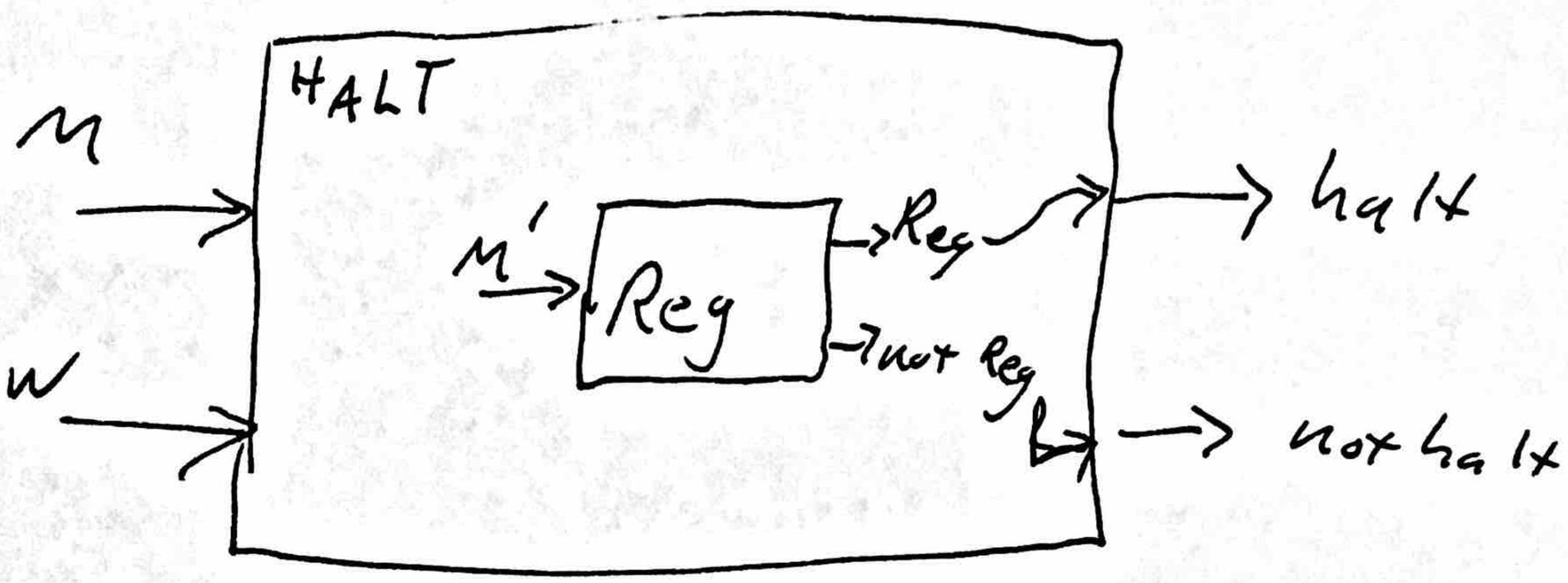
use a decider for $Regrm$ to decide HALT



- what is the "halt question"?
  does $M(w)$ halt?

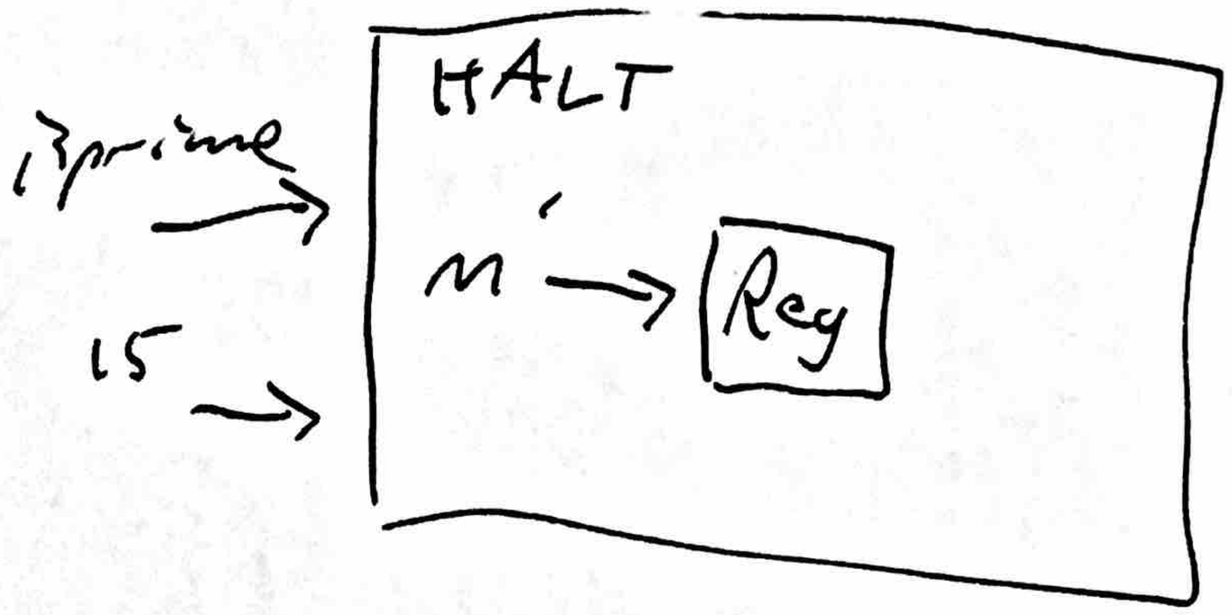
- is $L(M)$ Regular?
- use M + w to
  build an M' s.t. $L(M')$ is Reg
  iff $M(w)$ halts

```
def mprime(String x):
    if X ∈ a^n b^n:
        return True
    y = M(w)   ← if M(w) runs ∞
    return True   ← we can't get here
```

if $M(w)$ runs ∞, $L(M') = a^n b^n$
if $M(w)$ halted, $L(M') = \Sigma^*$

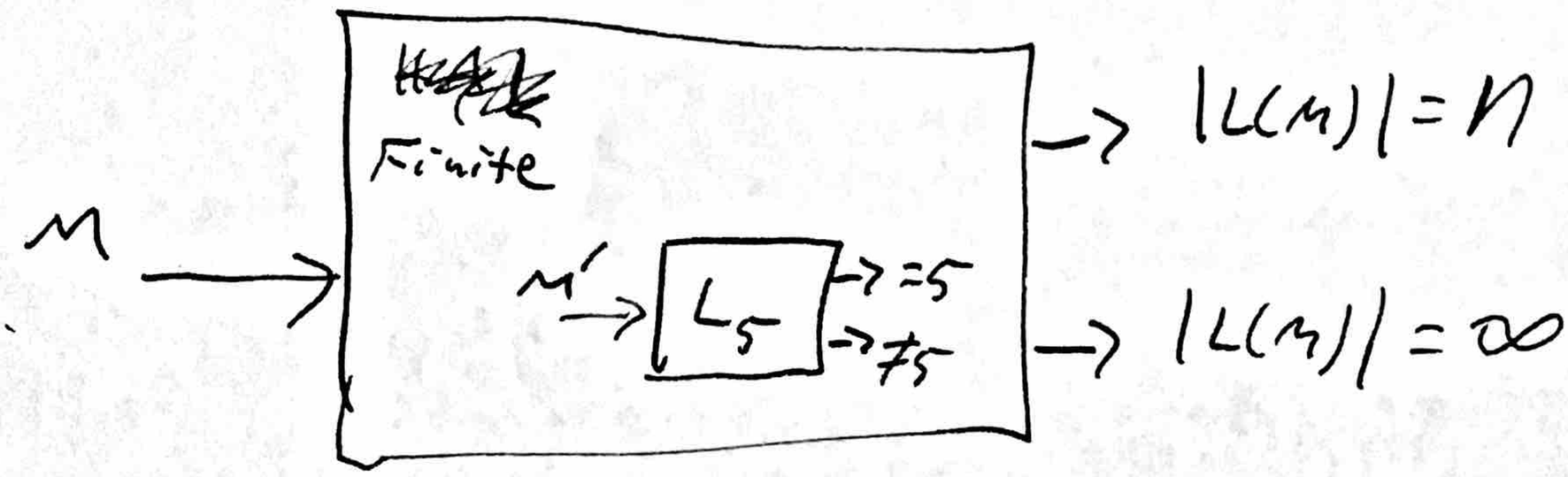
n = isPrime

w = 15




```
def mprime(string x):
    if unbn(x):
        return true
y = isPrime(15)
if x ∈ a* b*:
    return true
return False
```

$$L_5 = \{ M \mid |L(M)| == 5 \}$$



Build M' s.t. $|L(M')|$ is either
5 or infinite

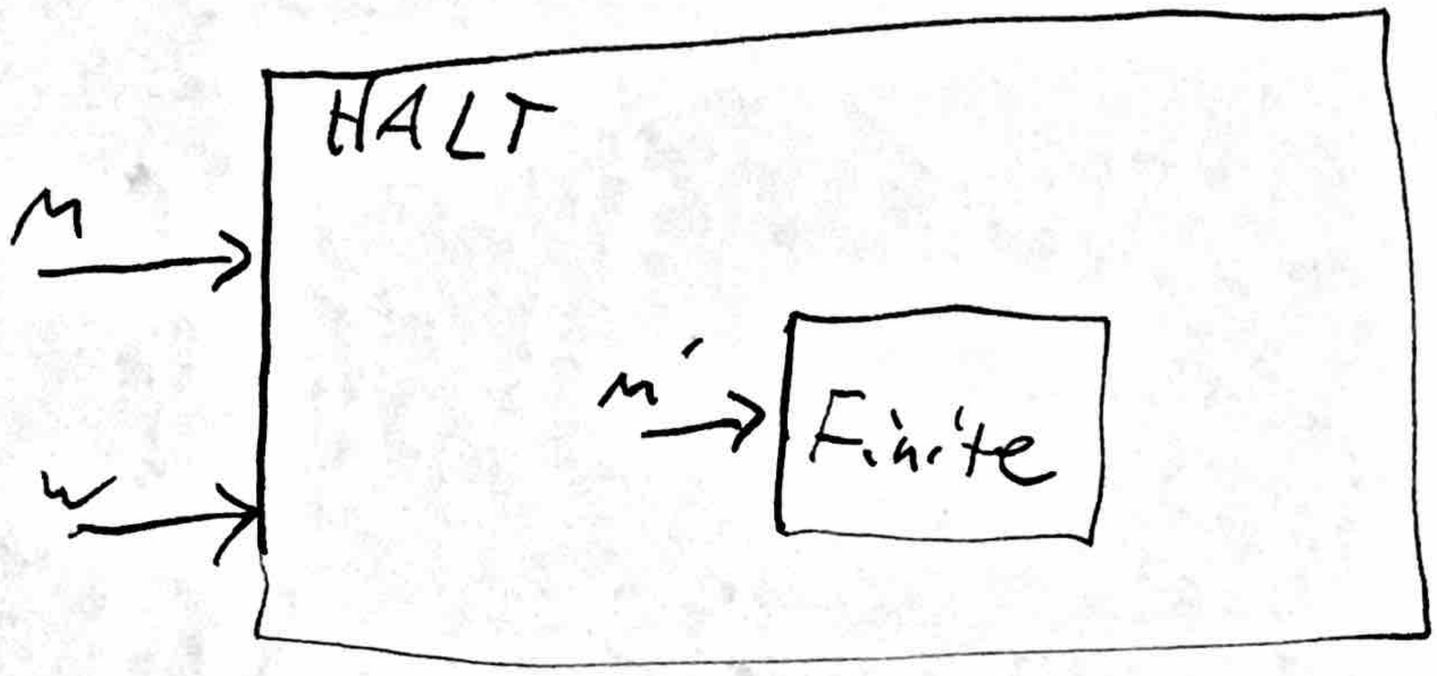
$|L(M')| = 5$ iff $|L(M)| = n$

$|L(M')| = \infty$ iff $|L(M)| = \infty$

M' → enumerate M

$$Finite_{TM} = \{ M \mid L(M) \text{ is Finite} \}$$

$$L(M) \text{ is Finite}$$



within halt, build a new M' s.t. $L(M')$ is finite iff $M(w)$ halts

```
def mprime(X):
    y = M(w)
    return true
```

$M(w)$ halts $\Rightarrow L(M') = \Sigma^*$

$M(w)$ runs $\infty \Rightarrow L(M') = \emptyset$