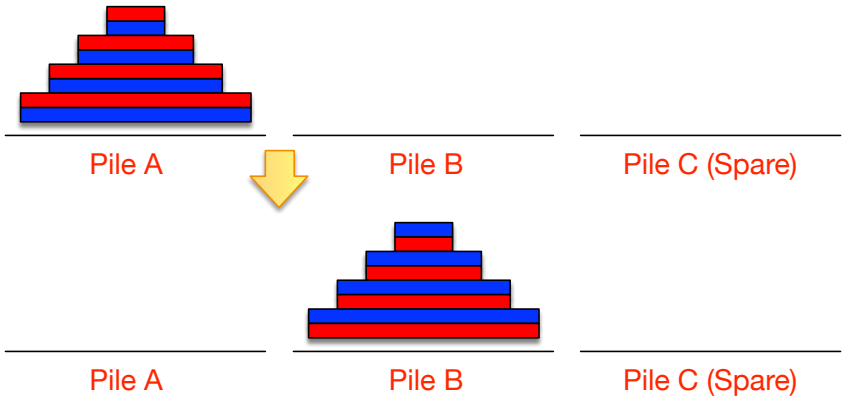
IE.2409
Laboratory Project

Magnetic Tower of Hanoi

Sunday, February 18

The *Tower of Hanoi* is a mathematical game for moving a set of N disks stacked in the order of decreasing size from one pile to another (using a spare pile) one disk at a time *without ever* placing a larger disk on top of a smaller disk. The *Magnetic Tower of Hanoi* is derived from the Tower of Hanoi with the following modifications:

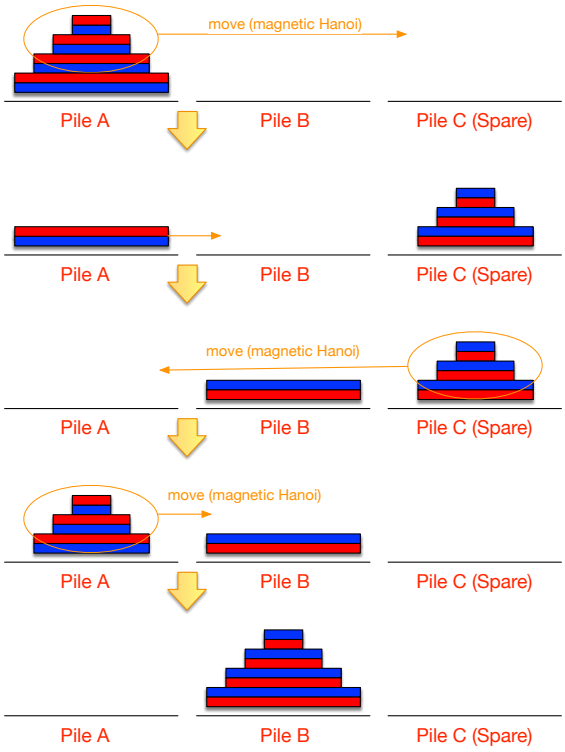
1. When a disk is moved, it is flipped: i.e., the color that was facing up before the move must face down after the move.
2. Two sides of different disks with the same color may not touch each other: e.g., a disk with its blue side facing downwards cannot be placed on top of a disk that has its blue side facing upwards.



The algorithm for moving N disks in the original Tower of Hanoi game can best be described in a *recursive* manner as described below:

1. Move the top $N-1$ disks to a spare pile.
2. Move the largest disk to the destination.
3. Move the $N-1$ disks from the spare pile to the destination.

The algorithm becomes a bit more complex for the Magnetic Tower of Hanoi because of the *flipping* required each time a disk is moved as well as the *magnetic repulsion* problem. That is, the same color disks *repel* each other.



The following is a snippet of the algorithm. Note that this is not the entire algorithm. The complete algorithm must consider the color of the disk on top of the destination pile and take an appropriate action based on it. You must also consider how to terminate the algorithm properly.

```
/* move n disks from src to dst */
magnetic_hanoi (n, src, dst) {
    magnetic_hanoi (n - 1, src, tmp)    /* tmp = spare pile */
    move (1, src, dst)
    magnetic_hanoi (n - 1, tmp, src)
    magnetic_hanoi (n - 1, src, dst)
}
```

The project consists of two parts: (1) to determine the minimum number of *moves* necessary for moving N disks from pile A to pile B; (2) to simulate the game (the details of which will be discussed in class). Note that the algorithm used for this project must be *fully recursive*.

The number of *moves* it takes to complete a Tower of Hanoi game in the minimum number of steps can be calculated in a *recursive* manner as shown below.

```
int hanoi (int n)
{
  if (n == 1)
    return 1;
  else
    return 2 * hanoi(n-1) + 1;
}
```

The number of moves required for a Magnetic Tower of Hanoi game would be different but can be calculated in a similar manner or directly from the simulation.