**Chinese Remainder Theorem**

Given a, b, n, m

Find x such that

Solution:

* Let be the inverse of n modulo m
* Let be the inverse of m modulo n
* Set

**Nim Game**

N piles of stones

Two players take turns

Each player chooses a pile, and removes any number of stones from the pile

The one who takes the last stone wins

Find out the winner if both players play perfectly

Solution:

Given heaps of size:

Let nim-sum be

The first player wins iff the nim-sum is nonzero

Why?

If the nim-sum is zero, then whatever the current player does, the nim-sum of the next state is nonzero

If the num-sum is nonzero, it is possible to force it to become zero (not obvious, but true).

**Playing multiple games at once**

At each turn, each player chooses a game and makes a move.

You lose if there is no possible move.

**Grundy Numbers (Nimbers)**

For each game, we compute its Grundy number

The first player wins iff the XOR of all grundy numbers is nonzero

**Computing the grundy numbers**

Let S be a state, and be states reachable from S using a single move.

The Grundy number of a losing state is 0

The Grundy number g(S) of S is the smallest nonnegative integer that does not appear in