

Modular Arithmetic

Multiplication and Multiplicative Inverses

Modulus 9

$$0 \bmod 9 = 0$$

$$1 \bmod 9 = 1$$

$$2 \bmod 9 = 2$$

$$3 \bmod 9 = 3$$

$$4 \bmod 9 = 4$$

$$5 \bmod 9 = 5$$

$$6 \bmod 9 = 6$$

$$7 \bmod 9 = 7$$

$$8 \bmod 9 = 8$$

$$9 \bmod 9 = 0$$

$$10 \bmod 9 = 1$$

$$11 \bmod 9 = 2$$

$$12 \bmod 9 = 3$$

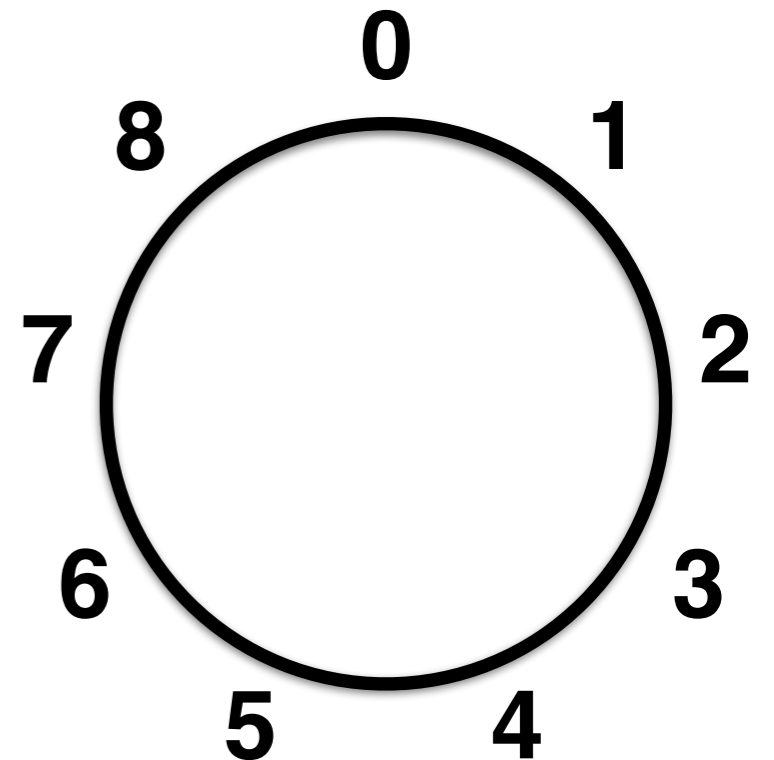
$$13 \bmod 9 = 4$$

$$14 \bmod 9 = 5$$

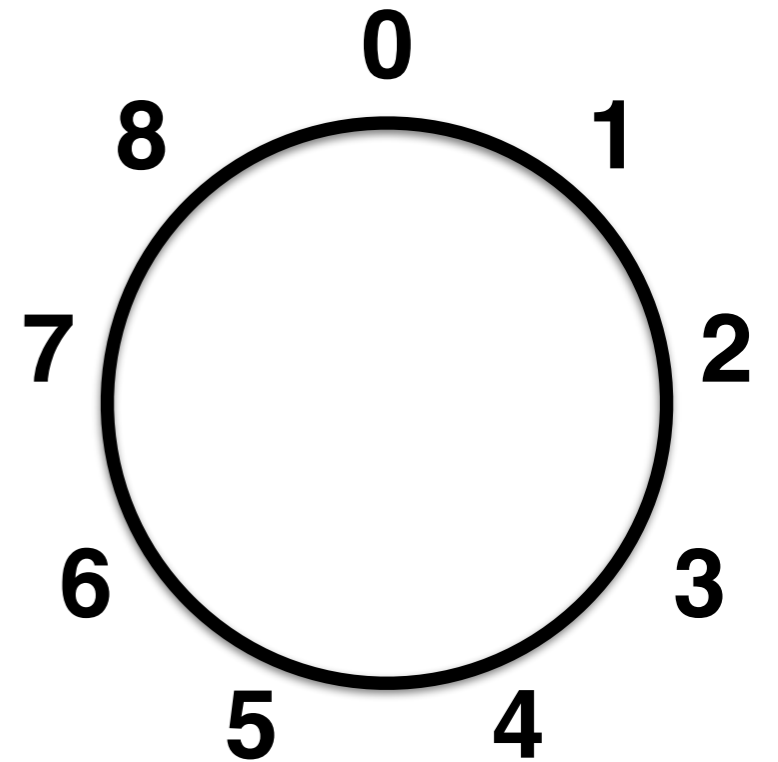
$$15 \bmod 9 = 6$$

$$16 \bmod 9 = 7$$

$$17 \bmod 9 = 8$$



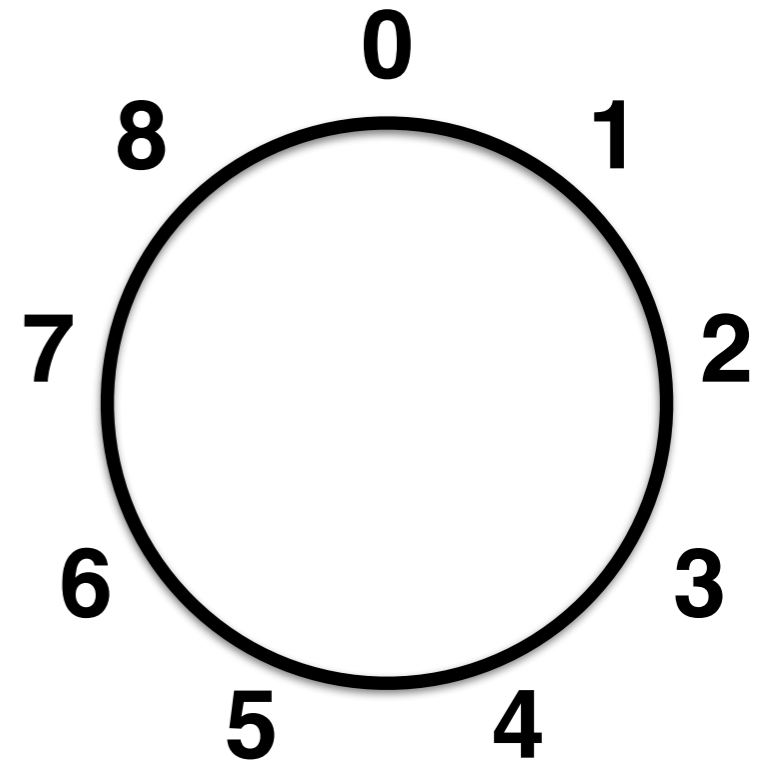
Modulus 9



$$2 * 9 \bmod 9 = (2 \bmod 9) * (0 \bmod 9) = 2 * 0 = 0$$

$$2 * 10 \bmod 9 = (2 \bmod 9) * (10 \bmod 9) = 2 * 1 = 2$$

Modulus 9



$$2 * 9 \bmod 9 = (2 \bmod 9) * (0 \bmod 9) = 2 * 0 = 0$$

$$2 * 10 \bmod 9 = (2 \bmod 9) * (10 \bmod 9) = 2 * 1 = 2$$

$$2 * 5 \bmod 9 = (2 \bmod 9) * (5 \bmod 9) = 2 * 5 = 10 = 1$$

5 is the *multiplicative inverse* of 2, mod 9

Modulus 9

$$6 * 1 \bmod 9 = 6$$

$$6 * 2 \bmod 9 = 3$$

$$6 * 3 \bmod 9 = 0$$

$$6 * 4 \bmod 9 = 6$$

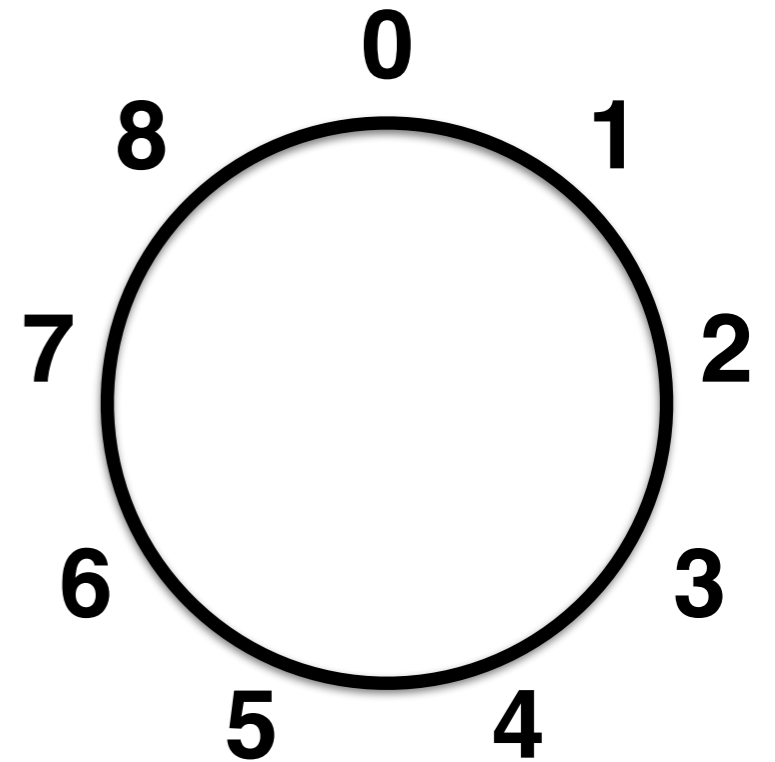
$$6 * 5 \bmod 9 = 3$$

$$6 * 6 \bmod 9 = 0$$

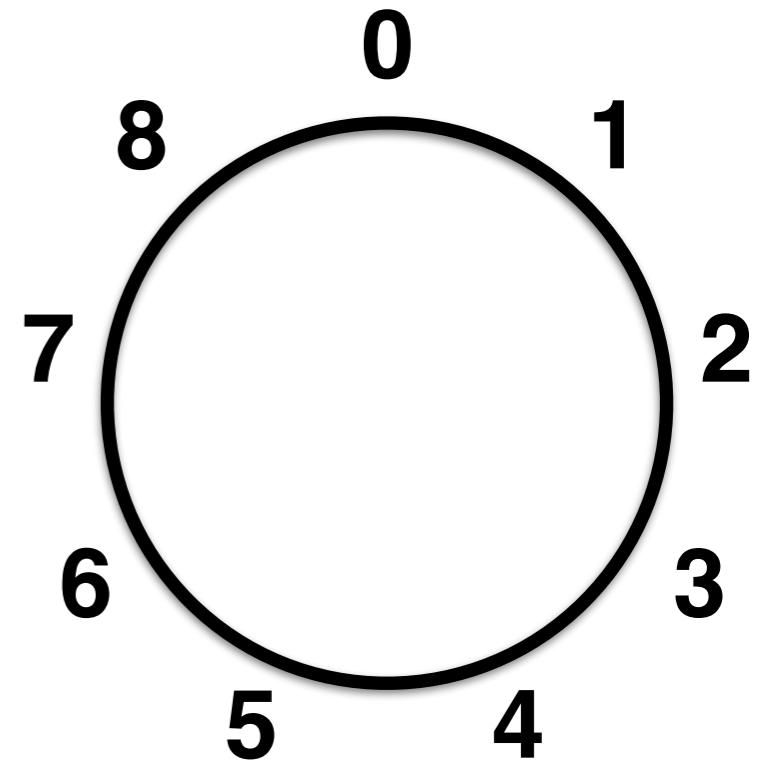
$$6 * 7 \bmod 9 = 6$$

$$6 * 8 \bmod 9 = 3$$

6 has no inverse mod 9



Modulus 9



$$7 * 1 \bmod 9 = 7$$

$$7 * 2 \bmod 9 = 5$$

$$7 * 3 \bmod 9 = 3$$

$$7 * 4 \bmod 9 = 1$$

4 is the multiplicative inverse of 7 mod 9

Modulus 4

$$0 \bmod 4 = 0$$

$$1 \bmod 4 = 1$$

$$2 \bmod 4 = 2$$

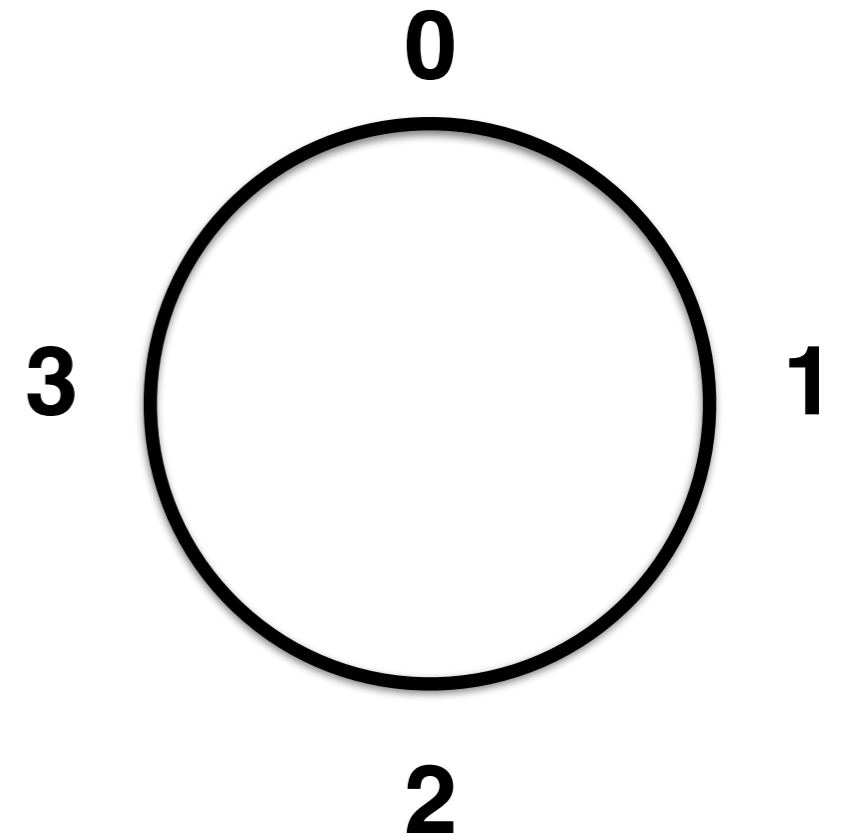
$$3 \bmod 4 = 3$$

$$4 \bmod 4 = 0$$

$$5 \bmod 4 = 1$$

$$12 \bmod 4 = 0$$

$$13 \bmod 4 = 1$$



Kahoot!