# HW 4

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## Question 9:

There are 5 integers and when divided by 4 from these consecutive integers, there will be 4 possible remainders: 0, 1, 2, 3.

$$n = \{1, 2, 3, 4, 5\}$$

$$n \% 4 = \{1, 2, 3, 0, 1\}$$

There are 5 pigeons into 4 pigeonholes. By pigeonhole principle, at least two of the 5 integers have the same remainder when divided by 4.

## Question 10:

So let 'A' be the number of computers (pigeons) and 'B' be the number of connections (pigeonhole)

Since there are 6 computers, there can only be 5 connections b/c one of the computer cannot connect to itself

$$A = 6, \quad B = 5$$

According to the pigeonhole principle, since there are 'k+1' objects placed into k boxes, then there is at least two computers connected to the same number of other computers

## Question 11:

Let $A_1 = \{1, 100\}$
$A_2 = \{2, 99\}$
$\vdots$
$A_{50} = \{50, 51\}$

Each of these pair shown adds up to 101. According to the pigeonhole principle, since there more objects placed into 'k' boxes then there is at least one box will contain two or more pairs that add up to 101.

## Question 12:

Since there are 51 houses on a street and each one of these houses have an address between 1000 and 1099, meaning 100 in total house addresses.

50 of which from 1000 to 1099 are even
50 from 1000 to 1099 are odd

Since there are 51 houses and more objects than there are evens or odds house addresses (50), then by pigeonhole principle, there will be at least two houses with consecutive house addresses

# Question 13:

The midpoint formula of two distinct points in an xy plane is:

$$\left(\frac{x_i + x_j}{2}, \frac{y_i + y_j}{2}\right)$$

$\frac{\text{even} + \text{even}}{2} = \text{integer}$

In order for at least one pair of these points to have integer coordinates, $x_i$ and $x_j$ has to be even or $y_i$ and $y_j$ has to be even. Since it is possible for both these pairs to be even, according to the pigeonhole principle, the midpoint of the line joining at least one pair of these points has integer coordinates