



Graphs of mod 10 on powers of 2 to 9

- Exponents = {0,1,2... 101 }
- Objects = { 2, 3, 4, 5, 6, 7, 8, 9, }
- Object_Power_Sets = { {x^{exp}} | x ∈ Objects ; exp ∈ Exponents }
- Cycle_Sets = { {o mod 10 } | o ∈ O ; O ∈ Object_Power_Sets }

Elements of Cycle Sets

These sets form a Group under the operation $\otimes_{10}(x,y) = (x * y) \bmod 10$. For identity element derivation [see below](#).

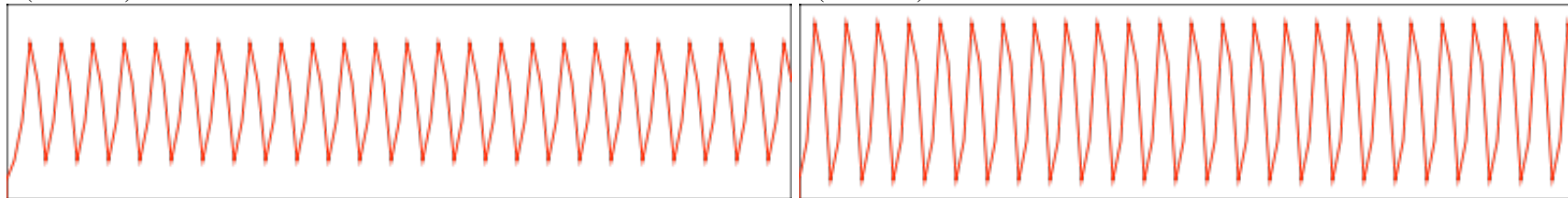
- Cycle_Set₂ = {2,4,8,6} [count=4] ([show table](#))
- Cycle_Set₃ = {1,3,9,7} [count=4] ([show table](#))
- Cycle_Set₄ = {4,6} [count=2] ([show table](#))
- Cycle_Set₅ = {5} [count=1] ([show table](#))
- Cycle_Set₆ = {6} [count=1] ([show table](#))
- Cycle_Set₇ = {1,7,9,3} [count=4] ([show table](#))
- Cycle_Set₈ = {8,4,2,6} [count=4] ([show table](#))
- Cycle_Set₉ = {1,9} [count=2] ([show table](#))

Horizontal View (back to top)

Last 1 digit(s) for powers of

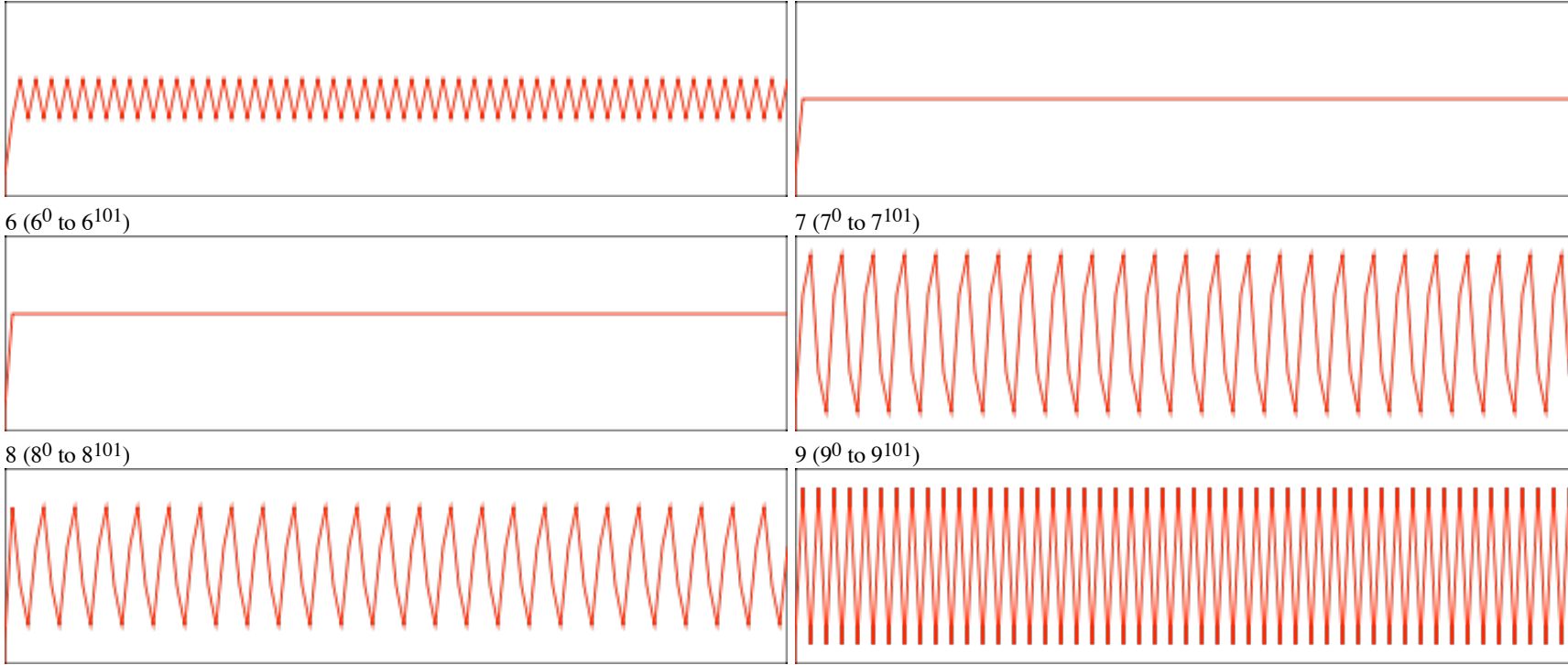
2 (2⁰ to 2¹⁰¹)

3 (3⁰ to 3¹⁰¹)



4 (4⁰ to 4¹⁰¹)

5 (5⁰ to 5¹⁰¹)



Vertical View (back to top)

Last 1 digit(s) for powers of

2 (2⁰ to 2¹⁰¹)

3 (3⁰ to 3¹⁰¹)

4 (4⁰ to 4¹⁰¹)

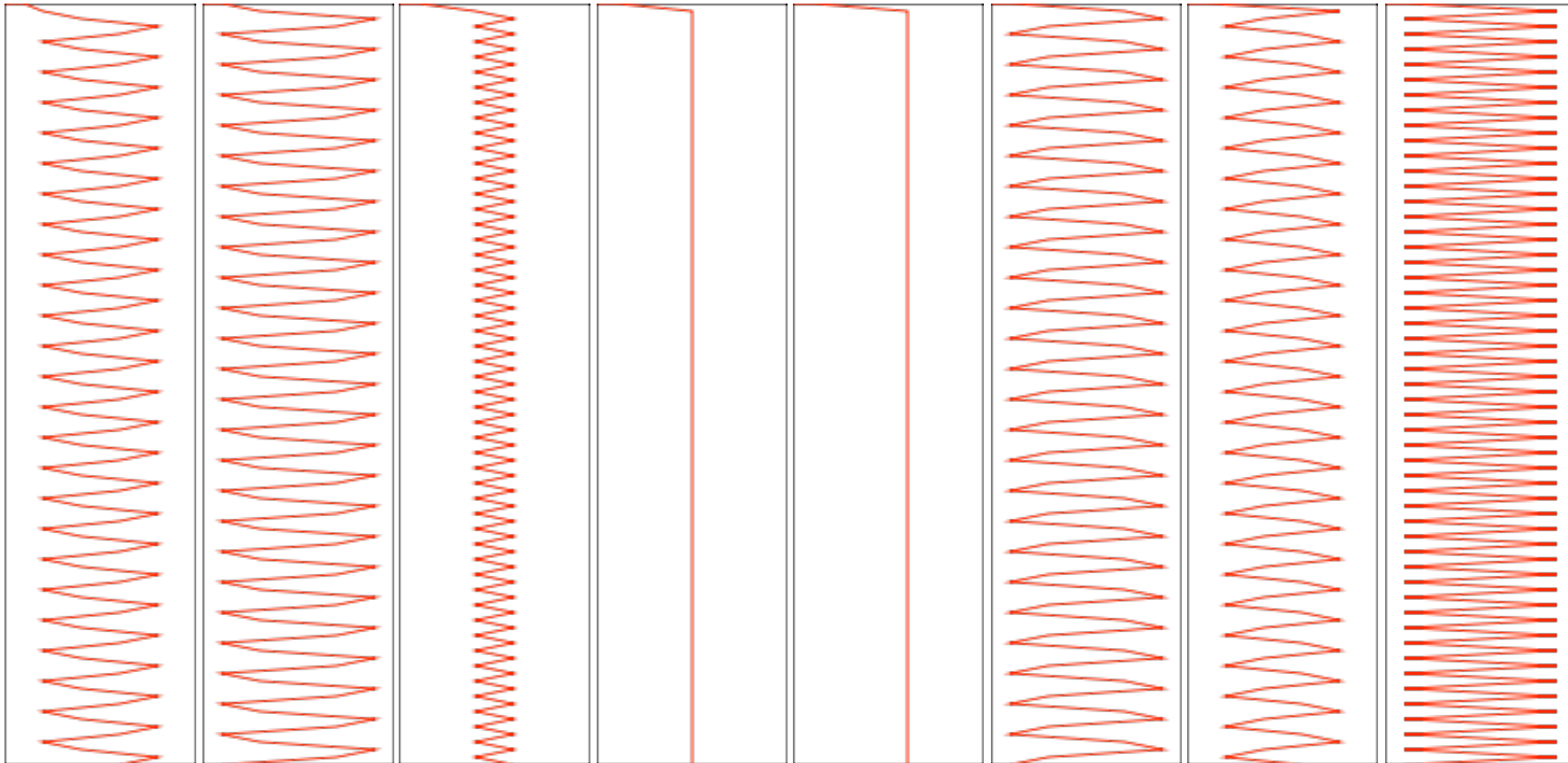
5 (5⁰ to 5¹⁰¹)

6 (6⁰ to 6¹⁰¹)

7 (7⁰ to 7¹⁰¹)

8 (8⁰ to 8¹⁰¹)

9 (9⁰ to 9¹⁰¹)



Identity element

The members in the cycle set (say x, y, z) will be a subset of Digits= $\{0,1,2,3,4,5,6,7,8,9\}$.

With the operator $\otimes_{10}(x,y) = (x * y) \bmod 10$, the search for identity element proceeds as follows:

- Let x be the identity element of a cycle set, then for any y from the cycle set, $(x * y) \bmod 10 = y$. This is possible with $x=1+u$ ($u \in \text{Digits}$). Then

$$\begin{aligned} (x*y) \bmod 10 &= (y+u*y) \bmod 10 \\ &= y \bmod 10 + (u*y) \bmod 10 \\ &= y + (u*y) \bmod 10 \end{aligned}$$
 need to find smallest u , such that $u*y$ to be a multiple of $\{\text{mod}_x\}$, then $(u*y) \bmod 10 = 0$
- An element y from Cycle_Set₂ or Cycle_Set₄ or Cycle_Set₆ or Cycle_Set₈ is of the form $y=2 * z$ (multiples of two below 10: $\{2, 4, 6, 8\}$), then

$$(x*y) \bmod 10 = (y+2*u*z) \bmod 10$$

$= y \bmod 10 + (2 * u * y) \bmod 10$
 $= y + (2 * u * y) \bmod 10$
 $2 * u * y$ to be multiple of 10, irrespective of y (member of cycle set)
 that is possible with $u=5$ ($x=6$) or $u=0$ ($x=1$), but then $x=1$ ($u=0$) is not a member
 $\therefore 6$ is the identity element for the cycle sets mentioned above

- An element y from Cycle_Set₃ or Cycle_Set₇ or Cycle_Set₉ is one of {1,3,7,9},

then $(x * y) \bmod 10$
 $= (y + u * z) \bmod 10$
 $= y \bmod 10 + (u * y) \bmod 10$
 $= y + (u * y) \bmod 10$
 $u * y$ to be multiple of 10, irrespective of y (member of cycle set)
 that is possible with $u=0$ ($x=1$)
 $\therefore 1$ is the identity element for the cycle sets mentioned above

- Cycle_Set₅ has just 5, it should be the identity.

then $(x * y) \bmod 10$
 $= (y + u * y) \bmod 10$
 $= y \bmod 10 + (u * y) \bmod 10$
 $= y + (u * y) \bmod 10$
 need $u * y$ to be multiple of 10, irrespective of y (member of cycle set)
 that is possible with $u=2$ ($x=3$) or $u=4$ ($x=5$), but then $x=3$ is not a member
 $\therefore 5$ is the identity element for the Cycle_Set₅