What is the largest power of 2 that is a divisor of $13^4 - 11^4$?

NO CALCULATORS!

Notice that we have a difference of squares:

$$13^4 - 11^4 = (13^2)^2 - (11^2)^2$$

$$= (13^2 - 11^2)(13^2 + 11^2)$$

We can apply the difference of squares formula again (to the first factor in the product):

$$= (13 - 11)(13 + 11)(169 + 121)$$

$$= 2 \times 24 \times 290$$

Now rewrite the above product to emphasise all the 2's:

$$= 2 \times (2 \times 2 \times 2 \times 3) \times (2 \times 145)$$

There are five twos in the above

product, hence the largest power of 2 which divides $13^4 - 11^4$ is

$$\boxed{2^5 = 32}$$