

Microsoft

IGROVERMIND>

28<sup>TH</sup> MAY 2021

1222-2022  
800 ANNI



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# OUR TEAM



University of Padua  
**Data  
physics**



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**Data  
physics**



 Erasmus Mundus  
JMD on  
Nuclear Physics

ALESSANDRO MARCOMINI

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# OUR QCHACK 2021

- *Technical depth*
- *Use of tools*
- *Creativity*
- *Educational value*

Brainstorming



Work\*



- New to Q#
- Simplify game rules



# IGROVERMIND⟩ @ QCHACK 2021



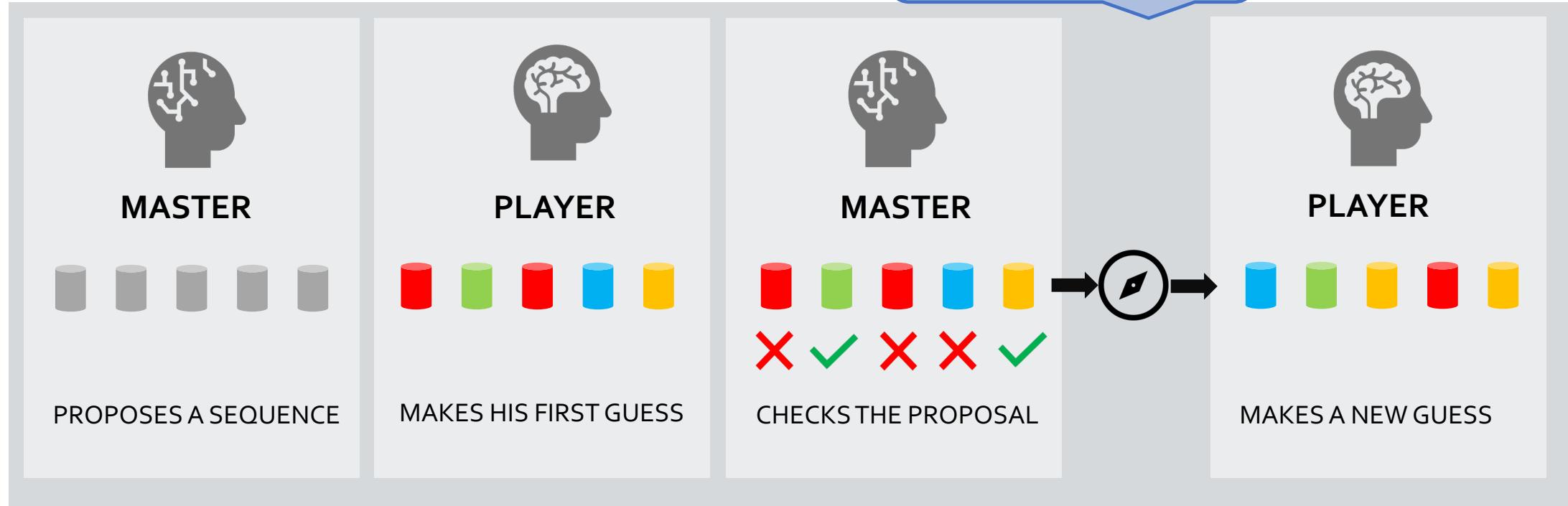
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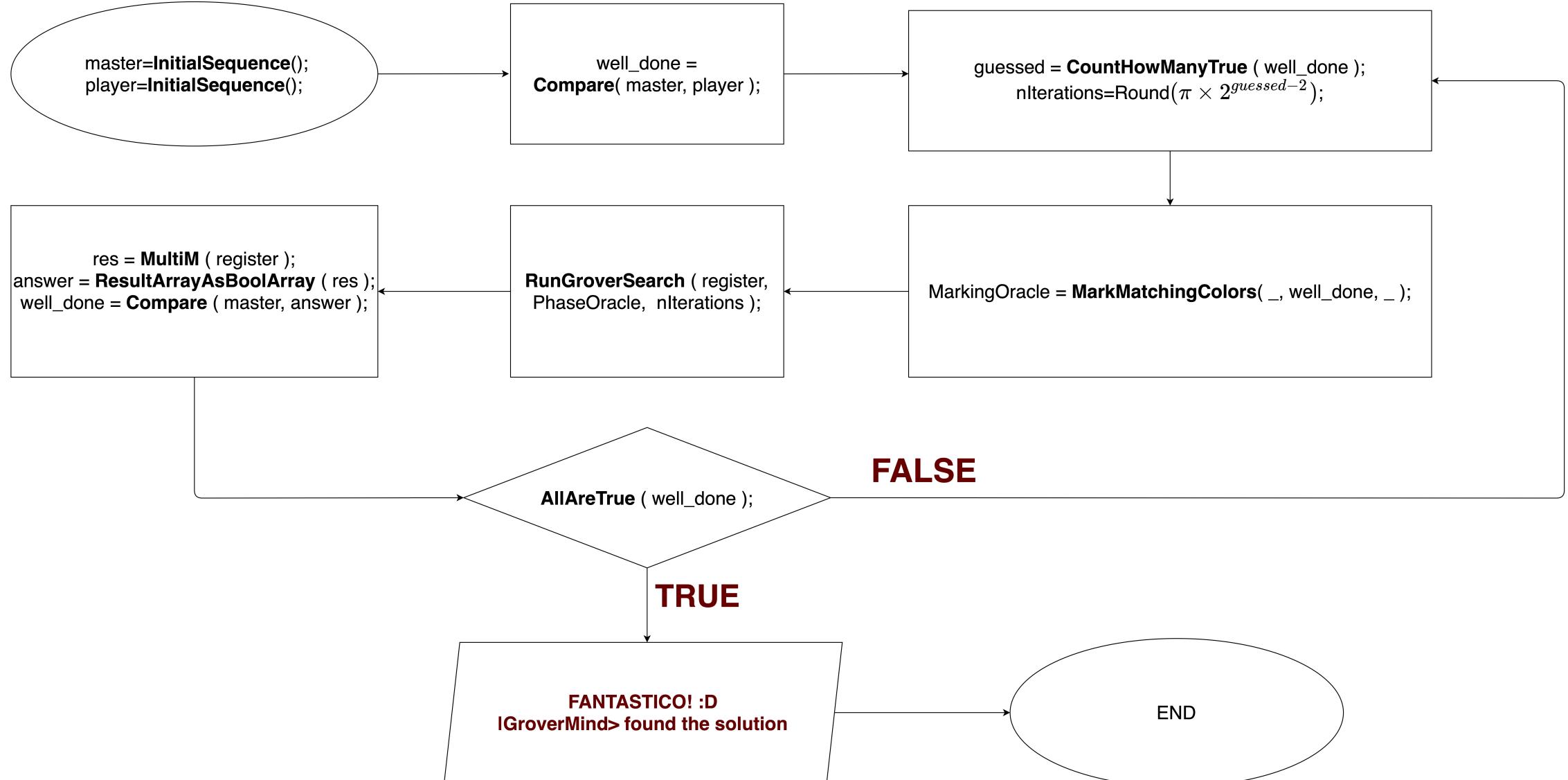


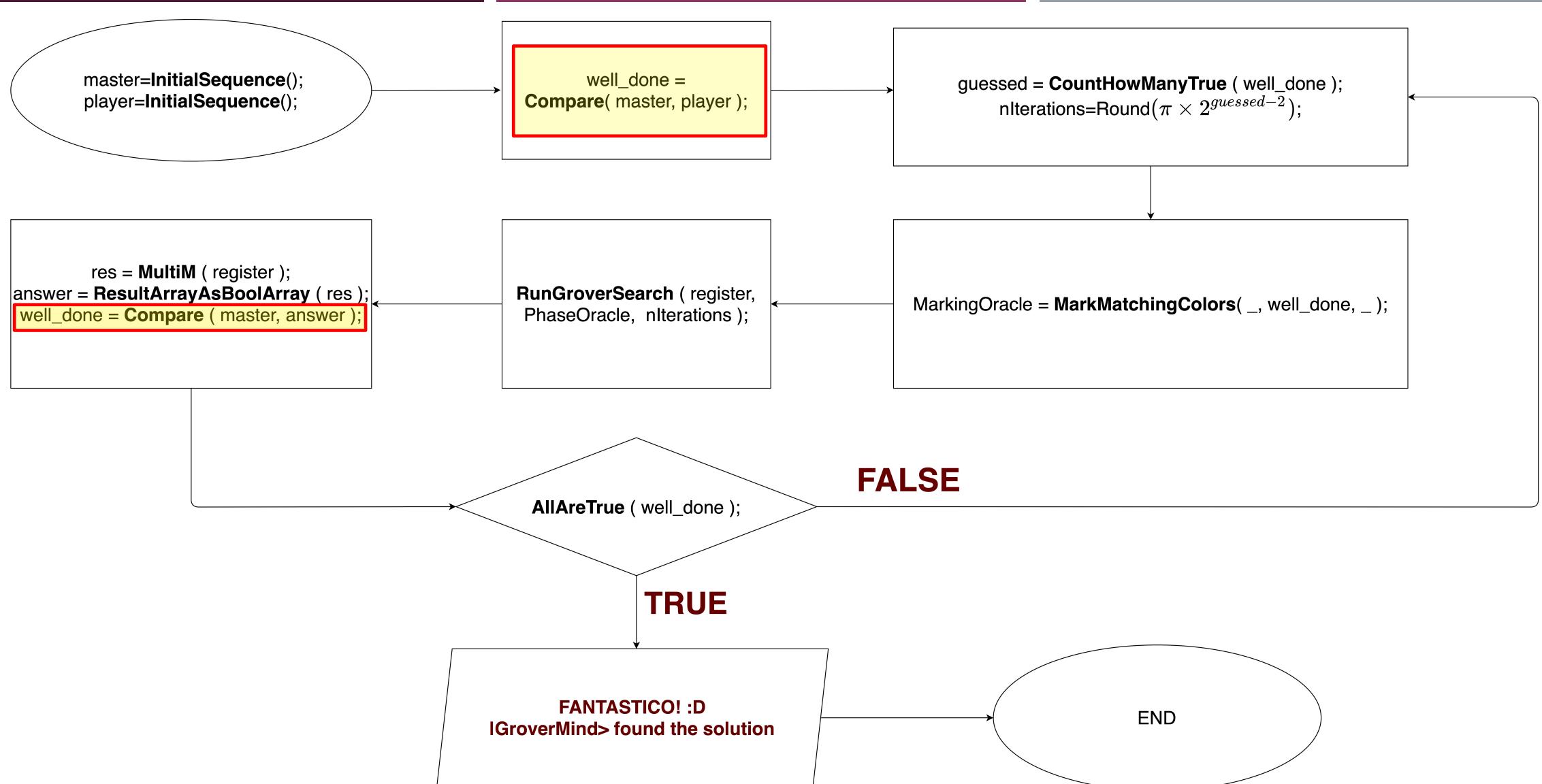
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# |GROVERMIND⟩

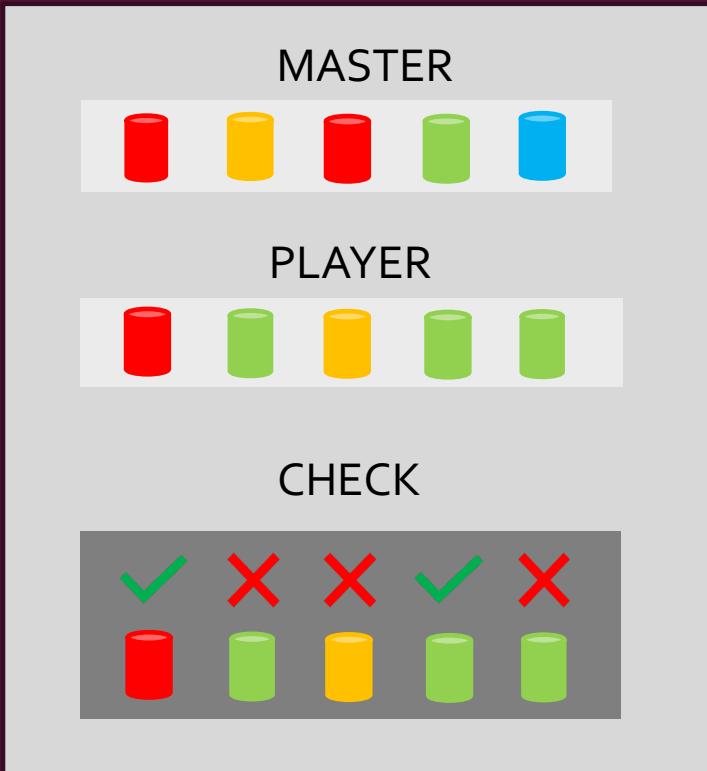
Here Grover's algorithm comes into play



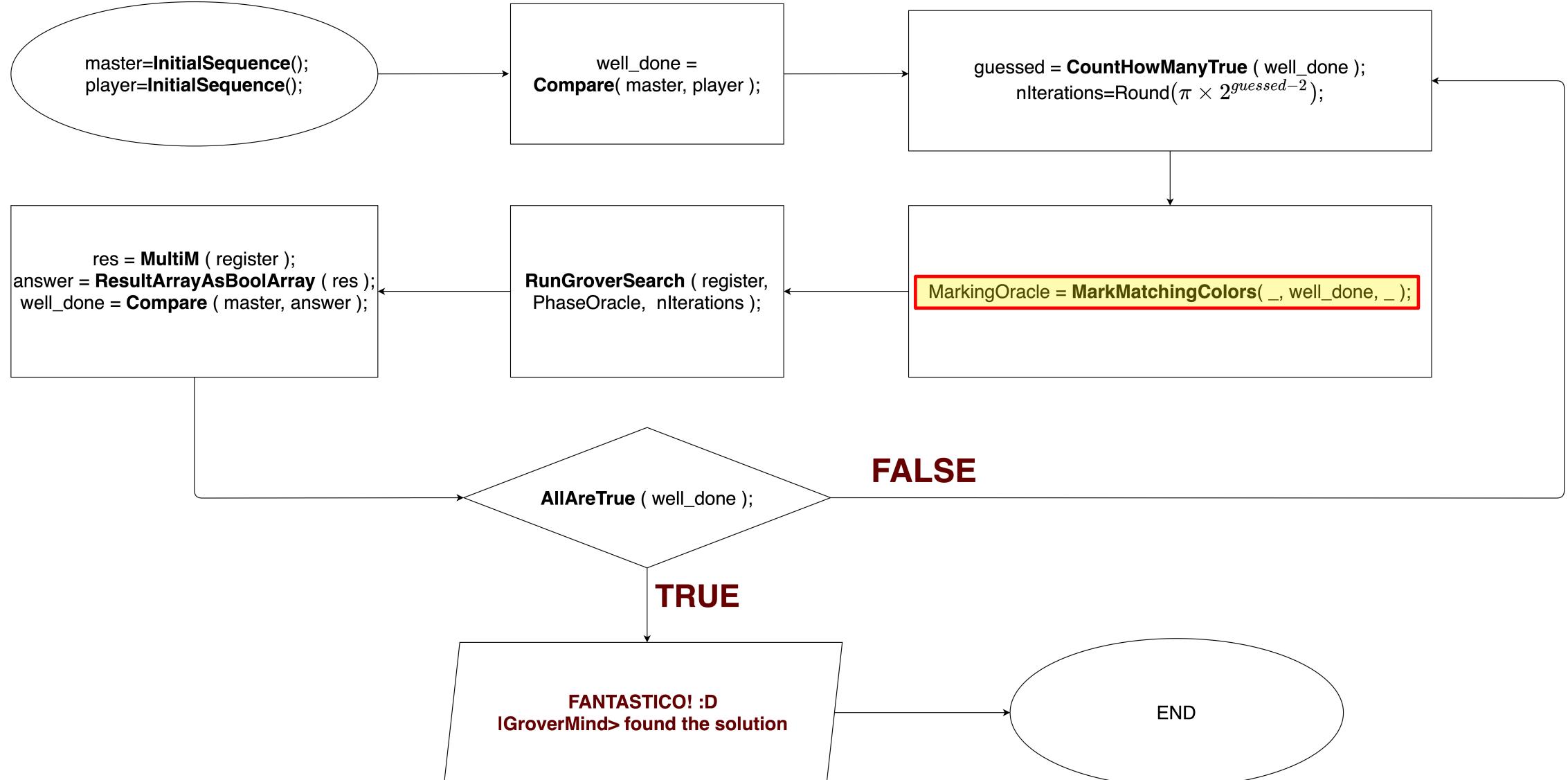




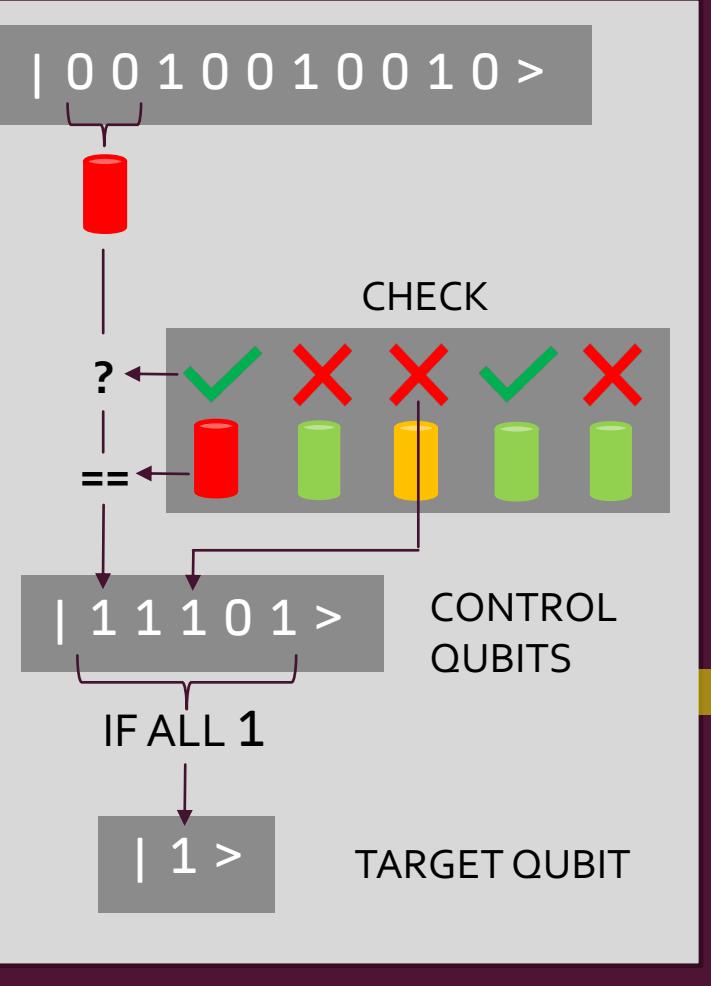
# COMPARISON



```
function Compare(master : Int[], player : Int[]) : (Bool,Int)[] {  
    //Compares the two sequences of colors.  
    //For each position in the grid, returns a tuple containing a boolean (true if the colors are matching,  
    //false otherwise) and the color of the player sequence.  
    mutable check = new (Bool,Int)[5];  
    for i in 0 .. 4 {  
        let control = master[i] == player[i];  
        set check w/= i <- (control, player[i]);  
    }  
    return check;  
}
```



# MARKING ORACLE



```
operation MarkMatchingColors(input : Qubit[], check : (Bool,Int)[], target : Qubit) : Unit is Adj {
    //GroverMind oracle
    let register_chunk = Chunks(2,input);
    use controlQubit = Qubit[Length(input)/2];
    within {
        for ((guess, col), (q, control)) in Zipped(check, Zipped(register_chunk, controlQubit)){
            if guess{
                ControlledOnInt(col,X)(q,control);
            }
            else {
                X(control);
            }
        }
    } apply {
        Controlled X(controlQubit, target);
    }
}
```



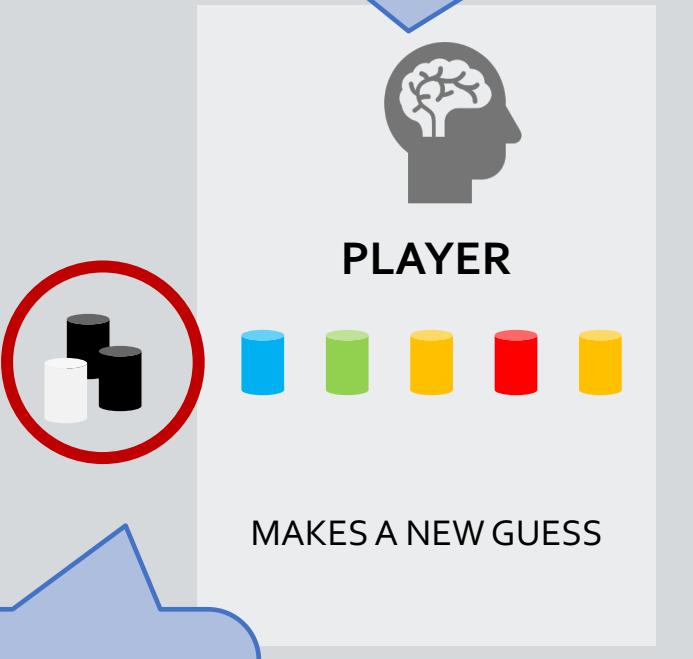
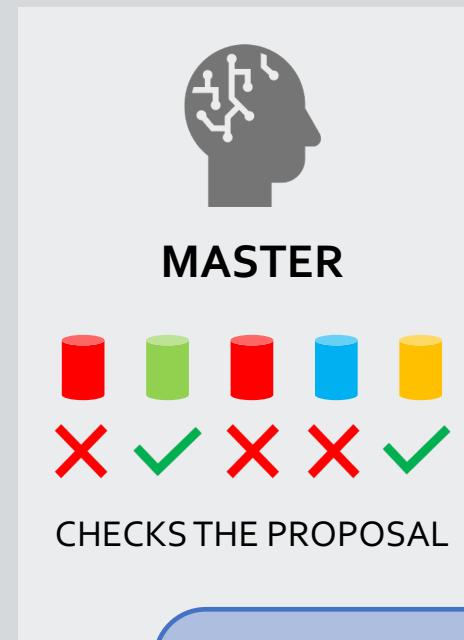
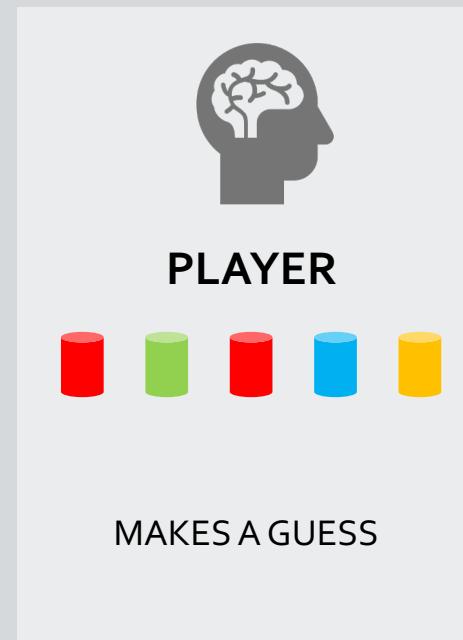
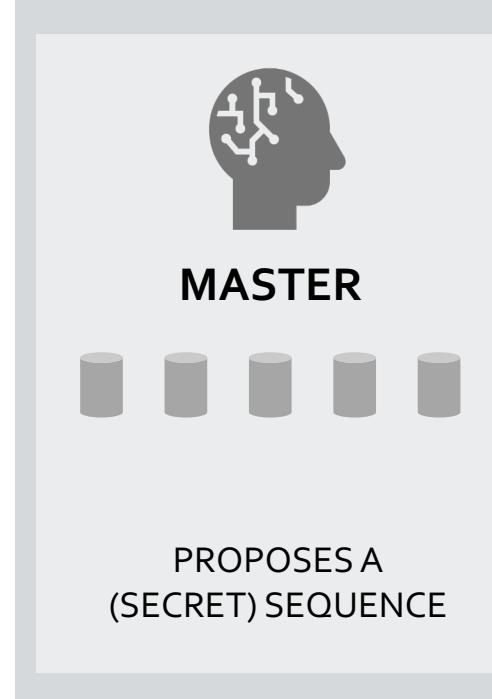
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# ONE STEP FURTHER: |GROVERMIND⟩ 2.0

Grover's algorithm narrows down the list of possible answers



Black peg for correct colors in correct positions.  
White for correct color in wrong positions.

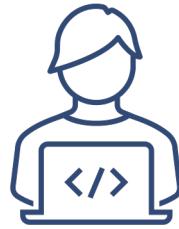
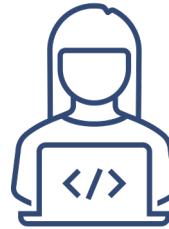
# OUTLOOK



- We are still developing **GroverMind 2.0**, that is already available on our **GitHub** page along with a classical version of the *real* **Mastermind**.
- Our efforts went into building a code that was **functional** and **optimized**.

Go check it out, any feedback would be greatly appreciated!

# IN SUMMARY



We implemented a **board game** in Q#



We **worked hard** and had fun together



We won a **Hackathon**



We met **new people** and **learned** a lot

```
117     if (H == null) { S = S + "S"; } else { S = S + "H"; }
118     if (X == null) { S = S + "S"; } else { S = S + "X"; }
119
120
121 DEMO TIME!
122
123         ApplyToEachA(H, register);
124         ApplyToEachA(X, register);
125     } apply {
126         Controlled Z(Most(register), Tail(register));
127     }
```

PROBLEMS OUTPUT TERMINAL DEBUG CONSOLE

1: powershell

Q#: Success! (0 errors, 0 warnings)

GroverMind -> C:\Users\samue\Desktop\Qsharp\qchack-microsoft-challenge\Part2\GroverMind> dotnet run

Build succeeded.

0 Warning(s)  
0 Error(s)



Time Elapsed 00:00:20.94

PS C:\Users\samue\Desktop\Qsharp\qchack-microsoft-challenge\Part2\GroverMind> dotnet run

=====

ITERATION 1:

Master sequence: [Green,Green,Blue,Red,Green]

Player guess: [Green, Yellow, Green, Red, Red]



Thanks for the  
attention!

# CONTACTS

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