2. Compute the value of

$3^{14159265358979323846264338327950288419716939937510582097494459230781 64}$ mod 11.

Yes, the exponenent is the first 70 decimal digits of π.

No, this is not relevant to the problem.

On problem #3 of assignment #6, you proved that $x^{k(p-1)+1} \bmod p = x \bmod p$ for all $x, k \in \mathbb{N}$ and prime p.

In this case, $p=11$ is prime, so

$$3^{1415\cdots8161} \bmod 11 = 3^{10\cdot 1415\cdots816+1} \bmod 11$$
$$= 3 \bmod 11$$
$$= 3$$

Thus,

$$3^{1415\cdots8164} \bmod 11 = 3^3 \cdot 3^{1415\cdots8161} \bmod 11$$
$$= 3^3 \cdot 3 \bmod 11$$
$$= 81 \bmod 11$$
$$= \boxed{4}$$

Alternatively, you could have simply observed the patern

$3^1 \bmod 11 = 3$	$3^6 \bmod 11 = 3$	$3^{11} \bmod 11 = 3$	$3^{16} \bmod 11 = 3$
$3^2 \bmod 11 = 9$	$3^7 \bmod 11 = 9$	$3^{12} \bmod 11 = 9$	$3^{17} \bmod 11 = 9$
$3^3 \bmod 11 = 5$	$3^8 \bmod 11 = 5$	$3^{13} \bmod 11 = 5$	$3^{18} \bmod 11 = 5$
$3^4 \bmod 11 = 4$	$3^9 \bmod 11 = 4$	$3^{14} \bmod 11 = 4$	$3^{19} \bmod 11 = 4$
$3^5 \bmod 11 = 1$	$3^{10} \bmod 11 = 1$	$3^{15} \bmod 11 = 1$	$3^{20} \bmod 11 = 1$

Since the pattern repeats every 5 (and hence every 10) values, any exponent with a final digit of 4 will yield an answer of $\boxed{4}$.