[] (Square brackets) = comment/description of problem

Unsure if placement of content is correct or Unsure if content is necessary or Needs fact checking

Document styling issue

To-do

Bad Description or Too Verbose or Needs more content or Confusing or Better wording needed

Problem with concept (e.g. which programing language to use)

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# Analysis

Ordering of titles? Should proposed solution/potential solutions/Objectives come before Data volumes/Analysis of data dictionary/Data sources and destinations…

How to choose ant simulation part (as this has no technical reasons and is purely biology realted)? Should this be mentioned in the problem background?

Explain ant simulation? (e.g. how can change the ant’s properties to change how long it survives for) Where should this be done? Should I explain why this is being done?

Should the document be specific to the end user or generic (e.g. use *pupil* or *user?*)

Do I need to explain what is meant by *survival of the fittest* and *simulation*? If so where?

Describe the concept of logging in as no password will be needed only the class ID and the pupil’s ID, these should be secret but do not need to be secure as gaining access to a pupils account is not dangerous. Also the teacher’s login dose require a password but just the class ID as the user name, as the teachers account if accessed dose leverage privileges.

Conflation between *evolution* and *survival of the fittest*

Conflation between *teaching tool* and *simulation* and *game*

Need to show that the simulation is the main project and that the teacher’s admin interface and the pupils score board are features of the simulation (not the main project)

## Background to problem

There is currently very few engaging learning tools to help teachers teach and motivate pupils to learn about the subject of natural selection. The subject itself is difficult to teach and although very interesting is hard to encourage pupils to do independent learning outside of the classroom. Natural selection has concepts such as survival of the fittest which can be challenging when people first come across them. What’s more there are many misconceptions about natural selection such as Lamarckism, these although sound plausible are wrong. Pupils find it hard to understand why they are wrong and so a tool to demonstrate survival of the fittest would be an excellent way for the pupils to understand for themselves why it is wrong rather than being taught simply that it is wrong.

The teacher in question is a biology teacher who needs a tool to help teach his two classes each year each containing from 15 – 20 12-13 year olds. Part of the course teachers the basic principles of evolution.

## Description of current system

The tool *“Who Wants to Live a Million Years?”* (<http://science.discovery.com/games-and-interactives/charles-darwin-game.htm>) is an example of a independent learning tool to help teach the concept of survival of the fittest. It is a flash based web application aimed at teaching the basic concepts of evolution by demonstration. The tool contains two main sections a learning section and a simulation section. Although both sections provide information on natural selection the learning section is much more informative. It shows the user both text and pictures in a fun animated way to help engage users. The simulation section allows the user to choose a starting population and then demonstrates a change in environment (new predator, natural disaster) to show how only those best suited to the new environment will survive and reproduce while the others will not. I think the simulation gives a bad representation of survival of the fittest as it presents mutations as a non-random event (user driven while in reality they are totally random and cannot be chosen). What’s more is I do not think that the simulation is engaging enough and doesn’t encourage users to look further into the concepts of evolution. There is minimal user interaction which does not make it fun.

[Condense this]

Another example of a learning tool from another subject which is successful is the *“Stop Disasters!”* ([http://www.stopdisastersgame.org](http://www.stopdisastersgame.org/)) simulation used to teach students about the subject of disaster prevention in geography. Again it is a web application based in flash and although the content area is not survival of the fittest it is a useful tool to study when developing a teaching tool for biology. The simulation is much more engaging then “Who Wants to Live a Million Years?” as allows the user to interact with it more and therefore is fun, the simulation encourages users to read more about the subject area using facts and links to more information. The simulation demonstrates why things happen not just how. All in all I think it is a good model to study when creating a similar tool for biology.

[Is this necessary]

I intend to make a biological simulation, I will improve on the mistakes in current models and learn from similar applications with the aim of making a fun and informative experience. I will use lots of interaction to help make it fun, and demonstrate the concepts of survival of the fittest in an interesting way to encourage the user to learn more about the subject area.

Aspects of the problem I will tackle

More problems with the current systems

Find more systems

## Identification of prospective user(s)

There are two users of the system.

The teacher who acts in an administration role as well as checking that each pupil has used the tool i.e. if they are set to use it for homework, they should be able to check that the homework was done. There would only be one teacher per group of pupils. Teachers would be able to add and remove pupils from their roster/generate accounts for the pupils. The administrator’s user interface with the tool will not have to be as streamline/look as good as the pupil’s user interface as it does not have to be interesting and fun.

There is also the pupil who uses the system as a learning tool by running the simulation and reading the information on survival of the fittest. There may be up to 25 pupils per teacher. The pupils will not be as competent as the teacher as they will not user the tool as often and therefore will need a simpler interface. The pupil’s user interface must also be more engaging and fun to encourage them to get excited about the subject.

## Identification of user needs and acceptable limitations

Is there are better way to format this section? Perhaps bullet points?

The tool needs to demonstrate the fundamental concepts of *survival of the fittest*.

This is the main purpose of the tool and should be the main priority. The pupils should be able to observer the processes of *survival of the fittest.*

The tool needs to be used both inside and outside the classroom

As the tool is used as both a teaching tool and a tool to prompt independent learning/further study into the subject area by pupils the tool must be able to be used within the classroom (or computer room) as well as by the pupils in their own time or for homework at home.

The tool needs to have a solid foundation in biological concepts of *survival of the fittest*.

As the tool is primarily a teaching tool to help pupils understand the concept of *survival of the fittest* the tool must be an accurate representation of this biological principle, otherwise it may not teach pupils and could further increase the confusion and understanding of this already difficult principle. And so the simulation must be sound from a biological perspective.

The tool must be suitable for 12-13 year olds [which year group dose this topic].

The tool must be simple to use and the concepts must be portrayed in a way to best engage this age group. What’s more, any linking content must be suitable for this age group.

The tool needs to be able to be used by all students in the classroom.

All pupils in the classroom and outside the classroom should have equal access to the tool, there should be no minimum system requirements (e.g. owning a smart phone), so everyone can use it.

The tool needs to be able to be demonstrated through a projector in the classroom.

When first introduced, the tool must be demonstrated by a teacher so that the pupils can get the most out of the tool and so that it is used correctly and all features used to their maximum effectively.

The tool must be extremely simple to use with minimum tutoring required.

As a teaching tool there should not be a steep learning curve as this defeats the point of simplifying the teaching of the concept.

The tool must be fun and engaging potentially competitive.

The tool should try to engage the pupil in the subject and encourage independent study.

The simulation should not be expected to be completely accurate and approximations may be made.

For instance the simulation may be in 2d rather than full scale 3d due to the complexity of such a project.

The simulation must have room for wavering from the true biology so not to introduce even more complex topics thus increasing confusion.

It should give an accurate depiction of what really happens but does not have to be reality as this may complicate the issue and make the concept of survival of the fittest even harder to teach.

More limitations

Interview/Surveys

## Data sources(s) and destinations(s)

There are two data sources, one from the teacher when they are inputting their class roster into the tools admin section. This will contain a list of up to 25 login ids of the pupils in the class. This data will be used to create records in a database [to technical for analysis?] which will be used to record the score [need to explain that there will be scoring?] of each pupil using the simulation. The scores are from the second data source, the pupils themselves, as they run and edit [explain why they would be editing anything?] the simulation they will generate a high score which would be an integer (specifying how long their simulation has run for), this will be inputted into the database alongside their login id and class id [explain why there are two ids?]. The score data of each pupil in a class would be used to generate a list of high scores for the class which any member of the class can access.

Data for ants change in attributes -> processed in simulation -> displayed as movement of ants. Is this needed?

## Data volumes

The volumes of data are very small, all that is required is to store a single 32bit integer (representing the score) and data of last login for each pupil id (less than 20 characters with utf-8 encoding) and class id (32bit integer representing unique class identifier). As classes contain less than 25 pupils each full class would be less than 1 kilobyte as only the highest score for each pupil would be held.

The tool itself would be less than 10mb(?)

How technical can this be?

## Analysis Data Dictionary

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Description | Relationships |
| Score | 32bit integer | Contains the highest score a user has reached, defaults to 0 |  |
| Last login date | Datetime date 8 bytes | Contains the last login date of the user, defaults to ? |  |
| User ID | <20 character string | Contains a unique identifying string for each pupil in a class i.e. first name + last name initial. Chosen by teacher |  |
| Class ID | 16bit integer | A globally unique integer to identify the class |  |

## Data Flow diagrams

## Entry relation diagrams

This is not applicable to my project.

## Object analysis diagrams

## Objectives

Should this include objectives for the ant simulation? (e.g. chemical trials, terrain simulation, certain attributes, random mutations….) Or should this just be for the interface (e.g. allow login, admin panel, high score board…) or both?

## Potential solutions

### Smart phone app

A smart phone app written in Java (android) or Objective-C (IOS) which would run the simulation on the phone and then connect to a remote server for login and keeping the highest score of each user. The teacher could have a password protected access to an admin panel within the app to add and remove users and to check that all of the pupils had logged into the system.

This would fore fill the majority of the requirements due to a smart phones portability it can be used both inside and outside the classroom. Phones are also internet enabled so logging into a remote server would not be a problem (unless they had no signal). The age group would already be familiar with the concept of apps and so would be familiar with the interface. And smart phones are powerful enough to run a complex biological simulation and so keeping the simulation accurate would not pose any difficulty.

Although, not everyone has a smart phone and so not everyone in the class would be able to use it. Furthermore due to the fragmentation of smart phone apps you would need to write the same app for multiple different architectures (IOS, android …) thus making the project even more complex. Lastly if the exercise is done in class there would be no way to know if the pupils where using the tool or using their phones for another use.

### Web application (HTML5, JavaScript)

A web application written in HTML5 and JavaScript again with a server side database is another solution. Using the web is a great solution as you know they will have internet and so logging in would not be a problem. People are very familiar with web application interfaces and so there would be a shallow learning curve. A more usual form factor for an admin interface could be used (a webpage). There would be little issue with cross compatibility as both html and JavaScript are web standards and implemented in all Morden browsers. What’s more the speed of JavaScript has increased dramatically and so it is fair to assume that a accurate simulation would be able to run smoothly. Access to the tool would not be a problem as almost everyone has access to a computer (i.e. school computer lab) thus for filling the users requirements.

However the complexity of the project may increase due to the use of multiple languages [language for server backend? Ruby on rails, php, nodejs], a server backend would be needed to control the user logins and also the admin panel and a separate language for the simulation inside of the browser.

### Desktop application

A desktop application written in C++ with a server backend could be used. Again this would be great as the simulation could easily run due to C++’s speed and also access to a desktop. A special login protected admin panel within the application could be used by the teacher for adding and removing pupils. A connection to a server could be used to update the scores in real time. Like the web application in (HTML5, JavaScript) it could be used by everyone at home or in the classroom for filling the end users specification.

Although the application would have to be cross compatible between the major Operating Systems (windows, mac and Linux) in order to make sure everyone could use it on their machine. Furthermore the increased setup time of tool would make it less user friendly (i.e. user must download and install the program).

Is 3 enough or are more needed? Potential suggestions:

Web application (Flash)

## Justification of chosen solution

The chosen solution would be an ant simulation written in JavaScript on a website hosted by a server which is running a database which would collect the high scores of each of the pupils and also would record their last login data, the information would be accessible by teacher (admin) and a high score board would be available to the pupils.

The solution was chosen due to cross compatibility between devices (i.e. it can work on any internet enabled platform). What’s more there would be a very shallow learning curve as everyone knows how to use the web.

Do I need to say anymore as the advantages are already mentioned in Potential solutions?

Survey/interviews

Analysis of current systems/observation

# Design

# Technical Solution

# System Testing

# System Maintenance

# User Manual

# Evaluation