

CS4050

UNIVERSITY OF WARWICK

Fourth Year Examinations: Summer 2009

Introduction to Empirical Modelling

Time allowed: 3 hours

Answer **Question 1**, and **Two** other questions.

Question 1 carries 20 marks. The other questions carry 15 marks.

Read carefully the instructions on the answer book and make sure that the particulars required are entered in each answer book.

Calculators are not required and not permitted.

Credit will be given for evidence of familiarity with a variety of standard illustrative models.

1. Study the description on page 2 of Burnley railway station and an accident that occurred there in 1852.

There have been several examples in the module of how Empirical Modelling can be applied in forming a 'construal' of a concurrent system. Explain what is meant by 'construal' in this context. [2]

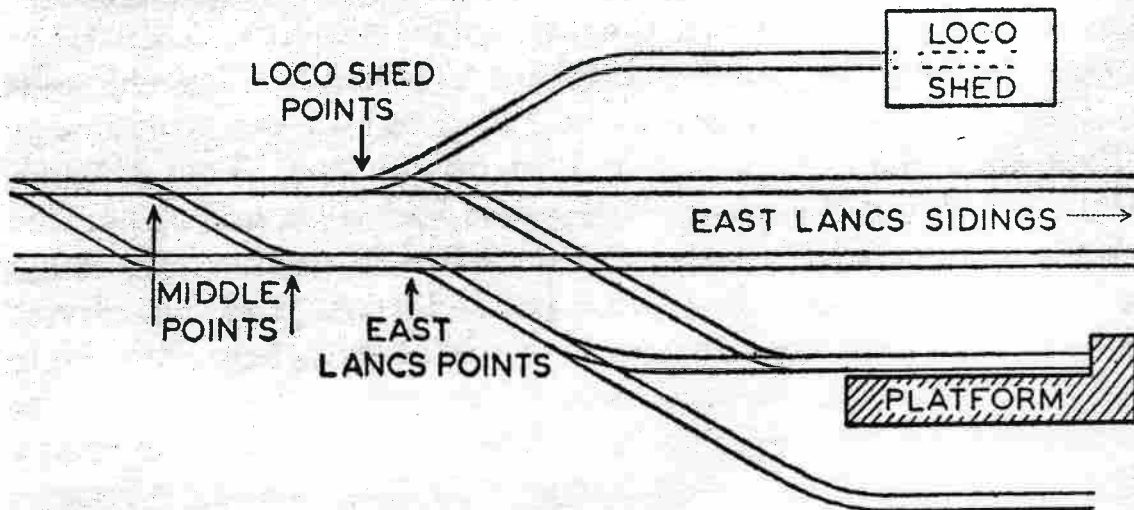
Give an account of the application of the principles and concepts of Empirical Modelling to making a construal of the accident described on page 2. Your account should contain the following three parts:

- (i) agent-oriented analysis based on the LSD notation; [5]
- (ii) interactive artefacts developed using definitive scripts; [5]
- (iii) the animation of LSD accounts within the conceptual framework of the Abstract Definitive Machine. [5]

The account given on page 2 is incomplete in many ways. Suppose a Board of Inquiry were set up by the railway company to investigate the circumstances and causes of the accident. As a result of your analysis above, identify and discuss further evidence that such a Board might look for in their investigations. [3]

Burnley Station and the accident Scenario for Question 1

The layout of Burnley station in 1852 was as shown below (not to scale):



BURNLEY STATION, 1852

The station is a terminus for a single line going through to the platform indicated. There were two tracks which continued past the terminus to the sidings where in the case of long trains passengers could get on and off. There are no signals and all the points are manually operated. The East Lancs Points are normally set to the platform, and are weighted in such a way that they have to be held in position with a lever in order to direct trains into the East Lancs Sidings. The sidings can hold much longer trains however - at most 6 coaches can stand adjacent to the platform.

The Accident

A school excursion train was returning from Goole to Burnley. It was an enormous double-headed train with 35 coaches which had to be returned to the East Lancs Sidings. At the end of the day the coaches are returned to the sidings by stopping the train before the middle points, uncoupling the locomotives and driving them ahead into the engine shed, then allowing the coaches to run down the gentle gradient over the middle points and the East Lancs Points into the sidings. An obliging blacksmith Tom Bridge was helping out at the station when the train returned and was delegated to hold the East Lancs Points in the appropriate position. The driver of one of the engines asked Bridge to switch the Loco Shed Points. As he did this, he released the East Lancs Points, thus redirecting the coaches to the platform, where three children and a teacher were killed in the collision with the buffers.

[Adapted from 'Red for Danger' by L.T.C. Rolt pp35-37.]

2. (a) Explain what is meant by a **definitive notation**. [3]
 (b) Describe the role played by the EDEN interpreter in the implementation of definitive notations, with reference to:
 (i) the way in which EDEN definitions, functions and actions support the interpretation of definitive scripts; [3]
 (ii) the role that the agent-oriented parser can play in implementing definitive notations. [2]
 (c) To what extent is it appropriate that definitive notations take such diverse forms? [1]
 Illustrate your answers to (a), (b) and (c) with reference to definitive notations such as Donald, Scout, Eddi, Gel and Arca. [6]
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3. (a) Describe the interactive characteristics of the **OXO Laboratory** discussed in the lectures. [3]
 (b) Outline the strategy and techniques that are used in constructing the OXO laboratory. [4]
 (c) Compare and contrast the OXO laboratory with programs to play noughts-and-crosses based on conventional paradigms. [5]
 (d) Highlight key respects in which experience of interacting with the OXO Laboratory can be related to William James's philosophical stance of *radical empiricism*. [3]
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4. (a) Briefly explain Seymour Papert's notion of *active learning* within a constructionist educational framework. [3]
 (b) Compare and contrast the qualities of Empirical Modelling as a way of supporting learning in a constructionist style with those afforded by variants of the Logo programming environment, with reference to:
 (i) the character of the interaction associated with the roles of teacher, pupil and developer; [4]
 (ii) the distinction between Empirical Modelling and "programming with dependency"; [4]
 (iii) the way in which a relationship between exploratory learning activities and propositional knowledge is conceived and established. [4]

Credit will be given for suitable illustrative examples.

5. Empirical Modelling is associated with a broader view of Computer Science.

Elaborate on this statement by:

(a) explaining how the focus of Empirical Modelling differs from that of conventional Computer Science; [5]

(b) discussing how a Computer Science curriculum based on Empirical Modelling might most appropriately address fundamental topics traditionally addressed by introducing mathematical abstractions, such as the theory of algorithms, semantics for software, logic in artificial intelligence, and database theory; [5]

(c) identifying respects in which current treatments of the topics listed in (b) have been recognised as limited or problematic. [5]

Credit will be given for references to papers such as those by Brooks, Harel, Cantwell-Smith, Ridley, etc made available in the module and your own wider reading, as well as to Empirical Modelling publications and models.
