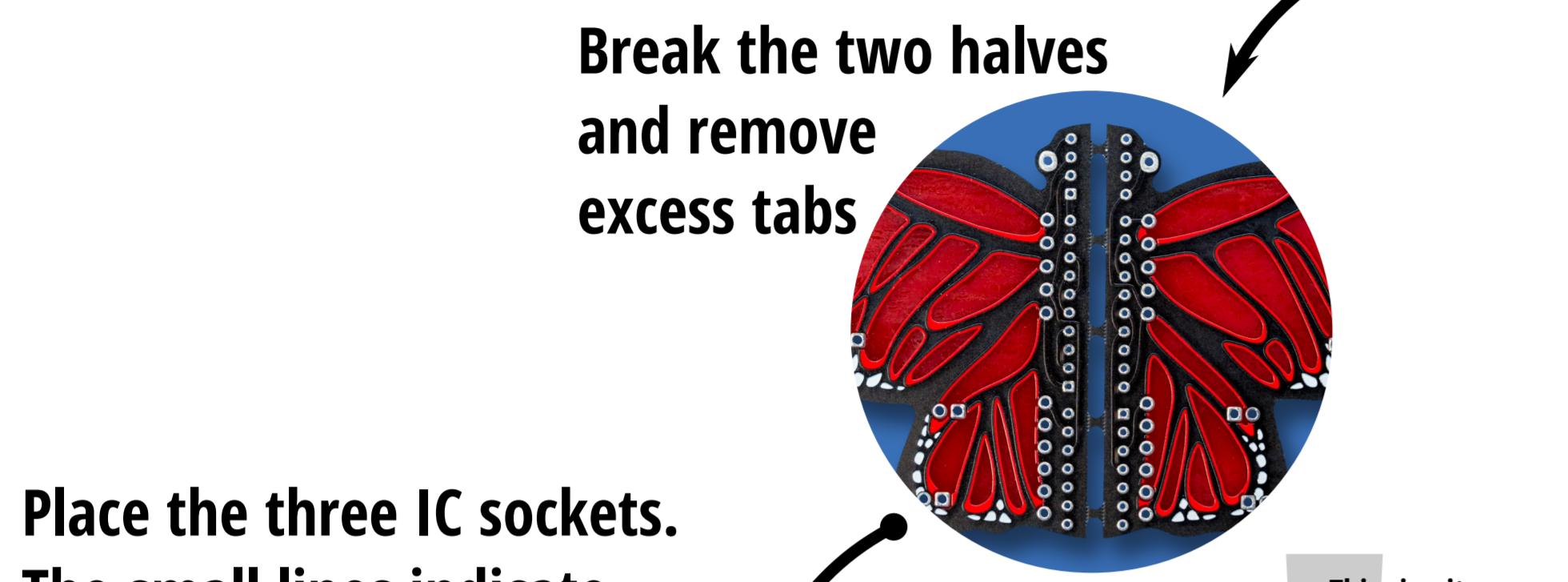




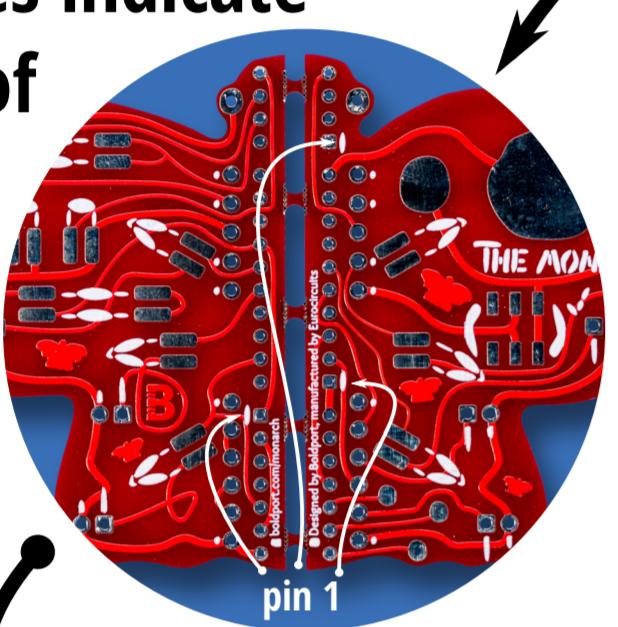
## The Monarch

[boldport.com/monarch](http://boldport.com/monarch)  
Designed by Boldport,  
manufactured by Eurocircuits

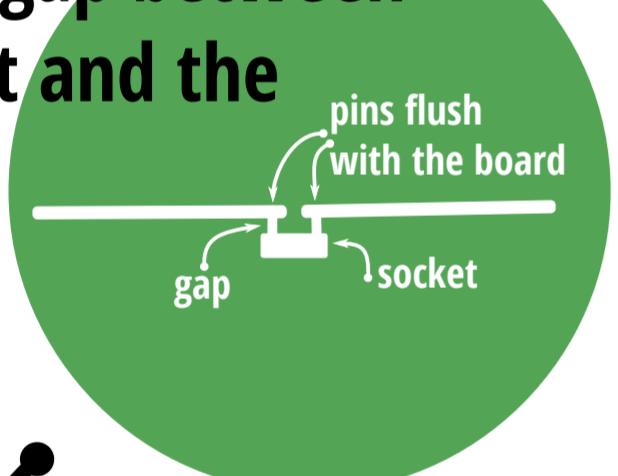
EURO  
CIRCUITS



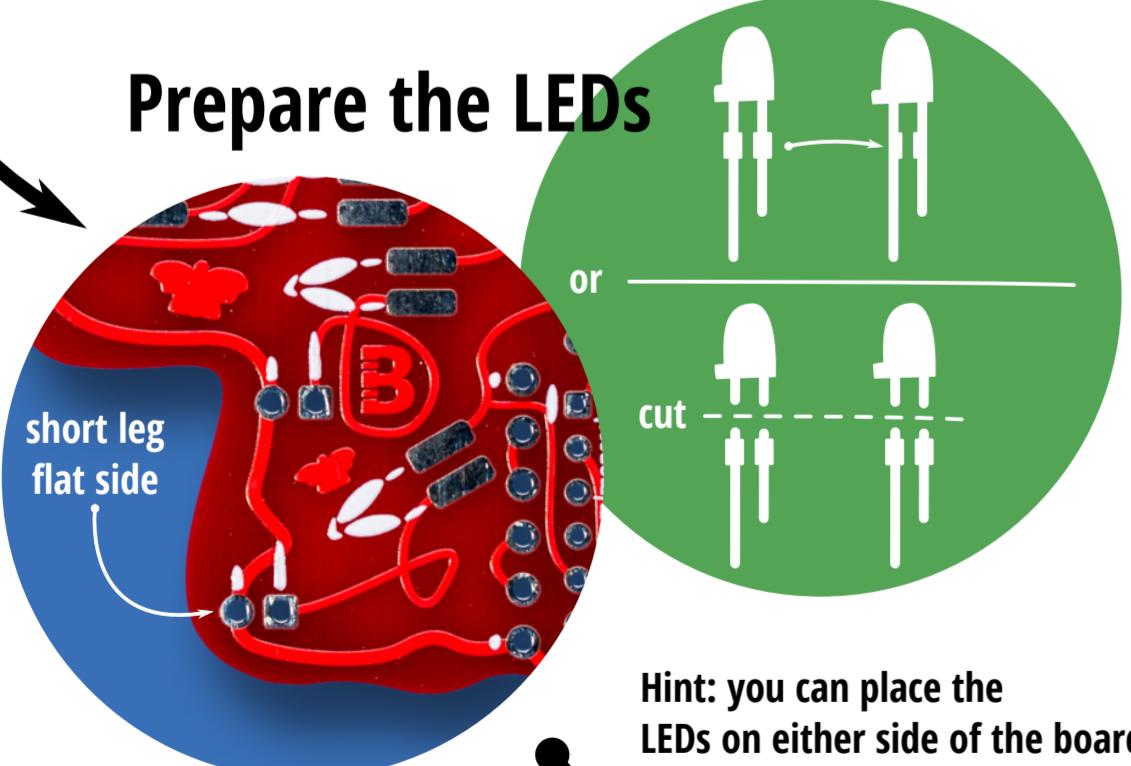
Place the three IC sockets.  
The small lines indicate  
the position of  
pin number 1



Now solder the sockets  
leaving a gap between  
the socket and the  
board

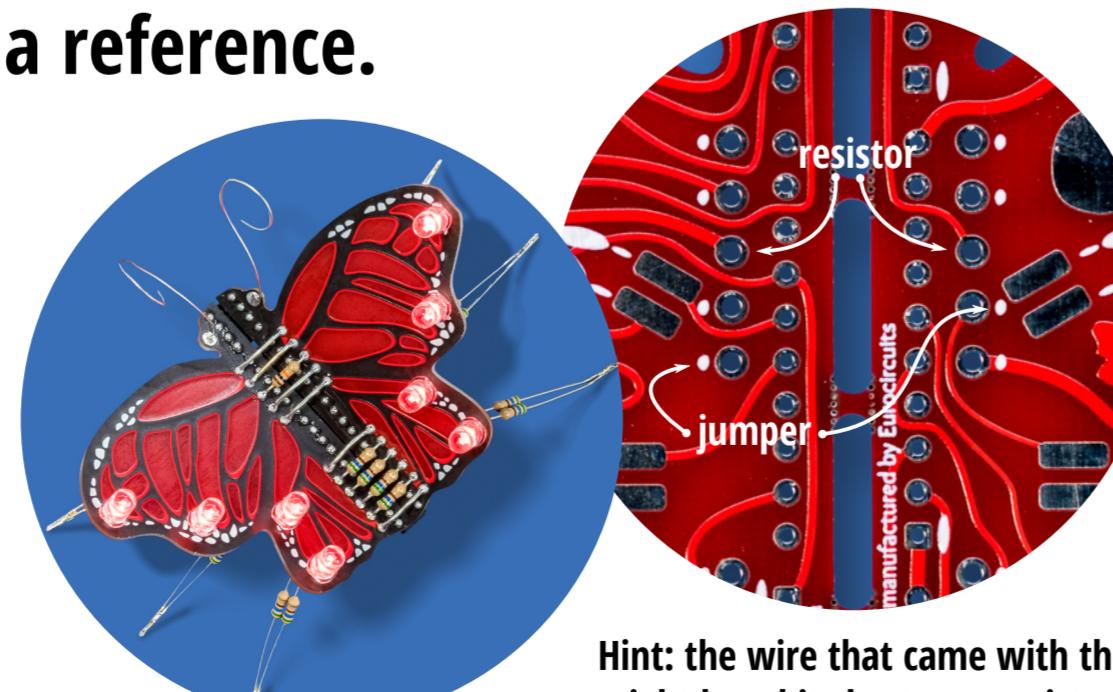


Prepare the LEDs

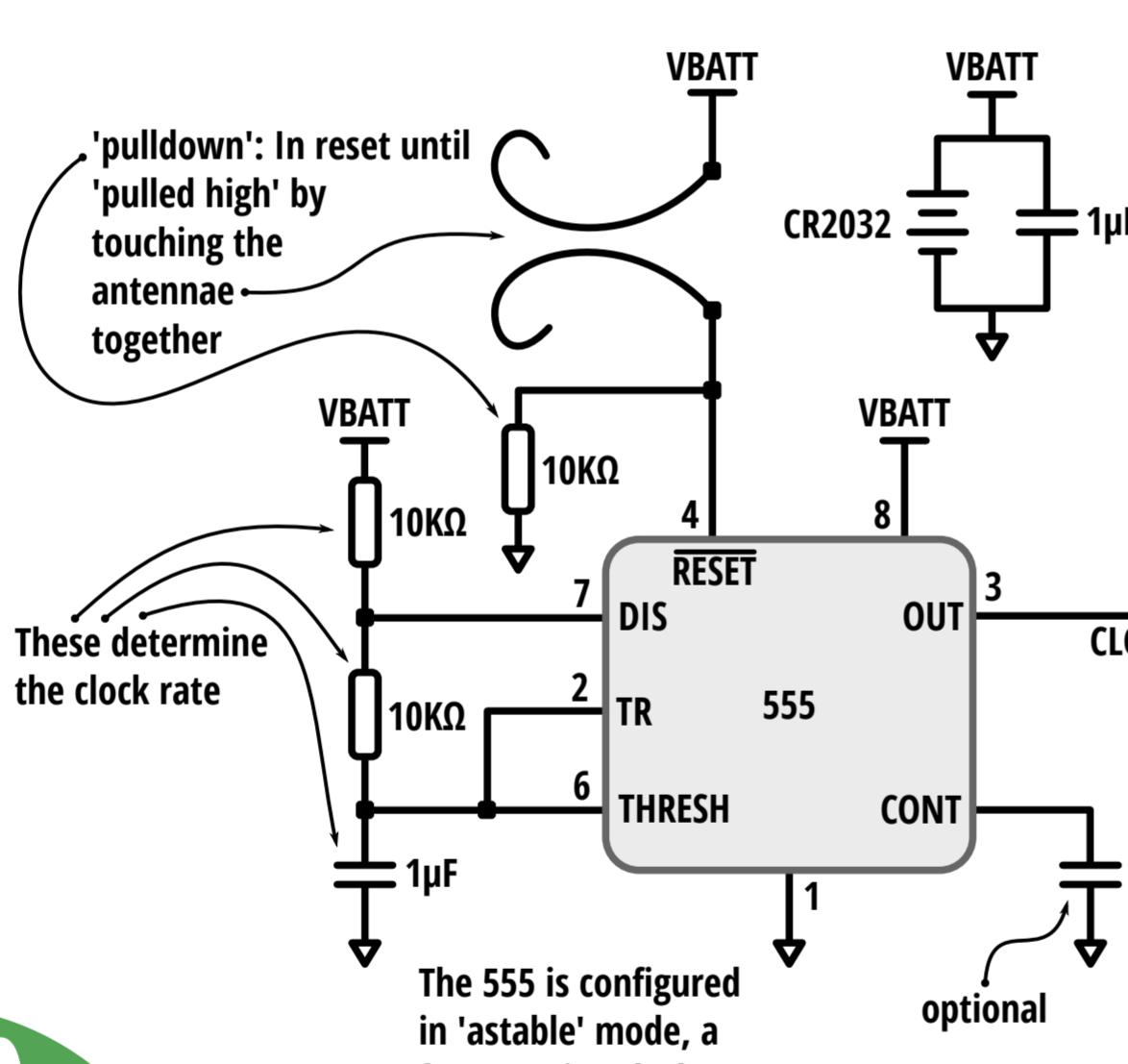


Hint: you can place the  
LEDs on either side of the board

Prepare the components using this image  
as a reference.

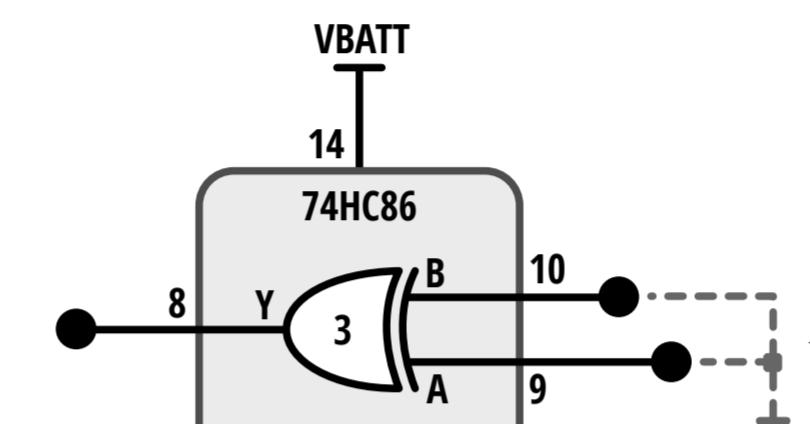


Hint: the wire that came with the project  
might be a bit short, use resistor leg clippings  
for some of the jumpers instead to leave  
plenty for the antennae

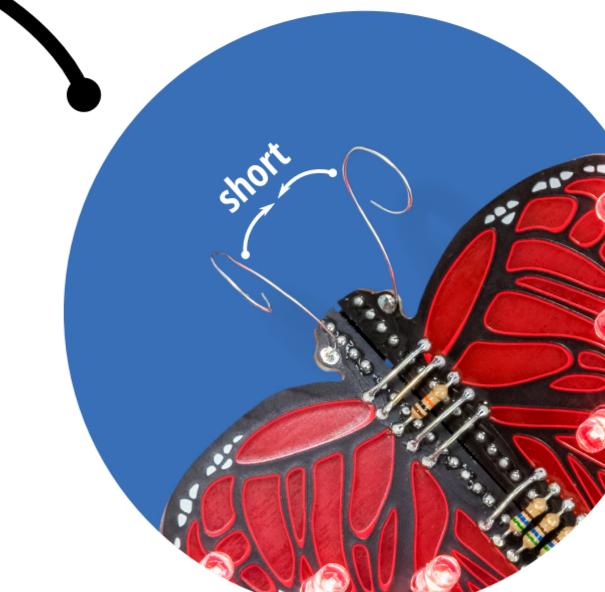


This circuit uses an LFSR or 'linear feedback shift register'. With the right feedback through XOR gates we can get all possible states of the amount of resistors, minus one. So here,  $2^8 - 1$ , or 255. A 'formula' that exhibits this behaviour is called a 'maximal length polynomial'.

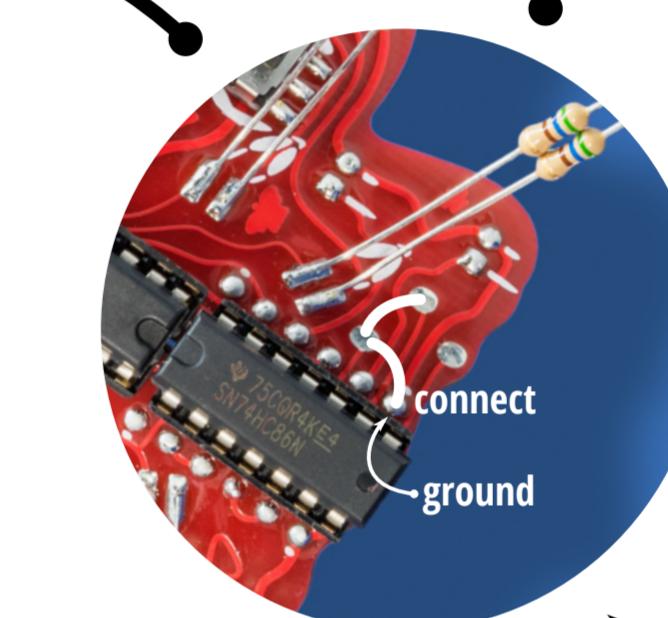
LFSRs are used as pseudo-random number generators. The output is random, but predictable. A true random number generator on the other hand is unpredictable.



Yay!

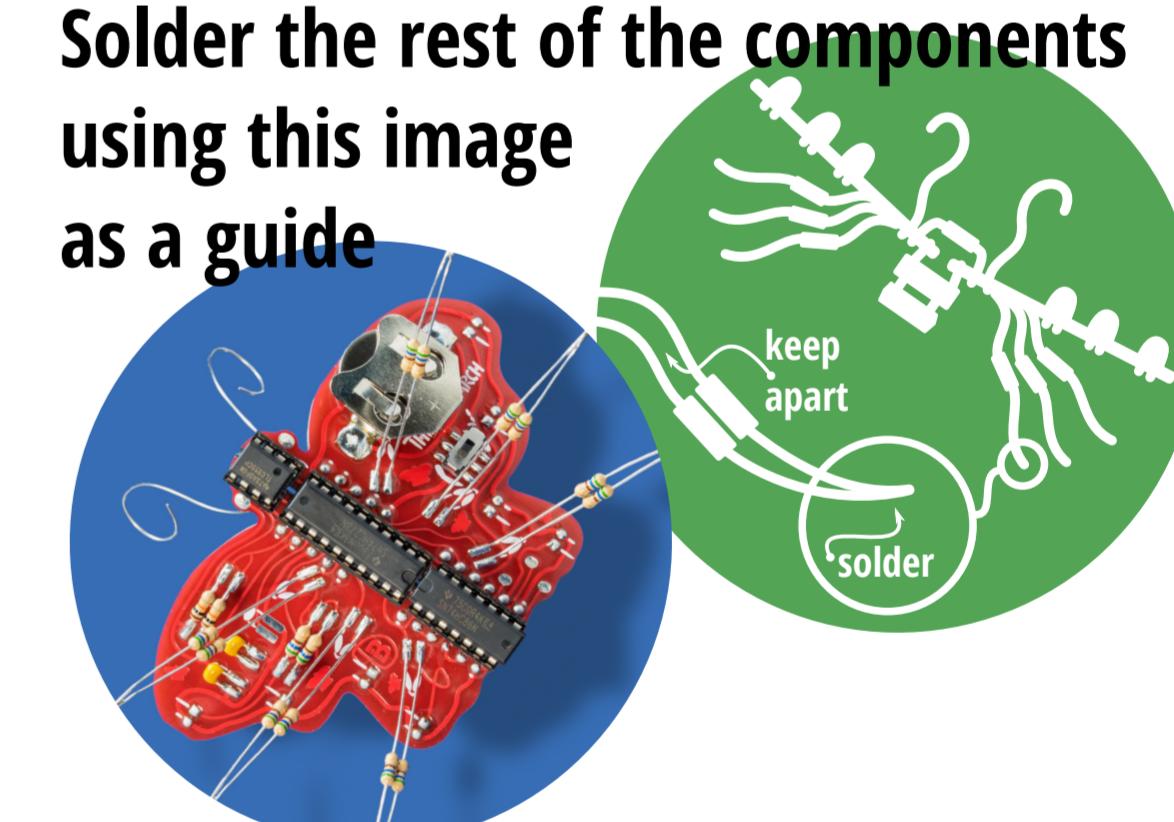


Insert battery, turn  
switch on and touch  
the antennae together  
to activate the circuit!

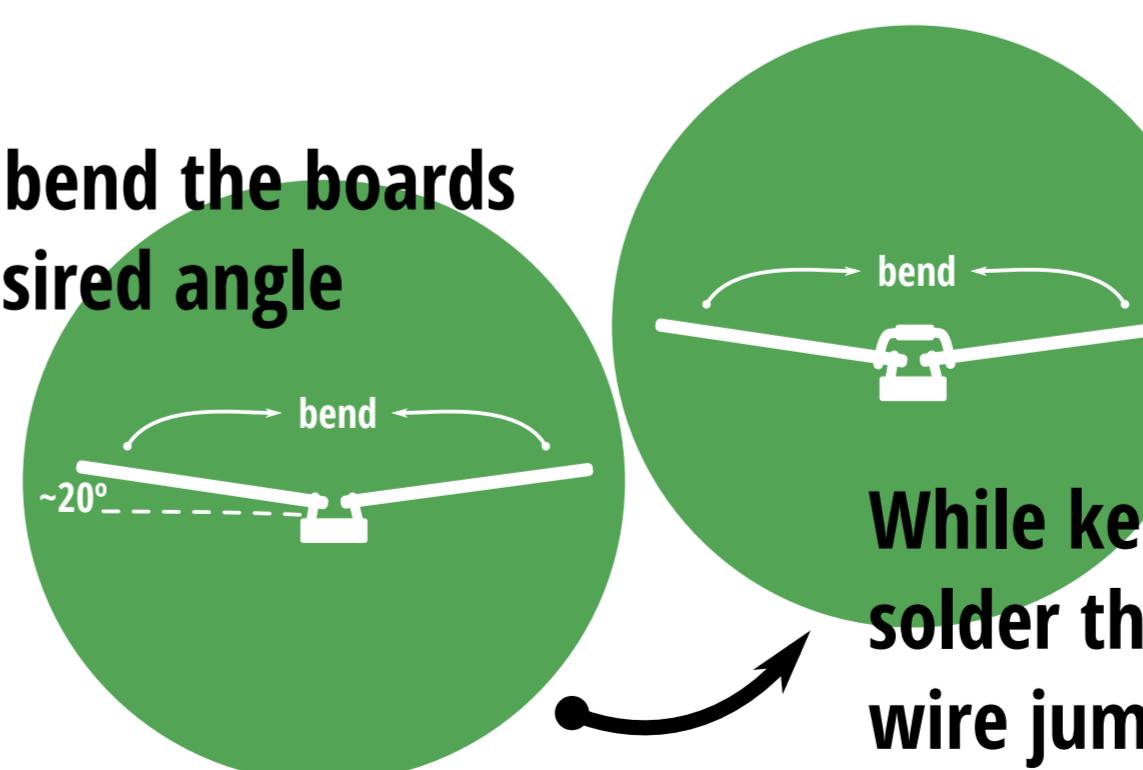


We left one XOR gate's inputs 'floating', unconnected, so that it could be used by you to try different LFSR arrangements. Leaving inputs floating is bad practice since it could lead to higher power consumption -- in the order of millamps in this case -- under some conditions. So even if the circuit will work without a fix, we strongly recommend using a short wire to connect the XOR's inputs to ground as shown.

Solder the rest of the components  
using this image  
as a guide



Gently bend the boards  
to a desired angle



While keeping the angle,  
solder the resistors and  
wire jumpers.

Did you notice that sometimes no LEDs  
are on when you switch the power on?  
Memory elements such as flip-flops have  
an undetermined on-state, so sometimes  
it happens that all of them start 'off'.

The problem is that an LFSR doesn't work  
when all registers are 'off' and a reset to  
a determined state on power-on was too  
much for this project.

What to do? Just try again until at least  
one LED is on when you turn the switch.