PDST
Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí

An Roinn Oideachais agus Scileanna
Department of Education and Skills

National Workshop 4
Day 2 Session 1:

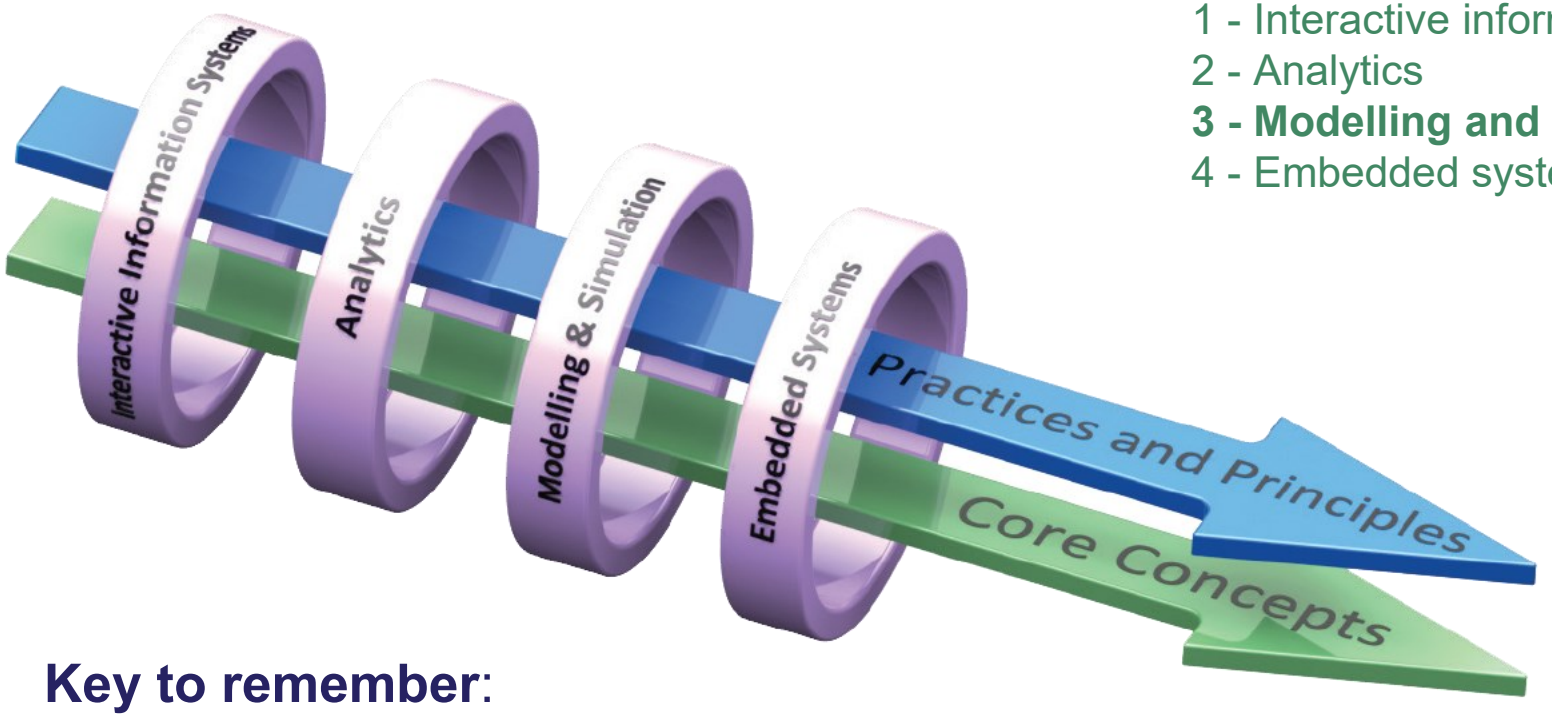
Modelling and Simulation

LEAVING CERTIFICATE
COMPUTER SCIENCE

LCCS Interwoven

The four applied learning tasks explore the four following contexts:

1 - Interactive information systems
2 - Analytics
3 - Modelling and simulation
4 - Embedded systems.



Key to remember:

Explore and teach the LOs through the lens of ALTs.

ALT3 Learning Outcomes

3.8. develop a model that will allow different scenarios to be tested

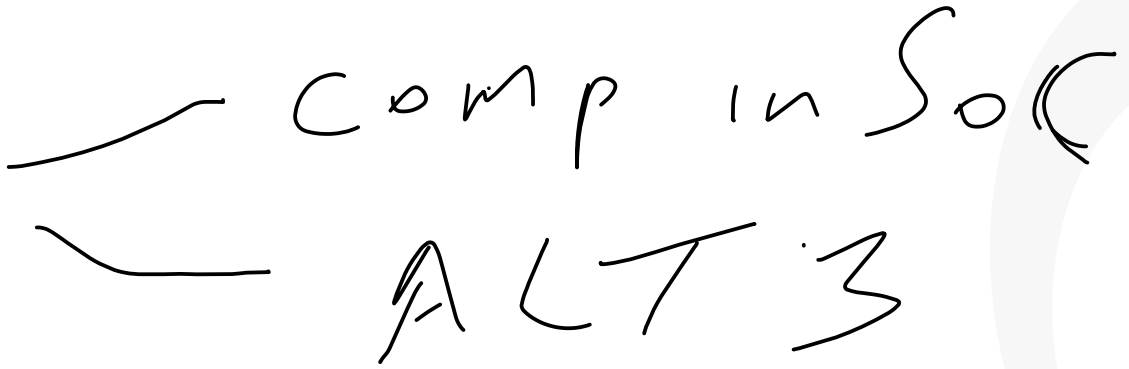
3.9. analyse and interpret the outcome of simulations **both before and after modifications have been made.**

3.10. explain the benefits of using agent-based modelling and how it can be used to demonstrate emergent behaviours

Today

Develop appreciation of models / different types of models

Modelling / Simulation in our context



Analysing models (Problem – *Everything is a model* !!!!!)

(…leading to Investigating / Planning **– Sinéad**
…design after lunch)

Types of Models

Model – Representation of a person / thing / structure / situation.

Abtraction – Minimalise

Simulation – Using the model…

<u>3 types:</u>

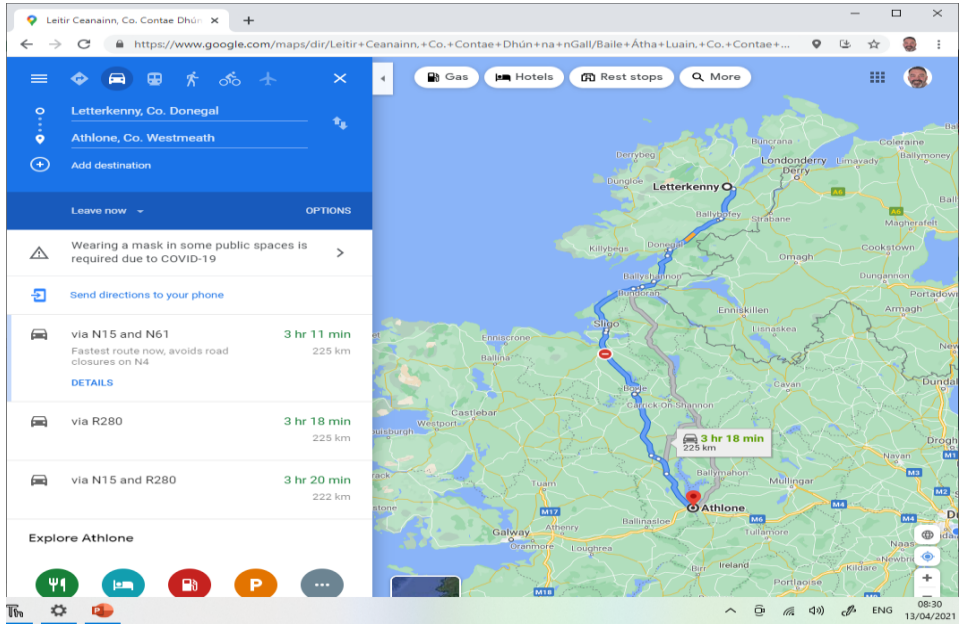
Physical Models: prototypes / engineering / constructions / human models

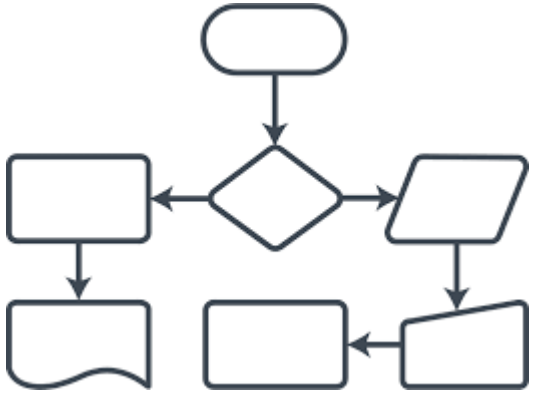
Schematic Models: diagram or graph / network / GPS / maps

Mathematical Models: represent situations in Mathematical language / algebra / leads to algorithms, coding.

Physical Models

Schematic Models

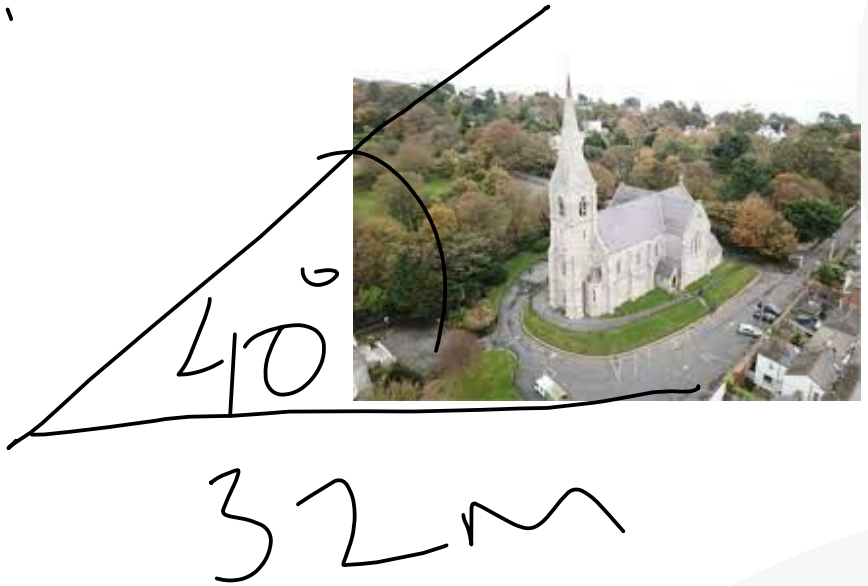




Mathematical Models

Mathematical language / algebra / leads to formulae, algorithms, coding…

Example:
Trigonometry – 2nd year class – get height of spire in Killiney Church



Model / Simulation Video

https://www.youtube.com/watch?v=M0iZ52kUOiQ

Assessing Models

Specification:

3.8. develop a model that will allow different scenarios to be tested

…difficult to solve analytically

…amenable to solution using modelling /simulation

...analyse relationships, patterns

George Box – *"All Models are **wrong** but some are **useful**"*

Mathematical Models

Aoife has 2 sweets – Ronan gives her another 3 – how many has she now.

How would a junior infant student model this?

(Assume they haven't learned to add yet, but they can count)

Why features of your modelling make it suitable for ALT 3 and what features make it unsuitable.

Assessing Models

Rough plan and analysis of models for 2 tax situations:

(Sisters Penny and Freda ask their brother, Seán, a LCCS student, to help them with their tax)

1. **<u>Penny</u>: *PAYE* – develop an outline model for tax due for a PAYE employee – for example a full-time teacher.**

2. **<u>Freda</u>: Develop a model for a *free-lance* musician, who does not have up-to-date accounts, and who teaches some classes, private tuition, does some gigs, especially in the summer.**

Analyse the 2 models and give an opinion as to which is the most useful for our purposes.

Assessing Models – General

George Box – “All Models are wrong but some are useful”

Features / Characteristics:

Generalise on features / characteristics which are evident in models useful for ALT3 in chat….

Assessing Models

George Box – “All Models are wrong but some are useful”

Features / Characteristics:

Future

Forecasting / Predicting

Messy

Real-life

Not easily solved by other means

Picking Models that are useful

Do they have one or more of they following ?:

Messy

Real-life

Not easily solved otherwise

In the future – difficult to predict / forecast

Involve assumptions

Difficult to predict

Involve probabilities / random

Applications Areas/Examples

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Sports – predicting outcomes

Business/Trade/Markets

Supply Chain Management

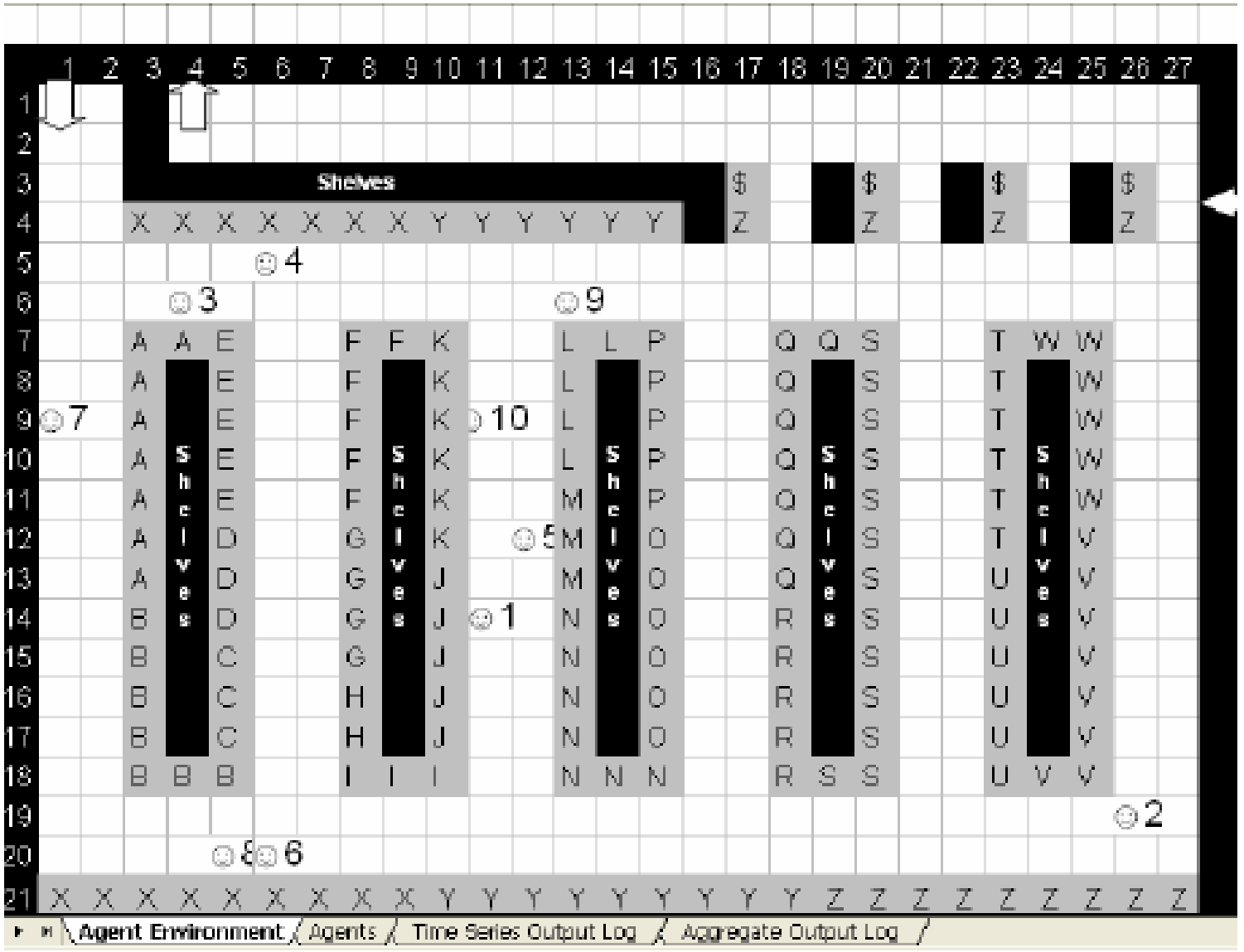
Chemistry / Physics / Biology

Biological Processes

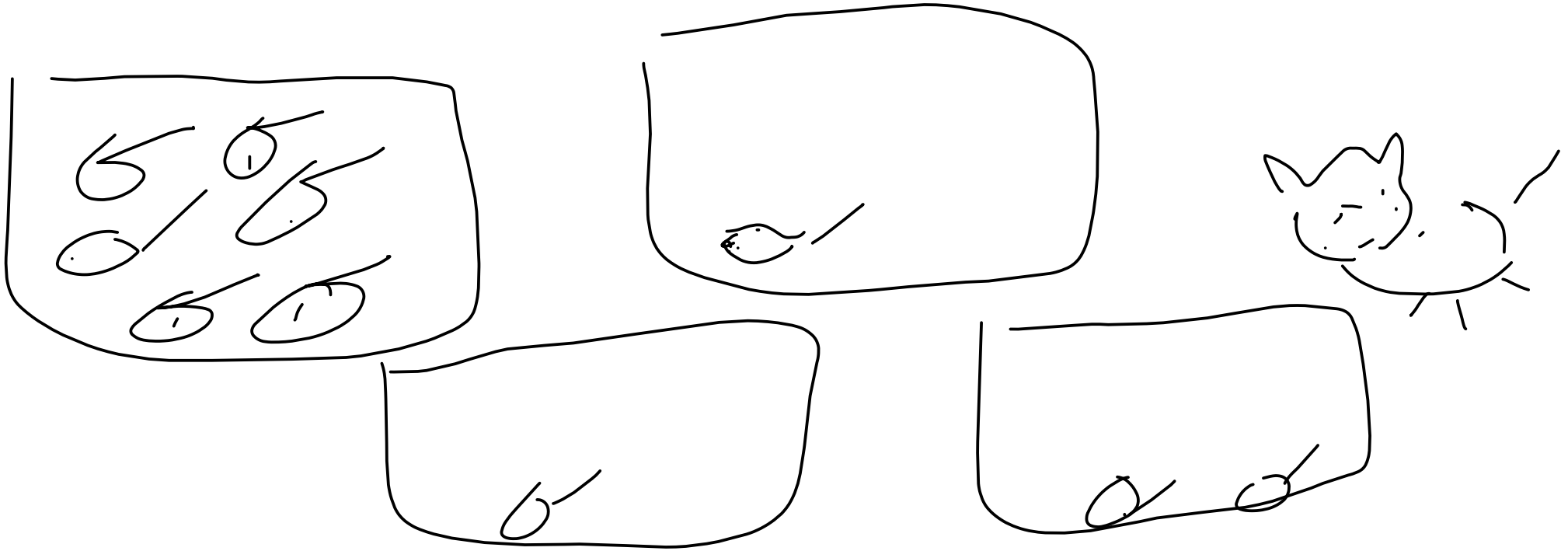
Human Movement e.g. school canteen, queues

Military

Example - Grocery Store



Cat and Mice



4 buildings in a factory plant – with a problem with mice.
Various different features of the model: Some rooms allow extra mice in.
Cat is more efficient at catching mice in some of the rooms rather than others.
Cat is randomly placed in one of the rooms for 2 hours at a time.
Some of the numbers change by %, by addition, or through a random function.

The code is here – it runs 3 simulations:
https://docs.google.com/document/d/1SdcQMoVCu7dL2FQrLC7iisKn-

Population

Carrick Population

Prepare a model for the increase and decrease in population of Carrick (current population 1,535) year-by-year.

Given the following details:
Births: 3% of the population per year
Deaths 2% of the population per year

The model can be an interactive Python program.

https://docs.google.com/document/d/1mQRQYjq_BVPQ36y2A88O8MHMiYLJPk8dV9GidUCU6JA/edit?usp=sharing

((And you may extend the problem:
People leaving: 3 equally likely scenarios depending on Economic factors:

1. 100 net people coming in.
2. 50 net people coming in.
3. 200 net people leaving.))

Predicting Football Results

Predict who will win next weekend’s matches.