Research Report (Simulation Techniques for Animation)

Title: Predator/ Prey Crowd Simulation

*(In total 800-1600 words, font size 11. The template is only a reference and its content is indicative. Please feel free to develop your own narrative structure. )*

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**Introduction** (250-500 words)**:**

For my project I will be creating a crowd simulation involving predator and prey rules. The simulation will initially involve an agent based crowd simulation of the prey as they wander about independently of each other avoiding other agents and collision with surrounding objects. For the collision detection I may look into a more complex method of collision detection involving implicit methods.

If a predator is detected by an agent the agent will alert surrounding agents of the predator which will require the use of a nearest neighbour algorithm. I will likely use an quadtree or a similar data structure to make locating surrounding agents more efficient.

Once the prey agents are alerted to a predator they will then flock together and travel away from the predator to give a stampede type effect. To achieve flocking I will use the flocking algorithm developed by Craig Reynolds.

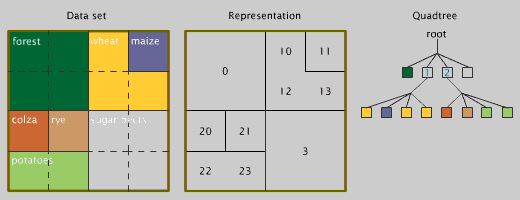
As an extension task I would like to include predator rules to allow predator to move towards prey when within a given range rather then moving around independently. I would also like to give the prey agents goals when predators aren't detected such as moving towards food sources etc. I may also include uneven terrain for agents to travel across and introduce varying velocity based on the terrain steepness, ie if travelling up hill agnets will slow down.

*Give general background and context of the project. You will need to highlight the link of the project to the simulation techniques. Please outline the main knowledge and techniques of simulation in your proposed implementation.*

**Methods** (400 – 800 words)**:**

The main methods I will use will be a flocking algorithm developed by Craig Reynolds. The flocking algorithm is made up of 3 components, collision avoidance, velocity matching and flock centring. For the collision detection aspect I will also be using a nearest neighbour algorithm to detected surrounding neighbours. This will be used to avoid collision with surrounding agents and to spread the predator alert. Ideally agents should not check every other agents position to check for intersections as this would equate to a O(N^2) algorithm making it slow and inefficient. Also in real world exams a large crowd of animals would not have knowledge of all other animals in the heard but merely its neighbours.

To improve the efficiency of this algorithm I will likely use a quadtree as although my simulation is in 3D agents will only move about the ground plane so collision detection is only strictly necessary in the x and z planes.



*A nearest neighbour algorithm will also be needed to detect predators within a certain radius of the prey agents but to improve efficiently I will likely test for prey within a range of the predator as there will be less predators then prey so less calculations will need to be preformed.*

*Once the predator is detected by the prey agent it will also need knowledge of its neighbours to pass the predator alert onto them and then they pass this onto their neighbours etc. This will need a more complex method as once this alert is passed onto a prey agent we already have a basic knowledge of its neighbours from the previous calculations so we don't want to recheck all its neighbours and we also don't care about already alerted prey agents to the efficiency of the algorithm needs to be improved.*

*Available key methods of simulation techniques for your implementation are listed here. The content can be description of the algorithm, key mathematical equations, pseudo codes and etc. Some examples and images are helpful. It is important to include your understanding of the related techniques and current state of the art.*

*Details should be presented for one or two key methods, no more than three.*

**Critical analysis** (150 – 300 words)**:**

*Analysis and comparison of the main methods listed, including personal reflection and insight.*

**Reference List:**

<http://harry.me/blog/2011/02/17/neat-algorithms-flocking/>

Reynolds, C.W., 1987. Flocks, herds and schools: A distributed behavioral model. *ACM SIGGRAPH computer graphics*,*21*(4), pp.25-34.  
  
Karamouzas, I., Sohre, N., Narain, R. and Guy, S.J., 2017. Implicit crowds: Optimization integrator for robust crowd simulation. *ACM Transactions on Graphics (TOG)*, *36*(4), p.136.

Disclaimer: We have endeavoured to make the information provided in this assignment template is correct at time of publication. However, there may be typos and mistakes so it will be your own responsibility to check. Please do not hesitate to contact [jchang@bournemouth.ac.uk](mailto:jchang@bournemouth.ac.uk) if you have any queries.