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10. a. Since $|s_i - t_i| \geq 0$, $d(s,t) \geq 0$

If $s = t$ then $|s_i - t_i| = 0$ so $d(s,t) = 0$

If $s \neq t$ then $\exists\ k \in \mathbb{N}$ such that $s_k \neq t_k$.

Thus $|s_k - t_k| > 0$ and $d(s,t) \geq \frac{|s_k - t_k|}{N^k}$.

b. Since $|s_i - t_i| = |t_i - s_i|$,

$$d(s,t) = \sum_{i=0}^{\infty} \frac{|s_i - t_i|}{N^i} = \sum_{i=0}^{\infty} \frac{|t_i - s_i|}{N^i} = d(t,s)$$

c. Let $s, t, u \in \Sigma_N$. Then

$$d(s,t) = \sum_{i=0}^{\infty} \frac{|s_i - t_i|}{N^i} = \sum_{i=0}^{\infty} \frac{|s_i - u_i + u_i - t_i|}{N^i} \leq \sum_{i=0}^{\infty} \frac{|s_i - u_i|}{N^i} + \frac{|u_i - t_i|}{N^i}$$

$$= \sum_{i=0}^{\infty} \frac{|s_i - u_i|}{N^i} + \sum_{i=0}^{\infty} \frac{|u_i - t_i|}{N^i} = d(s,u) + d(u,t)$$

11. also note since $|s_i - t_i| \leq N-1$

$$d(s,t) = \sum_{i=0}^{\infty} \frac{|s_i - t_i|}{N^i} \leq \sum_{i=0}^{\infty} \frac{N-1}{N^i} = \frac{N-1}{1-\frac{1}{N}} = N$$

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12. $\boxed{N}$ fixed points, they are the N constant sequences.

The points of period 2 are the number of 2 blocks. We have N choices for each. So there are $\boxed{N^2}$ points of period 2.

N of these are fixed so $\boxed{N^2 - N}$ prime period 2.

13. N^k