

# Spectrum of Computability

Given a binary string,  
does it contain a 1?



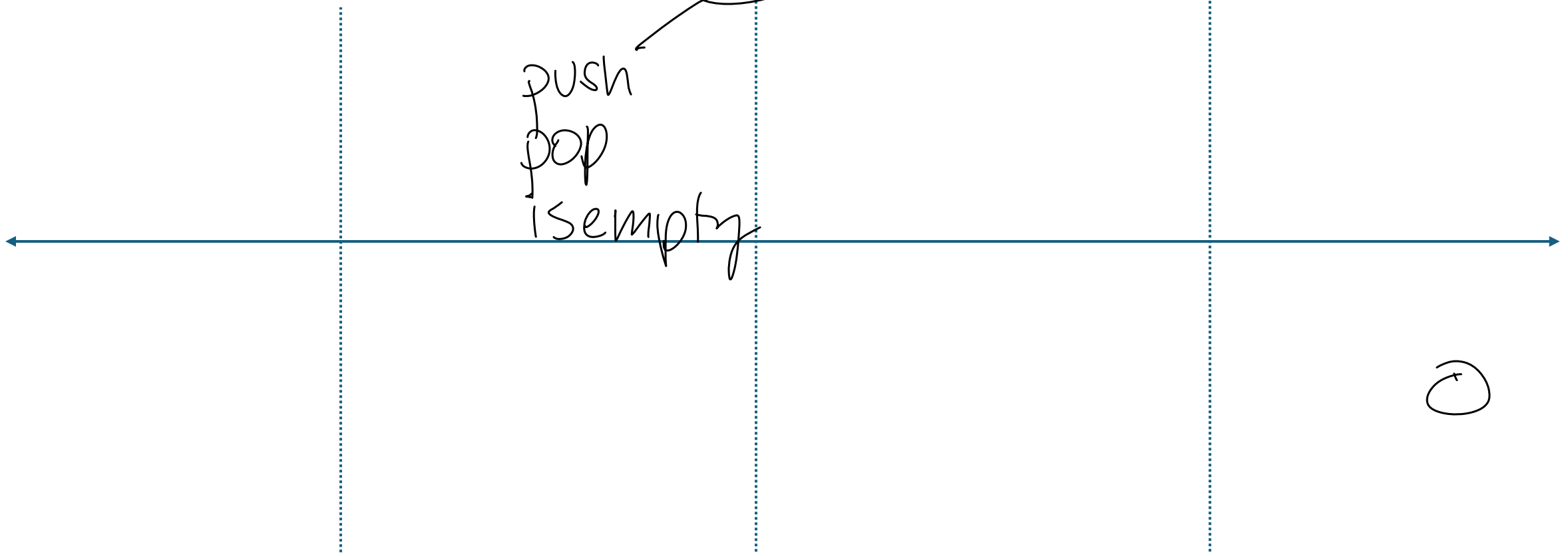
Given a graph, does it contain a  
clique of size 100?

# Spectrum of Computability

can be computed  
without (arbitrary)  
memory

can be computed  
with stack memory

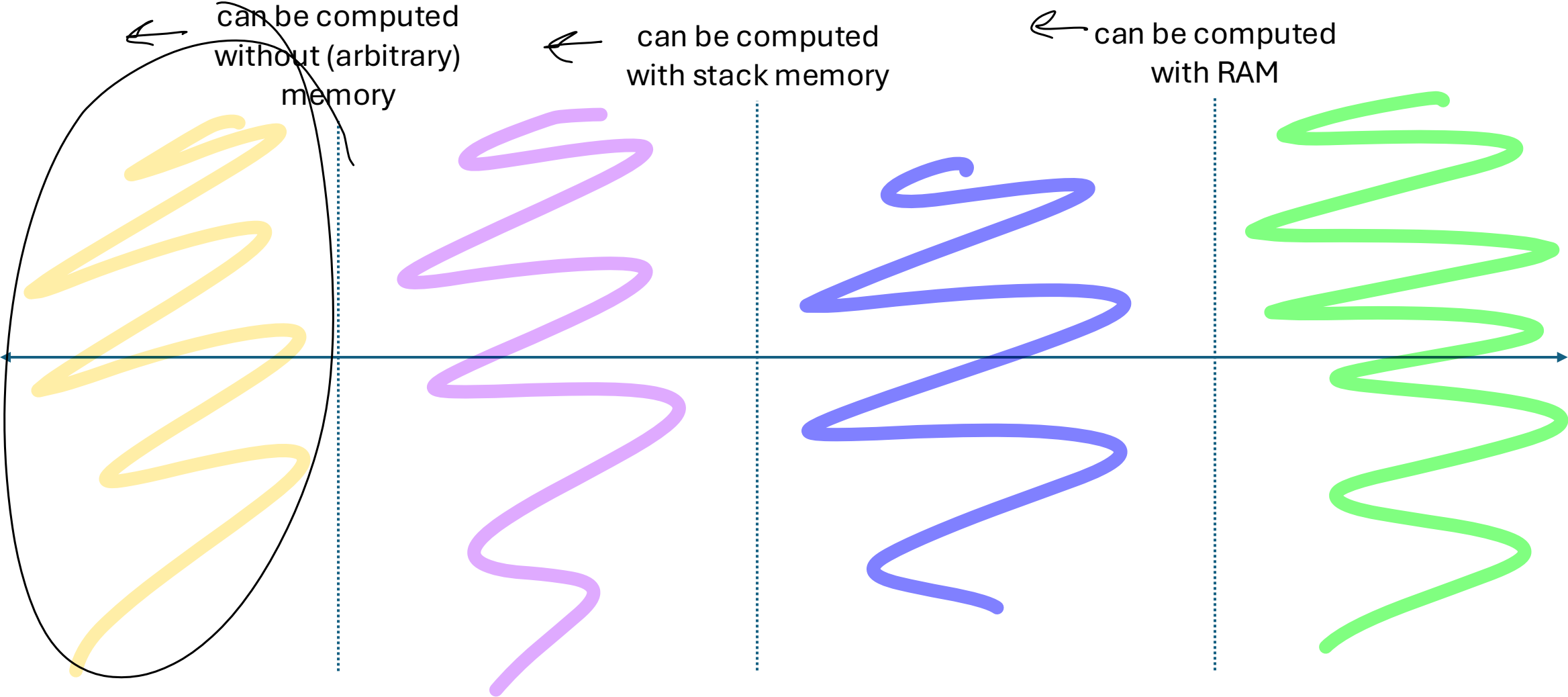
can be computed  
with RAM



push  
pop  
isempty



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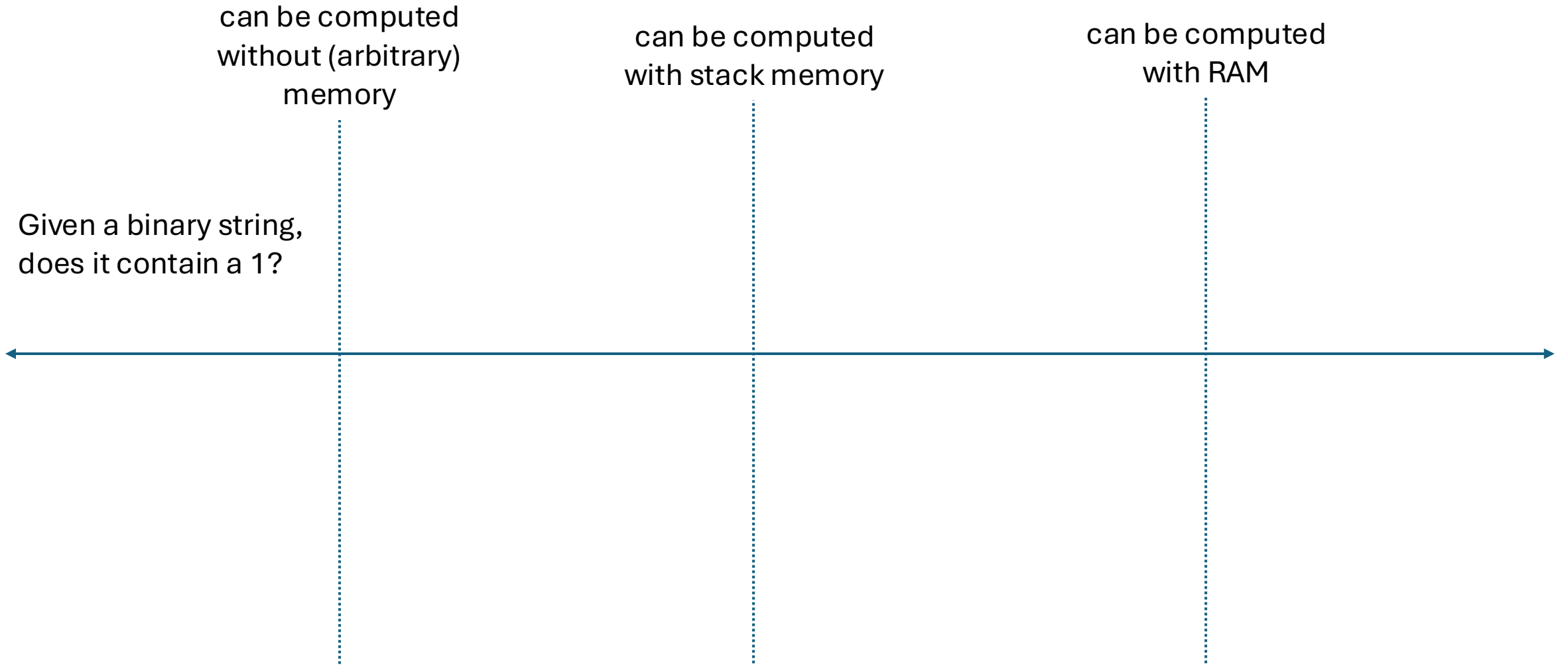
while there is a next symbol in input string:

    if symbol == 1:

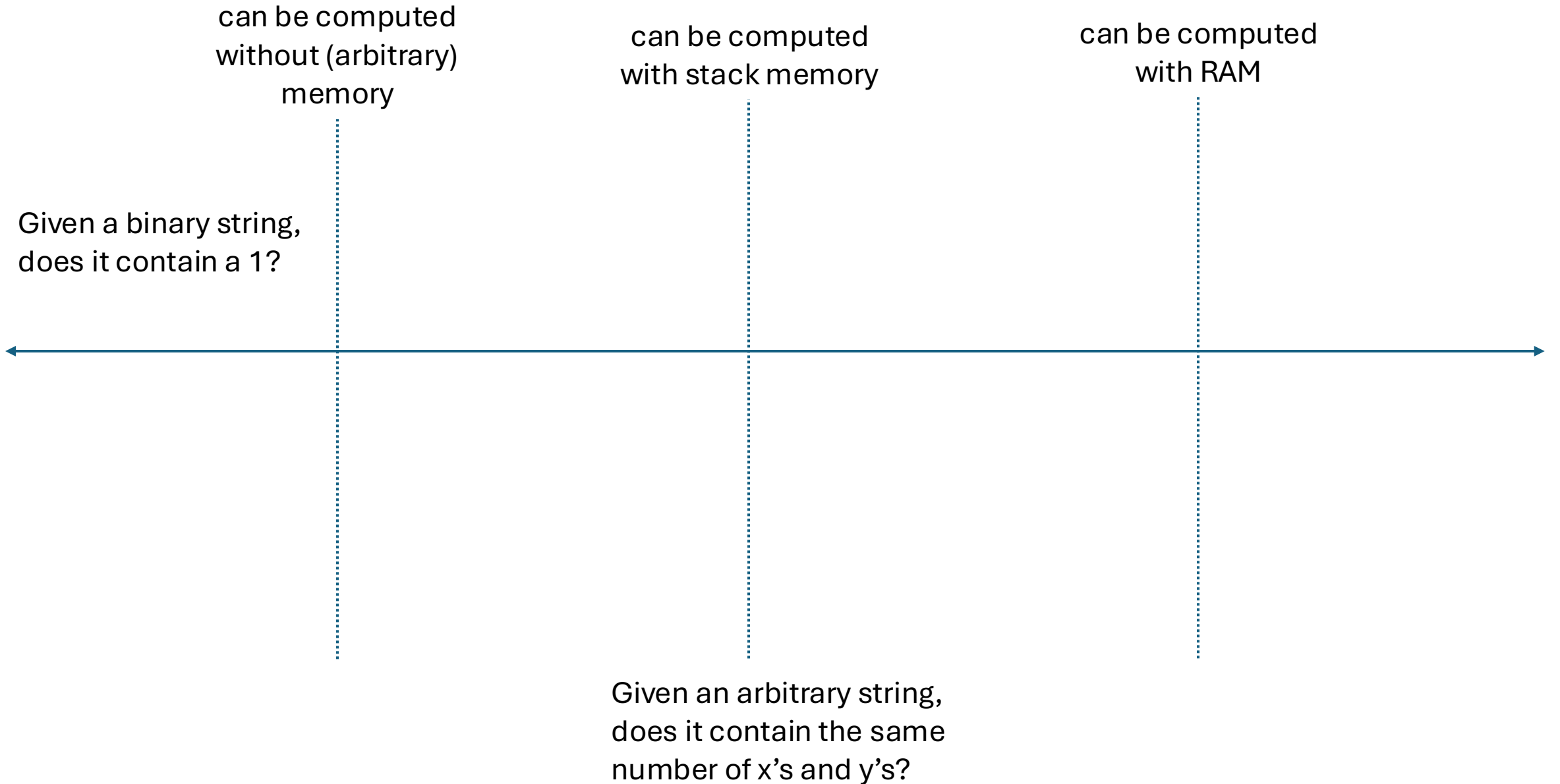
        return True

return False

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Given an arbitrary string, does it contain the same number of x's and y's?

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while there is a next symbol in input string:

    if symbol == x:

        push something onto the stack

    if symbol == y:

        pop something from the stack

if stack empty:

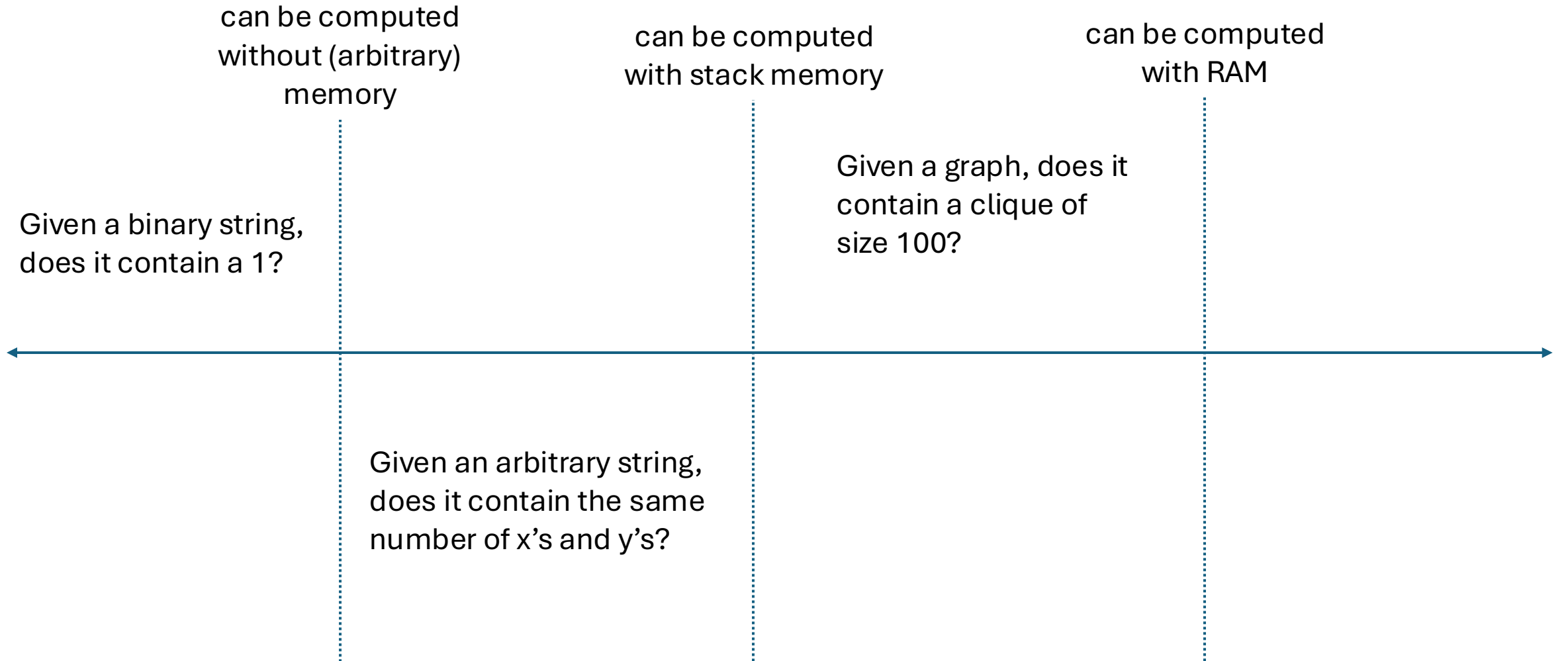
    return True

else:

    return False



# Spectrum of Computability



Given a Python program, decide whether it terminates on all inputs (does not contain an infinite loop).

Given a polynomial equation  $P(x_1, x_2, \dots, x_n) = 0$ , determine whether it has a solution where  $x_1, x_2, \dots, x_n$  are all integers.

Given a set of integers and a target integer  $T$ , determine whether there exist a subset of the integers that sums to  $T$ .

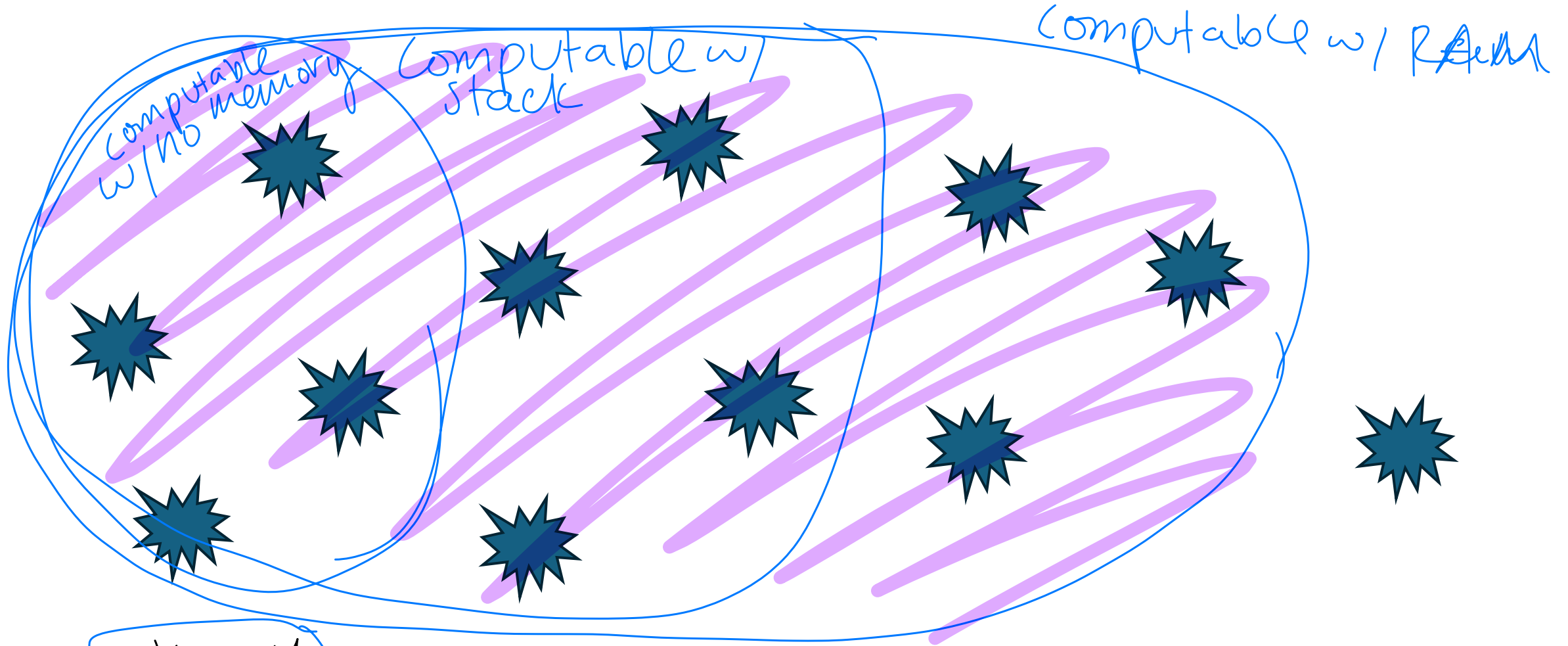
Given a Java program, are all parentheses and brackets matched and correctly nested?

Given an integer, decide whether it is prime.

Given an integer, find its prime factorization.

Given an integer, decide whether it is divisible by another integer  $k$ .

# All computational problems



wk 1-4

wk 4

wk 5-8