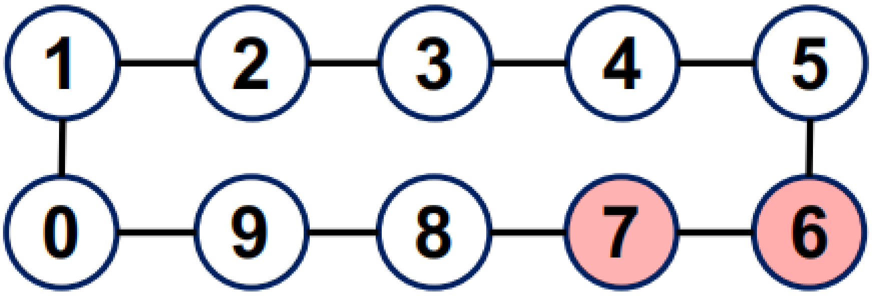
Q 1

When n≤3， the number of neighbors is 0.

When n=4， the number of neighbors is 2.

When n>4， the number of neighbors is n.

Reason: n cities are following neighborhood structures



For **Adjacent Two-City Change**, firstly we choose one city, we have n kinds. Then choose a adjacent city, we have 2 kinds. But in this process, we repeated the calculation, so we need to divide it by 2. So the result is n*2/2=n.

Q 2

When n≤3， the number of neighbors is 0.

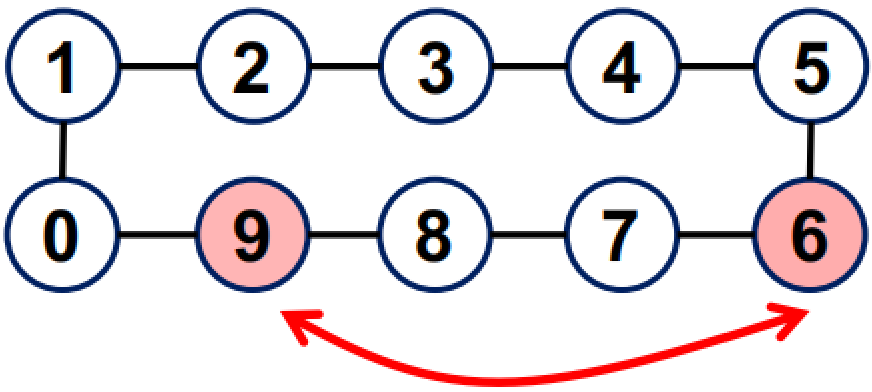
When n=4， the number of neighbors is 2.

When n>4， the number of neighbors is

$$\frac{n*(n-1)}{2}$$

.

Reason:



For **Arbitrary Two-City Change** , **including (1) Adjacent Two-City Change.** firstly we choose one city, we have n kinds. Then choose a city (include adjacent city), we have n-1 kinds. But in this process, we repeated the calculation, so we need to divide it by 2. So the result is n*(n-1)/2.

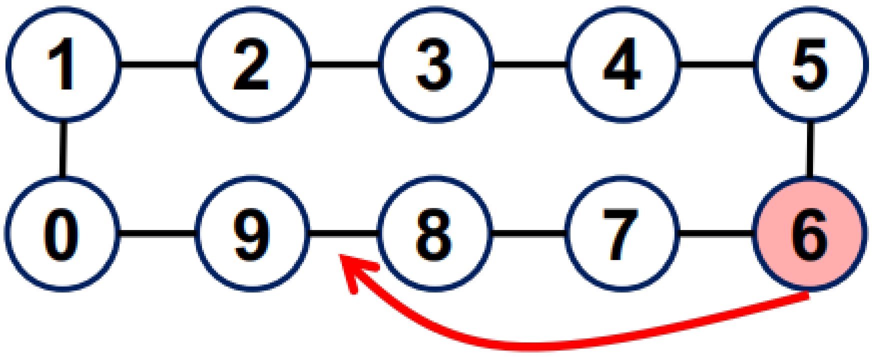
Q 3

Number of neighbors is

$$n*(n-2)-n$$

.

Reason:



For **Insertion (Shift)** ,firstly we choose one city which we will insert, we have n kinds. Then there are n-2 edges we can insert. But in this process, we repeated the calculation.

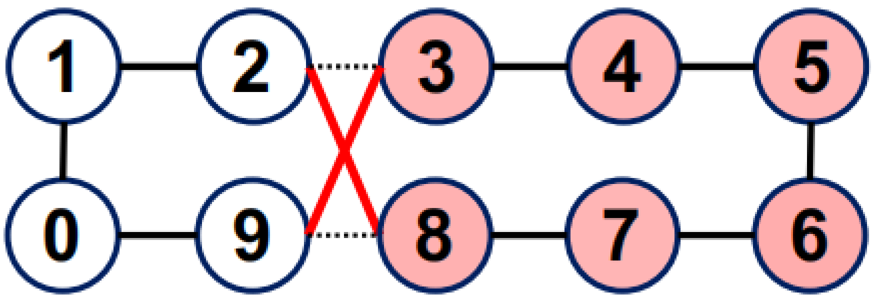
For example, we choose city 1 inserts city 2 and 3 is the same as we choose city 2 inserts city 0 and 1. There are a total of n edges, so we need to subtract n. So the result is n*(n-2)-n .

Q 4

Number of neighbors is

$$\frac{n*(n-3)}{2}$$

Reason:



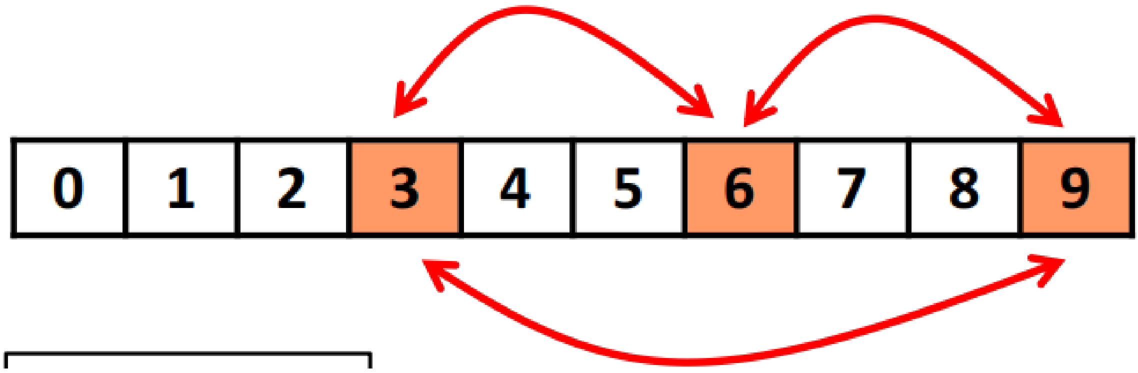
For **Inversion (Arbitrary Two-Edge Change)** , firstly we choose one edge to change, we have n kinds. Then we need to choose another edge to change, and this edge can't be the adjacent edges of the edge that we choose first. So there are n-3 edges we can choose. But in this process, we repeated the calculation, so we need to divide it by 2. So the result is n*(n-3)/2

Q 5

Number of neighbors is

$$\frac{2*n^3-3*n^2+n}{6}$$

Reason:



For **Arbitrary Three-City Change including two-city change in (1) and (2)** ,we divide this problem into 2 parts.

1: all the 3 numbers changed its index;

2: only 2 numbers changed its index;

So the result is

$$\frac{n*(n-1)*(n-2)}{3}+\frac{n*(n-1)}{2}=\frac{2*n^3-3*n^2+n}{6}$$