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**Turing machine calculates Fibonacci numbers**

**Report:**

This TM have 3-tape to calculate Fibonacci number by given index.

The first tape is for input of the index, Second tape it is for Fibonacci sequence that will generate by TM and Third tape it is for output of the Fibonacci number according to the index.

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| --- |
| Important State |
| a0-a3 | Copy the previous value by replace 1 with x and create new sequence. |
| b0-b5 | Copy the previous of the previous value by replace 1 with x and add to new sequence that had create by a0-a3. |
| c0-c1 | Replace every x back to 1 in-order to loop it again if there is still input remain. |
| 11 | Check whether it there still input remain. If yes will go in loop again. if no will go to state p0  |
| p0 | Print out the last Fibonacci sequence to tape 3. |

How a0-a3 and b0-b5 work:

Number of input = number of loop -2

Base case if index 1 or 2 then Fibonacci number will be 1

a0-a3 copy previous value to the new sequence and replace 1 with x

□□01010110□□ -> □□010101x0□□ -> □□010101x0□□ -> □□010101x0□□ -> □□010101x01□

And it will loop until it see 0 (which mean, it already complete copying the previous value.

□□01010xx011□□

Then it will move to state b0-b5 and copy before previous value.

□□01010xx011□□ -> □□010x0xx011□□ -> □□010x0xx011□□ (it will pass all x and one 0 and all 1) -> □□010x0xx011□□ -> □□010x0xx011□□ -> □□010x0xx0111□

And it will loop until it see 0 (which mean, it already complete copying the before-previous value.

And now it will move to c0-c1 and change all x back to 1 and add 0 behind

□□010x0xx0111□ -> □□01010110111□

And ready for loop if there still any input remain.

If no input remain it will move to p0 state and copy last Fibonacci number and that in to tape 3 as output.

How to Use & Example:

If you want to know the Fibonacci number at index 4;

Input 4
 Input 1: □1111 □

 Input 2: □

 Input 3: □

So, as the result output will be 3.