

## Learning about and learning through Empirical Modelling

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## Papert (1993)

- “I am convinced that the best learning takes place when the learner takes charge”
- “The role of the teacher is to create the conditions for invention rather than provide ready-made knowledge”

*S. Papert (1993). The children's machine: Rethinking schools in the age of the computer. New York: Basic Books.*



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## Papert (1991)

- Constructionism is the idea that learning occurs “in a context where the learner is consciously engaged in constructing a public entity”

*S. Papert, I. Harel (1991). Situating constructionism. In Constructionism: Research reports and essays.*



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## Riley (1990)

- “These experiences [from Computers in the Curriculum Project] have led to the belief that students too, would learn more or understand better if they researched and developed their own computer models.”

*David Riley (1990). Learning about systems by making models. Computers & Education, 15, 255-263.*



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## Learning about EM

- What is EM and where did it come from?
  - Using computers for sense-making activities (e.g. model building and exploration)
  - Principles and tools developed at Warwick by Meurig Beynon, Steve Russ and many others
- What are the applications for EM?
  - Software engineering, concurrency, graphics, artificial intelligence, and... education



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## The basics of EM

- Construction of models leads to personal understanding
- Correspondence between world and computer – models with meaning
- Key ideas:
  - Exploratory environment for model building, extension and refinement
  - Observables, dependency and agent actions



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## EM module

- Computer Science 4<sup>th</sup> year module: "Introduction to Empirical Modelling"
- Started in October 2002
- Module assessment is through examination and coursework
- Changed the style of coursework in 2004 to include the publication of an online journal requiring students to submit papers and models

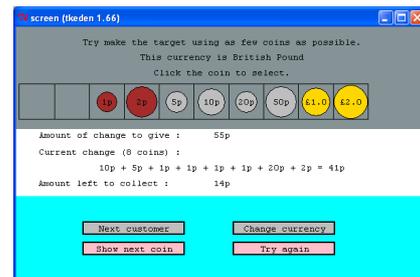
## The coursework: WEB-EM

- Warwick Electronic Bulletin on Empirical Modelling
- Issued a Call for Papers requiring two submissions:
  - a paper title and abstract (part 1)
  - full paper and accompanying model (part 2)
- Requested that "students submit original and high quality papers relating to EM and its applications supported by a relevant documented modelling study"

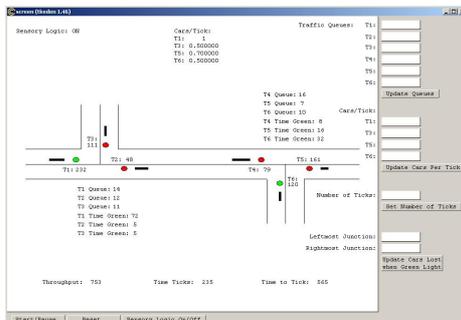
## WEB-EM objectives

- To assess the students' understanding of Empirical Modelling through written and modelling exercises based on a common theme of the students' own choice
- To equip the students with basic research skills that would be useful in further education

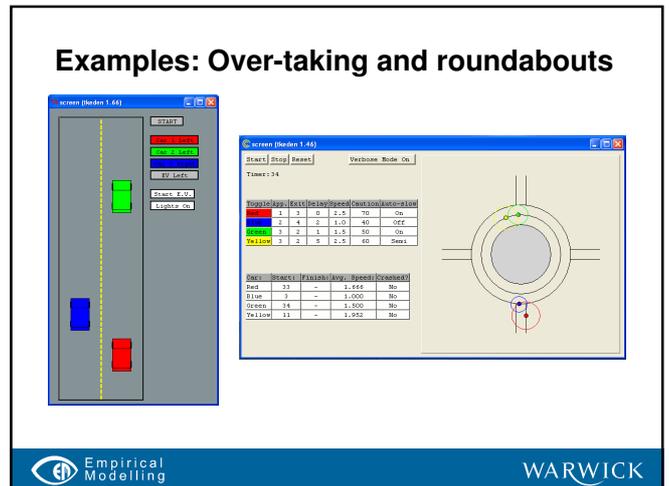
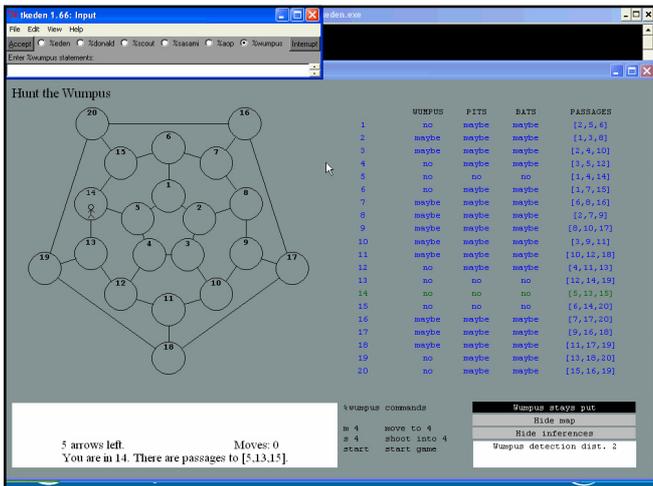
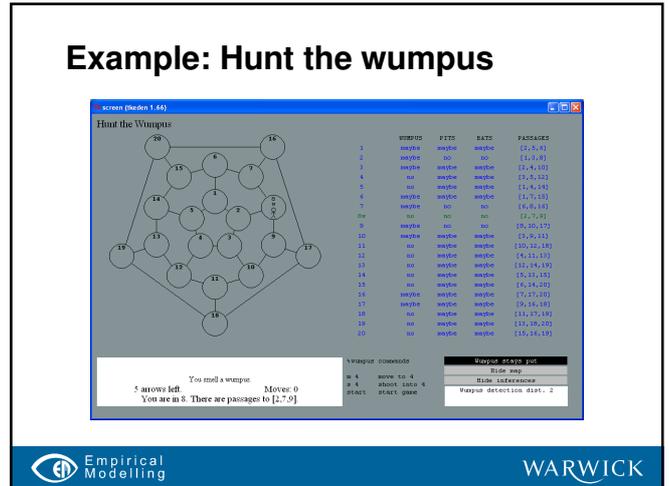
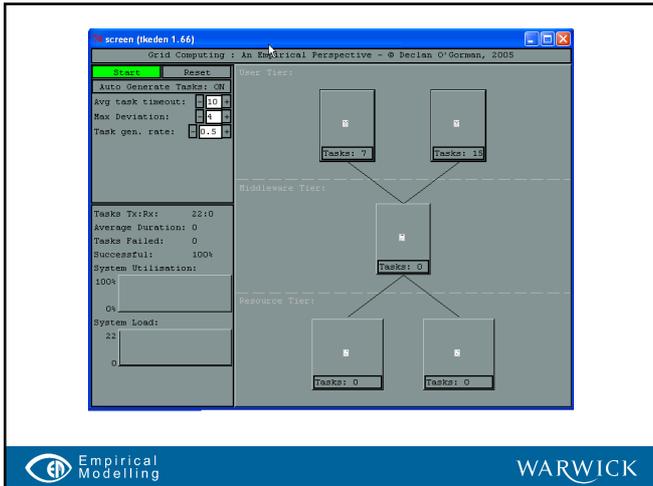
## Example: Non-decimal bases



## Example: Traffic lights



## Example: Grid computing



## Analysis

- The coursework has shown that:
  - Learning can occur and skills can be developed without a preconceived objective
  - Learning is stimulated by personal interest
  - Learning is reinforced when practice and principles are combined
  - Learning is aided by exploration

## Concluding remarks

- Did the coursework meet the objectives?
- Answer: Probably
- But what else did the students learn?

## Concluding remarks

- Questions to be asked:
  - Did students only learn about Empirical Modelling?
  - What learning occurred in domains other than Empirical Modelling?
  - What role did the journal style of coursework play in encouraging learning in other domains?
  - What role did the tools play in enabling learning in other domains?
  - Can EM be used more generally for learning?