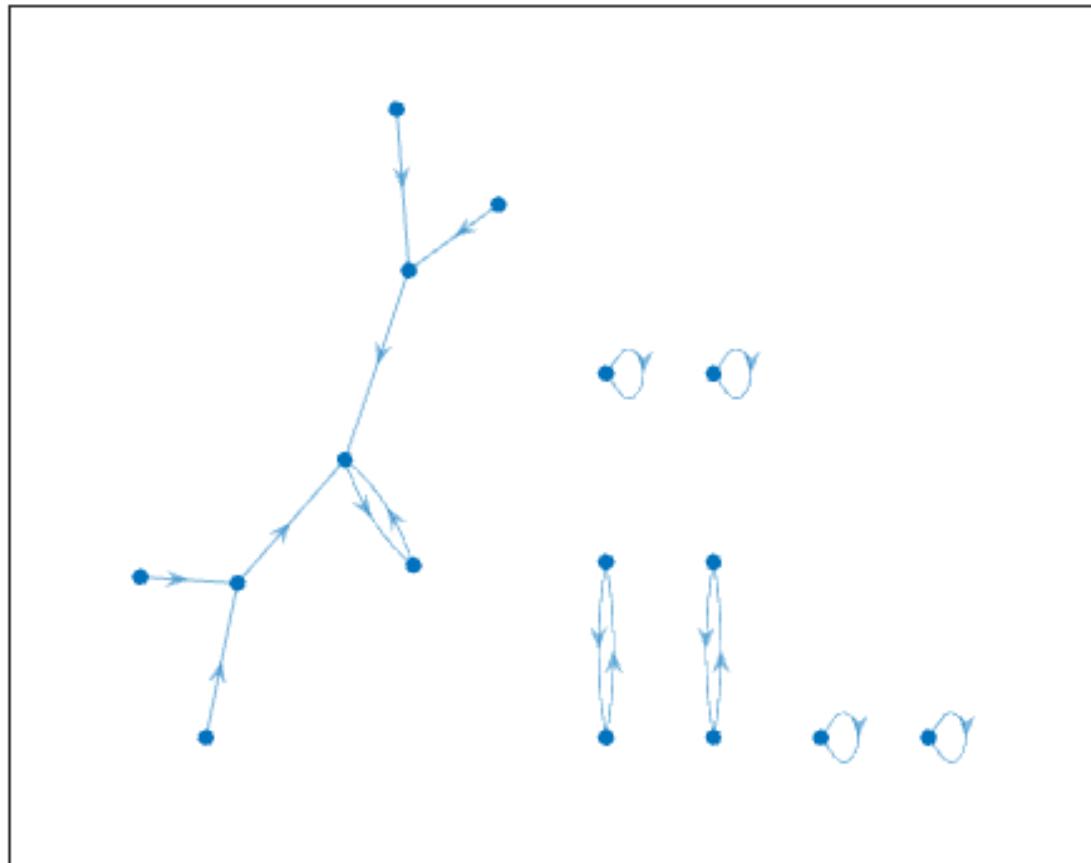


Figura 3.687: Atractor regla 73 n=4

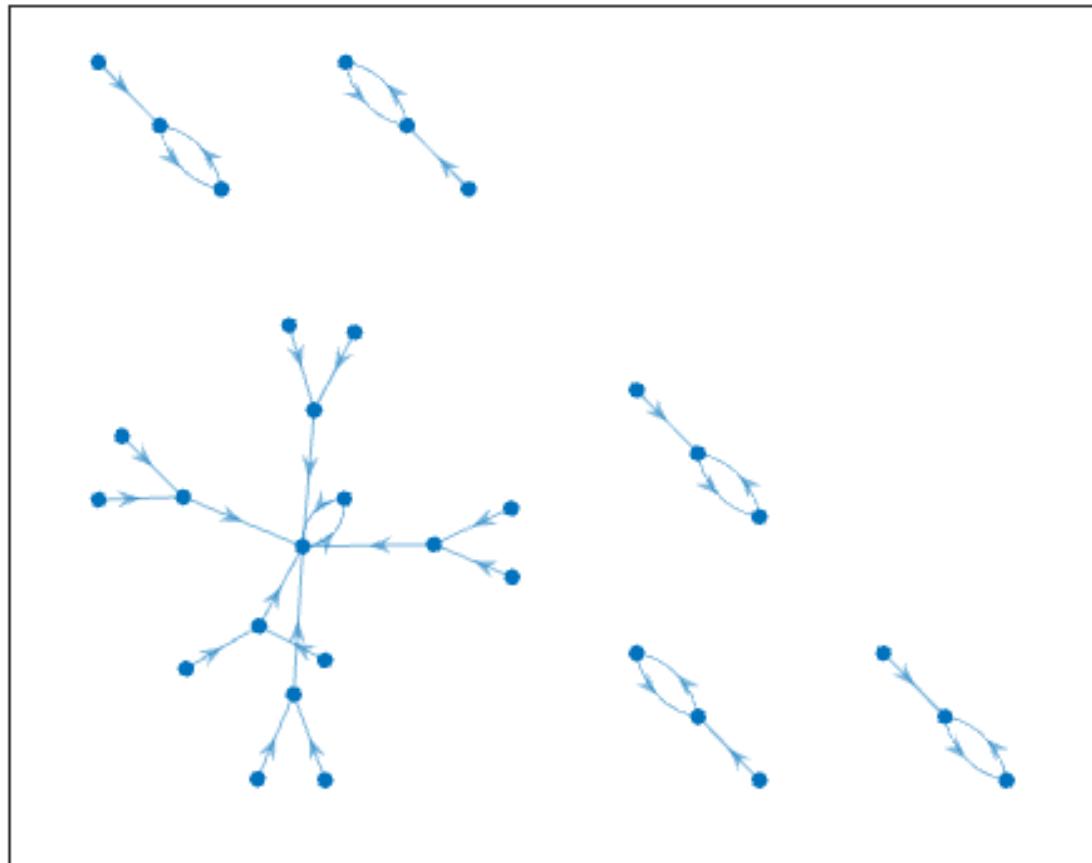


Figura 3.688: Atractor regla 73 n=5

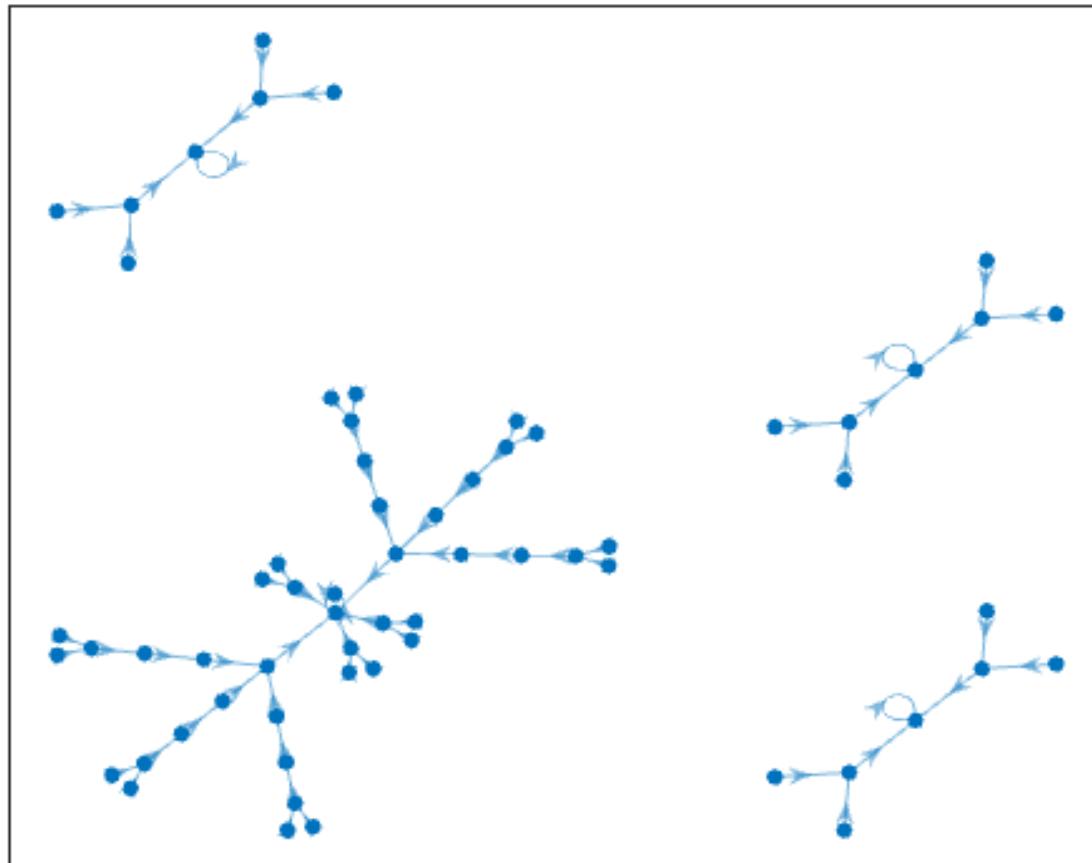


Figura 3.689: Atractor regla 73 n=6

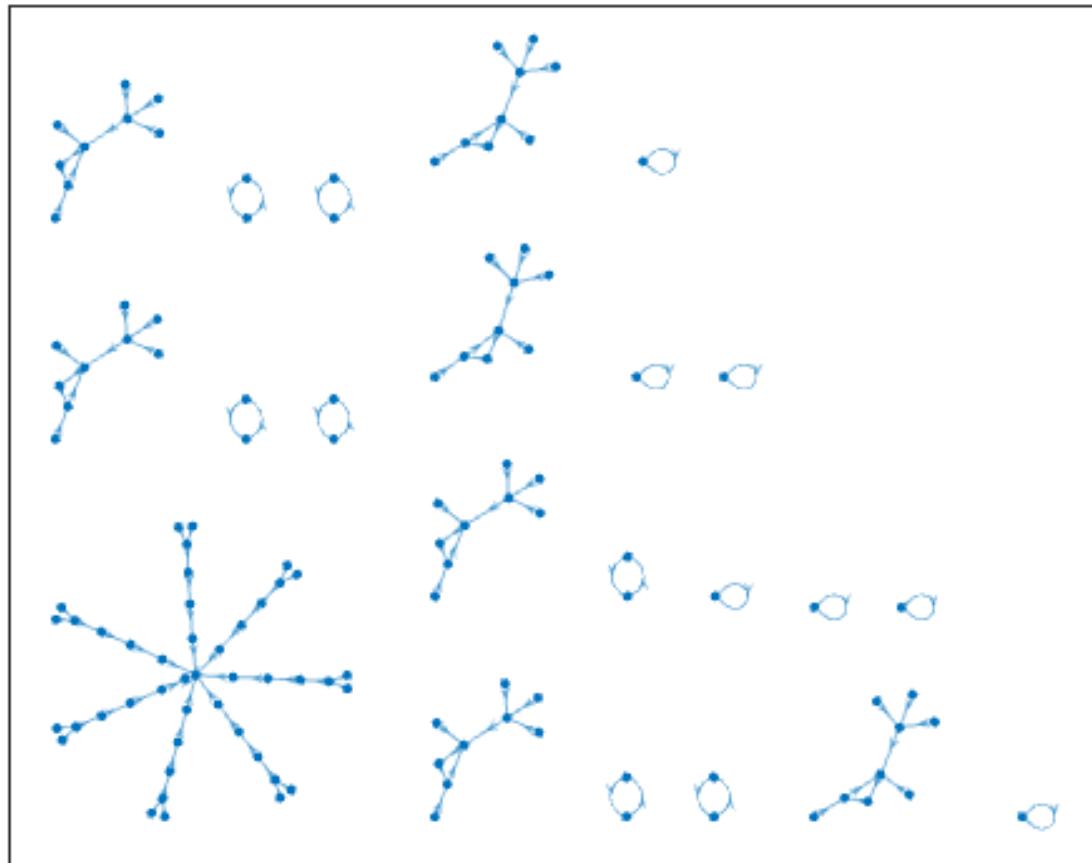


Figura 3.690: Atractor regla 73 n=7

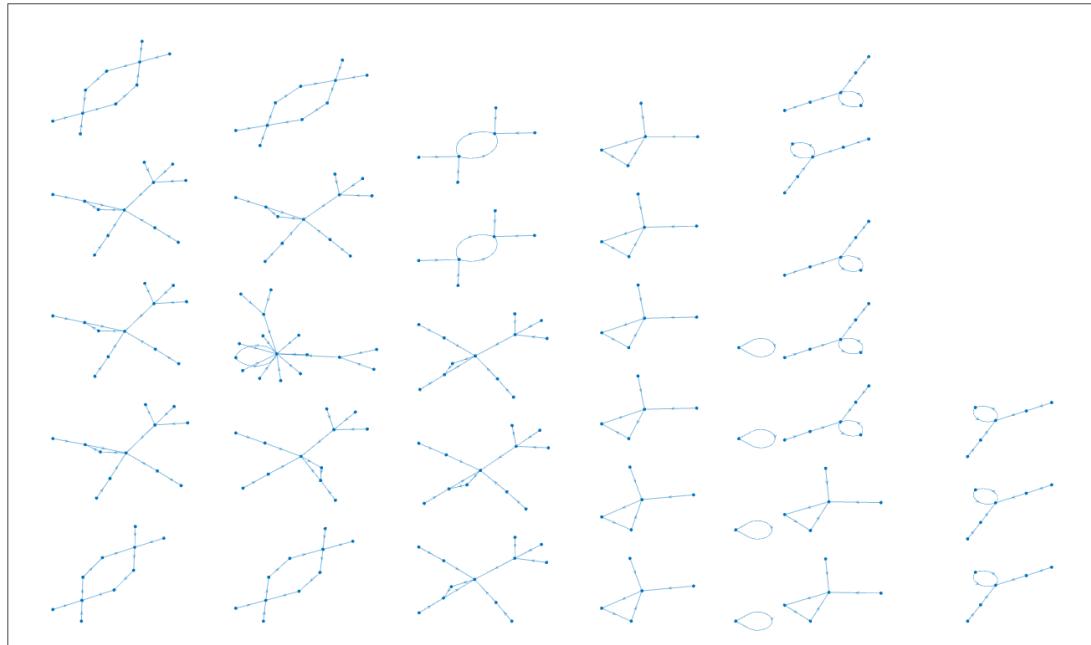


Figura 3.691: Atractor regla 73 n=8

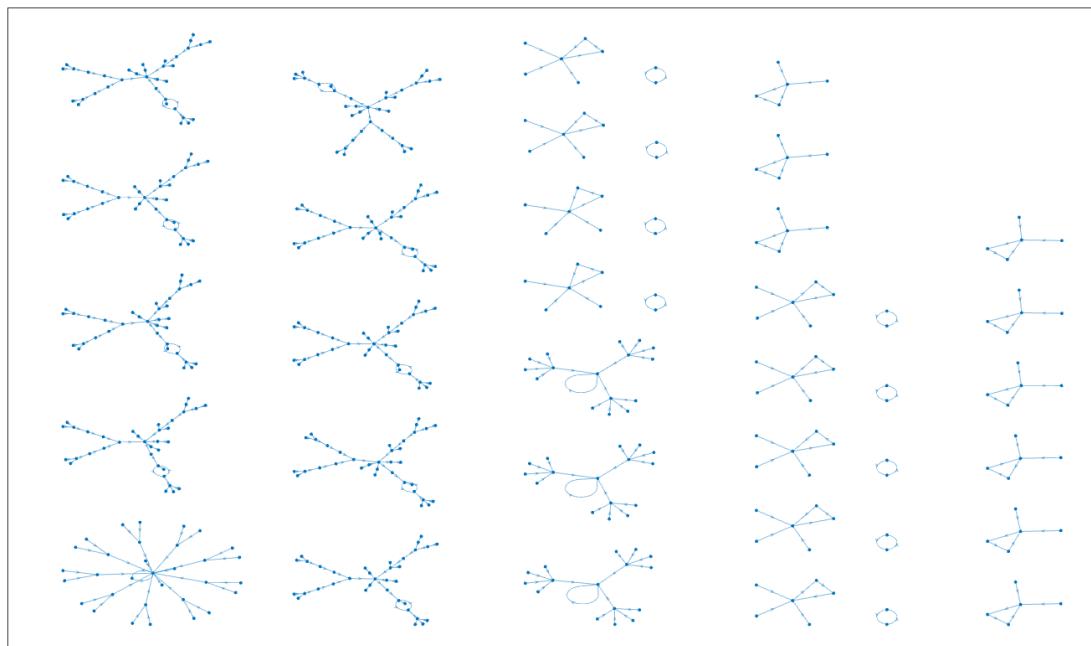


Figura 3.692: Atractor regla 73 n=9

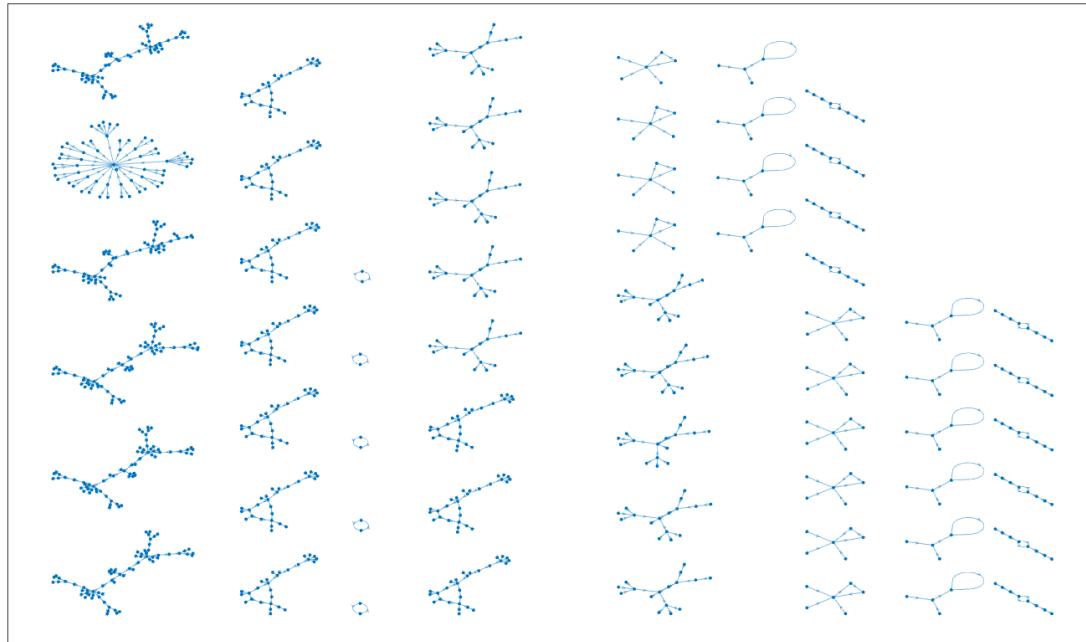


Figura 3.693: Atractor regla 73 n=10

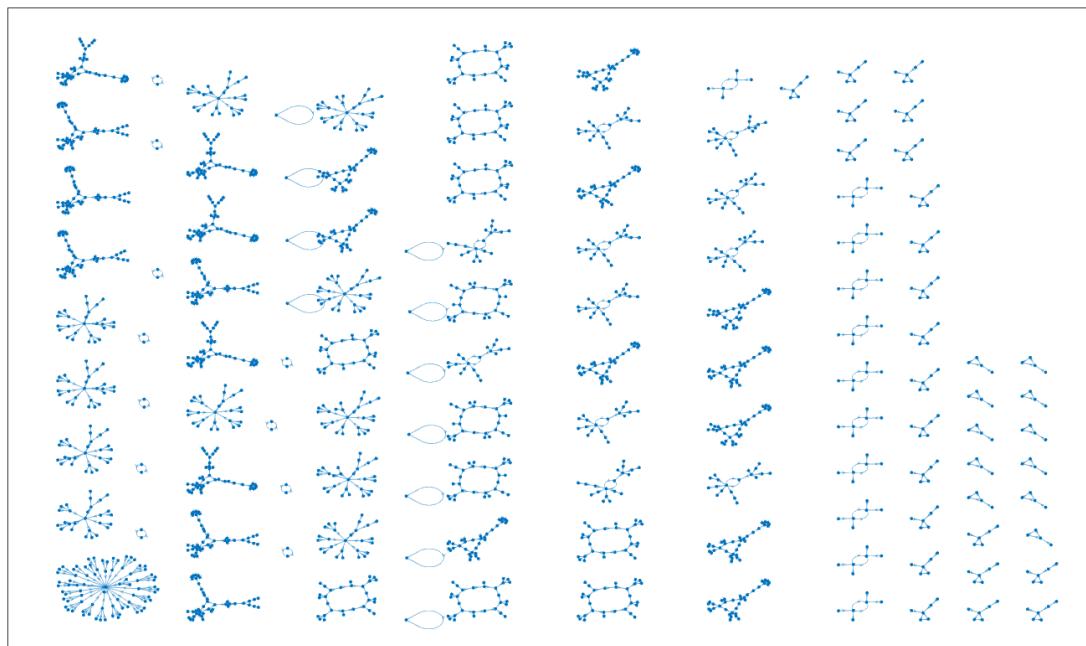


Figura 3.694: Atractor regla 73 n=11

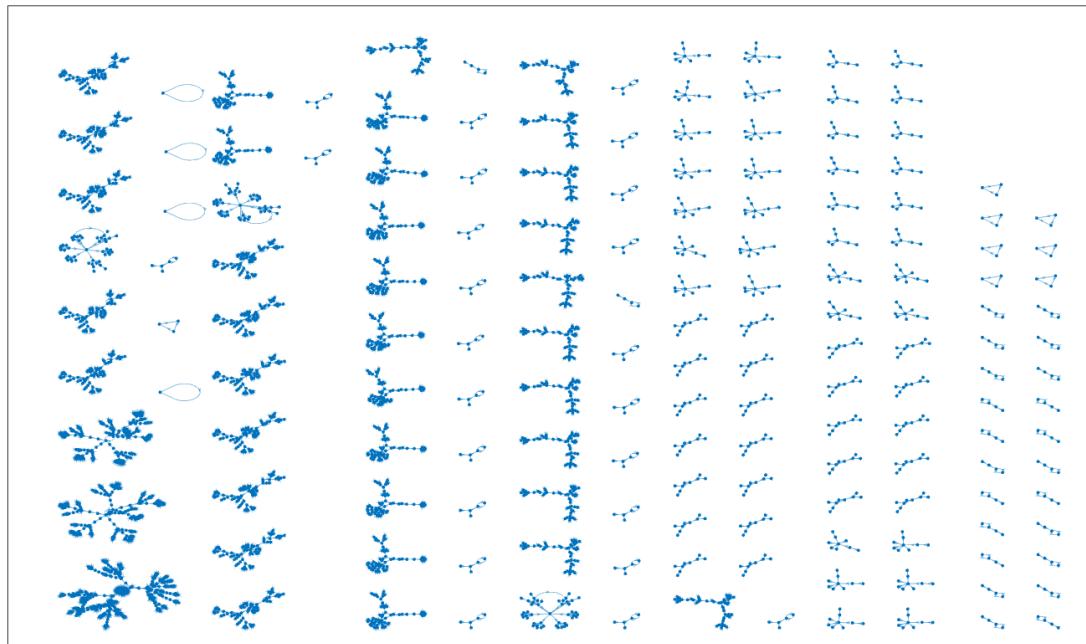


Figura 3.695: Atractor regla 73 n=12

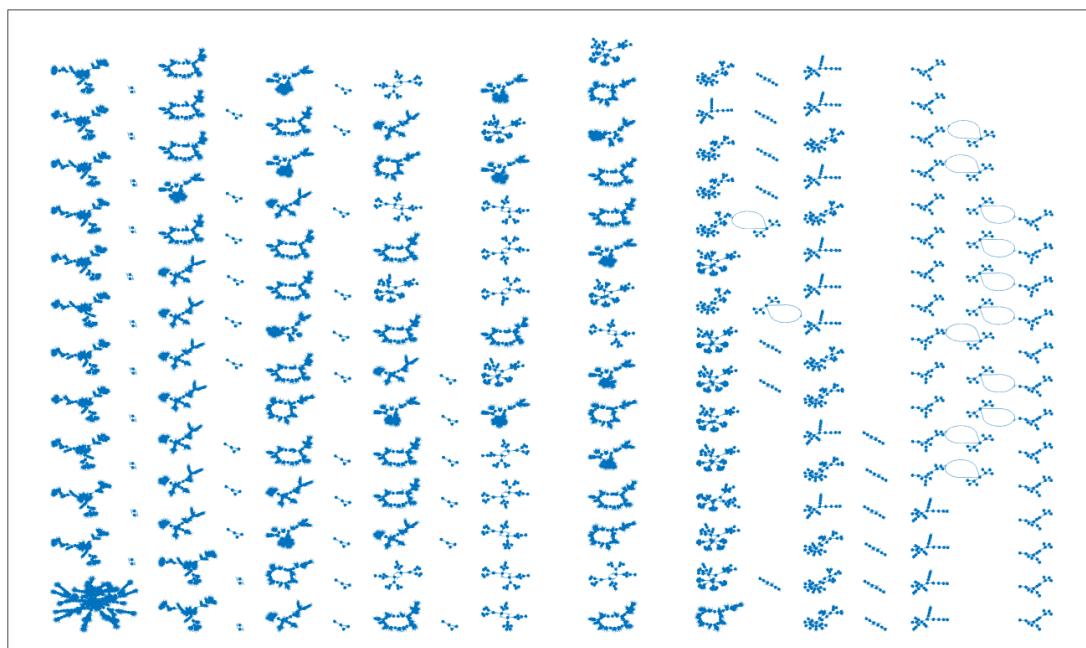


Figura 3.696: Atractor regla 73 n=13

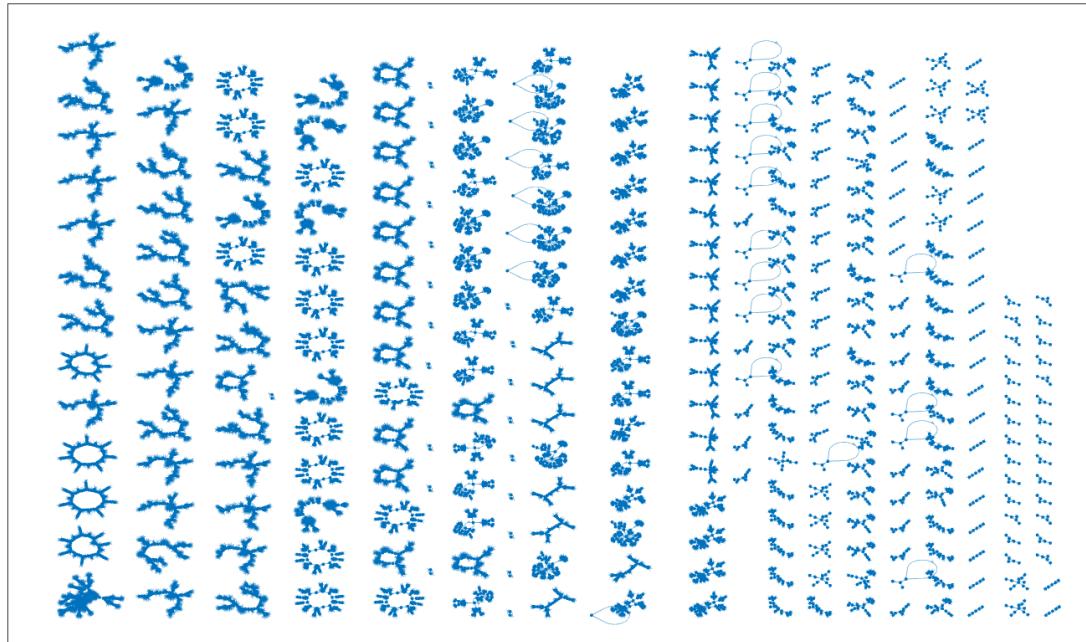


Figura 3.697: Atractor regla 73 n=14

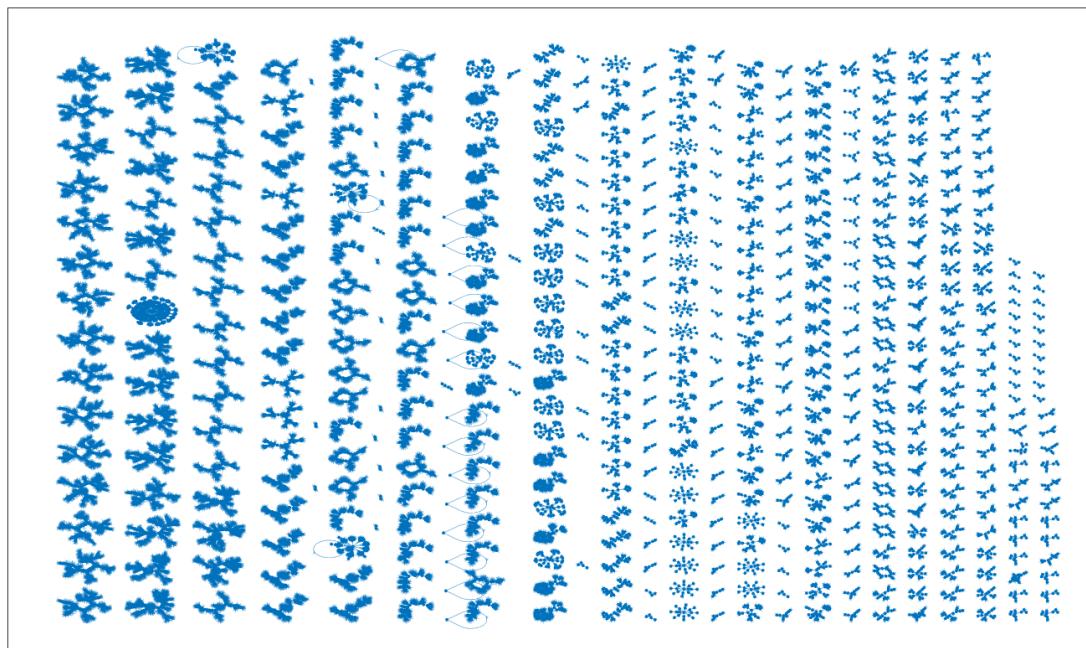


Figura 3.698: Atractor regla 73 n=15

3.52. Reglas 74,88,173,229

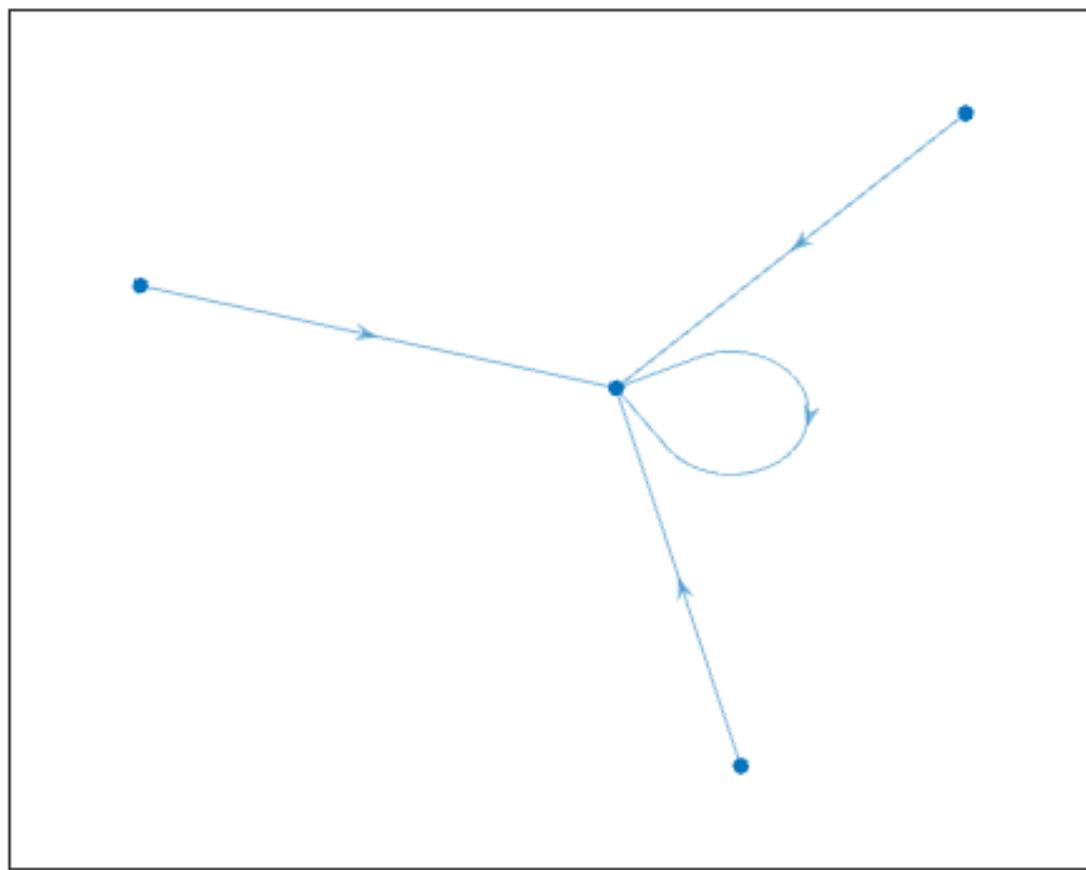


Figura 3.699: Atractor regla 74 n=2

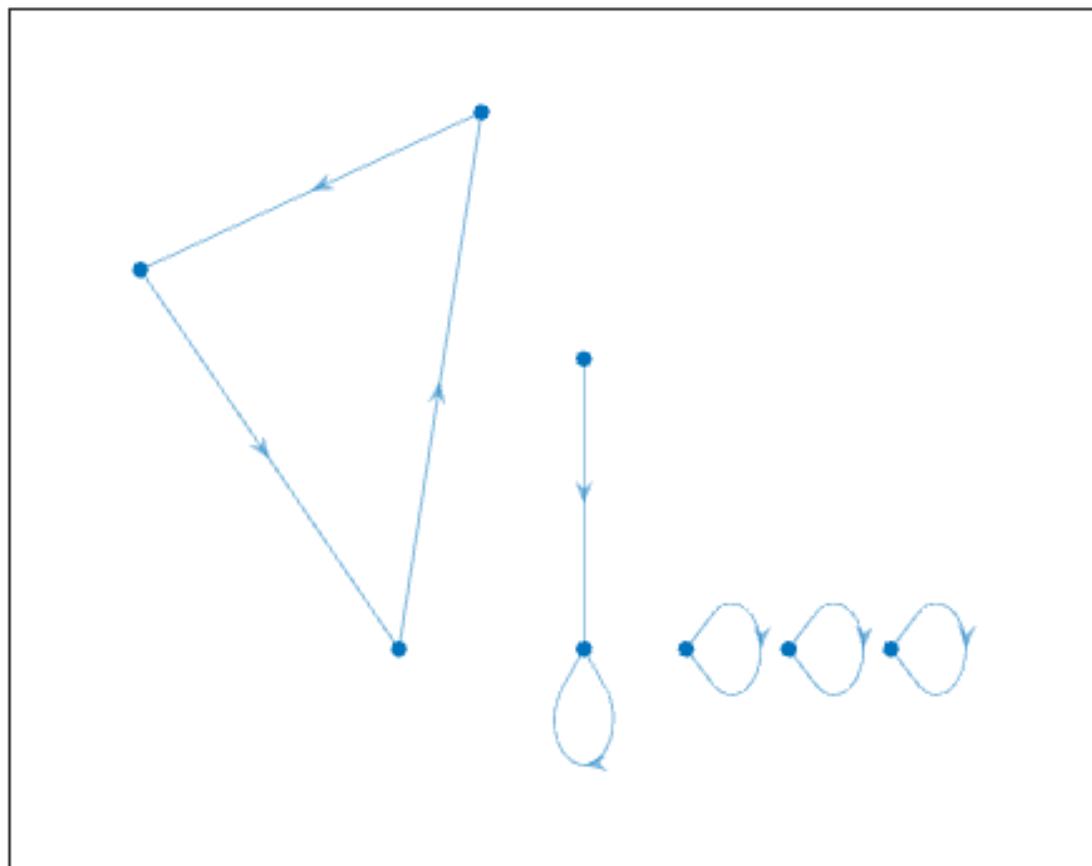


Figura 3.700: Atractor regla 74 $n=3$

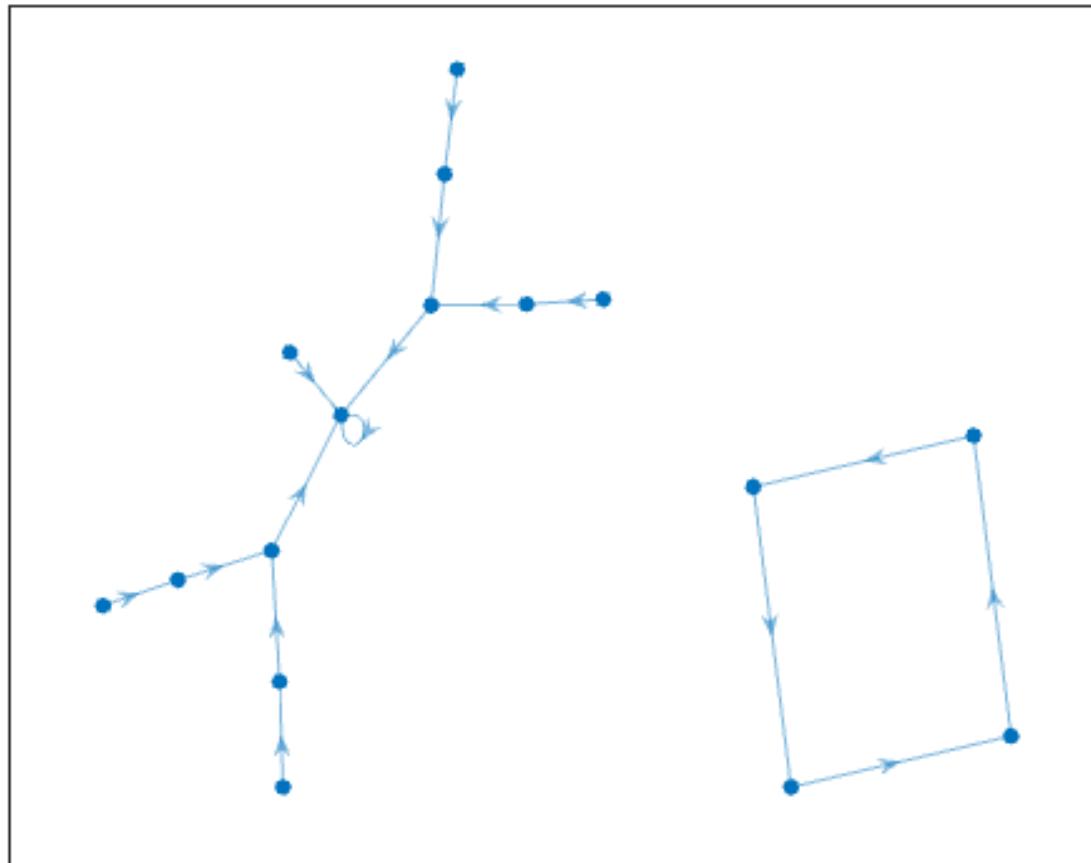


Figura 3.701: Atractor regla 74 n=4

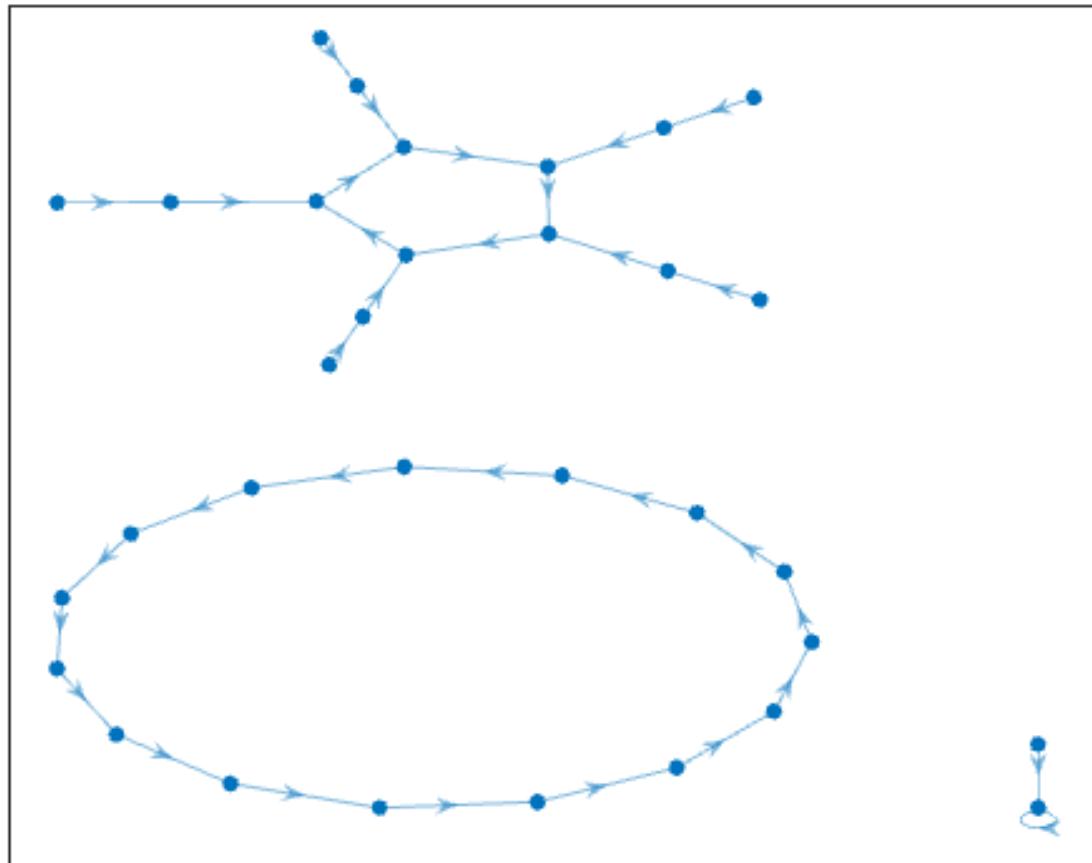


Figura 3.702: Atractor regla 74 n=5

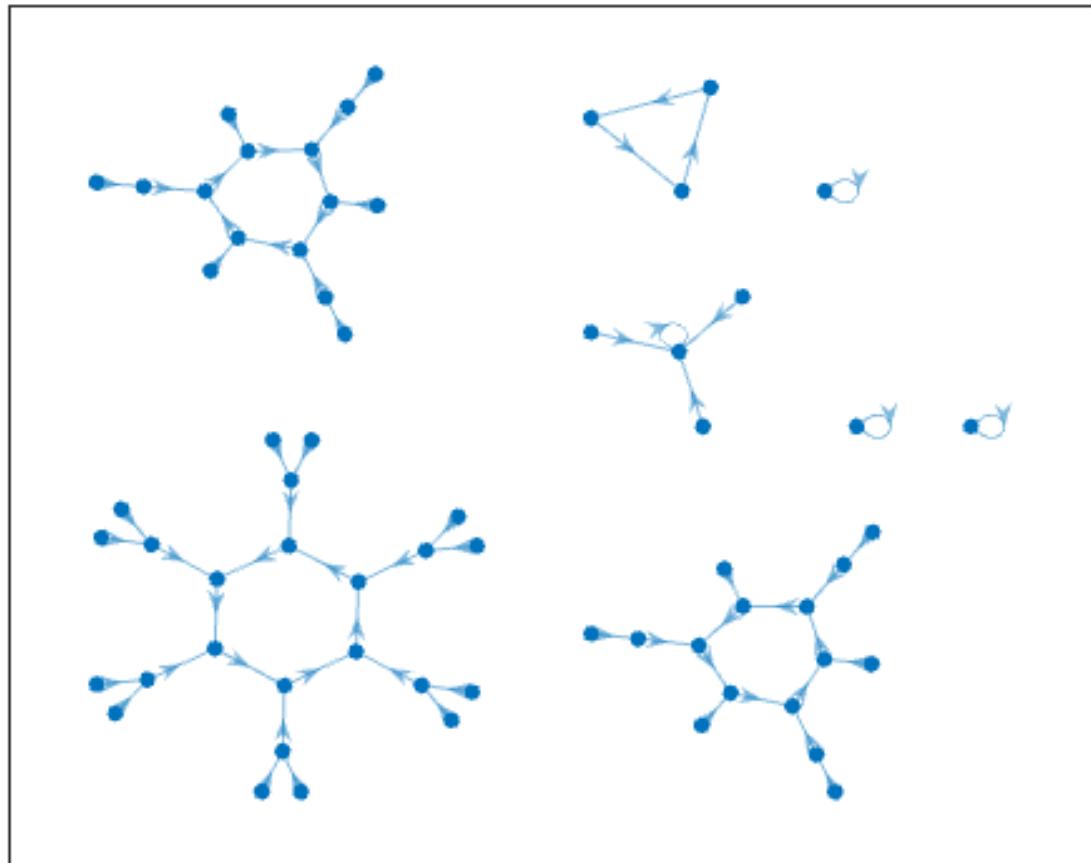
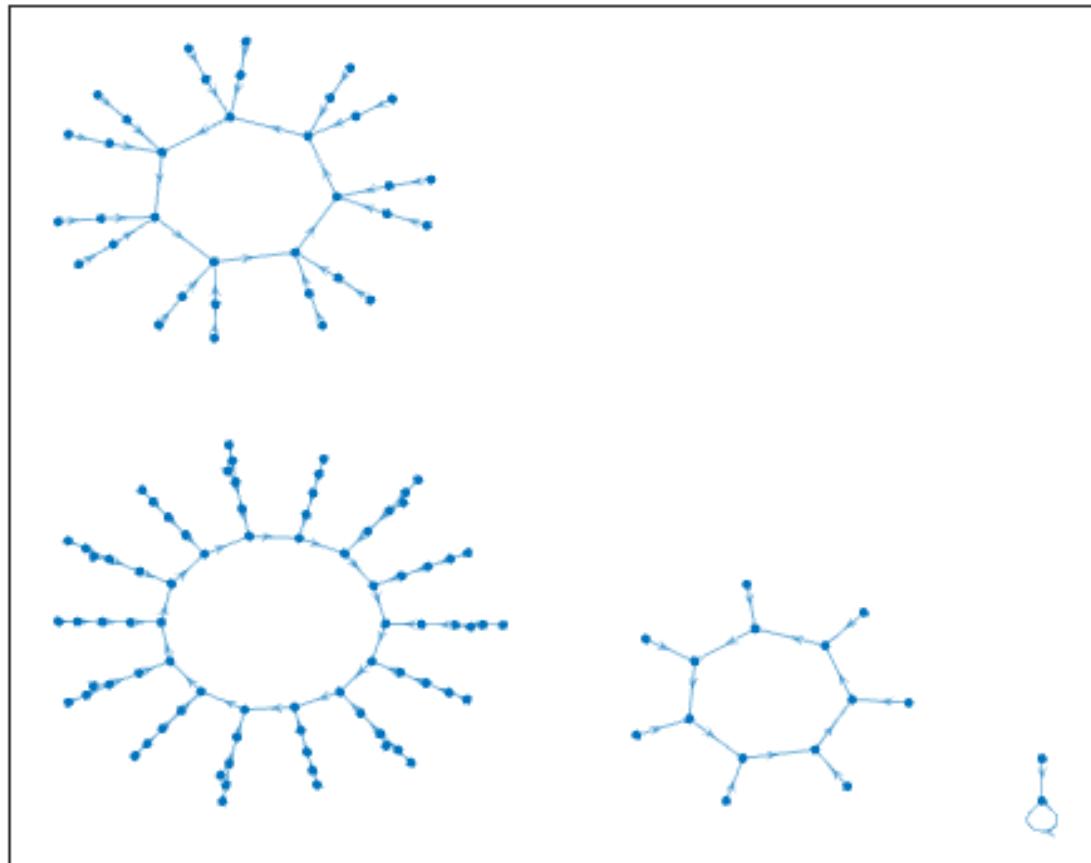


Figura 3.703: Atractor regla 74 n=6

Figura 3.704: Atractor regla 74 $n=7$

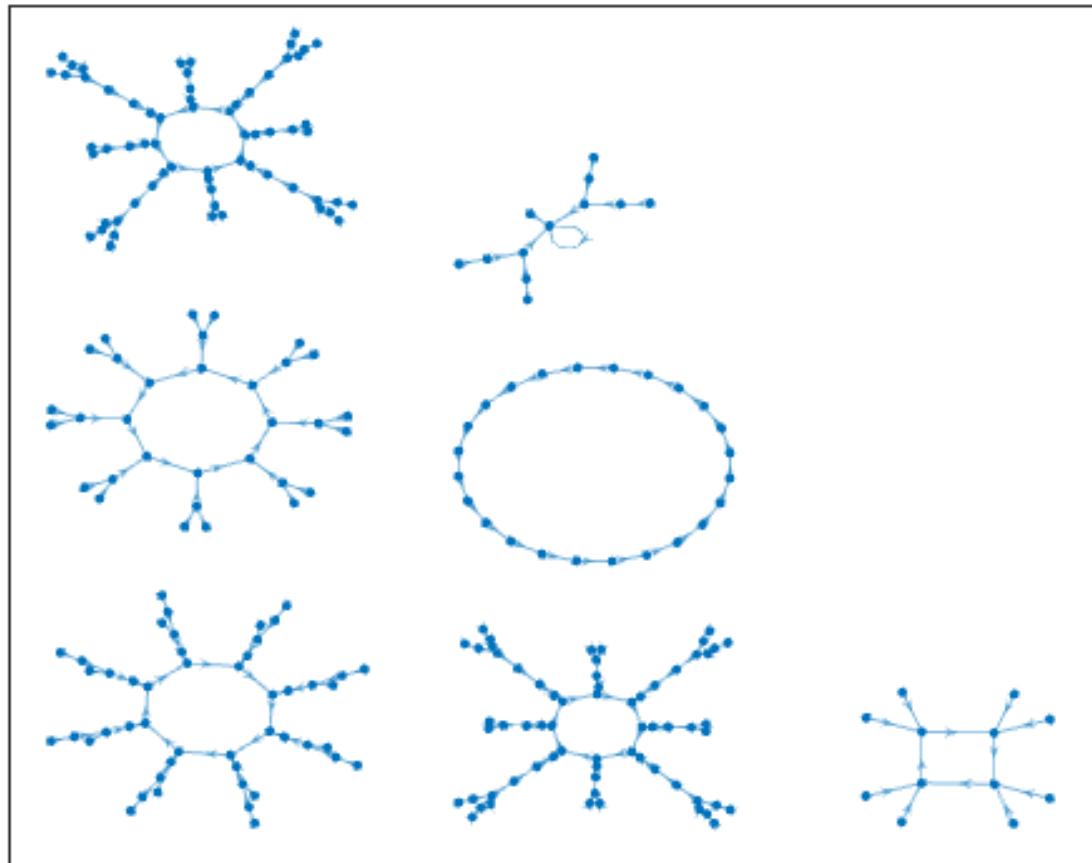


Figura 3.705: Atractor regla 74 n=8

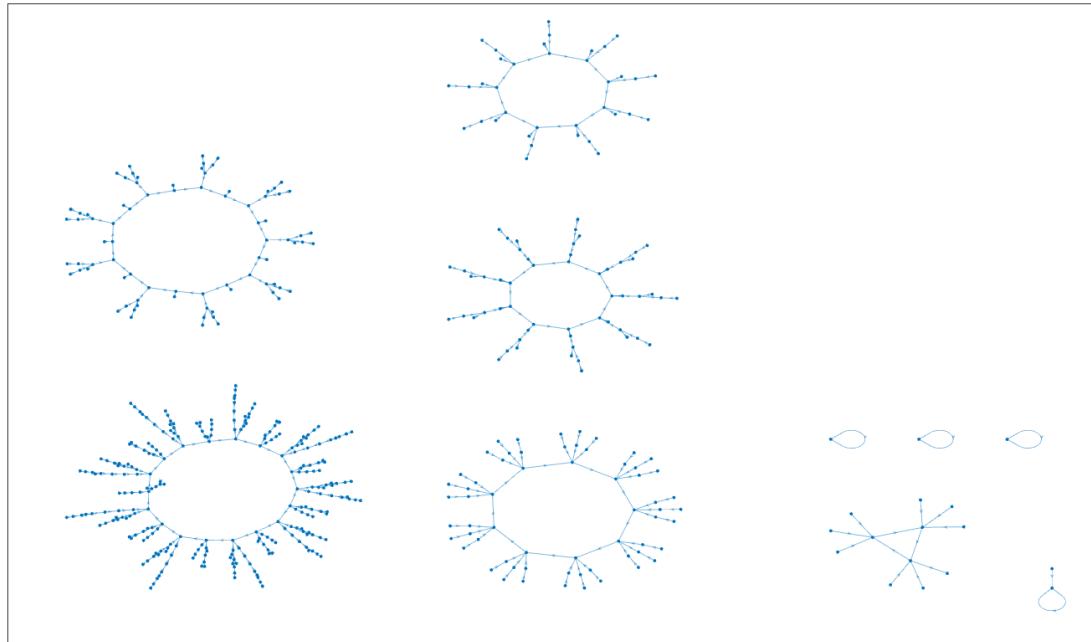


Figura 3.706: Atractor regla 74 n=9

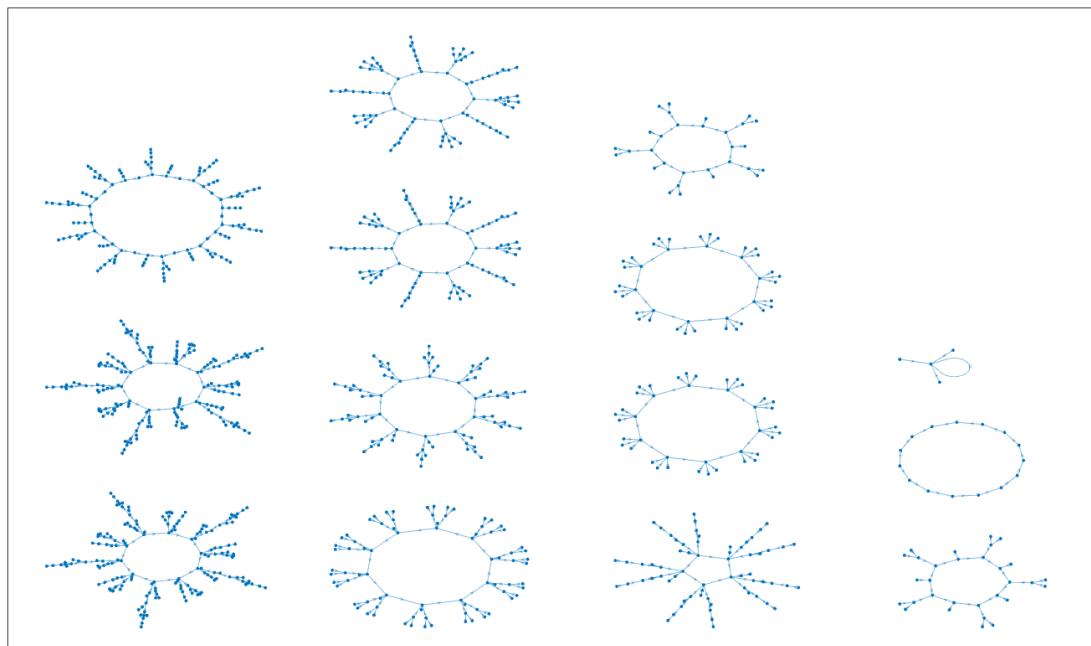


Figura 3.707: Atractor regla 74 n=10

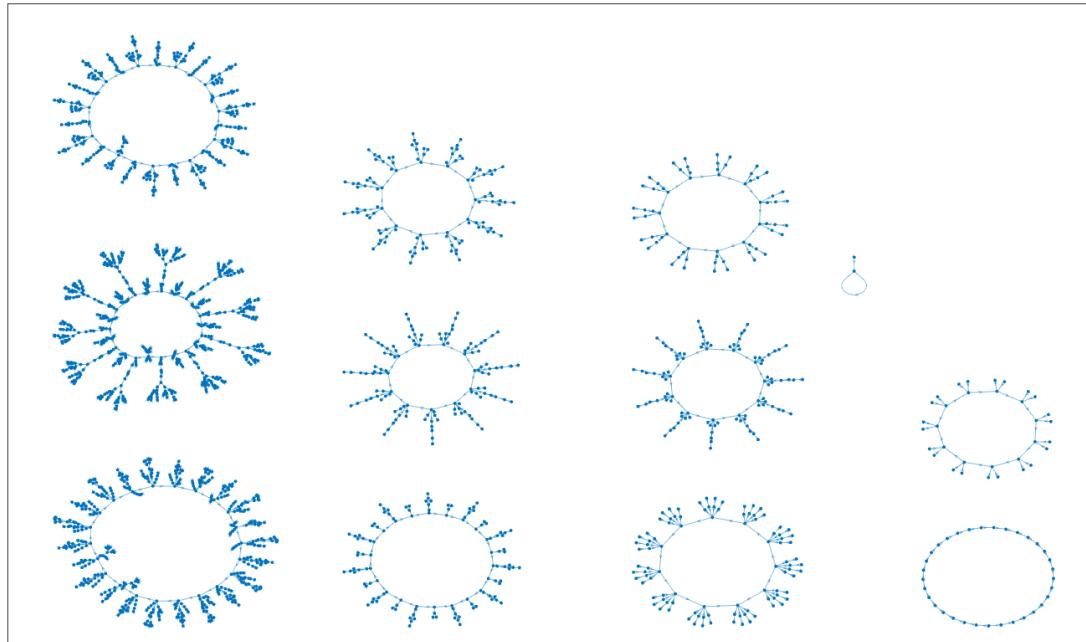


Figura 3.708: Atractor regla 74 n=11

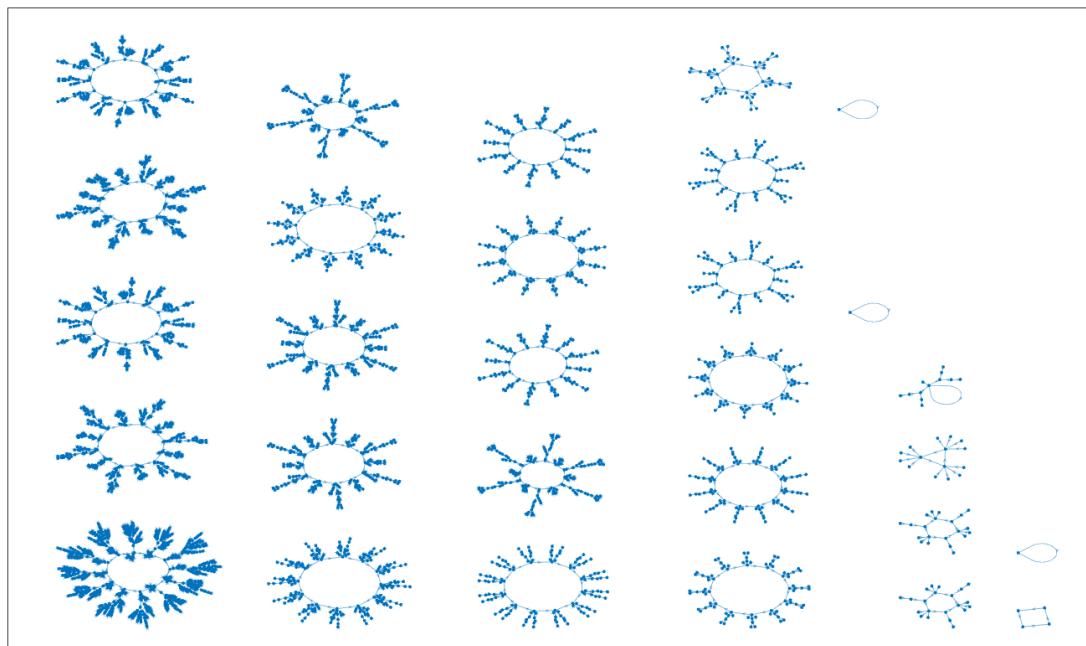


Figura 3.709: Atractor regla 74 n=12

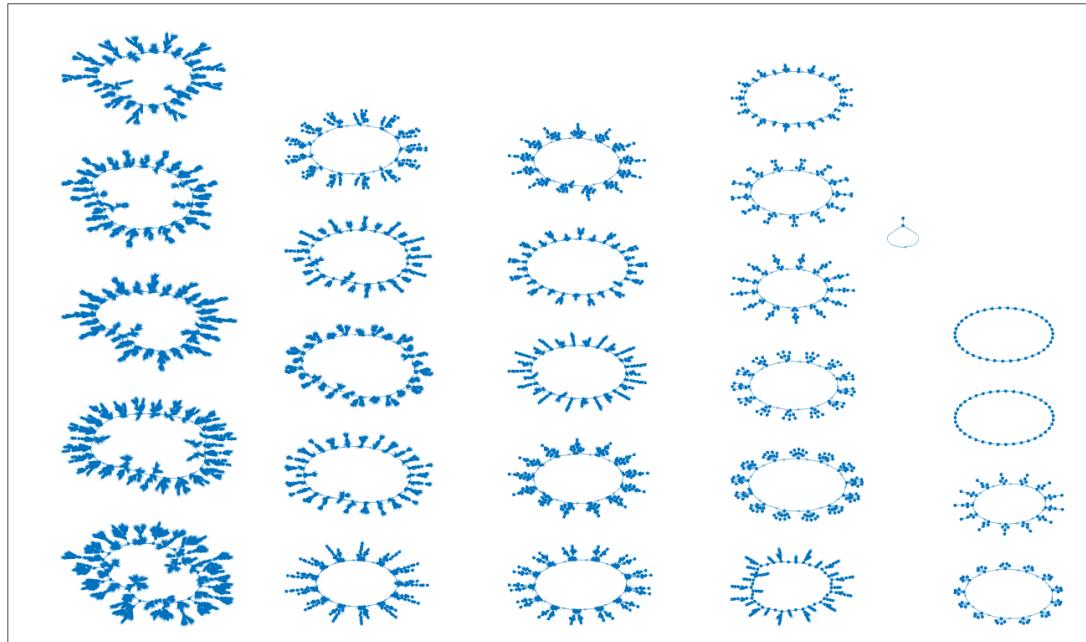


Figura 3.710: Atractor regla 74 n=13

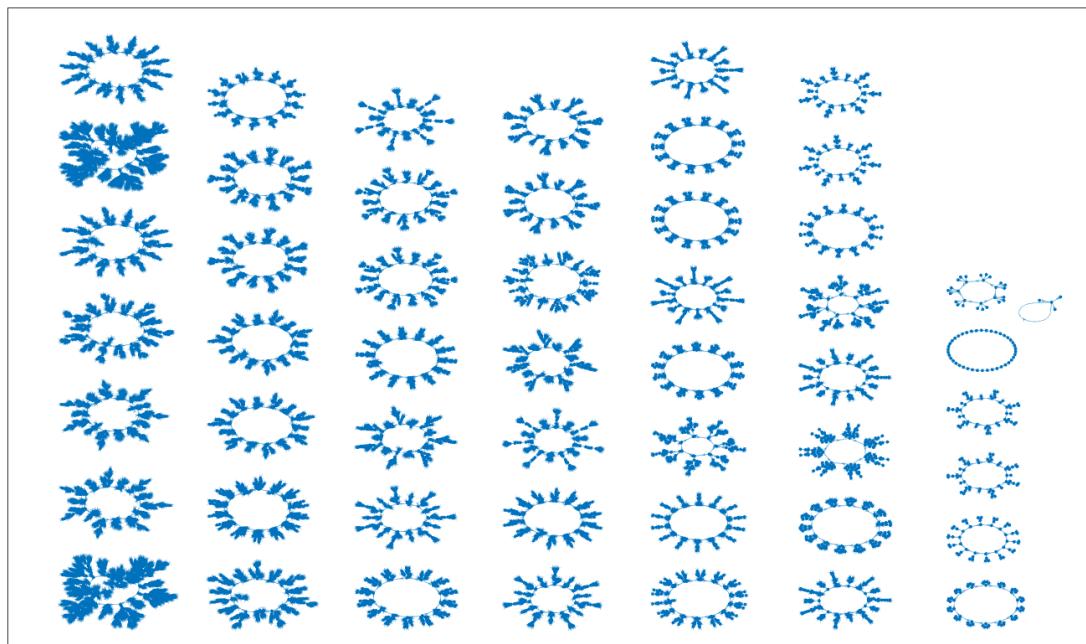


Figura 3.711: Atractor regla 74 n=14

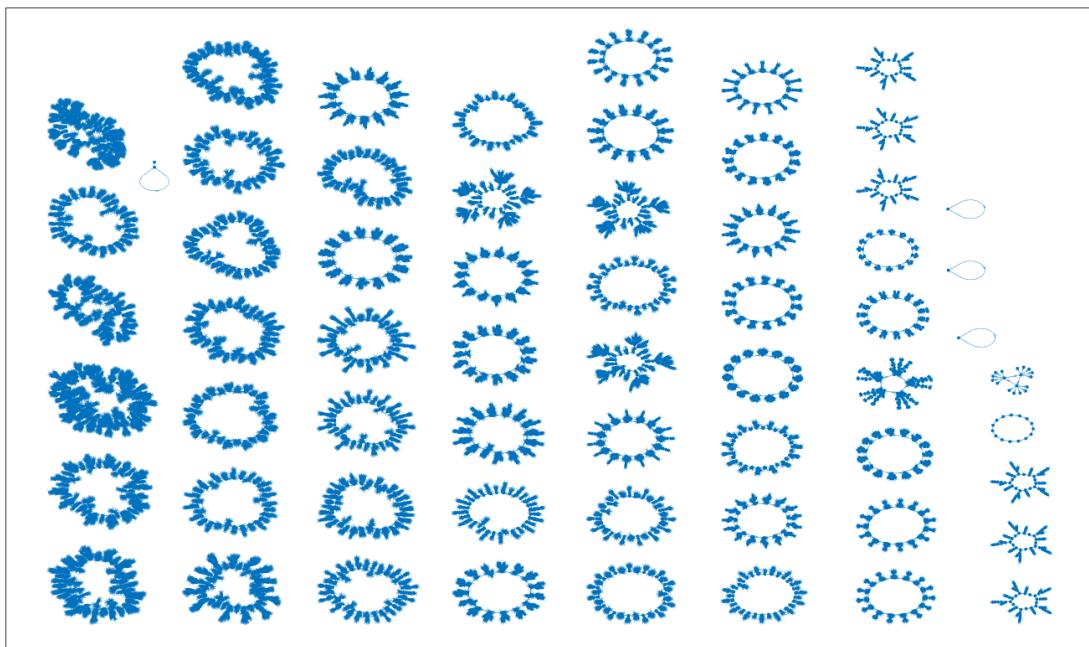


Figura 3.712: Atractor regla 74 n=15

3.53. Reglas 76,205

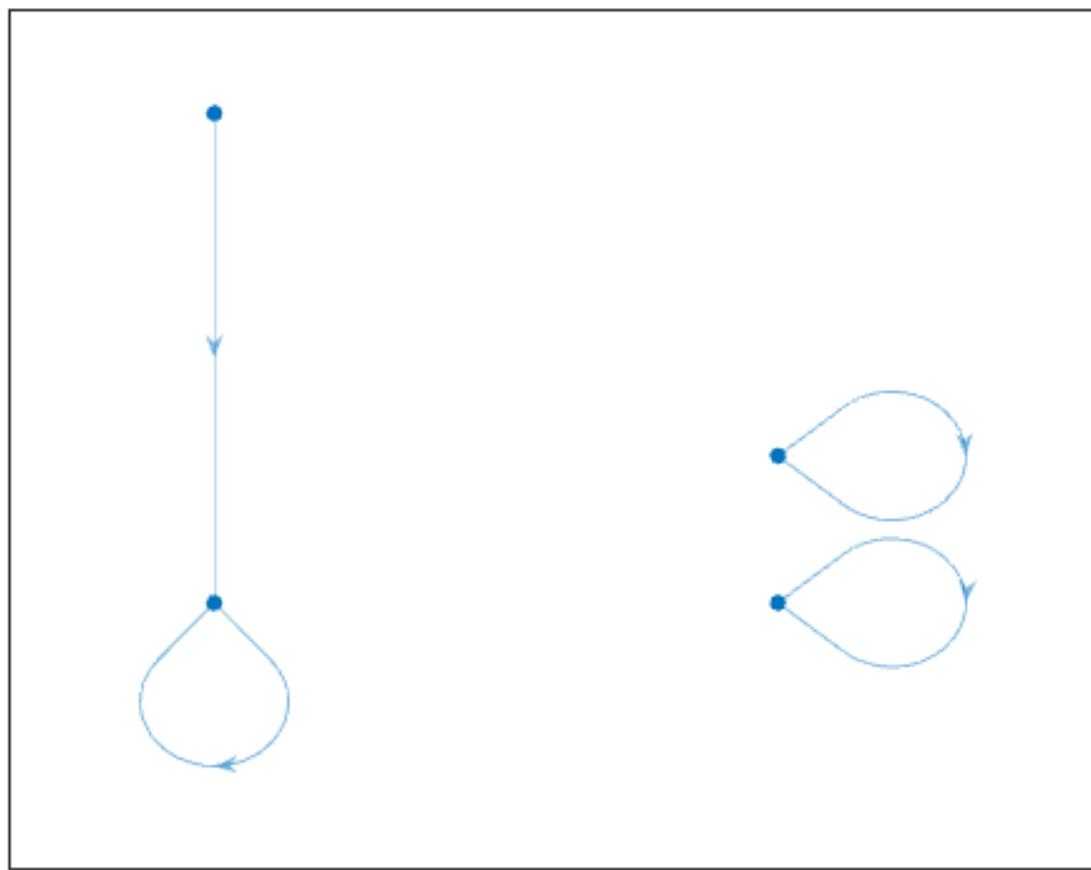


Figura 3.713: Atractor regla 76 n=2

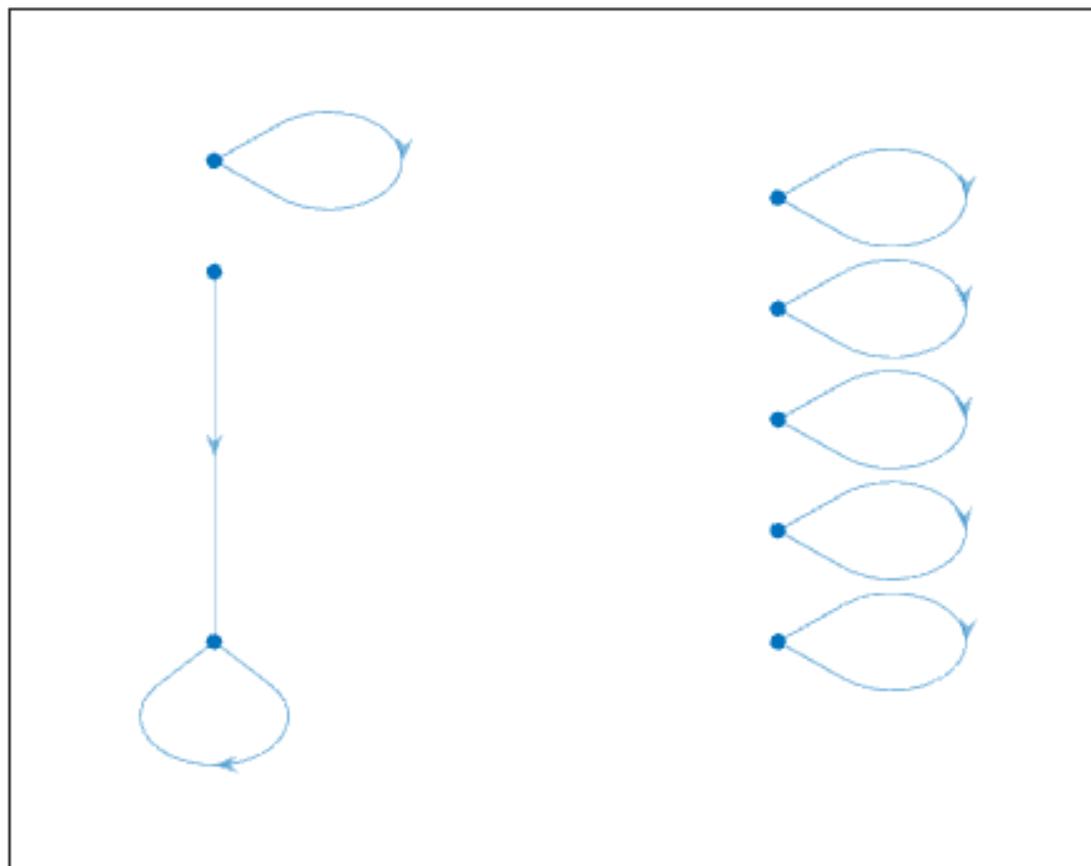
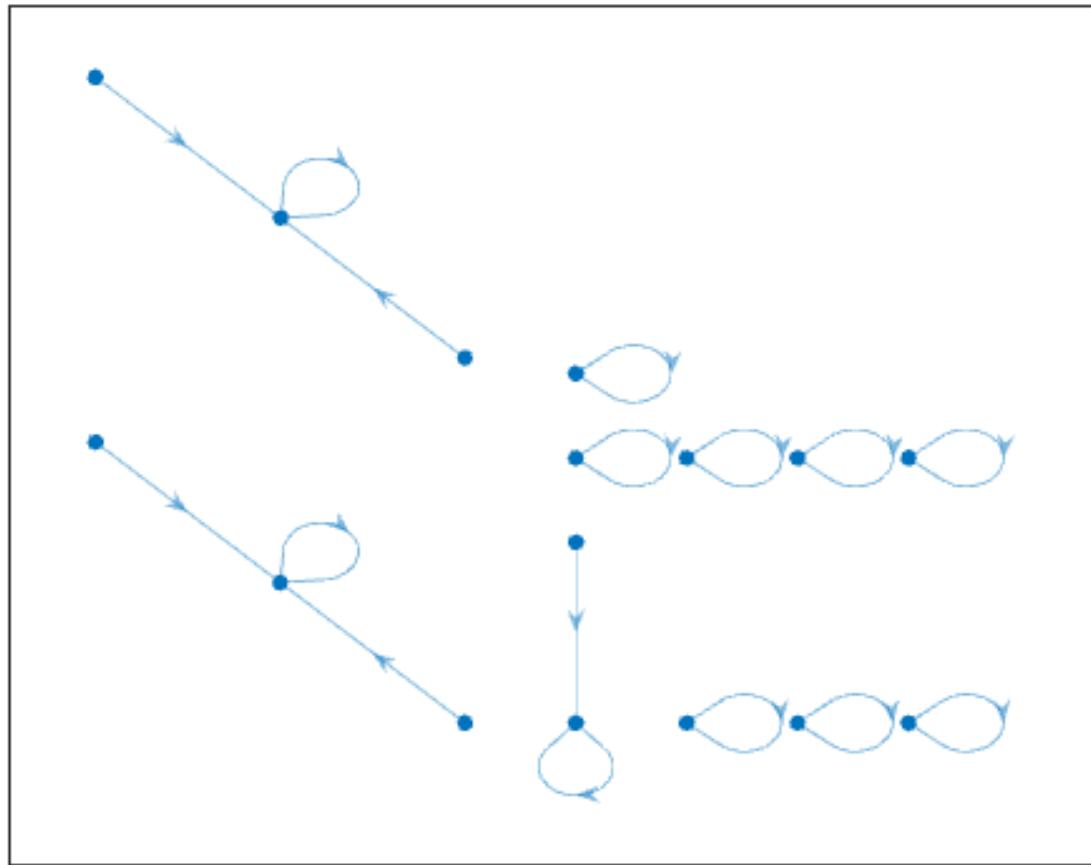


Figura 3.714: Atractor regla 76 n=3

Figura 3.715: Atractor regla 76 $n=4$

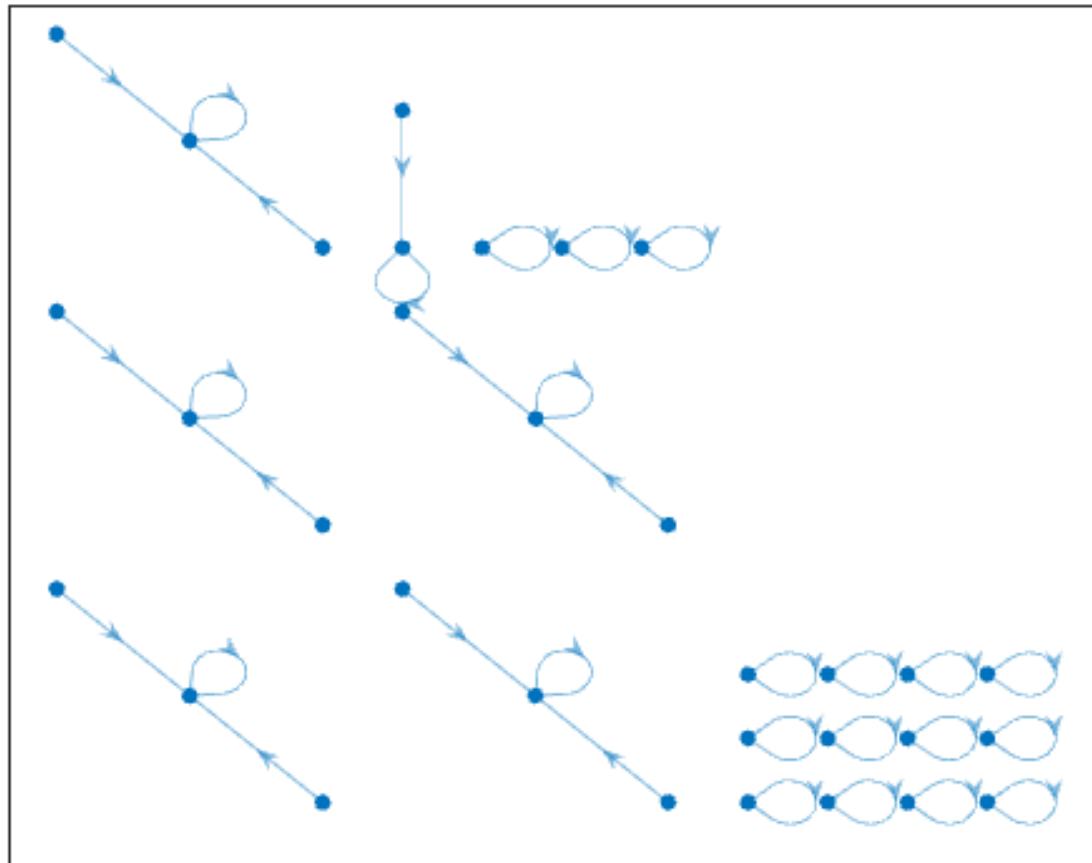


Figura 3.716: Atractor regla 76 n=5

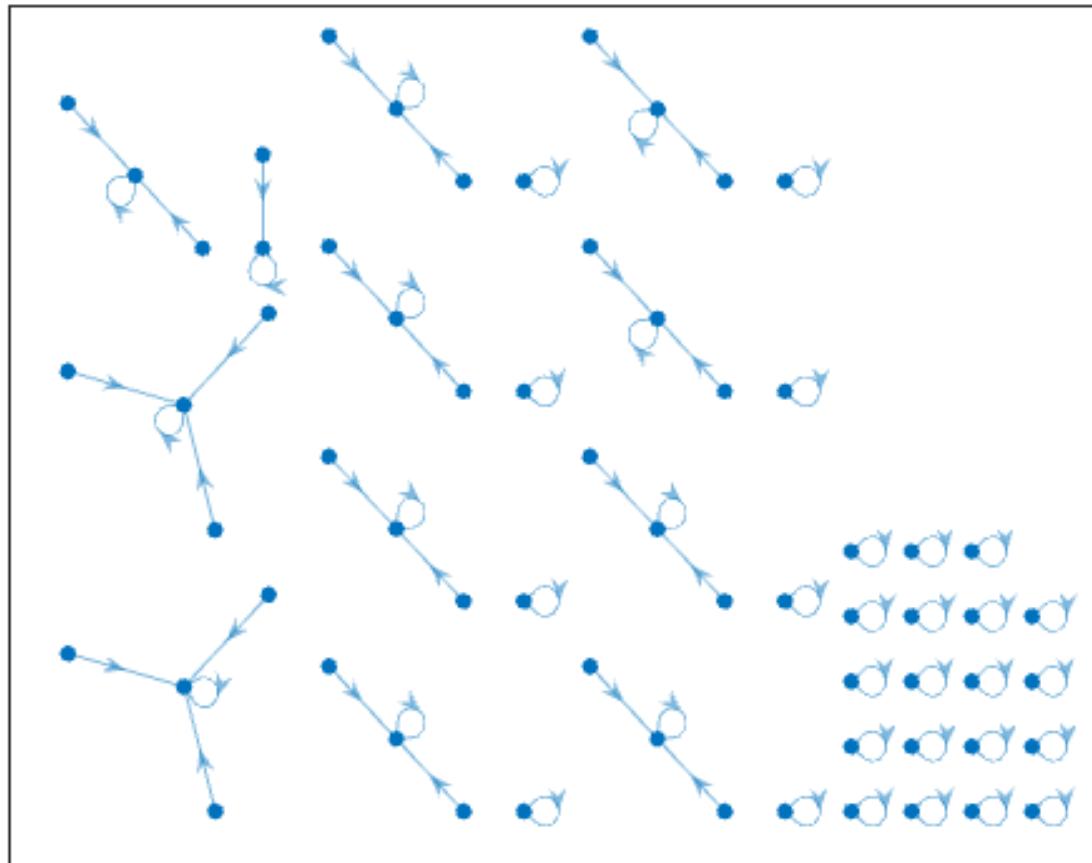


Figura 3.717: Atractor regla 76 n=6

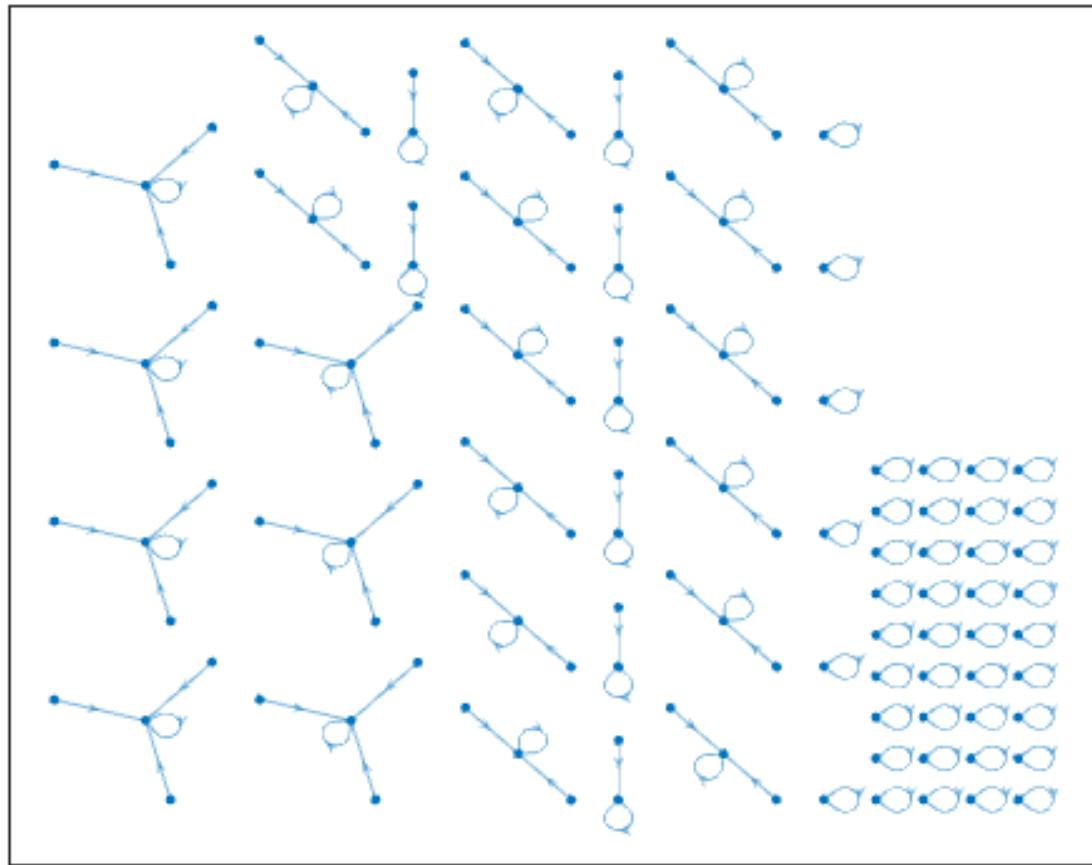


Figura 3.718: Atractor regla 76 n=7

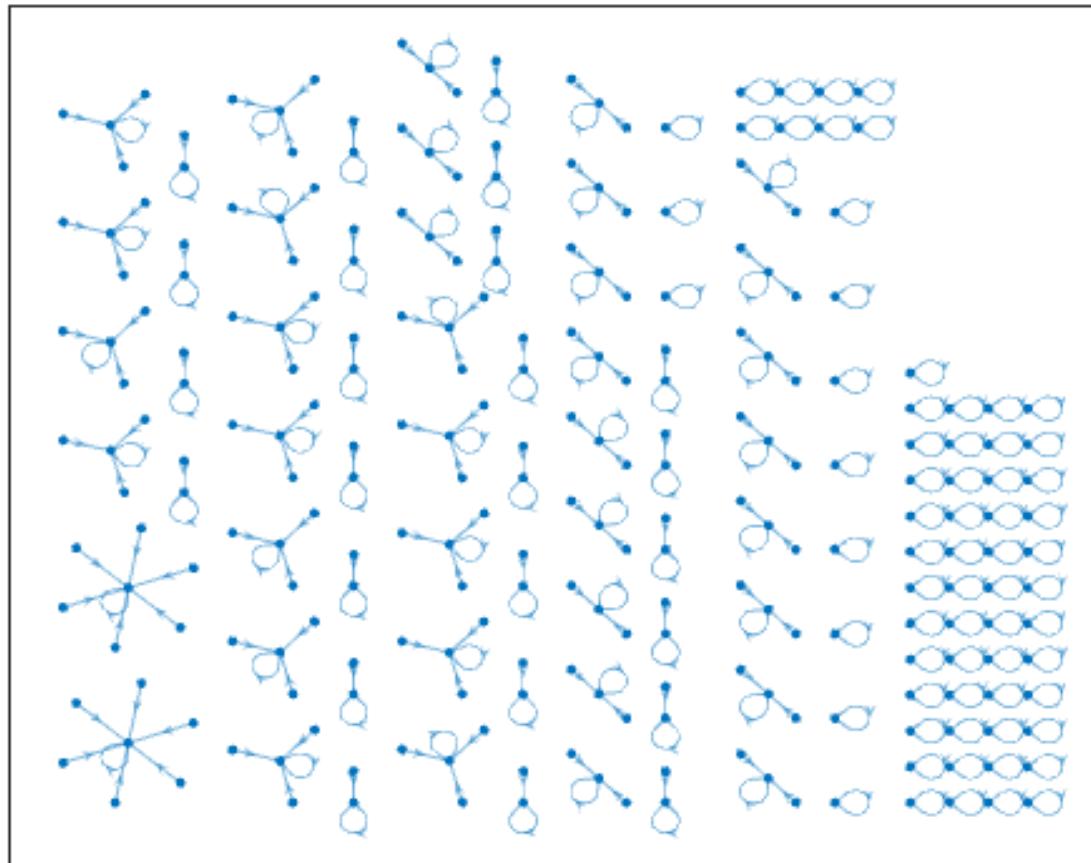


Figura 3.719: Atractor regla 76 n=8

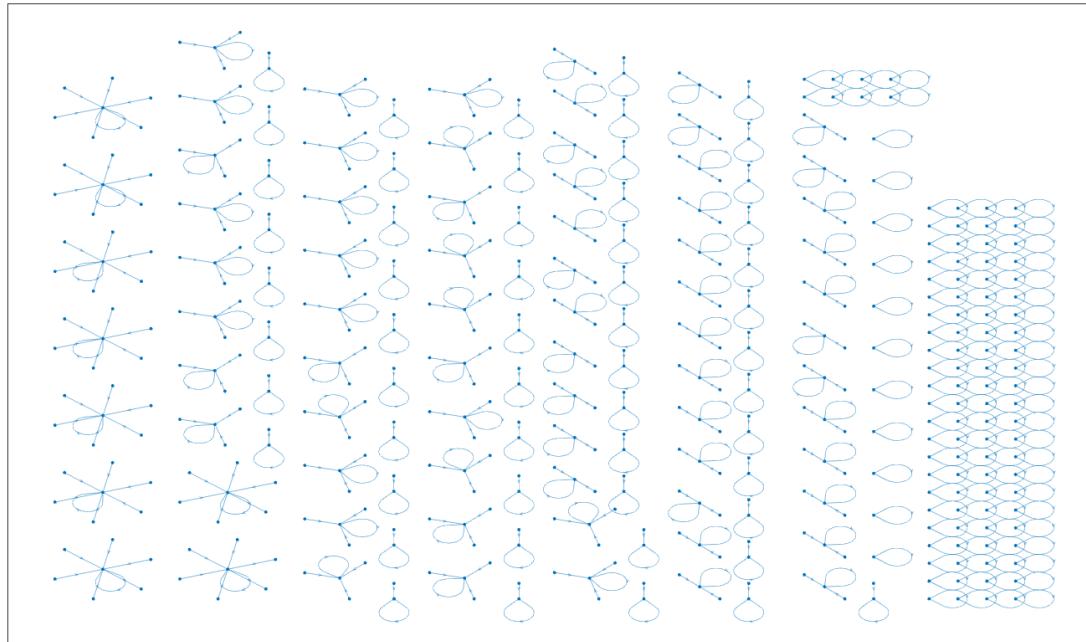


Figura 3.720: Atractor regla 76 n=9

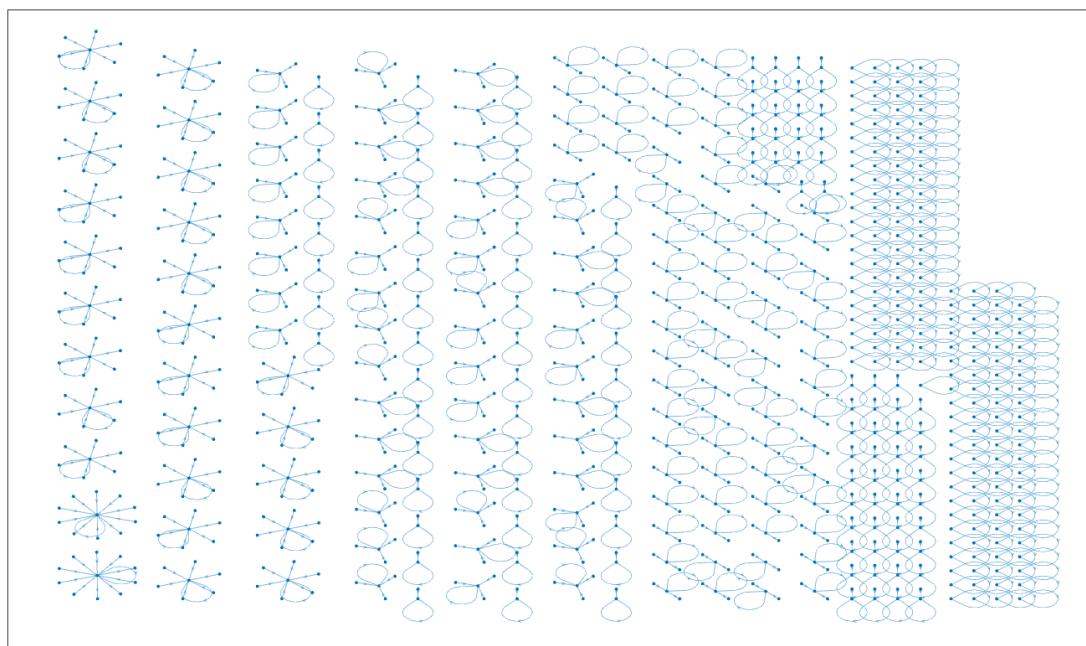


Figura 3.721: Atractor regla 76 n=10

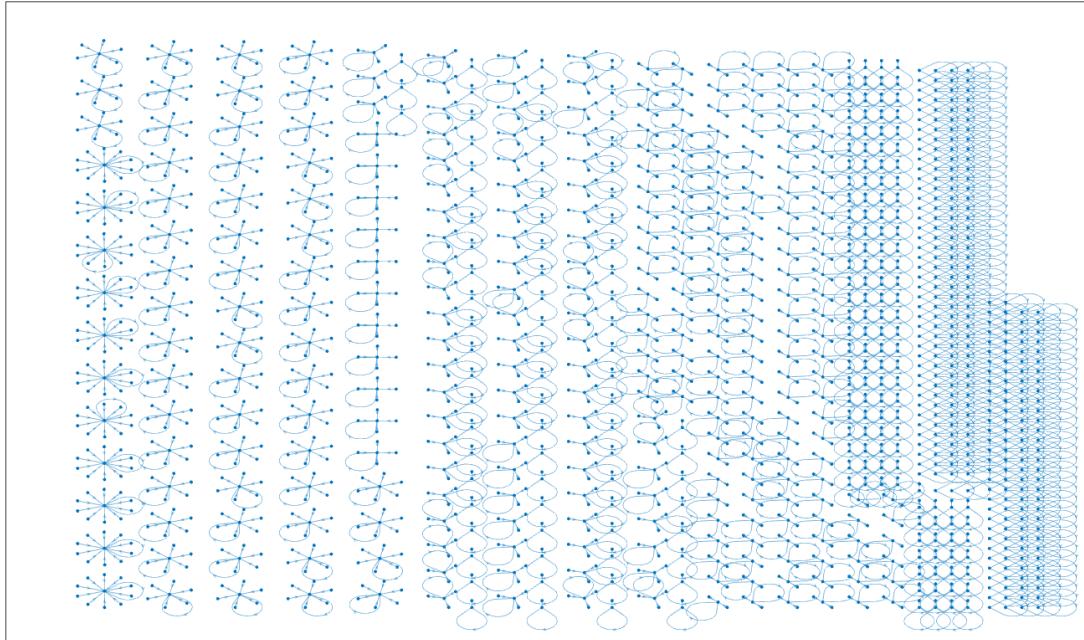


Figura 3.722: Atractor regla 76 n=11

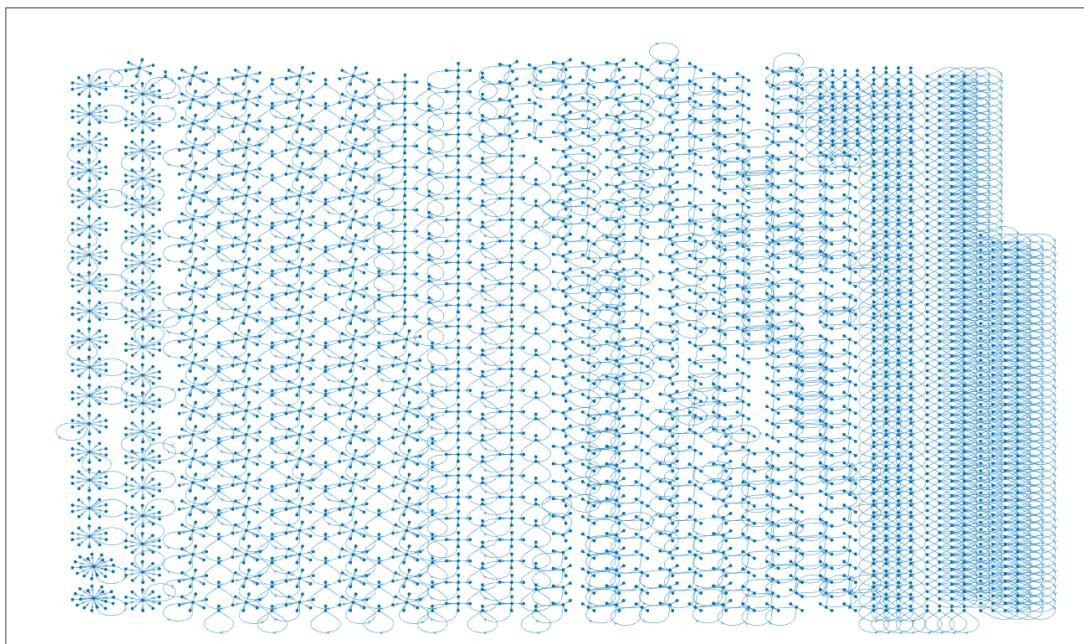


Figura 3.723: Atractor regla 76 n=12

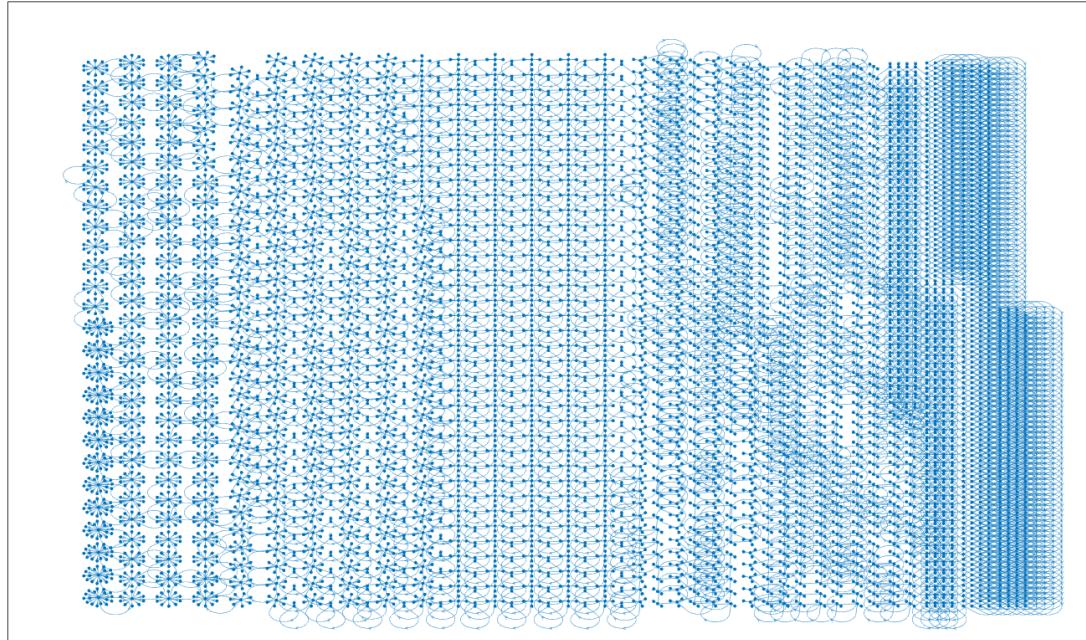


Figura 3.724: Atractor regla 76 n=13

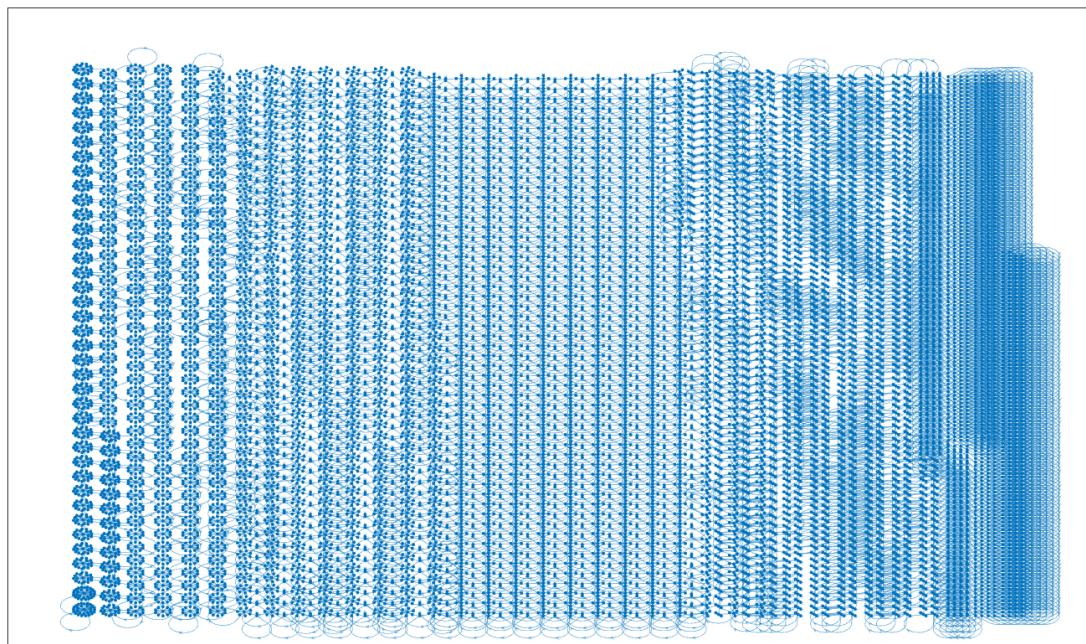


Figura 3.725: Atractor regla 76 n=14

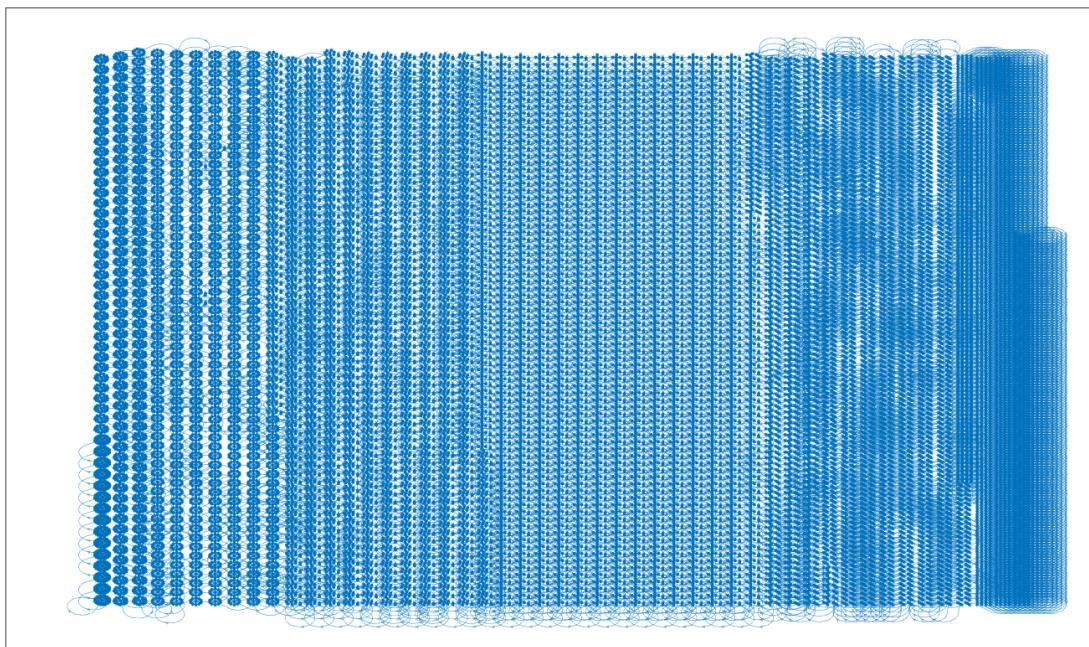
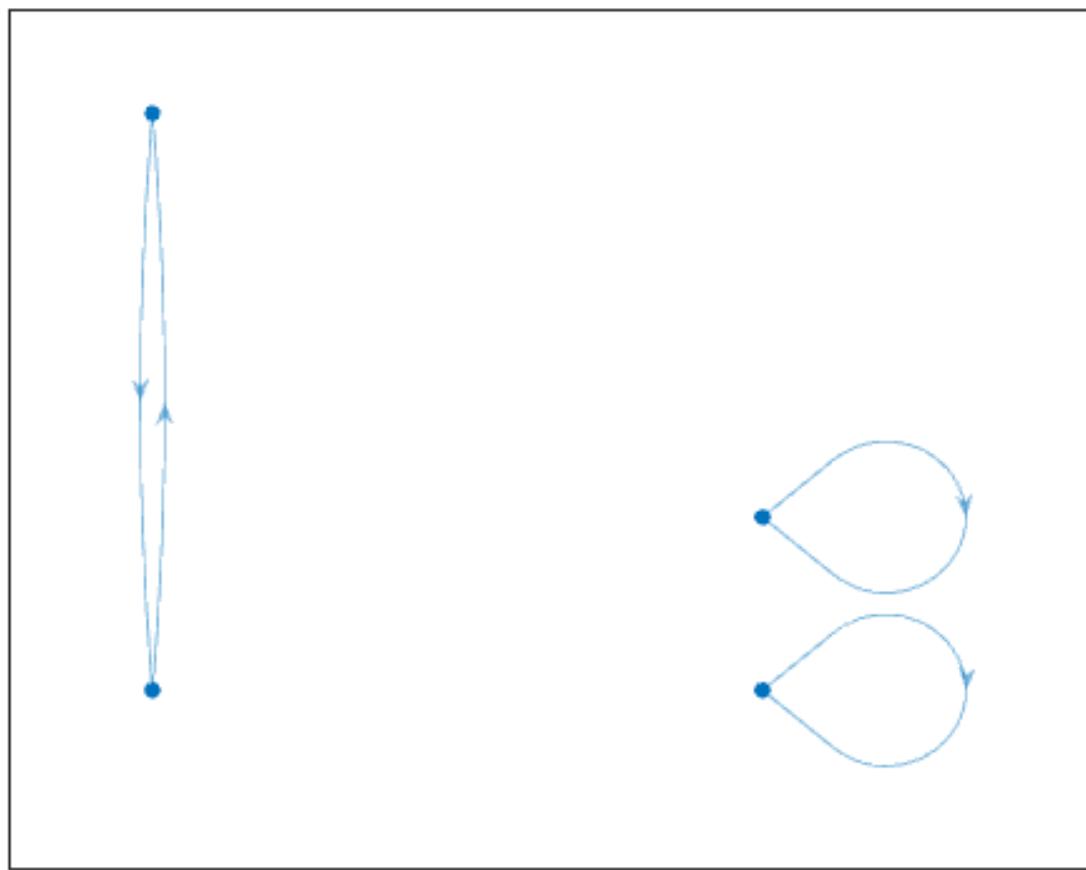


Figura 3.726: Atractor regla 76 n=15

3.54. Reglas 77

Figura 3.727: Atractor regla 77 $n=2$

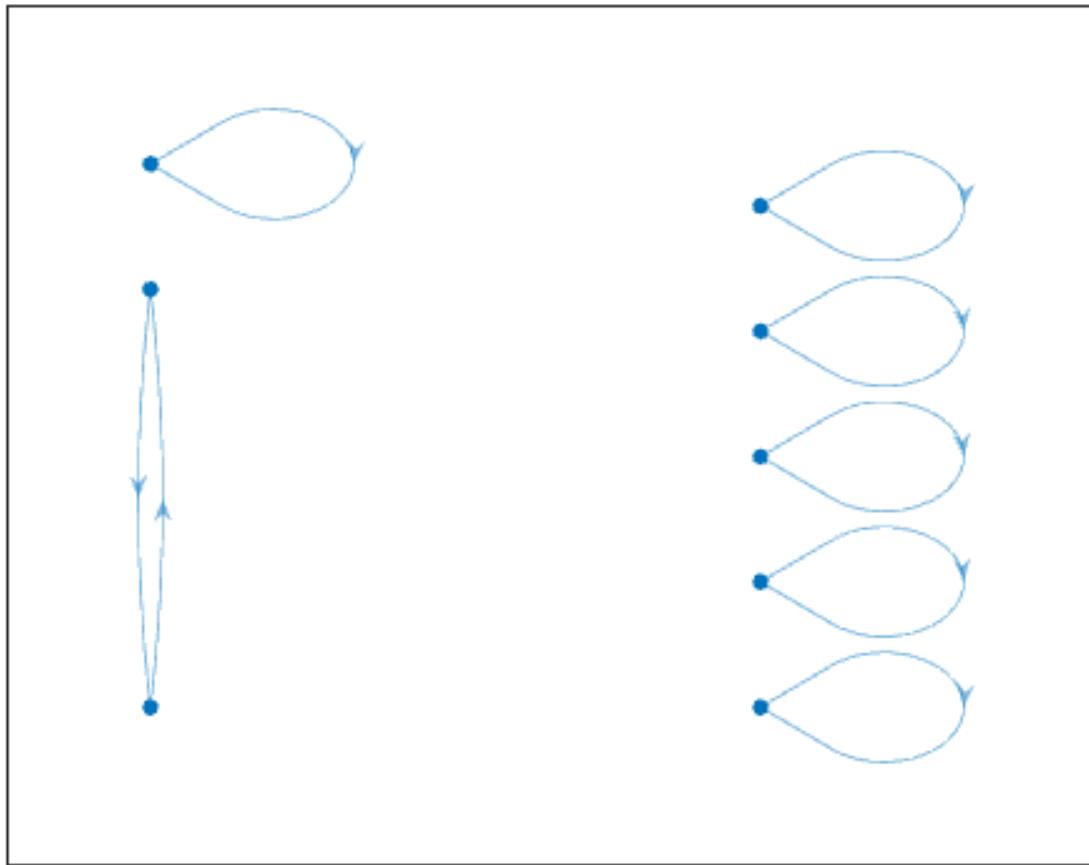
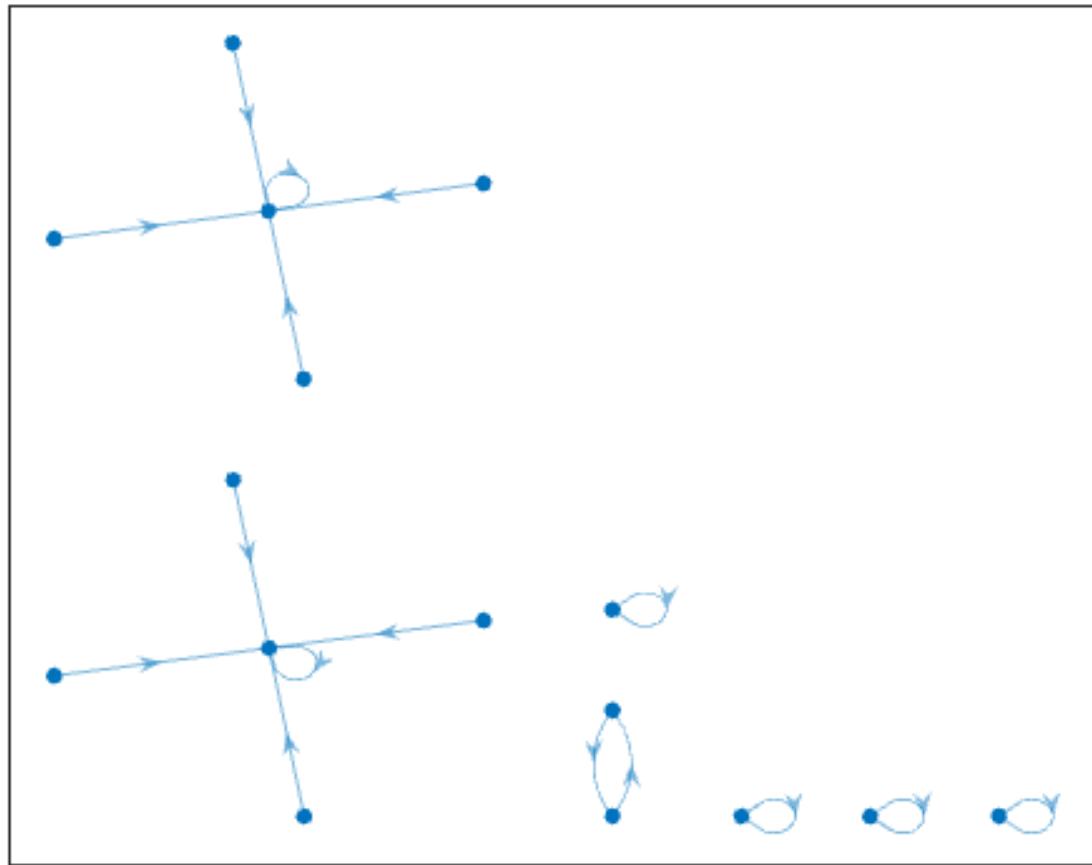


Figura 3.728: Atractor regla 77 n=3

Figura 3.729: Atractor regla 77 $n=4$

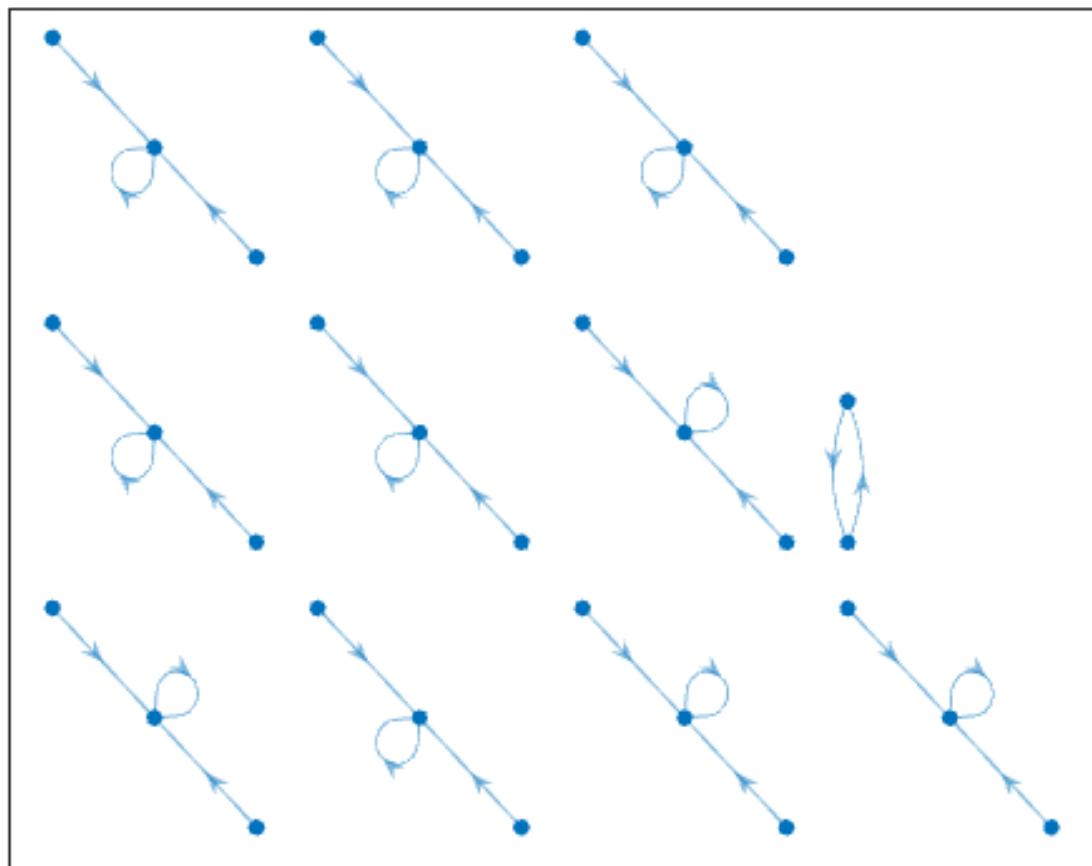
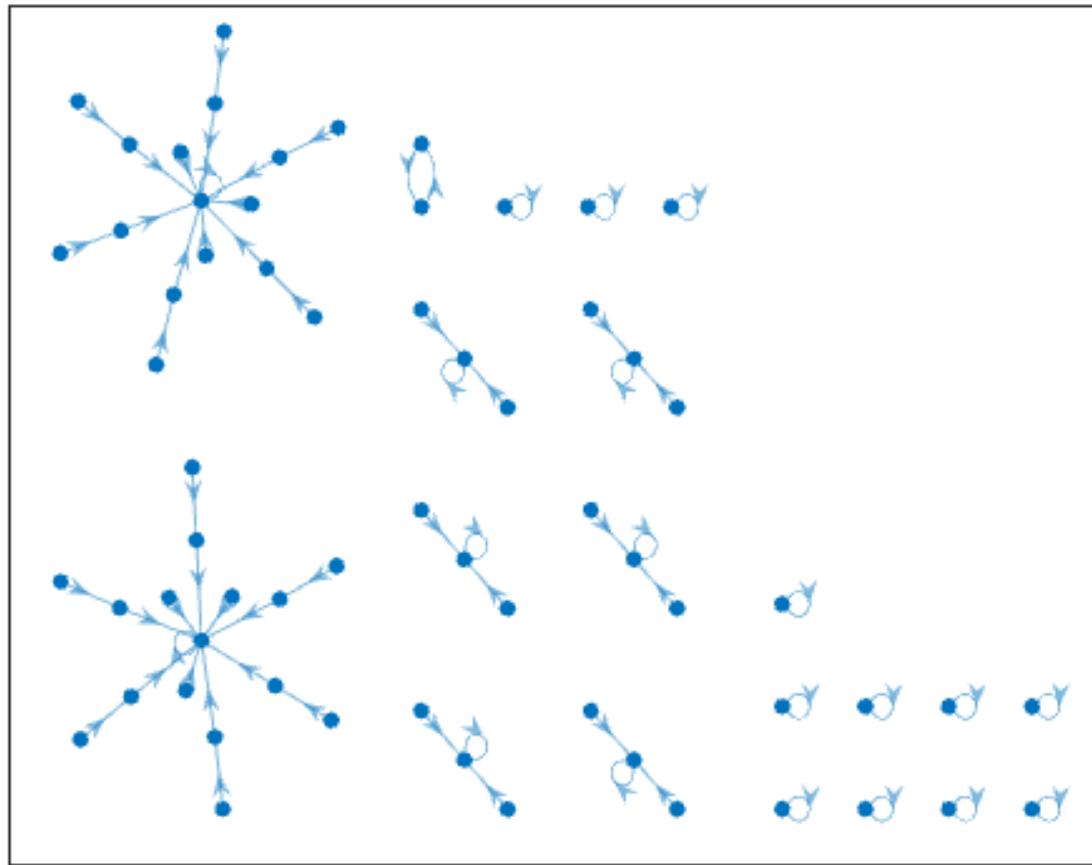


Figura 3.730: Atractor regla 77 n=5

Figura 3.731: Atractor regla 77 $n=6$

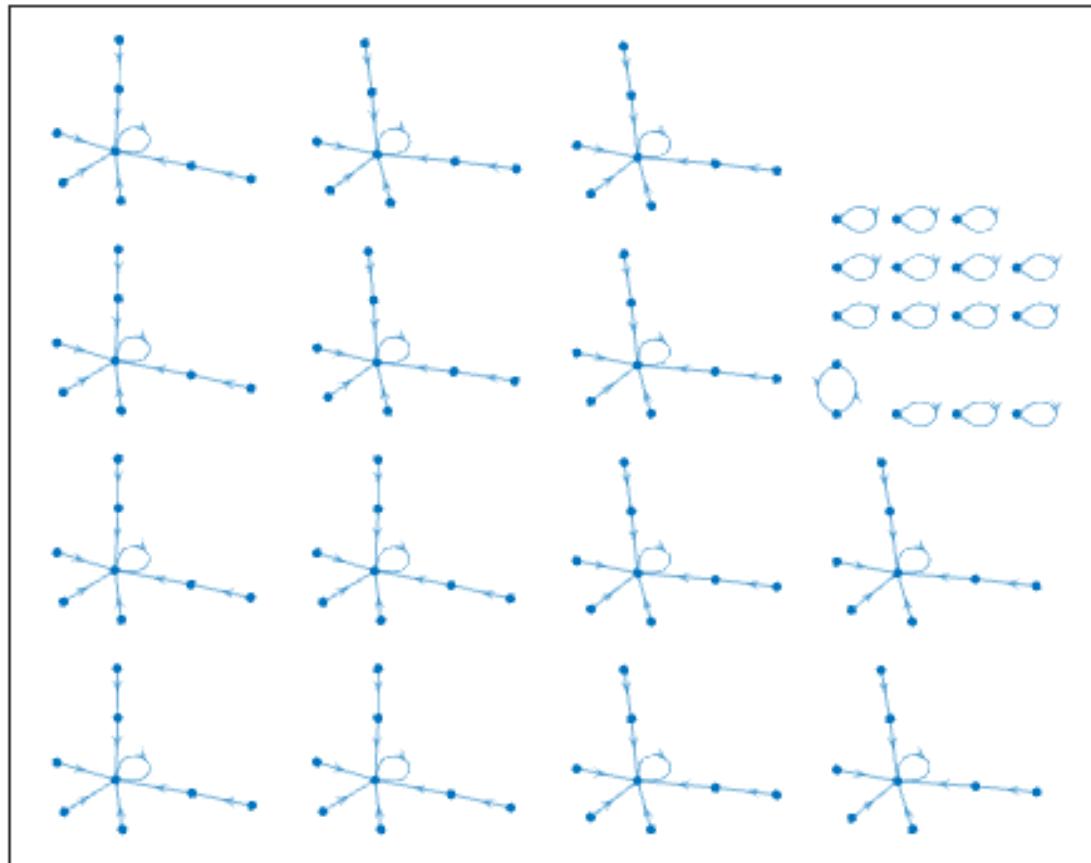


Figura 3.732: Atractor regla 77 n=7

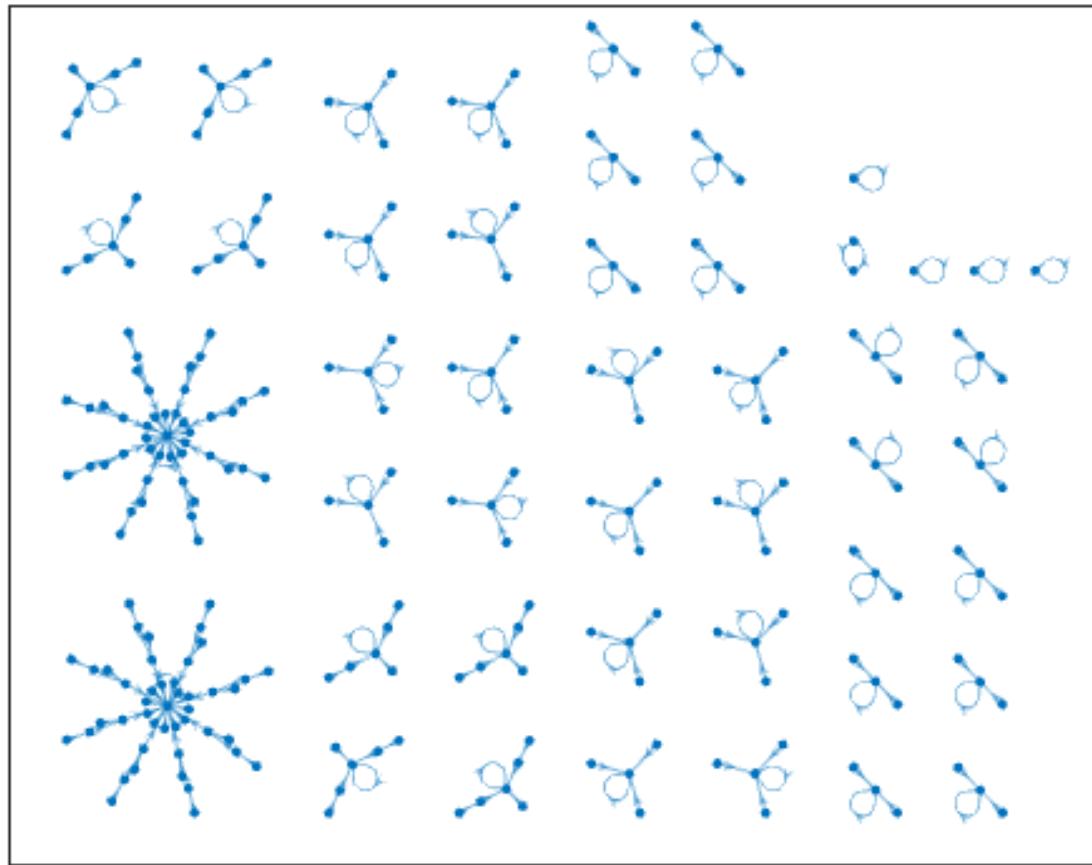


Figura 3.733: Atractor regla 77 n=8

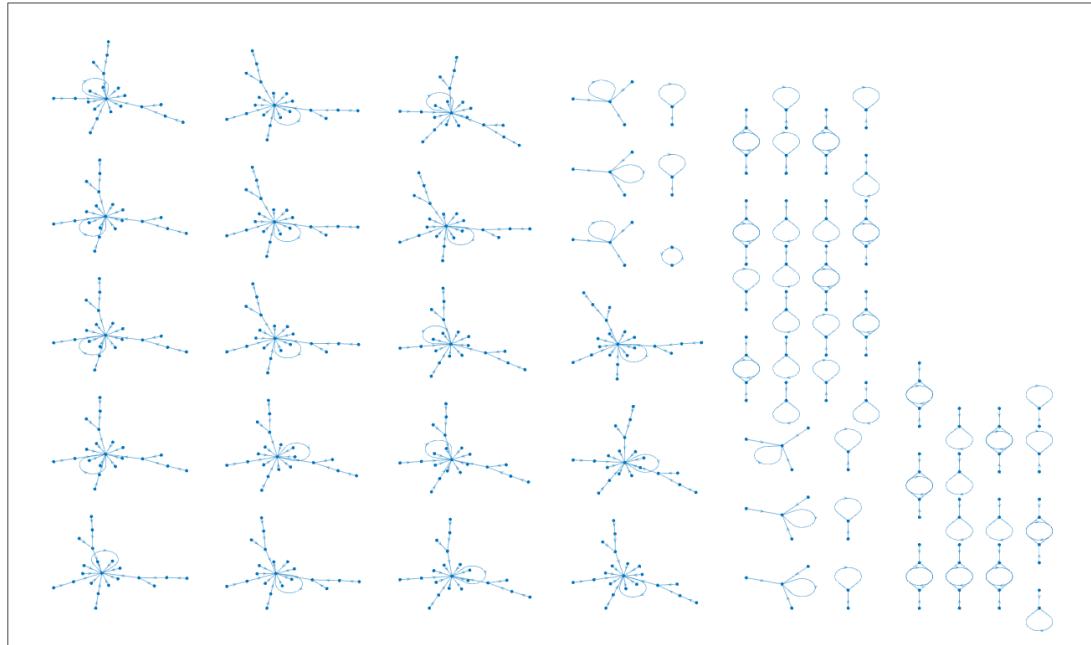


Figura 3.734: Atractor regla 77 n=9

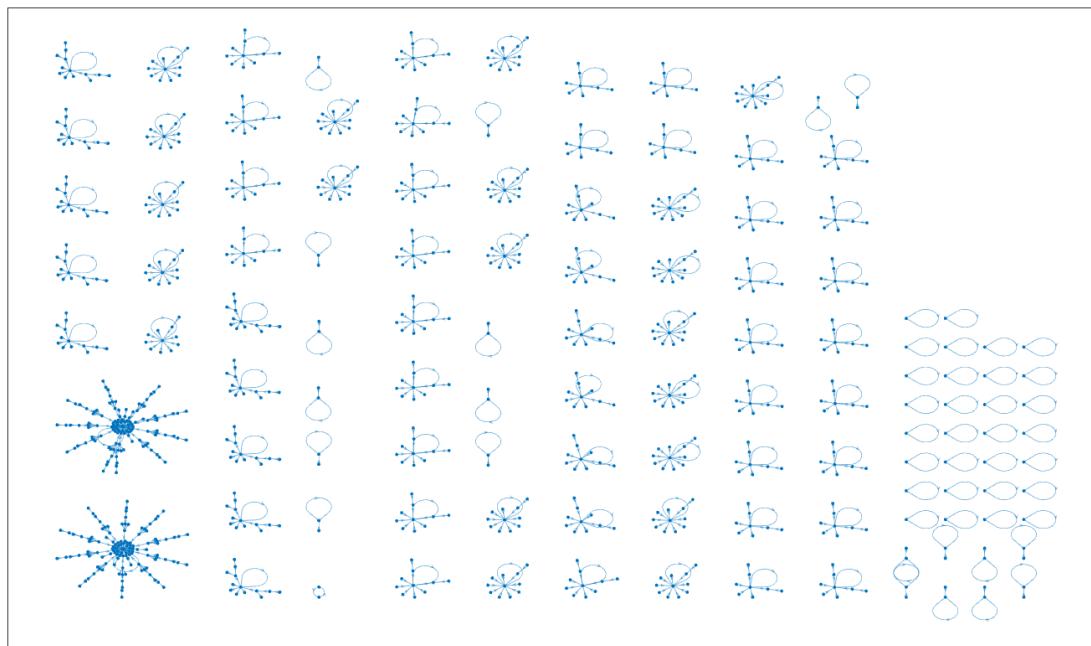


Figura 3.735: Atractor regla 77 n=10

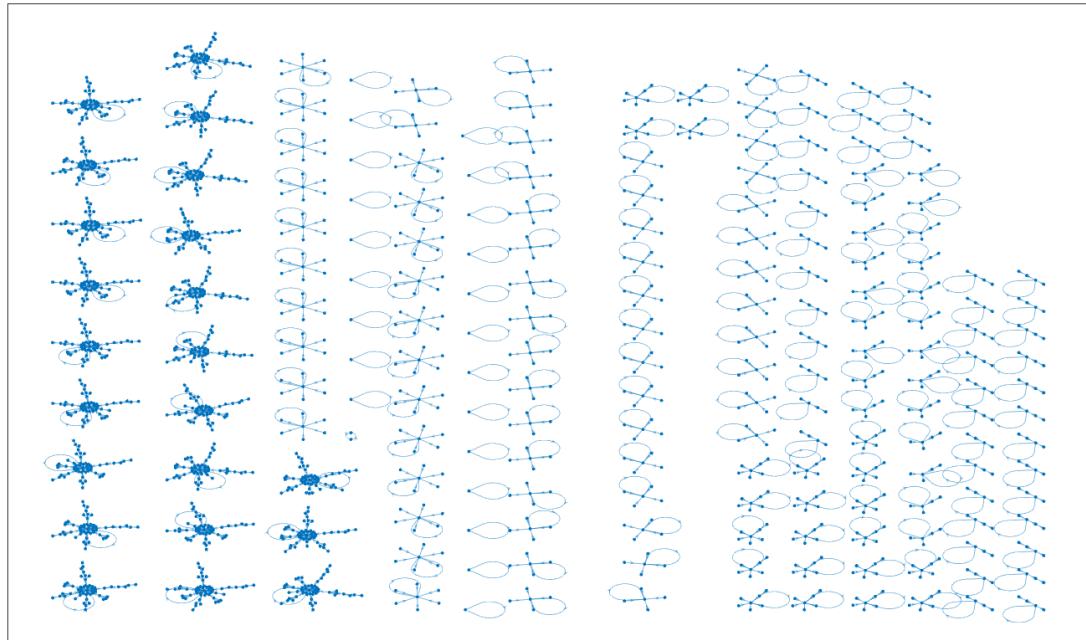


Figura 3.736: Atractor regla 77 n=11

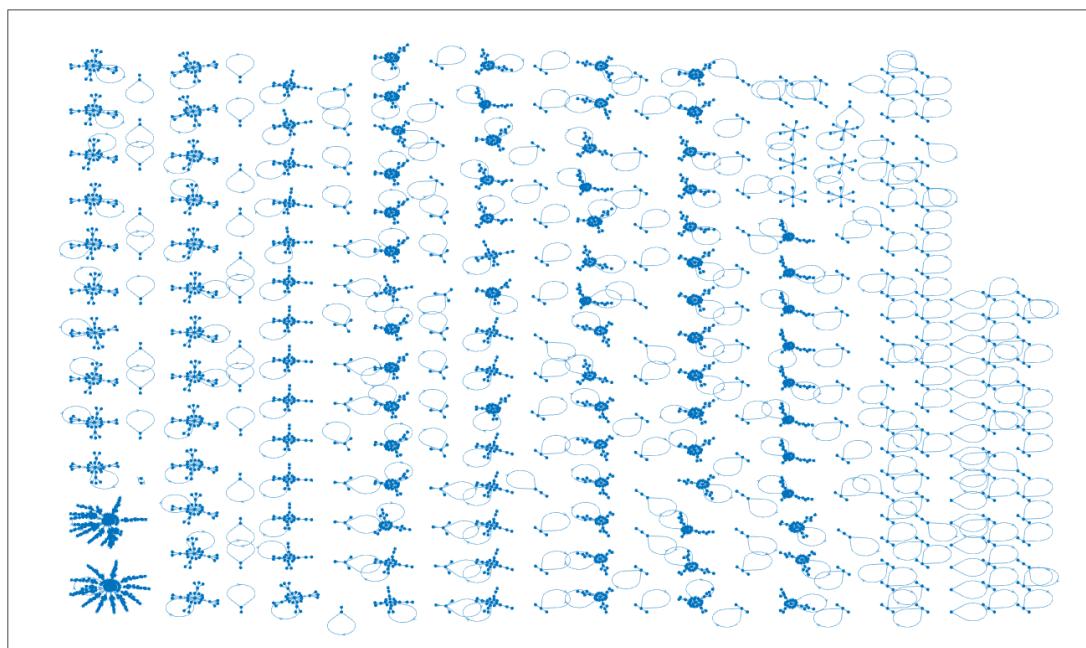


Figura 3.737: Atractor regla 77 n=12

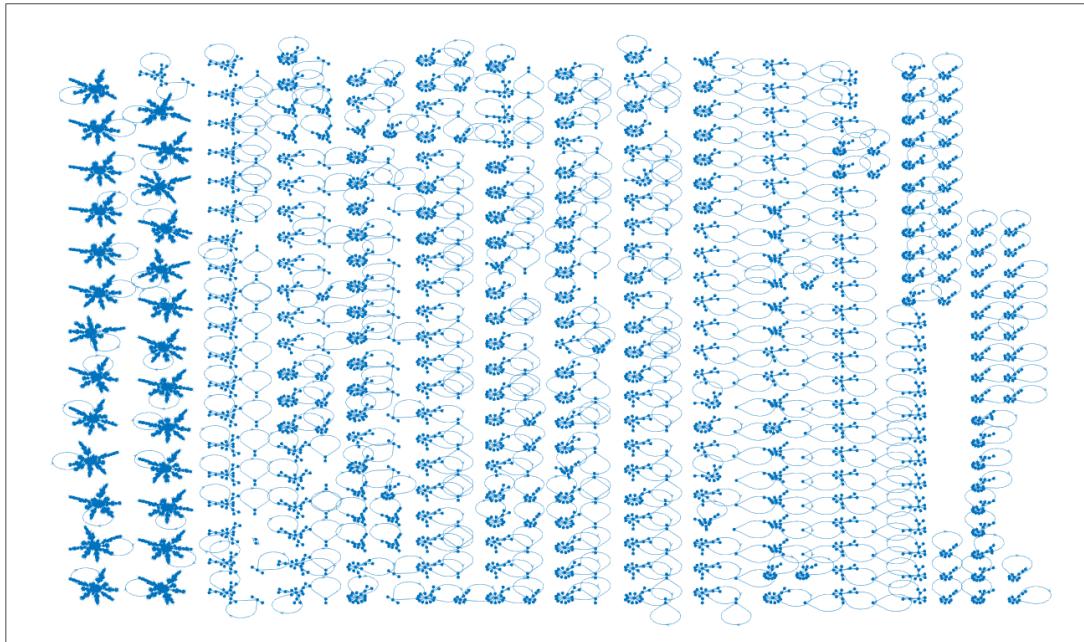


Figura 3.738: Atractor regla 77 n=13

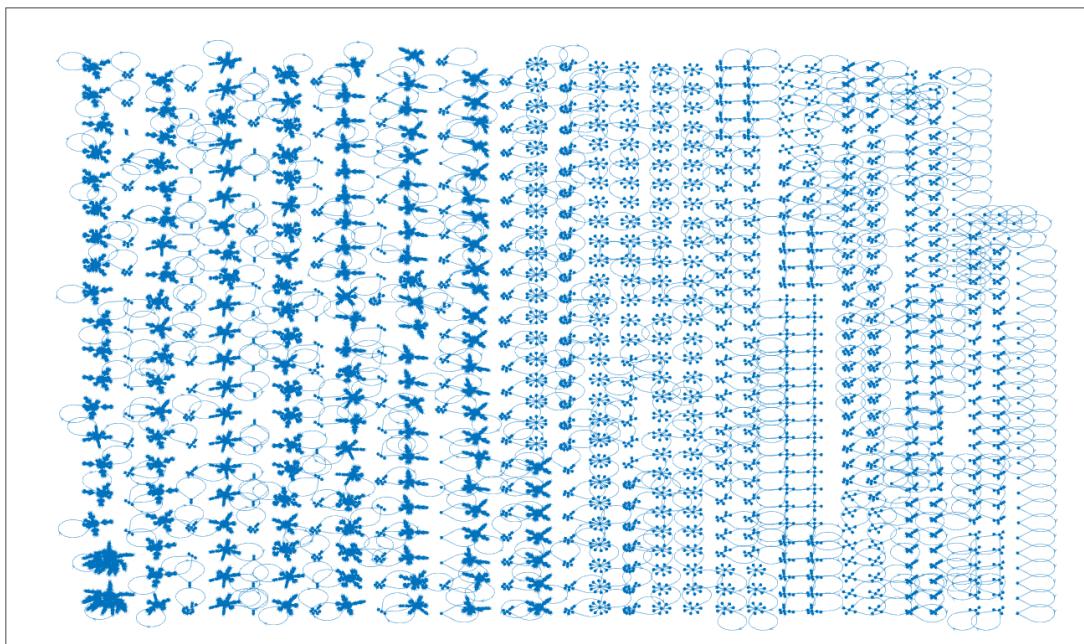


Figura 3.739: Atractor regla 77 n=14

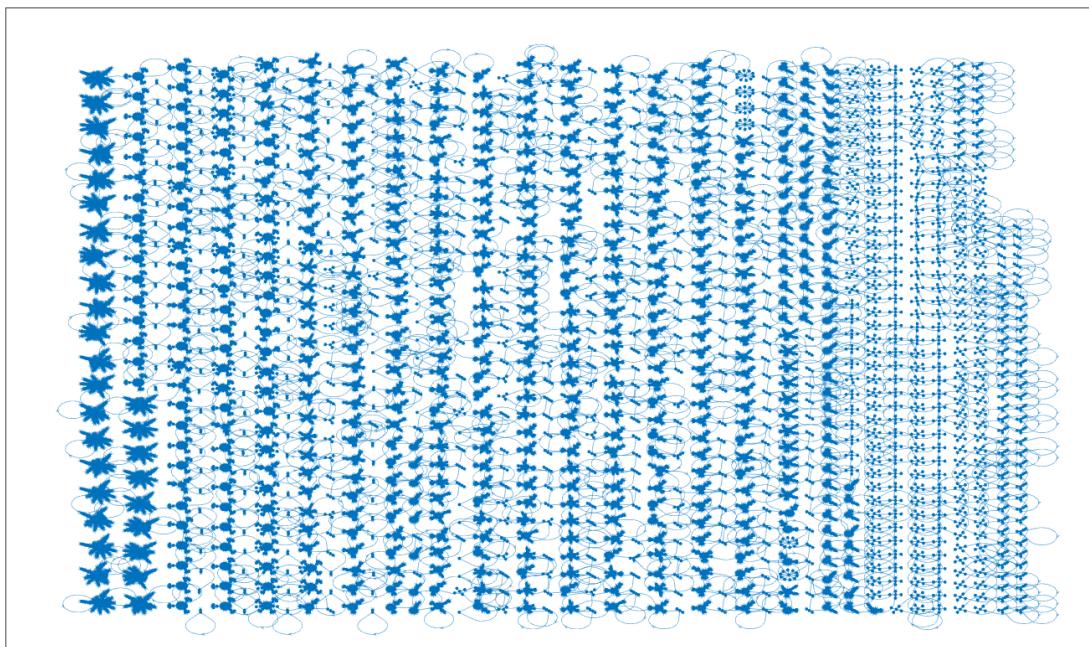


Figura 3.740: Atractor regla 77 n=15

3.55. Reglas 78,92,141,197

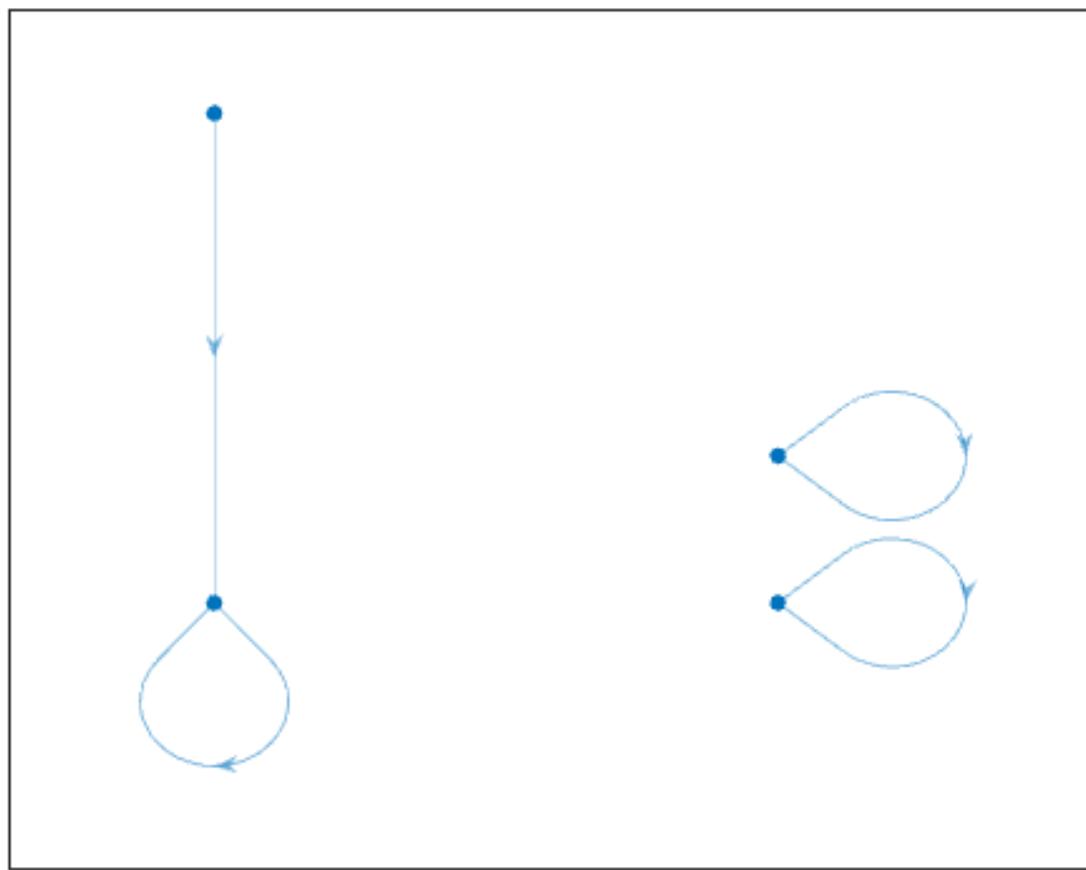


Figura 3.741: Atractor regla 78 n=2

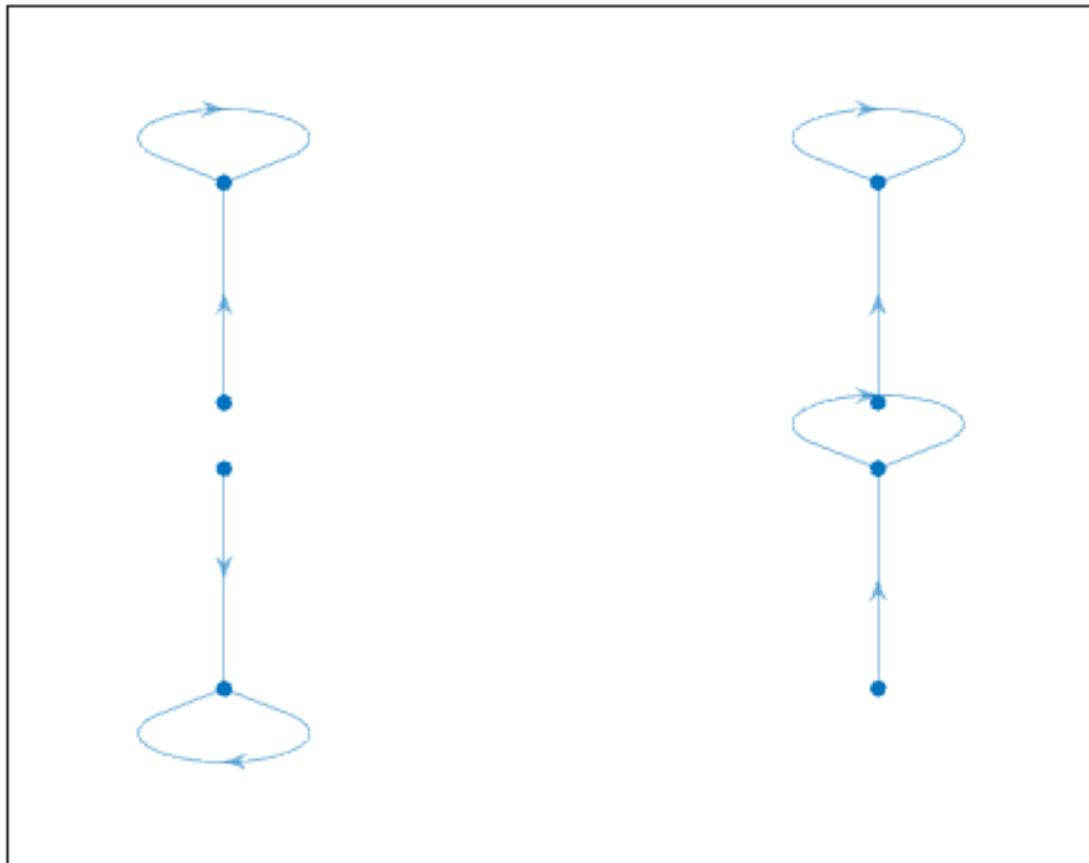


Figura 3.742: Atractor regla 78 n=3

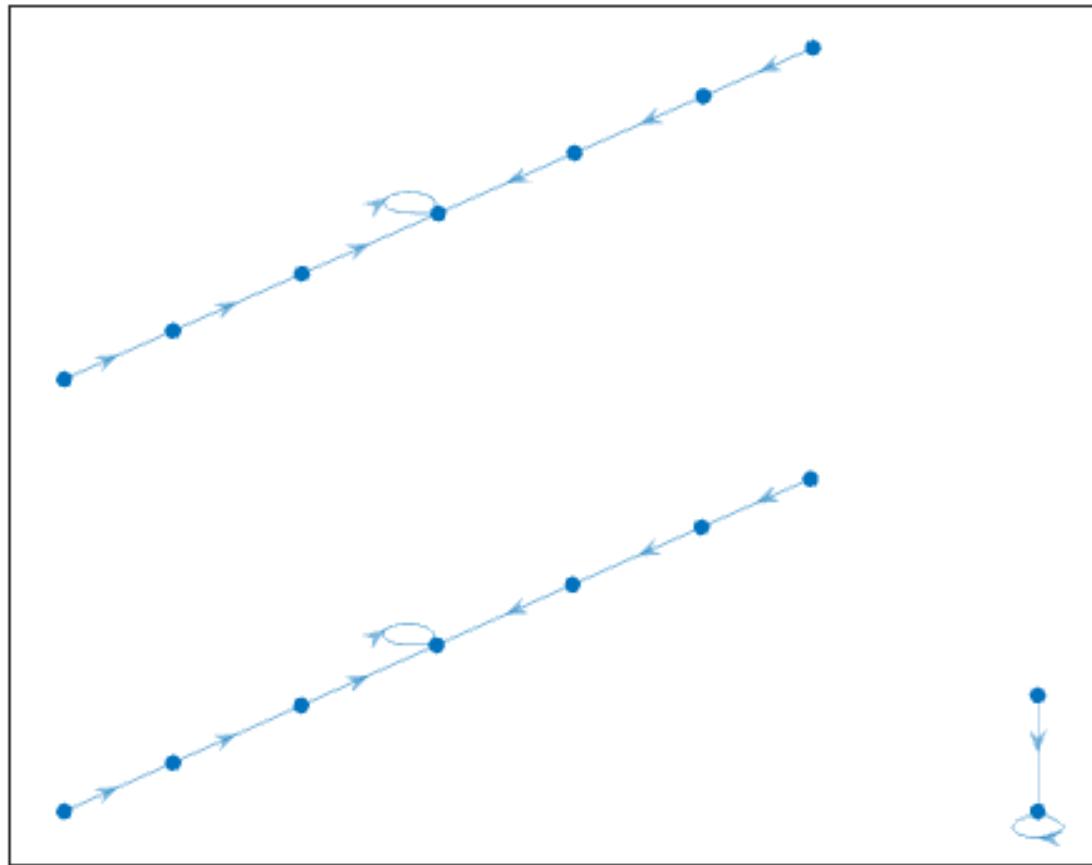


Figura 3.743: Atractor regla 78 n=4

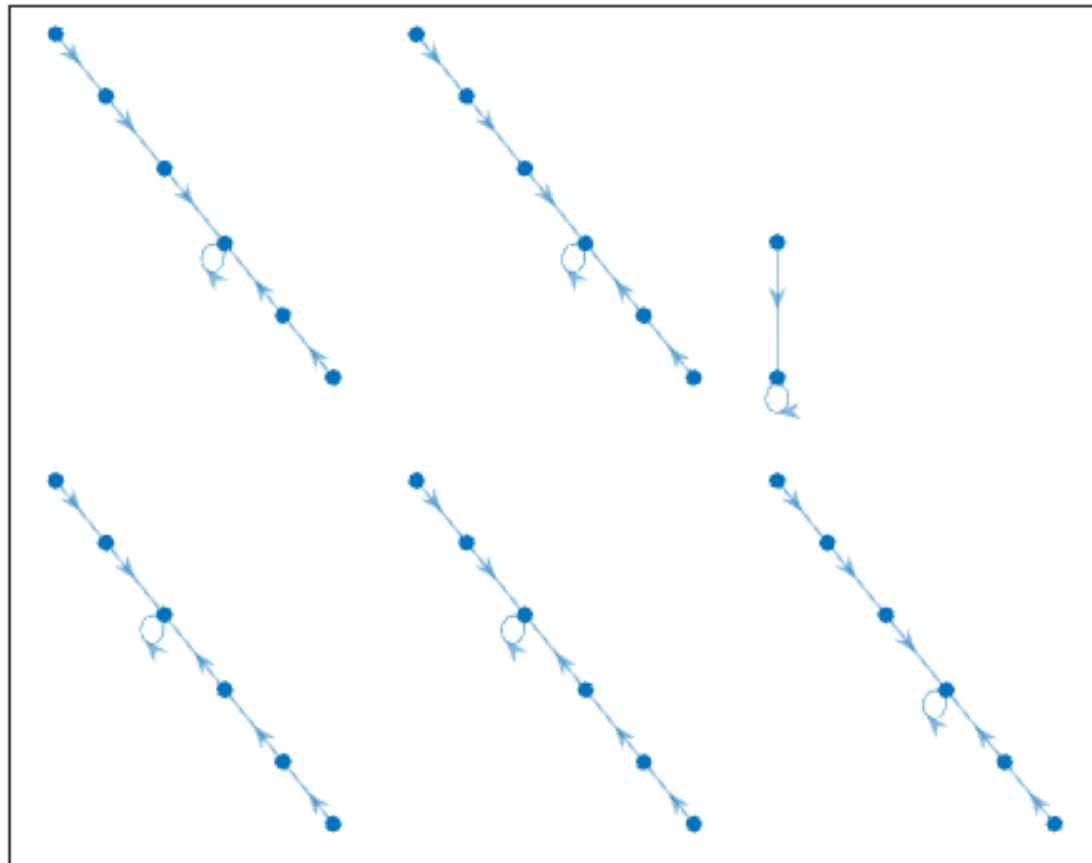


Figura 3.744: Atractor regla 78 n=5

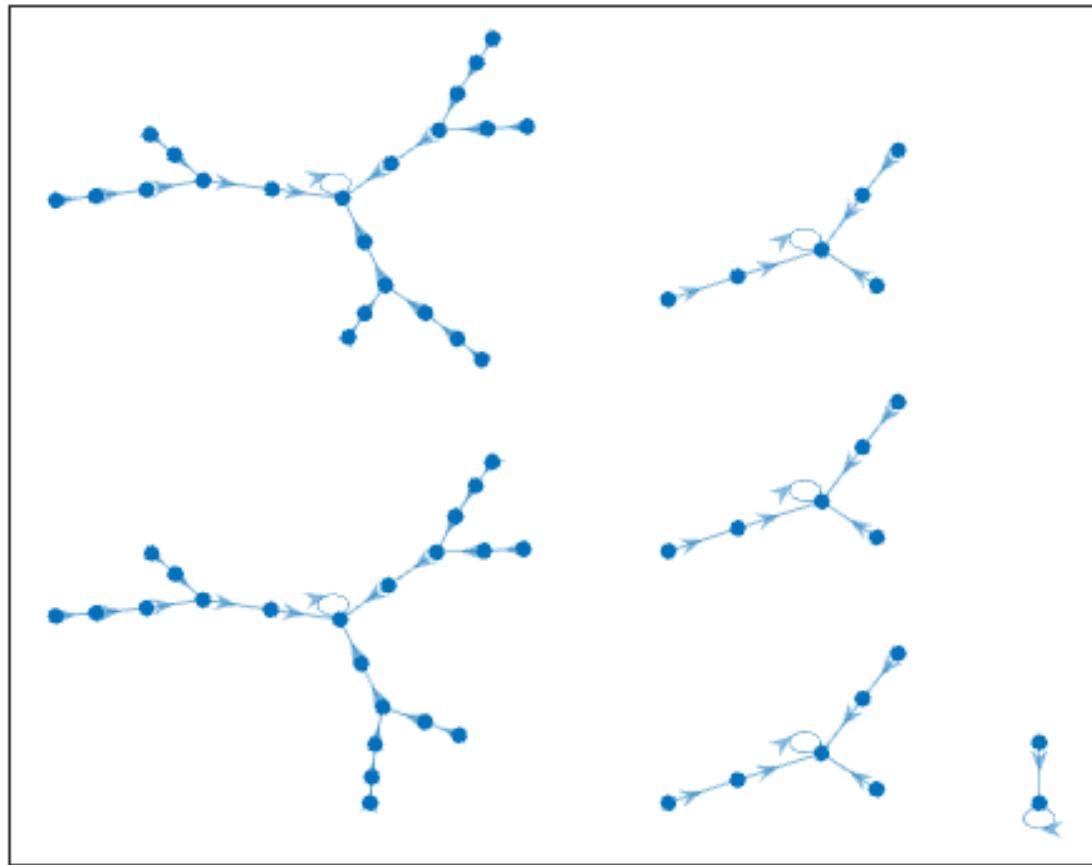


Figura 3.745: Atractor regla 78 n=6

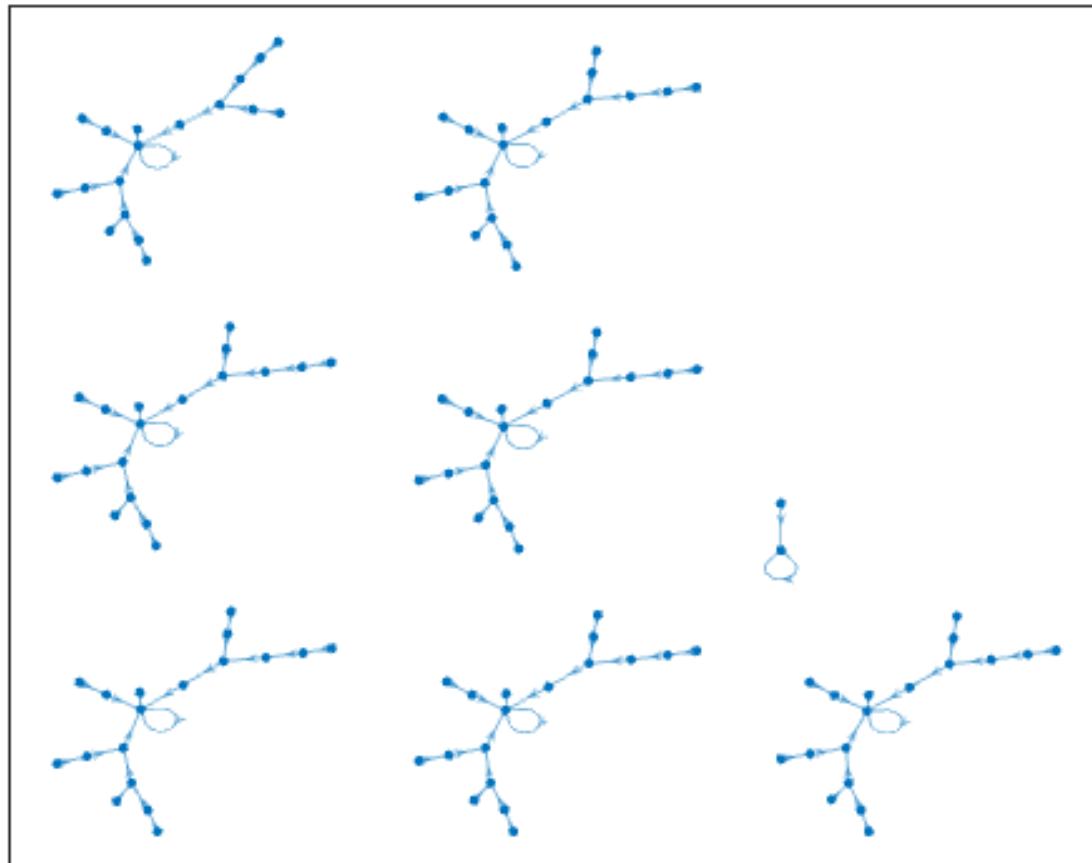


Figura 3.746: Atractor regla 78 n=7

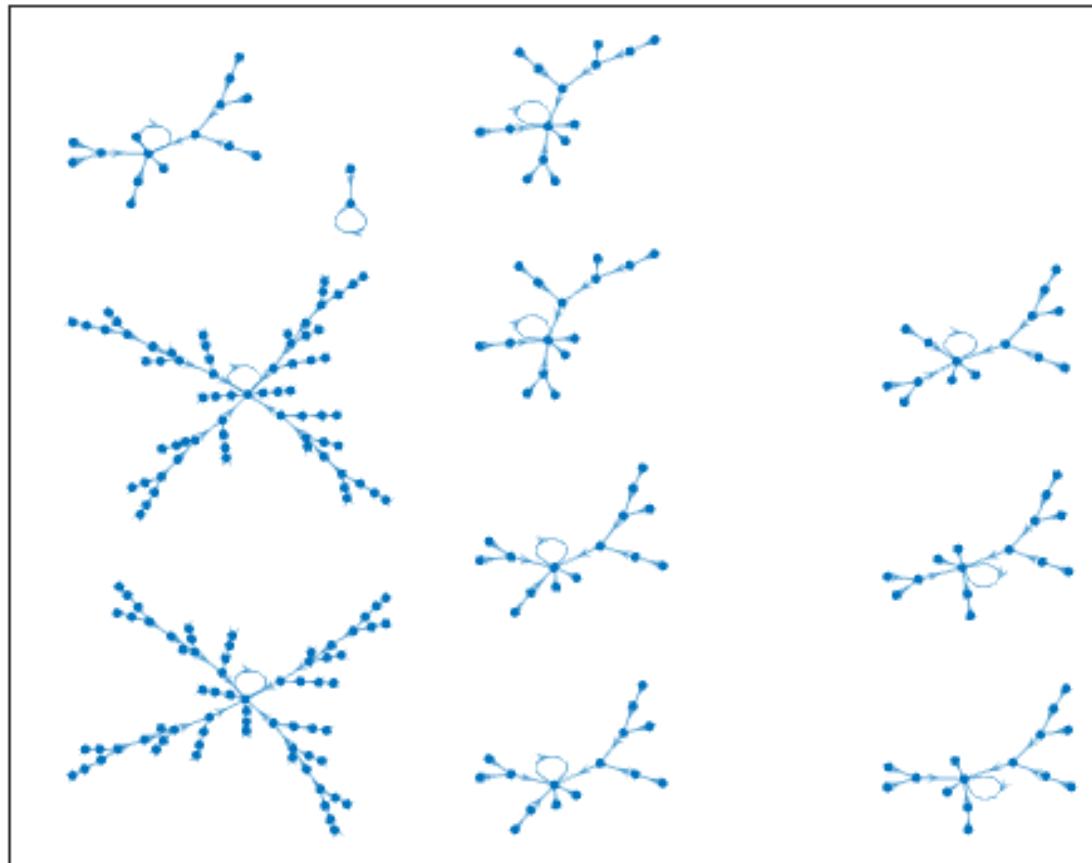


Figura 3.747: Atractor regla 78 n=8

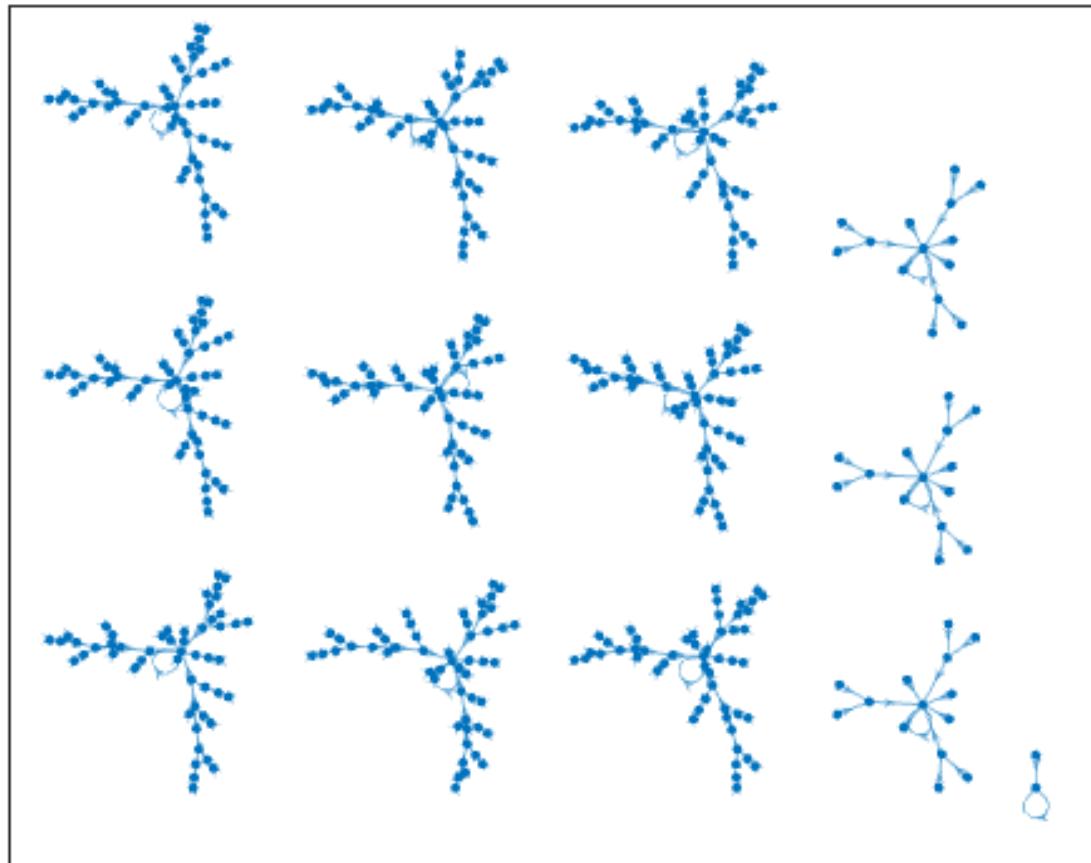


Figura 3.748: Atractor regla 78 n=9

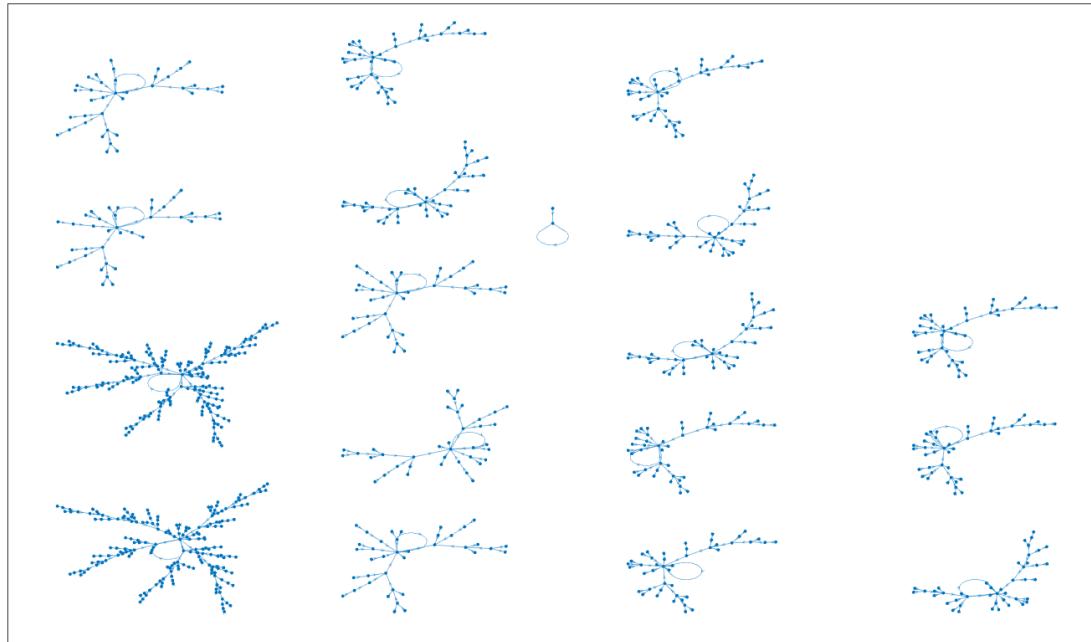


Figura 3.749: Atractor regla 78 n=10

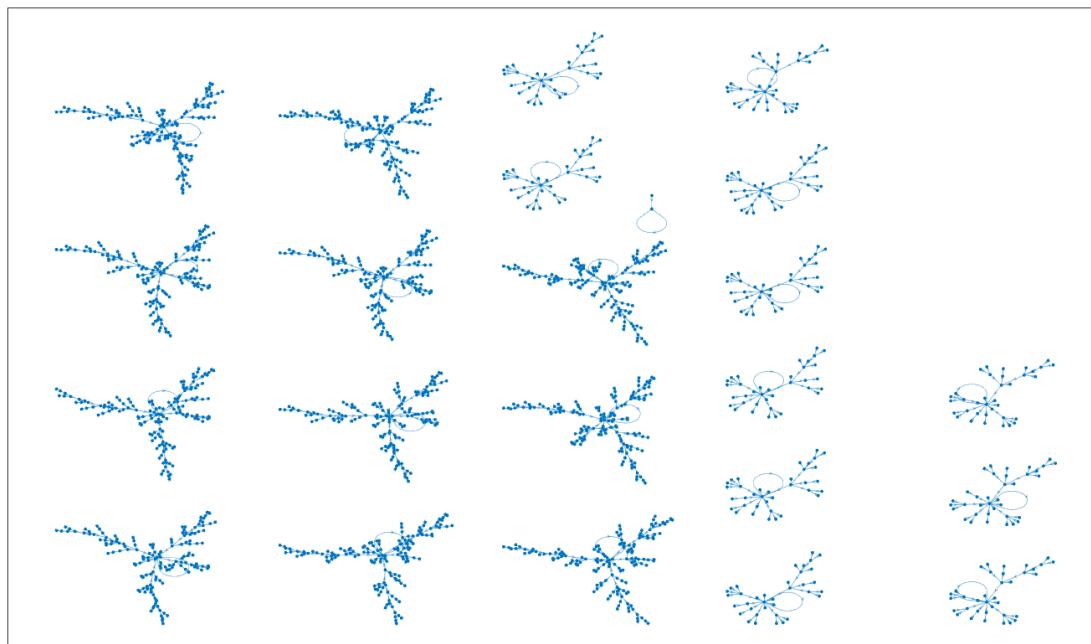


Figura 3.750: Atractor regla 78 n=11

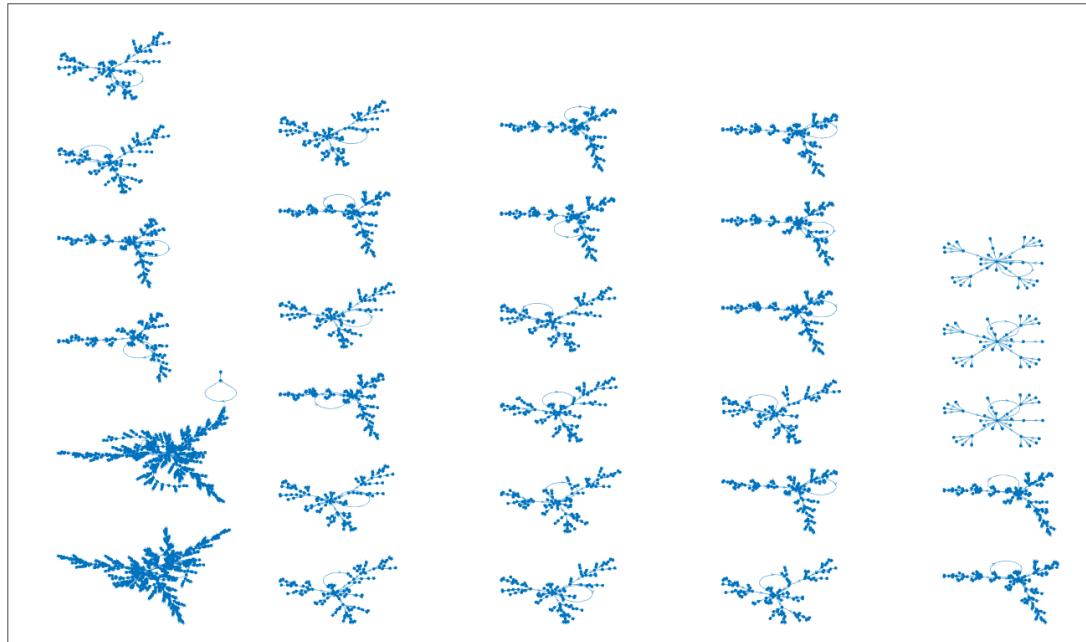


Figura 3.751: Atractor regla 78 n=12

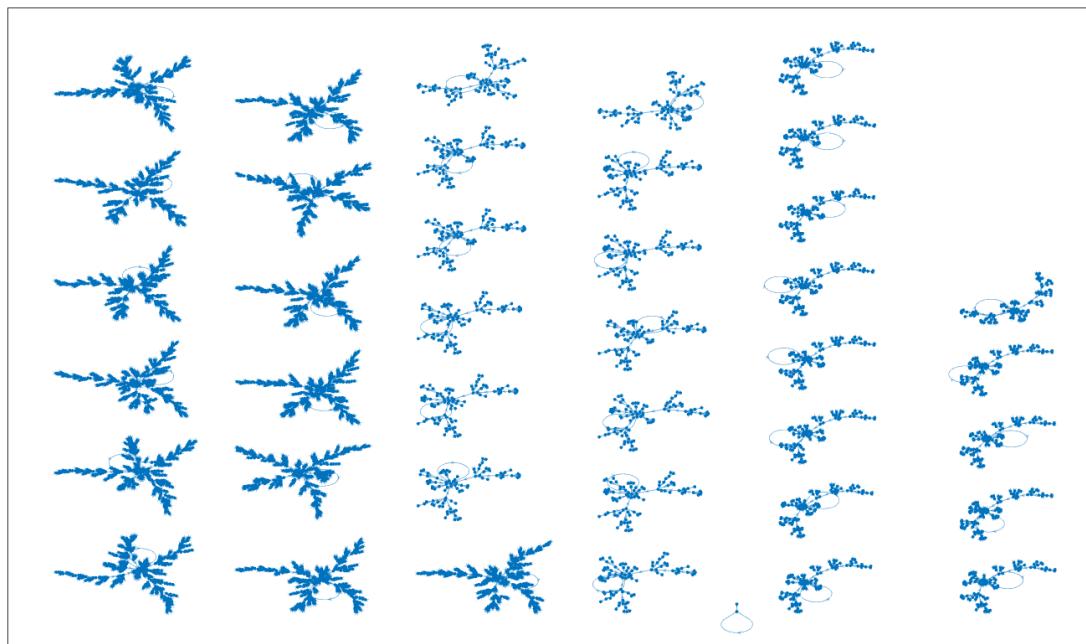
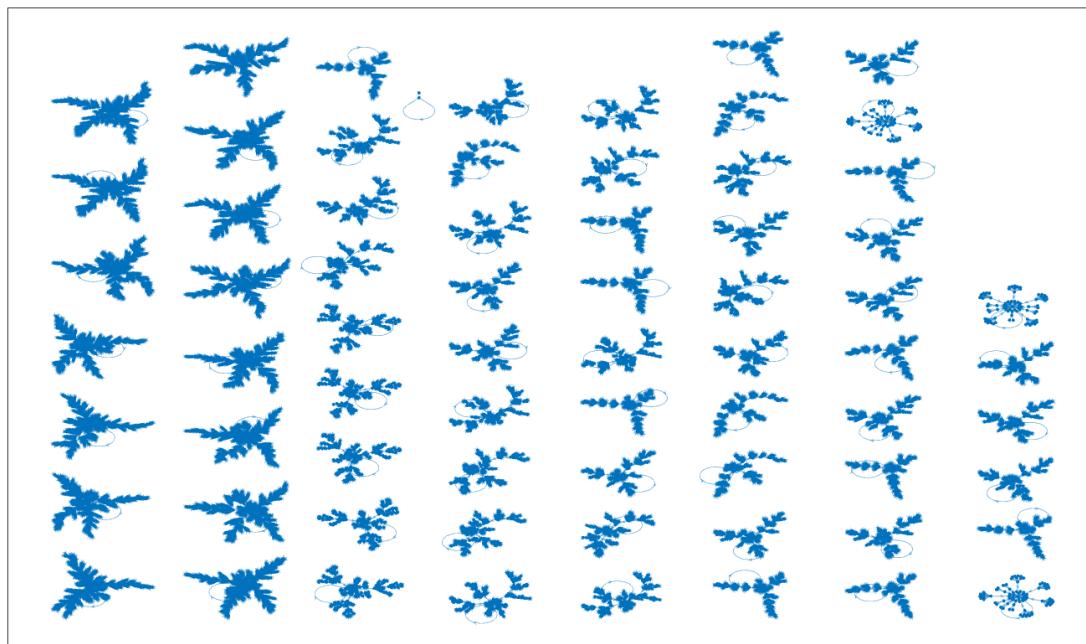


Figura 3.752: Atractor regla 78 n=13

Figura 3.753: Atractor regla 78 $n=14$ Figura 3.754: Atractor regla 78 $n=15$

3.56. Reglas 90,165

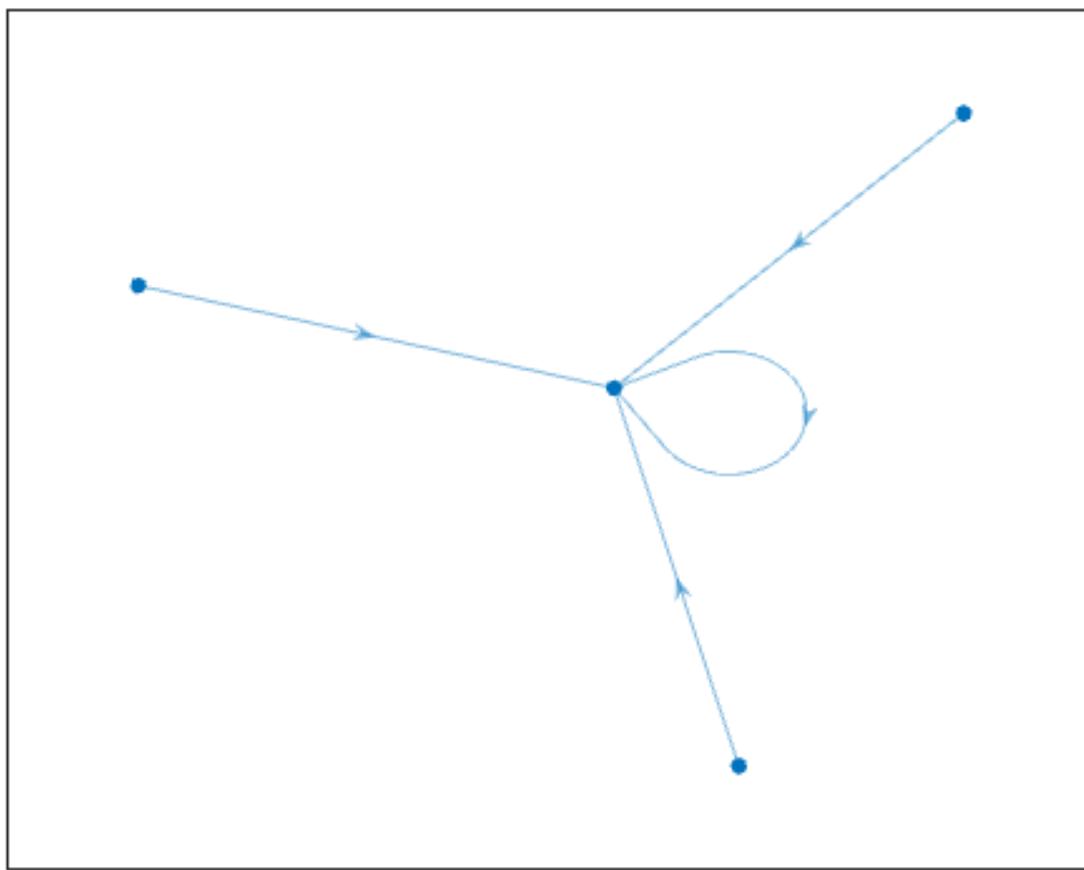


Figura 3.755: Atractor regla 90 $n=2$

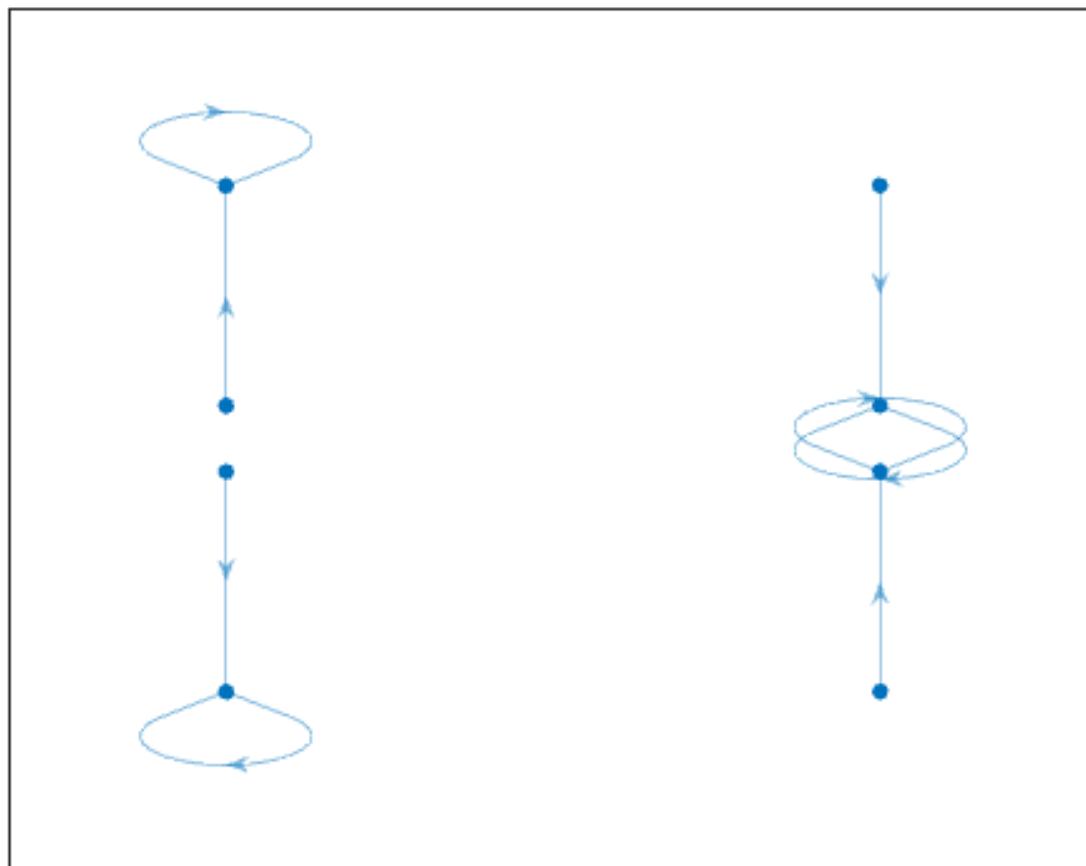


Figura 3.756: Atractor regla 90 n=3

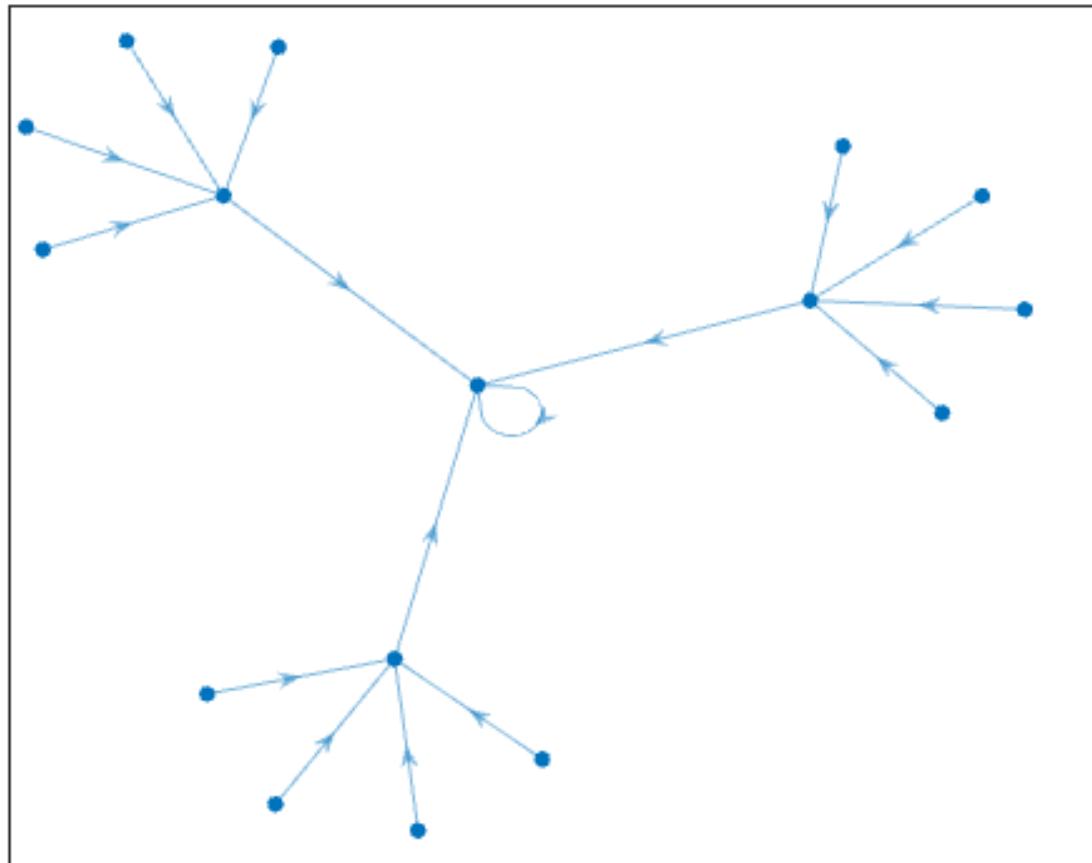


Figura 3.757: Atractor regla 90 n=4

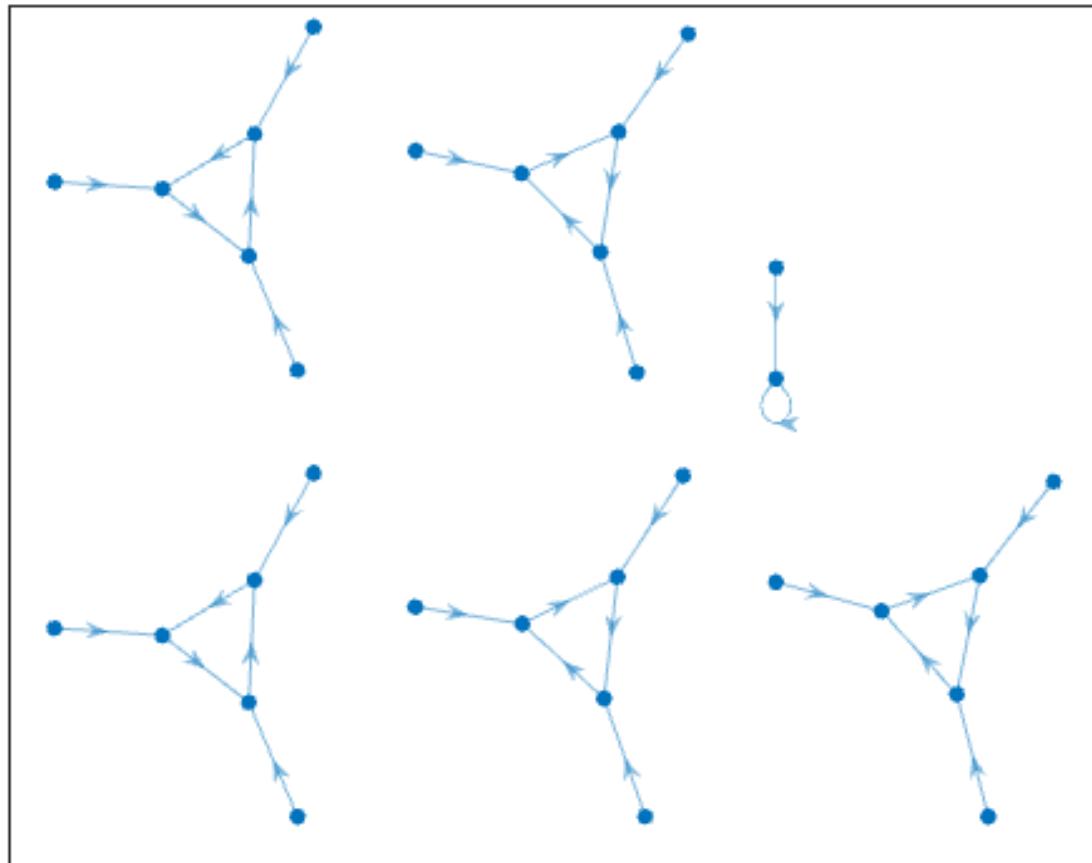


Figura 3.758: Atractor regla 90 n=5

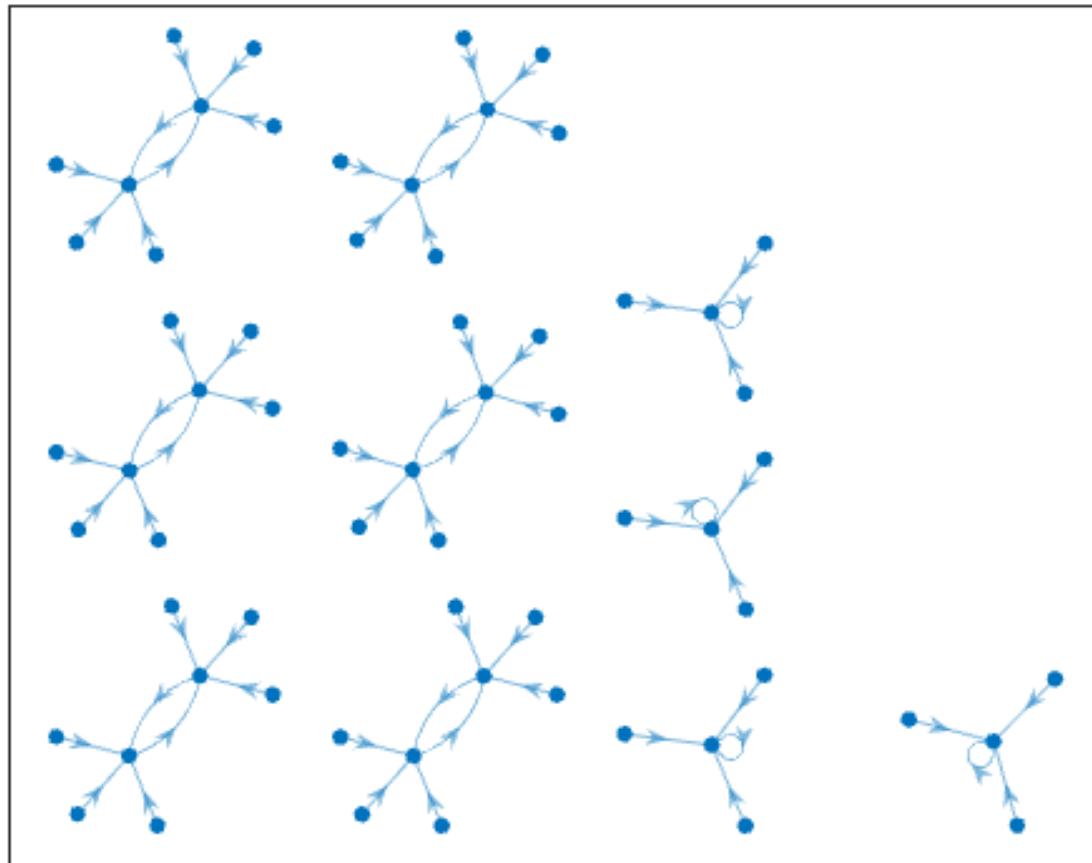


Figura 3.759: Atractor regla 90 n=6

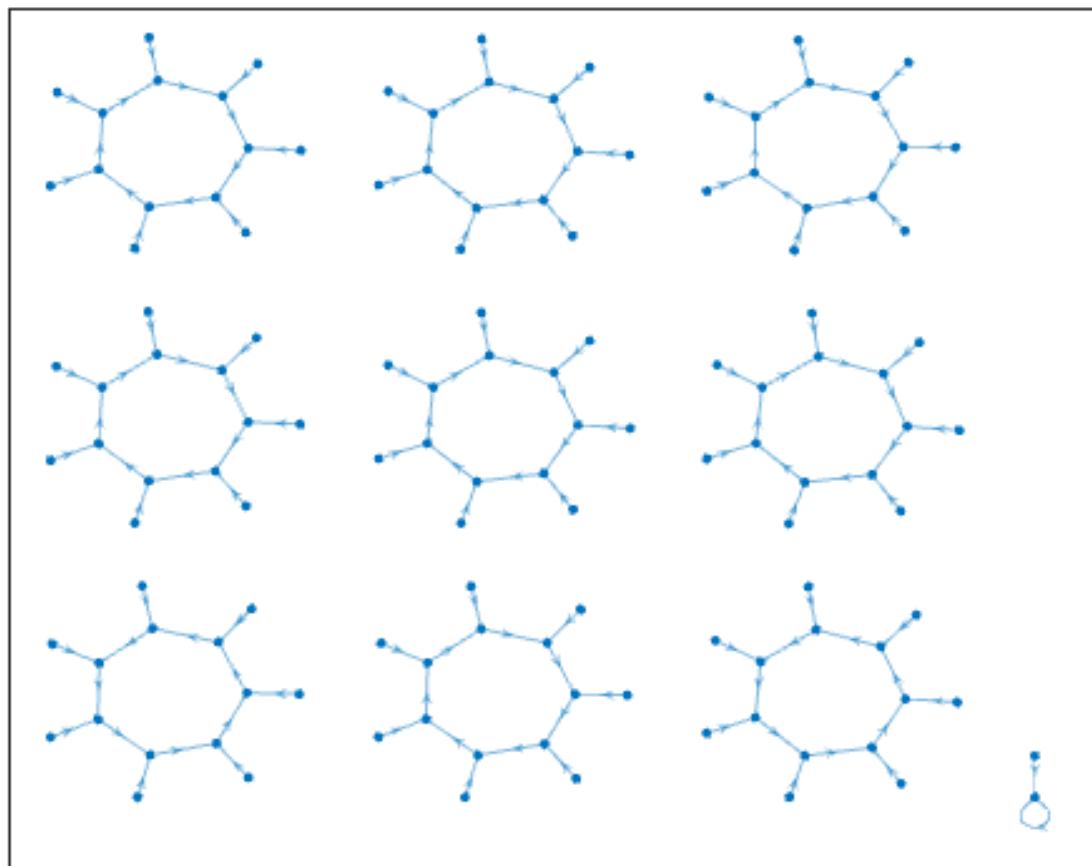


Figura 3.760: Atractor regla 90 n=7

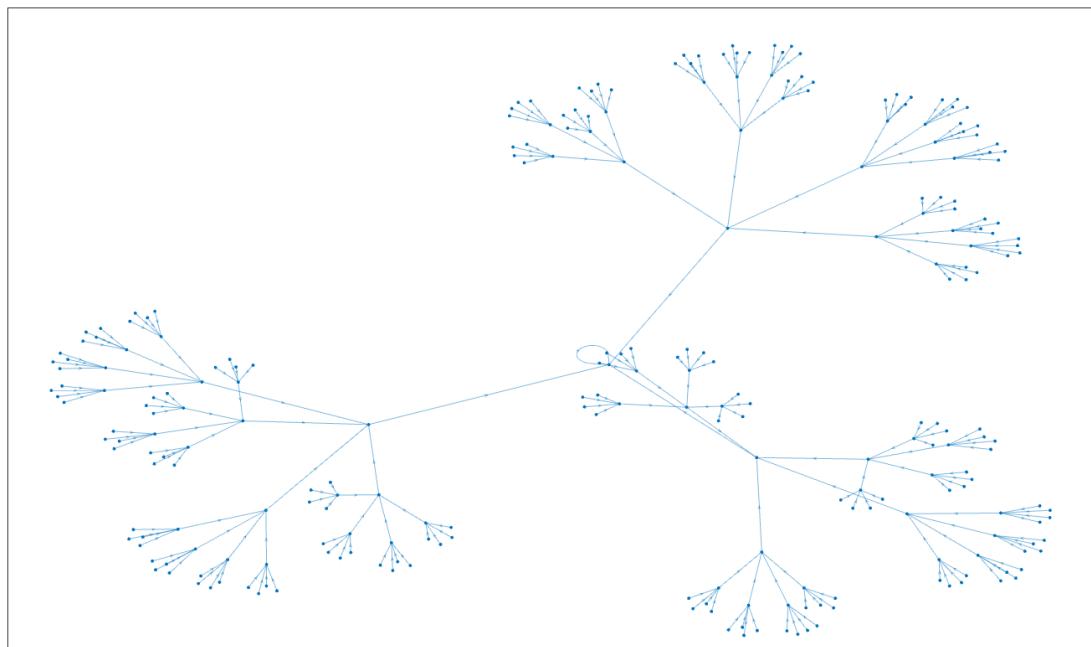


Figura 3.761: Atractor regla 90 $n=8$

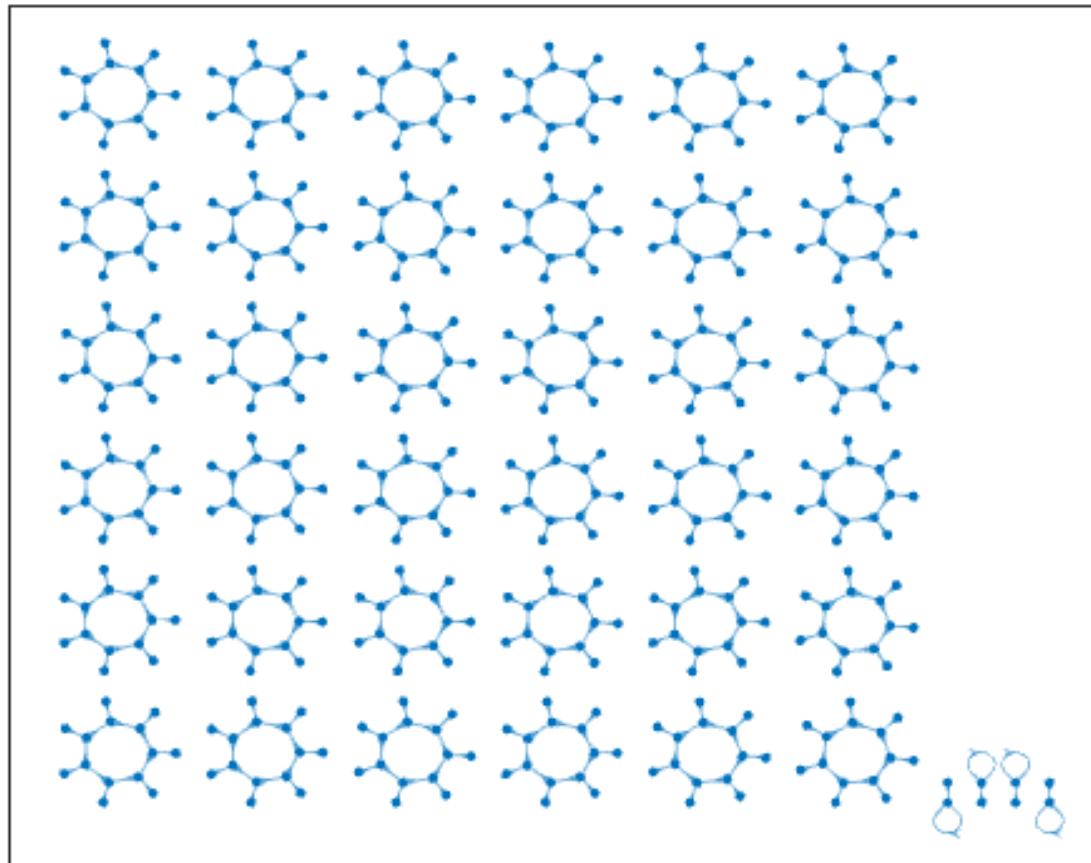
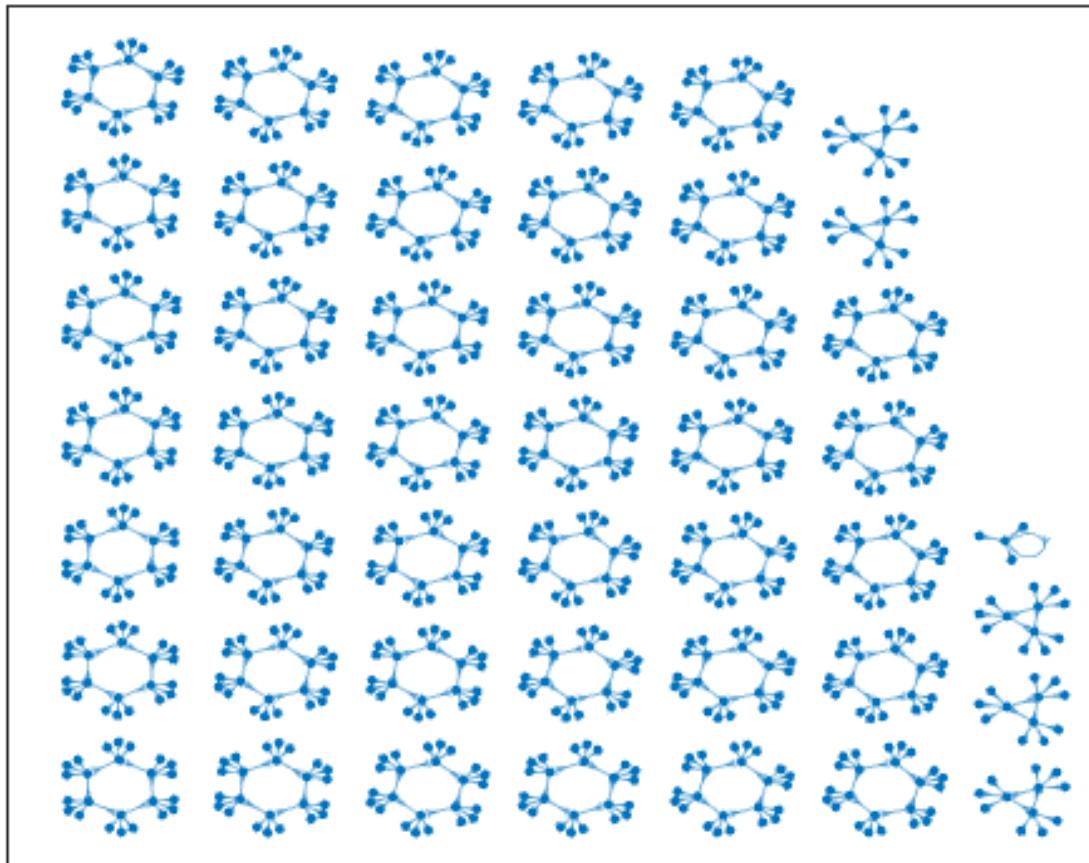


Figura 3.762: Atractor regla 90 n=9

Figura 3.763: Atractor regla 90 $n=10$

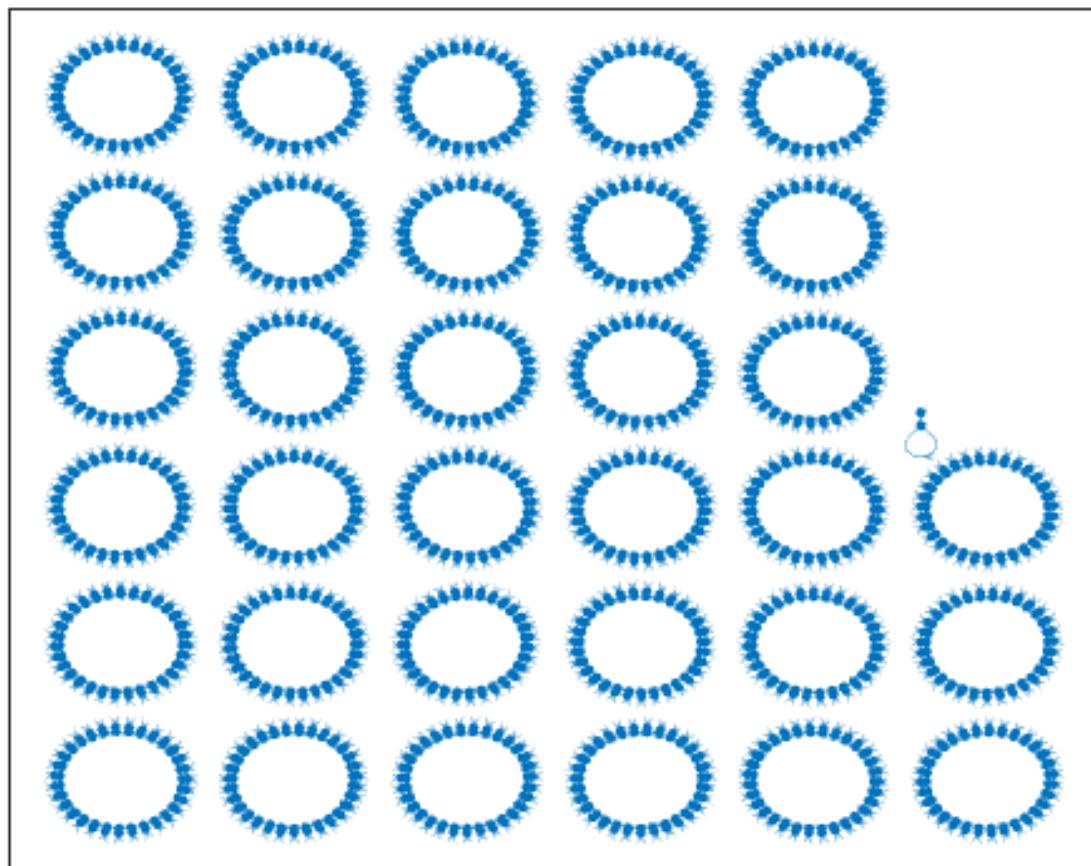


Figura 3.764: Atractor regla 90 n=11

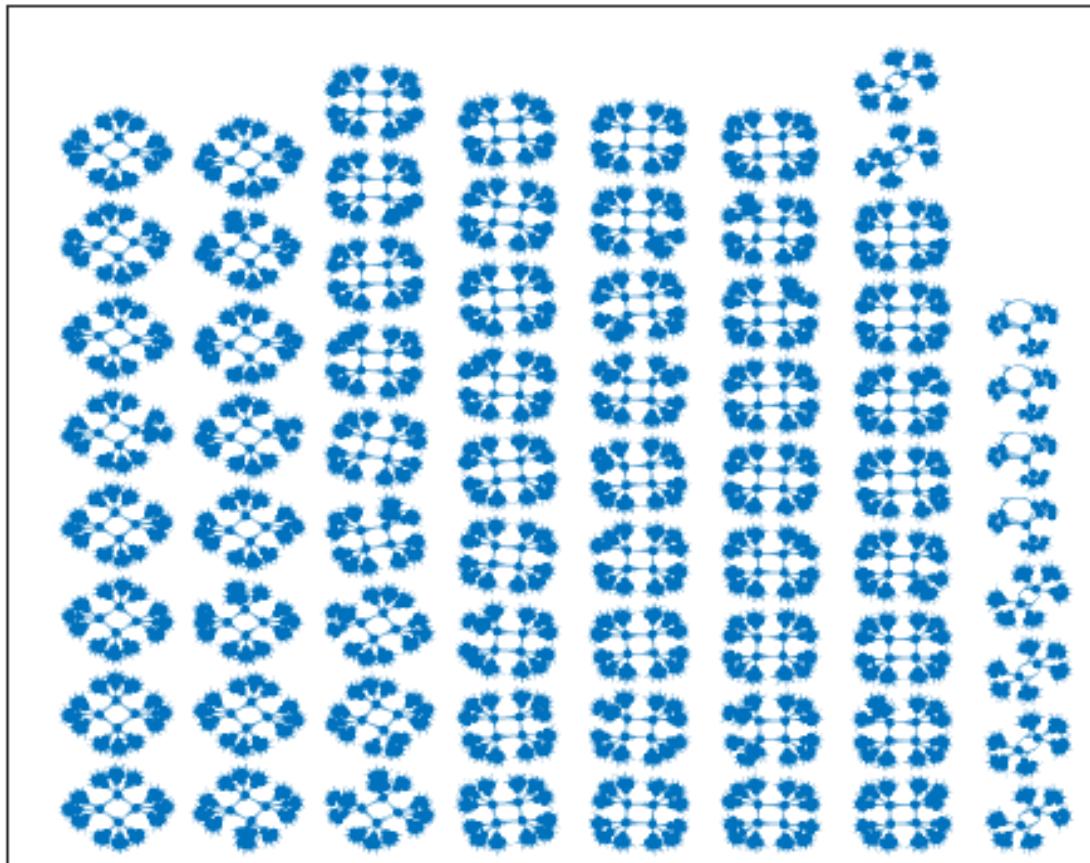


Figura 3.765: Atractor regla 90 n=12

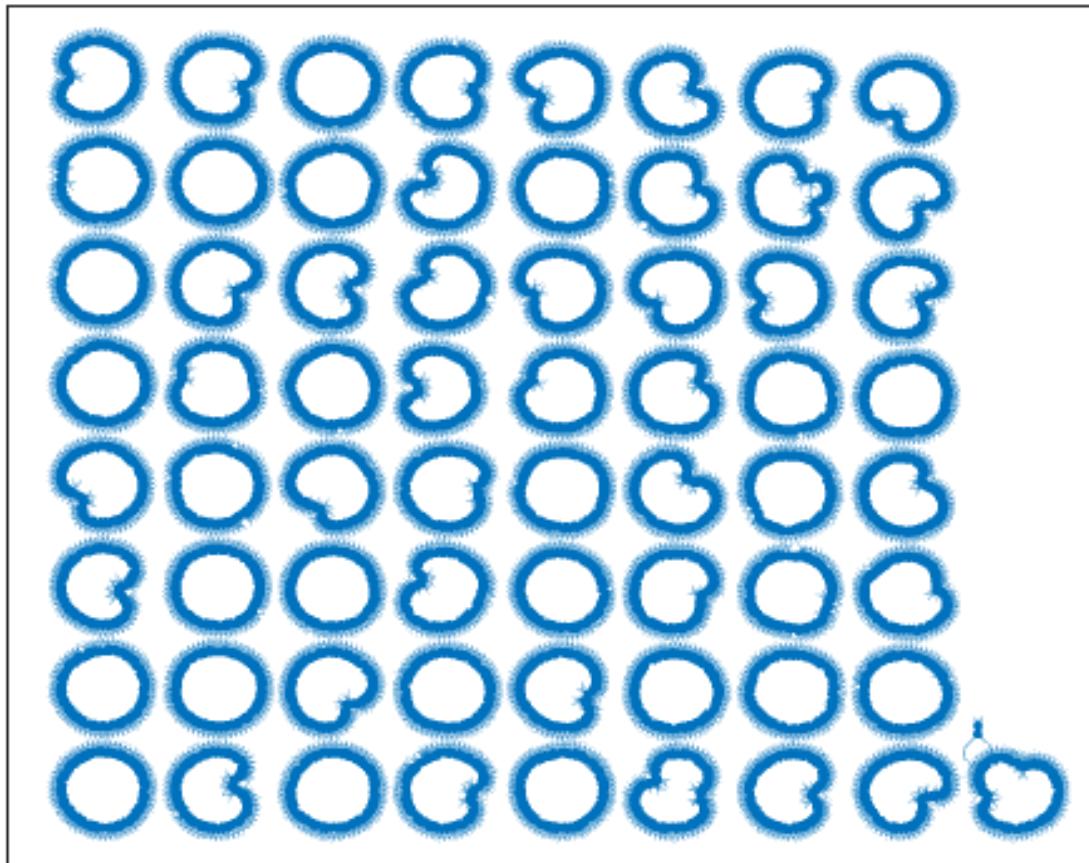


Figura 3.766: Atractor regla 90 n=13

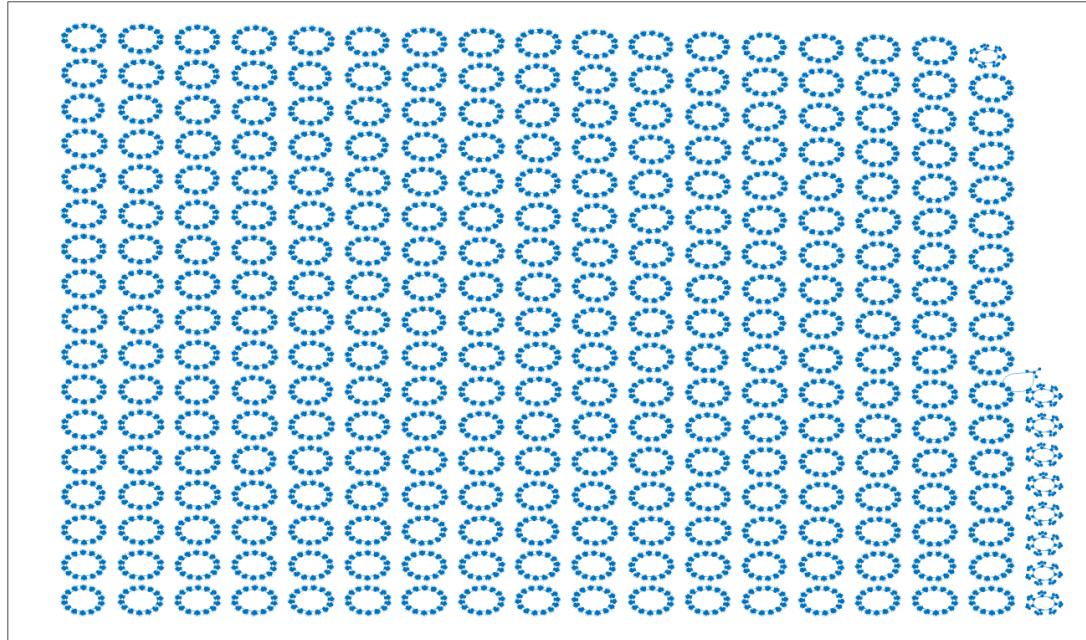


Figura 3.767: Atractor regla 90 n=14

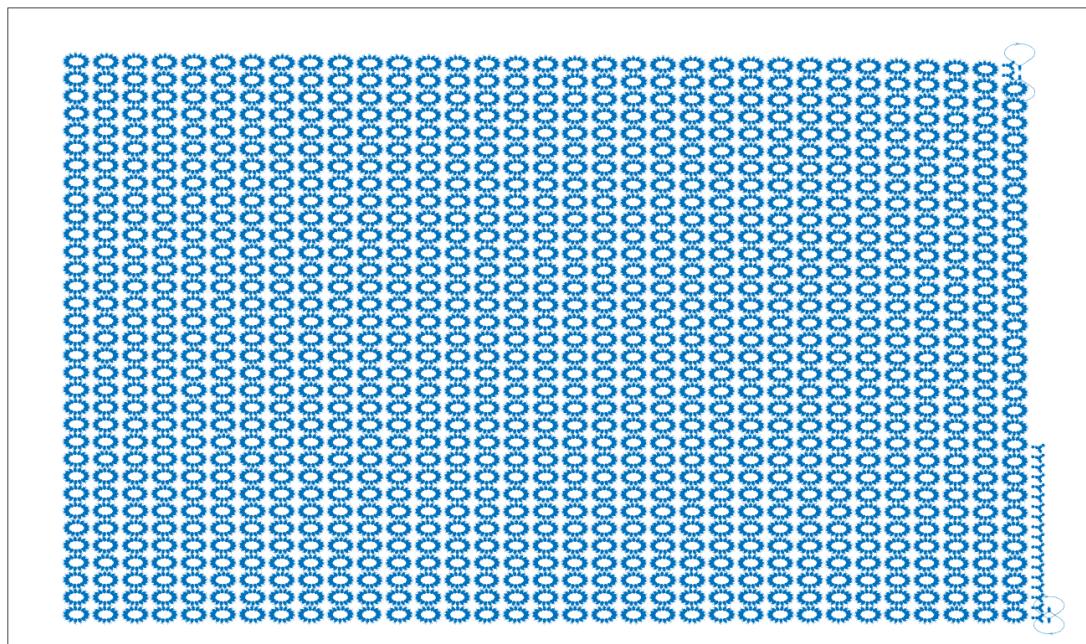


Figura 3.768: Atractor regla 90 n=15

3.57. Reglas 94,133

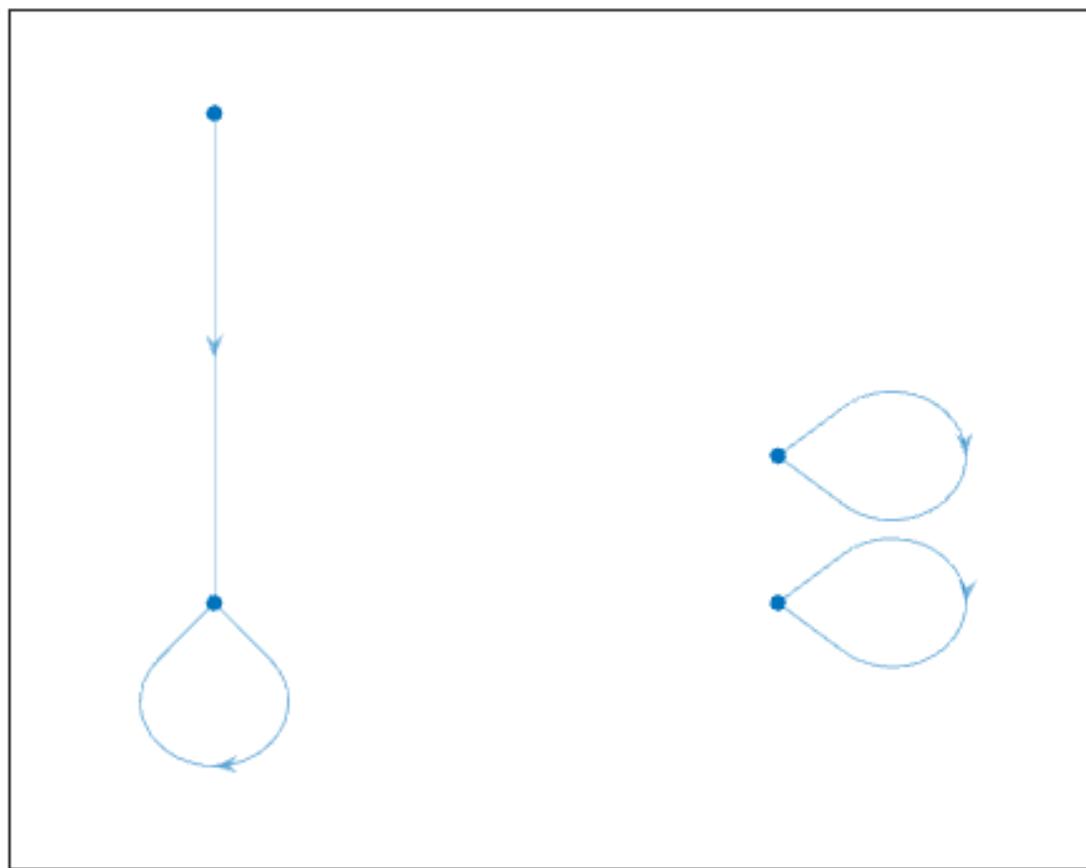
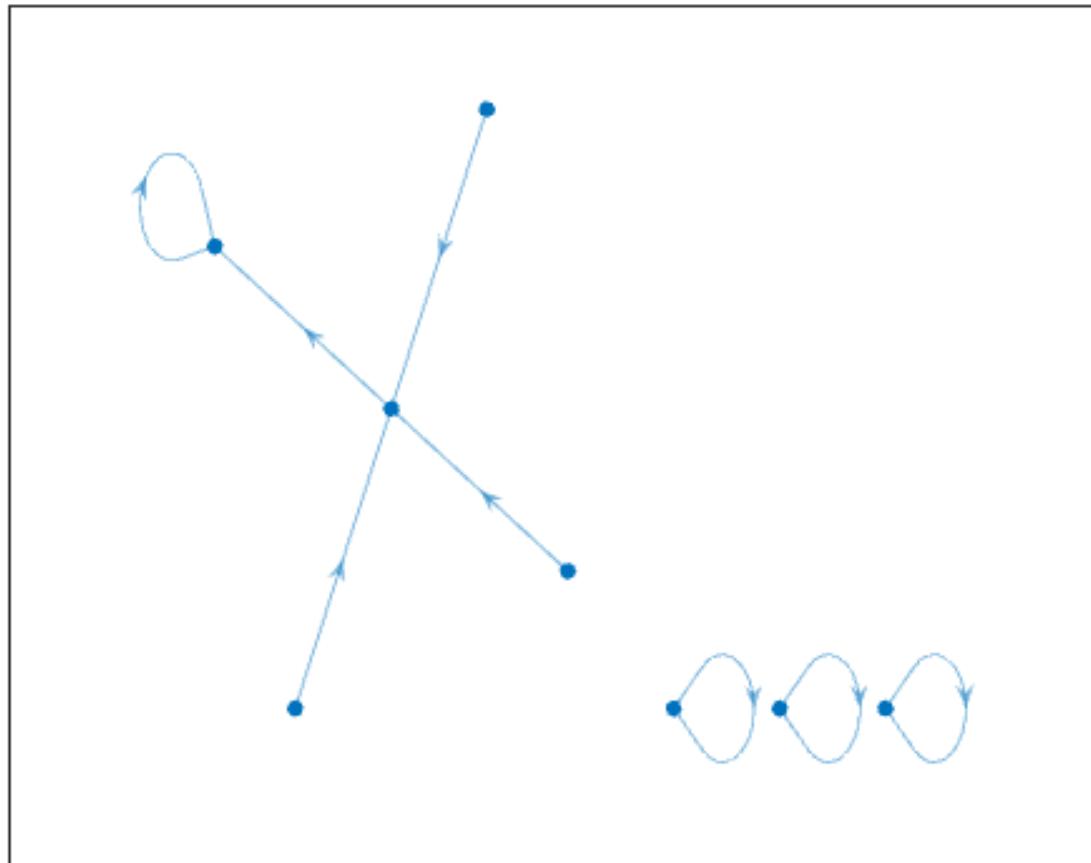
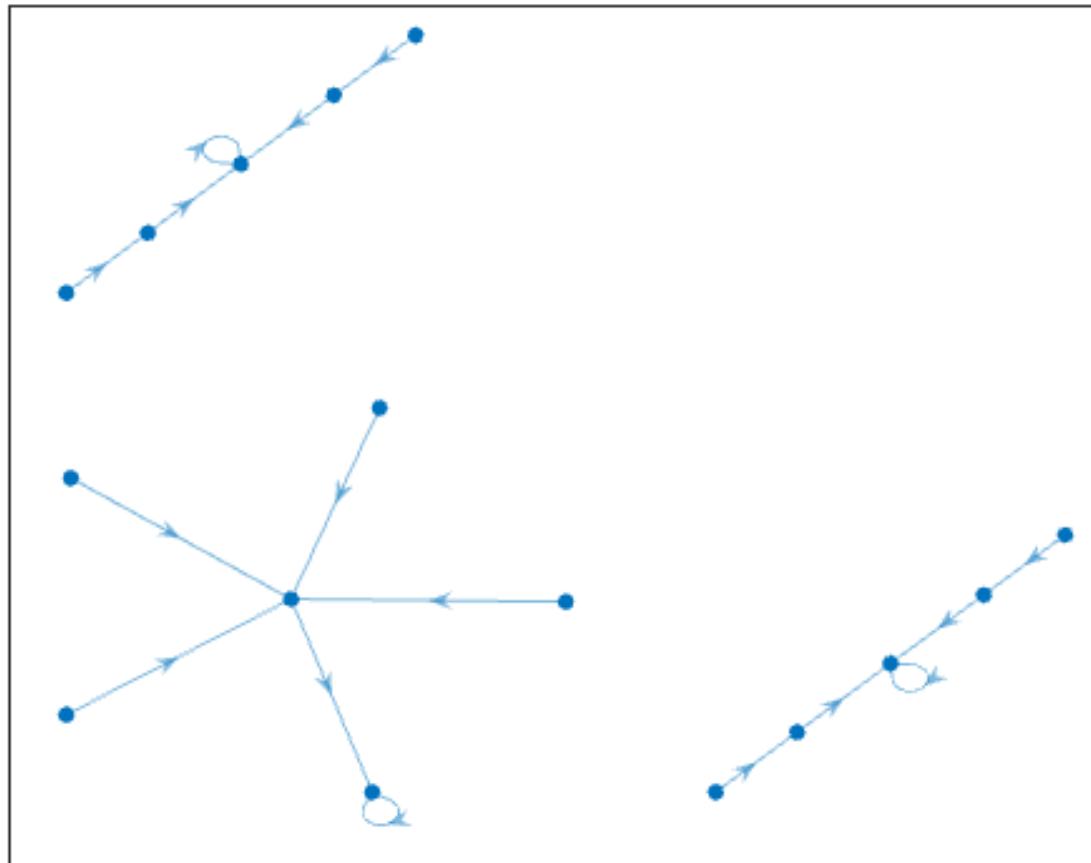


Figura 3.769: Atractor regla 94 n=2

Figura 3.770: Atractor regla 94 $n=3$

Figura 3.771: Atractor regla 94 $n=4$

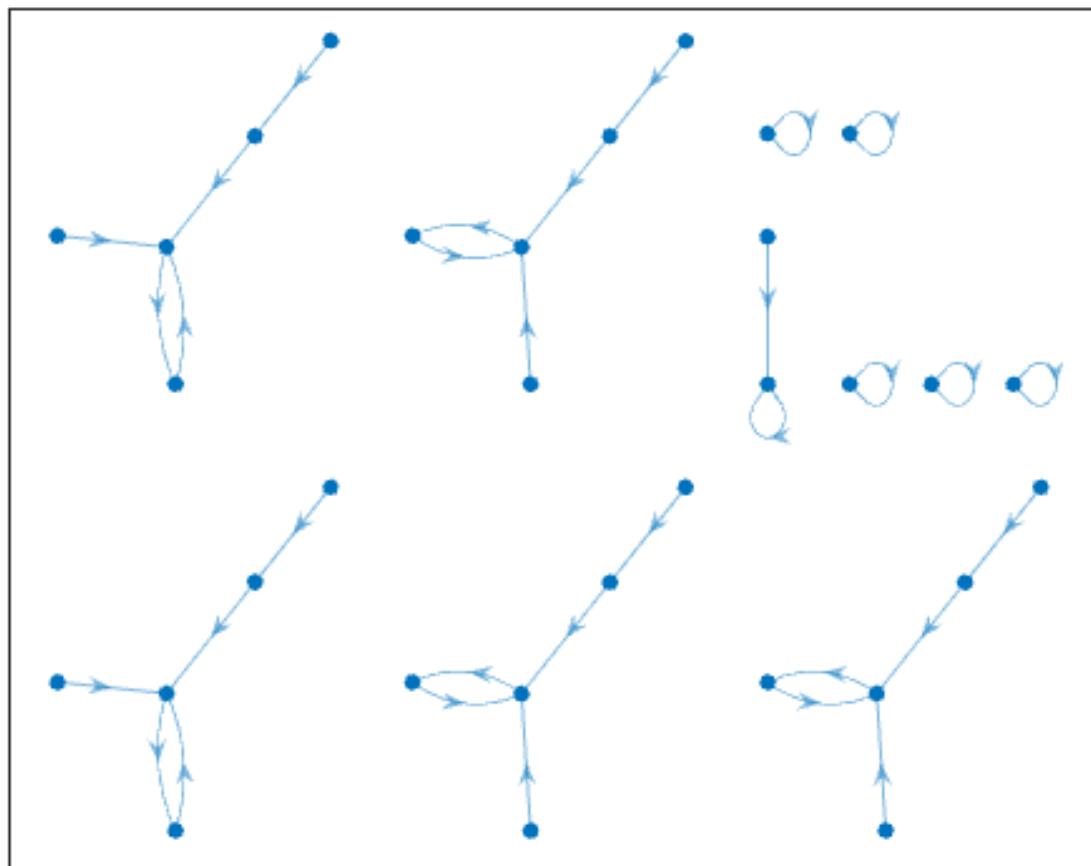


Figura 3.772: Atractor regla 94 n=5

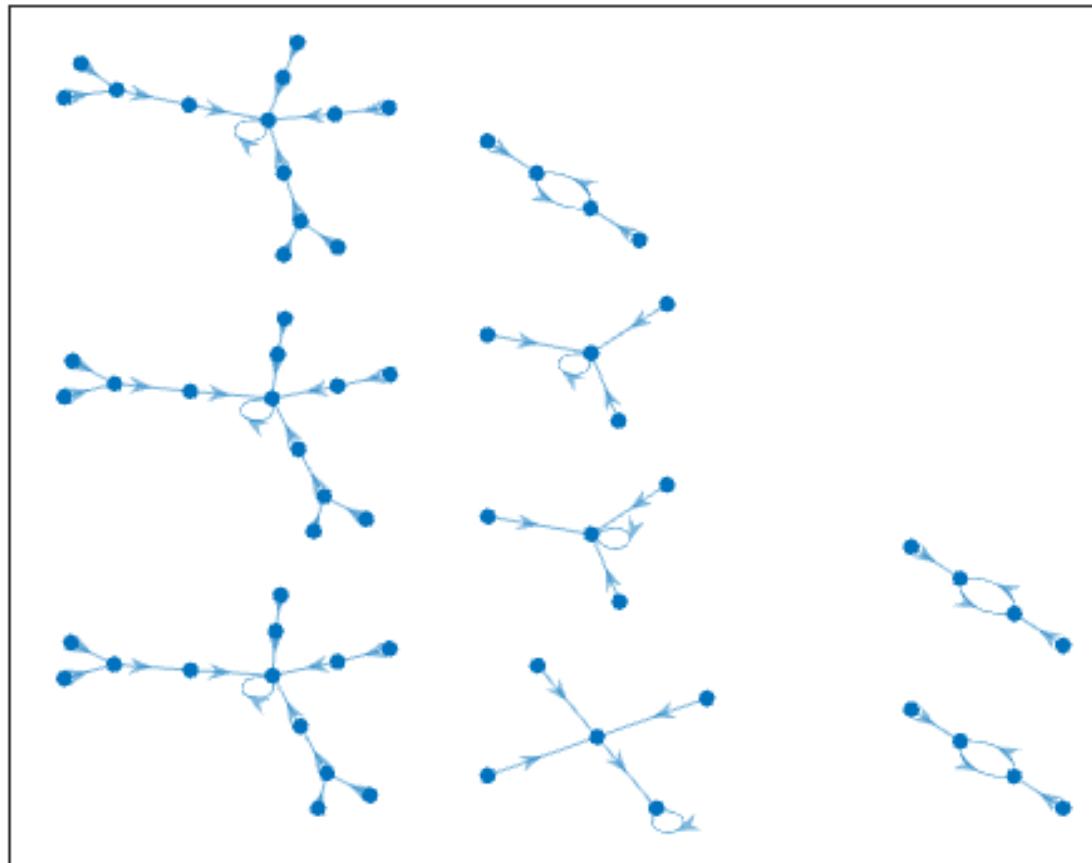


Figura 3.773: Atractor regla 94 n=6

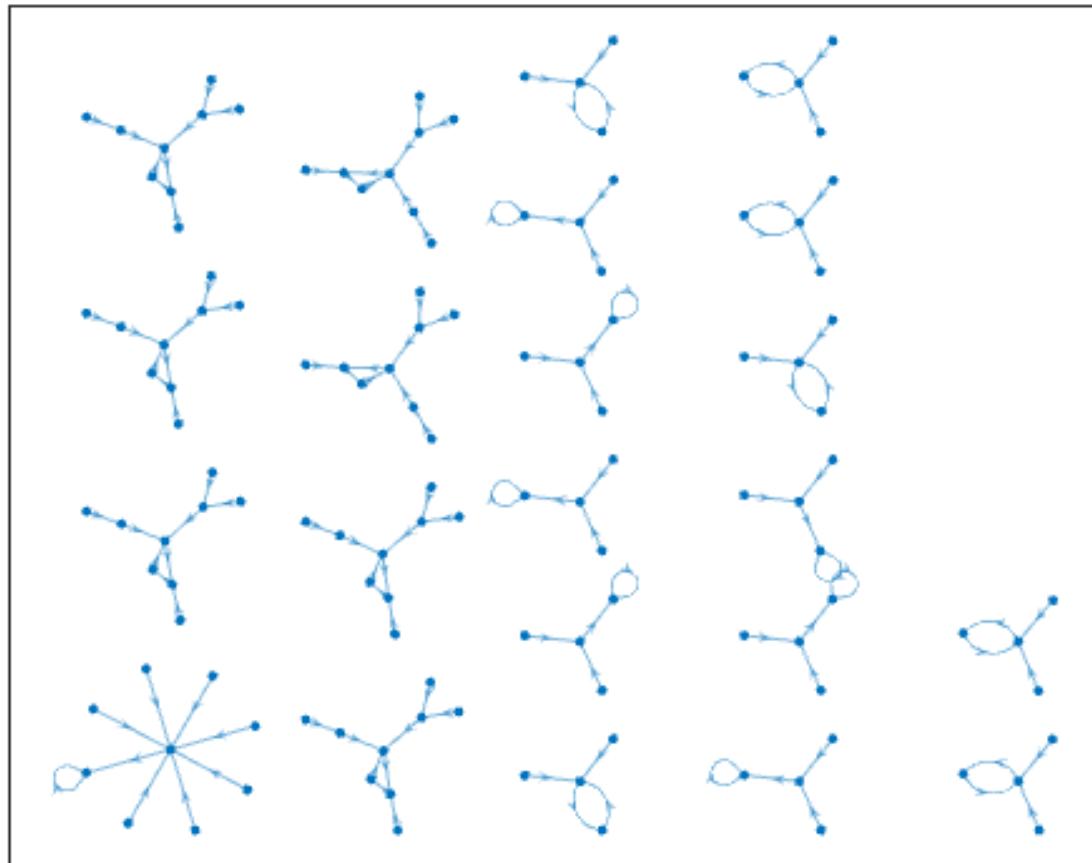


Figura 3.774: Atractor regla 94 n=7

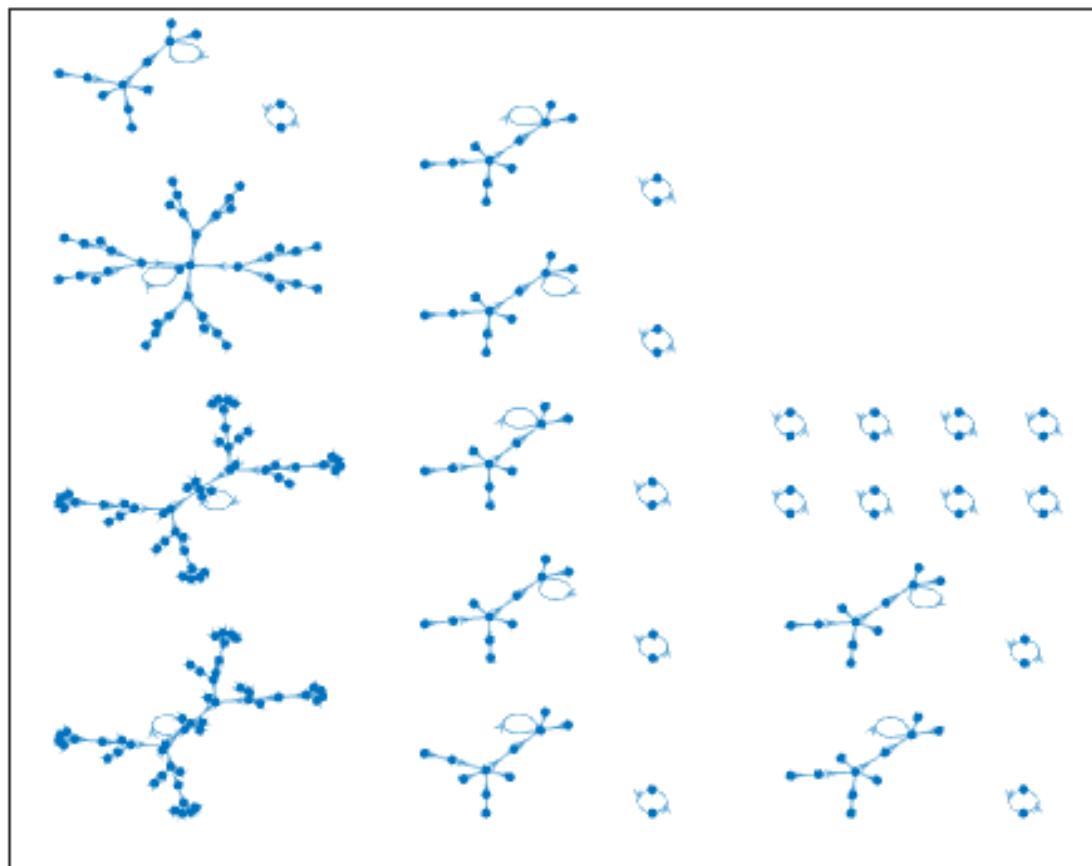


Figura 3.775: Atractor regla 94 n=8

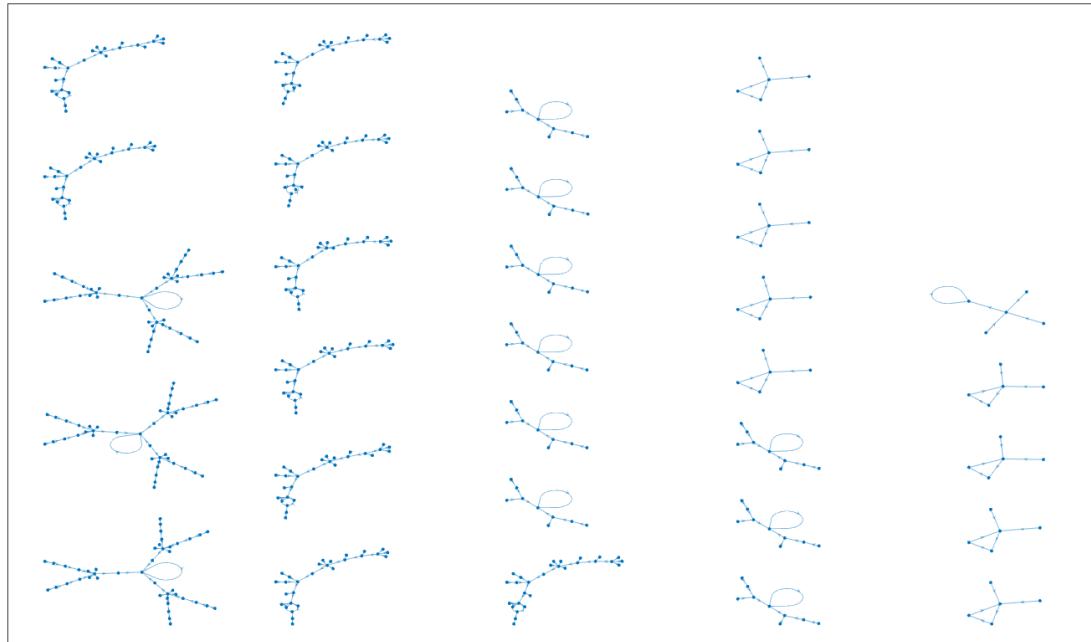


Figura 3.776: Atractor regla 94 n=9

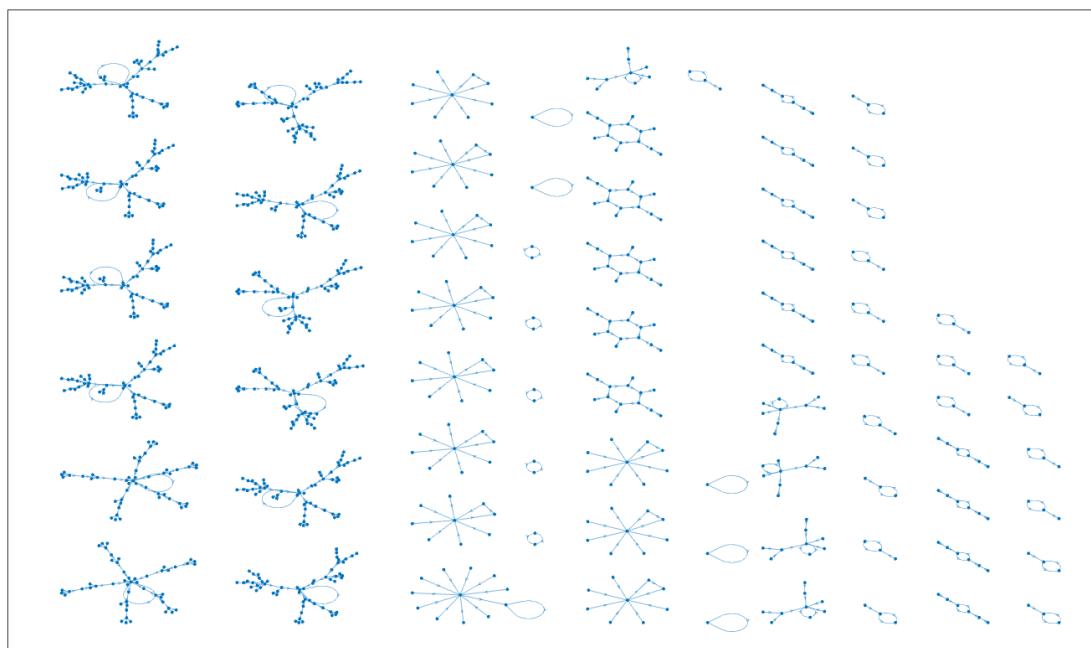


Figura 3.777: Atractor regla 94 n=10

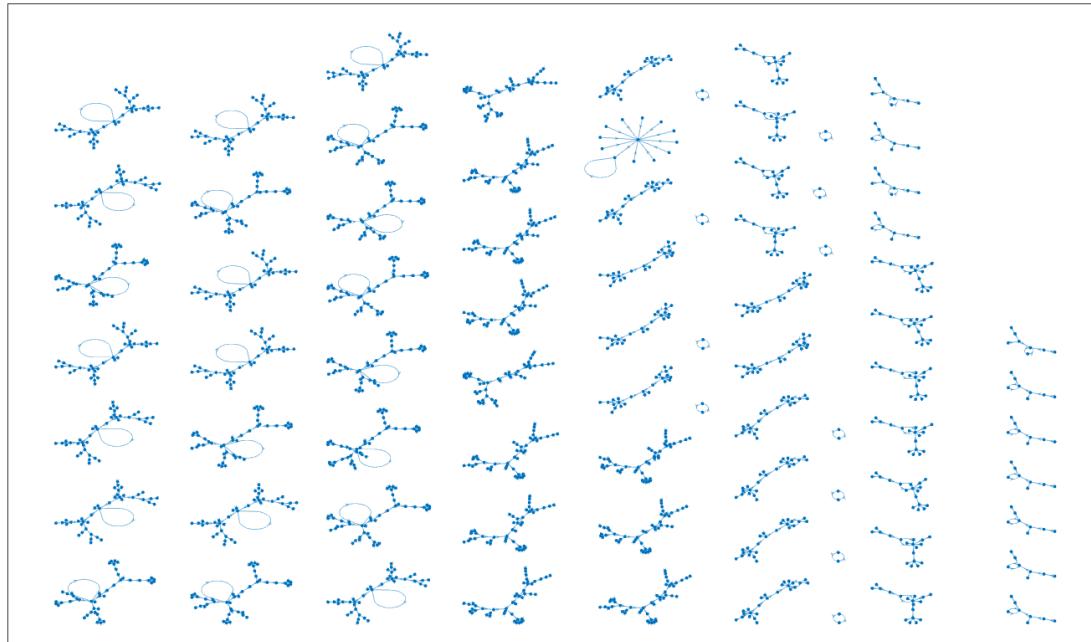


Figura 3.778: Atractor regla 94 n=11

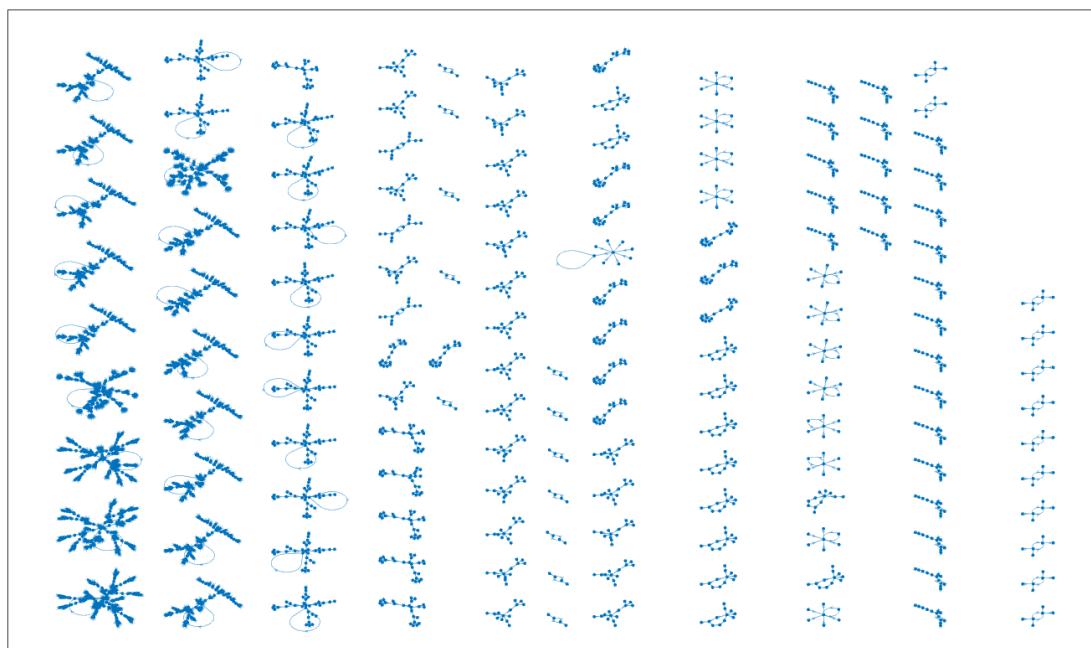


Figura 3.779: Atractor regla 94 n=12

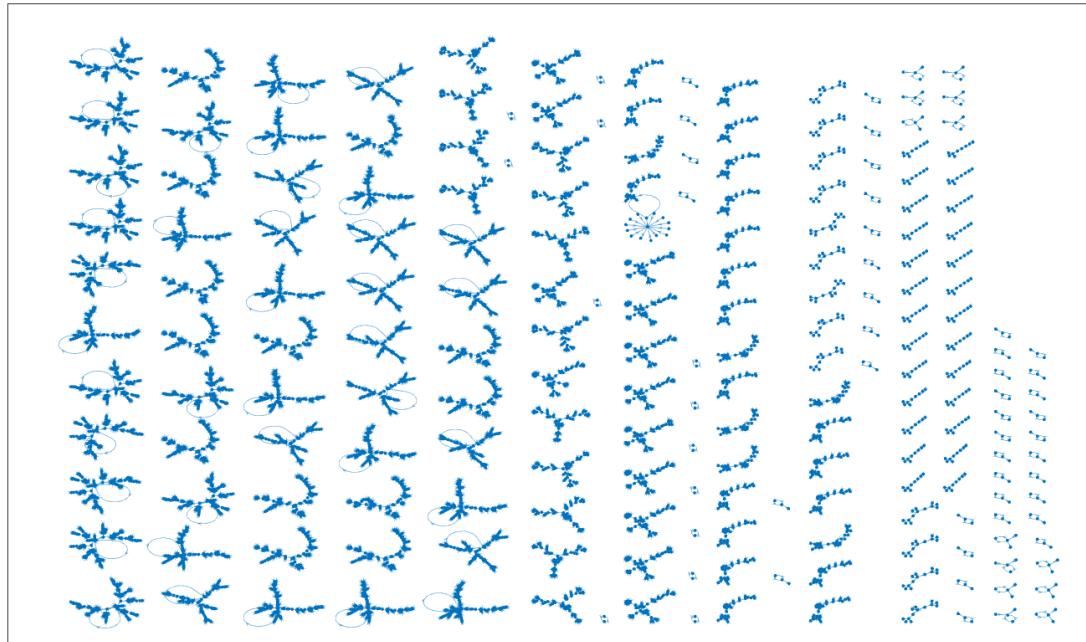


Figura 3.780: Atractor regla 94 n=13

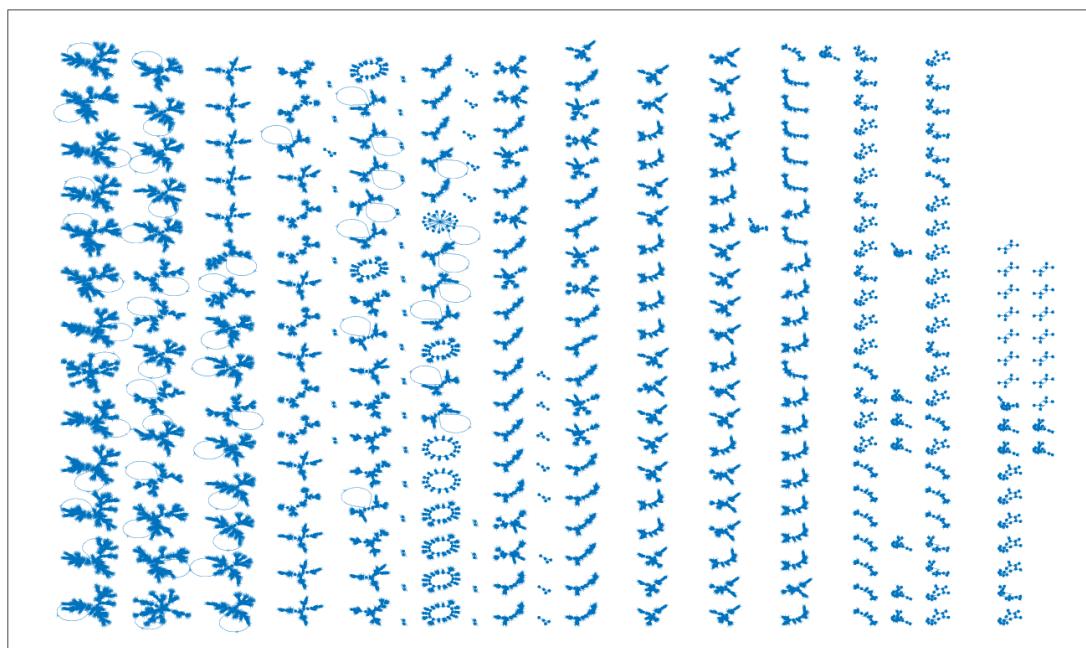
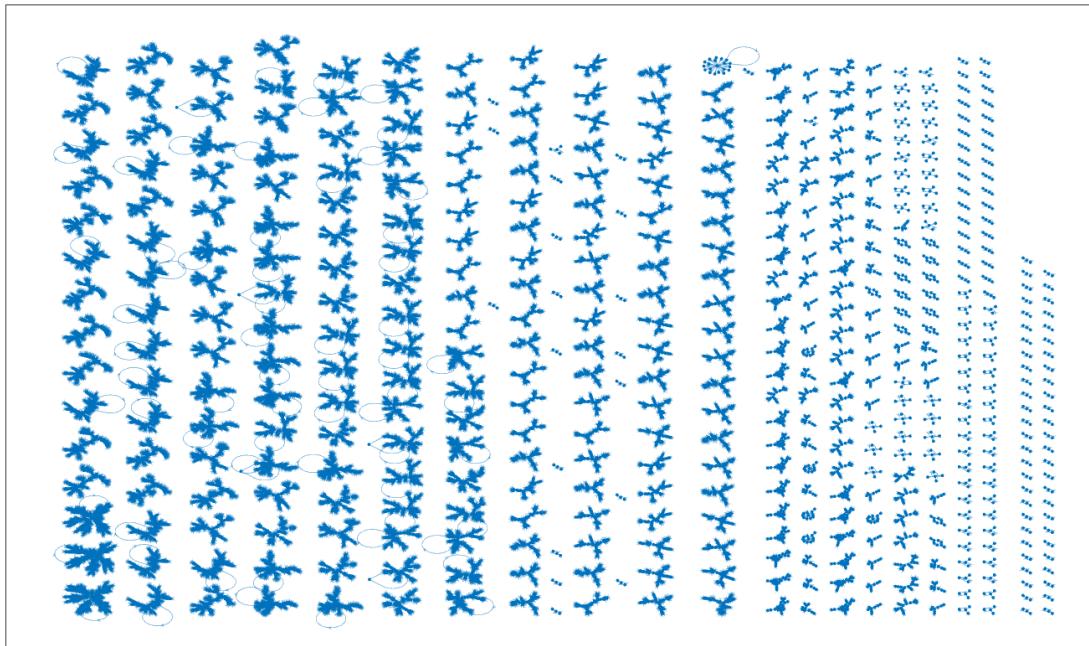


Figura 3.781: Atractor regla 94 n=14

Figura 3.782: Atractor regla 94 $n=15$

3.58. Reglas 104,233

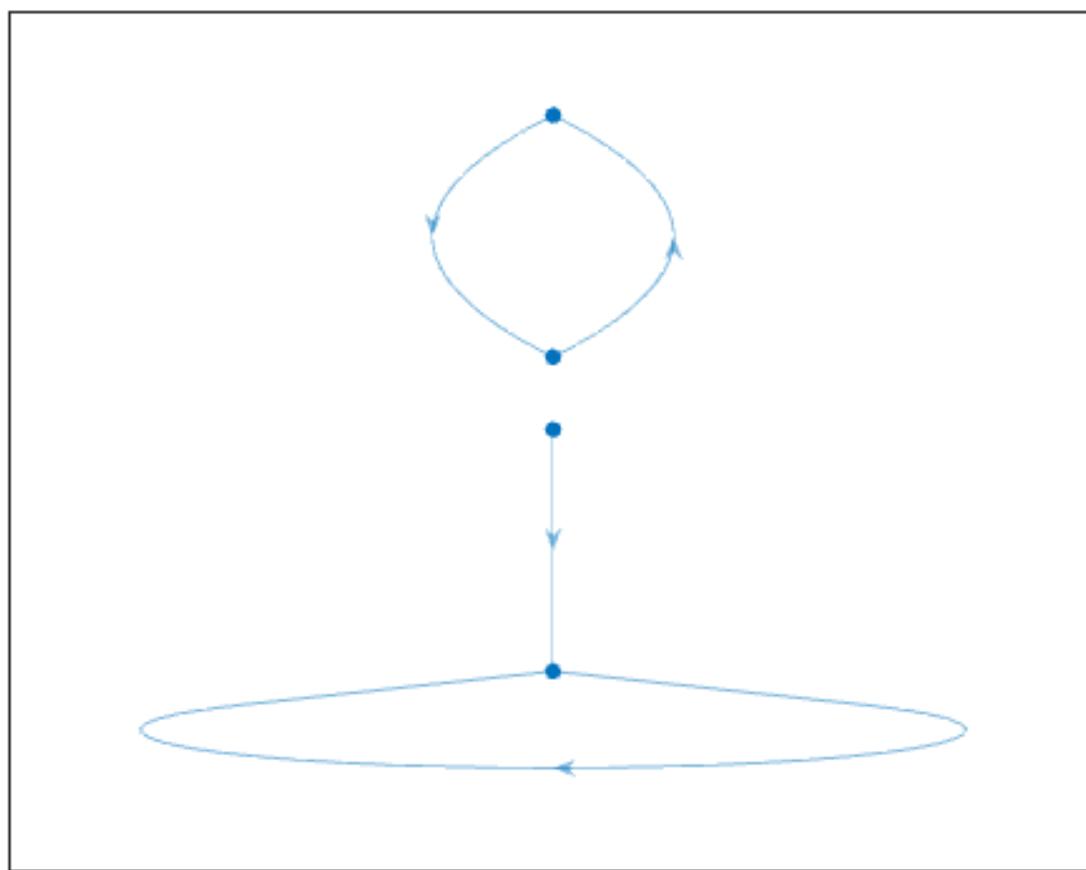
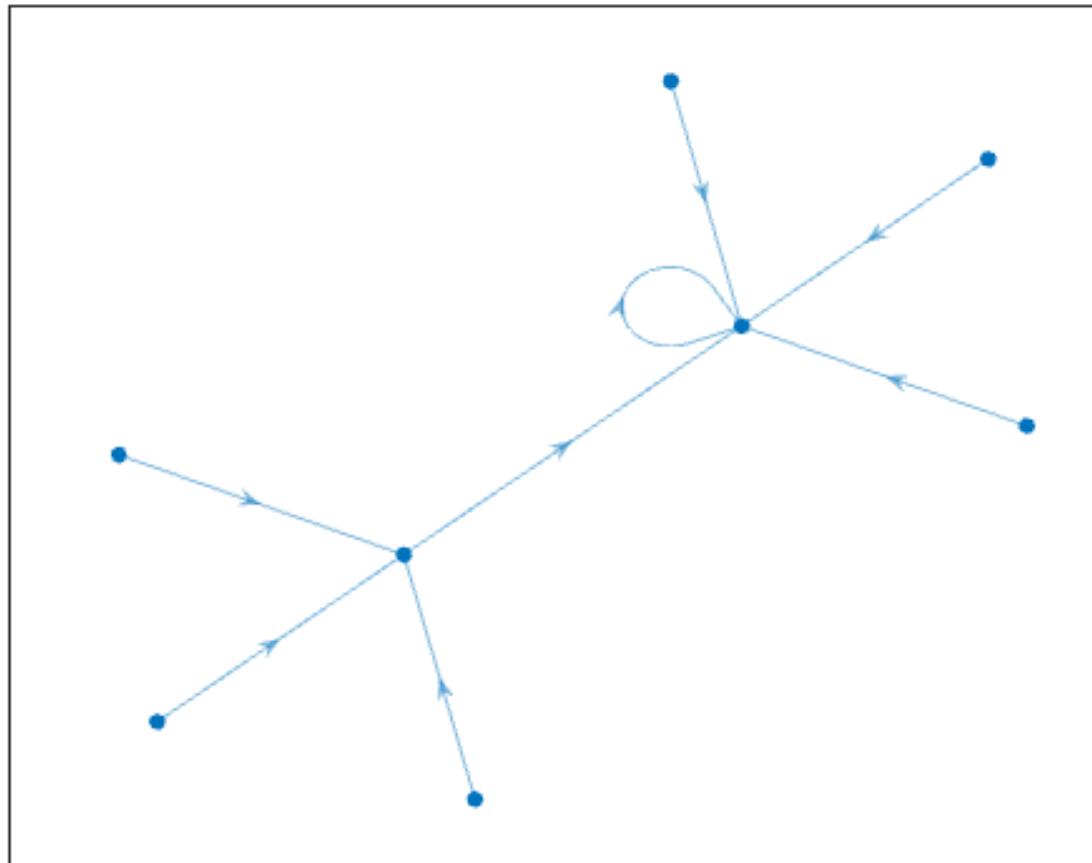
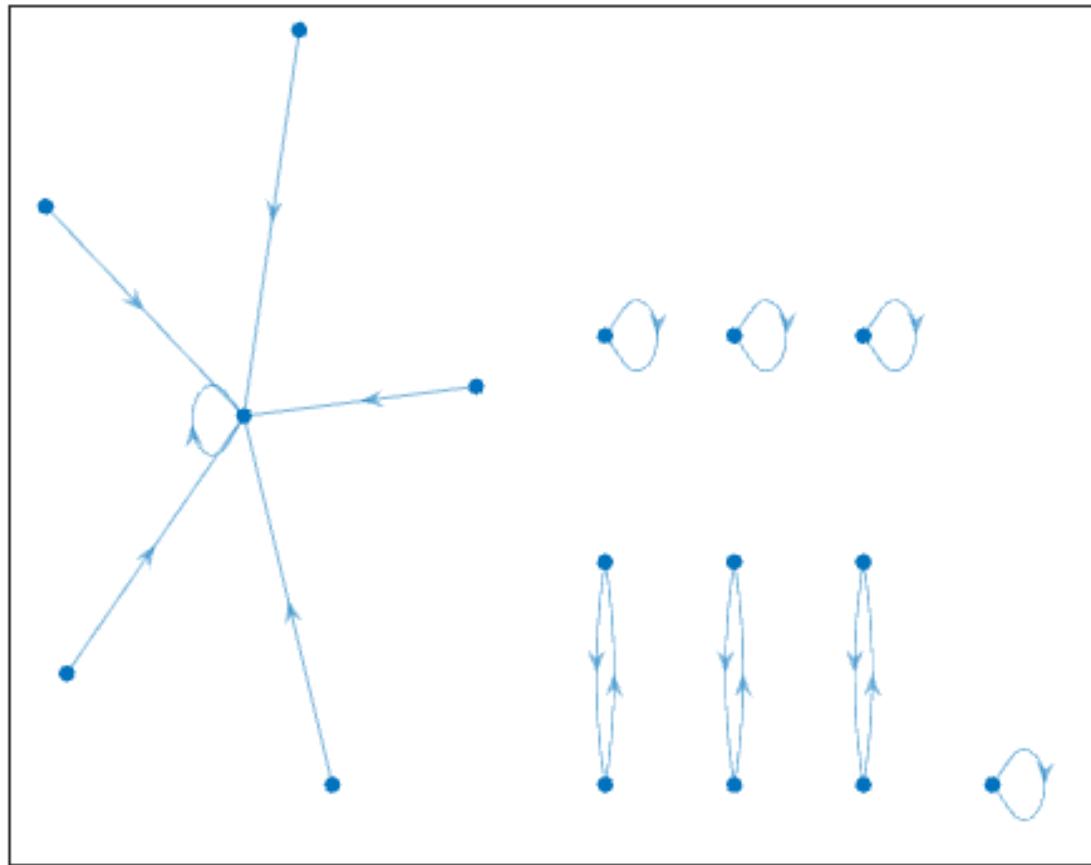


Figura 3.783: Atractor regla 104 n=2

Figura 3.784: Atractor regla 104 $n=3$

Figura 3.785: Atractor regla 104 $n=4$

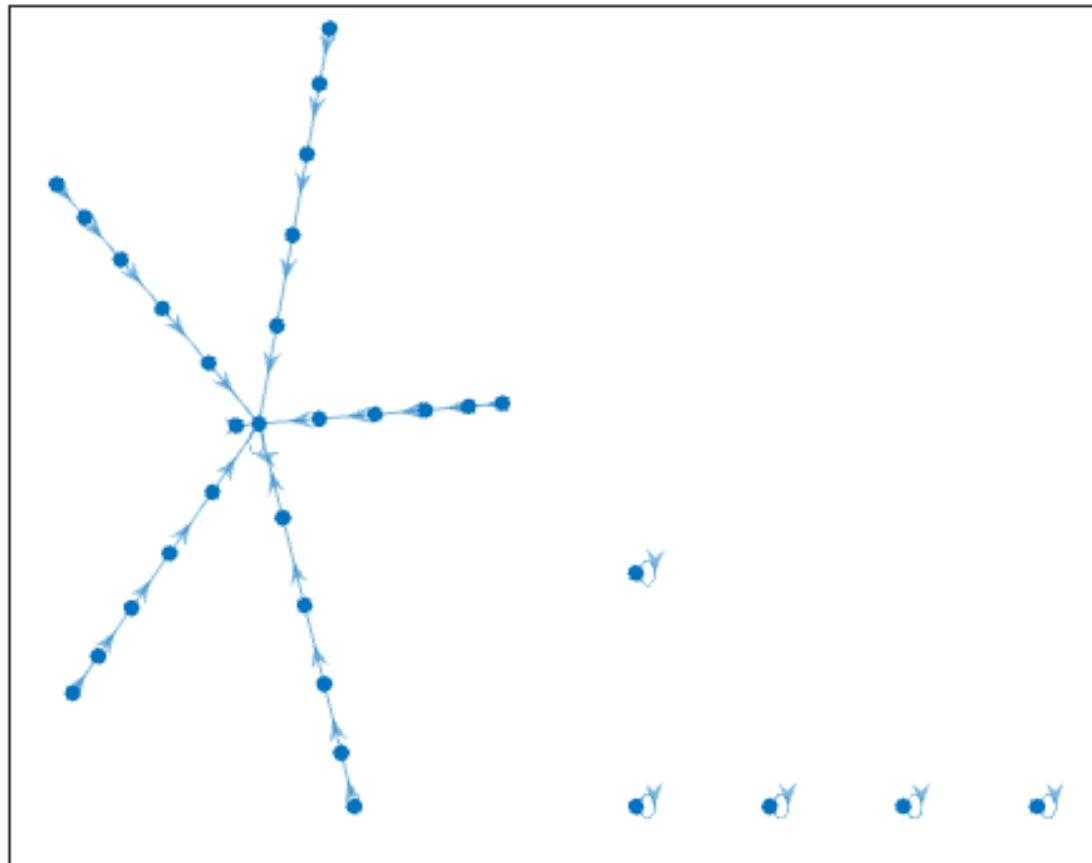


Figura 3.786: Atractor regla 104 n=5

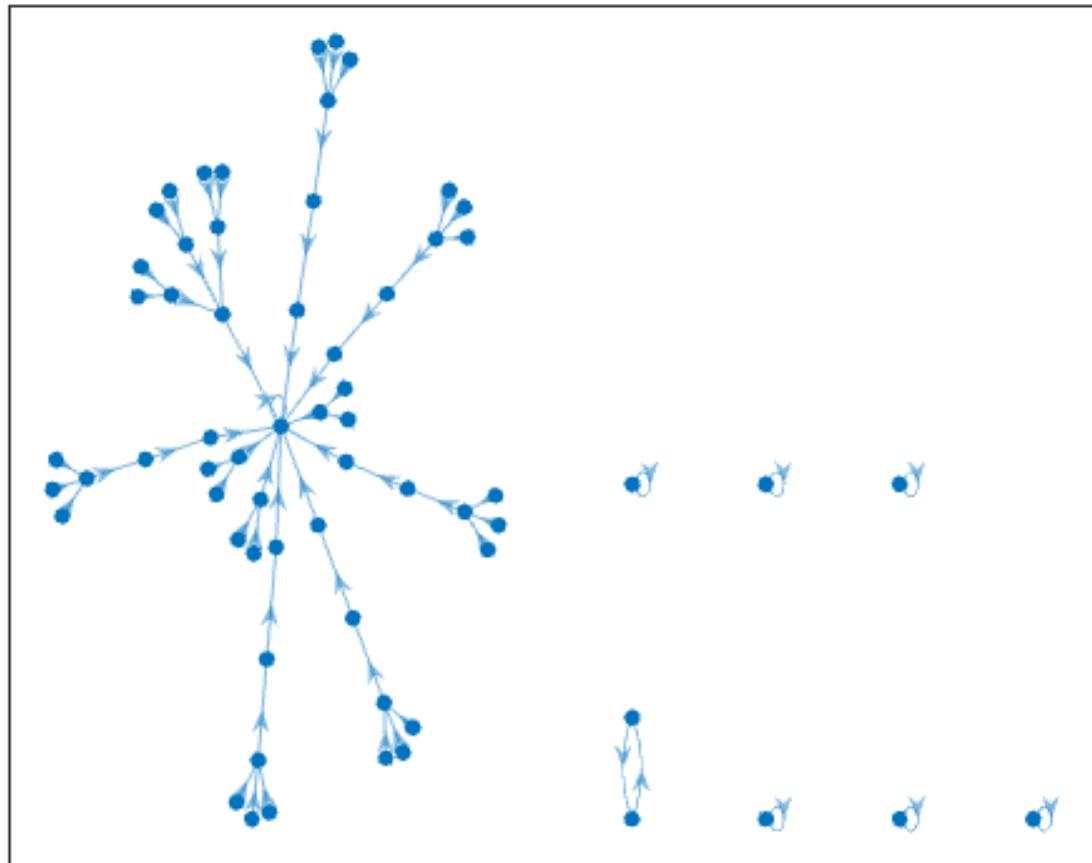


Figura 3.787: Atractor regla 104 n=6

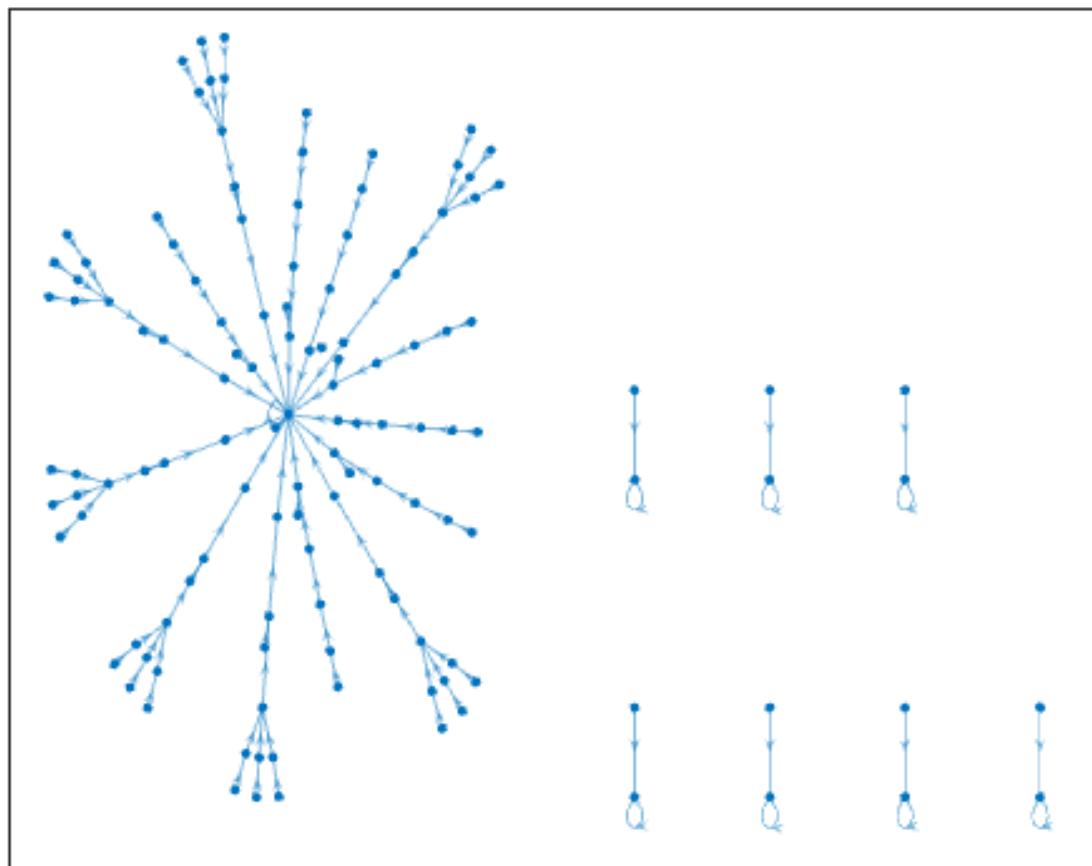


Figura 3.788: Atractor regla 104 n=7

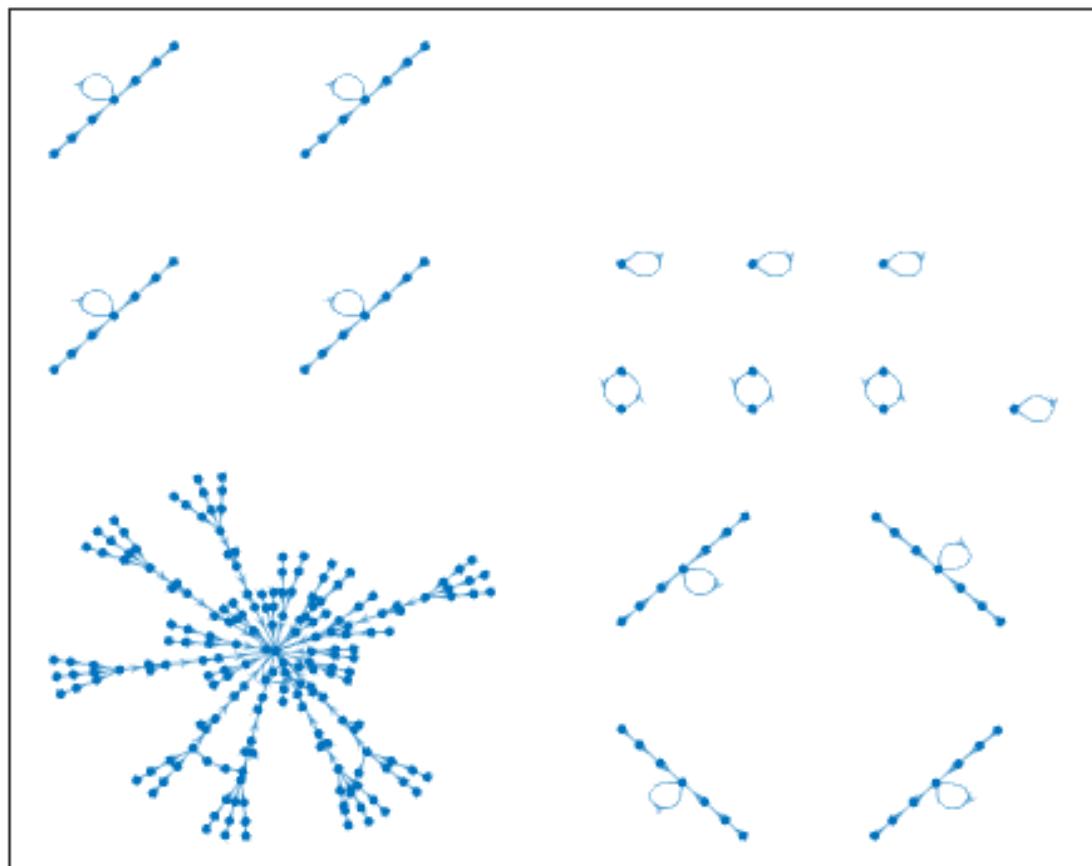
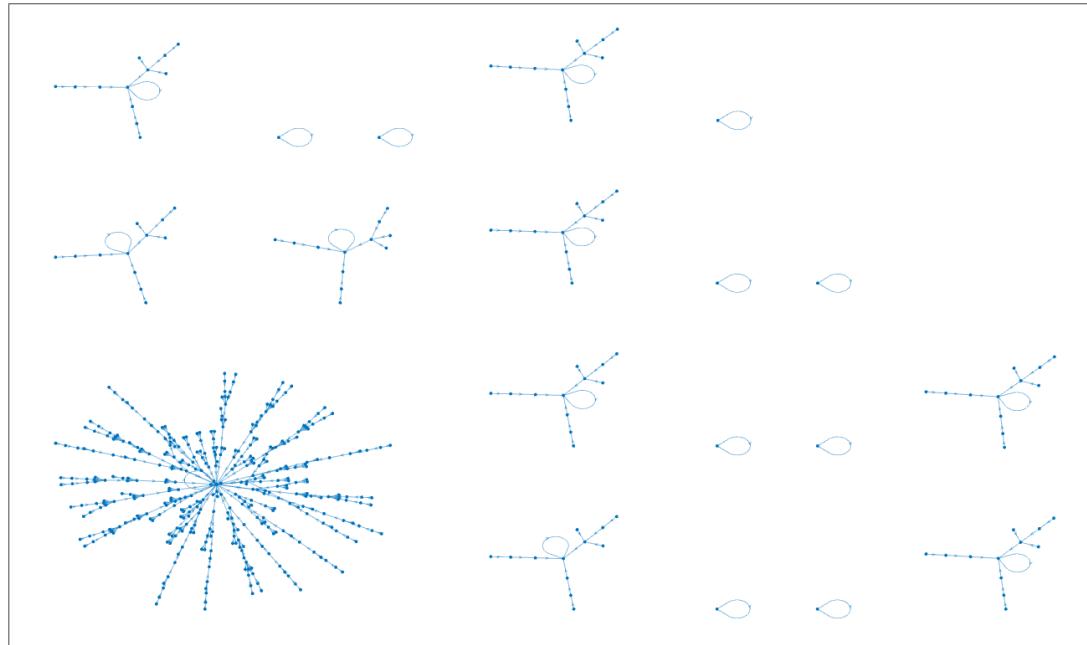
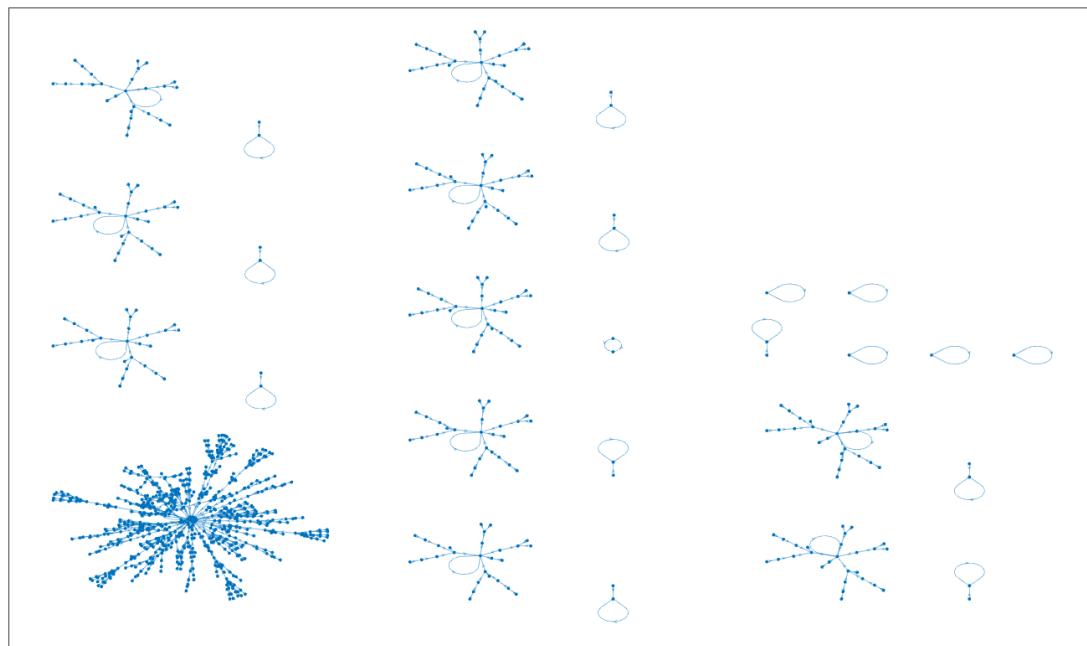


Figura 3.789: Atractor regla 104 n=8

Figura 3.790: Atractor regla 104 $n=9$ Figura 3.791: Atractor regla 104 $n=10$

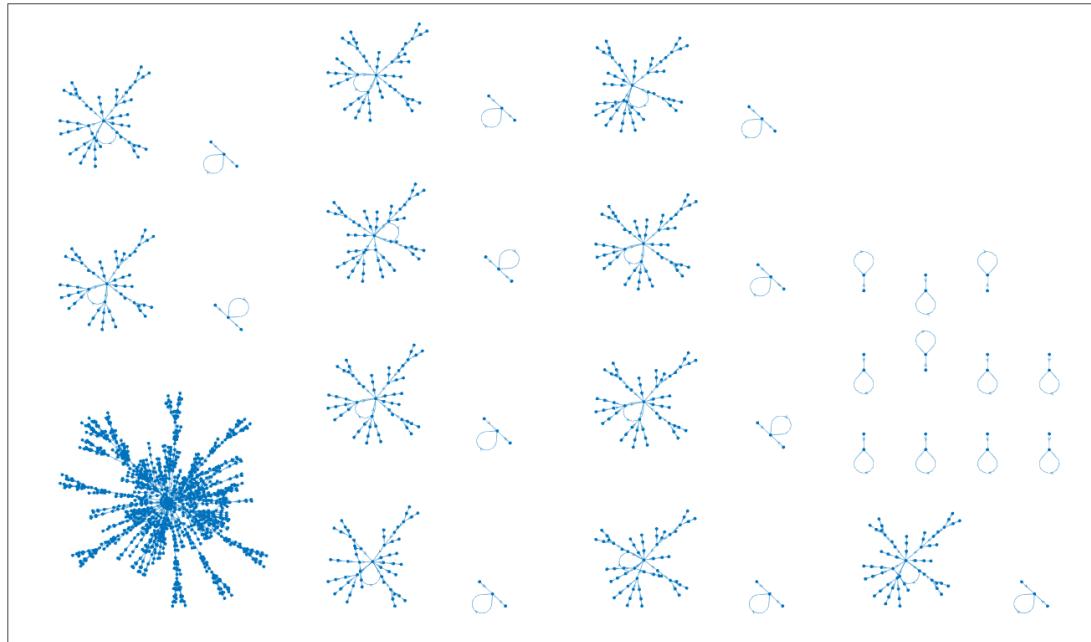


Figura 3.792: Atractor regla 104 n=11

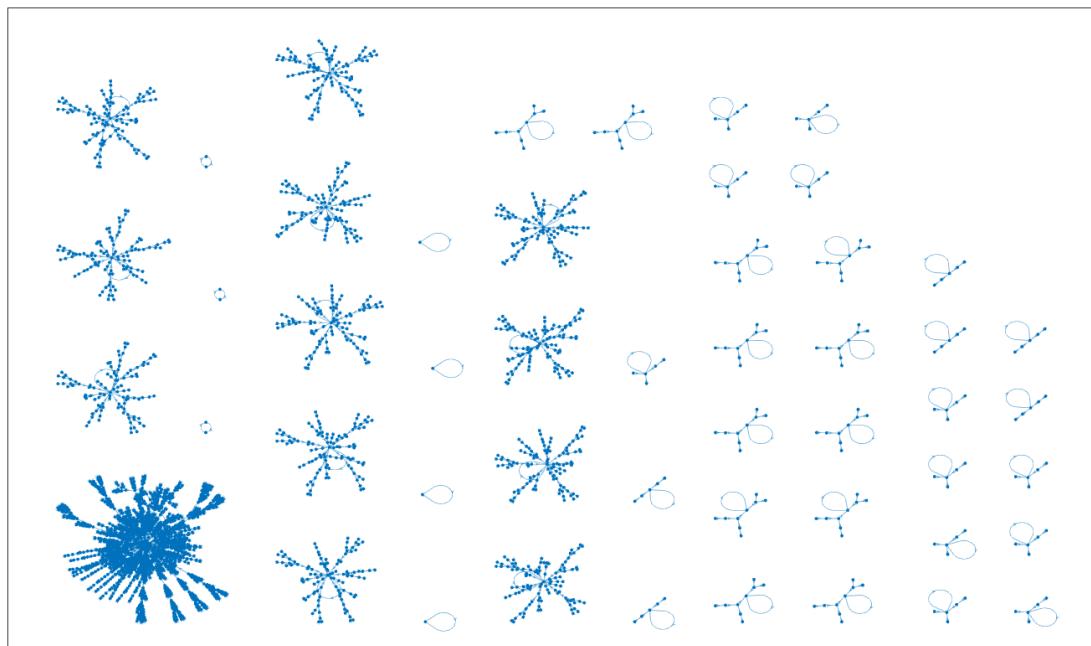


Figura 3.793: Atractor regla 104 n=12

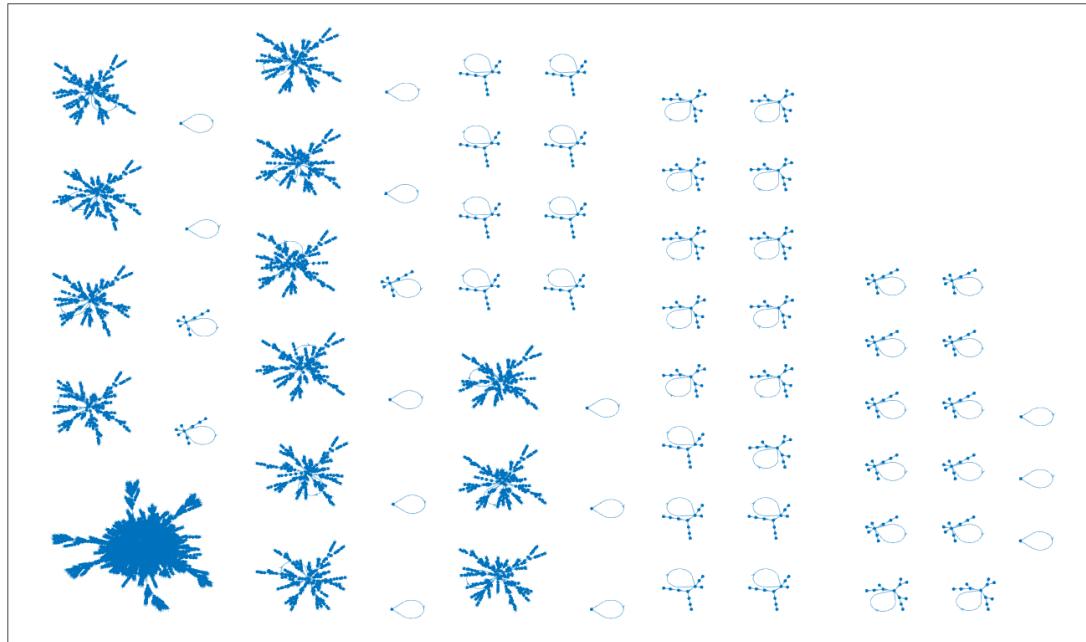


Figura 3.794: Atractor regla 104 n=13

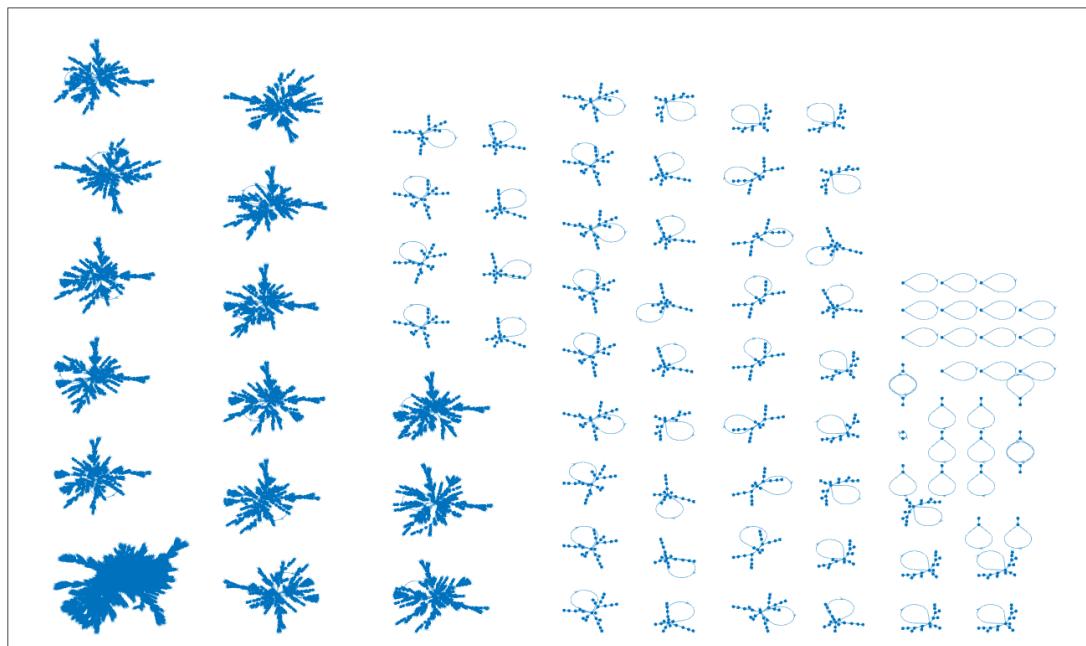


Figura 3.795: Atractor regla 104 n=14

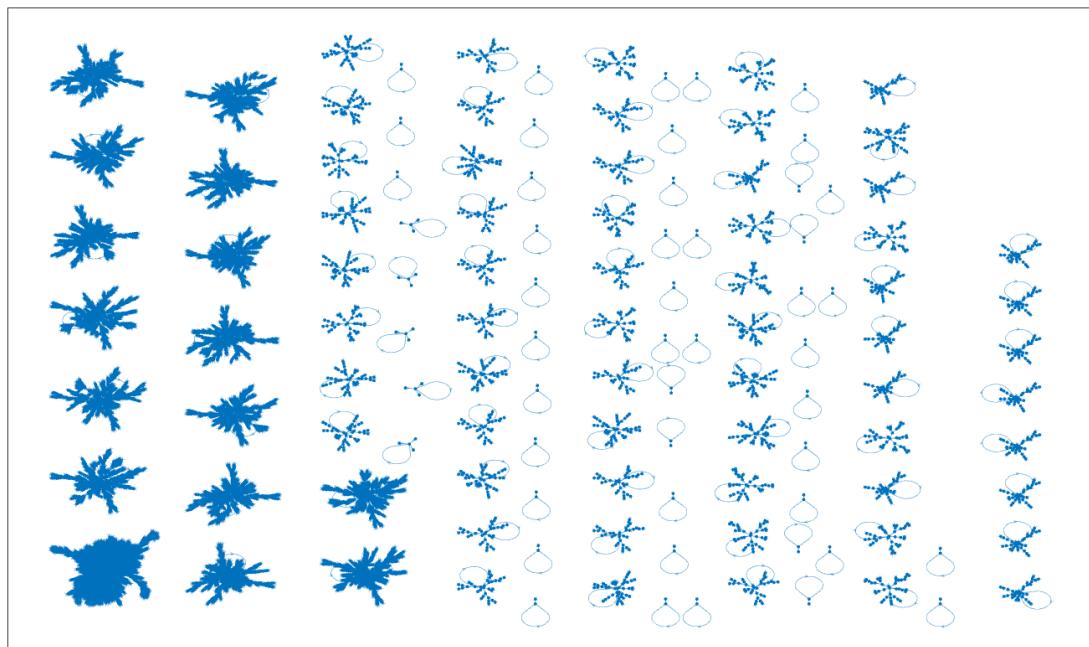


Figura 3.796: Atractor regla 104 n=15

3.59. Reglas 105

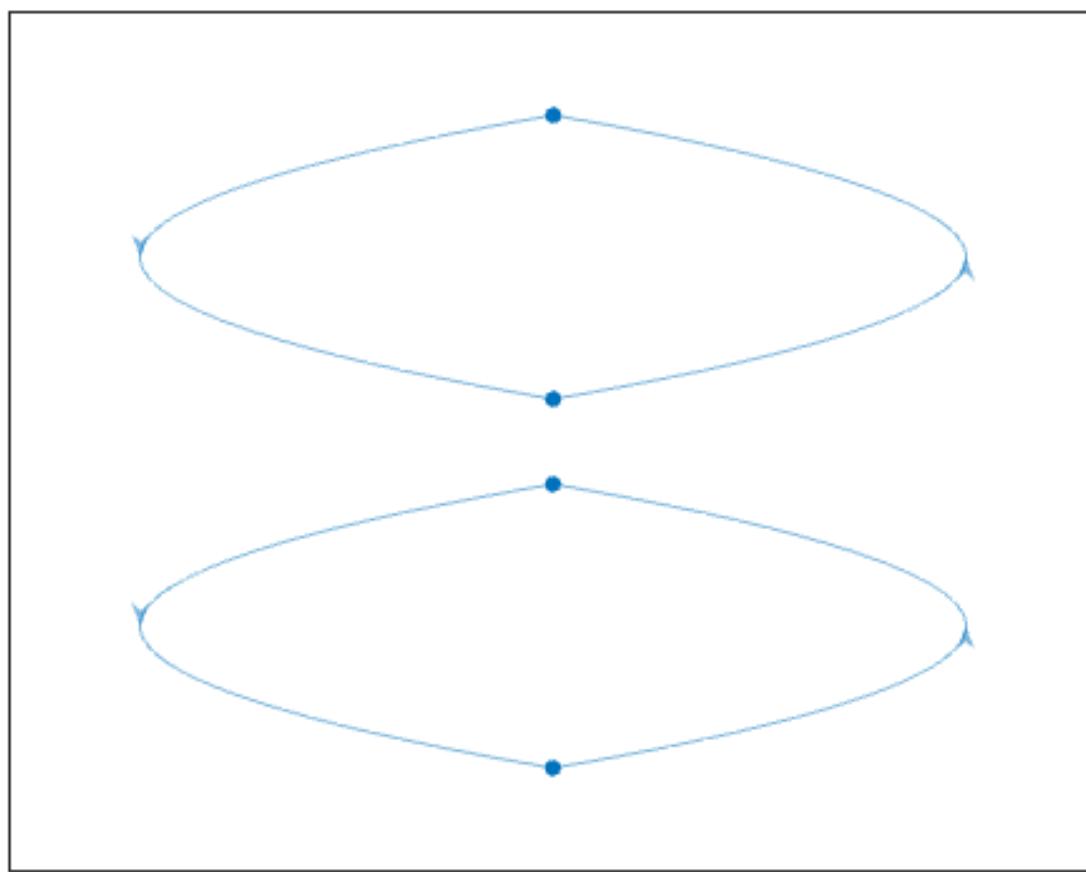


Figura 3.797: Atractor regla 105 n=2

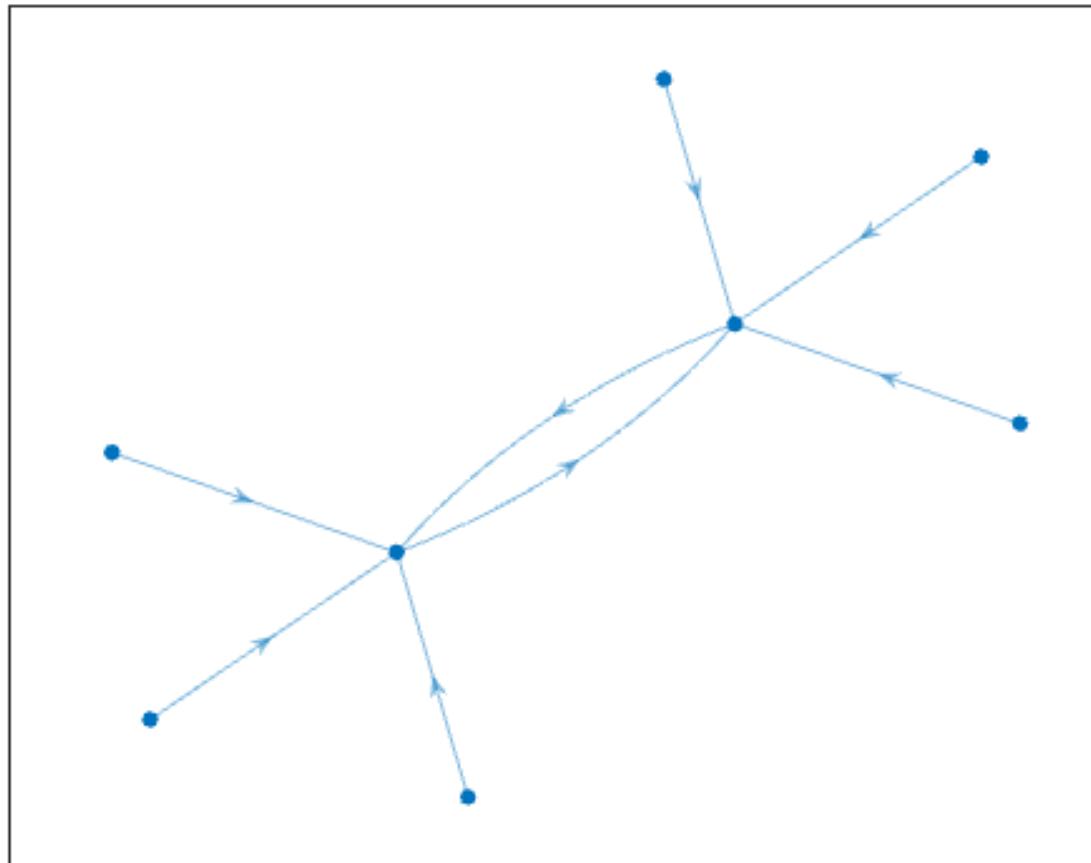


Figura 3.798: Atractor regla 105 n=3

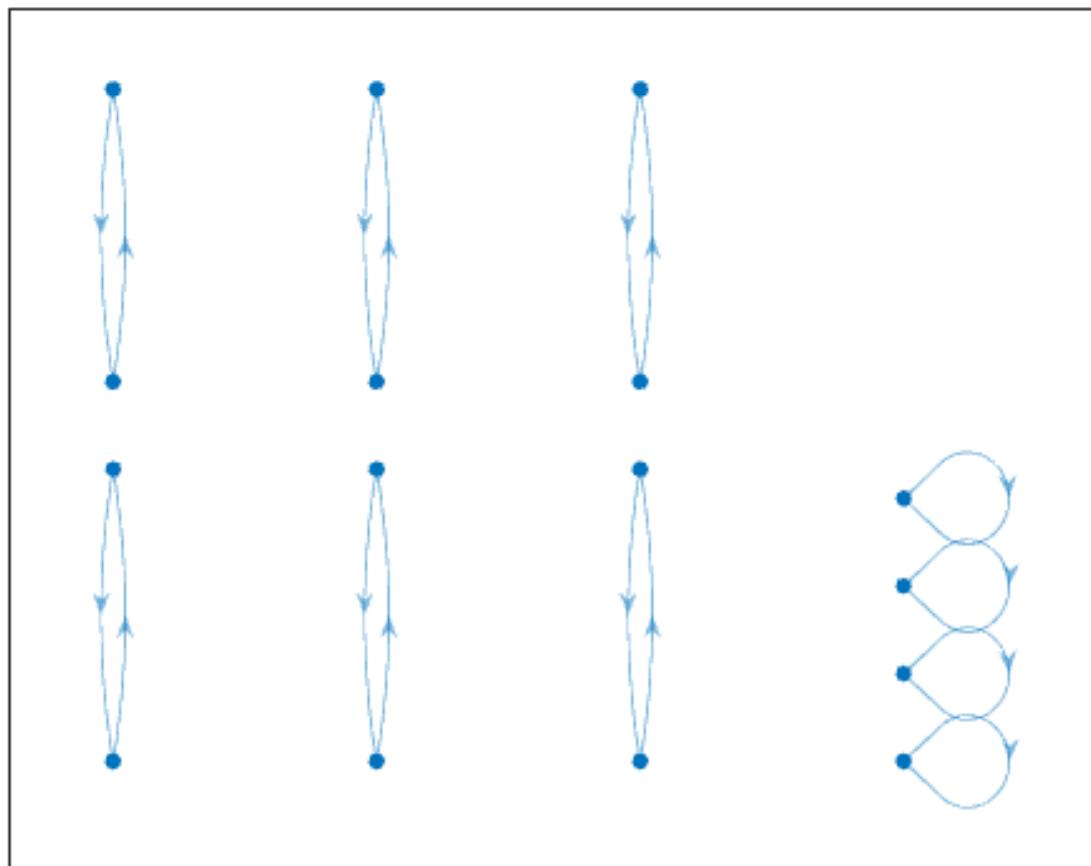


Figura 3.799: Atractor regla 105 n=4

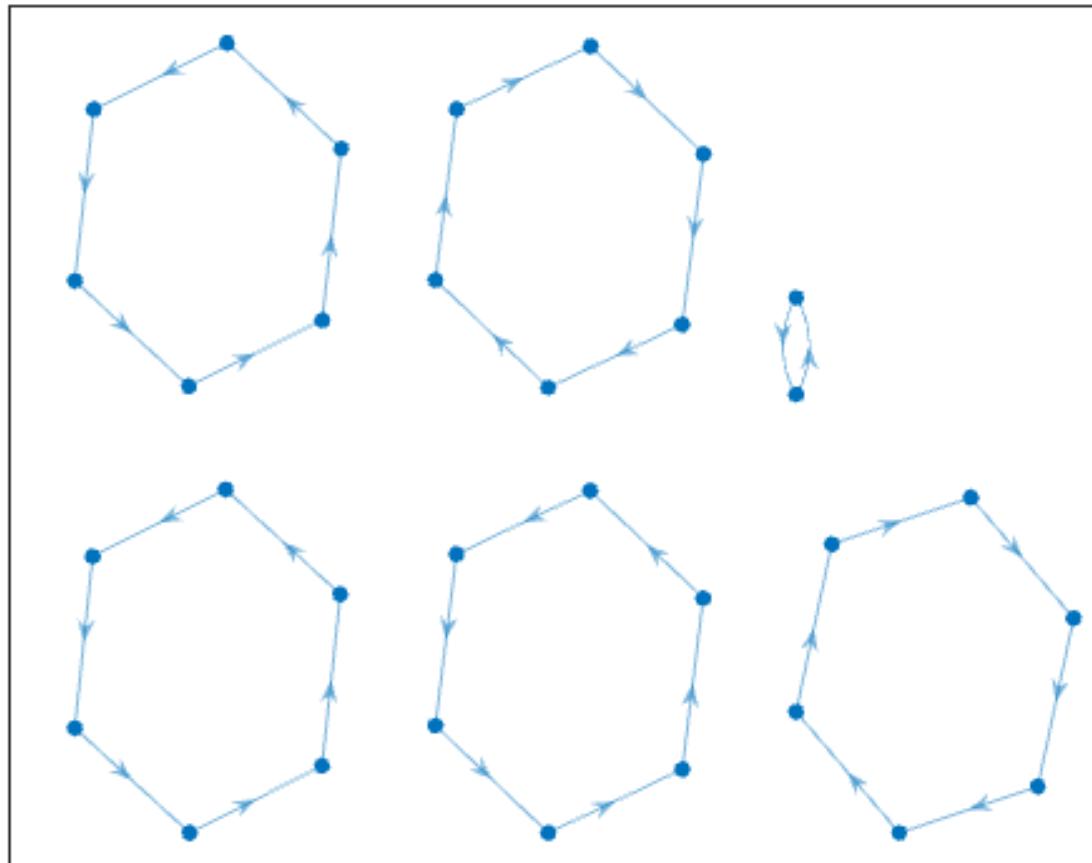


Figura 3.800: Atractor regla 105 n=5

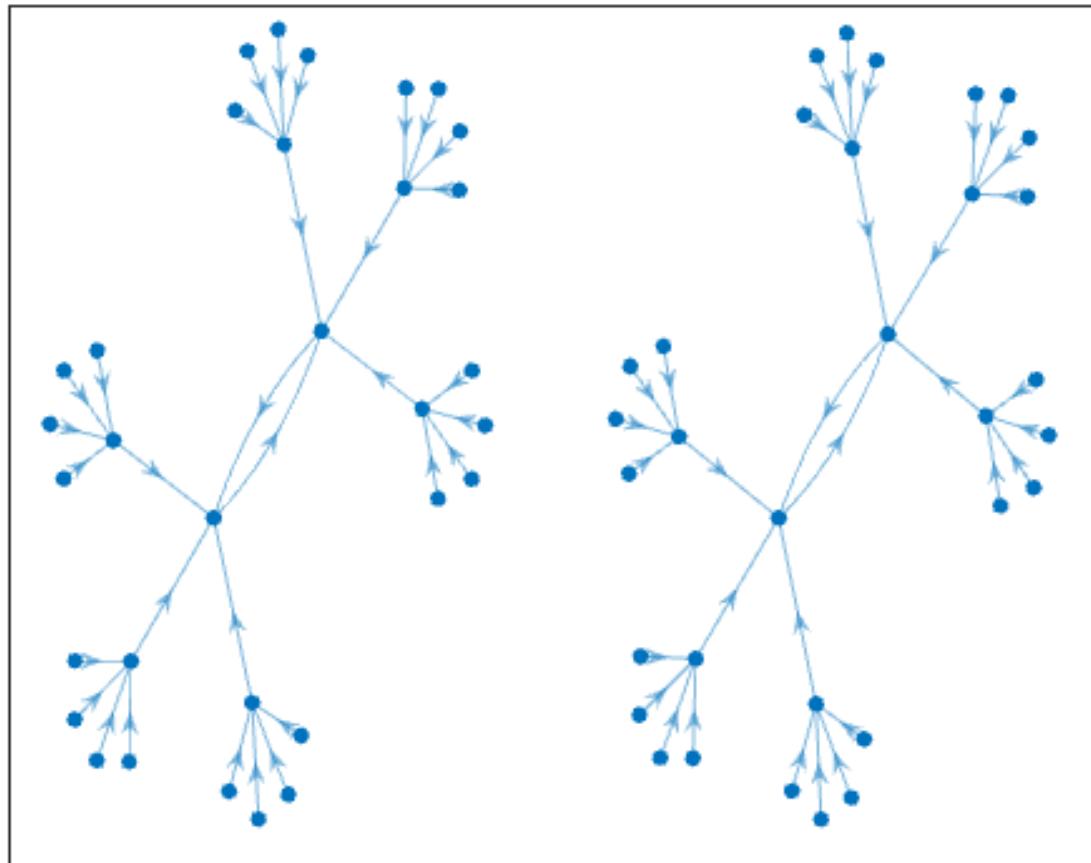


Figura 3.801: Atractor regla 105 n=6

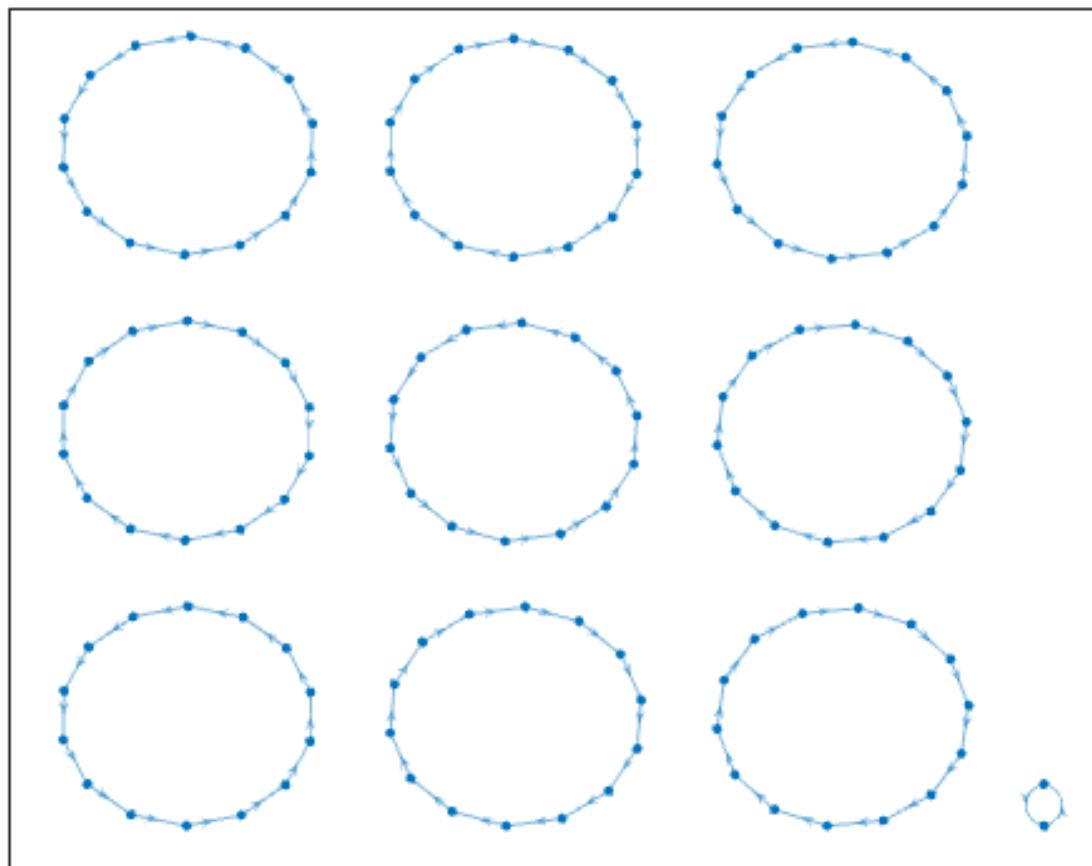


Figura 3.802: Atractor regla 105 n=7

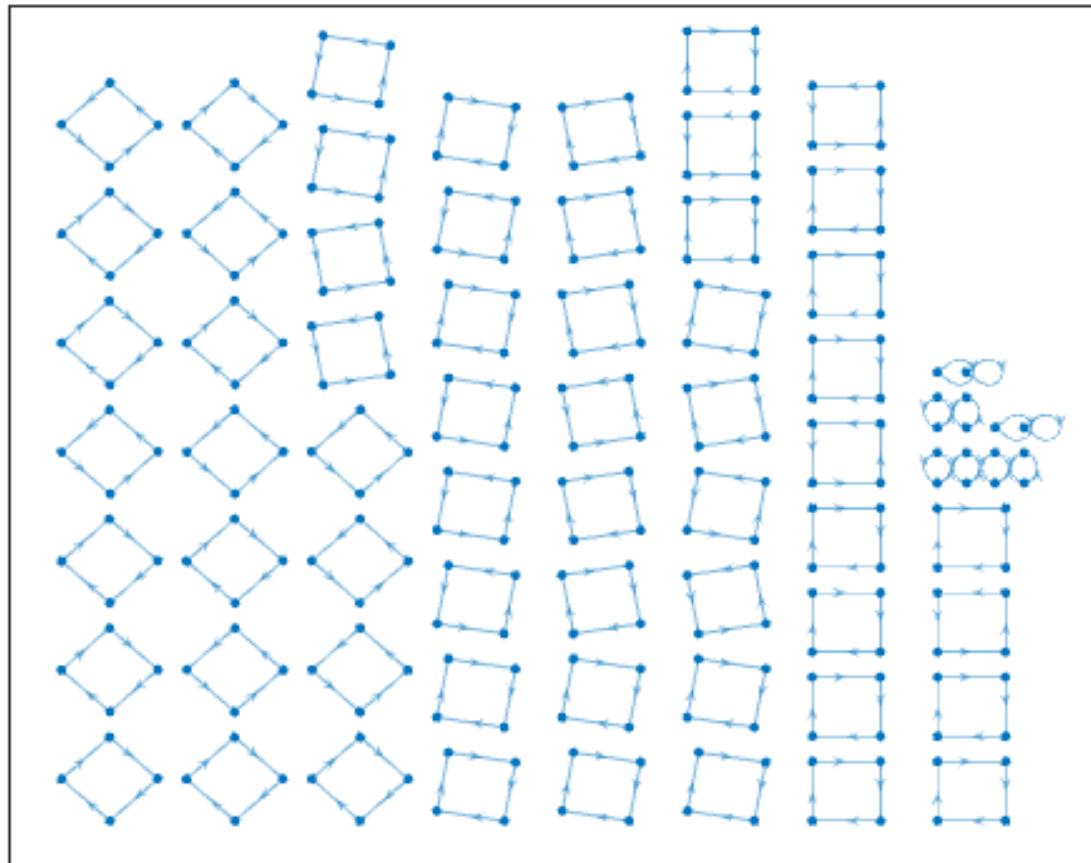


Figura 3.803: Atractor regla 105 n=8

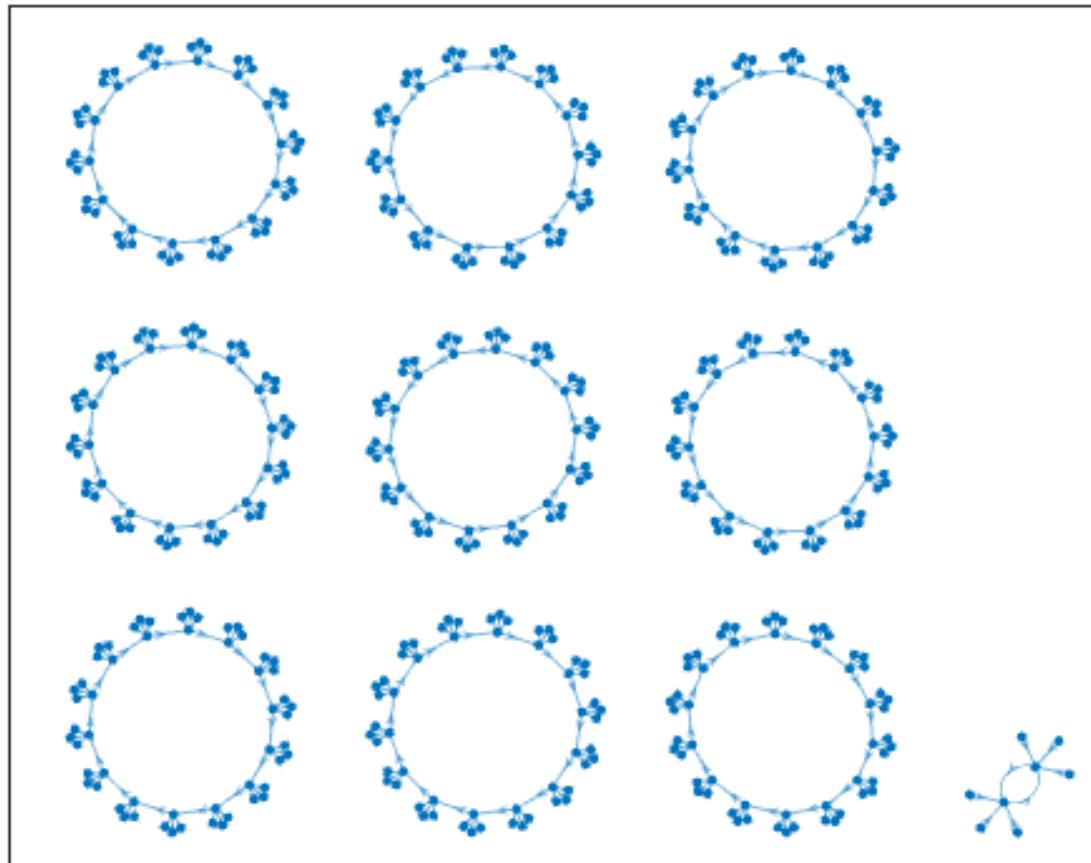


Figura 3.804: Atractor regla 105 n=9

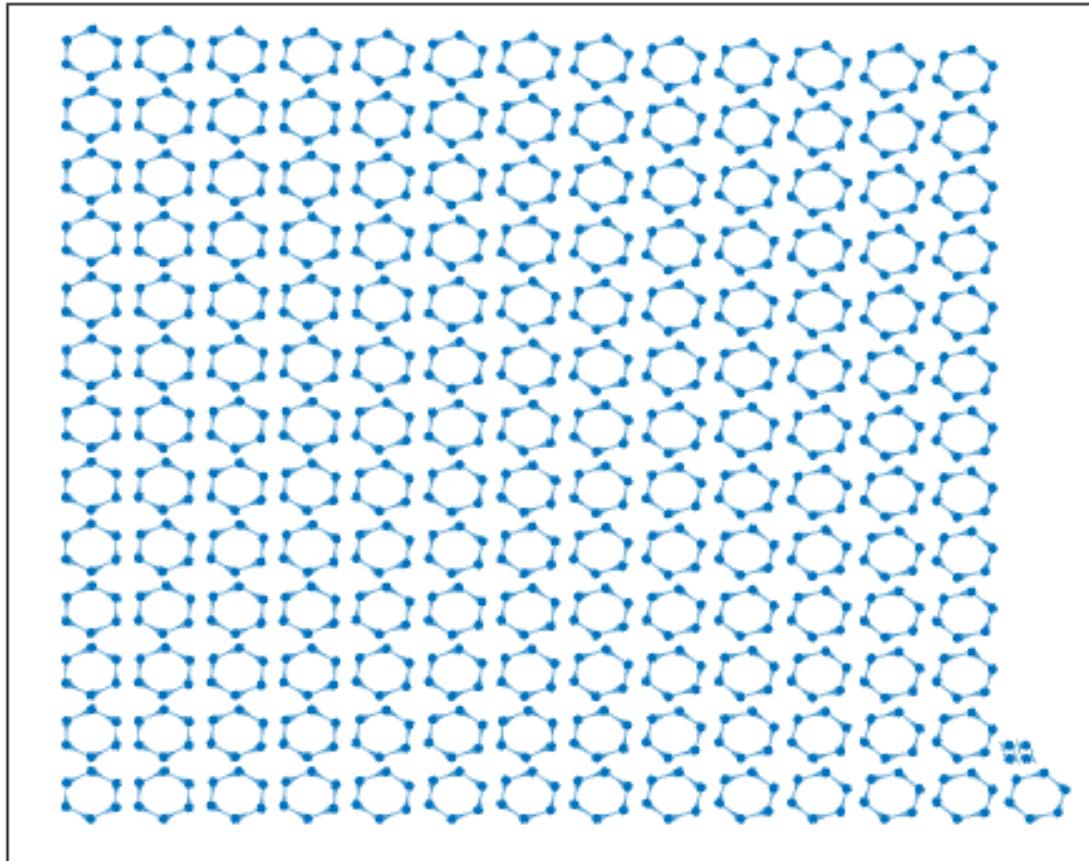


Figura 3.805: Atractor regla 105 n=10

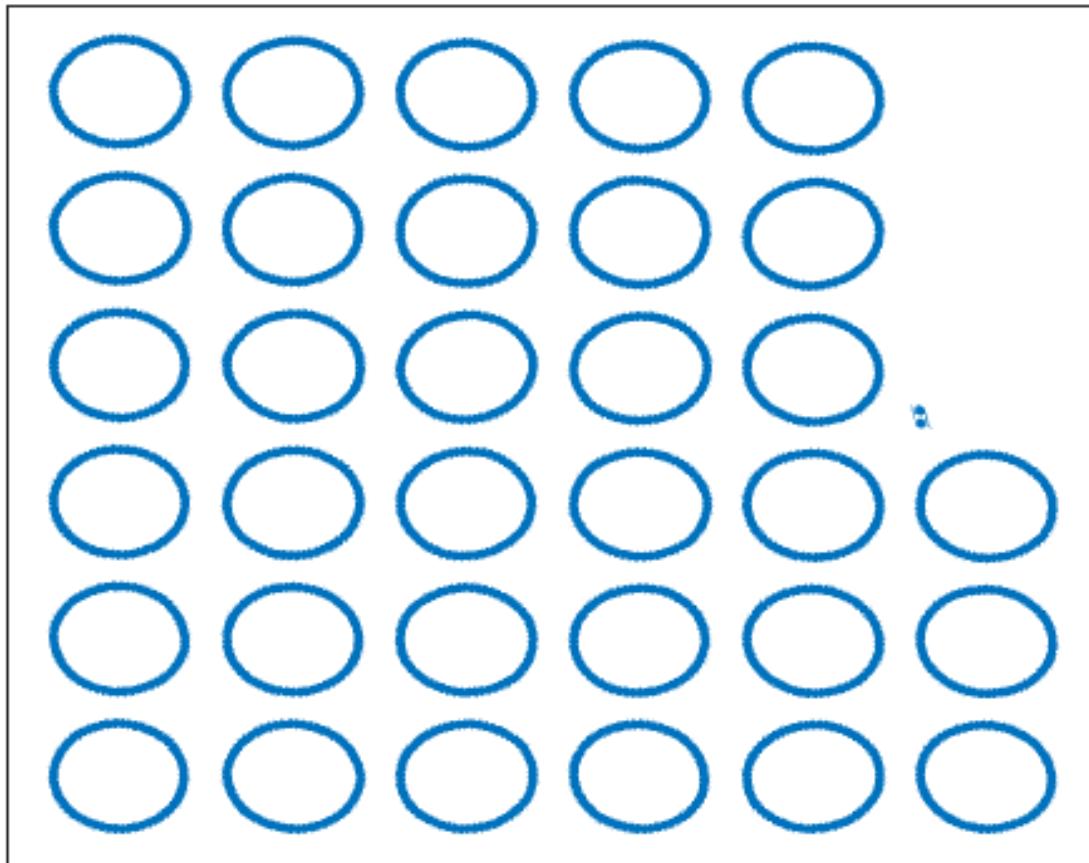


Figura 3.806: Atractor regla 105 n=11

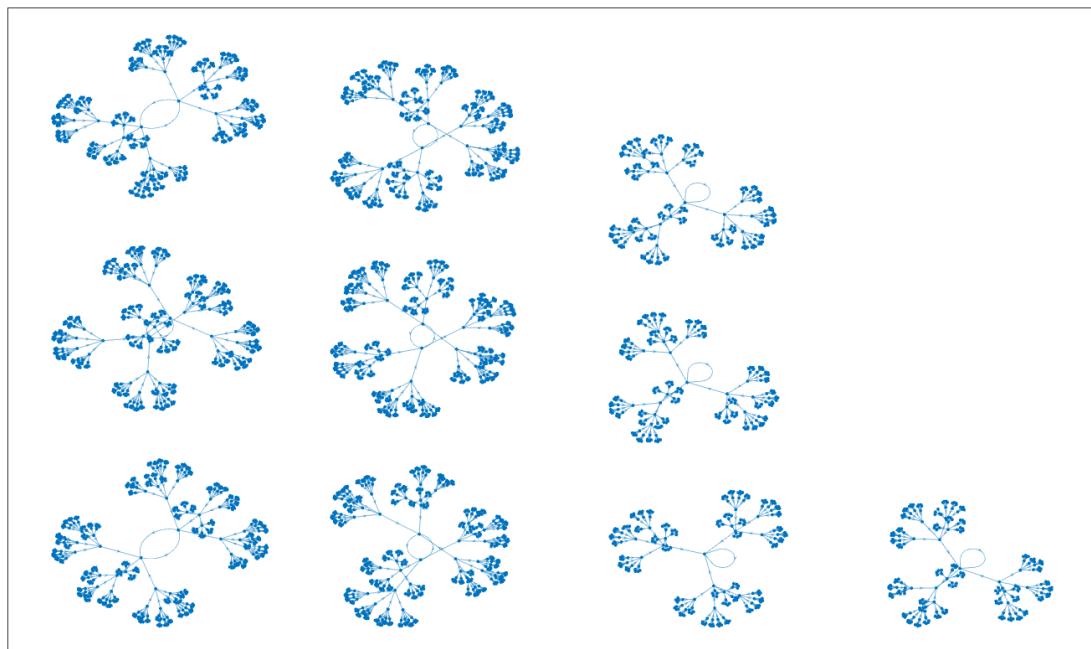


Figura 3.807: Atractor regla 105 n=12

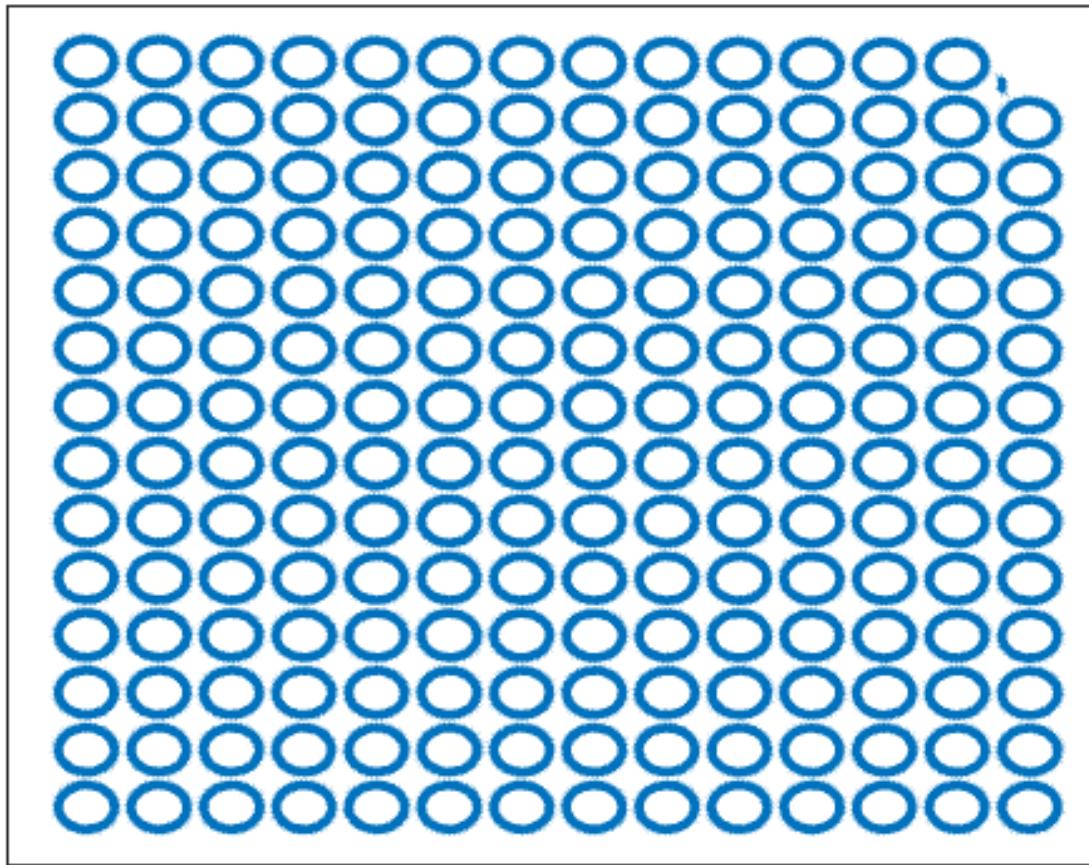


Figura 3.808: Atractor regla 105 n=13

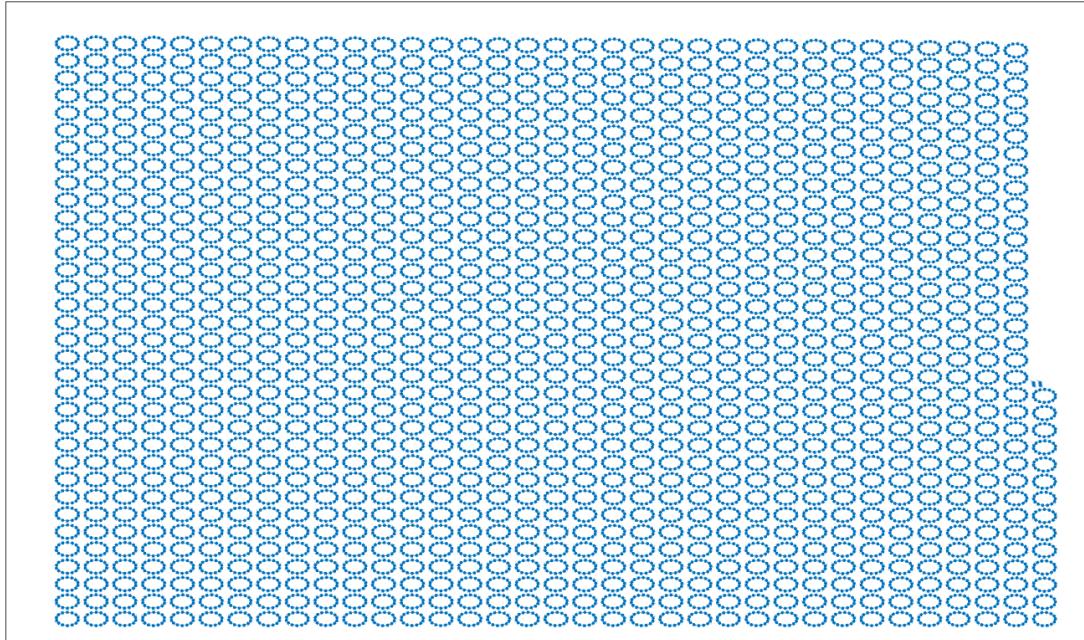


Figura 3.809: Atractor regla 105 n=14

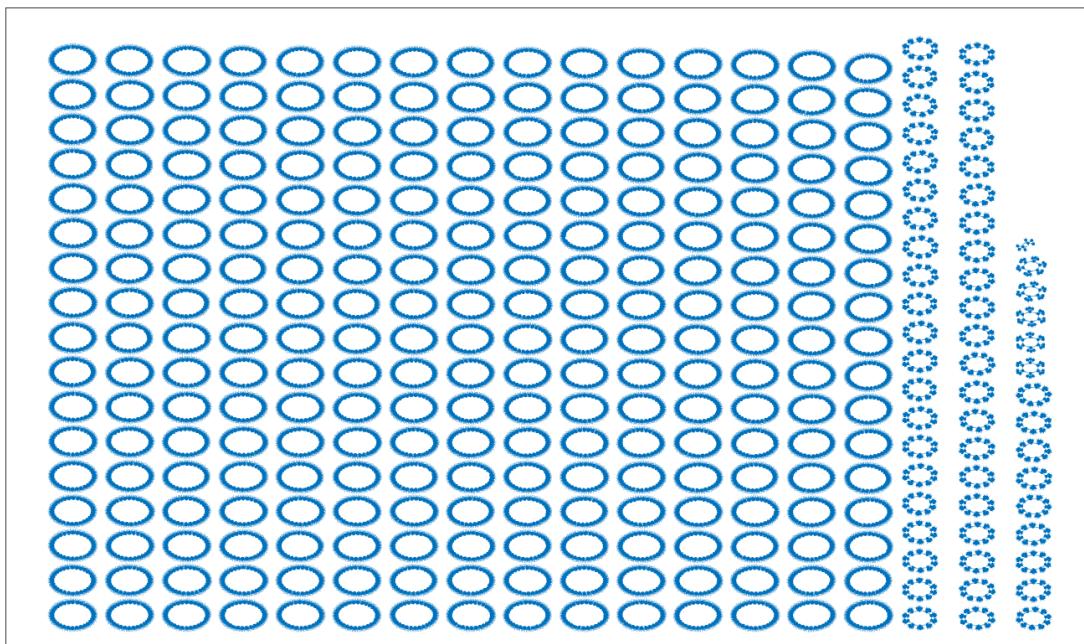


Figura 3.810: Atractor regla 105 n=15

3.60. Reglas 106,120,169,225

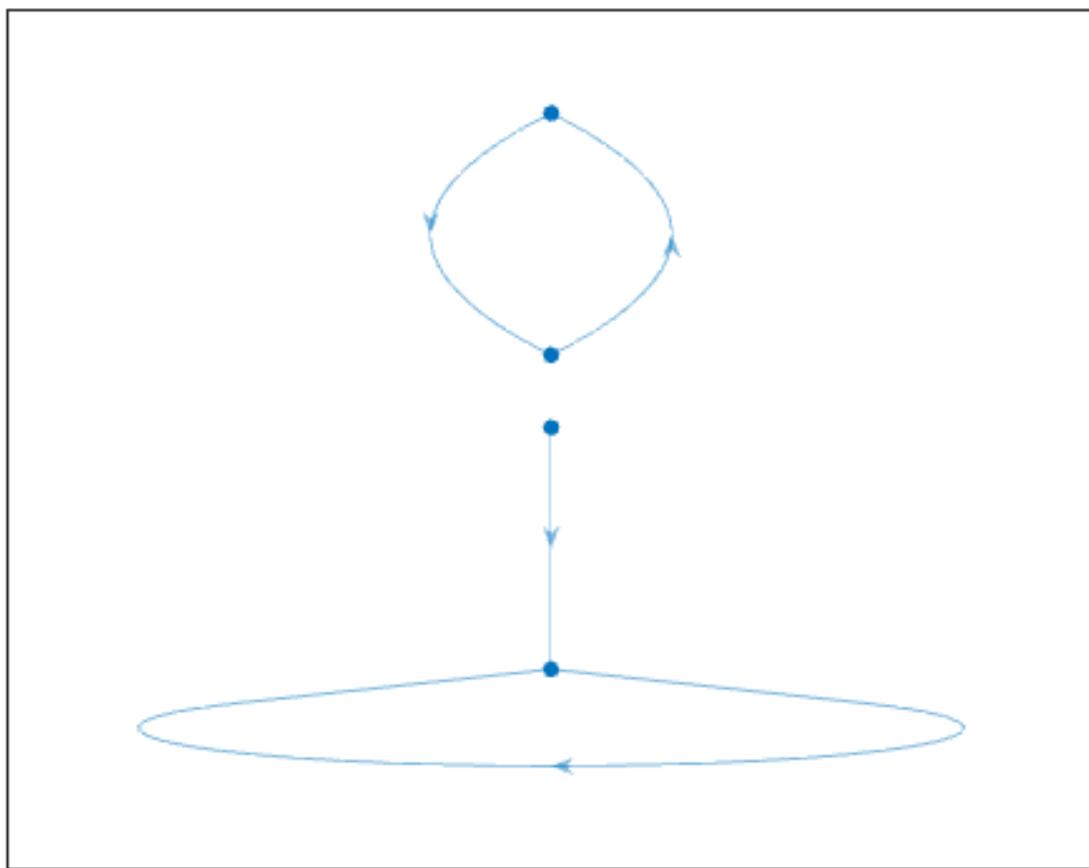


Figura 3.811: Atractor regla 106 n=2

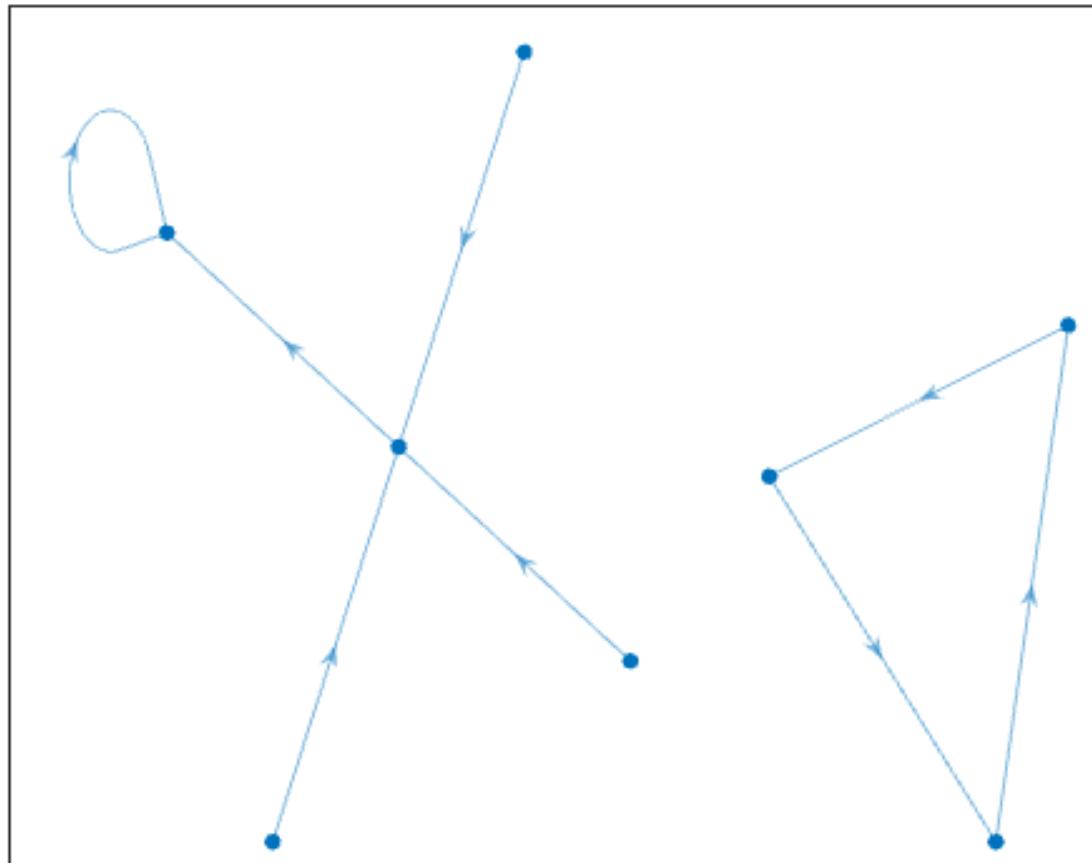


Figura 3.812: Atractor regla 106 n=3

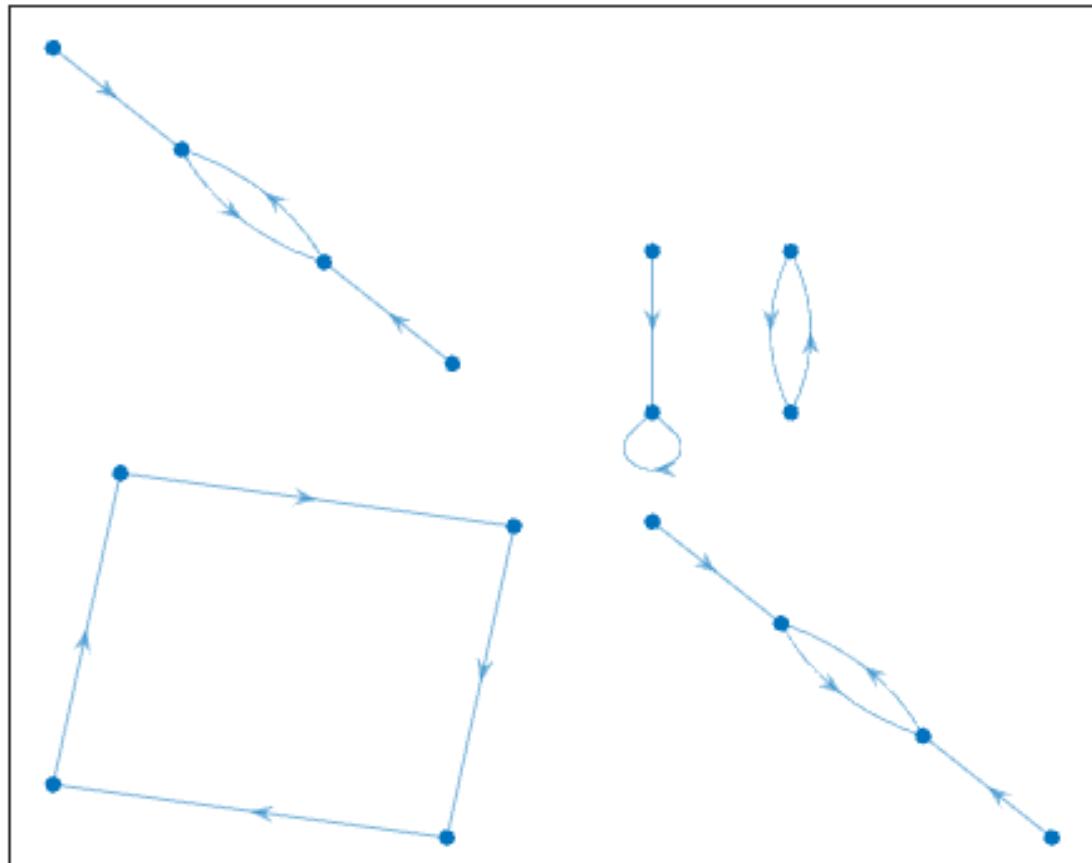
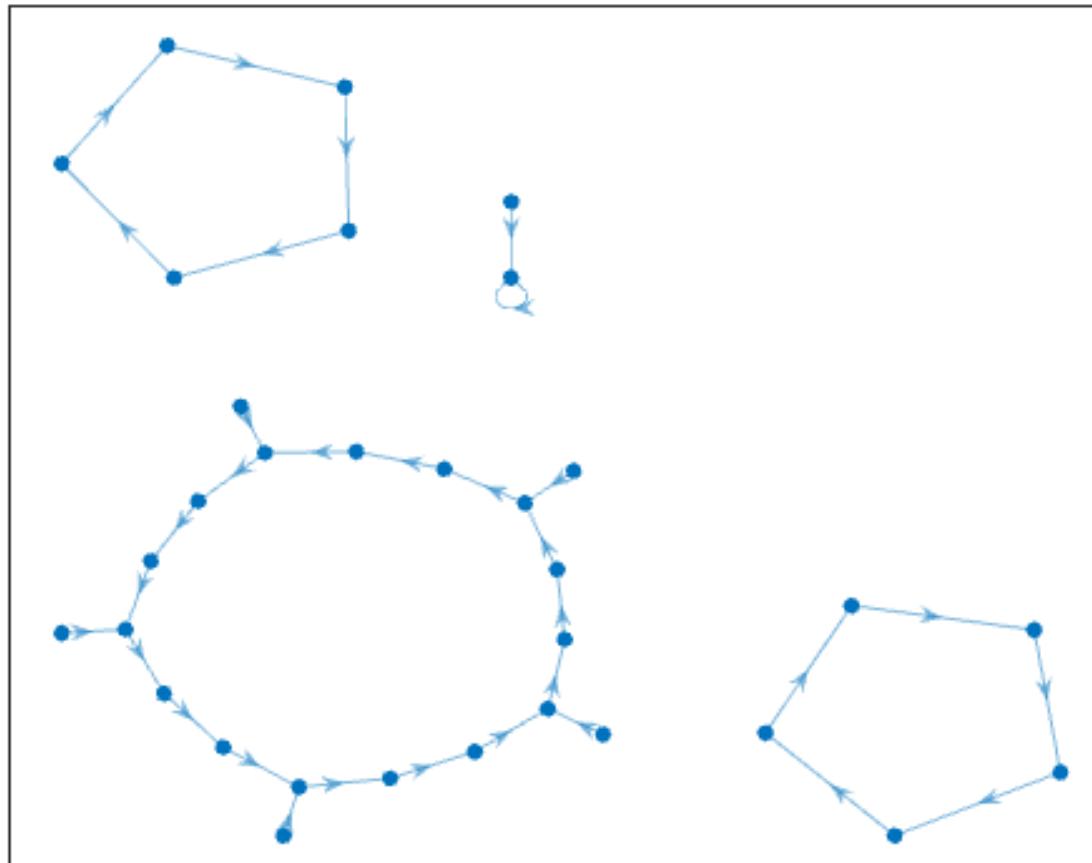


Figura 3.813: Atractor regla 106 n=4

Figura 3.814: Atractor regla 106 $n=5$

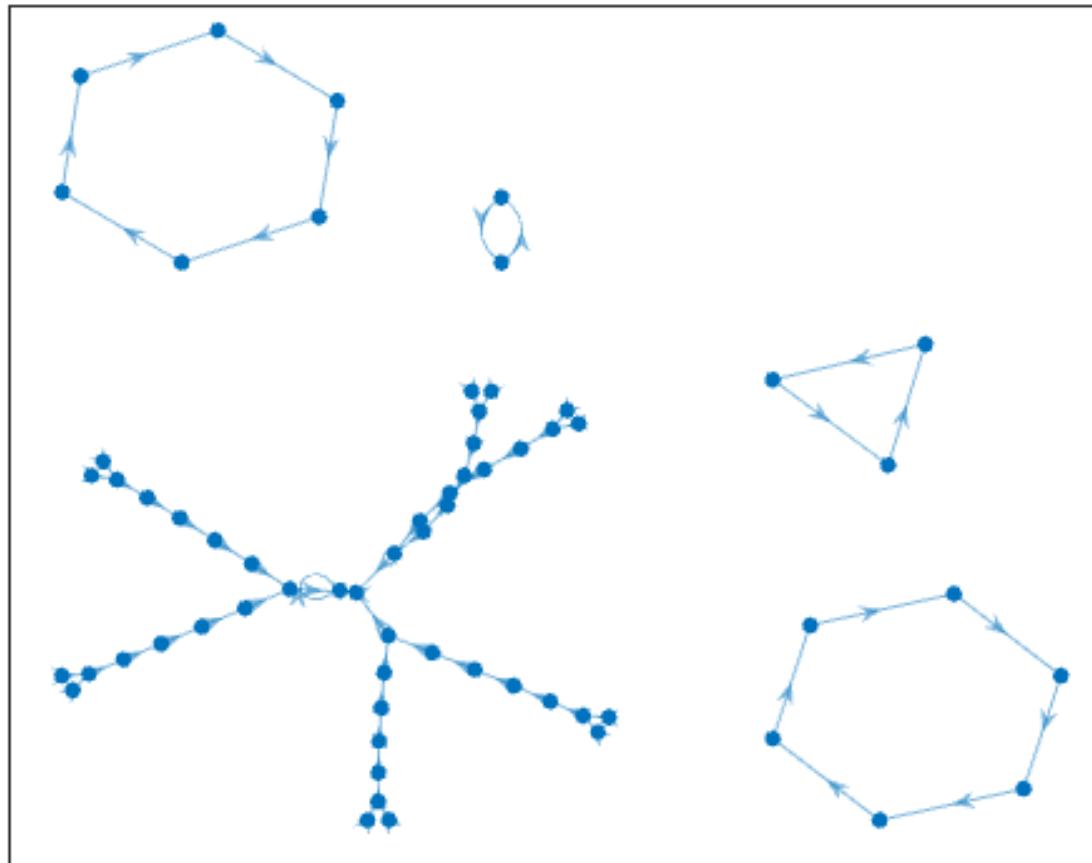


Figura 3.815: Atractor regla 106 n=6

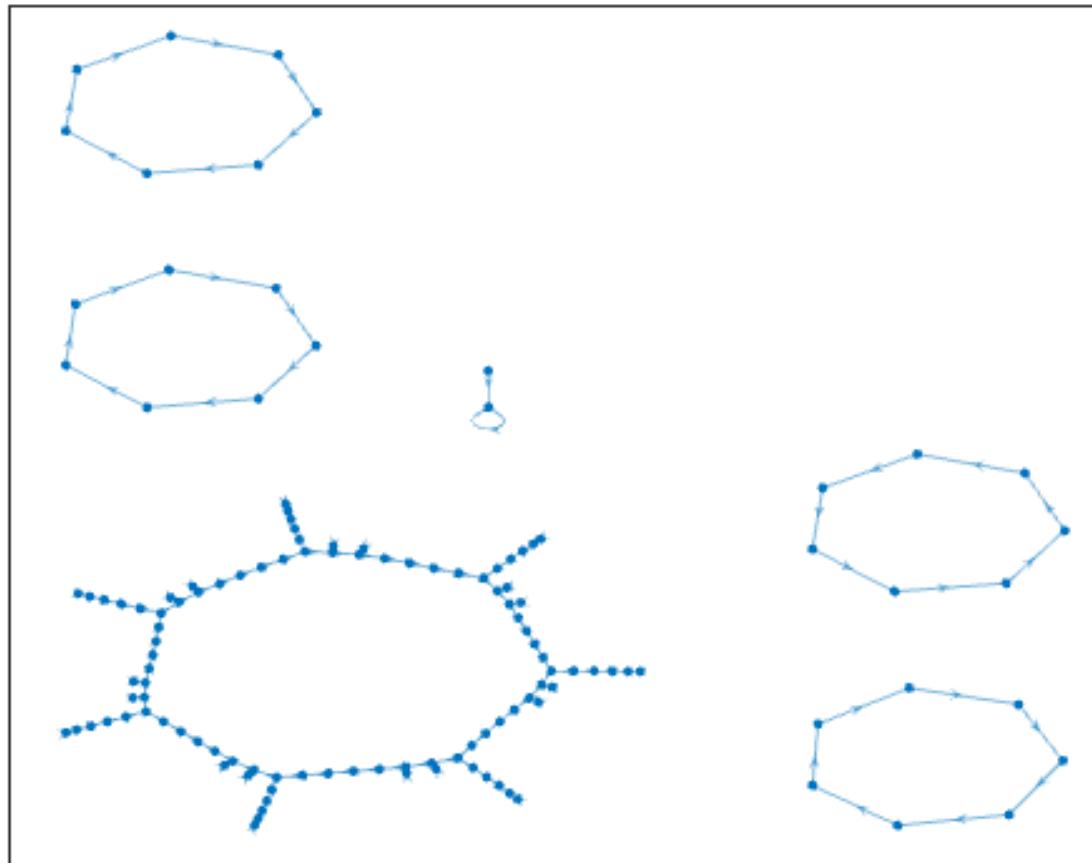


Figura 3.816: Atractor regla 106 n=7

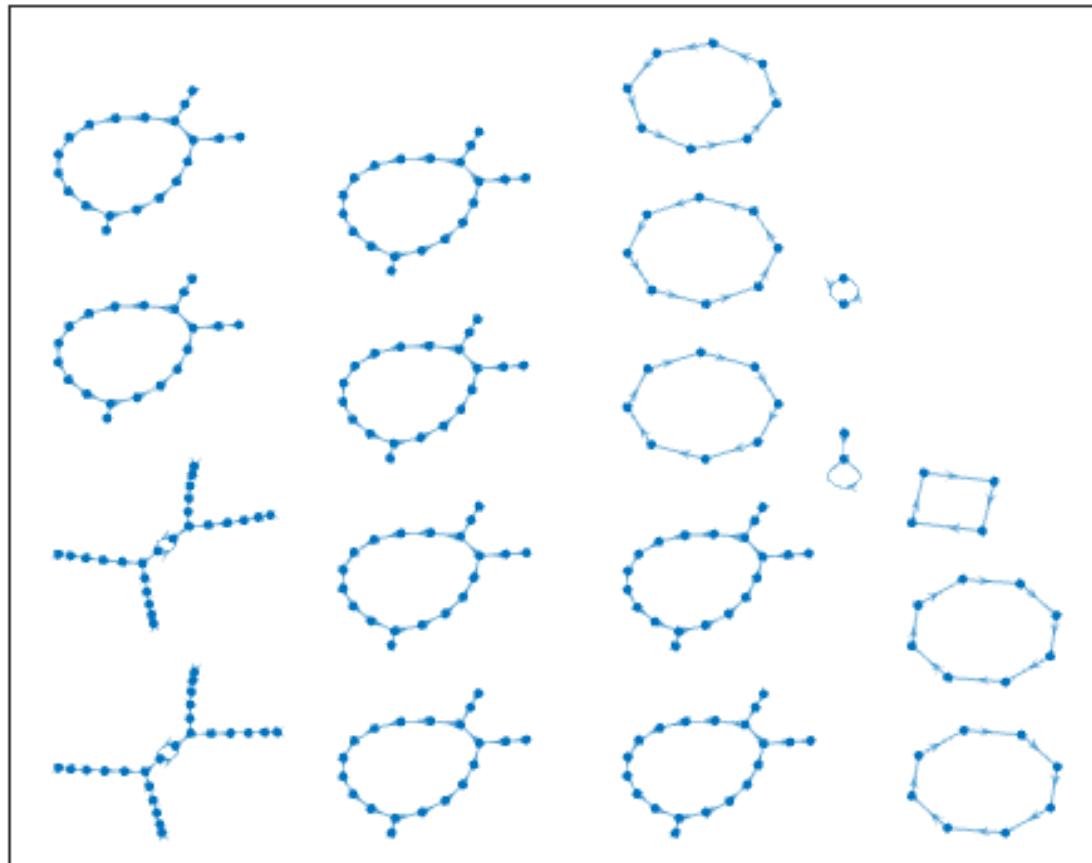


Figura 3.817: Atractor regla 106 n=8

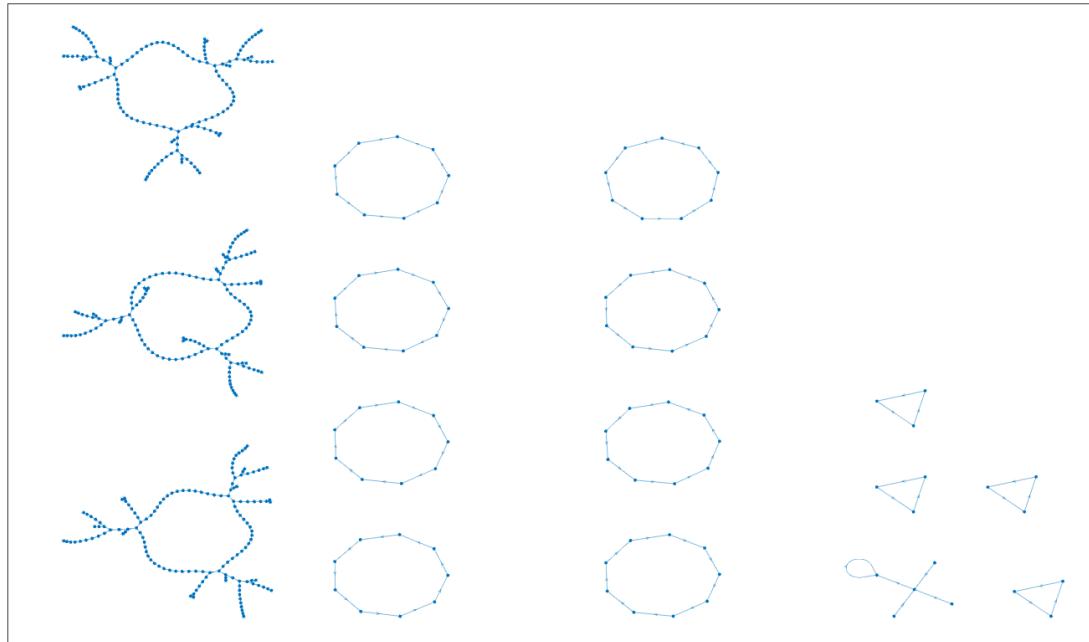


Figura 3.818: Atractor regla 106 n=9

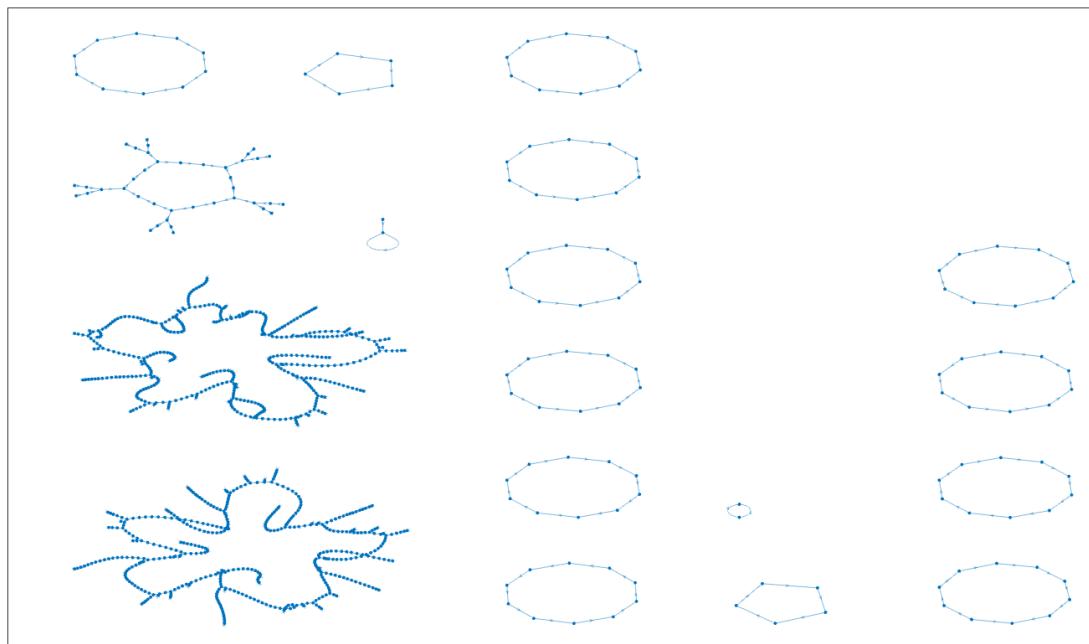


Figura 3.819: Atractor regla 106 n=10

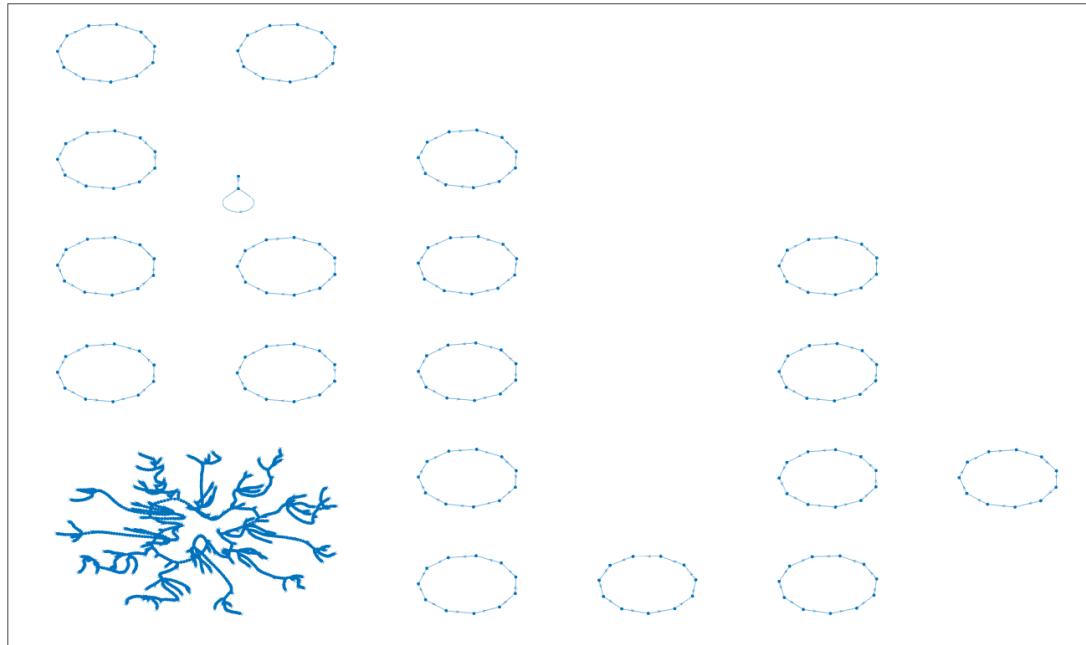


Figura 3.820: Atractor regla 106 n=11

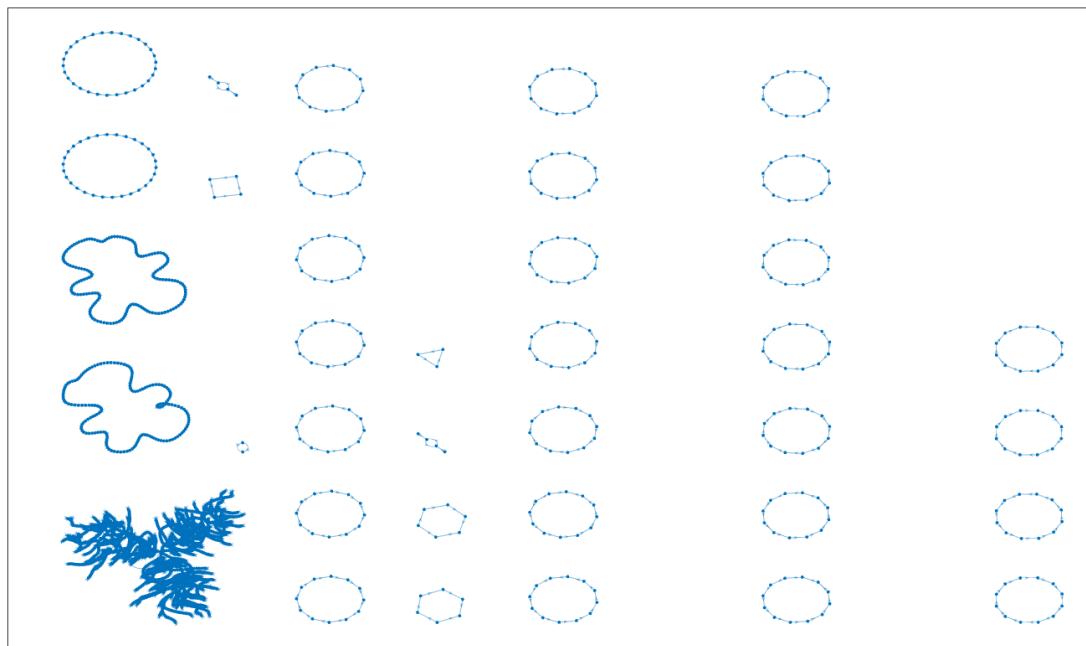


Figura 3.821: Atractor regla 106 n=12

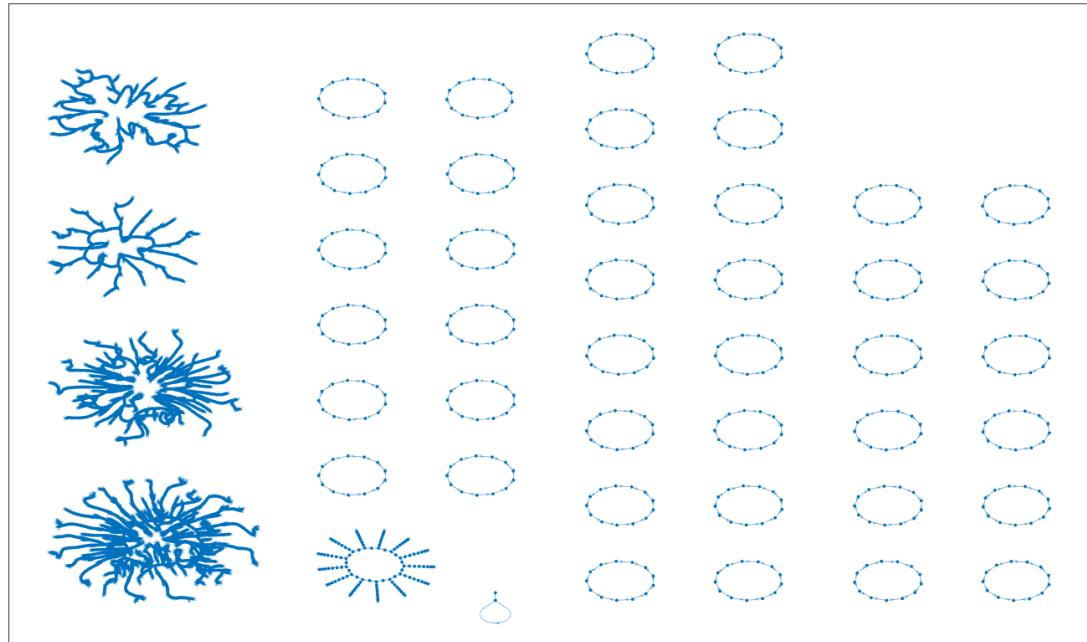


Figura 3.822: Atractor regla 106 n=13

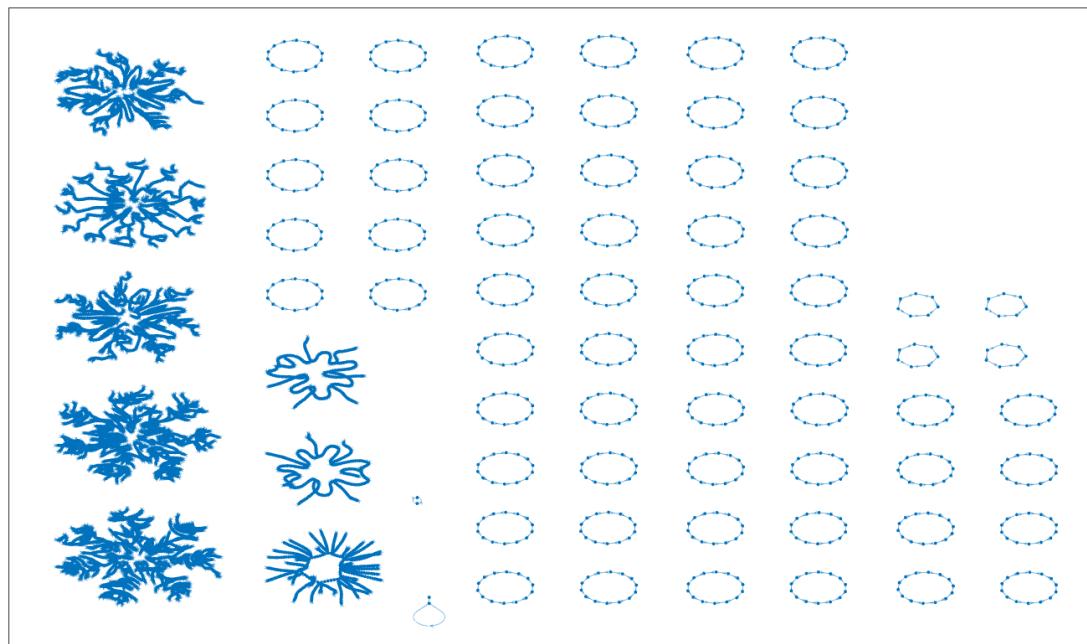


Figura 3.823: Atractor regla 106 n=14

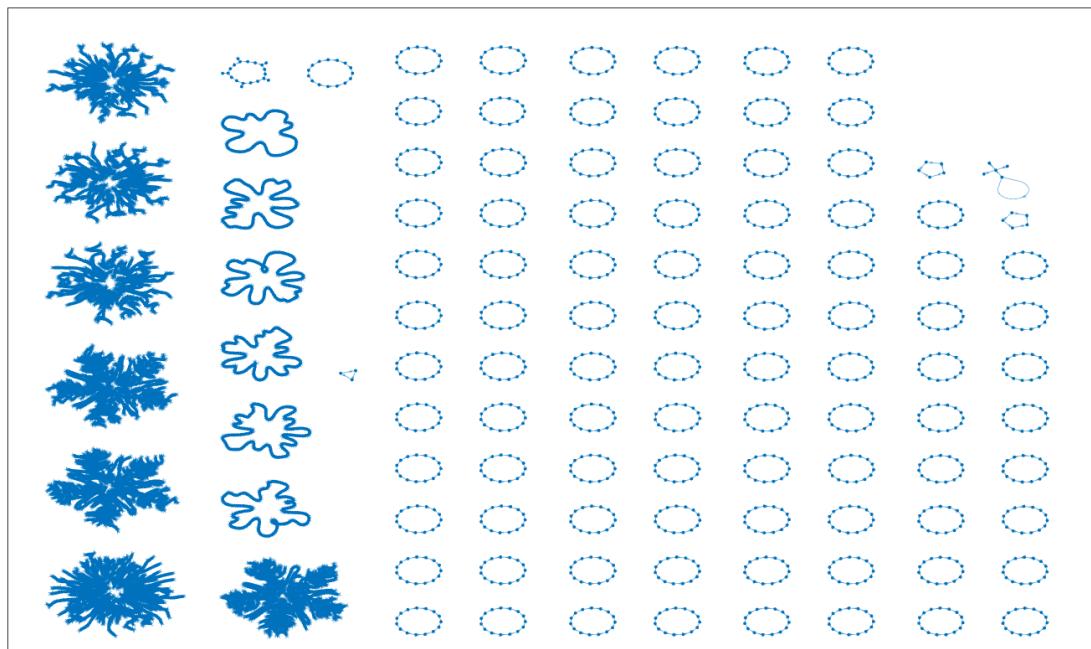


Figura 3.824: Atractor regla 106 n=15

3.61. Reglas 108,201

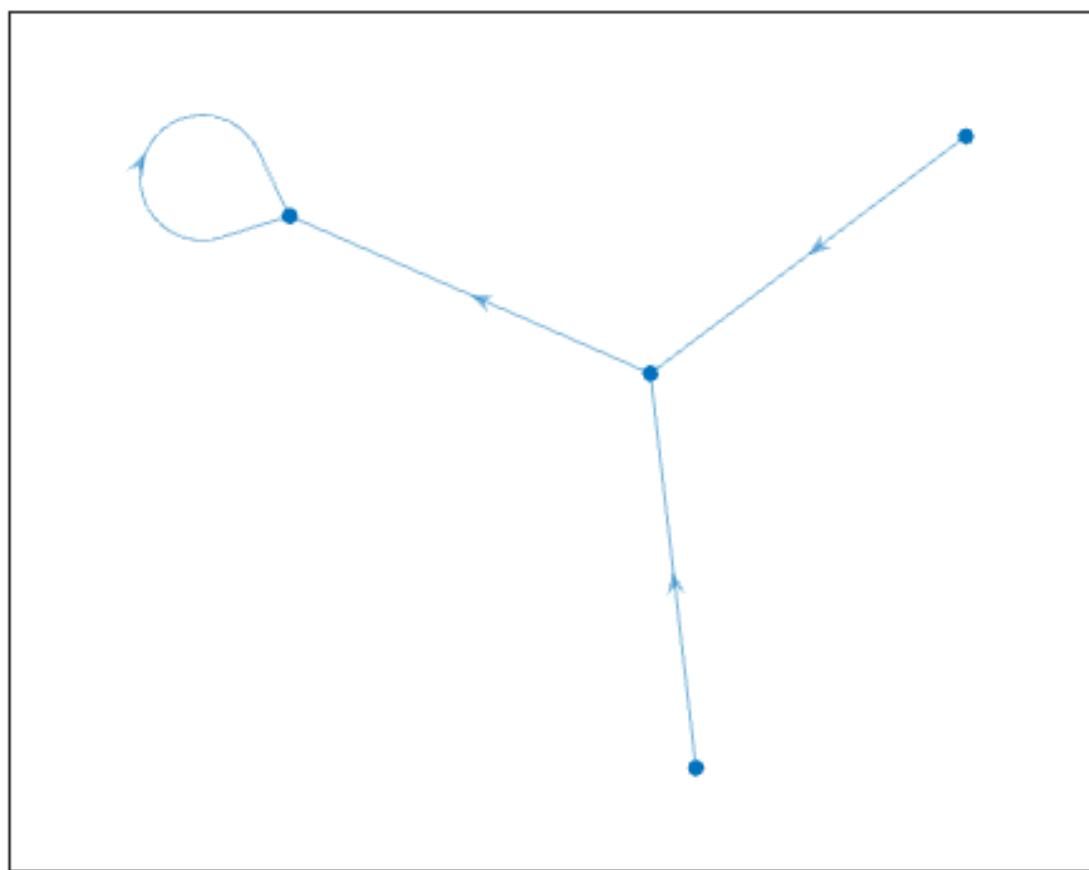


Figura 3.825: Atractor regla 108 n=2

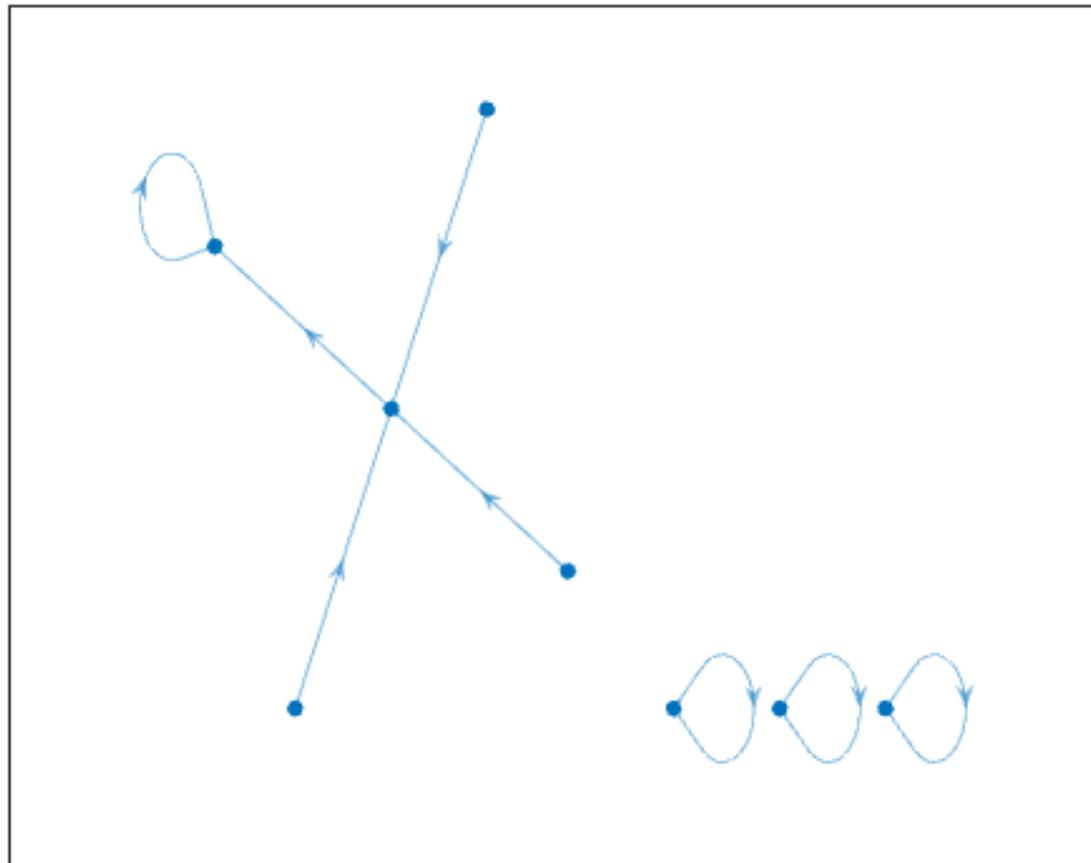
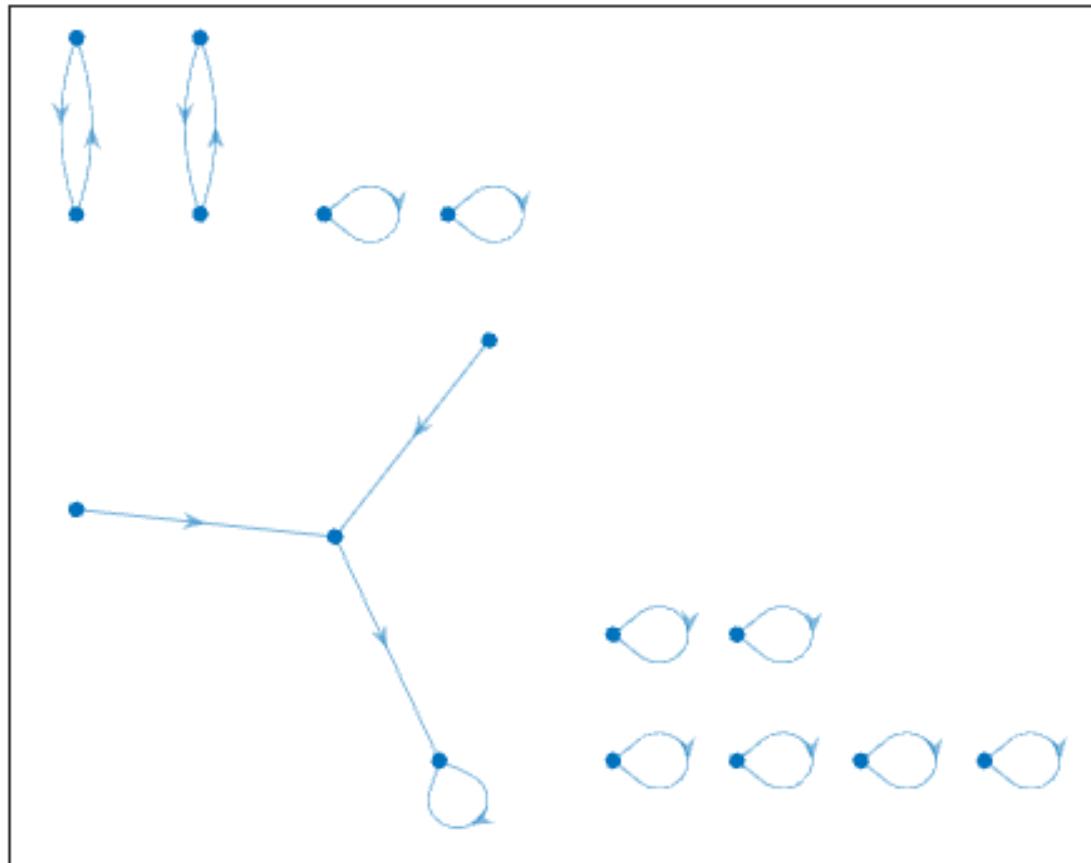


Figura 3.826: Atractor regla 108 n=3

Figura 3.827: Atractor regla 108 $n=4$

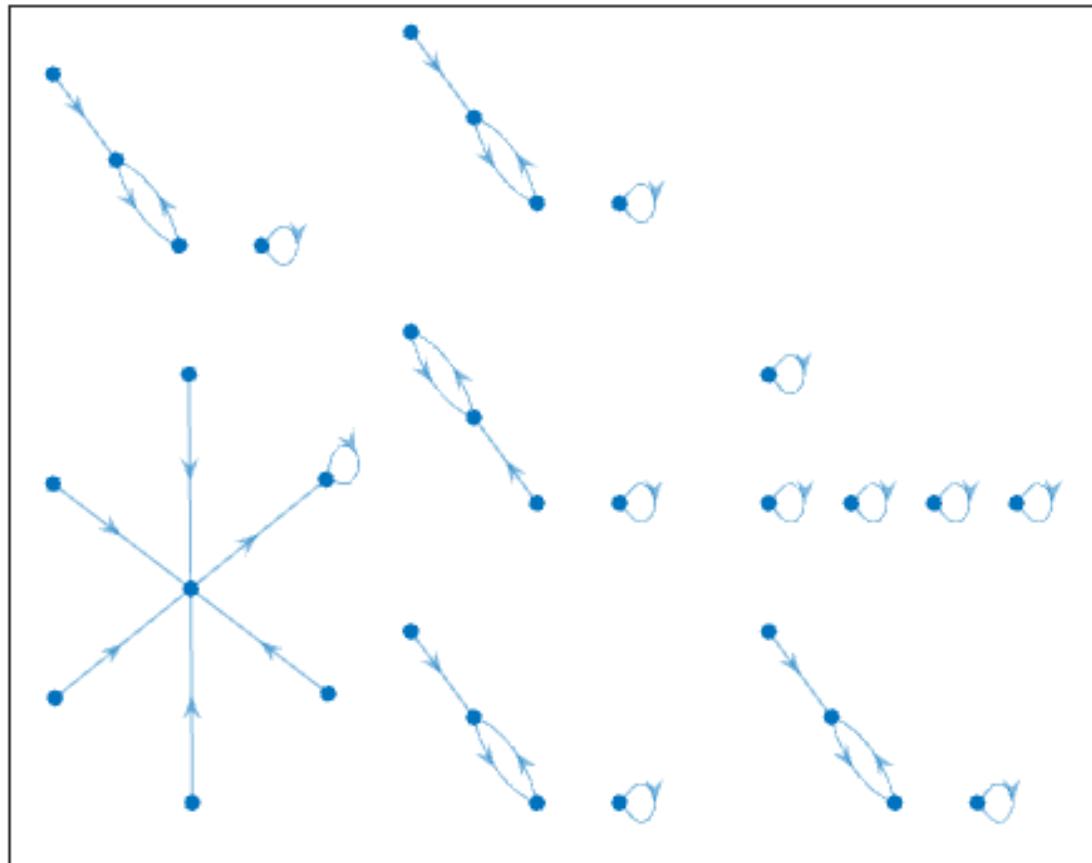


Figura 3.828: Atractor regla 108 n=5

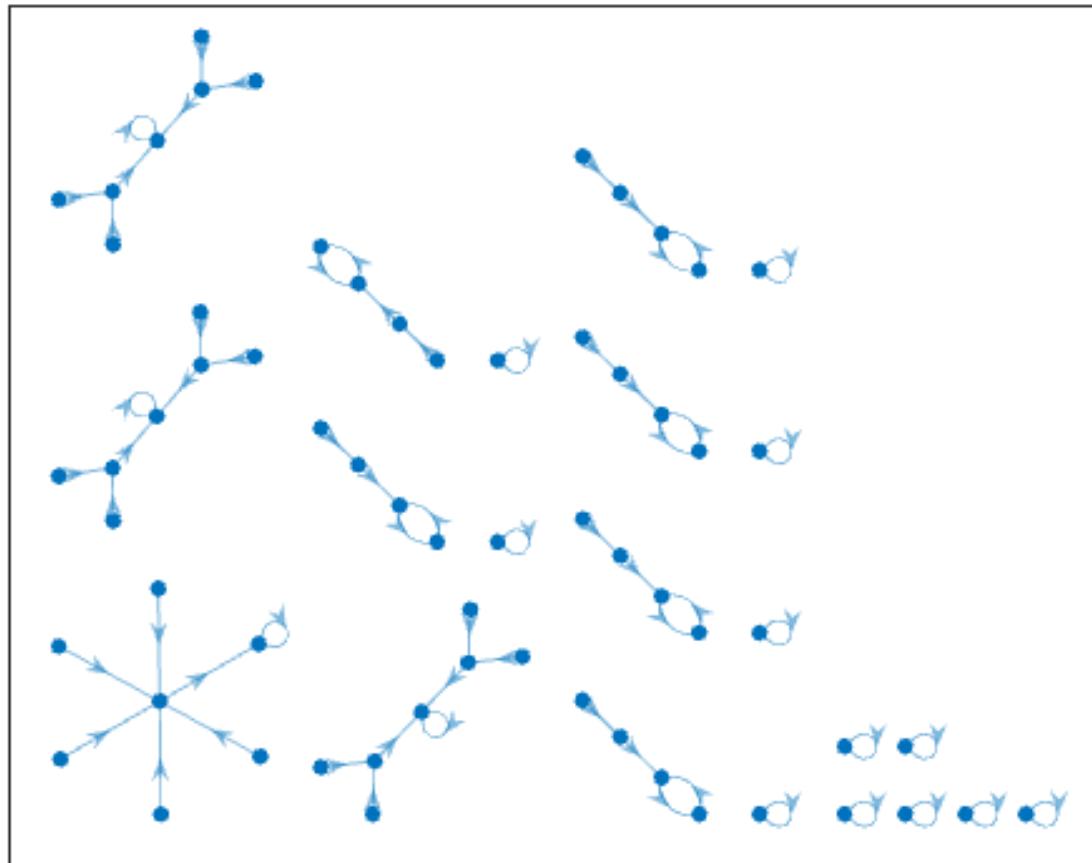


Figura 3.829: Atractor regla 108 n=6

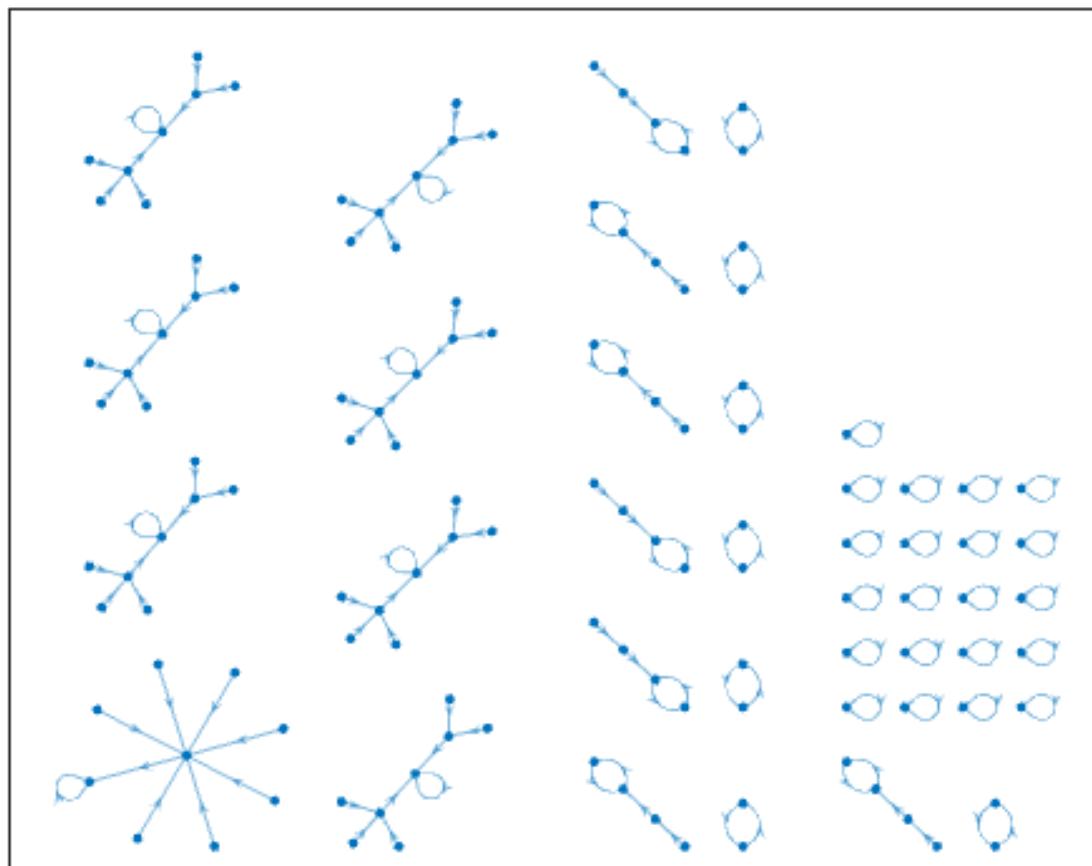


Figura 3.830: Atractor regla 108 n=7

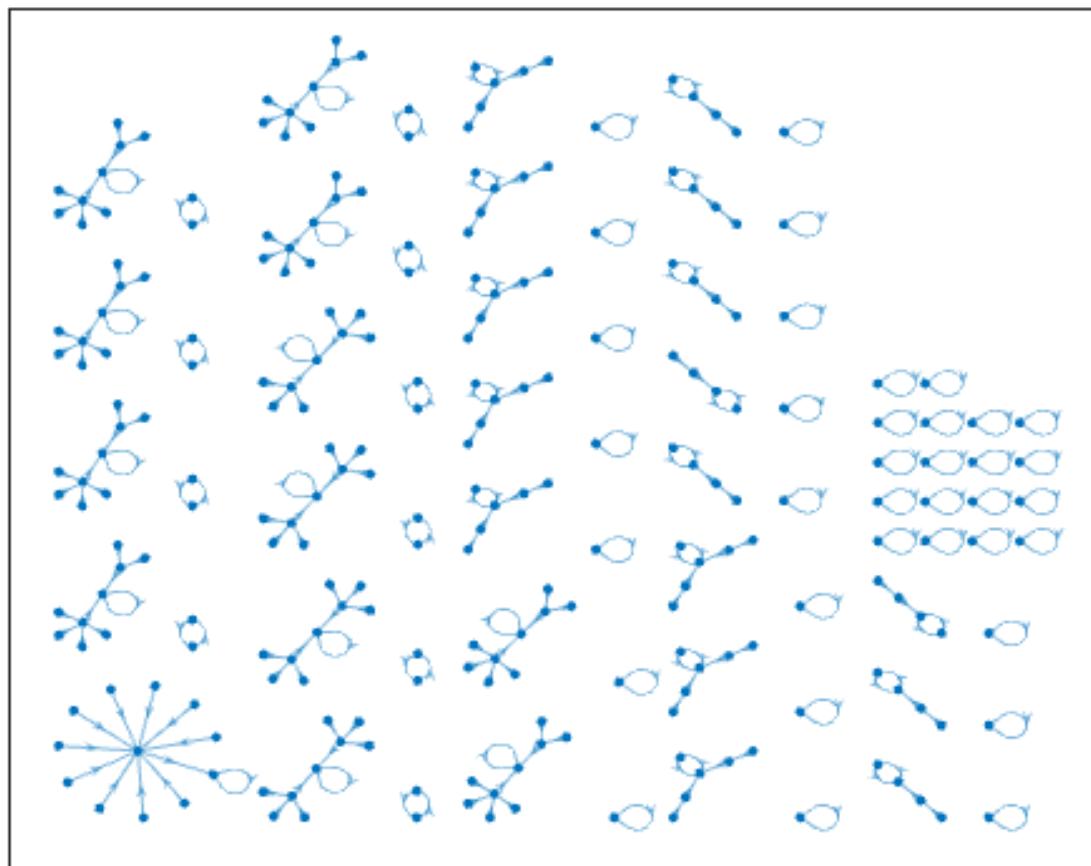


Figura 3.831: Atractor regla 108 n=8

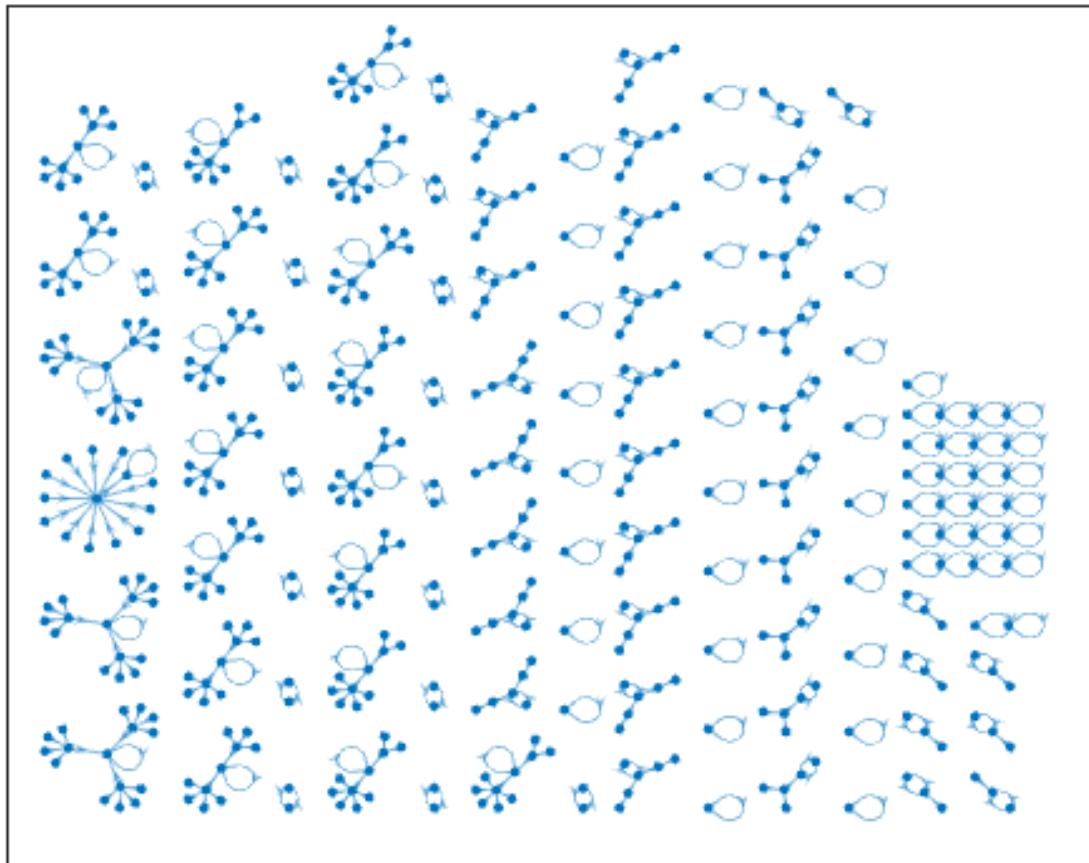


Figura 3.832: Atractor regla 108 n=9

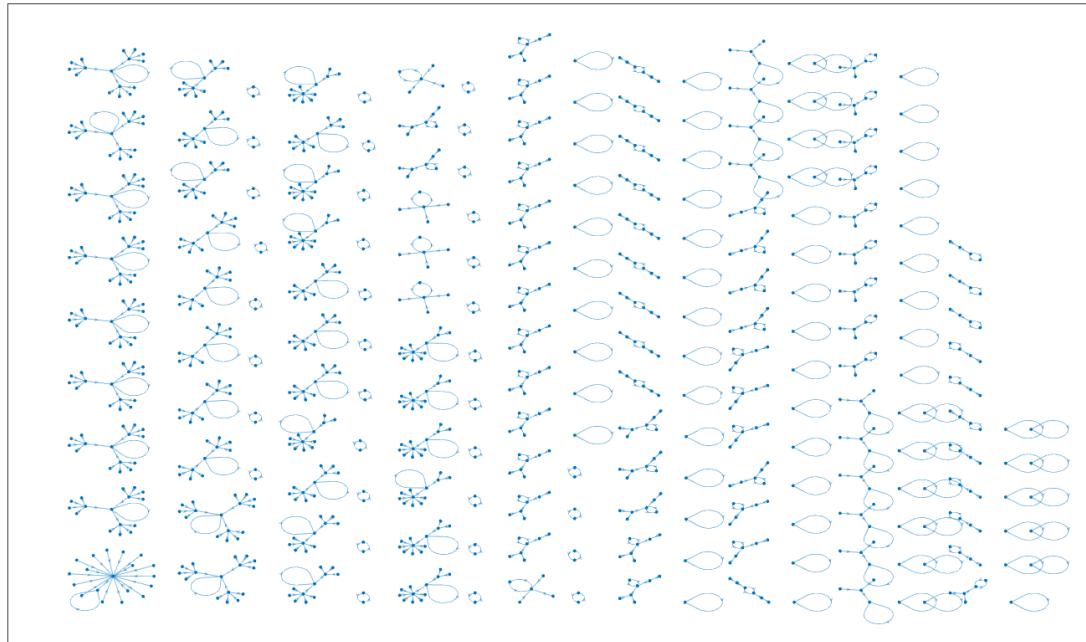


Figura 3.833: Atractor regla 108 n=10

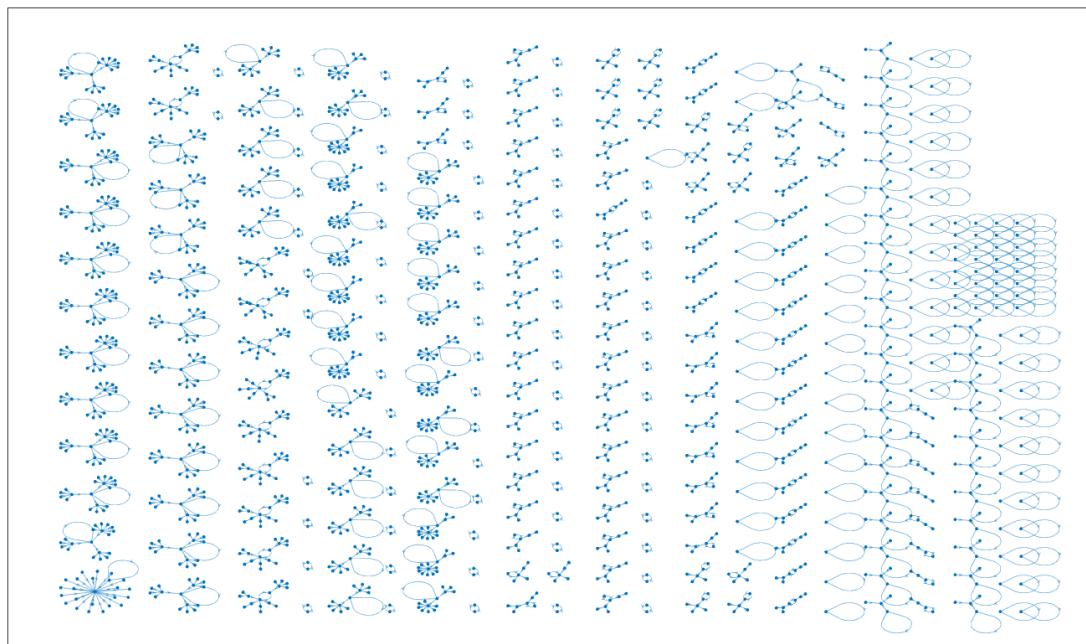


Figura 3.834: Atractor regla 108 n=11

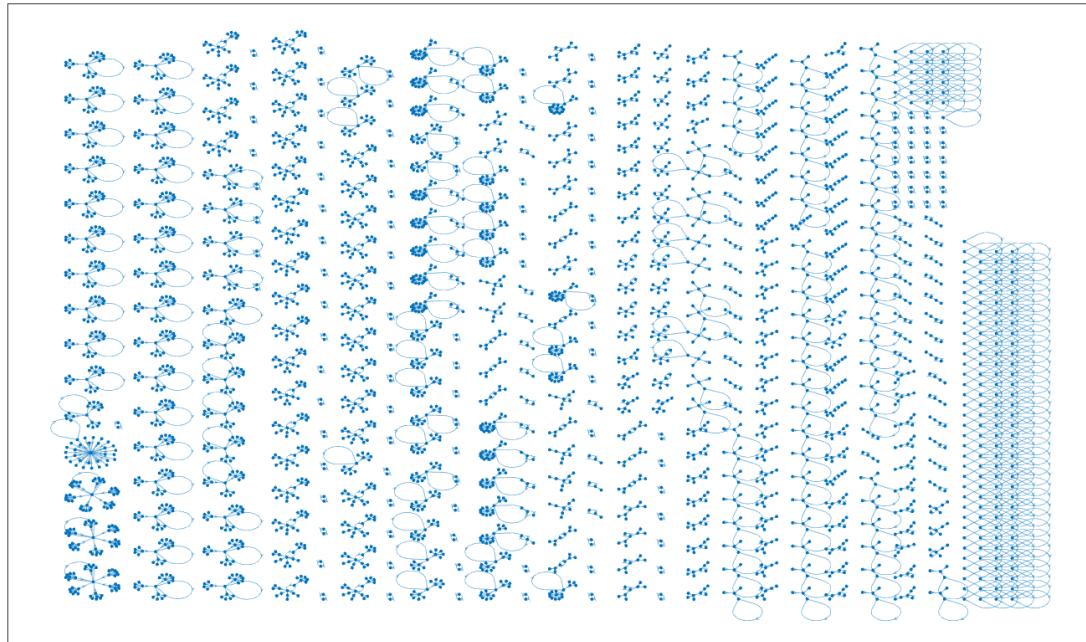


Figura 3.835: Atractor regla 108 n=12

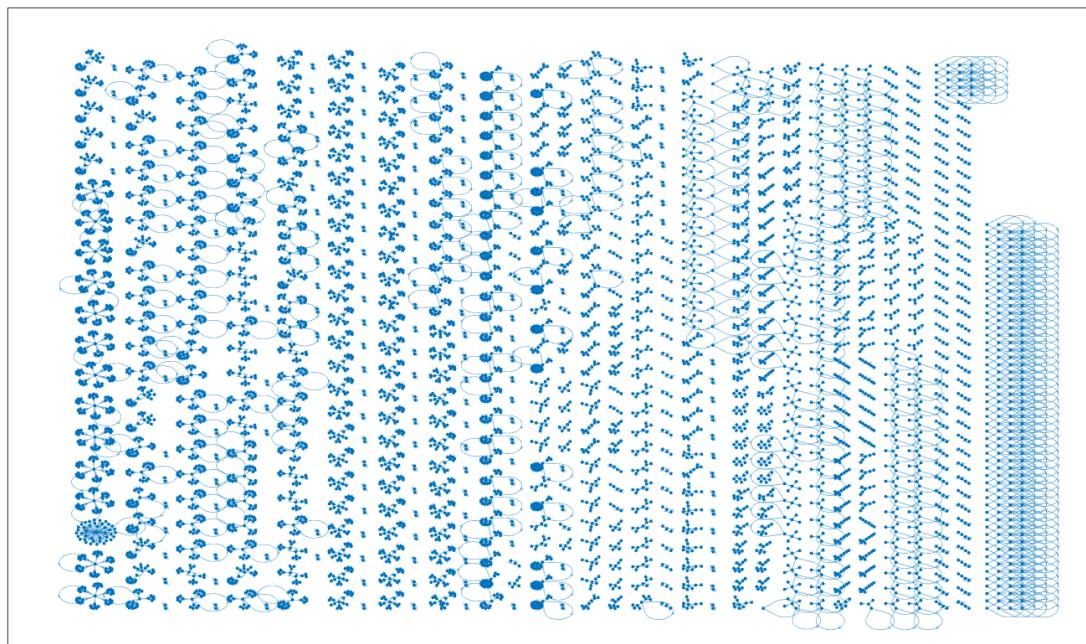


Figura 3.836: Atractor regla 108 n=13

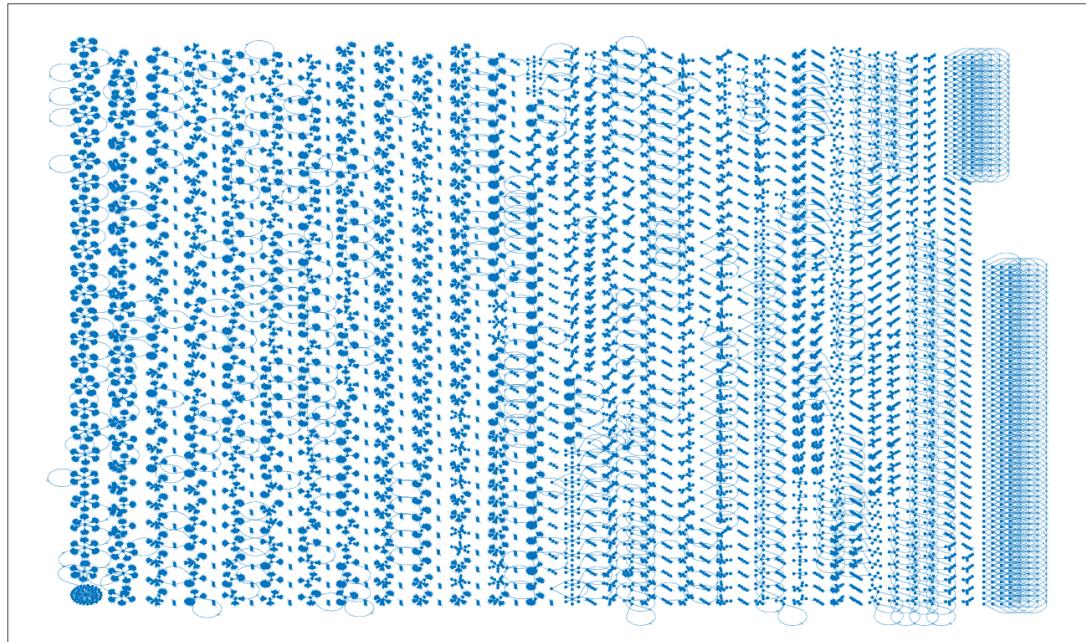


Figura 3.837: Atractor regla 108 n=14

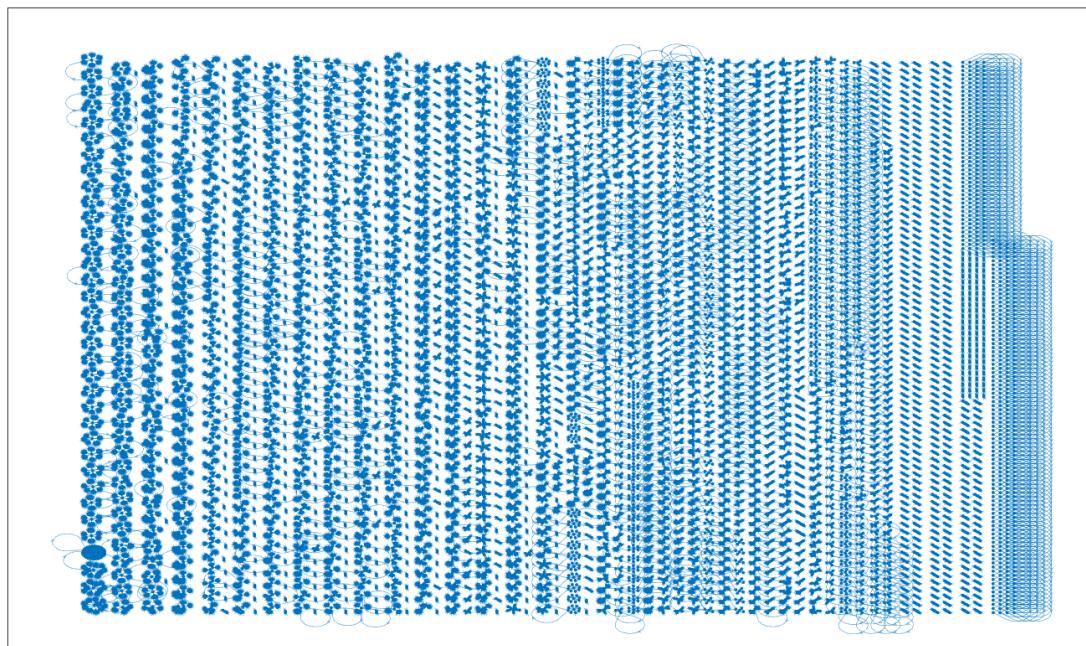


Figura 3.838: Atractor regla 108 n=15

3.62. Reglas 110,124,137,193

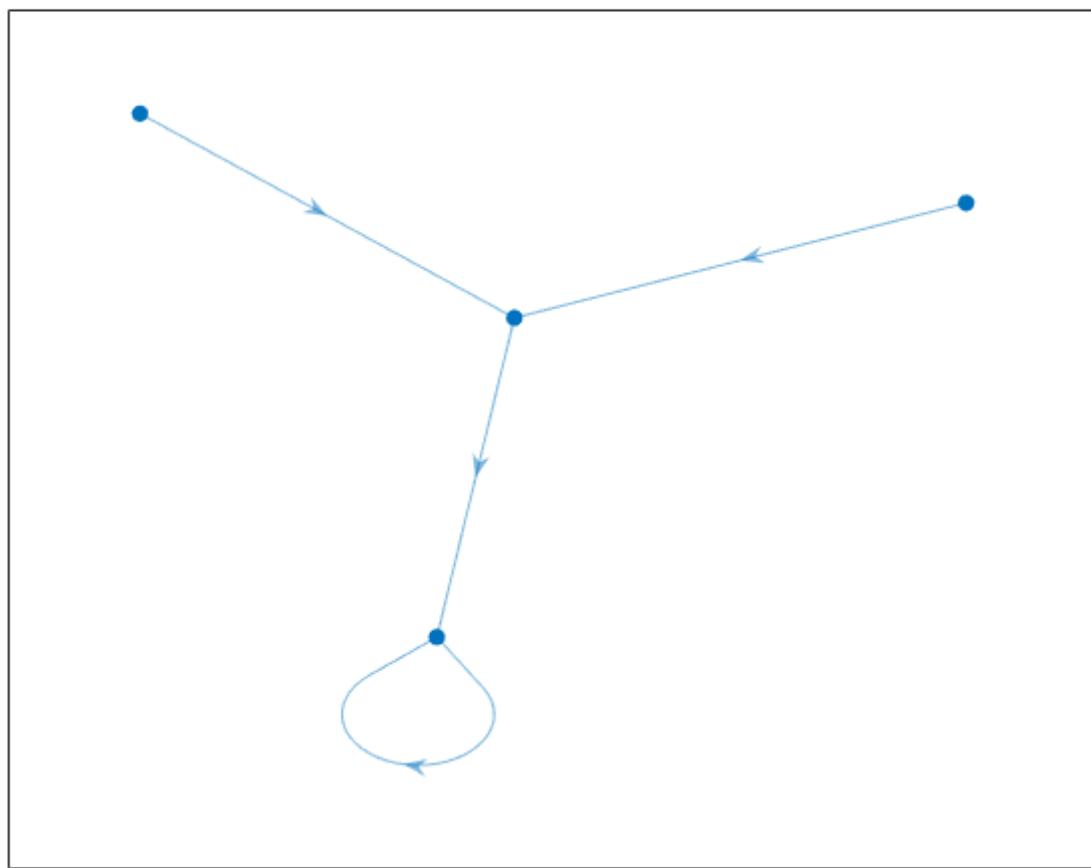


Figura 3.839: Atractor regla 110 n=2

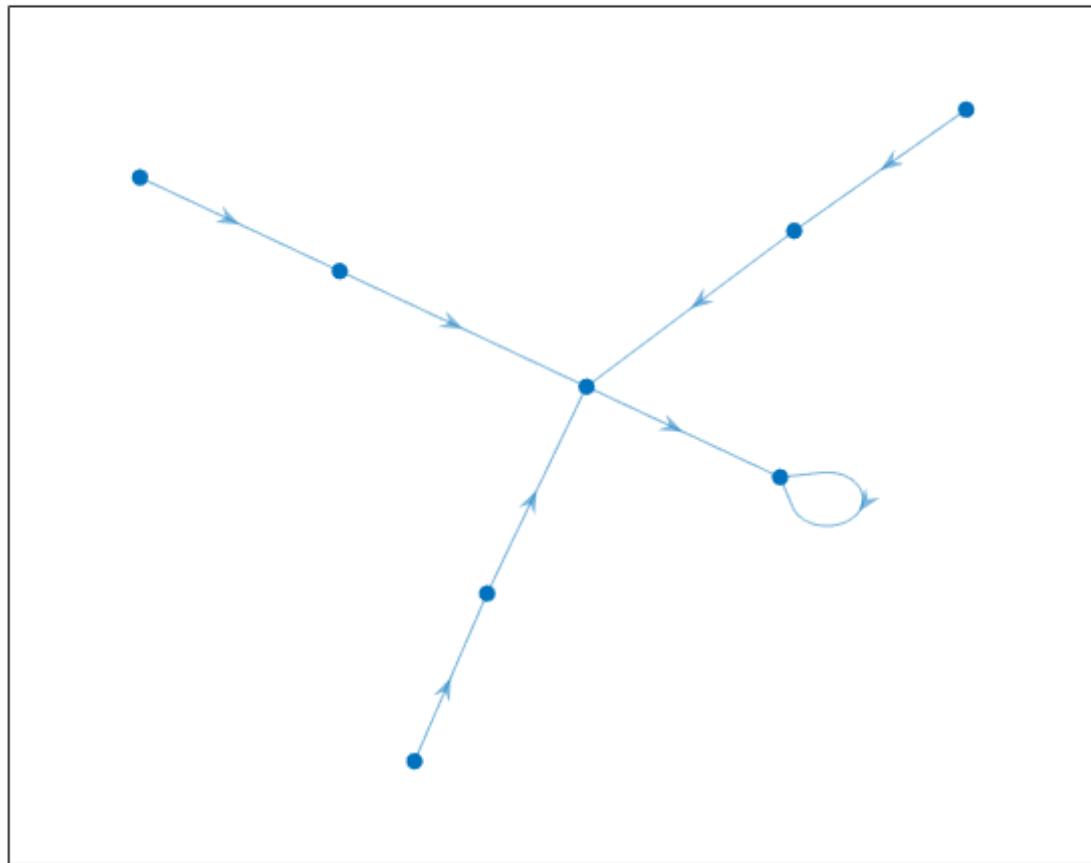


Figura 3.840: Atractor regla 110 n=3

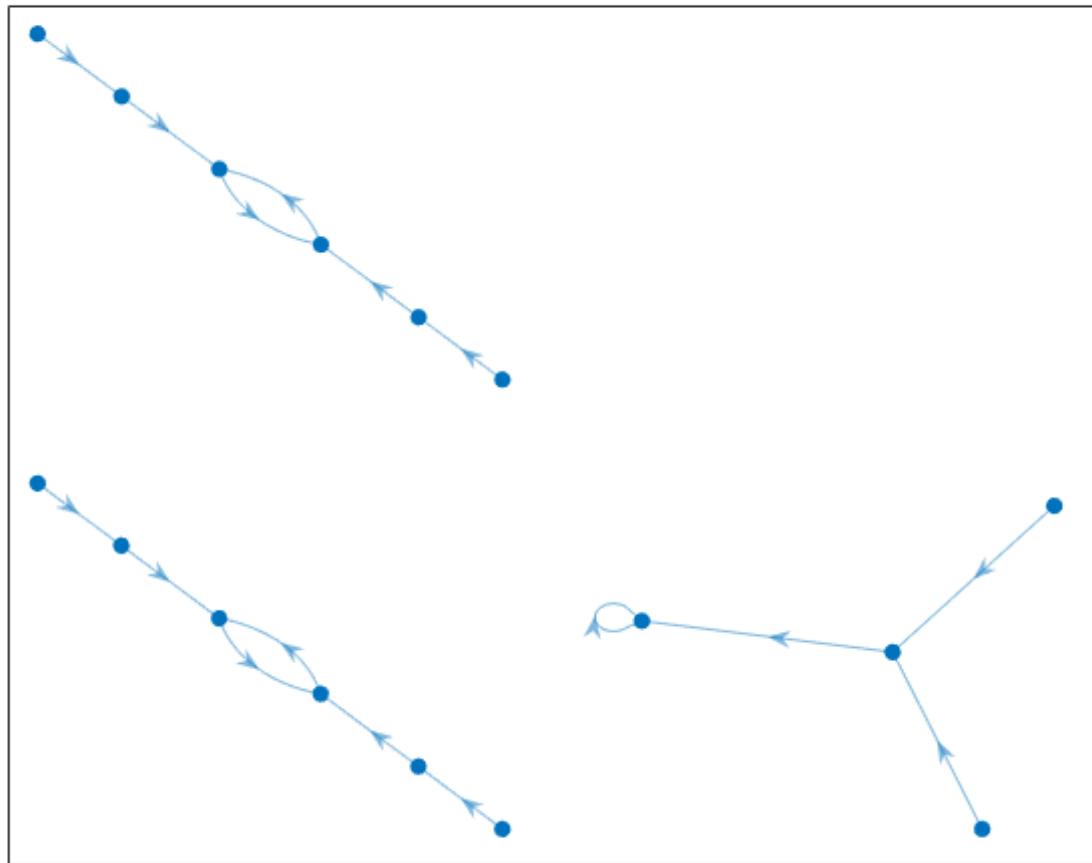


Figura 3.841: Atractor regla 110 n=4

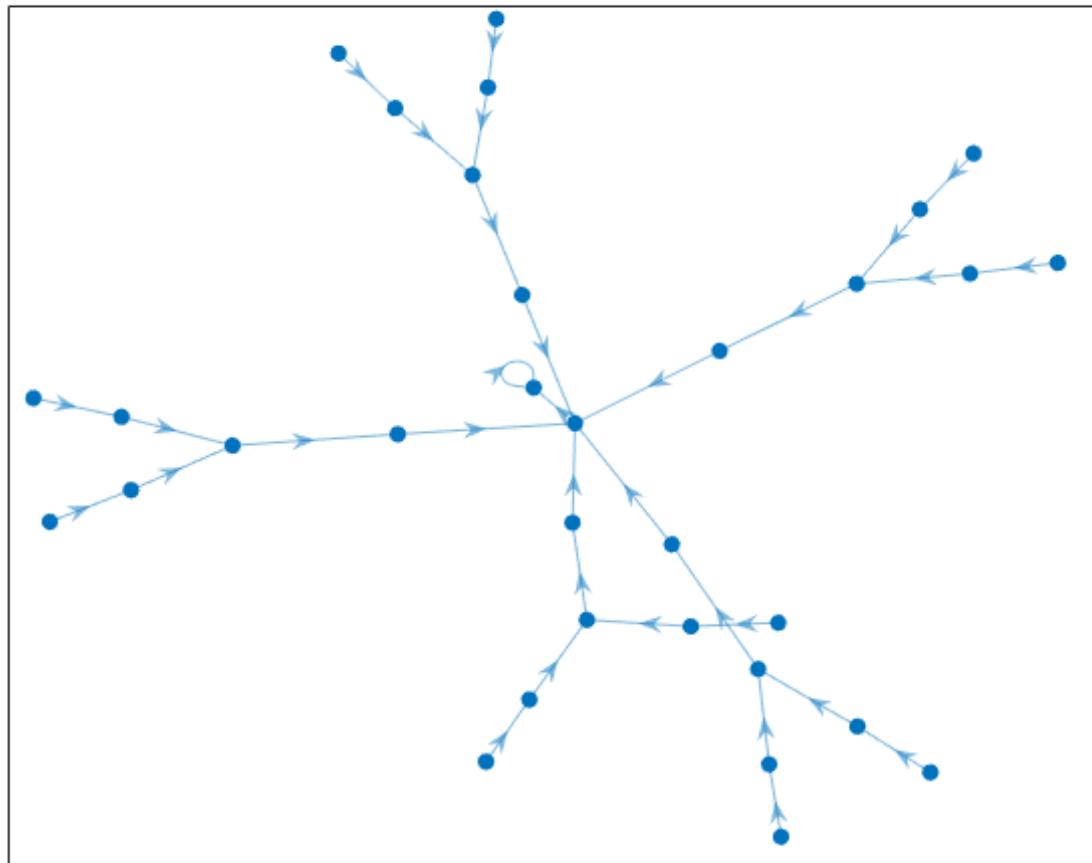


Figura 3.842: Atractor regla 110 n=5

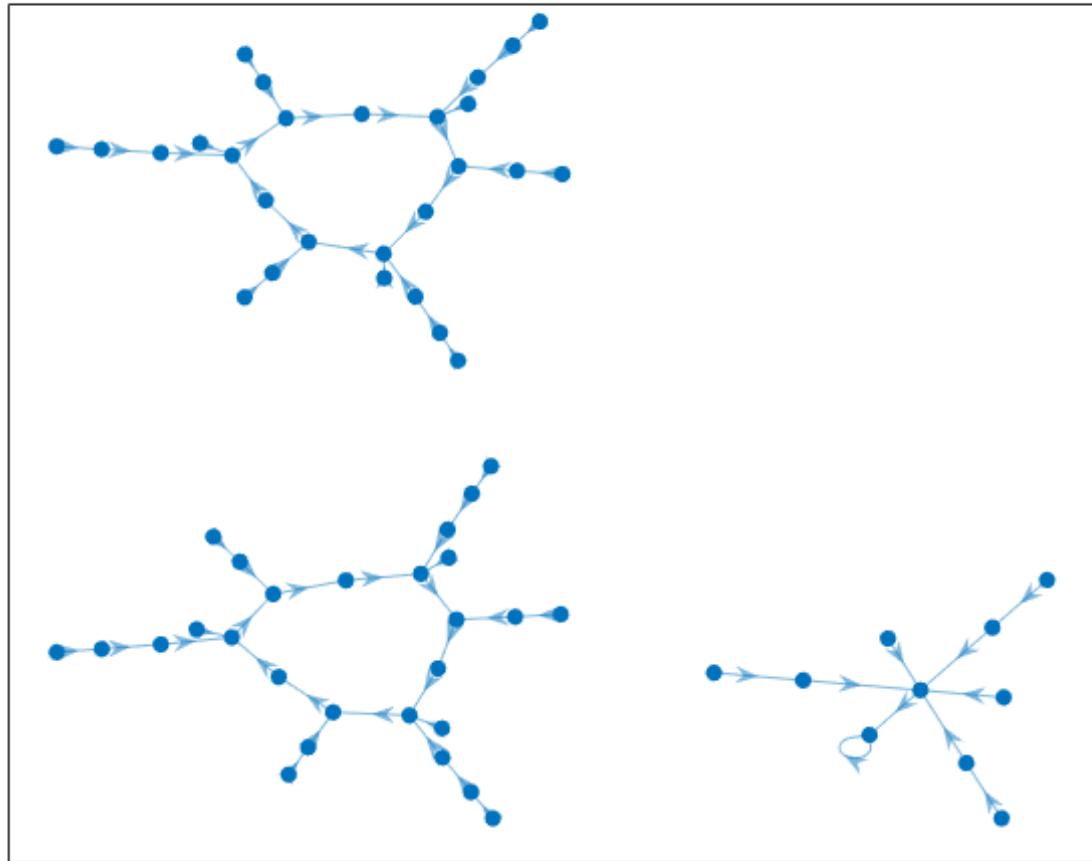


Figura 3.843: Atractor regla 110 n=6

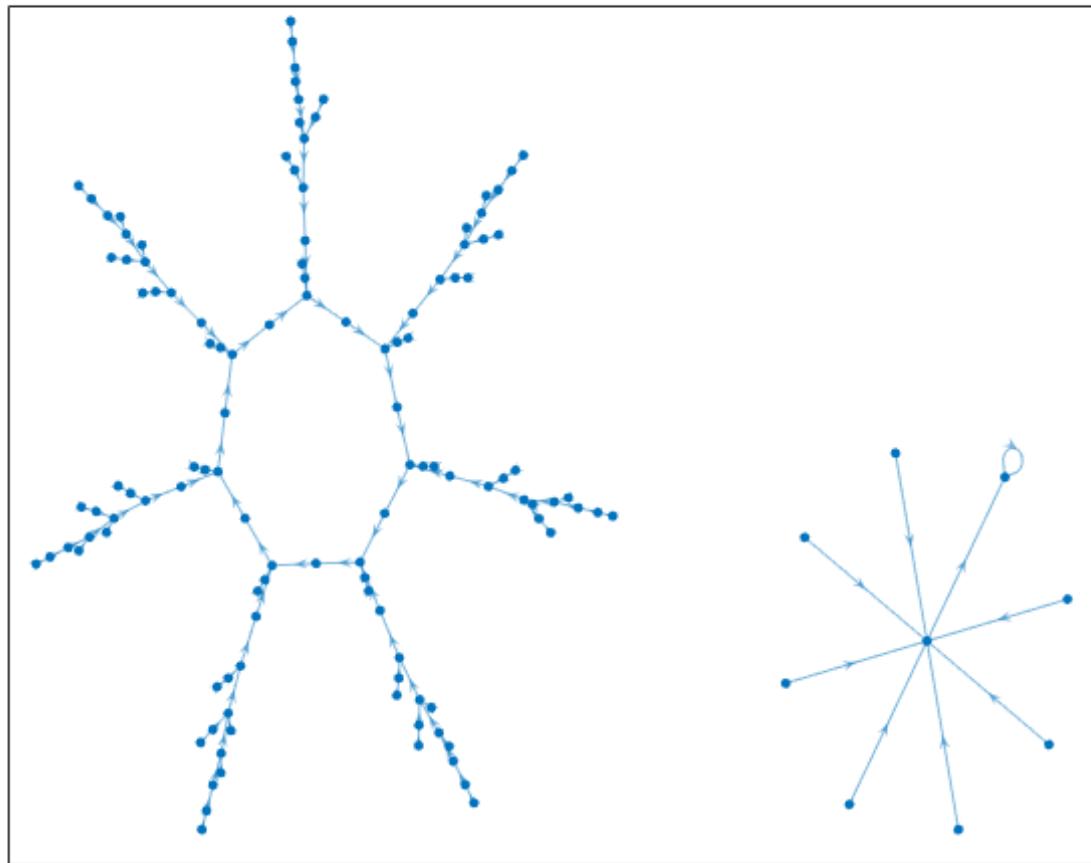


Figura 3.844: Atractor regla 110 n=7

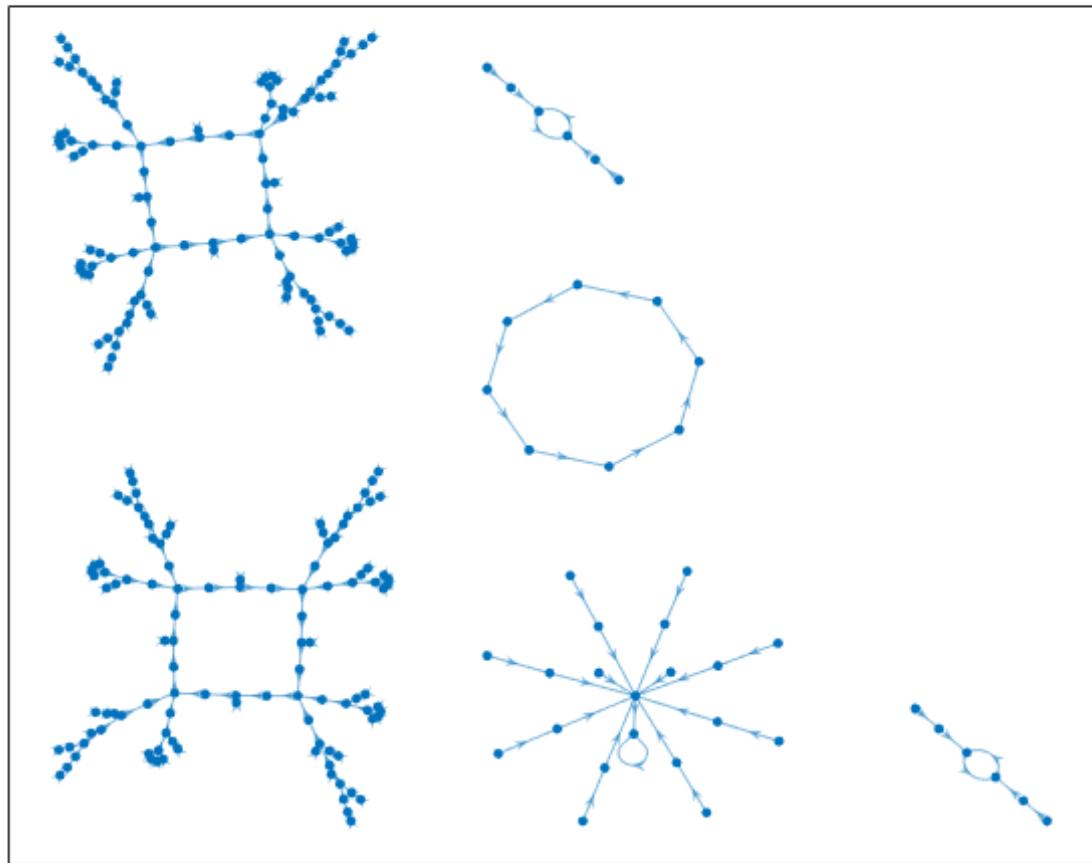


Figura 3.845: Atractor regla 110 n=8

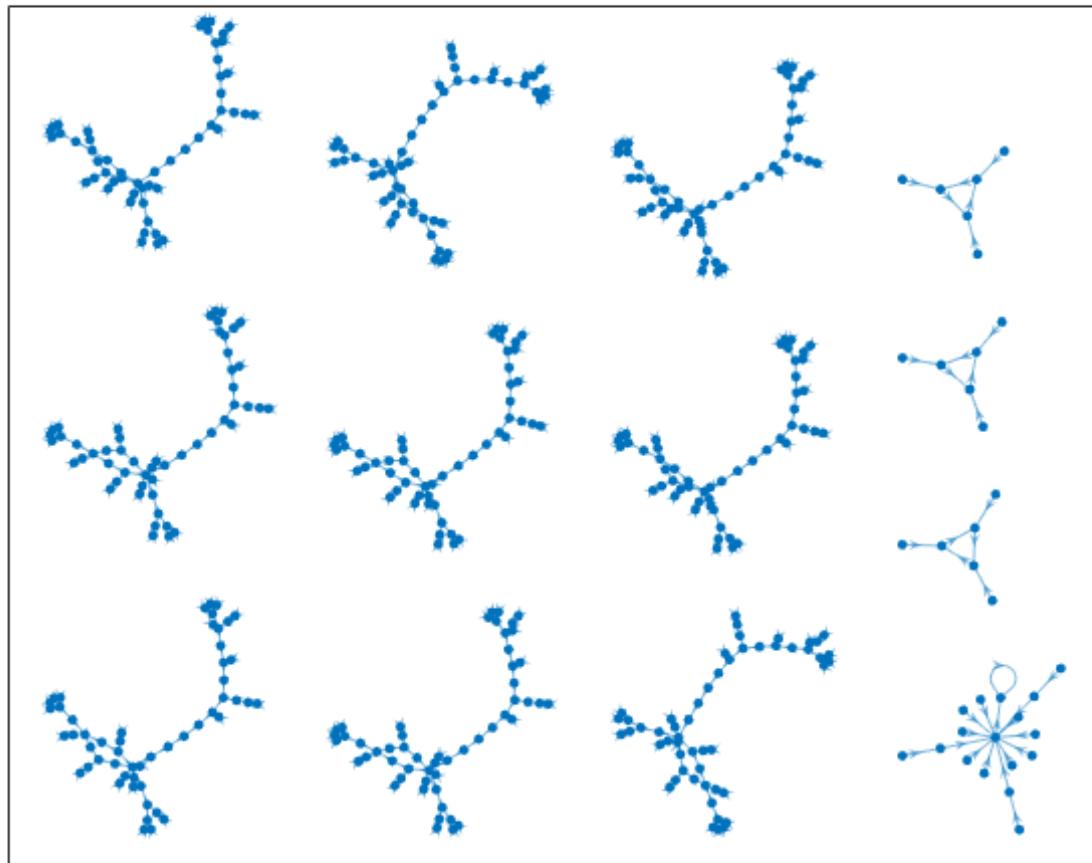


Figura 3.846: Atractor regla 110 n=9

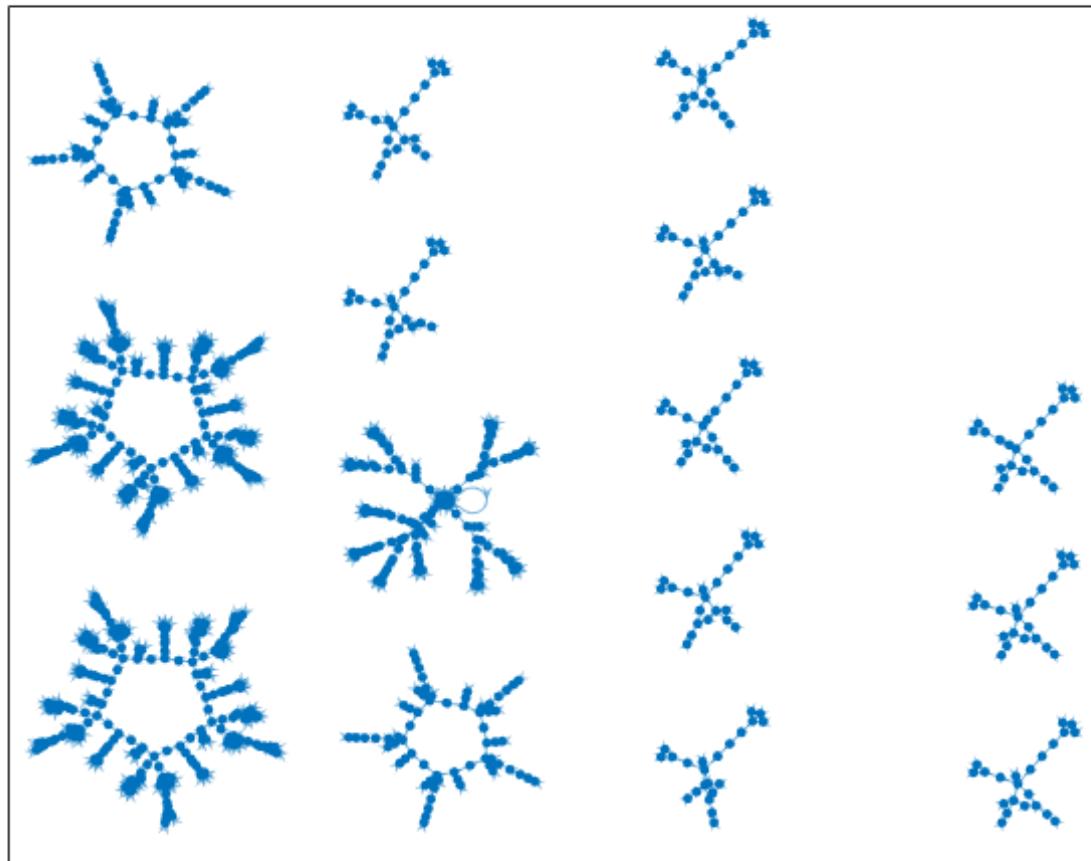


Figura 3.847: Atractor regla 110 n=10

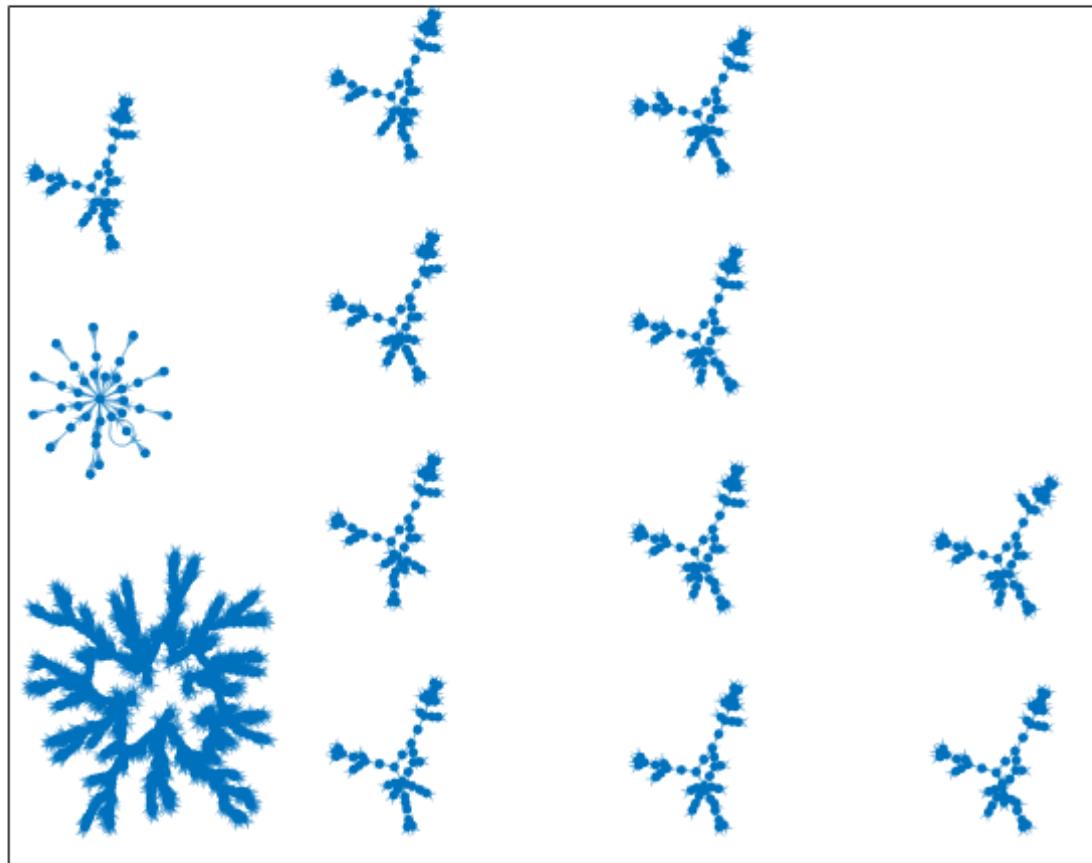
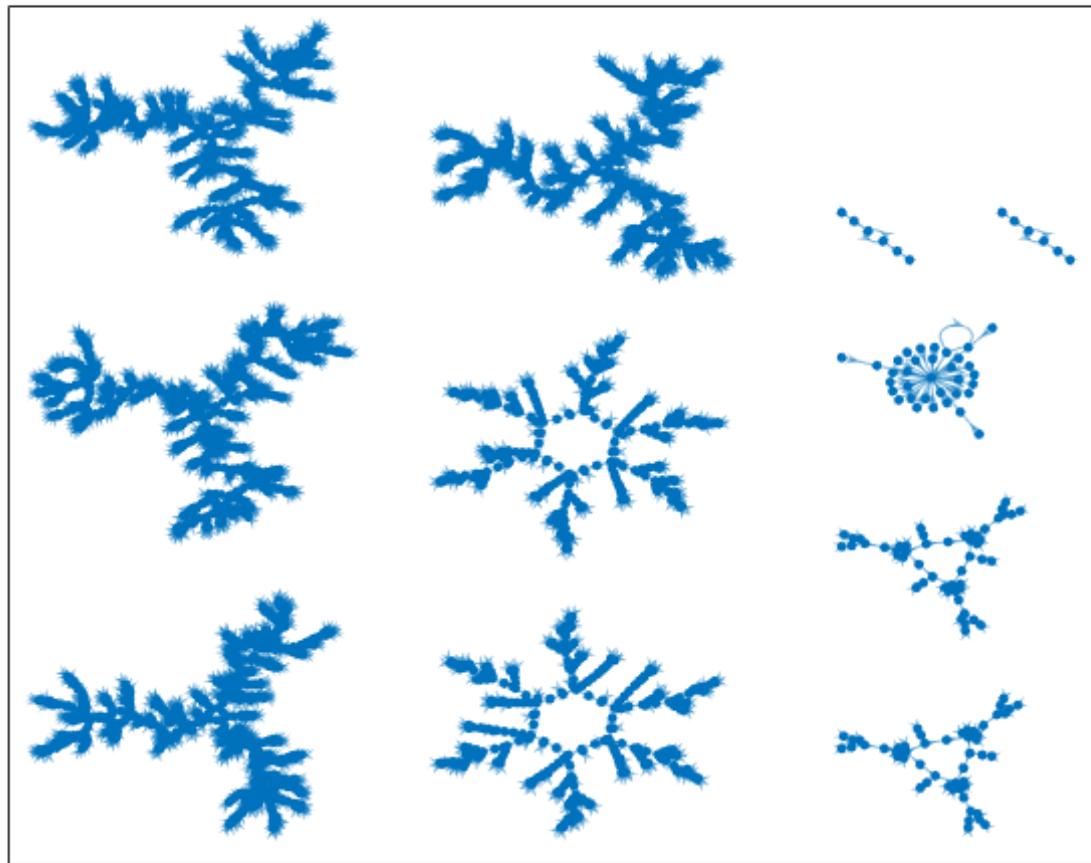


Figura 3.848: Atractor regla 110 n=11

Figura 3.849: Atractor regla 110 $n=12$

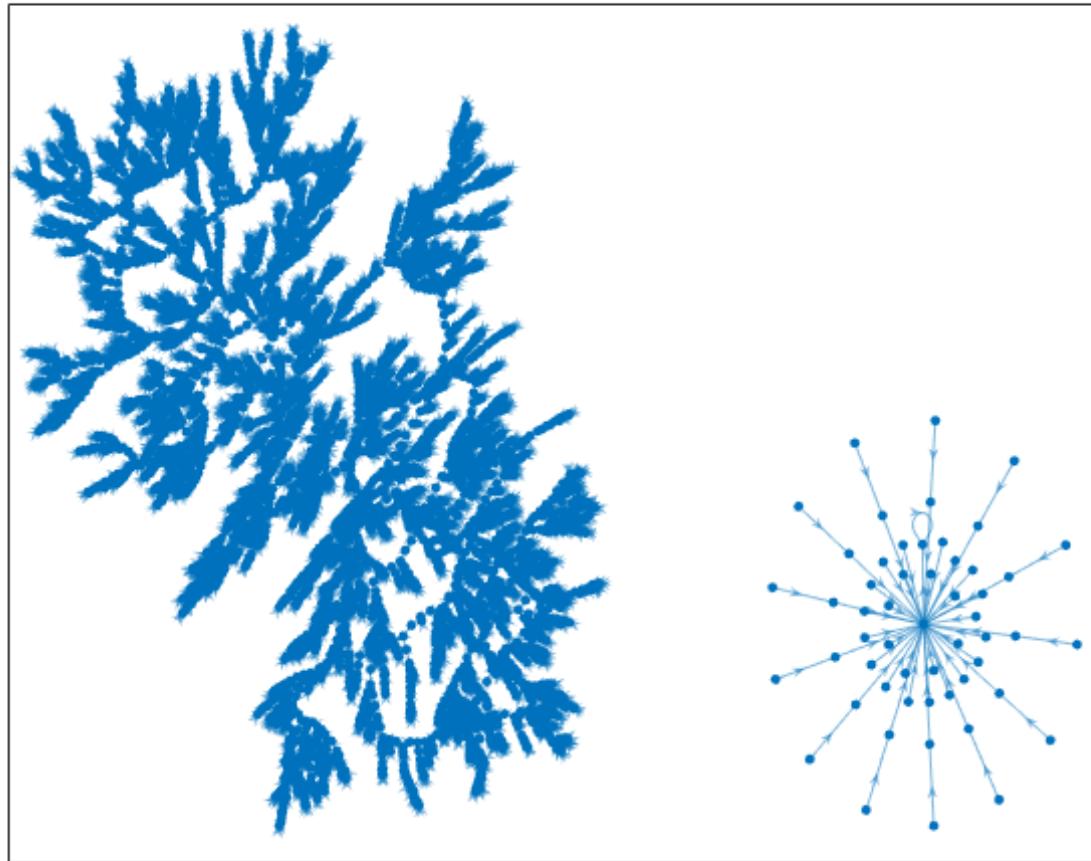
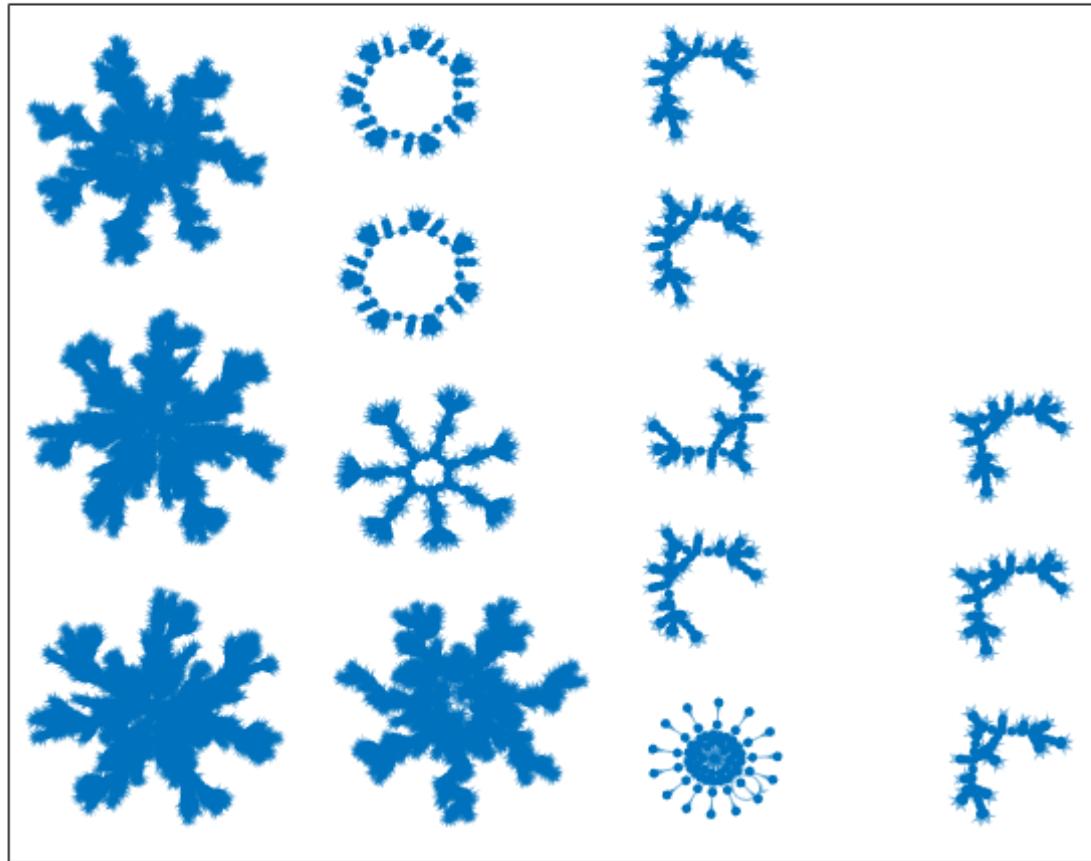


Figura 3.850: Atractor regla 110 n=13

Figura 3.851: Atractor regla 110 $n=14$

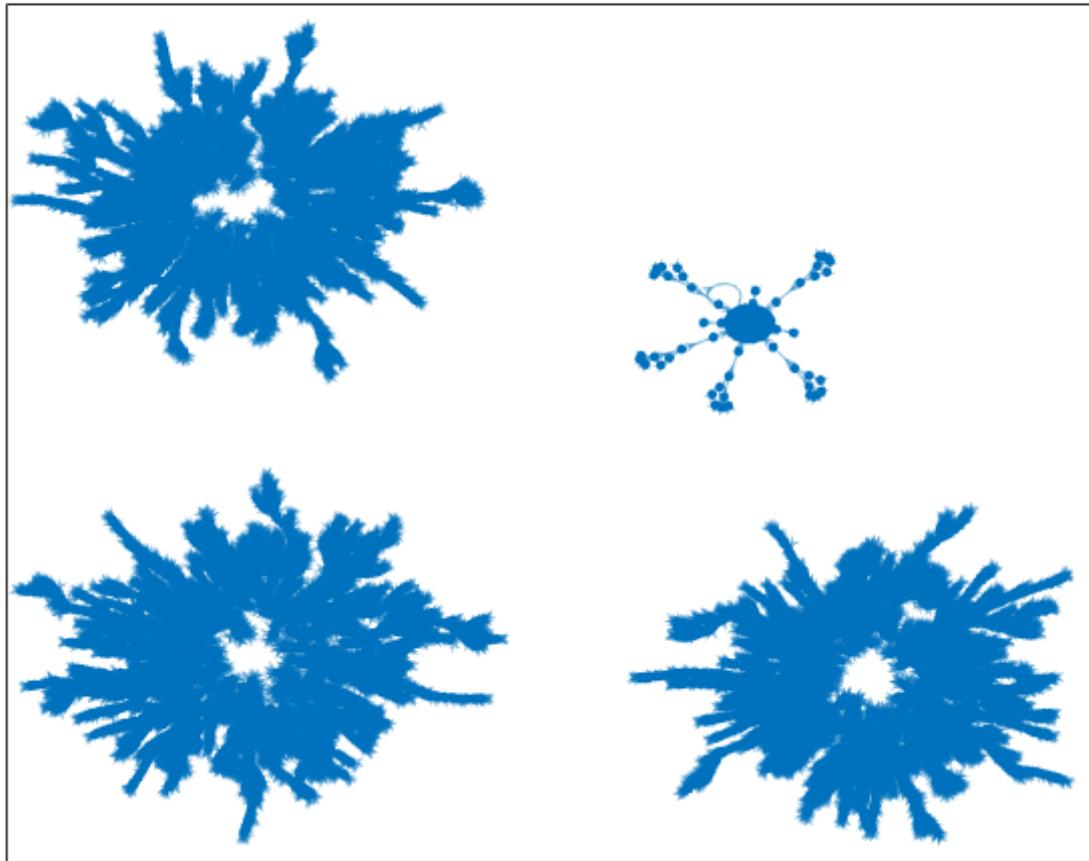


Figura 3.852: Atractor regla 110 n=15

Capítulo 4

Capturas

NOTA

El programa crea espacios cuadrados. El espacio se determina por el producto del número de células que se quieran por fila multiplicado por el tamaño de la célula.

EJEMPLO: Si se quieren 200 células de tamaño 4, entonces el mundo que se generará será de 800x800.

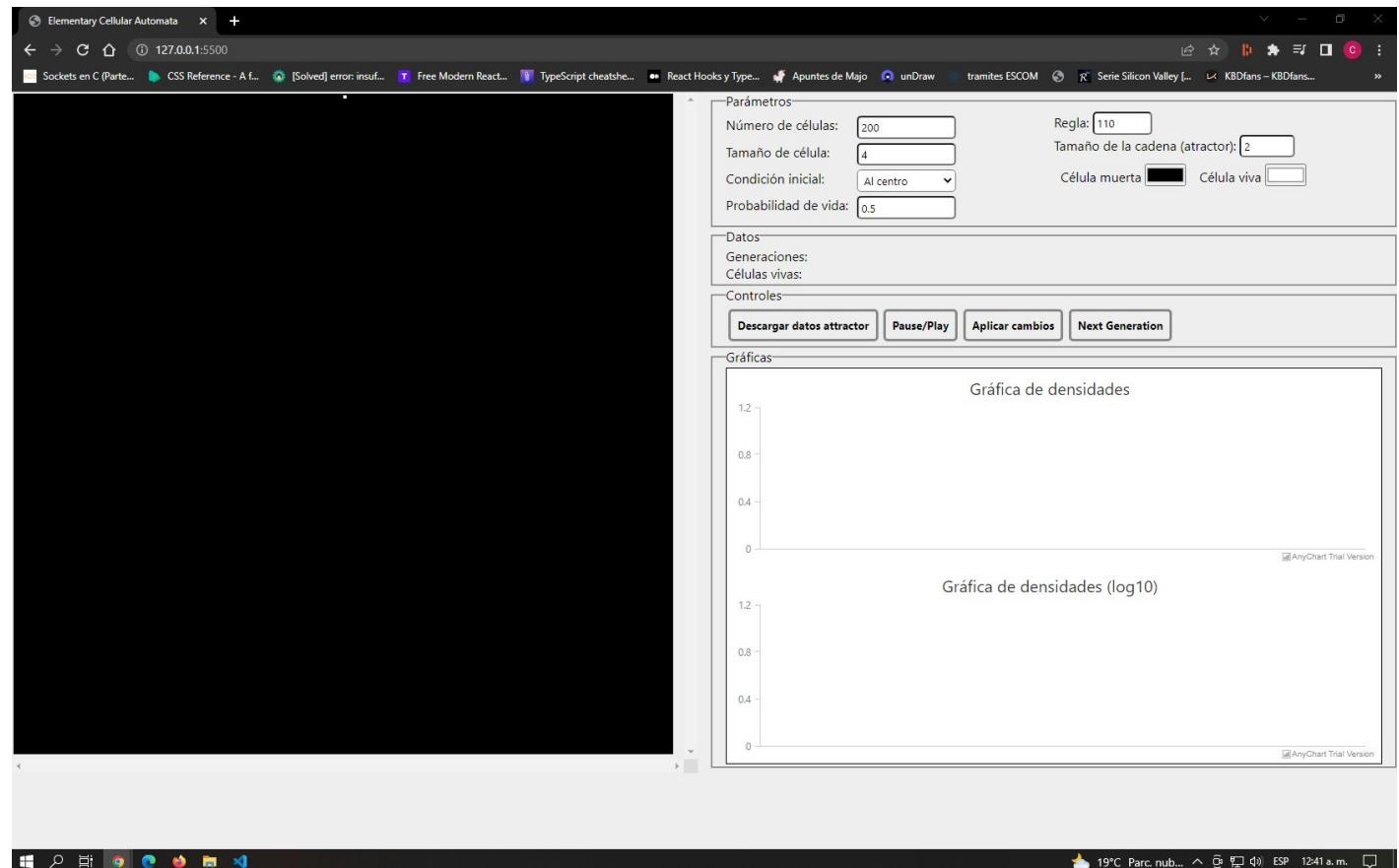


Figura 4.1: Configuración inicial, regla 110, inicio con célula en el centro

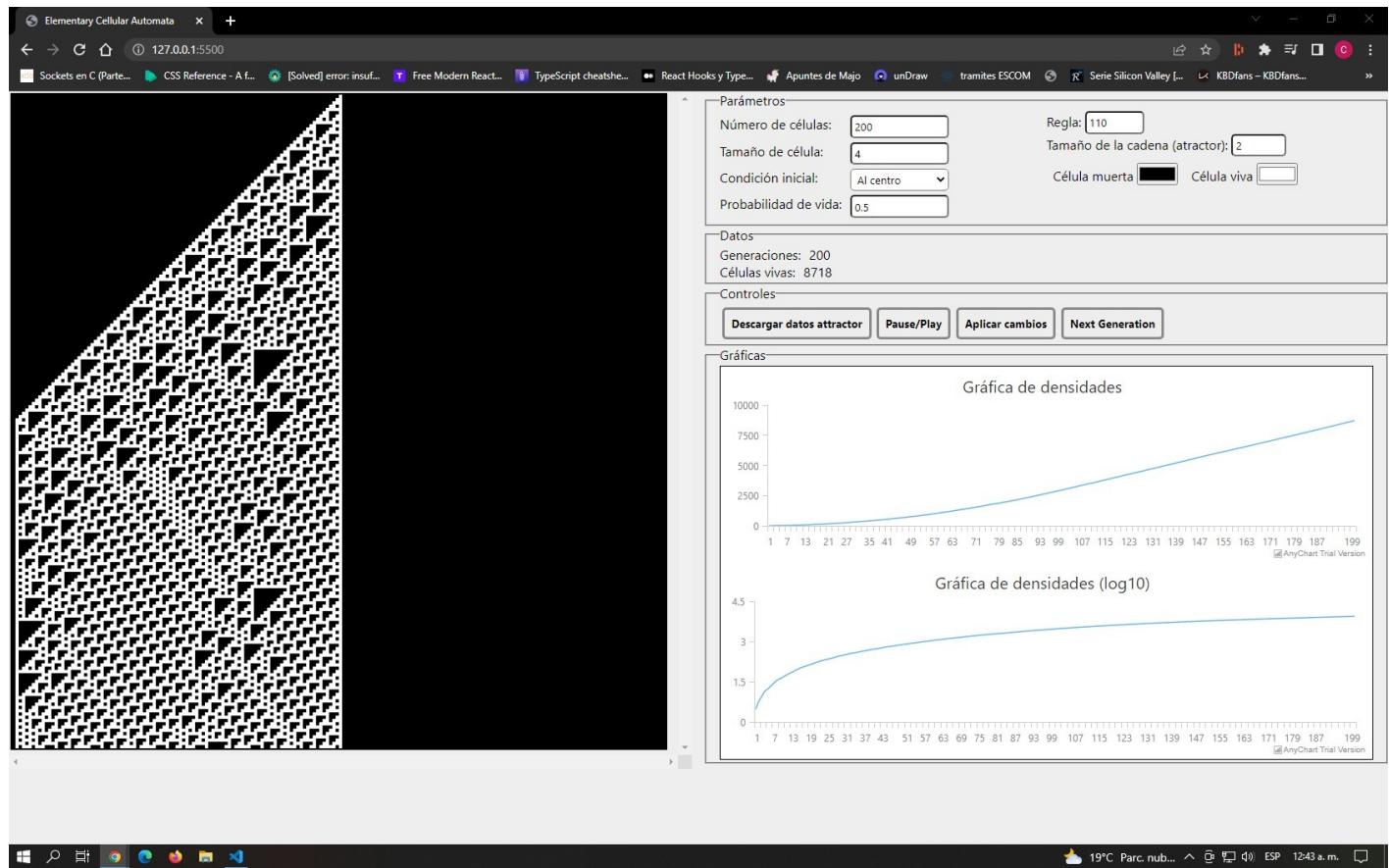


Figura 4.2: Funcionando con la configuración inicial

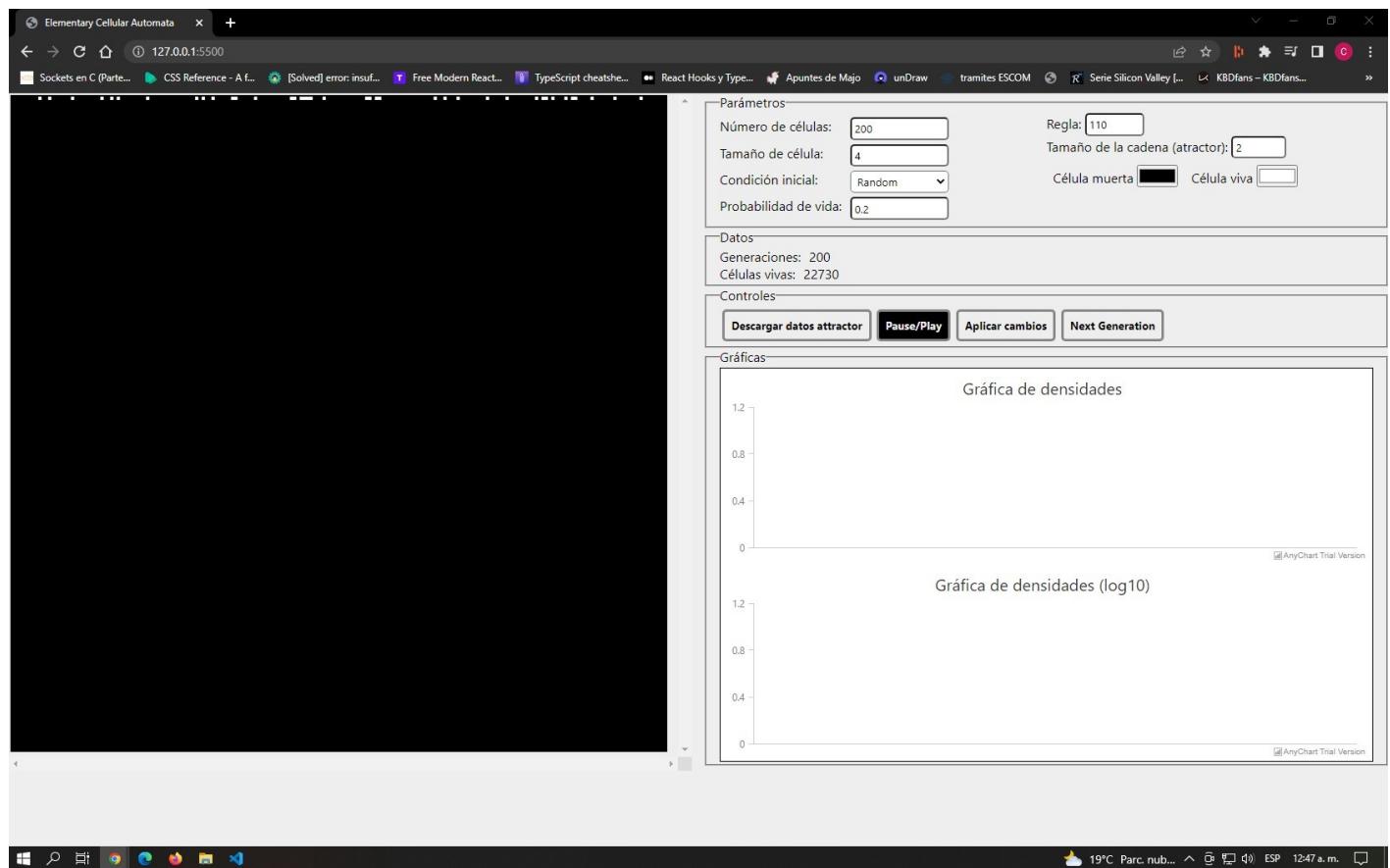


Figura 4.3: Regla 110, inicio con células random, probabilidad de 0.2

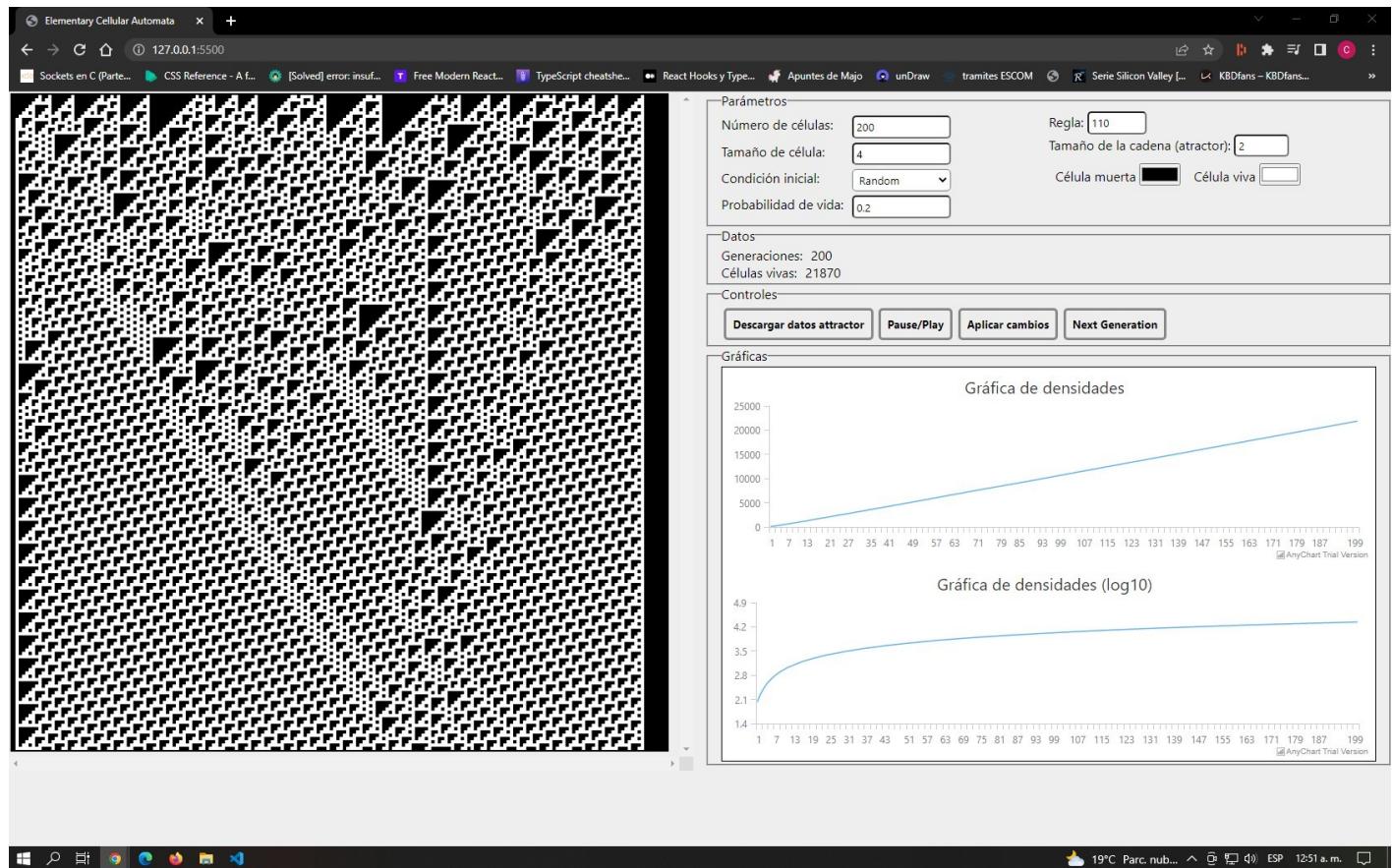


Figura 4.4: Funcionando con regla 110, células random, probabilidad 0.2

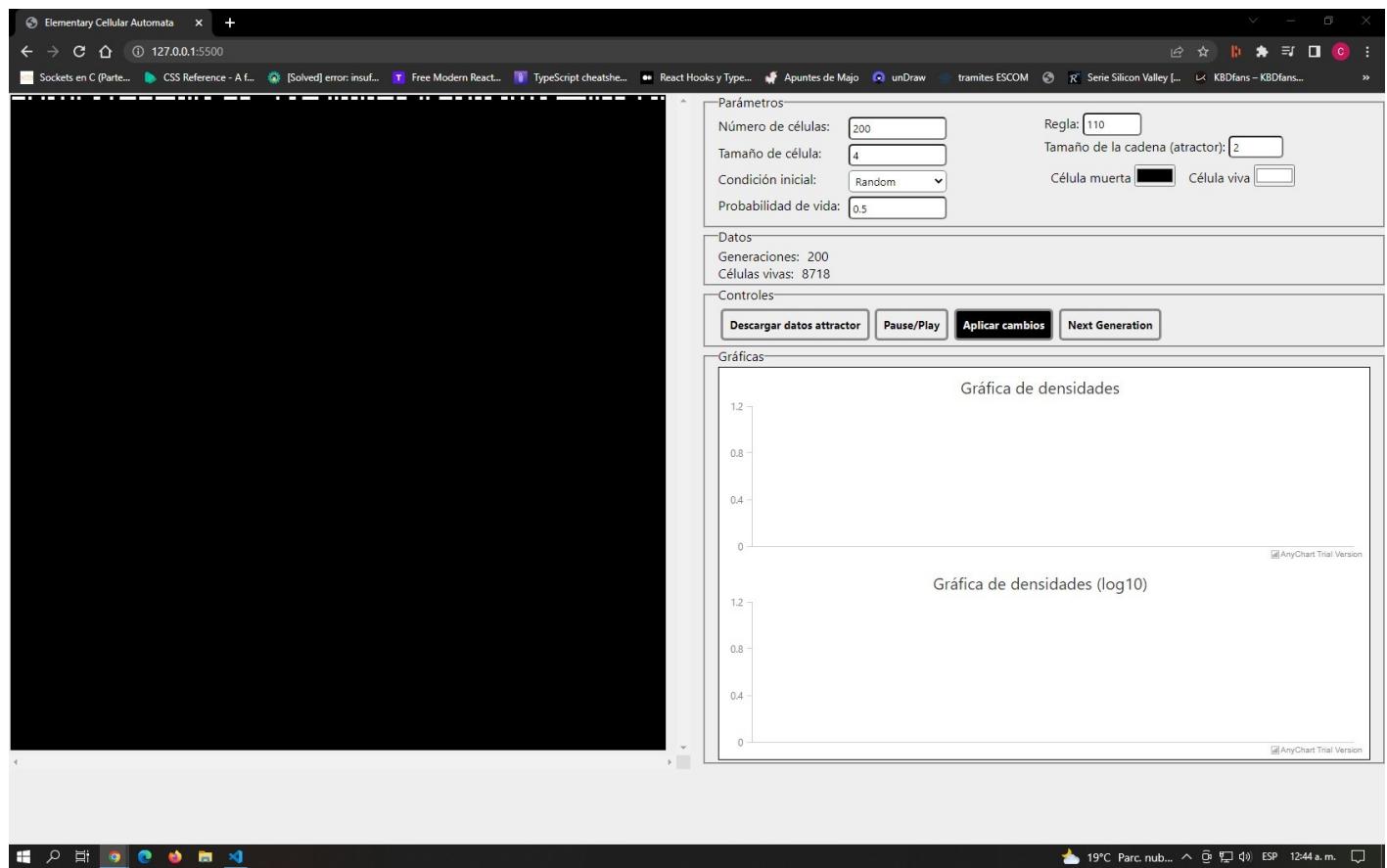


Figura 4.5: Regla 110, inicio con células random, probabilidad de 0.5

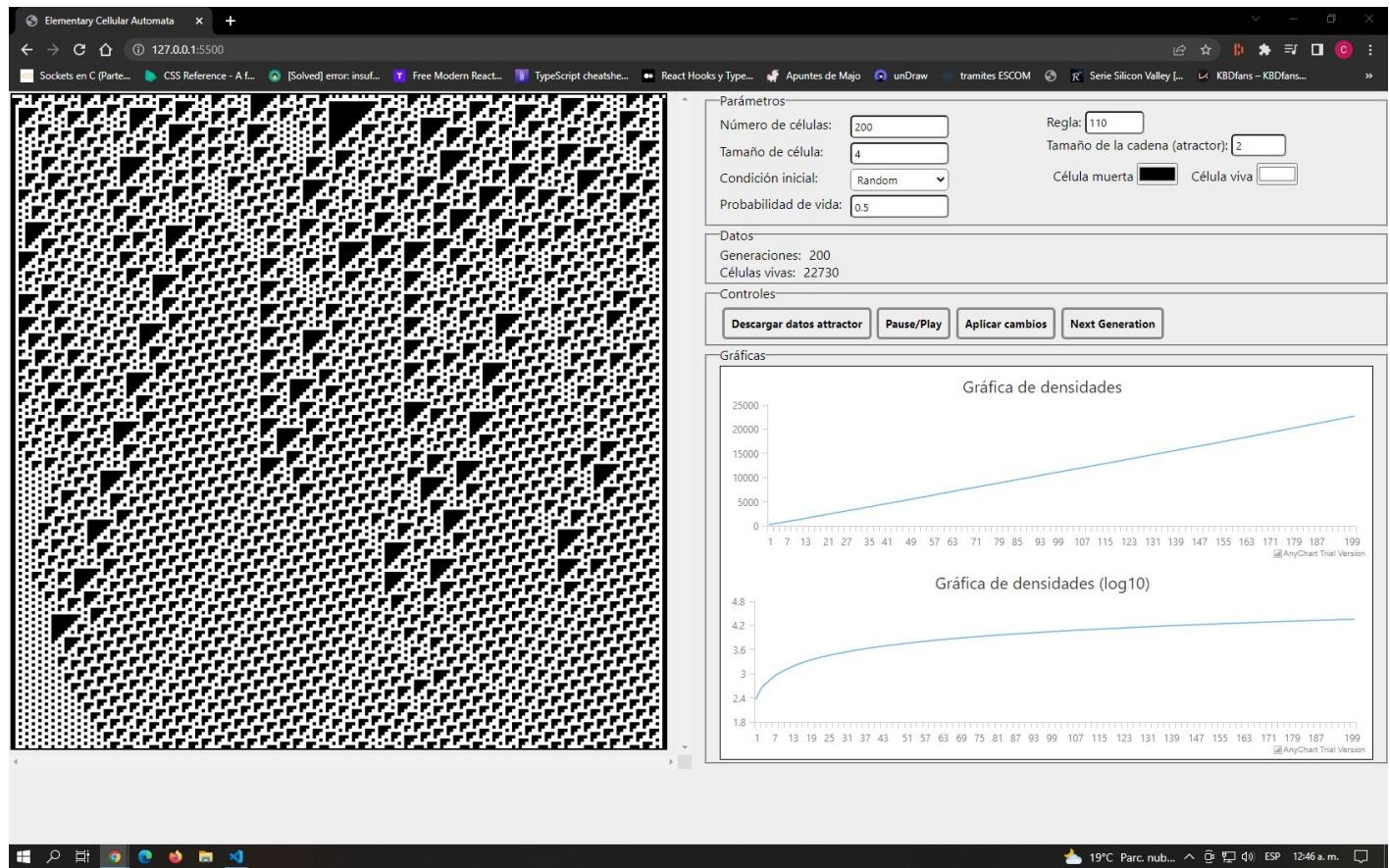


Figura 4.6: Funcionando con regla 110, células random, probabilidad 0.5

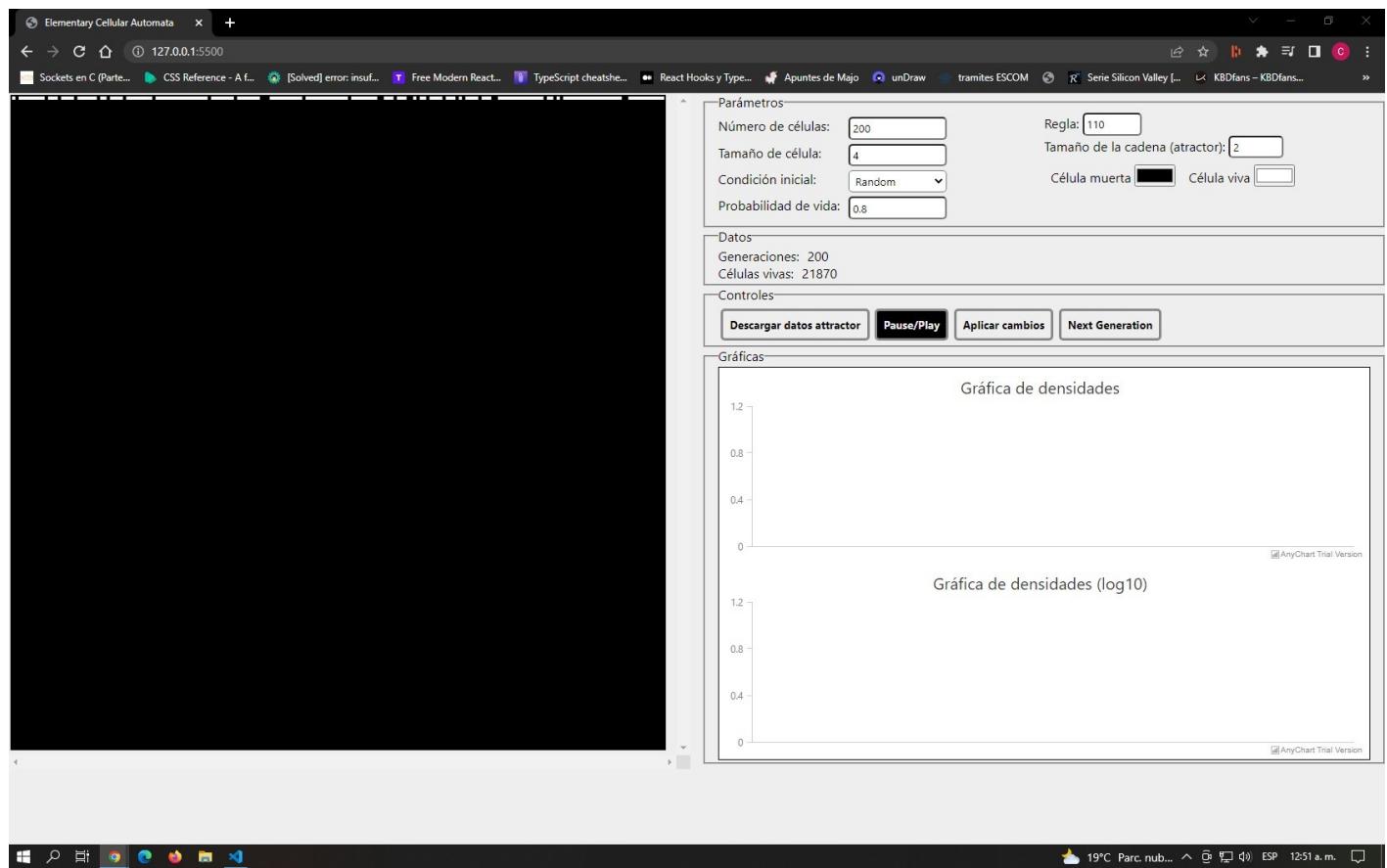


Figura 4.7: Regla 110, inicio con células random, probabilidad de 0.8

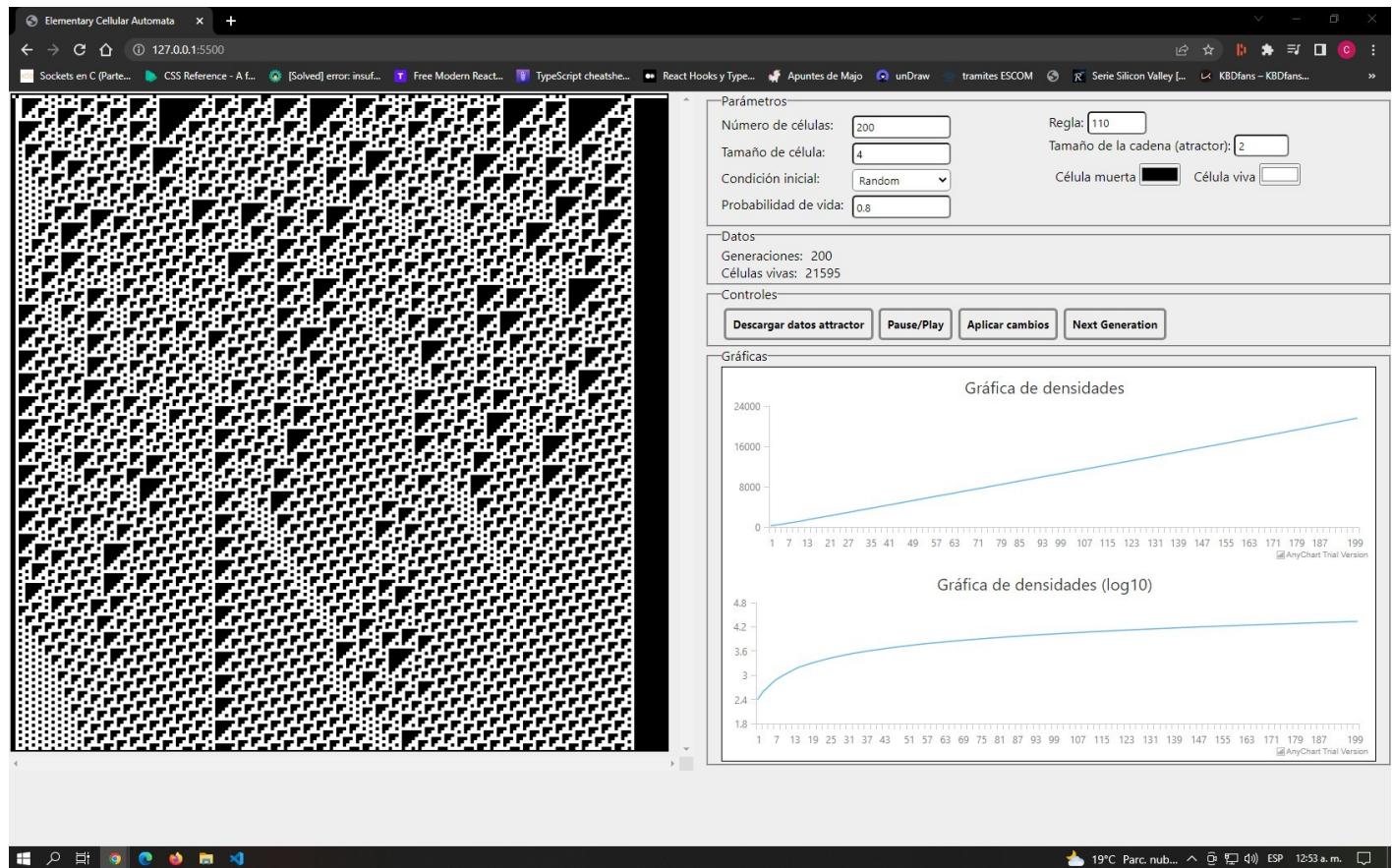


Figura 4.8: Funcionando con regla 110, células random, probabilidad 0.8

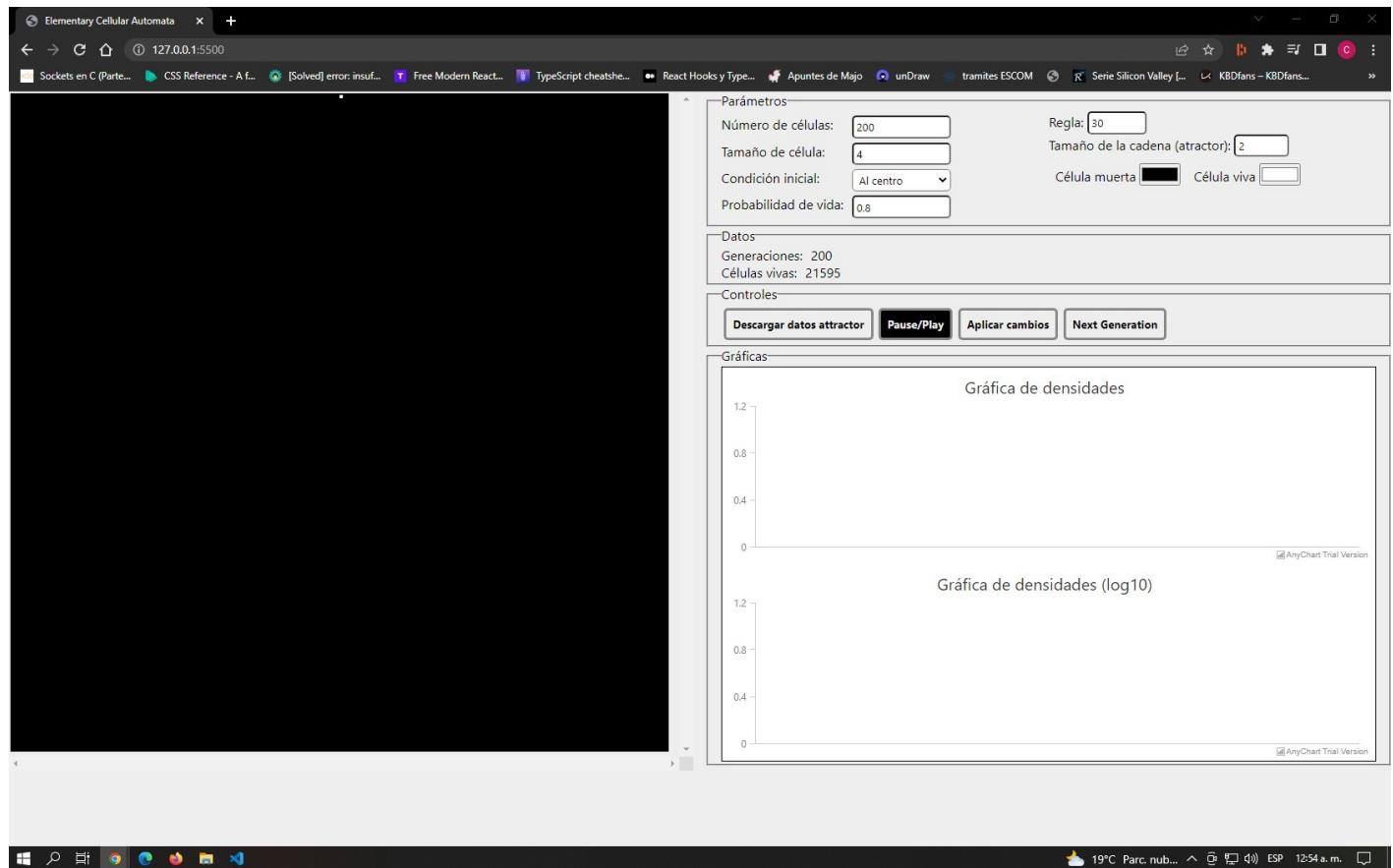


Figura 4.9: Regla 30 con inicio de célula al centro

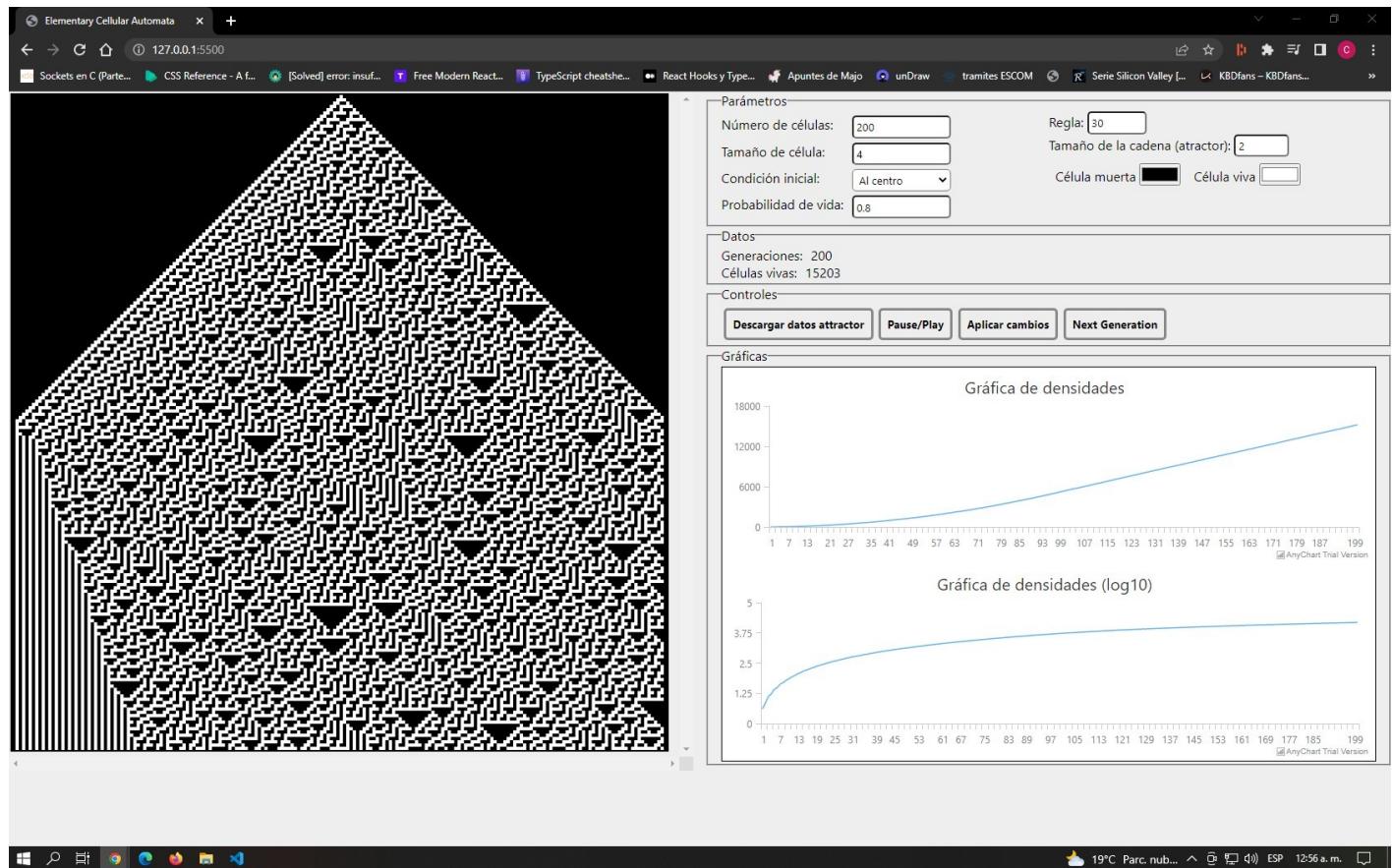


Figura 4.10: Funcionando con regla 30, inicio con célula al centro

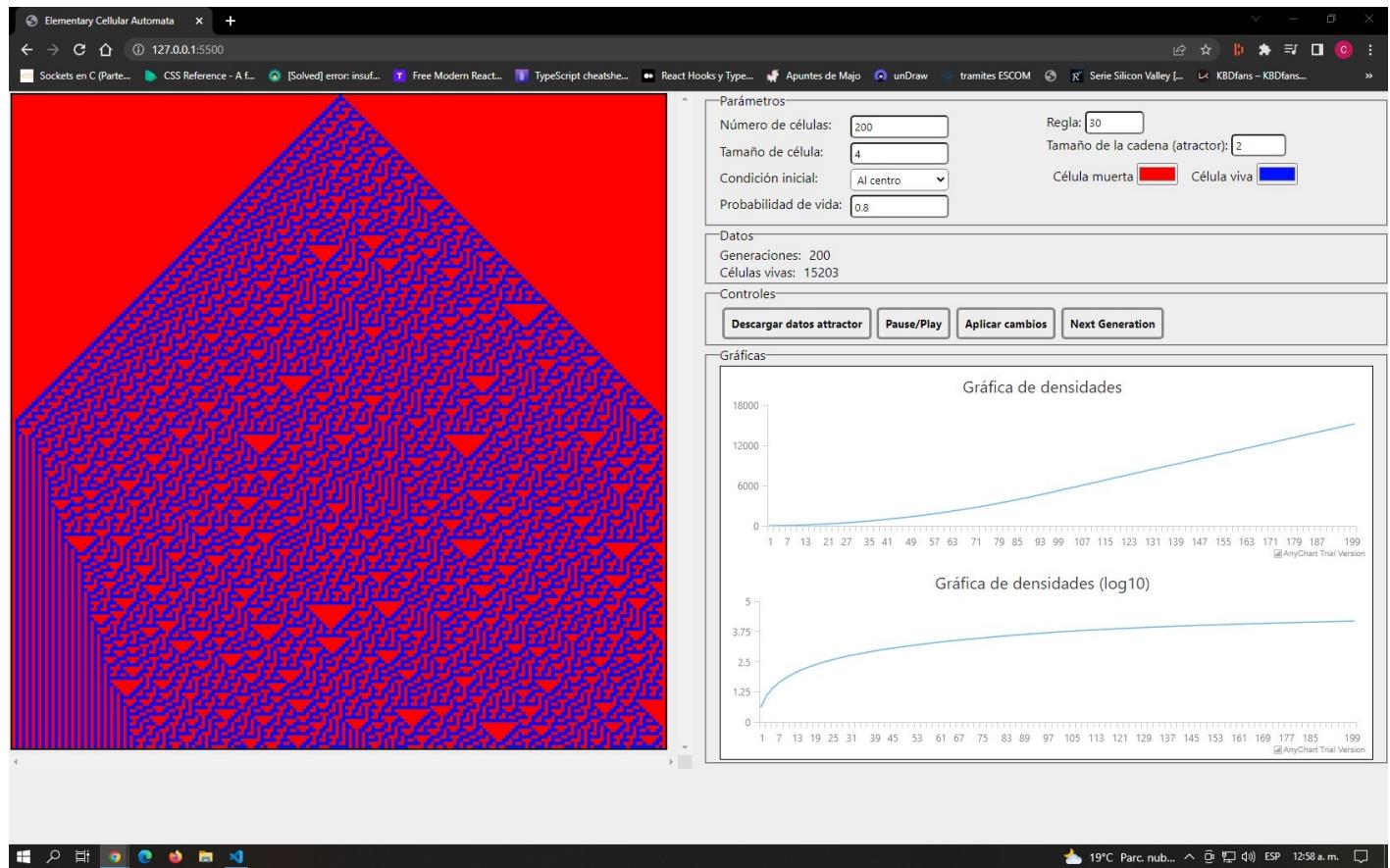


Figura 4.11: Regla 30 con colores cambiados

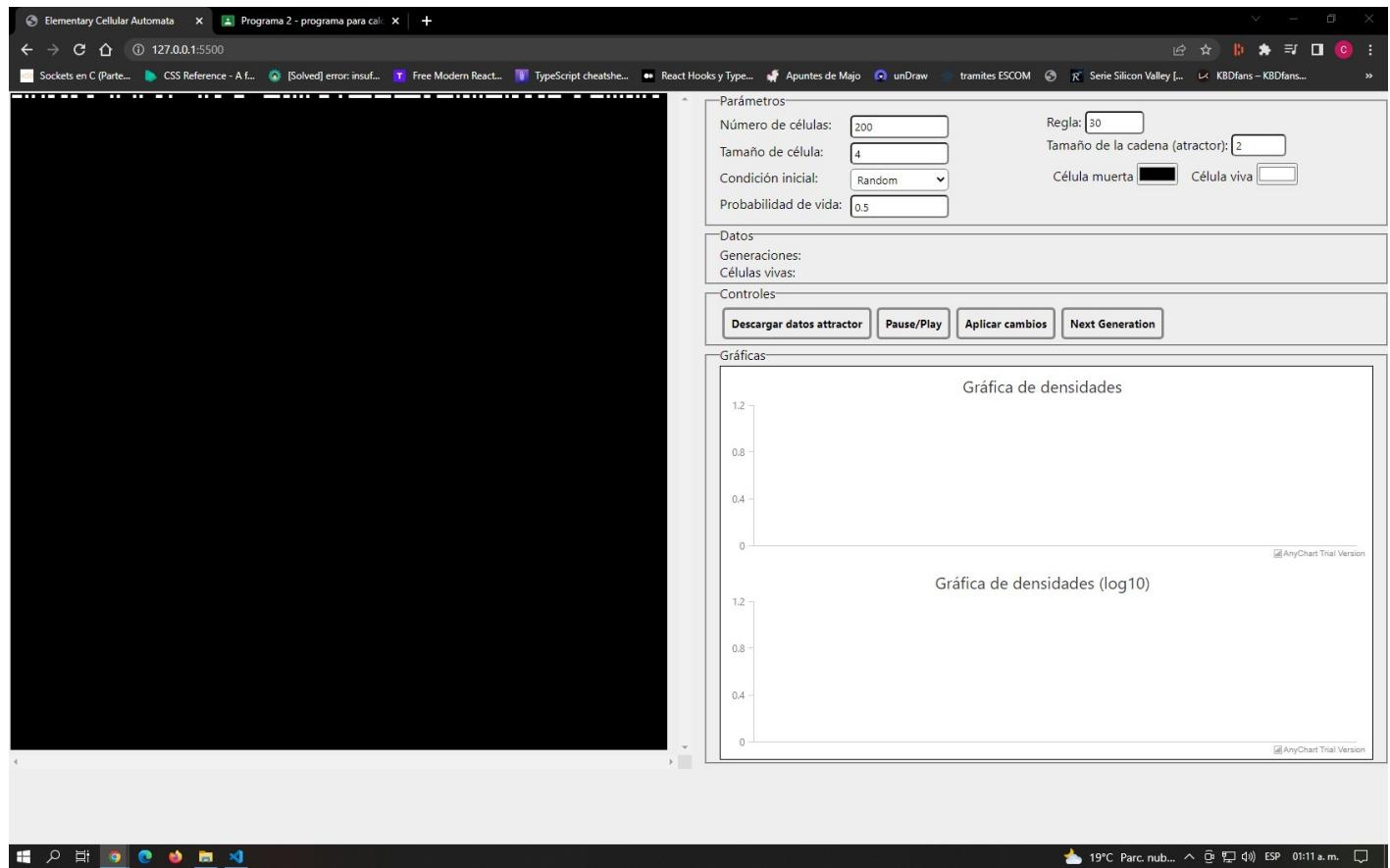


Figura 4.12: Regla 30 inicio con células random, probabilidad 0.5

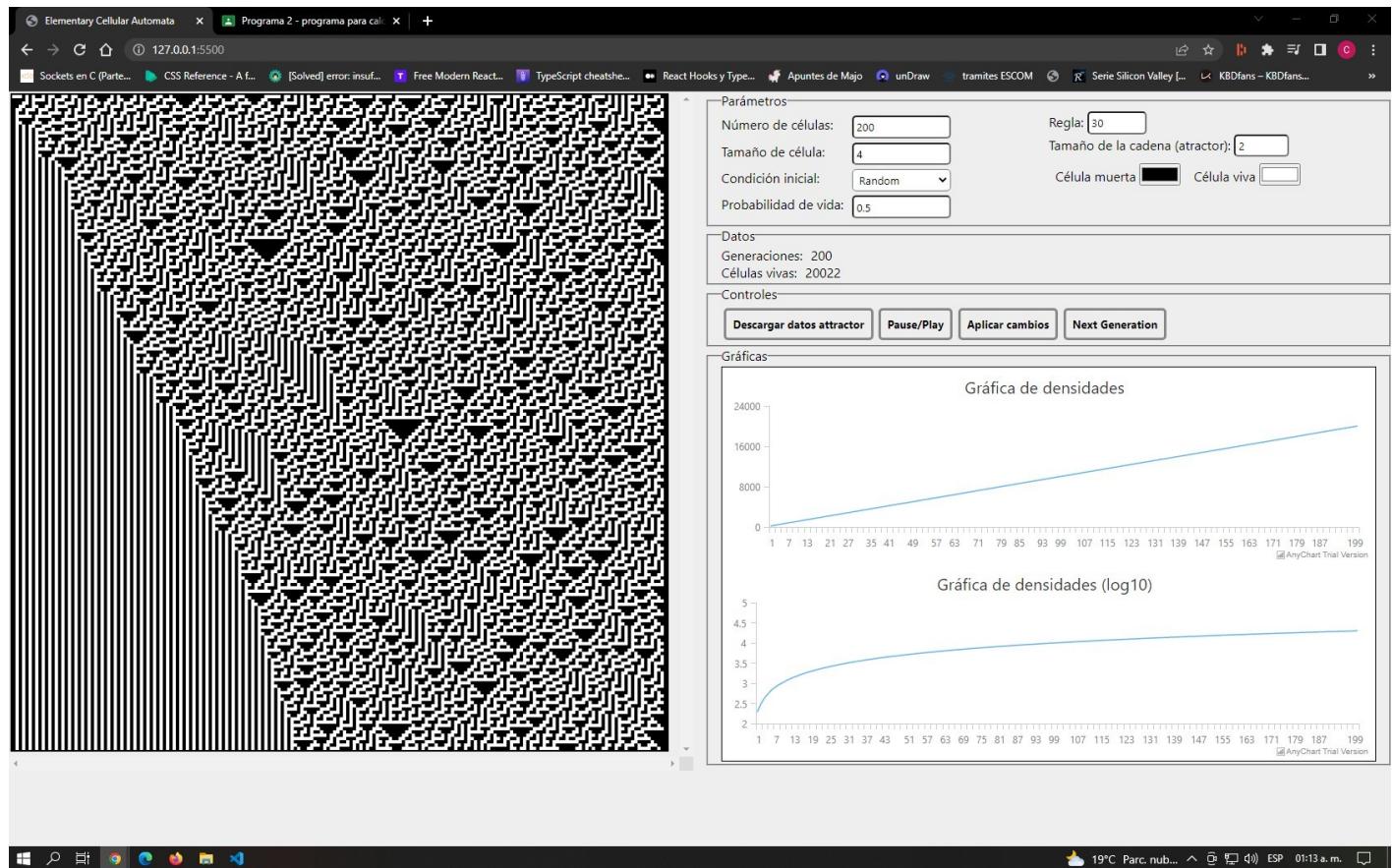


Figura 4.13: Funcionando con regla 30, células random, probabilidad 0.5