

# Introducing Propositional Logic and Queueing Theory with the InfoTraffic Interactive Learning Environments

Ruedi Arnold  
Institute for Pervasive Computing  
ETH Zurich  
8092 Zurich, Switzerland  
rarnold@inf.ethz.ch

## ABSTRACT

InfoTraffic [2] is a collection of learning environments for teaching fundamental concepts of computer science and mathematics. So far, the two programs LogicTraffic, targeted at propositional logic, and QueueTraffic, targeted at queueing theory have been released<sup>1</sup>. Both are freely available and can be downloaded (along with teaching materials) from [1]. This demonstration abstract gives a very brief introduction to these two programs and their use in class.

## Categories and Subject Descriptors

K.3.1 [Computers and Education]: Computer Uses in Education—*Computer-assisted instruction*; G.4 [Mathematical Software]: [User interfaces]

## General Terms

Human Factors, Design, Experimentation, Theory

## Keywords

learning environment, propositional logic, queueing theory, fundamental topics, abstract concepts

## 1. INFOTRAFFIC

Do you think of propositional logic when you see traffic lights at intersections? Or do you reason about what the throughput of a street might be while being caught up in a traffic jam? Most people do not, we presume. But as InfoTraffic shows, traffic and its control can serve as an excellent example to illustrate some fundamental, abstract concepts of computer science. This way, learners can not only connect new topics to prior knowledge, but also be less afraid of abstract topics.

The InfoTraffic learning environments are based on four didactical concepts [2]: teaching fundamental topics; introducing abstract topics with an example instead of rules or a theory; using different representations (symbolic, iconic, and virtual-enactive); and allowing a high level of interactivity. For references and further elaboration see [2].

<sup>1</sup>A subsequent environment DynaTraffic, focusing on the concepts of dynamic systems and modeling, is currently under development.

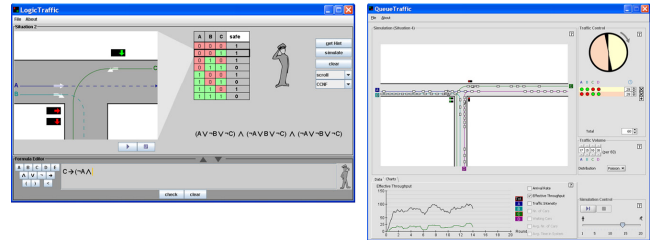


Figure 1: The learning environments LogicTraffic (left) and QueueTraffic (right).

## 1.1 LogicTraffic and Safe Intersections

LogicTraffic offers an introduction to propositional logic (i.e., concepts such as variables, truth values, logical operators, and normal forms) using the example of traffic lights control at an intersection. The main idea is to find a formula in propositional logic that makes a given intersection “safe”, i.e., which prevents collisions through appropriate signaling on the corresponding traffic lights. Lanes correspond to variables, and *true* and *false* indicates a green and red light, respectively; so “safe” formulas avoid any two crossing lanes to simultaneously have their traffic lights on green.

## 1.2 QueueTraffic and Traffic Jams

QueueTraffic gently introduces queueing theory (i.e., concepts such as throughput, average waiting time, and poisson distribution) by letting students simulate and analyze traffic flow at an intersection. Relevant system parameters can easily be changed and their impact can directly be analyzed through simulation and statistics. The main idea is that students gain an intuitive understanding of basic queueing theory through experimentation with a range of different intersections, by changing parameters like the arrival rate of cars and the timing of the individual traffic lights, and observing the resulting system behavior.

## 2. REFERENCES

- [1] Learning environment InfoTraffic, online along with teaching material freely available.  
<http://swisseduc.ch/compscience/infottraffic>, 2007.
- [2] R. Arnold, M. Langheinrich, and W. Hartmann. InfoTraffic – Teaching Important Concepts of Computer Science and Math through Real-World Examples. In *Proceedings of the ACM SIGCSE Technical Symposium 2007*, pages 105–109. ACM Press, New York, 2007.