

# Cyclic Sequences

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**Abstract**—This paper studies some properties of cyclic sequences.

## I. INTRODUCTION

Sequences which consist of only repeating objects of information. For example, we can consider the sequence of binary values representing the number 42:

$$1\ 0\ 1\ 0\ 1\ 0$$

The smallest partition that repeats itself is [1 0]. We can introduce positional indexes that map to our elements which are unique to each sub-sequence,

$$p_1 \rightarrow 0\ p_2 \rightarrow 1$$

Now we can represent our original sequence in the form of smaller sequences of variable form:

$$42 = p\ q\ r\ s$$

$$p_1 p_2 q_1 q_2 r_1 r_2 s_1 s_2$$

Just like we mapped individual elements of our sub-sequence, we can also map the sub-sequences themselves, such that:

$$p \rightarrow 0\ q \rightarrow 1\ r \rightarrow 2\ s \rightarrow 3$$

## II. DISTANCE

Let  $k$  be the number of elements in each sub-sequence

Case 1: Distance between elements  $p_i \in p$  and  $s_j \in s$

Distance  $d$  is given by,

$$d = |p_f - p_i| + |s_j - s_0| + |p_{\text{index}} - s_{\text{index}} - 1| + |p_{\text{index}} - s_{\text{index}} - 1| * k$$

## III. OCCURRENCES

Let  $v$  represent the number of a sub-sequences in a range

To find the occurrences of  $a_n$  in a range of the sequence

Let  $pos$  be the set consisting of all the locations of each  $a_n$  in a complete sub-sequence

Occurrences  $o$  is given by,

$$o = \text{length}(p \cap pos) + \text{length}(s \cap pos) + \text{length}(pos) * (v - 2)$$

## IV. PREDICTION

Let  $sub$  represent a complete sub-sequence

From element  $p_i$ , find what the  $n^{\text{th}}$  element would be,

Let  $num$  be the number of sub-sequences possible,

$$num = |n - (p_f - p_i)| / size$$

if  $num$  is a natural number, then  $n^{\text{th}}$  element is the last element in our last sub-sequence

if  $num$  is a decimal number, then the decimal part represents the partial sub-sequence where the last element is the  $n^{\text{th}}$  element

Let  $z$  be the decimal part of  $num$

Element is given by,

$$el_n = \text{last} - \text{element}((1/z) * sub)$$