Flocking behaviour is found in the animal kingdom in mammals, birds, fish and insects. There are many different forms of swarming in animals and there are also very different reasons for such behaviour. For example, fish shoals may offer protection against predators by confusing them and making it hard to single out a prey.

A swarm consists of a group of individuals. Each individual continuously modifies its velocity using three simple rules: keep distance between neighbours, match velocity of your neighbours, and check for boundaries.

In this lecture we will develop a Java application to simulate flocking behaviour.

For a readable introduction to swarm intelligence see the article on *Swarm Behaviour* in National Geographic Magazine July 2007 at http://www7.nationalgeographic.com/ngm/0707/feature5/index.html

Step 1: From the problem statement, identify potential classes (often nouns)
Step 2: Identify the responsibilities of those classes: what operations must be performed by the system
Step 3: Class model
Step 4: Create code outlines: classes and instance variables, capturing associations
Step 5: Complete the application by coding and testing the full behaviours of your classes

Step 1: Problem statement with possible classes (nouns) identified.

A swarm consists of a group of individuals. Each individual continuously modifies its velocity using three simple rules: keep distance between neighbours, match velocity of your neighbours, and check for boundaries.

Modelling points:
A swarm is a set of individuals
Each individual has a velocity
Each individual has neighbours
The swarm has boundaries
3 rules determine how individuals modify their velocity

Step 2: Classes

Initial Model
Questions for this model:
Where are neighbours determined? In the swarm class or in the individual class? Why?
How are viewer and swarm linked? How can we minimize the coupling between them ie. separate model from view? Can we make viewer reusable?
What is a boundary?
What controls the evolution of the swarm (application of rules and changing states of individuals)?
More detailed model

Java Code
See lecture index on the CITS1220 web pages to download the code

Extension Questions
Metrics: measure and report on the effectiveness of the swarm:
How compact is the group at different times?
How is swarming affected by different numbers of individuals?
How is swarming affected by the boundaries of the swarm area?
Study the three swarm rules: How do they work? How can they be modified?