



Using Automatic Detection and Characterization to Measure Educational Impact of nanoHUB

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1998

```
117     }
118
119     Vector<MasterString> mskeys = new Vector<MasterString>(masters.keySet());
120     Collections.sort(mskeys);
121     for (int it = mskeys.size() - 1; it >= 0; it--) {
122         MasterString ms = mskeys.get(it);
123         Vector<SubsumedString> subs = masters.get(ms);
124         ol[0] = ms.count.toString();
125         ol[1] = ms.s;
126         ol[2] = subs.get(0).count.toString();
127         ol[3] = subs.get(0).s;
128         ol[4] = Double.toString(subs.get(0).levenshtein);
129         ol[5] = Double.toString(subs.get(0).jarowinkler);
130         w.writeNext(ol);
131         for (int i = 1; i < subs.size(); i++) {
132             SubsumedString ss = subs.get(i);
133             ol[0] = "";
134             ol[1] = "";
135             ol[2] = ss.count.toString();
136             ol[3] = ss.s;
137             ol[4] = Double.toString(ss.levenshtein);
138             ol[5] = Double.toString(ss.jarowinkler);
139             w.writeNext(ol);
140         }
141     }
142
143     w.close();
144 } catch (Exception e) {
145     System.err.println("Exception" + e + " at line " + linesRead);
146     e.printStackTrace();
147 }
```




Theoretical Electron Density Visualizer

Input Simulate Terminate Keep for later

WFN:

Function

Choice:

Grid dimensions and coarseness

Size:

Increment:

Center

X:

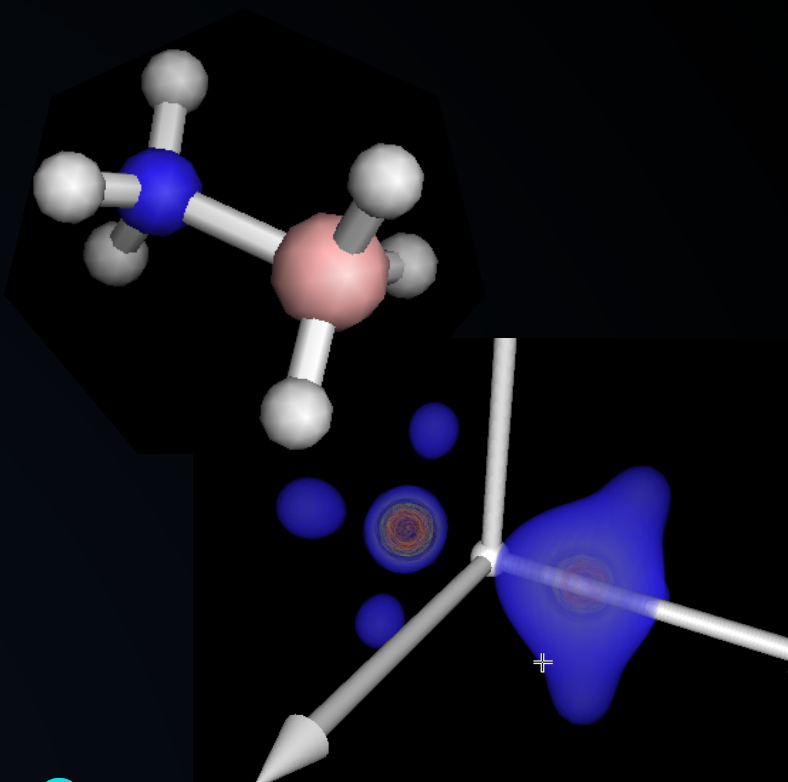
Y:

Z:

Wavefunction:

GAUSSIAN	H 1	(CENTRE 1)	1.10637695	-1.91630108	-2.19048878	CHARGE = 1.0
H 2	(CENTRE 2)	1.10637695	1.91630108 <th>-2.19048878</th> <td>CHARGE = 1.0</td>	-2.19048878	CHARGE = 1.0	
H 3	(CENTRE 3)	-2.21275389	0.00000000 <th>-2.19048878</th> <td>CHARGE = 1.0</td>	-2.19048878	CHARGE = 1.0	
B 4	(CENTRE 4)	0.00000000	0.00000000 <th>-1.61633643</th> <td>CHARGE = 5.0</td>	-1.61633643	CHARGE = 5.0	
N 5	(CENTRE 5)	0.00000000	0.00000000	1.52755535	CHARGE = 7.0	
H 6	(CENTRE 6)	-0.89935284	1.55772481	2.22014914	CHARGE = 1.0	

Storage (manage) 79% 30GB 780 x 600



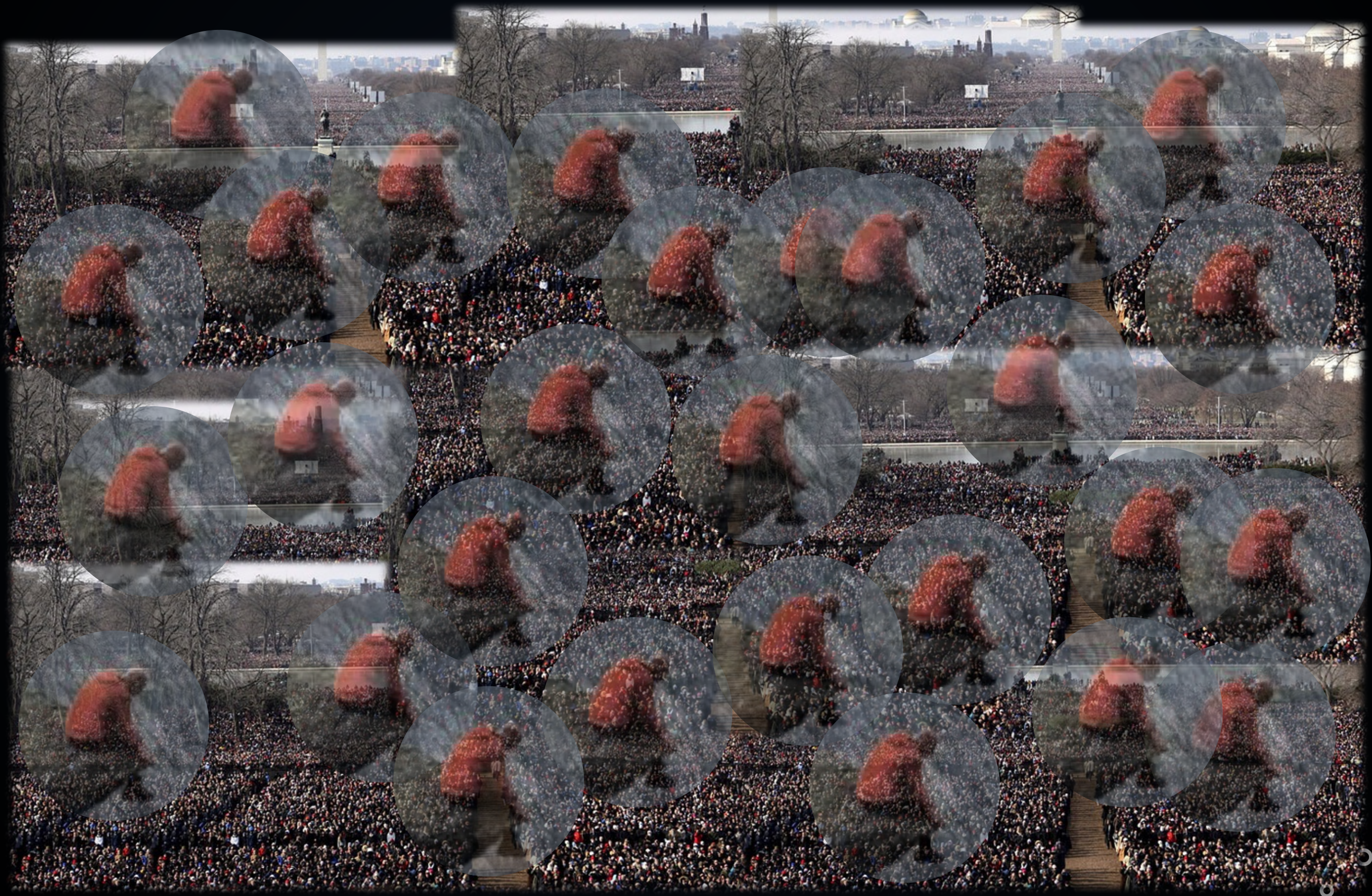
```

Vector<MasterString> askeys = new Vector<MasterString>(masters.keySet());
Collections.sort(askeys);
for (int i = askeys.size() - 1; i >= 0; i--) {
    MasterString ms = askeys.get(i);
    Vector<SubsumedString> subs = masters.get(ms);
    o1[0] = ms.count.toString();
    o1[1] = ms.s;
    o1[2] = subs.get(0).count.toString();
    o1[3] = subs.get(0).s;
    o1[4] = Double.toString(subs.get(0).levenshtein);
    o1[5] = Double.toString(subs.get(0).jarowinkler);
    v.writeNext(o1);
    for (int i = 1; i < subs.size(); i++) {
        SubsumedString ss = subs.get(i);
        o1[0] = ss.count.toString();
        o1[1] = ss.s;
        o1[2] = ss.count.toString();
        o1[3] = ss.s;
        o1[4] = Double.toString(ss.levenshtein);
        o1[5] = Double.toString(ss.jarowinkler);
        v.writeNext(o1);
    }
}
v.close();
} catch (Exception e) {
    System.err.println("Exception" + e + " at line " + linesRead);
    e.printStackTrace();
}

```





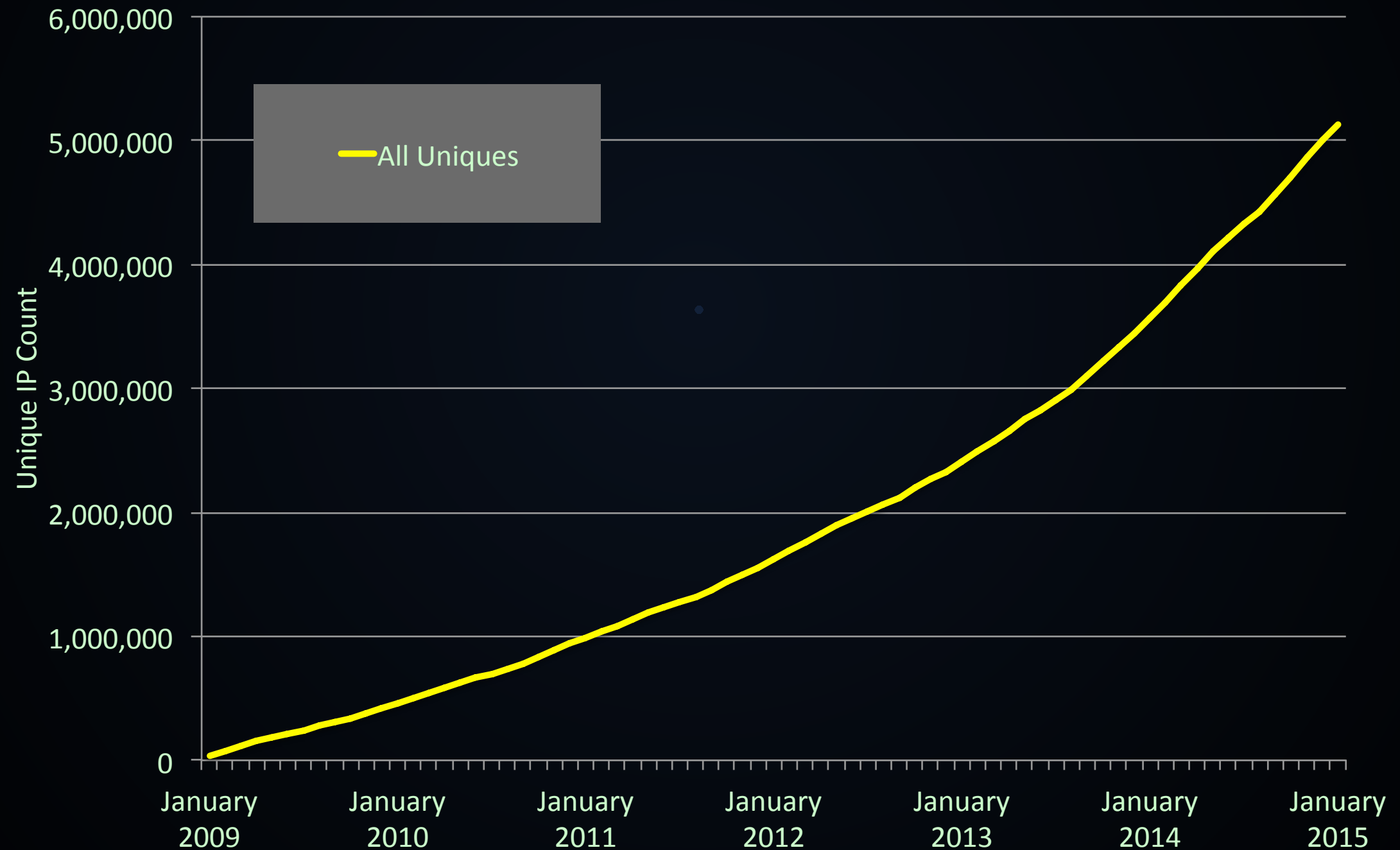


NANOHUB

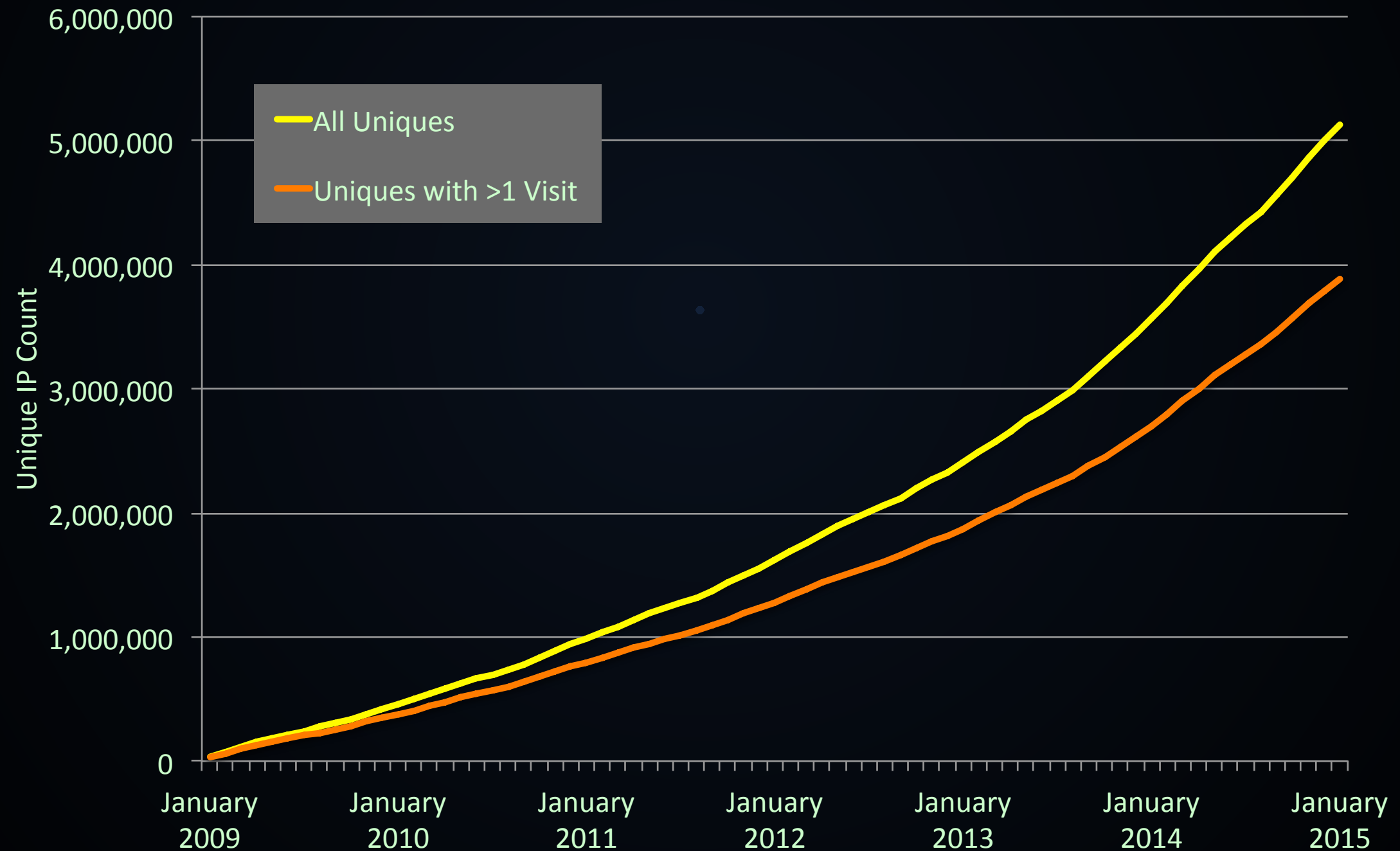


500+ Simulation Tools
6100+ Other Resources
3900+ Online Presentations
700+ Teaching Materials
35,000+ Students Reached
1,400,000 Unique (re)Visitors Annually
800,000 Simulations Annually

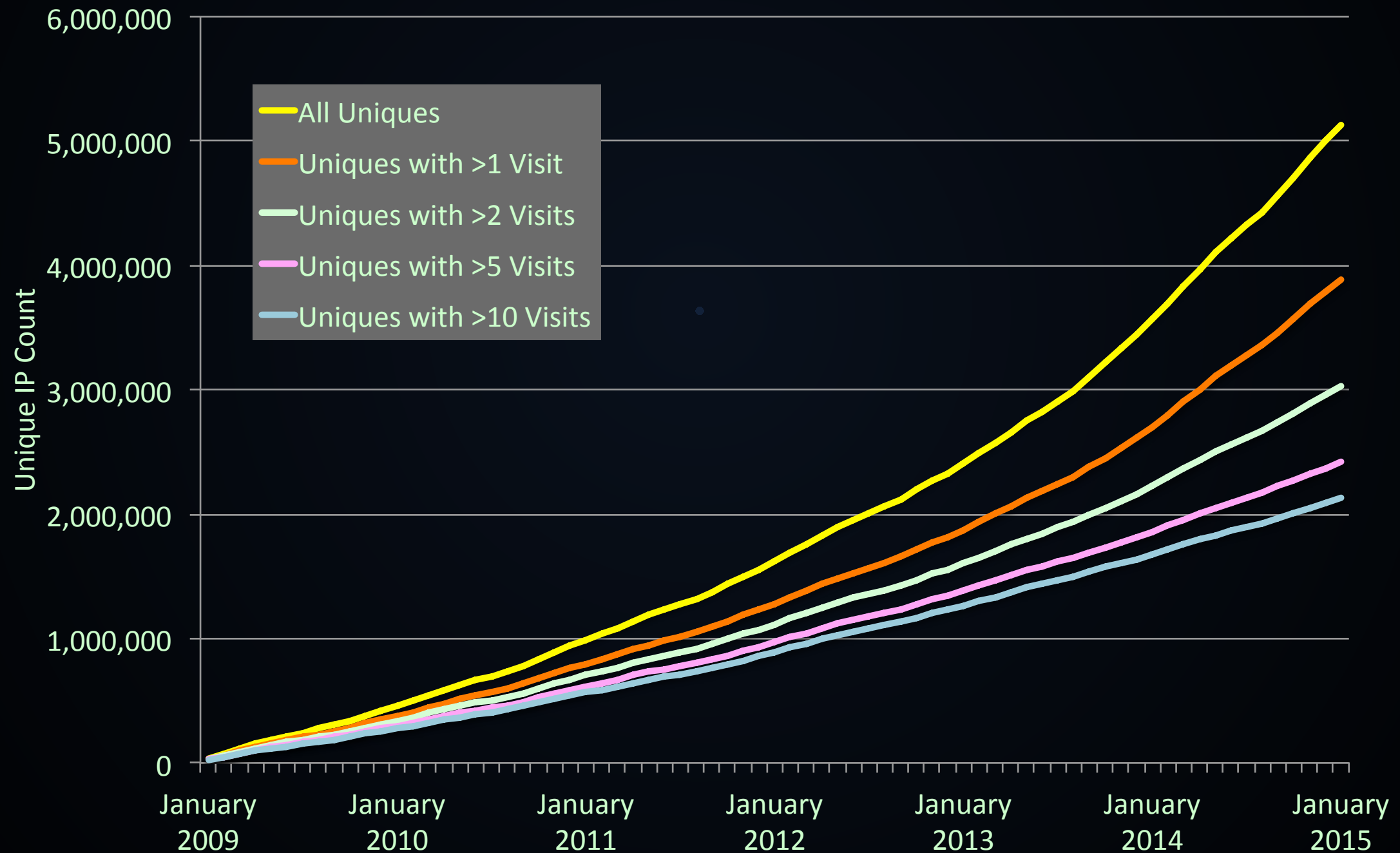
We knew a lot of people came



We knew a lot of people came back



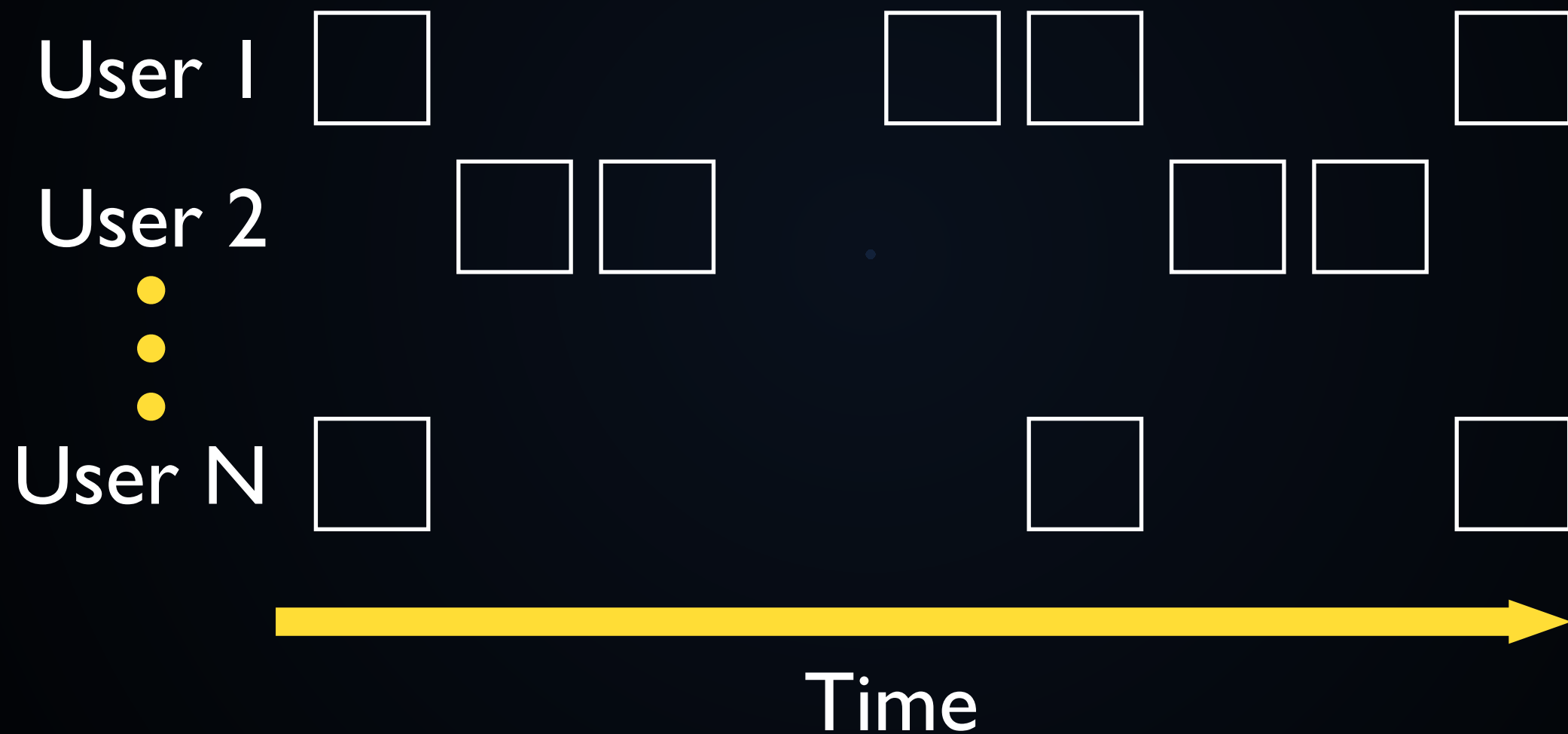
And a lot of people came back pretty much



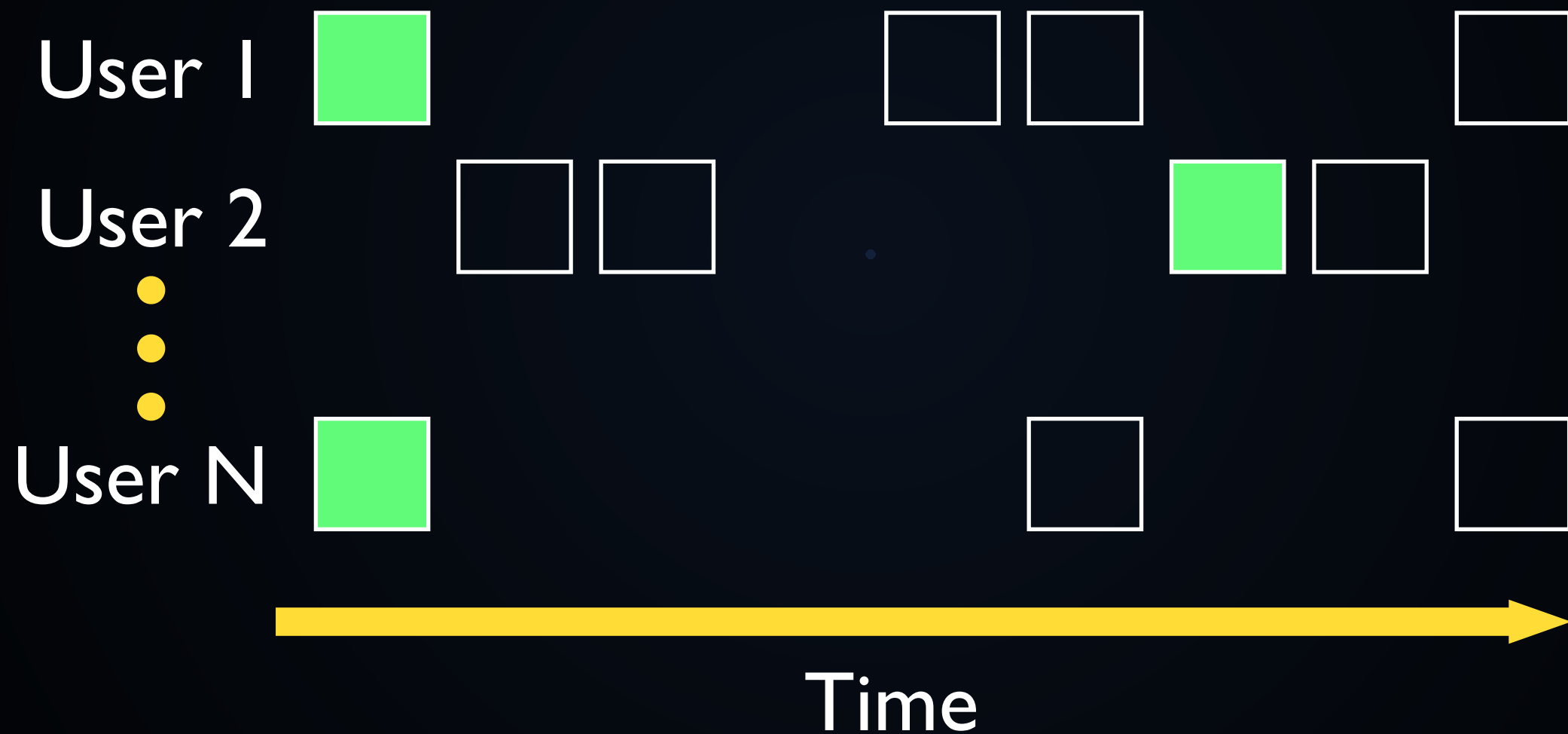
The Savannah of nanoHUB



SIMULATION VISUALIZATION



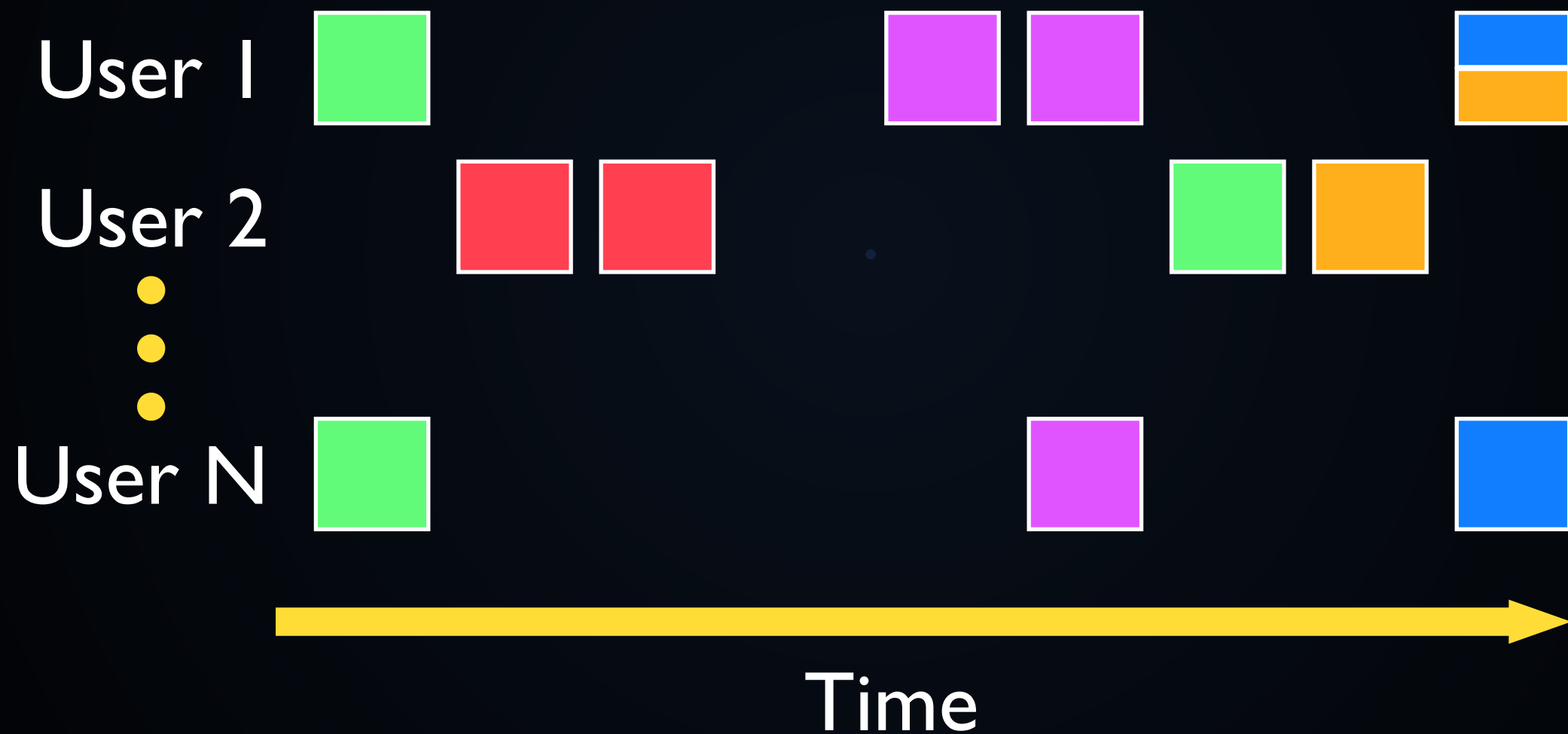
SIMULATION VISUALIZATION



■ Tool I



SIMULATION VISUALIZATION



■ Tool 1 ■ Tool 2 ■ Tool 3 ■ Tool 4 ■ Tool 5



SIMULATION VISUALIZATION



Pattern 1

Pattern 2



CLUSTERING



CLUSTERING



CLUSTERING



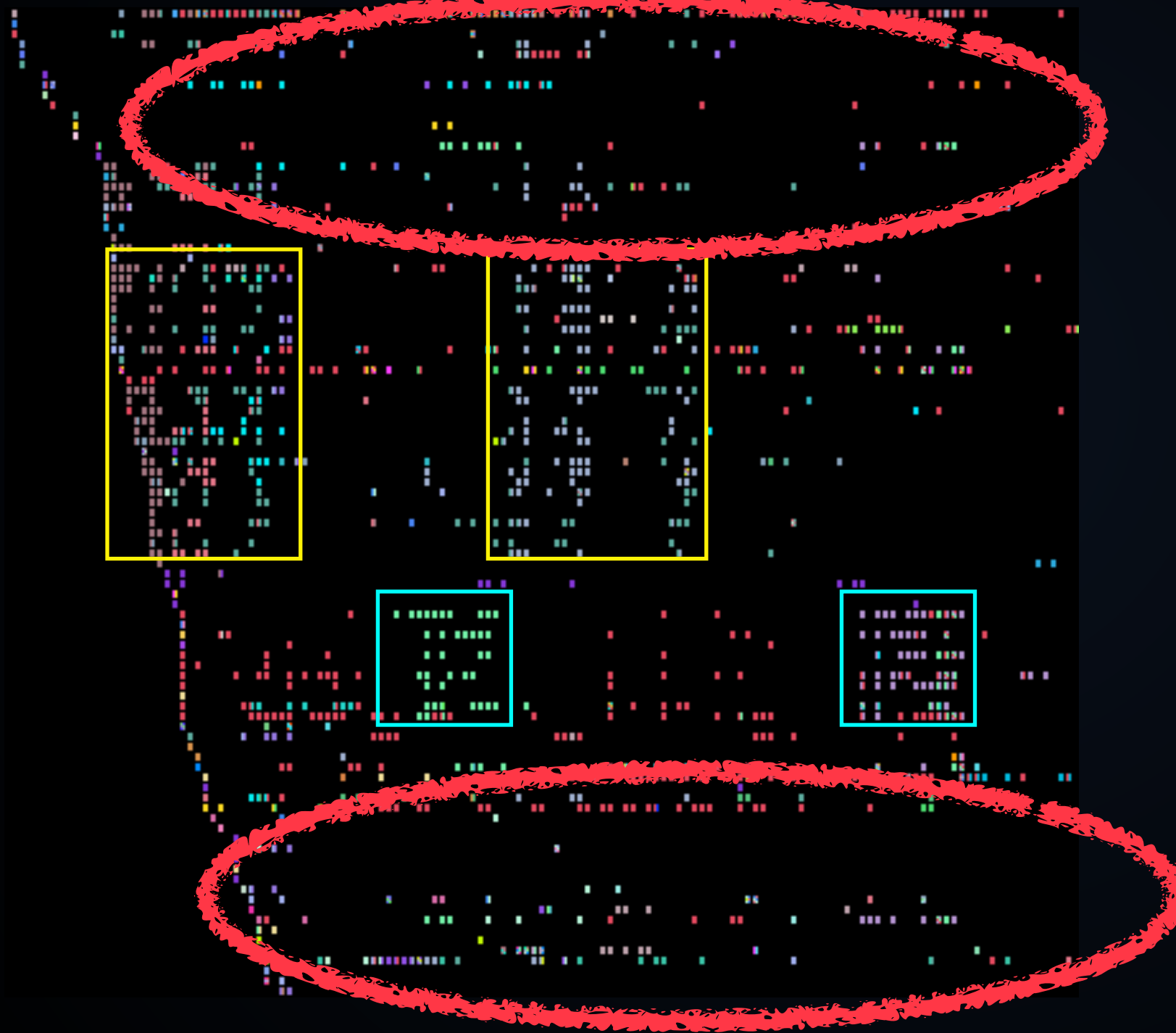
CLUSTERING



CLUSTERING



SIMULATION VISUALIZATION



Pattern 1

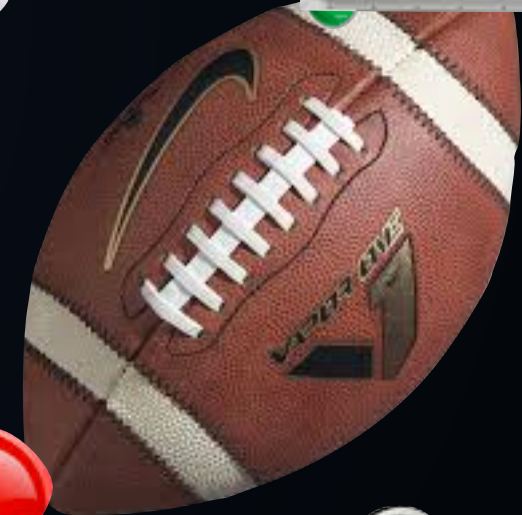
Pattern 2



CLUSTERING



CLUSTERING



CLUSTERING



CLUSTERING

How many do we need?

What do we do with the stuff that
doesn't fit our differentiation
characteristics?



CLUSTERING

$$S_{xdt} = p_s(n-d) \quad (1)$$

$$n > d \wedge t \in U_{xn} \wedge \neg \exists m: (m > d \wedge t \in U_{xm} \wedge m < n) \quad (2)$$

$$N_{xdt} = p_N |n-d| \quad (3)$$

$$n: t \in U_{xn} \neg \exists m: (m \neq d \wedge t \in U_{xm} \wedge |m-d| < |n-d|) \quad (4)$$

$$I_{xdt} = \frac{p_I (D_{\max} - D_{\min})}{\left| \bigcup_d U_{xd} \right|} \quad (5)$$

$$I_{xdt} = \frac{p_I (D_{\max} - D_{\min})}{b \min \left(T, \left| \bigcup_d U_{xd} \right| \right) + c \max \left(0, \left| \bigcup_d U_{xd} \right| - T \right)} \quad (6)$$

$$E_{ij} = \sum_{d=D_{\min}}^{D_{\max}} \left(\sum_{t \in U_{jd} - U_{id}} M_{idt} + \sum_{t \in U_{id} - U_{jd}} M_{jdt} \right) \quad (7)$$

$$M_{xdt} = \min(S_{xdt}, N_{xdt}, I_{xdt}) \quad (8)$$

$$C_i = \{P_i\} \bigcup_{x: E_{ix} < H} \{P_x\} \quad (9)$$

$$C_i = C_i \cup C_j \quad (10)$$

$$C = C - C_j \quad (11)$$

$$i, j: |C_i \cap C_j| \geq q |C_j| \quad (12a)$$

$$\wedge (\neg \exists m: m \neq i \wedge |C_m| > |C_j| \wedge |C_i \cap C_m| \geq q |C_m|) \quad (12b)$$

$$\wedge (\neg \exists k, l: k \neq l \wedge k \neq i \wedge |C_k| > |C_i| \wedge |C_k \cap C_l| \geq q |C_l|) \quad (12c)$$

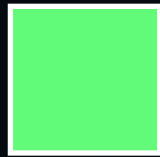


Similarity

User I



User N



1: add orange
2: add purple

Penalties Assessed



= 3.04

Similarity



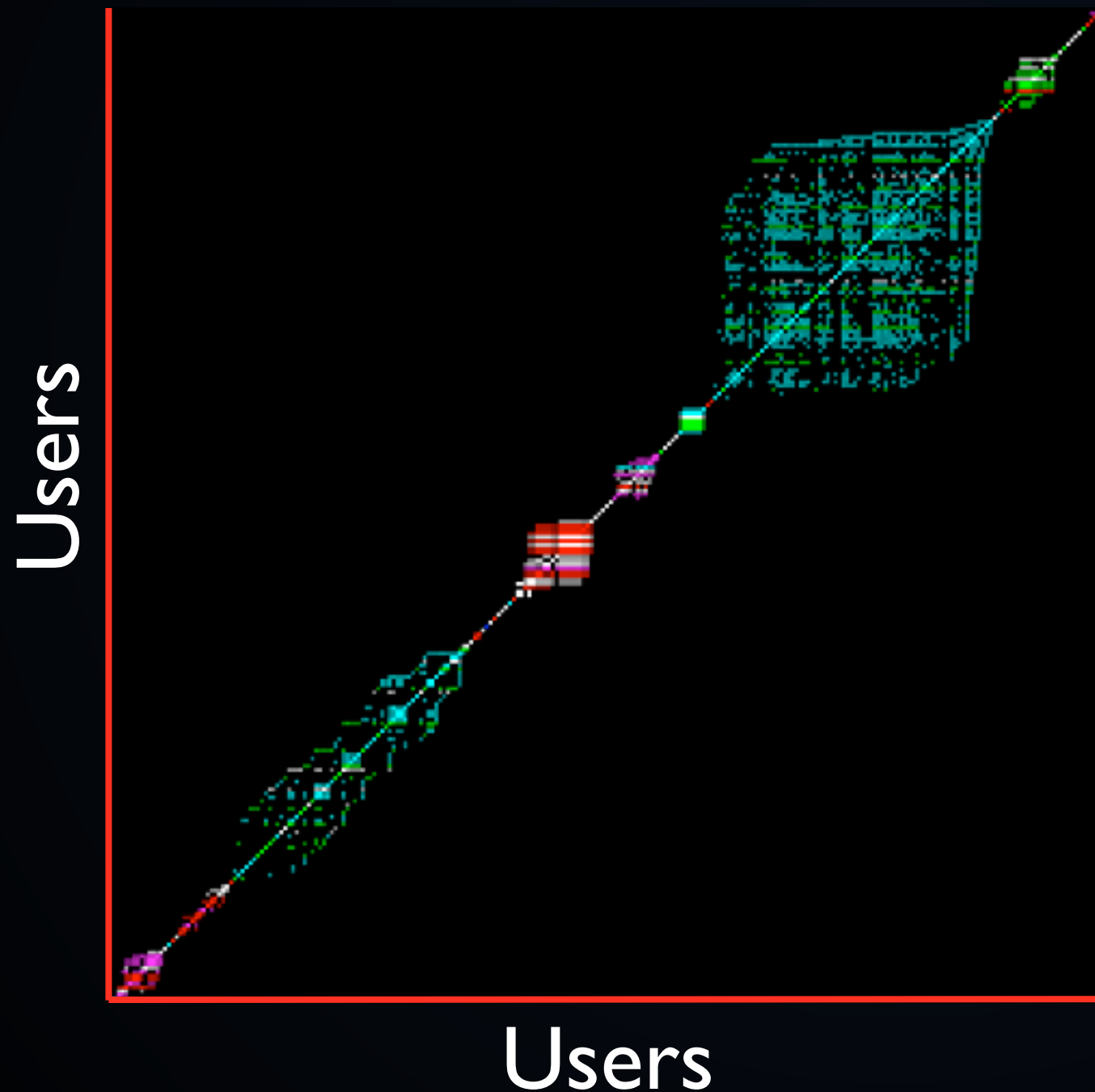
1: move orange
2: move green
3: add red
4: add red

5: add purple
6: add purple
7: add blue

Penalties Assessed

~~||||~~ || = 25.6

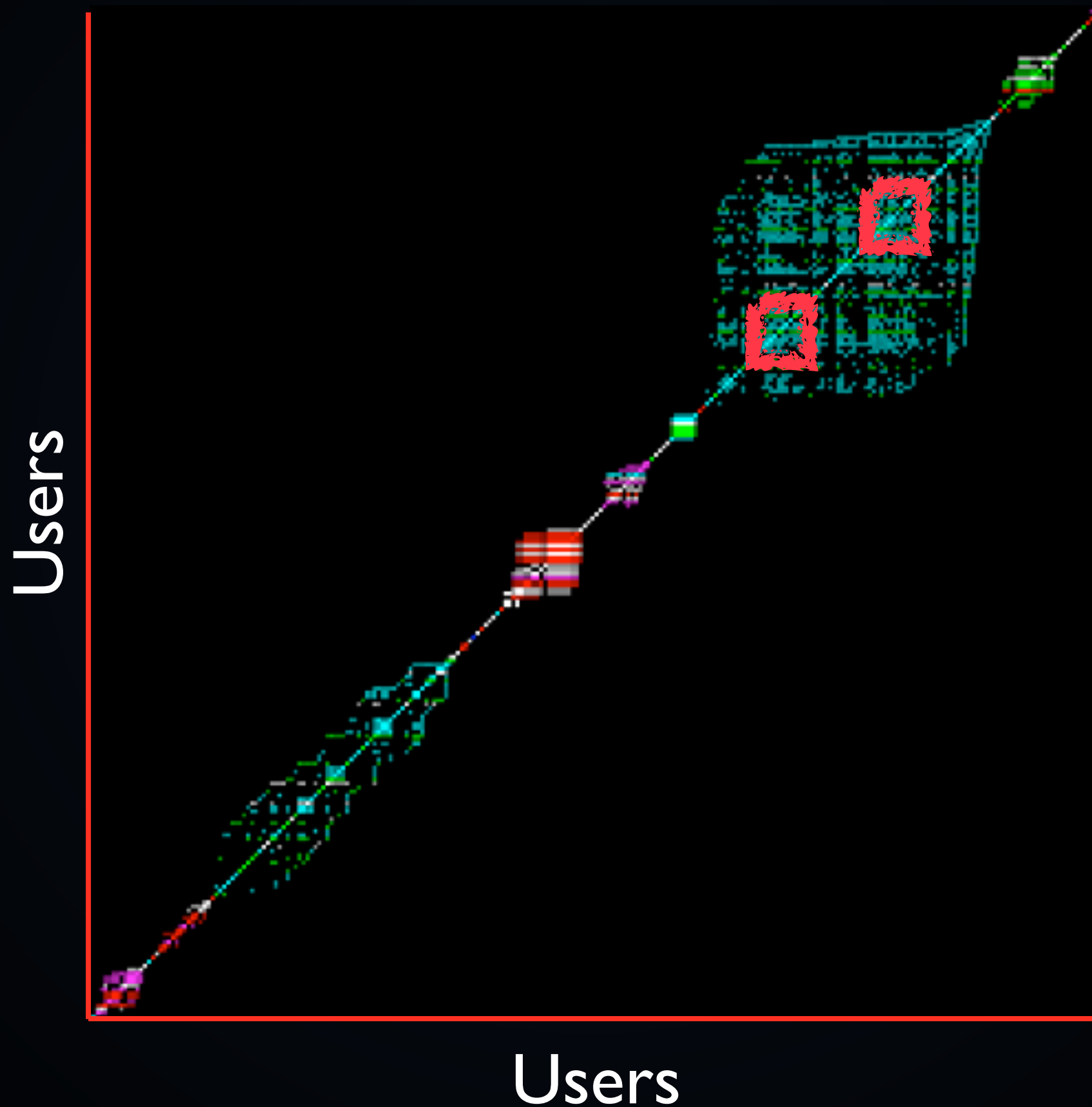
Clustering by Growth



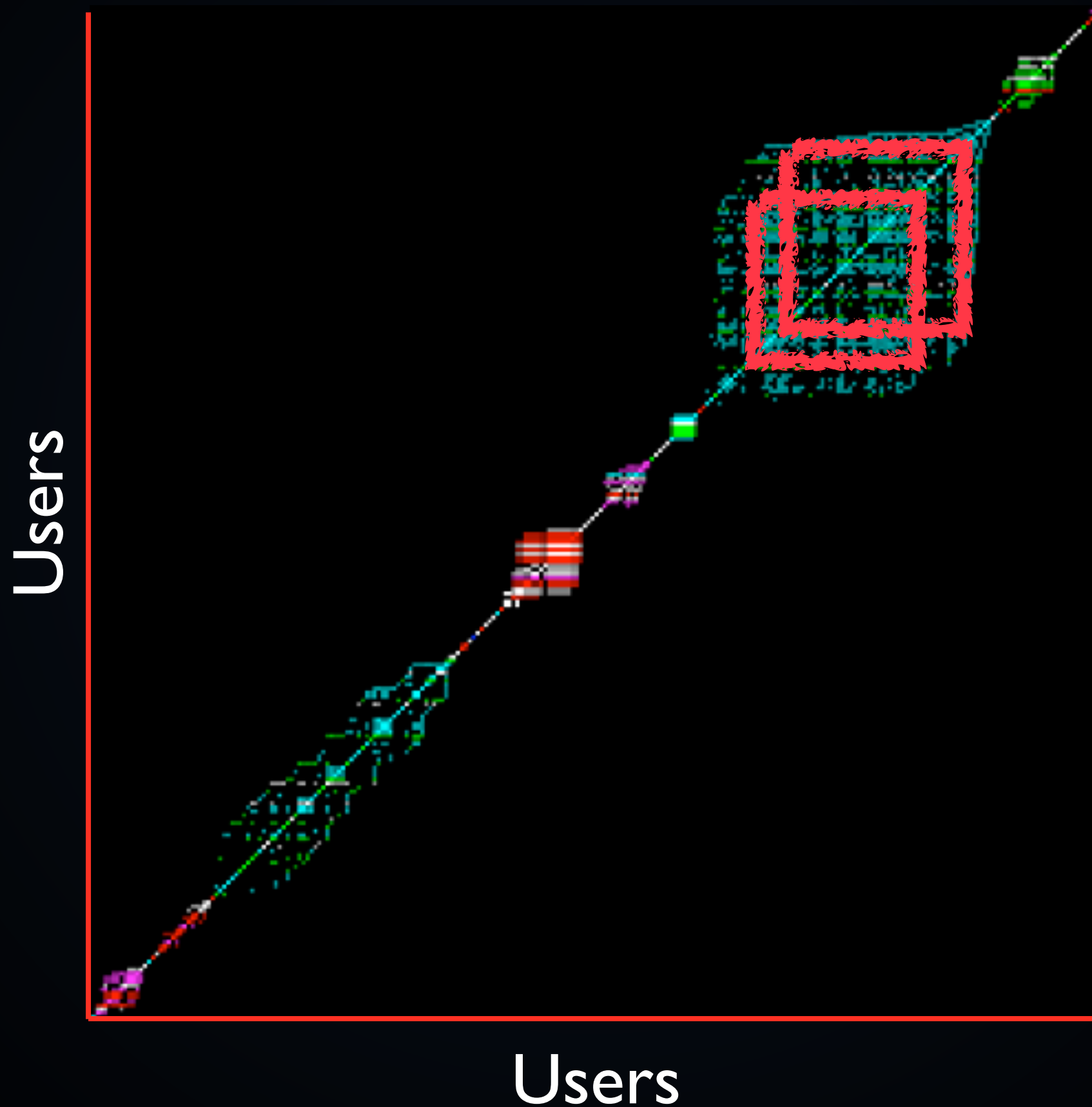
Dot intensity is the strength of User-User similarity

Existence of clusters becomes evident

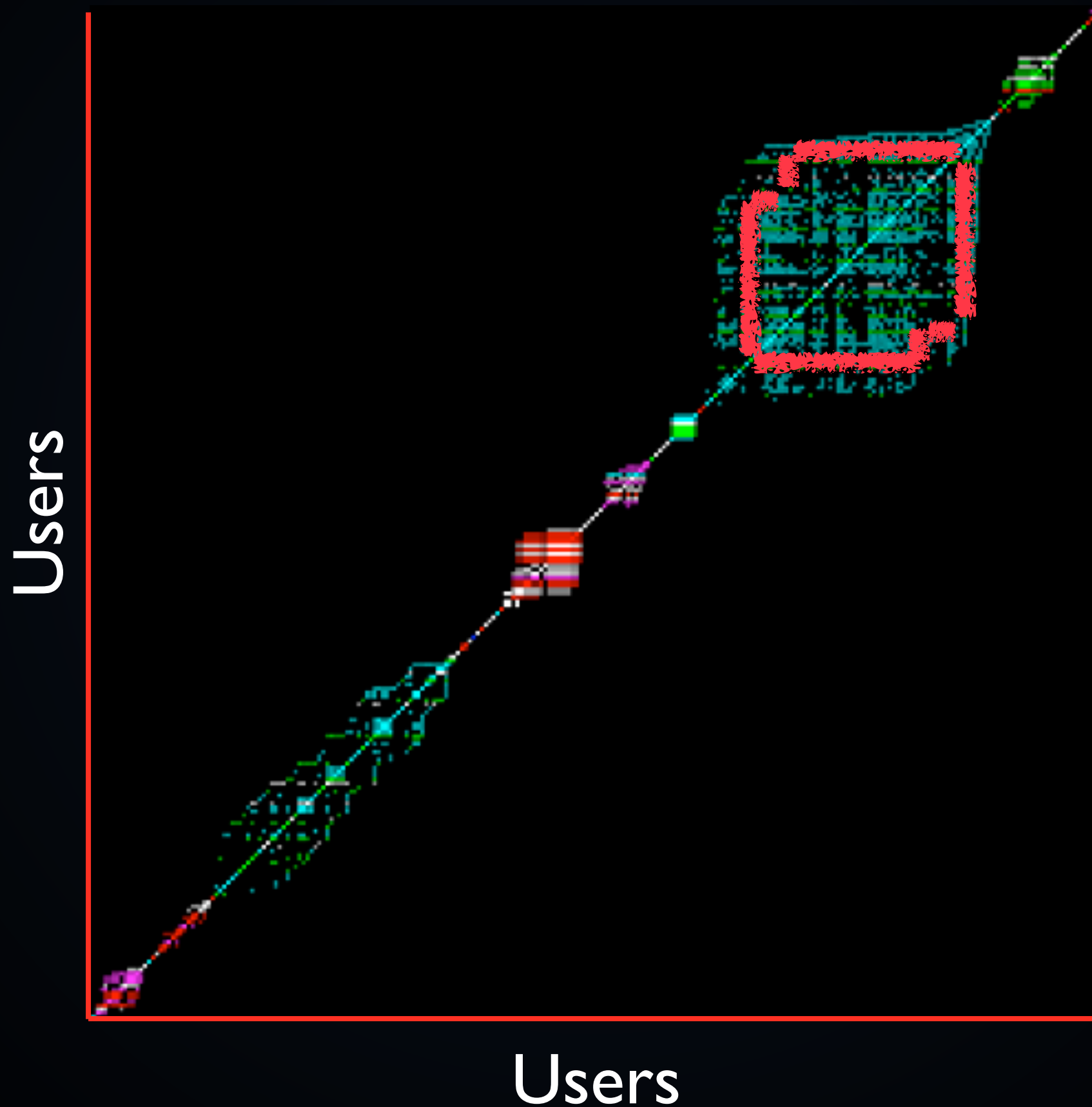
Clustering by Growth



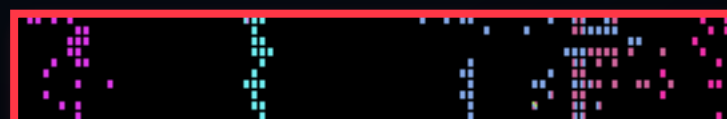
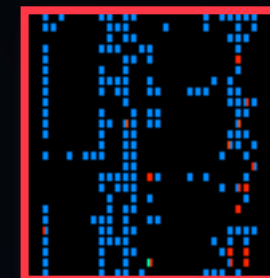
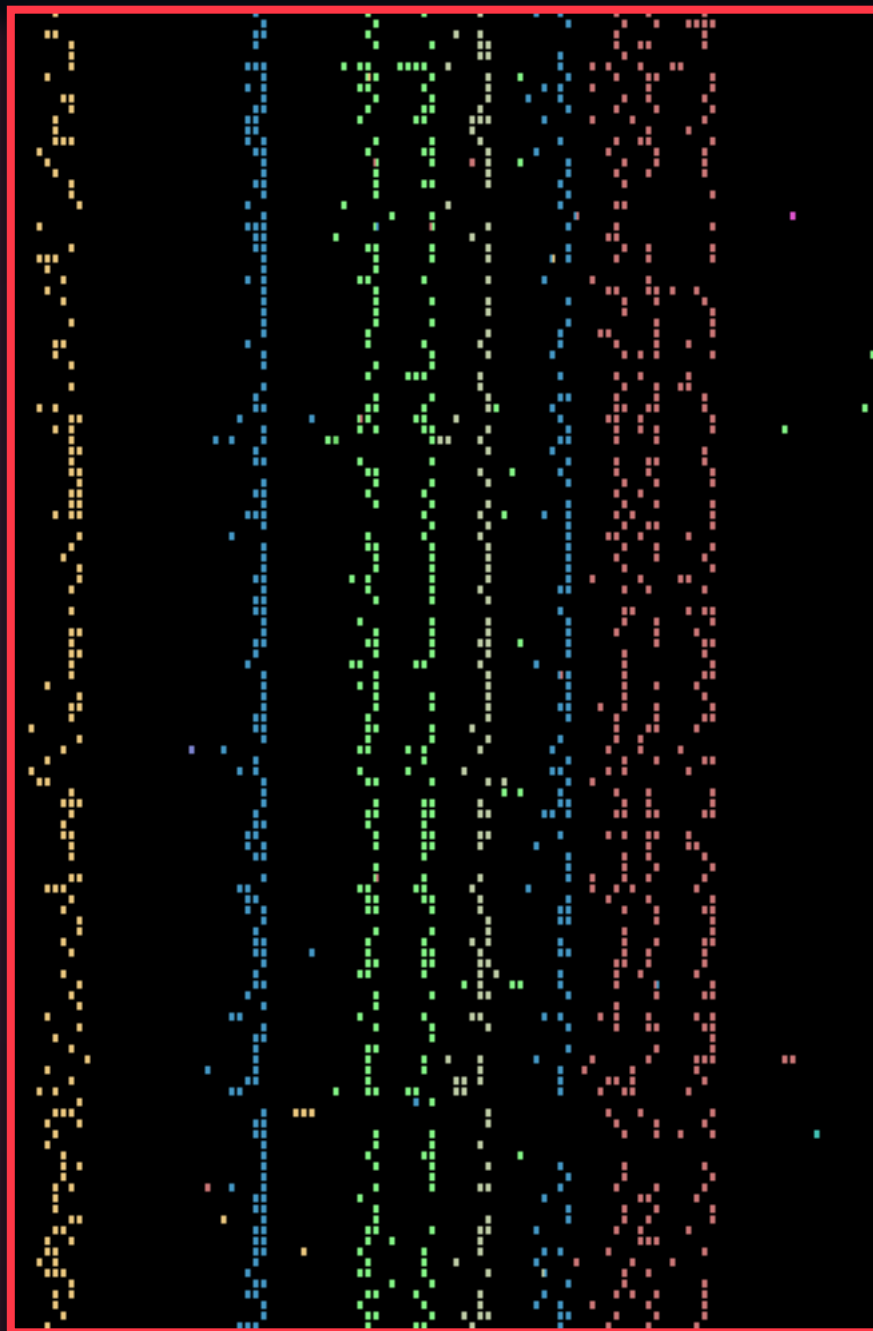
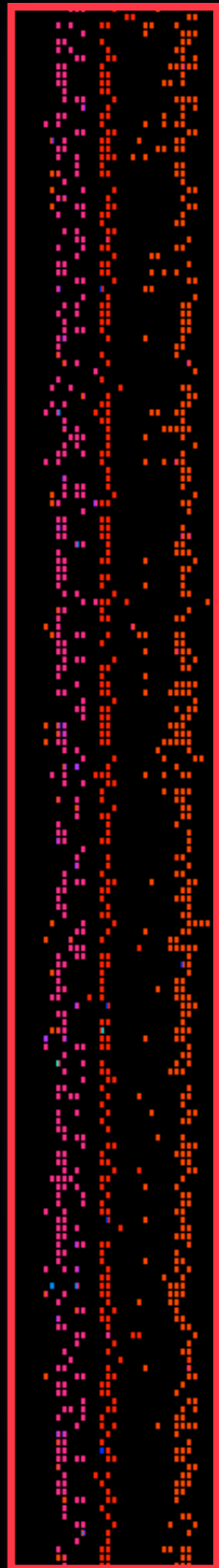
Clustering by Growth



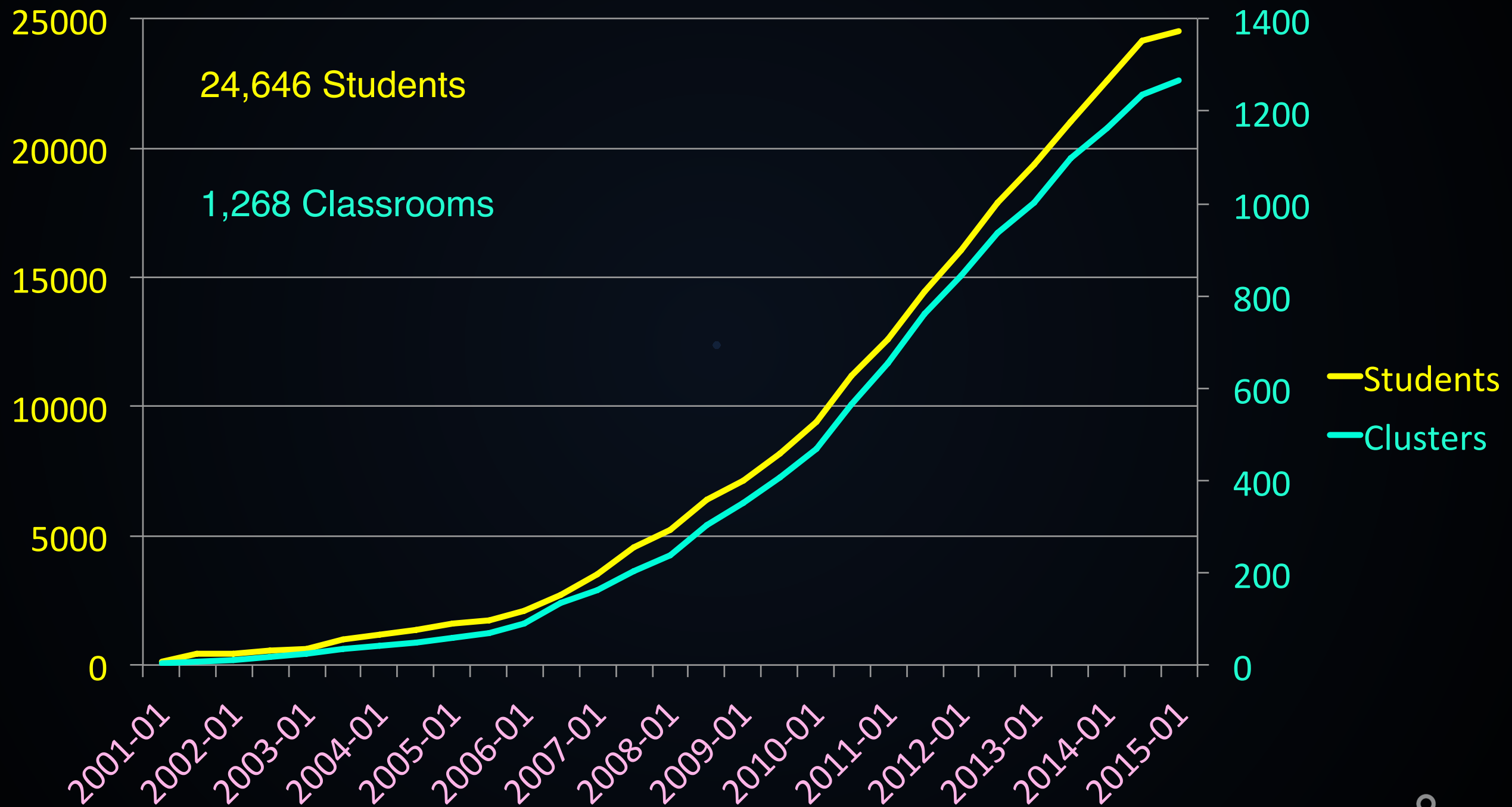
Clustering by Growth



CLASSROOM CLUSTERS



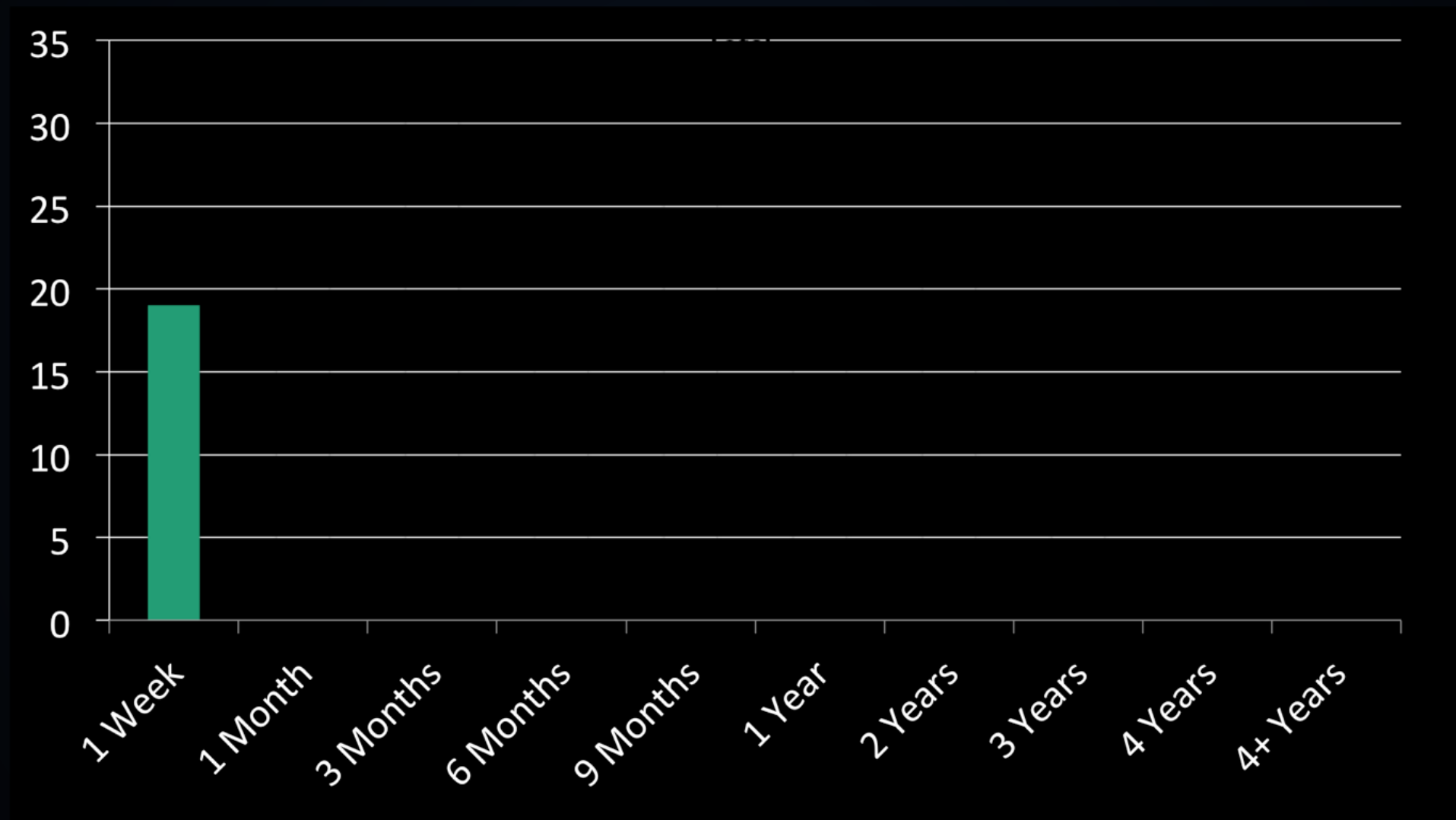
CLASSROOM IMPACT



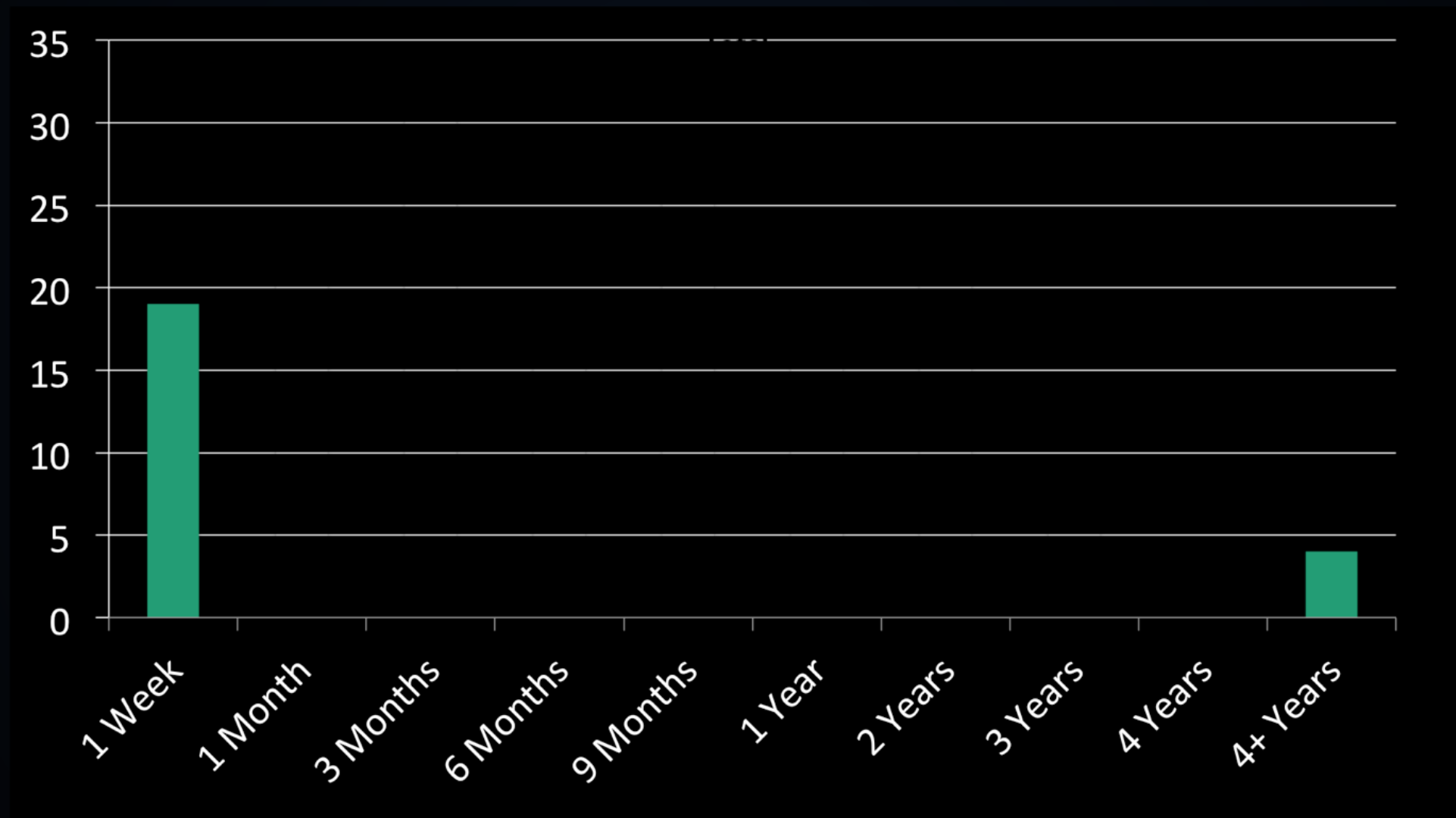
Today > 30,000 students in > 2,000 classrooms



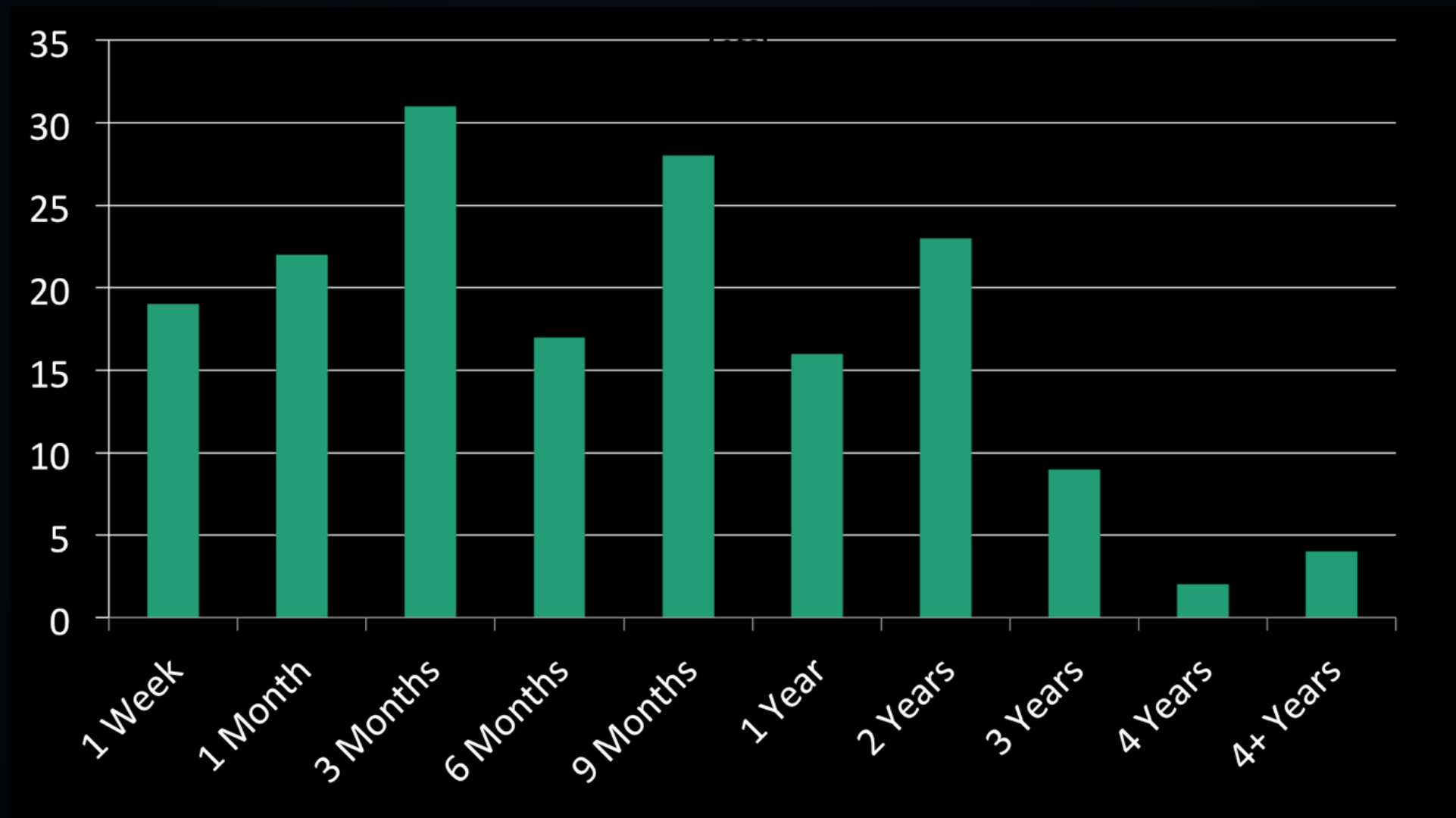
IMPACT - ADOPTION



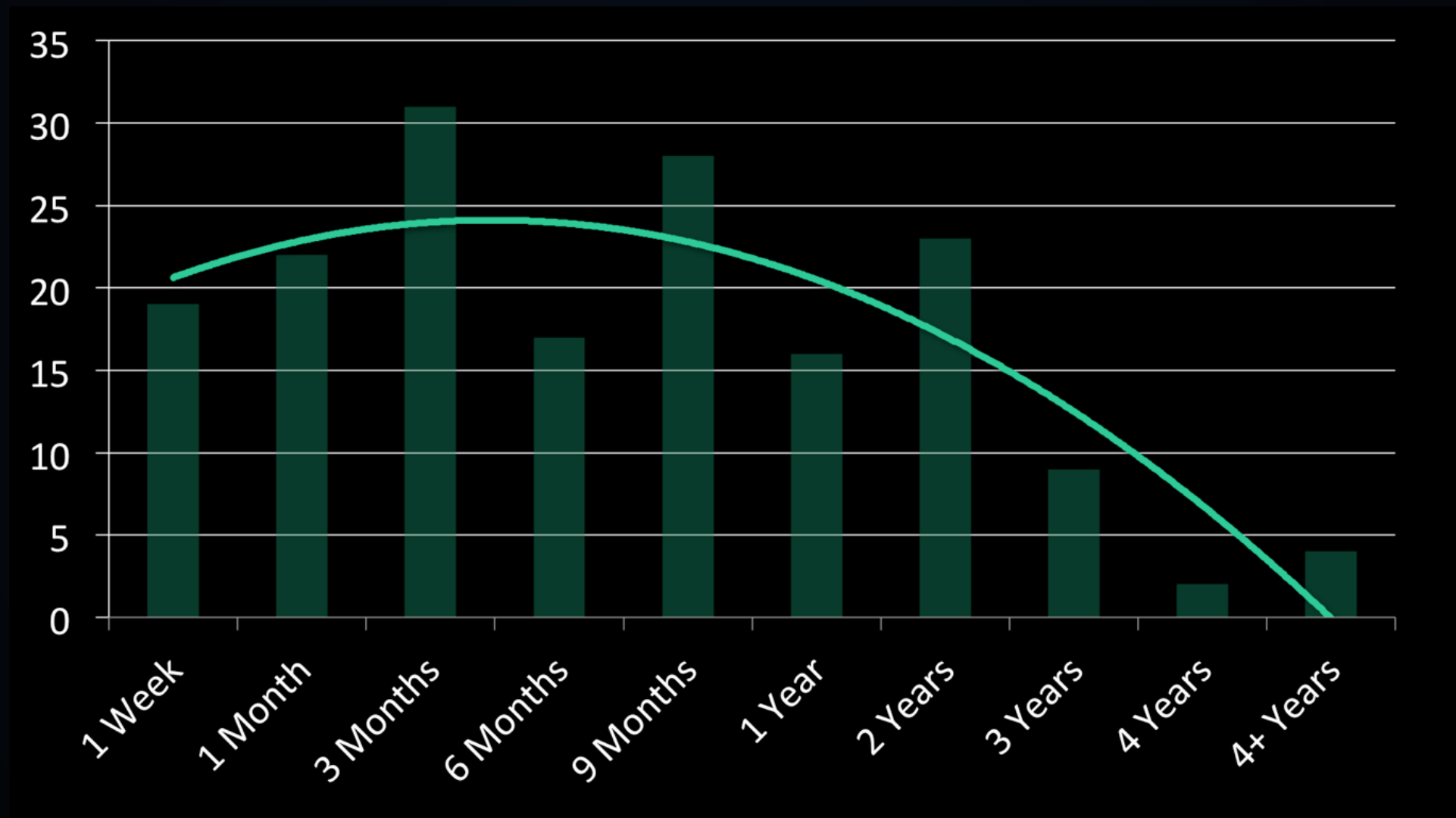
IMPACT - ADOPTION



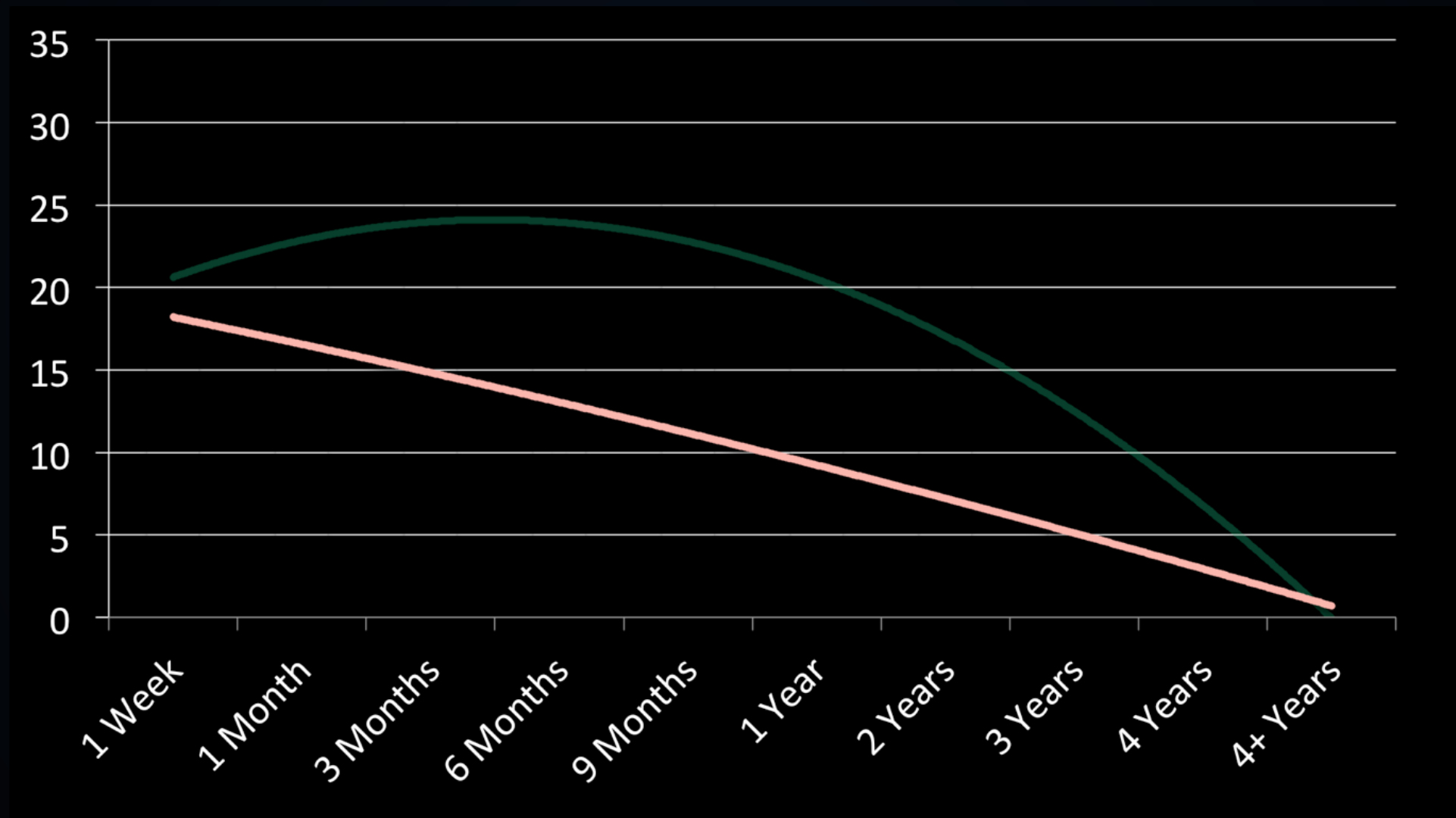
IMPACT - ADOPTION



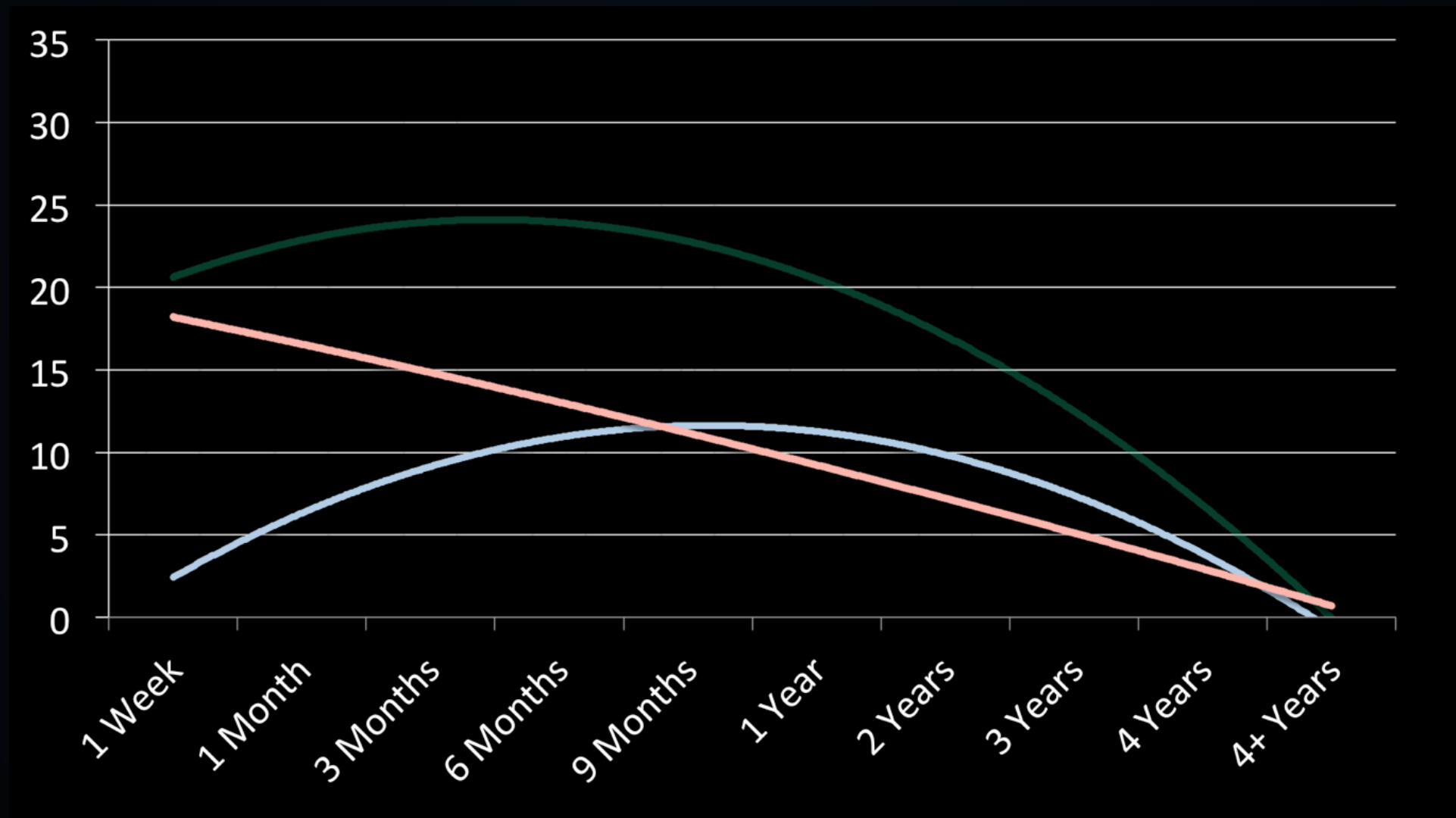
IMPACT - ADOPTION



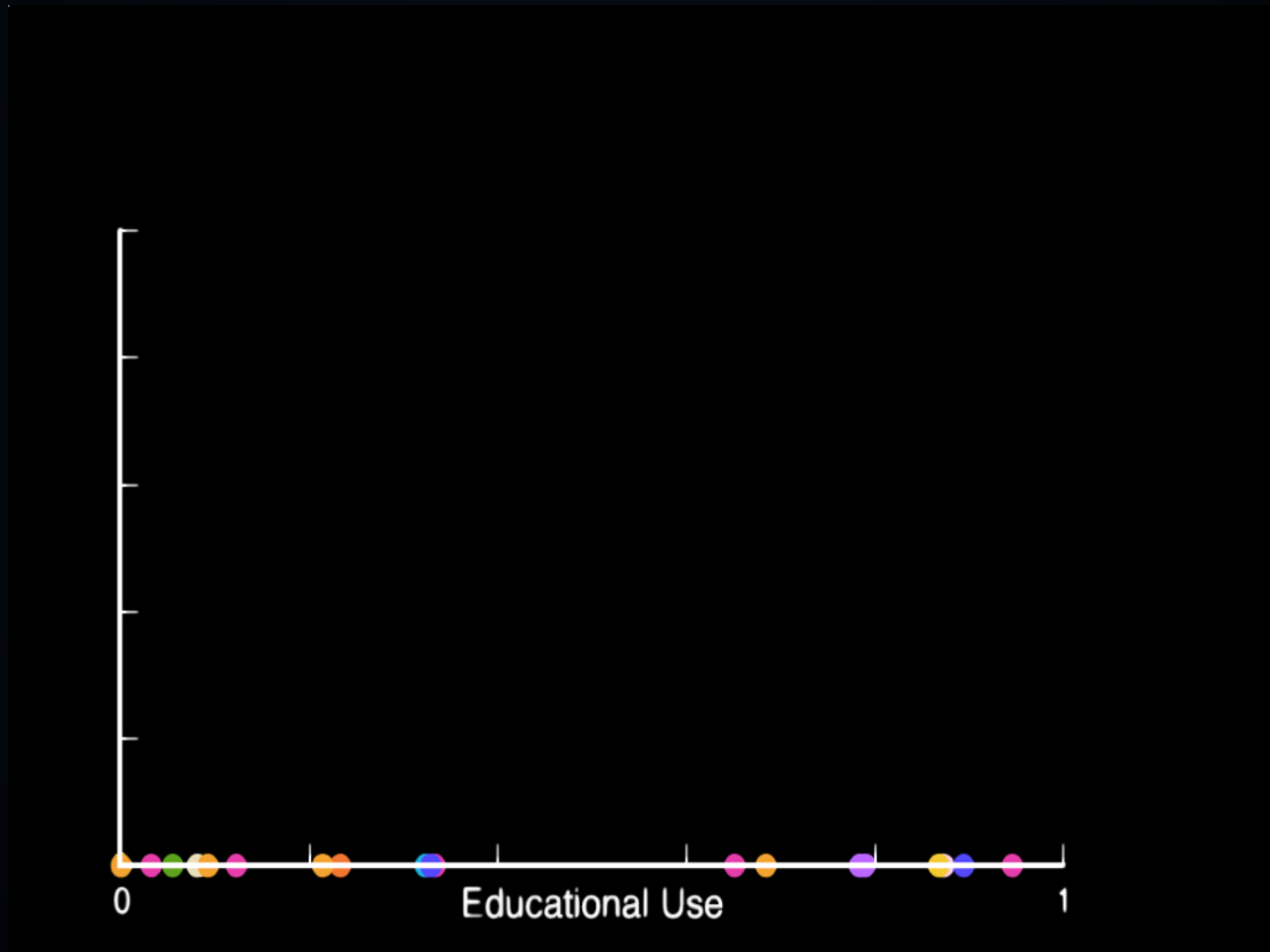
IMPACT - ADOPTION



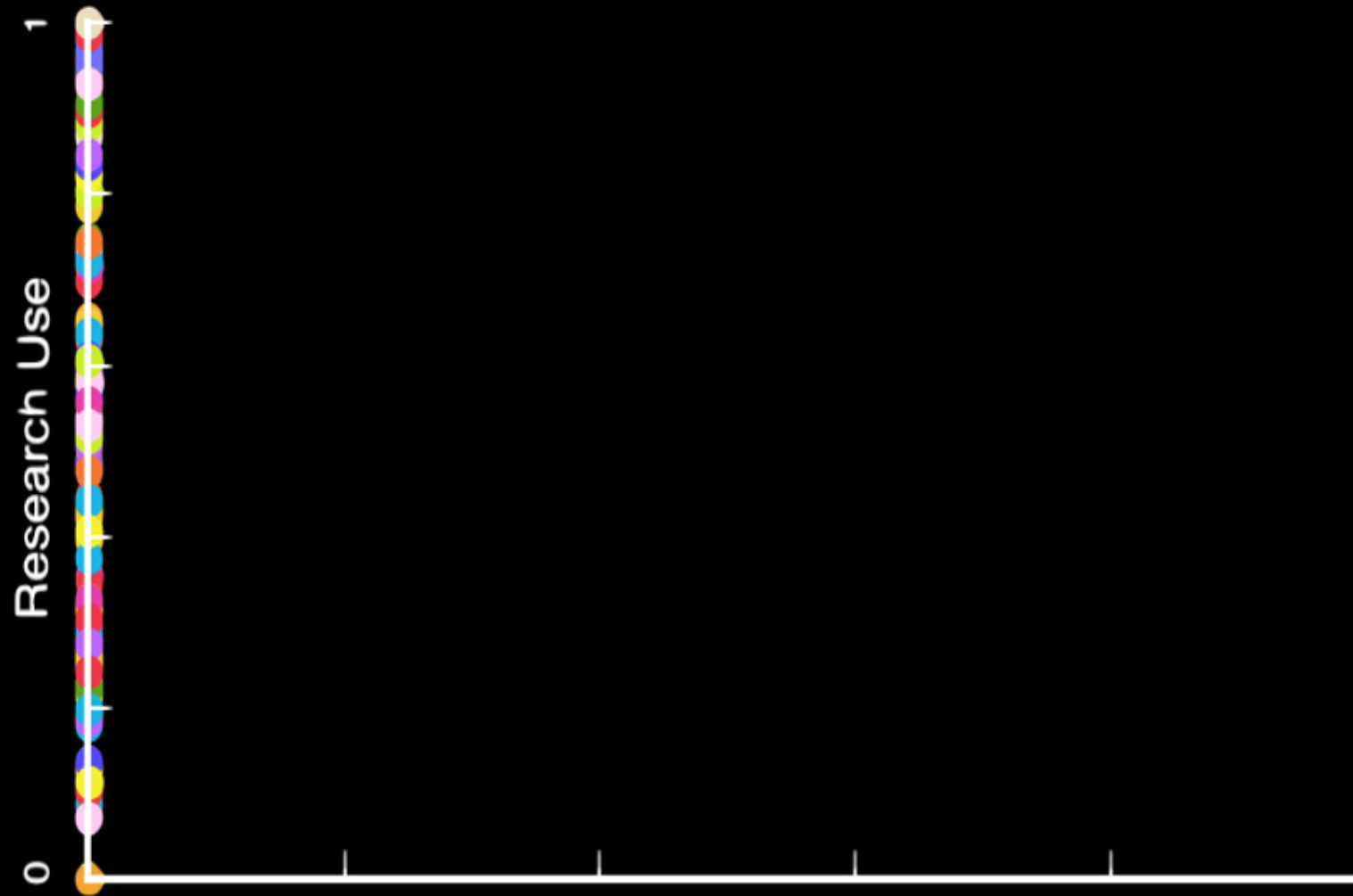
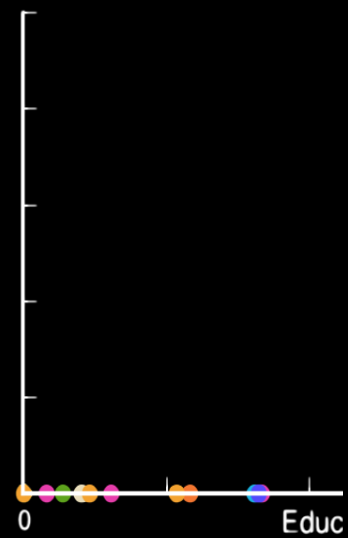
IMPACT - ADOPTION



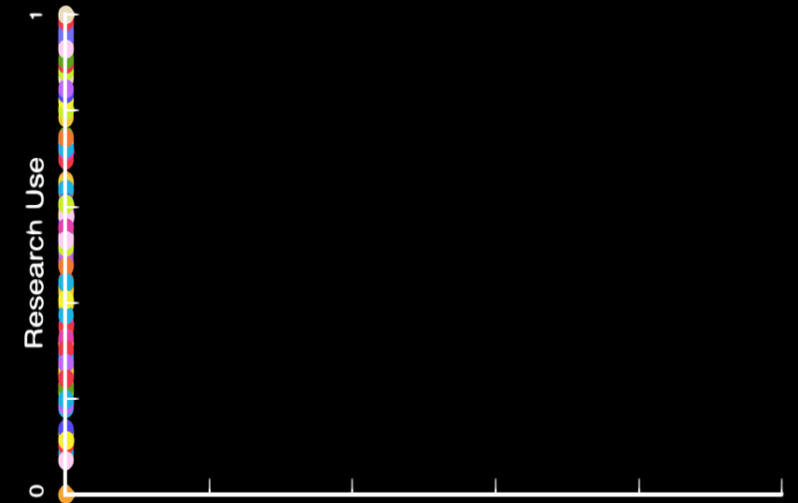
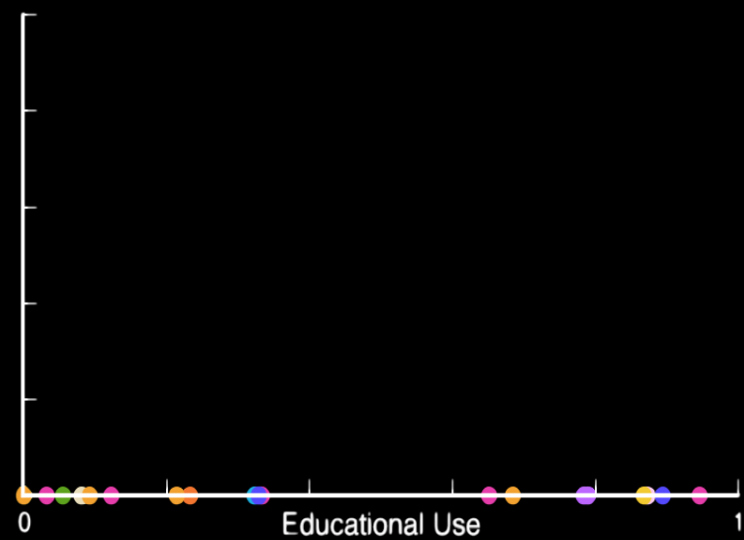
IMPACT - MIGRATION



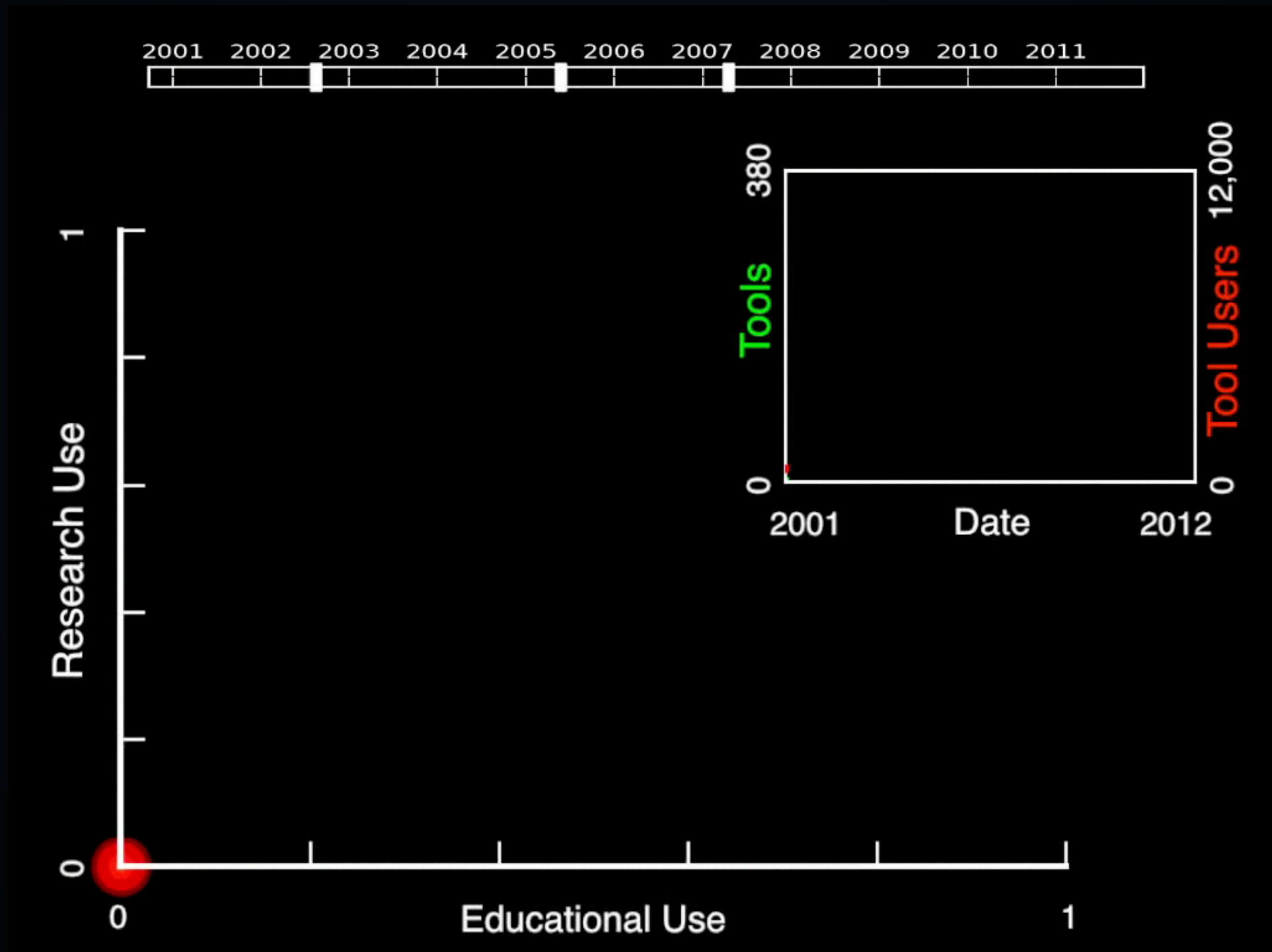
IMPACT - MIGRATION



IMPACT - MIGRATION



IMPACT - MIGRATION



Credit: Dwight McKay

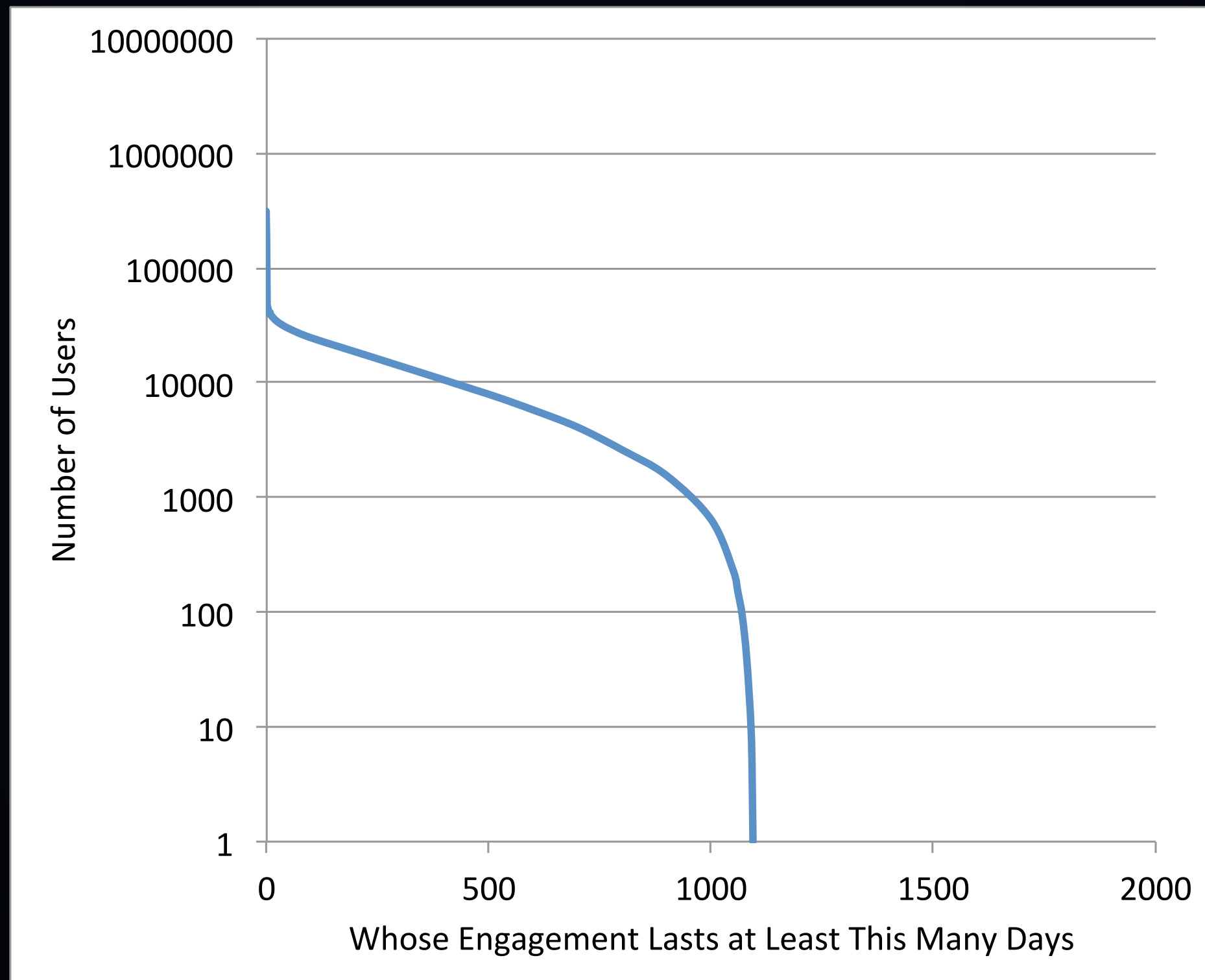




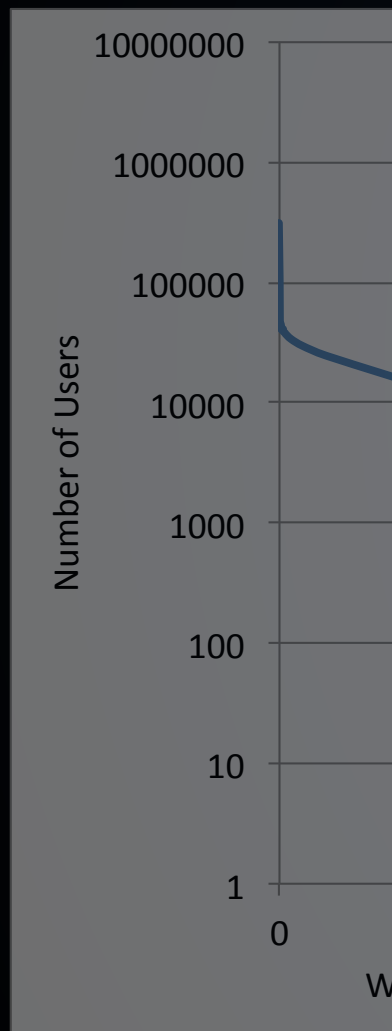
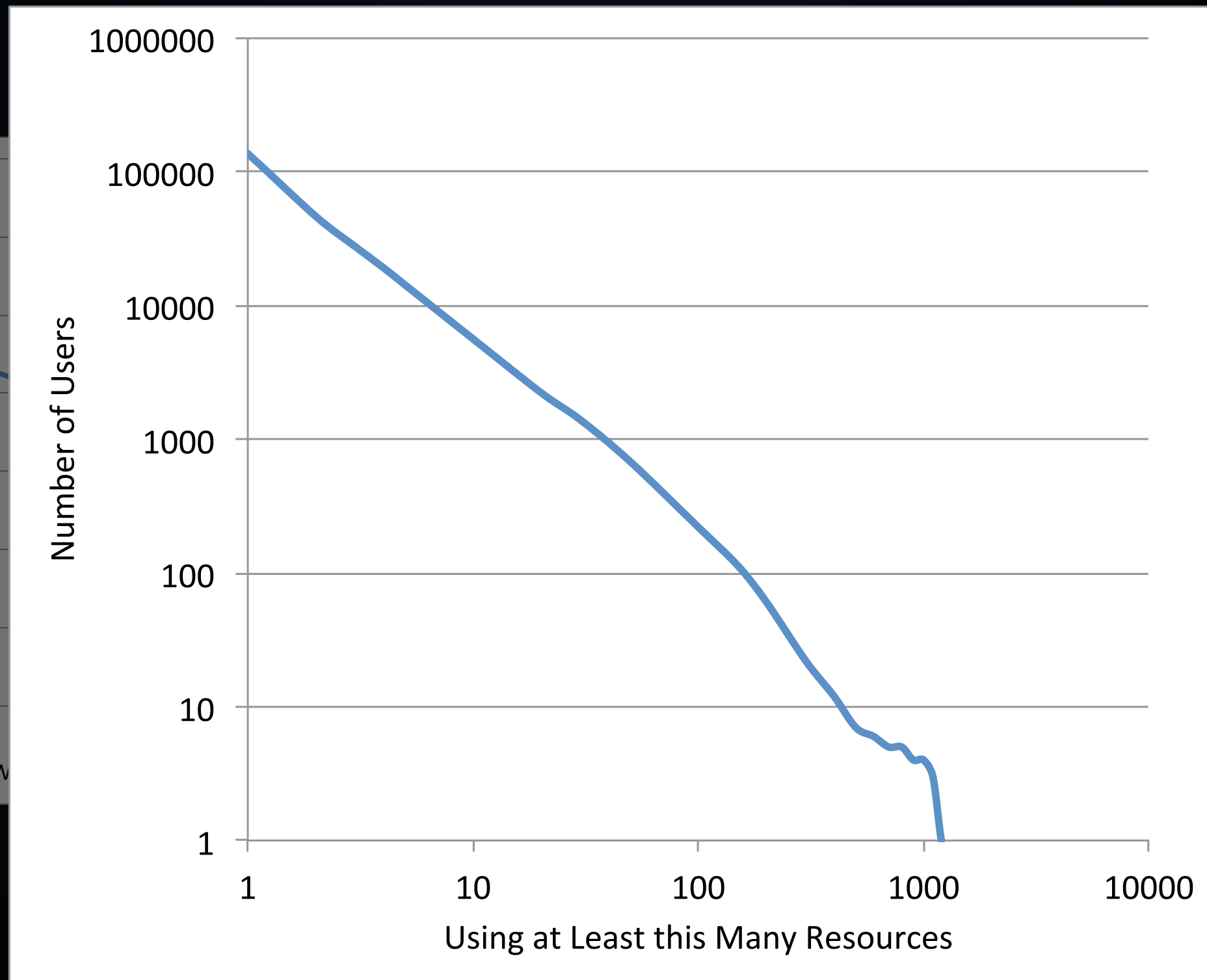
Who Cares?



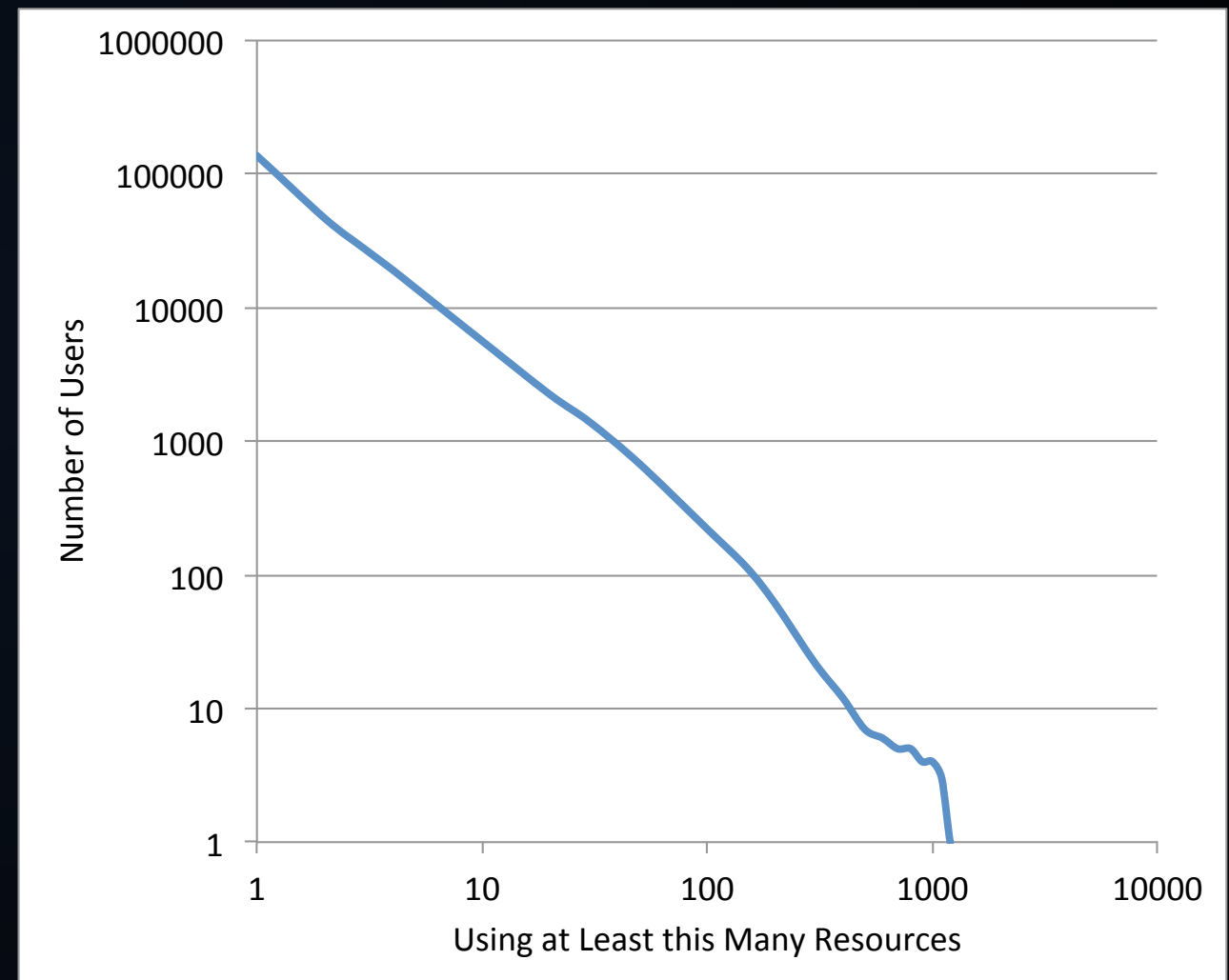
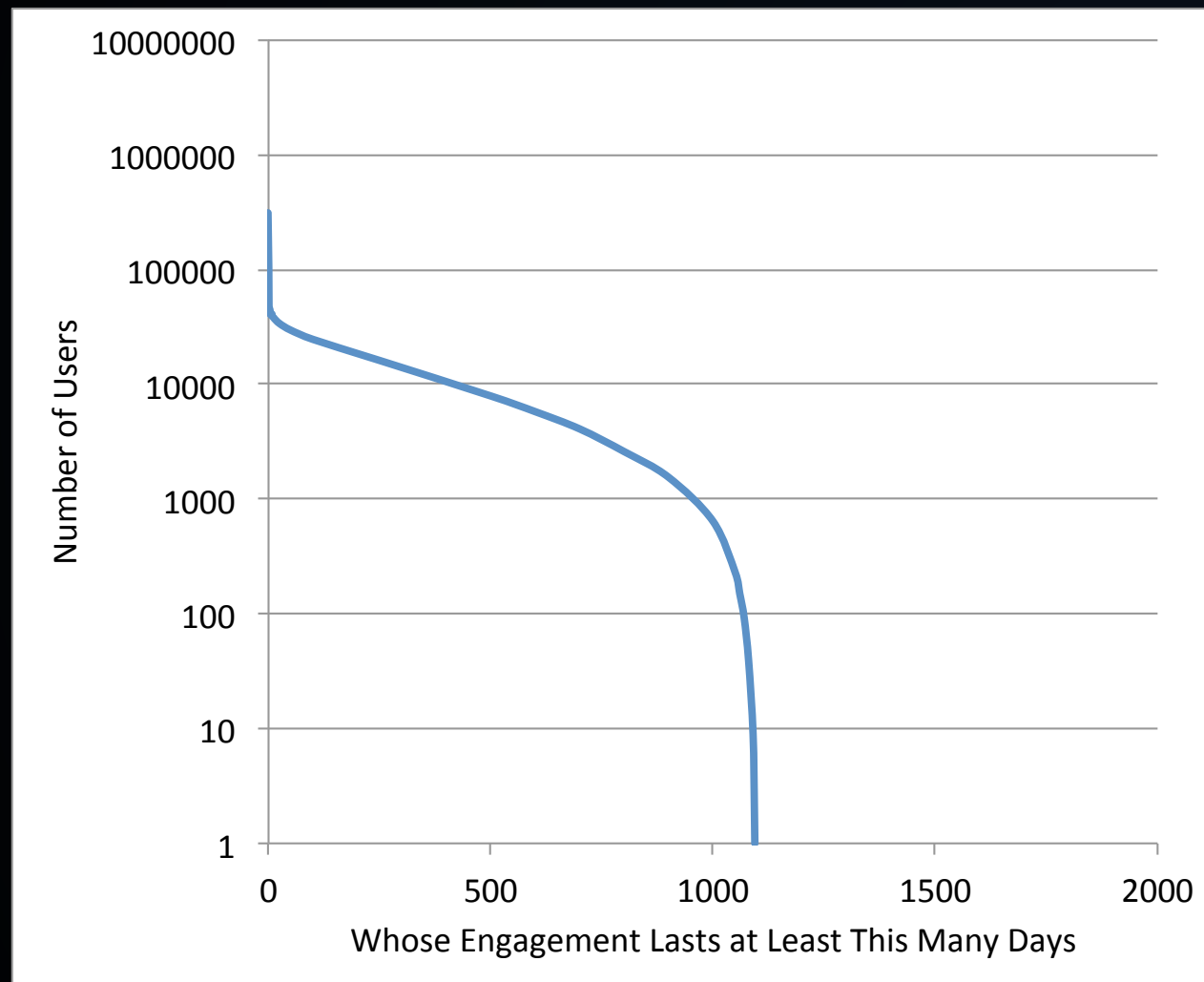
STRATEGY DRIVING CURVES



STRATEGY DRIVING CURVES

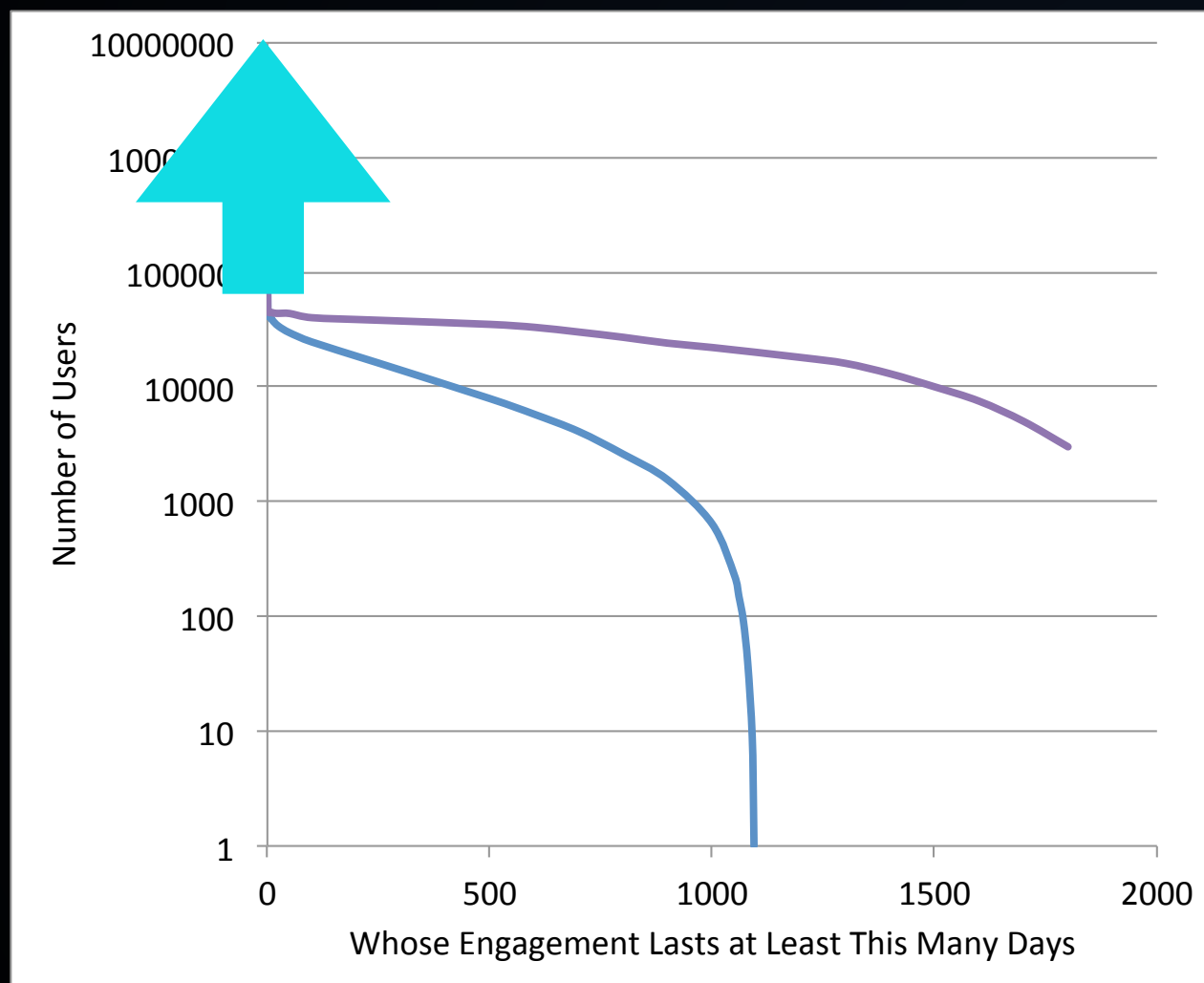


STRATEGY DRIVING CURVES

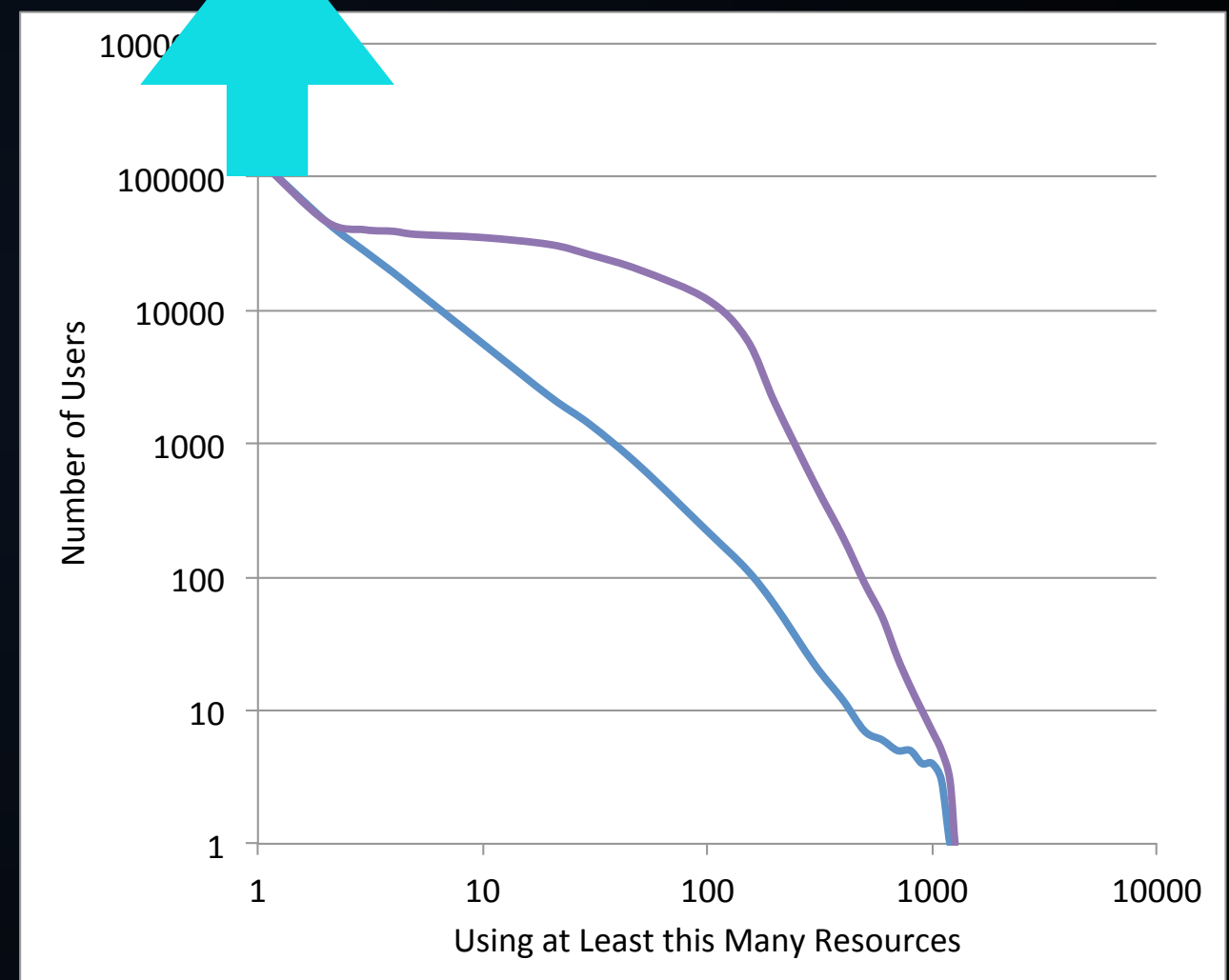


STRATEGY DRIVING CURVES

To Increase User Engagement...



Lengthening



Deepening

Growing



POTENTIAL DATA DRIVEN SUSTAINABILITY INTERVENTIONS



- **Lengthening**
 - Recommend new simulations based on the behavior of others
 - Show instructors how their tools may be used more comprehensively in other classroom settings
- **Deepening**
 - Recommend related simulation tools to those a user has accessed
 - Show instructors tools related to those used in their classroom settings
- **Growing**
 - Data driven identification of educational domain champions
 - Producing “packaged” instruction kits to new instructors