System of qubits. Task 3.

First we need a register for storing secret code. For example $|011\rangle$
Same for ~~random~~ guessed number.
For example $|101\rangle$.
Second we need to design also qubits for all possible candidates.
We can register them in one superposition state. For exemple.

$$|000\rangle \xrightarrow{H^{\otimes k}} \frac{1}{2\sqrt{2}}\left(|000\rangle + |001\rangle + |010\rangle + |011\rangle + |100\rangle + |101\rangle + |110\rangle + |111\rangle\right)$$

$$8 \cdot \frac{1}{x^2} = 1 \qquad x^2 = \frac{1}{8}, \qquad x = \frac{1}{2\sqrt{2}}$$

To achive this we will use Hadama gate to change the initial $|00\rangle$ state into superposition of all possible states.

Later I'll explain for why we need this additional states as well, but for now we need also states to store score and the NXOR result. secret code $|011\rangle$

For example

	score	NXOR
$\vert 000\rangle$	$\vert 11\rangle$	$\vert 111\rangle$
$\vert 001\rangle$	$\vert 10\rangle$	$\vert 110\rangle$
$\vert 010\rangle$	$\vert 10\rangle$	$\vert 101\rangle$
$\vert 011\rangle$	$\vert 01\rangle$	$\vert 100\rangle$
$\vert 100\rangle$	$\vert 10\rangle$	$\vert 011\rangle$
$\vert 101\rangle$	$\vert 01\rangle$	$\vert 010\rangle$
$\vert 110\rangle$	$\vert 01\rangle$	$\vert 001\rangle$
$\vert 111\rangle$	$\vert 00\rangle$	$\vert 000\rangle$

$$|000\rangle|\cancel{00}\rangle|111\rangle \longrightarrow \frac{1}{2\sqrt{2}}\left(|000\rangle + \ldots |111\rangle\right)|11$$

Designing quantum gates. Task 4,5

So basically we need couple of gates to achive our solution.
First as mentioned in Task 3
We need <u>Hadamard gate</u> to transform into superposition
We need to create a gate that does NXOR, ~~[illegible]~~ and then calculats resulting 1's.
For example $|000\rangle \longrightarrow |111\rangle \quad 1+1+1=3$

So Let's start from begining.

$$|000\rangle|11\rangle|111\rangle \xrightarrow{H^{\otimes 3}} \frac{1}{2\sqrt{2}}\left(|000\rangle + \cdot \cdot |111\rangle|11\rangle|11\right.$$

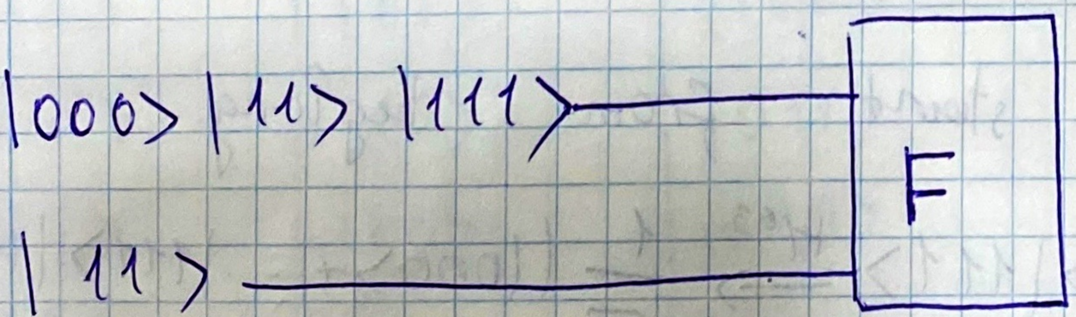
$$\longrightarrow \frac{1}{2\sqrt{2}}\left(|000\rangle|41\rangle|111\rangle + \cdot \cdot \cdot \cdot\right)$$

↑
score

$\boxed{11\rangle}$

One more thing forgot to mentio
We will use Haming distance ga
to calculate score between two
state.

As the algorithm itsels goes with minimizing number of candidates, we need a gate that flips the bits as it becomes equals to zero. Let's call it F gate.



We can also use Control-NOT gate to control white bits to flip.

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Applying the F gate will result having minimized number of candidates. If after F gate number of canditates is one, it means we found the seeret. If no, we need to take another guess from previous step and repeat again.