DEPARTMENT OF MATHEMATICS

**MATHS 190 Lecture 2 Summary**

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In this lecture we illustrate two important observations:

- Its possible to estimate very large numbers of things by breaking one large problem down into a lot of smaller ones.
- The pigeonhole principle. This principle says that if you have to put N things into N-1 boxes, at least one box has to have two things in it.

In Lecture 2 we studied two main questions:

**Question 1: How many tennis balls would it take to fill up the lecture room?**

To answer this, we filled a box with tennis balls and counted how many tennis balls it took. We then estimated how many boxes it would take to fill up the room. From that we could calculate how many tennis balls would be needed to fill the lecture room.

This gave us an idea of how to estimate large numbers of things, by counting the number in a smaller area and multiplying up.

We illustrated the pigeonhole principle by using tennis balls in cans. If you have five cans, each of which can hold a maximum of three tennis balls, you know that at least two cans must contain the same number of tennis balls. It's easy to see when using small numbers like this, and then the principle can be applied to Question 2.

**Question 2: Are there two people with the identical number of hairs on their body?**

First, we estimated the maximum number of hairs a person could have on their body. We did this the same way as Question 1, by counting the number in a smaller area, and multiplying up. We then compared this number to the total number of people in the world, and applied the pigeonhole principle.

The answer is YES, there must be at least two such people!

Before you come to the next lecture: You should spend an hour or two thinking and reading about the ideas presented in the lecture. You should also:

- Read 2.2 in the text and think about other patterns you see in nature, or around you in your daily life.
- Bring **a pineapple** to the next class on Monday.

Other activities you could do if you have time are:

- Try out the hairy body question on a friend or family member. Can they figure out the answer?
- Bring along about 1 million of something to the tutorial and describe how you estimate the number to be about 1 million.