

# Digital Schoolhouse Puzzle Page

*"If I had an hour to solve a problem I'd spend 55 minutes thinking about the problem and 5 minutes thinking about solutions"*

Albert Einstein

## Welcome to the Digital Schoolhouse Puzzle Page

On this paper, we will investigate a series of puzzles that can be used to promote Computational Thinking. This month we will investigate the Sock Selection question which has been used by Amazon in interviewing applicants.

### Cash Boxes

You have a thousand £1 coins. How can you distribute them among 10 boxes so that any amount between £1 and £1000, inclusive, can be given as some combination of these boxes? No change is allowed of course.

### Answer:

The solution to this puzzle takes advantages of the binary system.

Let us put 1, 2, 4, 8, 16, 32, 64, 128, 256 £1 coin in the first nine boxes and  $1000 - (1 + 2 + 4 + 8 + 16 + 32 + 64 + 128 + 256) = 489$  £1 coins in the tenth box. Any amount, A, smaller than 489 can be obtained as a combination of these powers of 2, i.e  $2^0 \dots 2^8$ .

The largest integer a nine digit binary number can be represented is  $2^9 - 1 = 511$ .

Therefore, any amount between 489 and 1000, inclusive, can be represented as  $489 + A'$  where  $0 \leq A' \leq 511$ . Hence, it can be obtained as the contents of the tenth envelope and a combination of the first nine, the latter given by the binary representation of  $A'$ .

### Linkage to Computer Science

This solution uses binary to represent the problem's input. i.e. the number of £1 coins in each of the cash boxes. Every decimal integer has a unique representation in the binary number system. The binary number system is important because it has proved to be the most convenient for computer implementation.

### Puzzle 16: Easy

7					5		6	4
	1			9				2
		4	2	1		9		
			7			2		
2			4	5	3			9
		5			1			
		6		7	2	3		
5					4		8	
9	7		5					6

### Puzzle 17: Medium

		9					1		
			8	2					
8			3				5	6	7
4	2			5			6	3	9
9	5	7		8				4	1
7	6	1			8				2
				6	4				
		4					8		

### Puzzle 18: Hard

		6	8		5		9		
			6				8	4	3
	1			9	4				
2		7					6		
3									5
		1					3		4
			7	5				6	
6	2	9			8				
	8		9		6	1			

### Solutions

7	8	5	9	4	6	1	3	2
2	9	3	1	8	4	7	5	6
1	3	4	7	5	2	9	6	8
4	6	1	5	2	7	3	8	9
3	4	8	1	6	9	7	2	5
2	5	7	4	3	6	1	9	8
5	9	2	9	4	5	7	6	3
8	1	7	6	8	2	5	3	9
4	7	6	3	5	2	9	1	8

Puzzle 18: (Hard, difficulty rating 0.65)

3	9	4	7	6	1	2	8	5
2	8	5	7	6	4	9	1	3
7	6	1	9	3	8	4	5	2
9	5	7	6	8	3	2	4	1
6	1	3	2	4	9	7	8	5
4	2	8	1	5	7	6	3	9
8	4	2	3	9	1	5	6	7
1	7	6	8	2	5	3	9	4
5	3	9	4	7	6	1	2	8

Puzzle 17 (Medium, difficulty rating 0.54)

9	7	1	5	3	8	4	2	6
5	3	2	6	9	7	8	1	4
4	8	6	1	7	2	3	9	5
3	9	5	8	2	1	6	4	7
6	1	9	8	1	5	3	7	2
3	4	8	7	6	9	2	5	1
8	5	4	2	1	7	9	3	6
1	7	6	8	2	5	3	9	4
5	3	9	4	7	6	1	2	8

Puzzle 16: (Easy, difficulty rating 0.44)