Software diversification as an obfuscation technique

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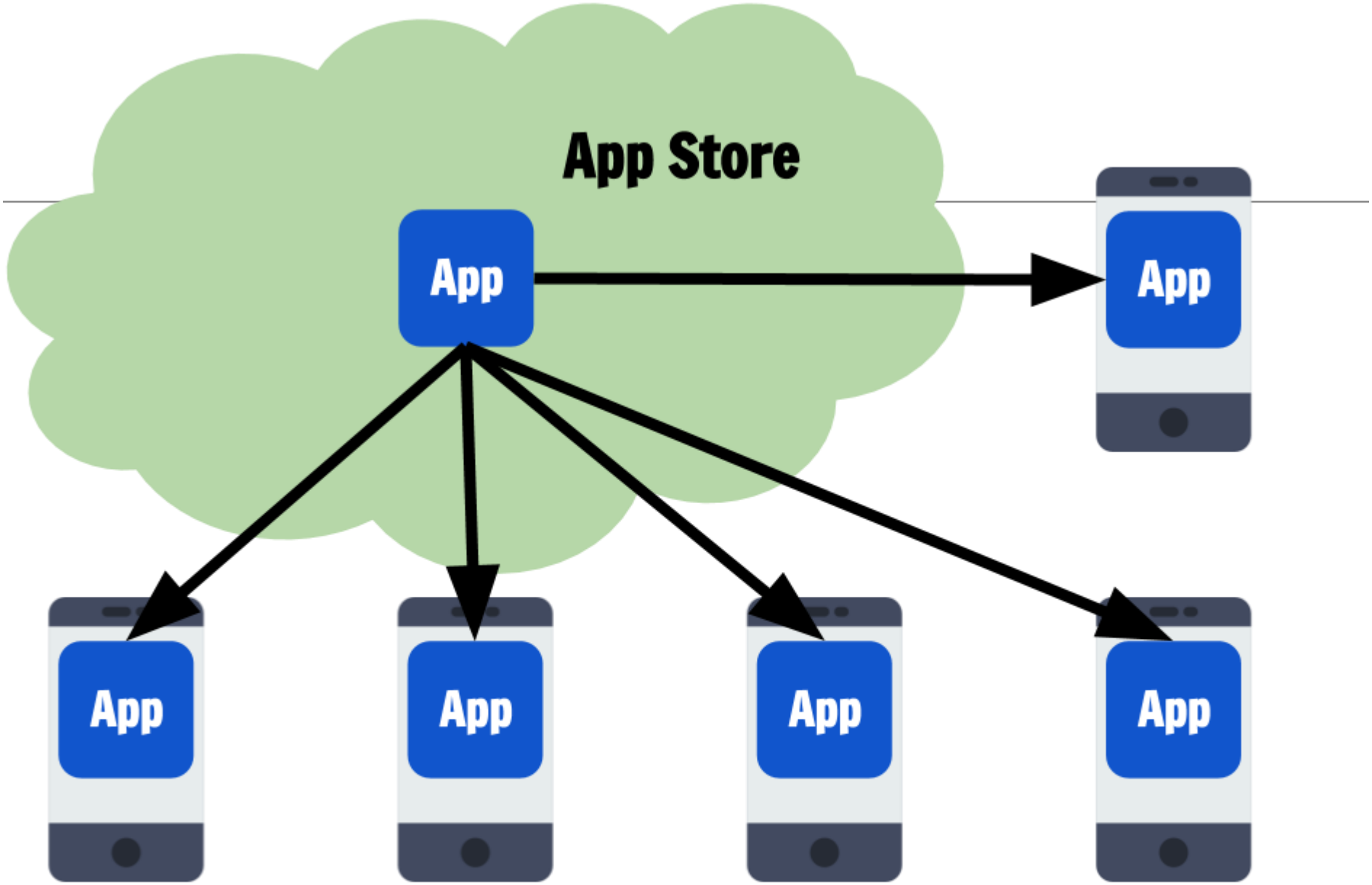
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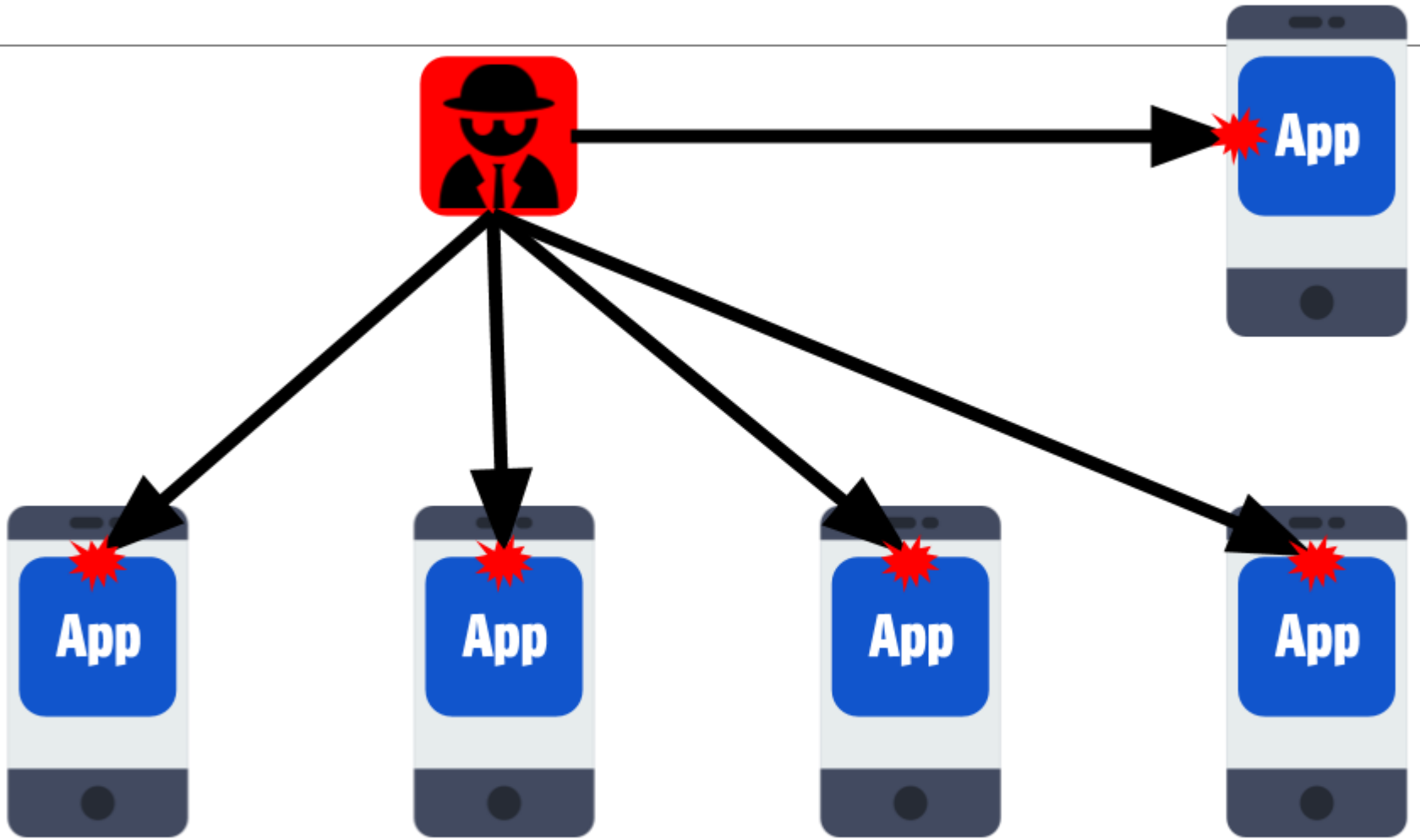
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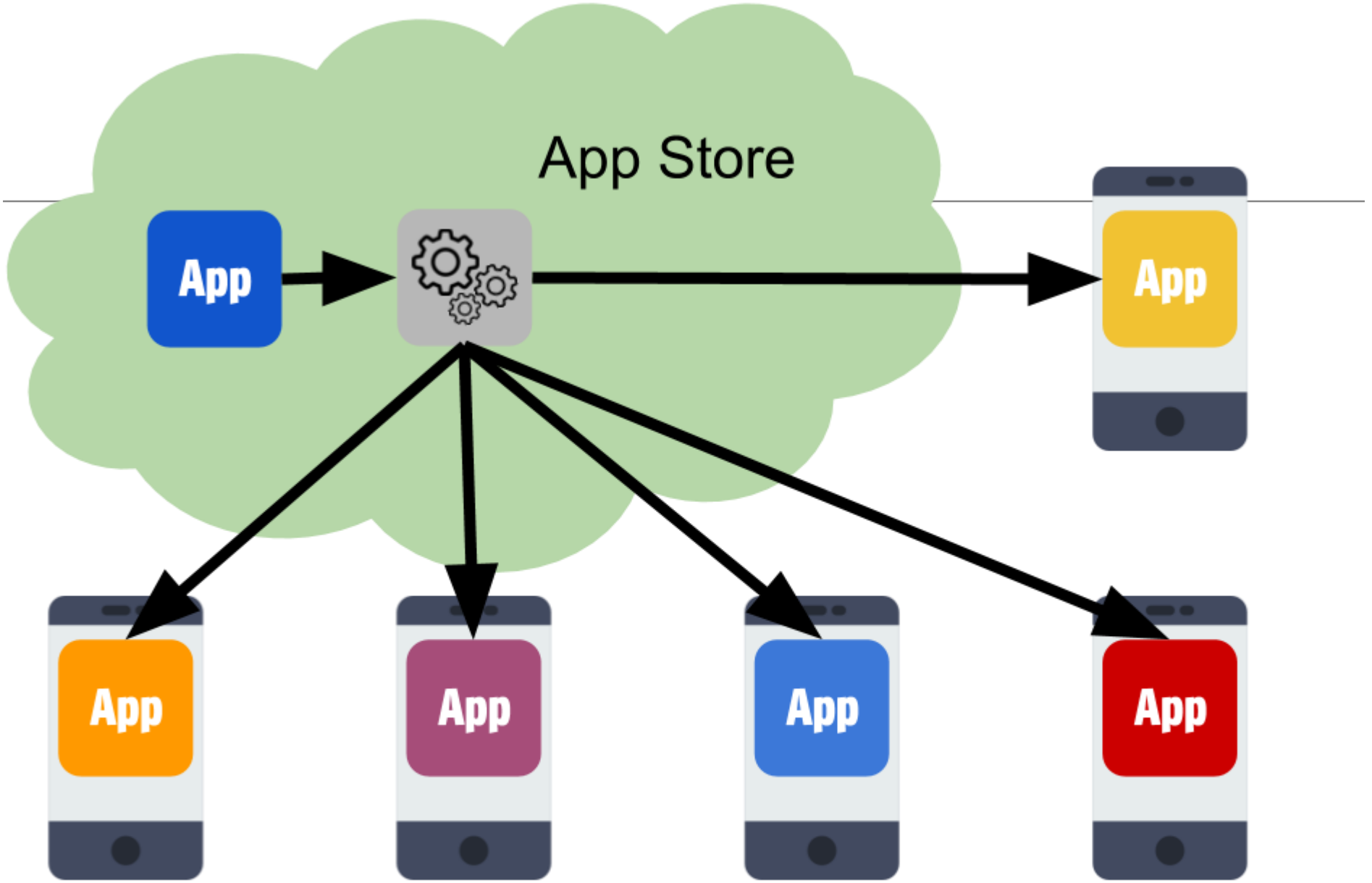
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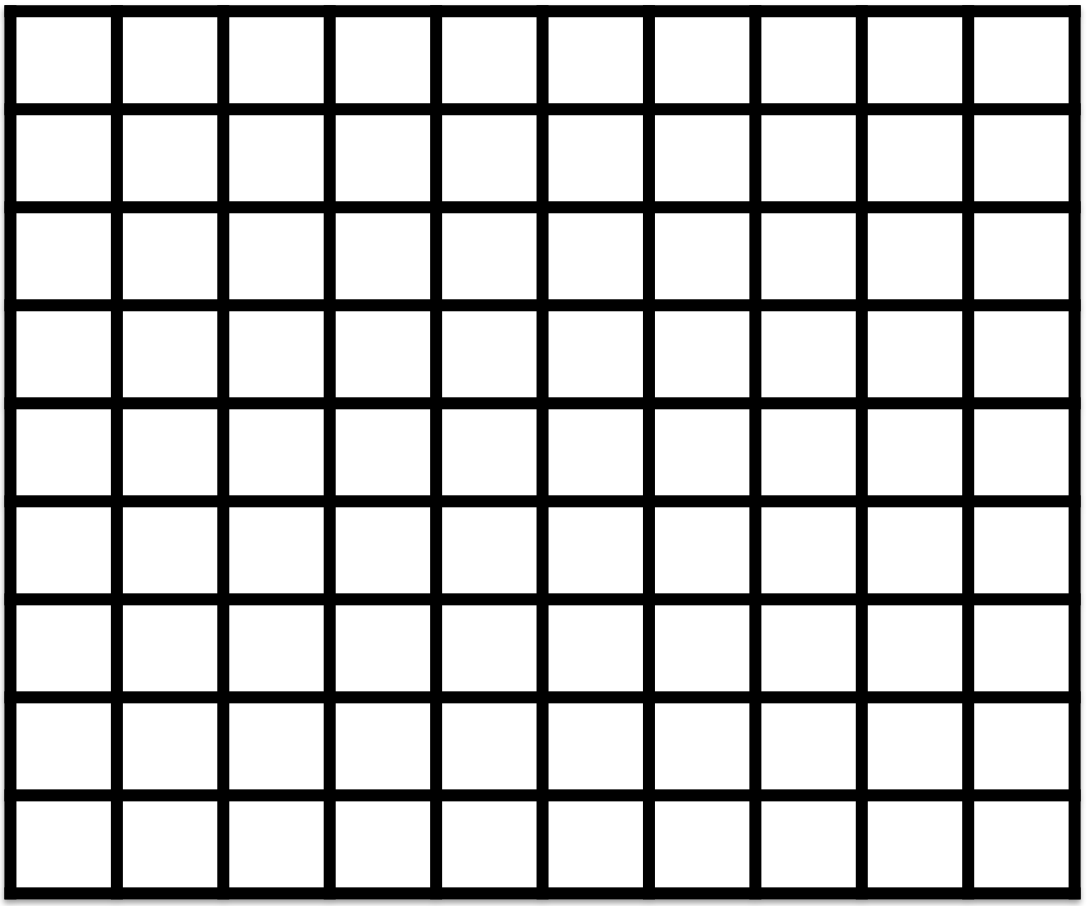
Challenges for automatic diversity

1. Foundational paradox
   - Software brittleness
2. Trade software correctness and diversity

$$\tau(P) \equiv P \wedge \delta(\tau(P), P) \neq 0$$

3. Explore the space of transformations
   - Where and how to transform
4. Quantify diversity and its impact
   - Quantity of diversity
   - Effectivness for obfuscation

Software brittleness



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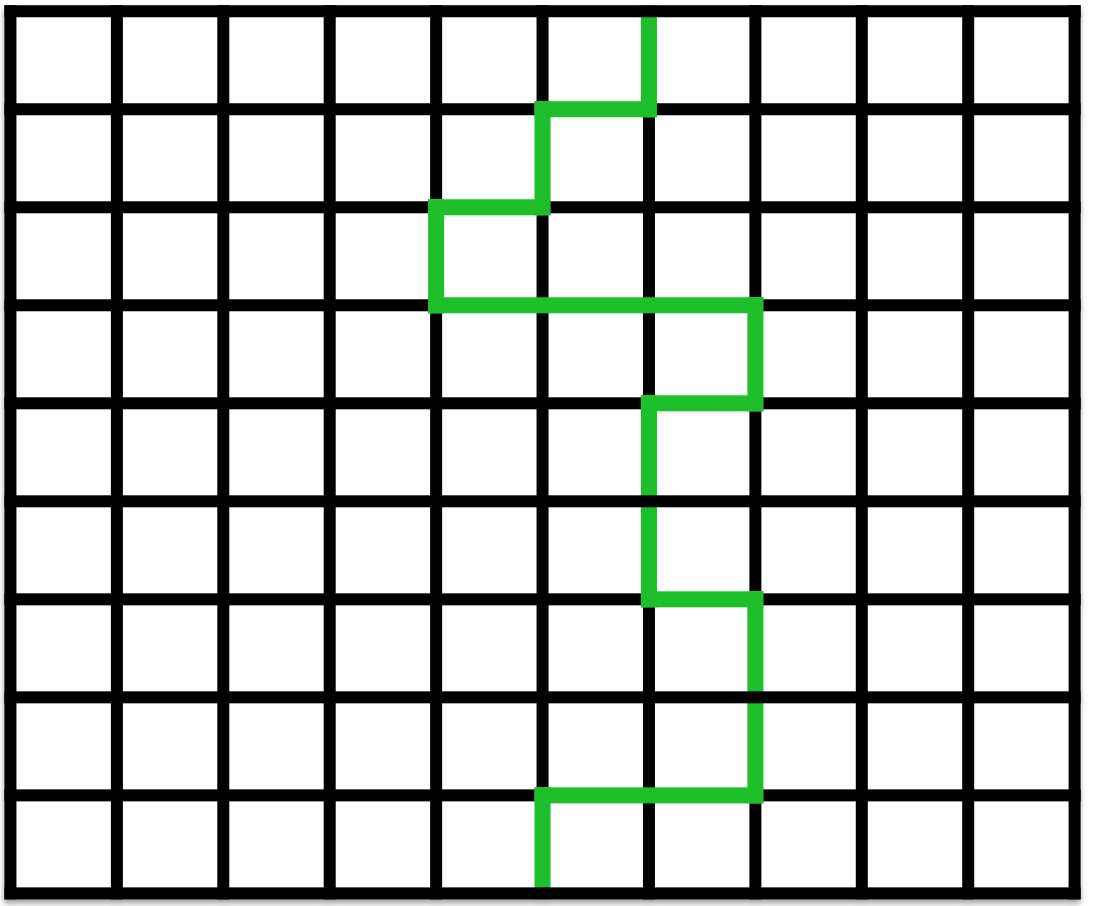
G. Berry. « A la chasse aux bugs, la maladie du certain » (8 juin 2011)

Software brittleness



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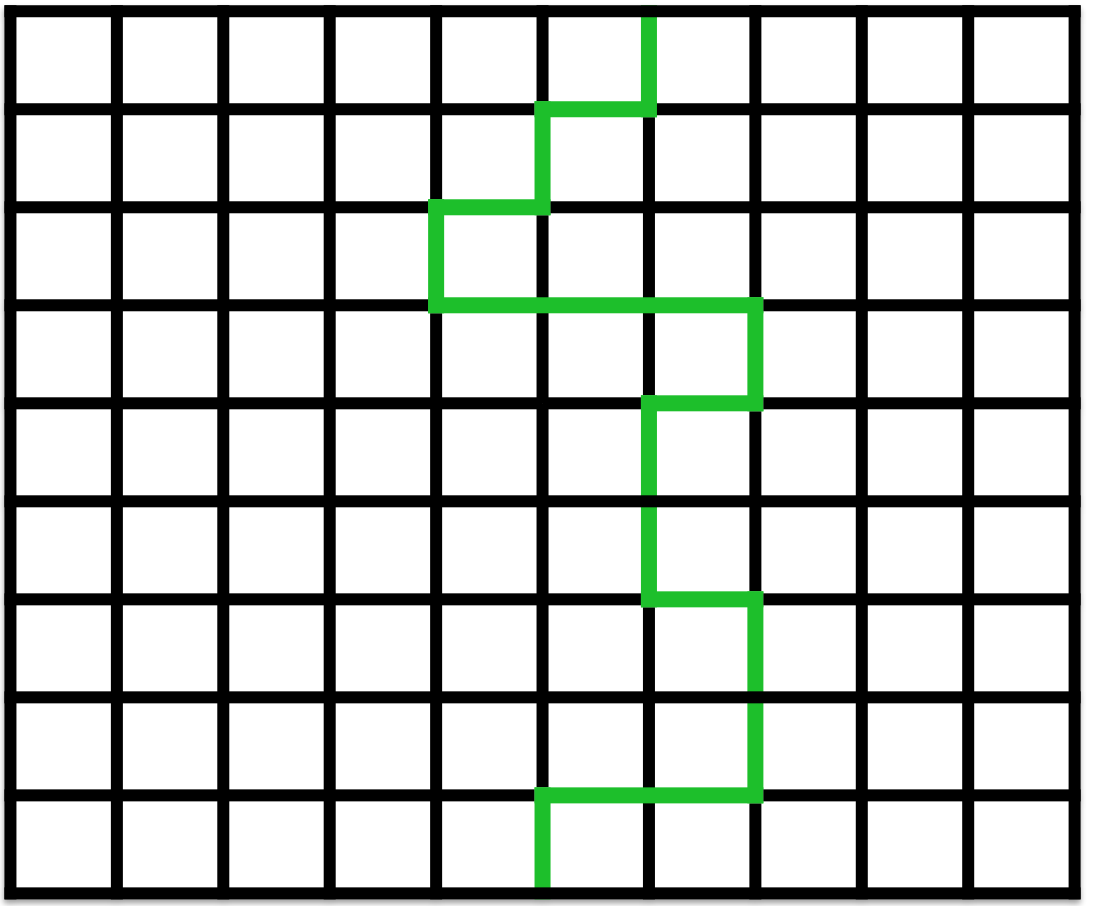
Software brittleness



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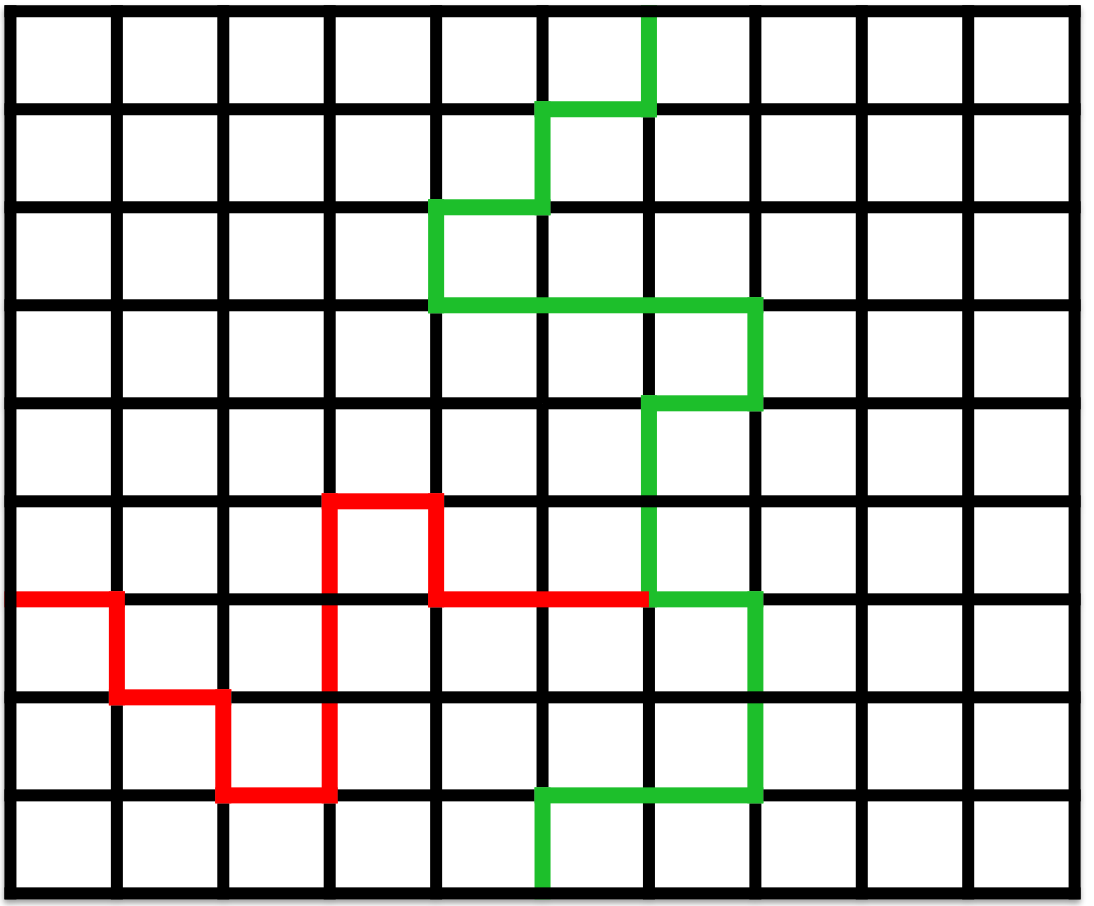

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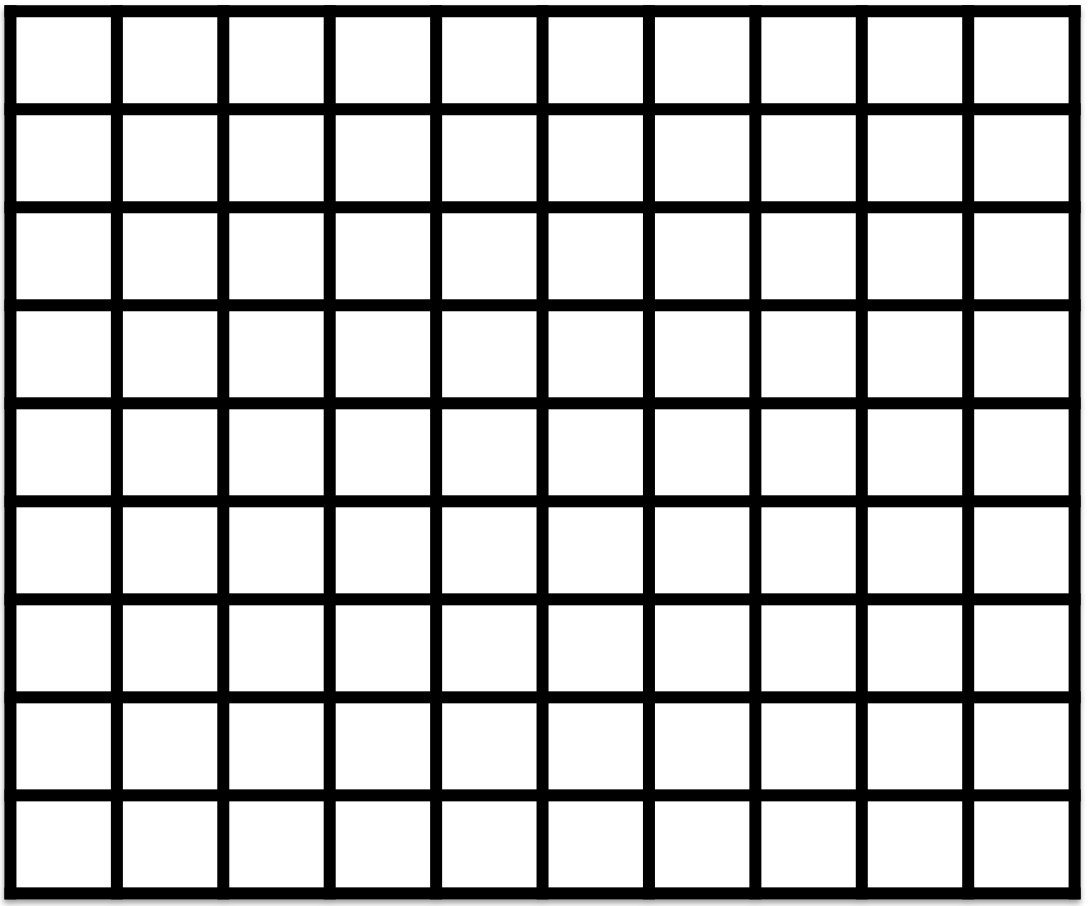

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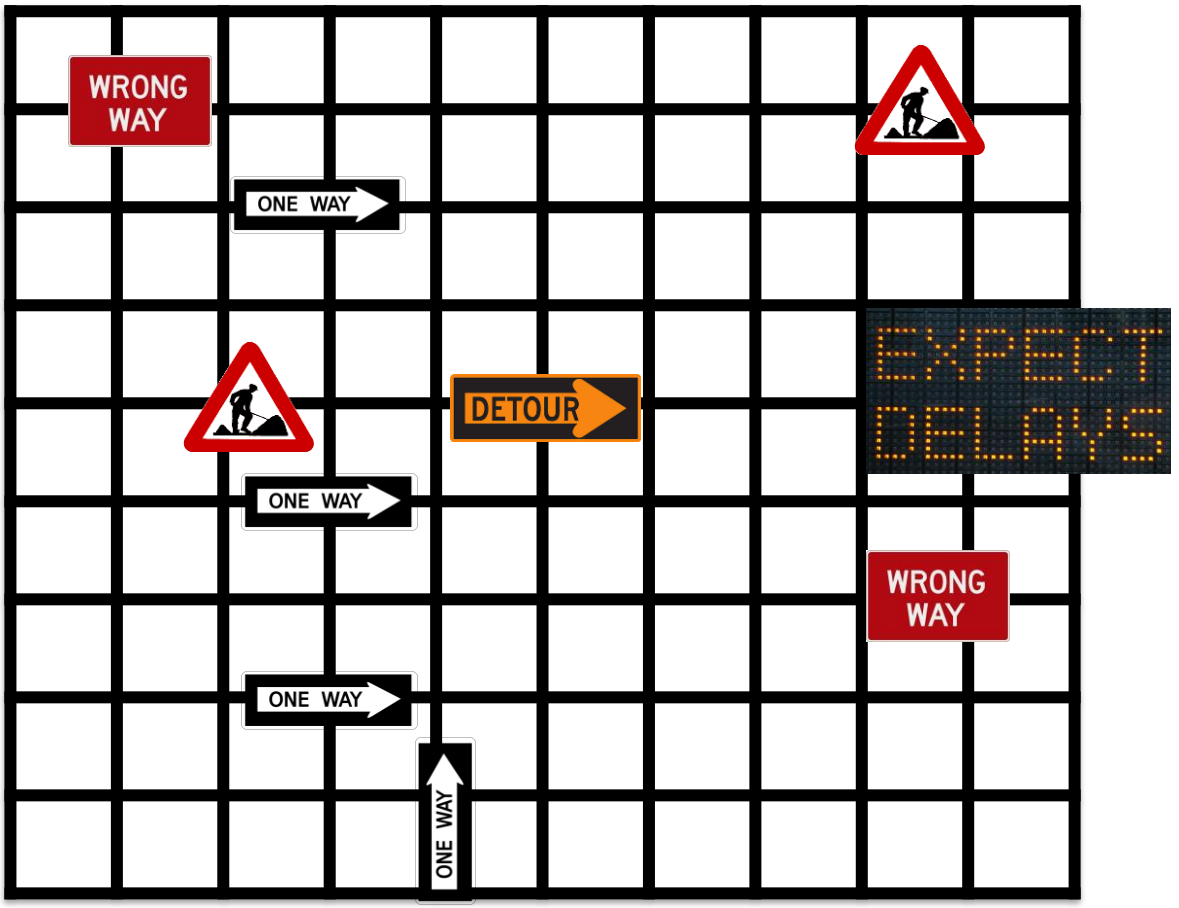
Software plasticity?



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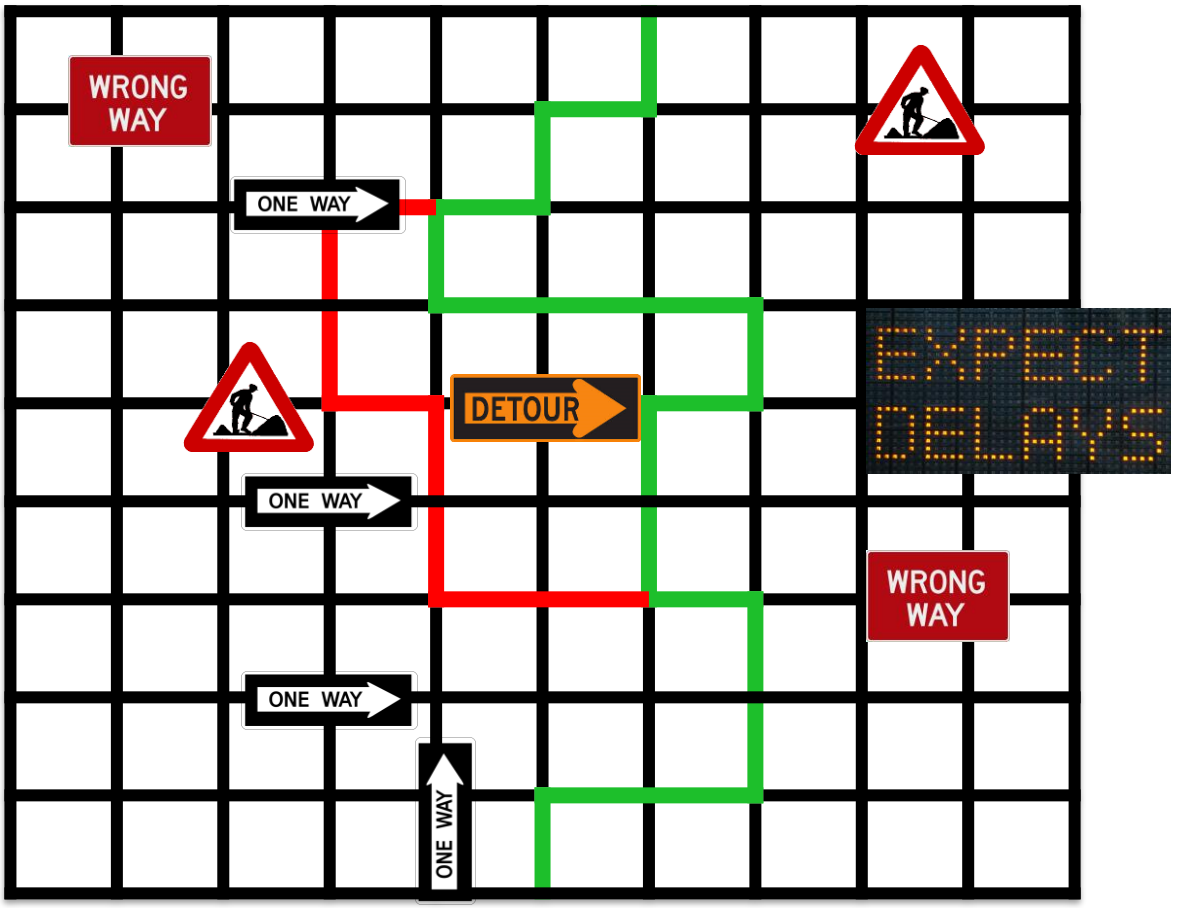
Software plasticity?



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An example

```
import org.apache.commons.collections.list.TreeList;
public class QuickSort {
   TreeList sort(TreeList arr) {
      int pivot = 0;
      TreeList less = new TreeList ();
      TreeList pivotList = new TreeList ();
      TreeList more = new TreeList ();
      for(int i=1;i<arr.size();i++)  {
         if ((Integer)arr.get(i) < ((Integer)arr.get(pivot))) {
            less.add(arr.get(i));
         }
         else if ((Integer)arr.get(i) > ((Integer)arr.get(pivot)))
            more.add(arr.get(i));
            else
               pivotList.add(arr.get(i));
         }
      pivotList.add(arr.get(pivot));
      less = sort(less);
      more = sort(more);
      less.addAll(pivotList);
      less.addAll(more);
      return less;
    }
```

An example

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import org.apache.commons.collections.list.TreeList;
public class QuickSort {
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      pivotList.add(arr.get(pivot));
      less = sort(less);
      more = sort(more);
      less.addAll(pivotList);
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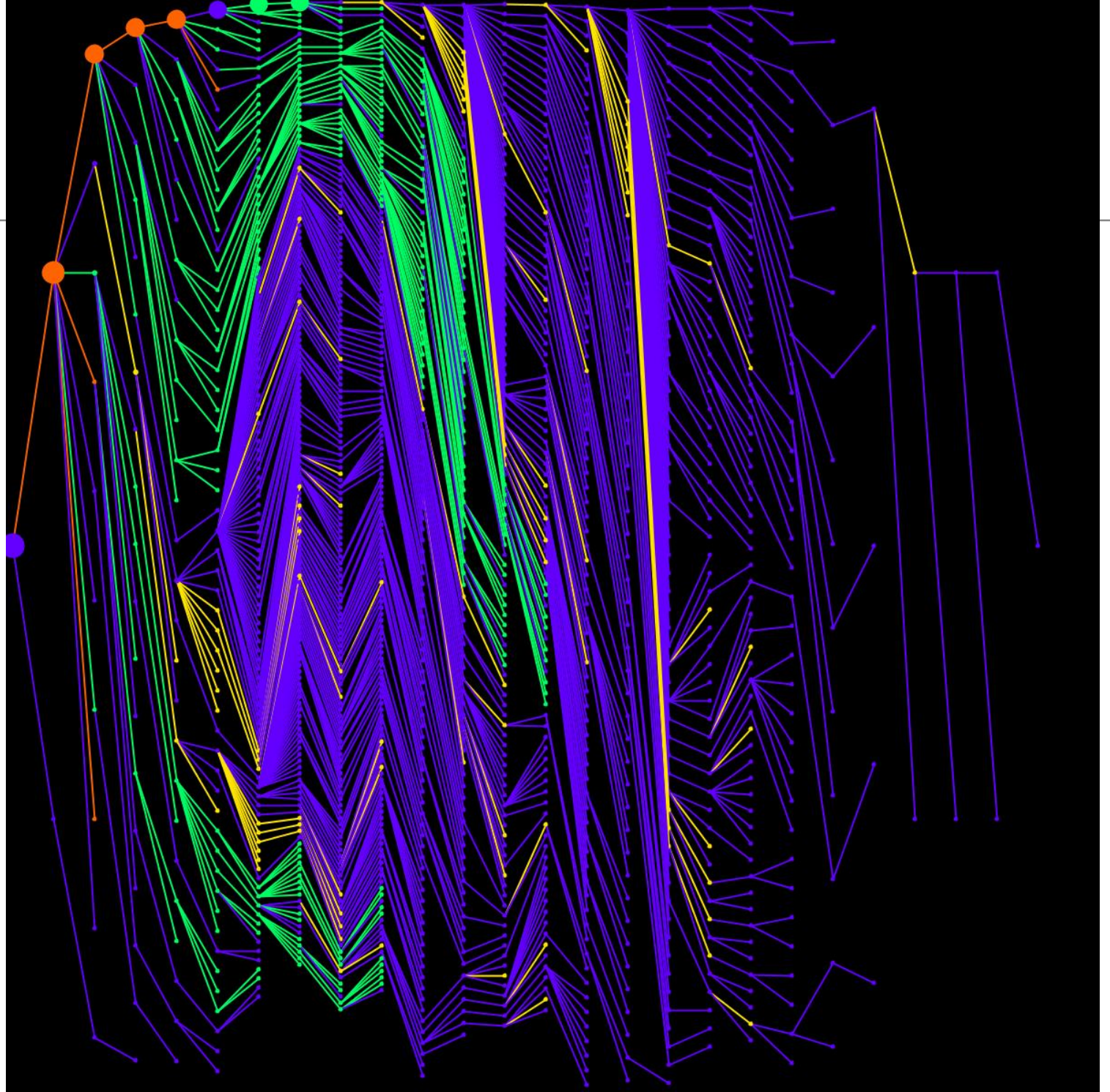
      return less;
    }
```

sort([1,4,2,7,9,3,7,4,0])



Code diversification

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      less = sort(less);
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      less.addAll(pivotList);
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      return less;
    }
```

Code diversification

```
import java.util.ArrayList;
import java.util.List;
public class QuickSort {
   List sort(List arr) {
      int pivot = 0;
      List less = new ArrayList();
      List pivotList = new ArrayList();
      List more = new ArrayList();
      for(int i=1;i<arr.size();i++)  {
         if ((Integer)arr.get(i) < ((Integer)arr.get(pivot))) {
            less.add(arr.get(i));
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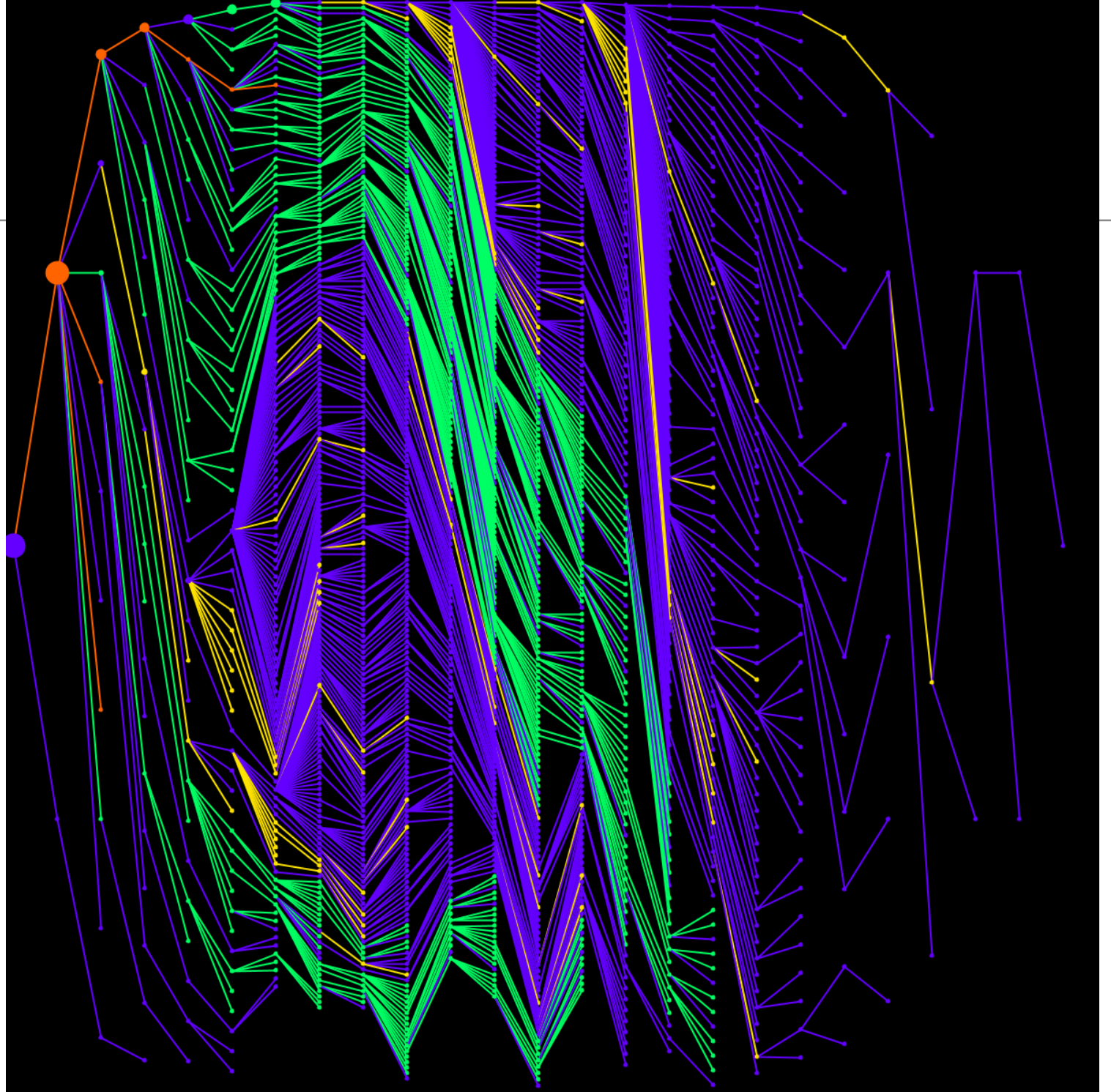

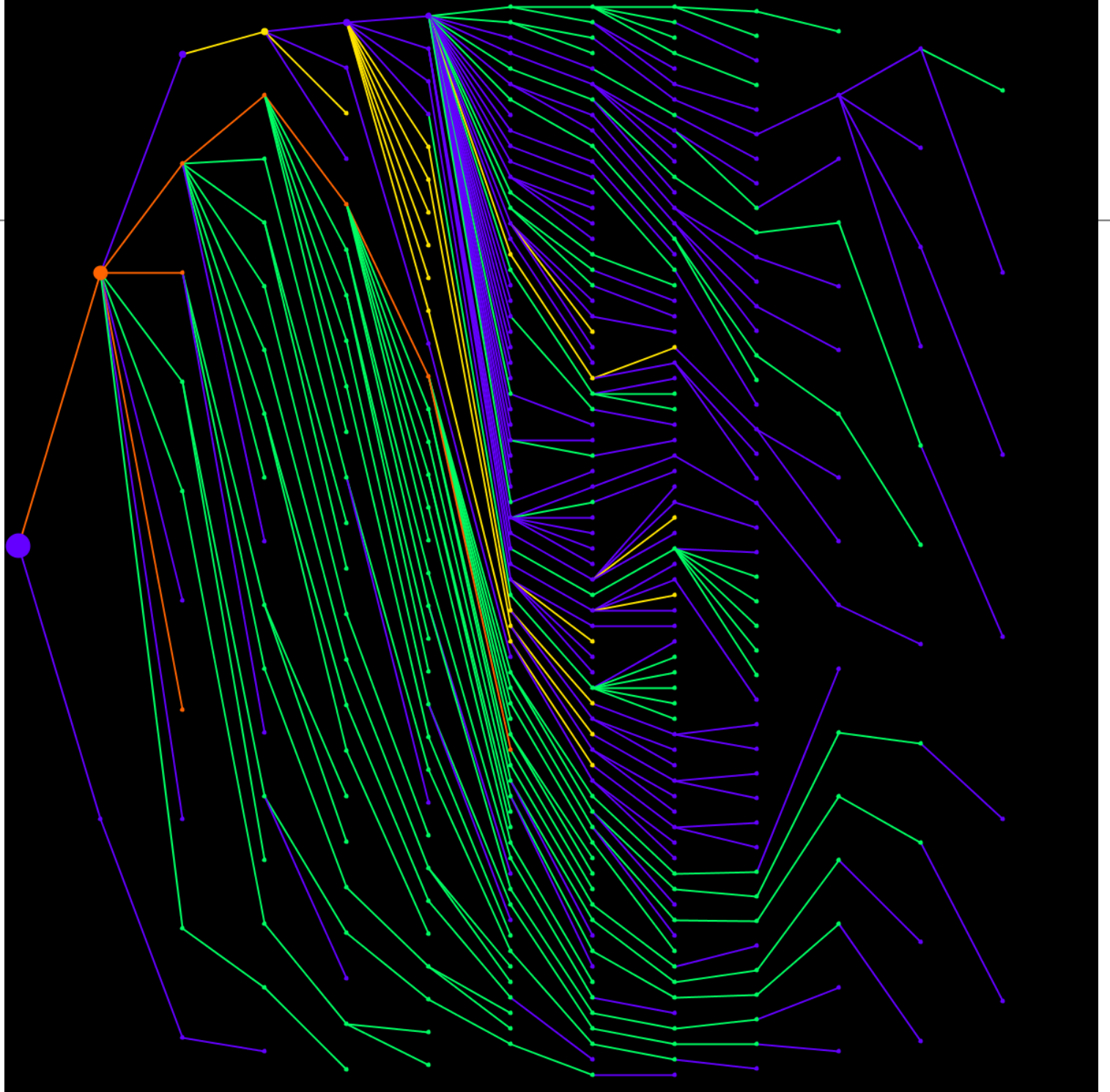

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            more.add(arr.get(i));
            else
               pivotList.add(arr.get(i));
         }
      isSorted(less);
      pivotList.add(arr.get(pivot));
      less = sort(less);
      more = sort(more);
      less.addAll(pivotList);
      less.addAll(more);
      return less;
    }
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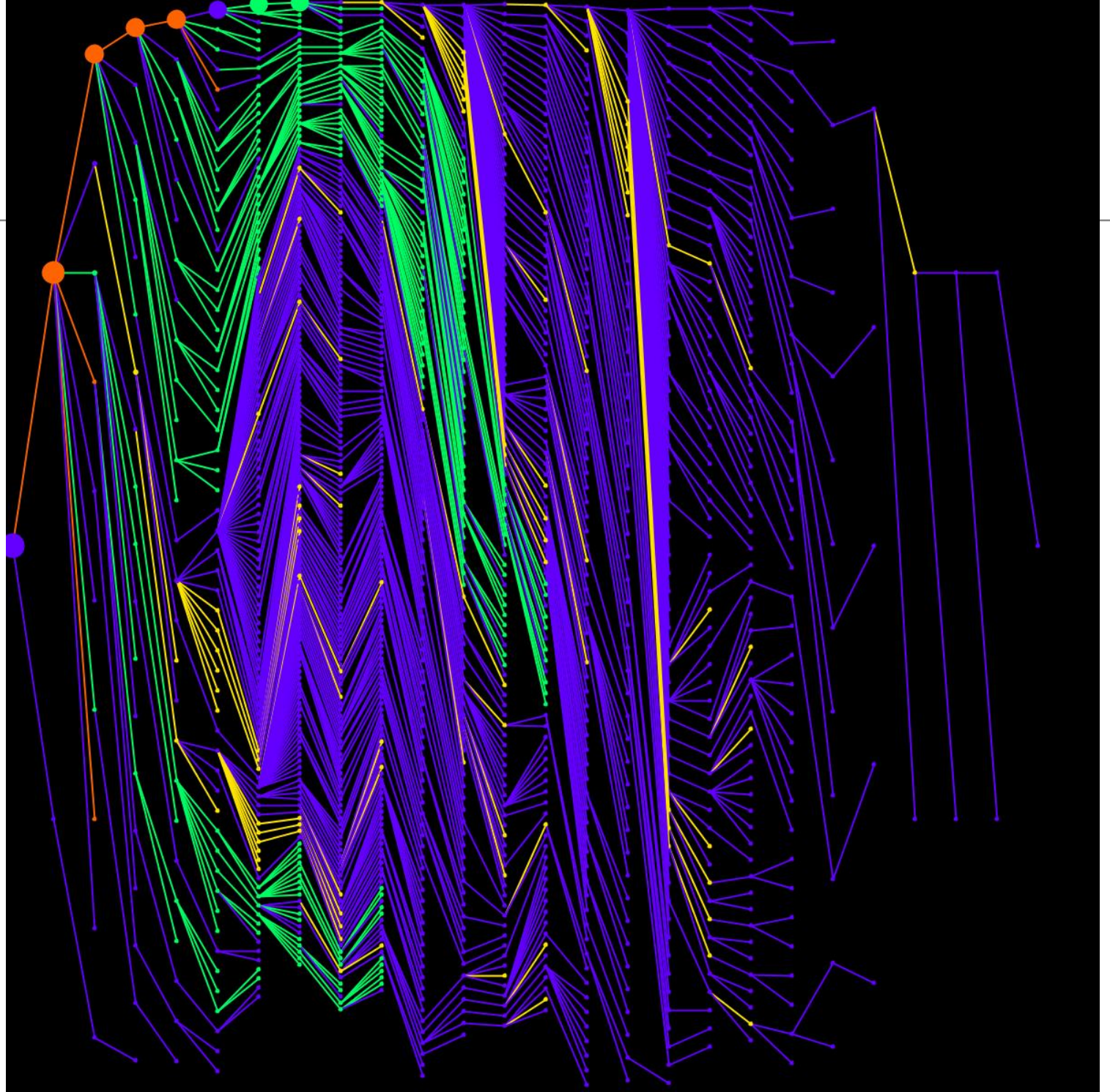

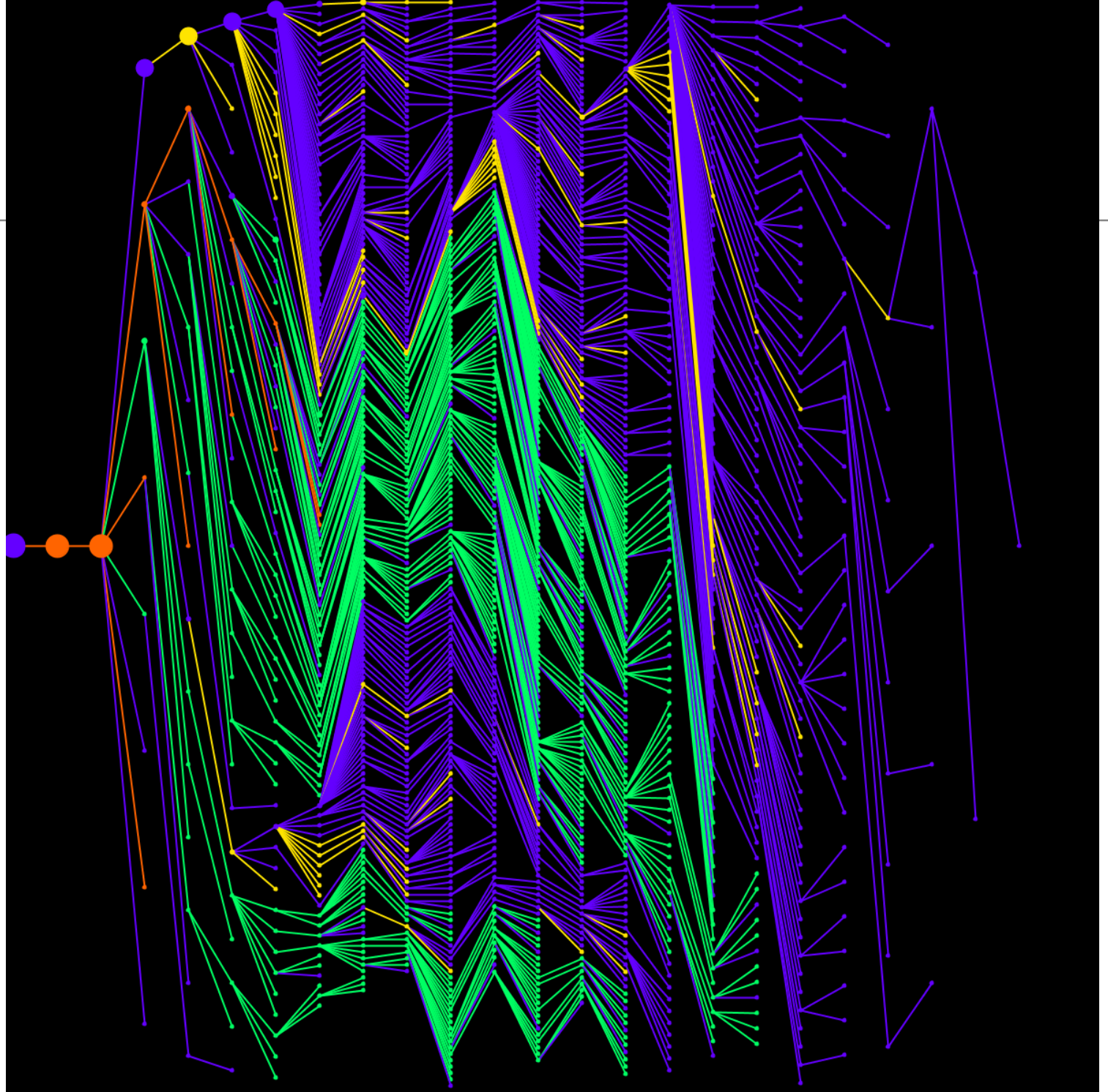

Conclusion

- Software diversity
  - is based on exact and approximate transformations
  - is an obfuscation technique
- How can we measure
  - computation diversity?
  - impact on protection?

B. Baudry, M. Monperrus. « The Multiple Facets of Software Diversity: Recent Developments in Year 2000 and Beyond ». ACM Comp. Surveys, 2015.

B. Baudry, S. Allier, M. Monperrus. « Tailored source code transformations to synthesize computationally diverse program variants ». ISSTA, 2014.