Problem 1.

To simplify this problem, let's consider a party of 3 people, denote A, B, C. The number of pairs of people shake hands in this party is $\binom{3}{2} = 3$. In other words, there are three pairs, AB, AC and BC. Now we can classify distinct parties according to the number of handshakes.

i) $\#handshakes = 0 \implies \binom{3}{0}$

ii) $\#handshakes = 1 \implies \binom{3}{1}$

iii) $\#handshakes = 2 \implies \binom{3}{2}$

iv) $\#handshakes = 3 \implies \binom{3}{3}$

Since $\sum_{k=0}^{n} \binom{n}{k}$ is 2^n, $\binom{3}{0} + \binom{3}{1} + \binom{3}{2} + \binom{3}{3} = \sum_{k=0}^{3} \binom{3}{k} = 2^3 = 8$.

Hence, there are 8 distinguish parties.

Now, in our problem, The number of pairs of people shake hands in this party is $\binom{10}{2} = 45$.

We can classify distinct parties according to the number of handshakes.

1) $\#handshakes = 0 \implies \binom{45}{0}$

2) $\#handshakes = 1 \implies \binom{45}{1}$

$\vdots$

45) $\#handshakes = 45 \implies \binom{45}{45}$

Therefore, the number of possible parties is $\sum_{k=0}^{45} \binom{45}{k} = 2^{45}$.