2^{nd} *Way Solution of Collatz Sequence*

$Abstract$:

$let\ Collatz\ Sequence\ of\ (n) = S(n),\ loop\ of\ Collatz\ Sequence\ (n) = lS(n), \&$
$Collatz\ Fact = CF.$

$n, a, b, c, w \in N_{+}, n\ (Even) : \frac{n}{2}, or\ n\ (Odd): 3n+1\ \ldots (Collatz\ Sequence\ rules)$

$\because S(n) = \left\{\left[\left(\frac{n}{2}\right)\ or\ (3n+1)\right], \ldots, ?\right\} \ldots CF1 \Rightarrow$

$S(n) \supseteq S\left(\left(\frac{n}{2}\right)\ or\ (3n+1)\right) \ldots CF2\ \Rightarrow$

$lS(n) =\ lS\left(\left(\frac{n}{2}\right)\ or\ (3n+1)\right) \ldots CF3.$

$Example: if\ S(n) = \{a, b, c, \ldots, w\} \Rightarrow lS(n) = lS(a) = lS(b) = lS(c) = \cdots = lS(w)$

$Proof$:

$\because S(1) = \{4,2,1\} \Rightarrow lS(1) = \{4,2,1\}.$

$S(2) = \{1, 4,2\} \Rightarrow lS(2) = \{4,2,1\}.$

$S(3) = \{10, 5,16,8,4,2,1\} \Rightarrow lS(3) = lS(10) = \cdots = lS(2) = lS(1) = \{4,2,1\}.$

$S(4) = \{2,1,4\} \Rightarrow lS(4) = lS(2) = lS(1) = \{4,2,1\}.$

$S(5) = \{16,8,4,2,1\} \Rightarrow lS(5) = lS(16) = \cdots = lS(1) = \{4,2,1\}.$

$Then\ let\ lS(r) = \{4,2,1\}, r \in N_{+}.$

$\therefore\ lS(x) = \{4,2,1\}, \forall x \in Set\ Z = \{1,2,3,4,5,6,7,8,9, \ldots, r\}.$

$is\ lS(r+1) = \{4,2,1\}?$

$Part\ a)\ If\ (r+1) \in N_{even}\ \Rightarrow S(r+1) = \left\{\left(\frac{r+1}{2}\right), \ldots, ?\right\} \ldots CF1 \Rightarrow$

$lS(r+1) =\ lS\,(\frac{r+1}{2}) \ldots CF3$

$\because \frac{r+1}{2} \leq r \Rightarrow\ \frac{r+1}{2} \in Set\ Z = \left\{1,2,3,4,5,6,7,8,9, \ldots, \frac{r+1}{2}, \ldots r\right\} \Rightarrow$

$\therefore lS\ \left(\frac{r+1}{2}\right) = \{4,2,1\}$

$\therefore\ lS(r+1) = \{4,2,1\} \ldots (substitution)$

$\therefore lS(n) = \{4,2,1\}, \forall\ n \in N_{even}.$

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$Part\ b)\ If\ n \in N_{odd} \Rightarrow S(n) = \{3n+1, \ldots, ?\} \ldots CF1 \Rightarrow$

$\therefore lS(n) = lS(3n+1), \ldots\ CF3.$

$\because lS(3n+1) \in N_{even}$

$\therefore lS(3n+1) = \{4,2,1\} \ldots by\ Part\ a$

$\therefore lS(n) = \{4,2,1\}\ \forall\ n \in N_{odd} \ldots (substitution)$

$\therefore lS(n) = \{4,2,1\}, \forall\ n \in N_{+ \ldots} by\ Part\ a\ \&\ Part\ b.$

Referrence: Lothar Collatz (German: [ˈkɔlats]; July 6, 1910 – September 26, 1990) was a German mathematician, born in Arnsberg, Westphalia.

The "3*x* + 1" problem is also known as the Collatz conjecture, named after him and still unsolved. The Collatz–Wielandt formula for the Perron–Frobenius eigenvalue of a positive square matrix was also named after him.

Collatz's 1957 paper with Ulrich Sinogowitz,[1] who had been killed in the bombing of Darmstadt in World War II,[2] founded the field of spectral graph theory.

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