Algorithms: Solutions 5

Problem 1
Write an algorithm that randomly re-orders an array $A[1..n]$.

```
SHUFFLE(A, n)
for i ← n downto 2
    do j ← RANDOM(1, i)
       exchange A[i] ↔ A[j]
```

Problem 2
Consider a programming language that allows only integer numbers and supports addition, subtraction, and multiplication. Write an algorithm DIVIDE(n, m) that computes $\lfloor n/m \rfloor$, where n and m are positive integers.

Simple algorithm
The following computation takes $\Theta(\lceil n/m \rceil)$ time and $\Theta(1)$ space.

```
SLOW-DIVIDE(n, m)
ratio ← 1
while ratio · m ≤ n
    do ratio ← ratio + 1
return ratio − 1
```

Fast algorithm
The following recursive algorithm runs is $\Theta(\lg\lceil n/m \rceil)$ time. The space complexity is not constant; the algorithm requires $\Theta(\lg\lceil n/m \rceil)$ memory for the stack of recursive calls.

```
FAST-DIVIDE(n, m)
if n < m
    then return 0
ratio ← 2 · FAST-DIVIDE(n, 2 · m)
if n − ratio · m < m
    then return ratio
    else return ratio + 1
```