

$$N = 55$$

$$m = 13 ; 13^n$$

$$13^1 = 13$$

$$13^2 = 169 = 4 \pmod{55}$$

$$13^3 = 52$$

$$13^4 = 16$$

$$13^5 = 43$$

...

...

$$13^{15} = 32$$

⋮

$$13^{20} = 1$$

Period of $m = 13$ is

$$P = 20$$

$$\sum N^2 < 2^L < 2N^2.$$

$$N^2 = 3025 \quad 2N^2 = \overset{6050}{\cancel{4050}}$$

$$Q = 2^{12} = 4096$$

$$|\psi_1\rangle = \frac{1}{\sqrt{4096}} [|0,0\rangle + |1,0\rangle + \dots + |4095,0\rangle]$$

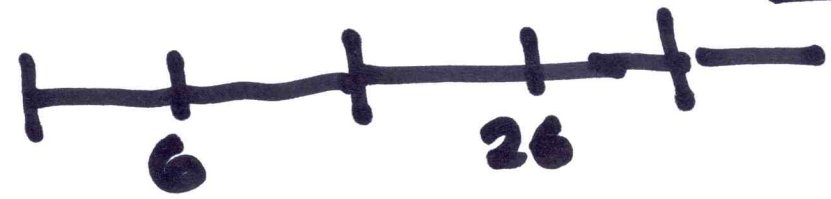
$$|\psi_2\rangle = \frac{1}{\sqrt{4096}} [|0,1\rangle + |1,13\rangle + |2,13^2 = \overset{4}{\cancel{1}} \text{ mod } 55\rangle + \dots + |20,13^{20} = 1 \text{ mod } 55\rangle + |4095, 13^{4095} = 31\rangle]$$

Measuring second register

→ 9 ! 205 values in
1st Register.

$$|\psi_3\rangle =$$

$$204 \times 20 = \underline{4080}$$



$$|\psi_3\rangle = \frac{1}{\sqrt{205}} [|6, 9\rangle + |26, 9\rangle + \dots + |4086, 9\rangle]$$

QFT on 1st Register.

$$|\psi\rangle = \frac{1}{\sqrt{M}} \sum_{d=0}^{M-1} |x_0 + dP, k\rangle$$

$$|\psi\rangle = \frac{1}{\sqrt{QM}} \sum_{y=0}^{Q-1} \sum_{d=0}^{M-1} \exp[2\pi i y(x_0 + dP)/Q] |y, k\rangle$$

$$= \frac{1}{\sqrt{QM}} \sum_{y=0}^{Q-1} e^{2\pi i y x_0 / Q} \sum_d e^{2\pi i y d P / Q} |y, k\rangle$$

$$= \frac{1}{\sqrt{QM}} \sum_{y=0}^{Q-1} e^{2\pi i y x_0 / Q} \left(\sum_{d=0}^{M-1} z^d \right) |y, k\rangle$$

$$z = e^{2\pi i y P / Q}$$

Measure 1st Register

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$$|y\rangle \frac{1}{\sqrt{M}} \left| \sum_{a=0}^{M-1} z^a \right|^2.$$