Students learn by doing. This paper describes the teaching of logic, simple computer architecture and its associated microcode system through a series of hardware logic trainers.

Keywords: logic, minitrainer, educational kits

CR Categories: B.1.1 – Microprogrammed logic arrays, B.1.5 – Instruction set interpretation.

1. INTRODUCTION
Teaching the operation of computer hardware has been a feature of courses offered in the Basser Department of Computer Science since its inception.

The design of special purpose equipment for teaching purposes was begun in 1971 by Arthur Sale and Ron Cullen. On the electronic side this featured the use of the then new TTL logic. On the mechanical side they adopted a very flexible system of modular circuit boards on 19inch rack modules. The flexible reconfiguration that this makes possible has been enormously helpful as the Logic Laboratory teaching has evolved.

In 1979 I introduced additional equipment, based on 2901 bit slice chips, to make possible the construction of simple 8 bit CPUs. (Bromley and Nicholson, 1986).

Originally these Computer Architecture labs used a manually loaded ROM and a RAM simulated by the then new Motorola 6800 D2 development kits. For both it was necessary for students to code and load the memory in hex.

More recently the ROM and RAM have been simulated by a PC and programmed by a simple retargetable assembler system, lass, implemented first as an awk script. Students are thus able to specify and modify both the computer architecture and its microcode description.

Throughout, the principal target of the Computer Architecture Laboratories has been the design and construction of a conventional Von Neumann single accumulator, three index register machine with a memory of 256 8-bits words. The microprogram is 256 32-bit words, although only about 32 words are typically used. Lass supports programming of both the microprogram memory and the target machine memory.

More recently students have implemented RISC architecture machines using the 32-bit memory for program and the 8-bit memory for data. Of course nothing would have prevented us from doing this in 1979 save only that the RISC concept had not then been invented.

A TRIBUTE TO JOHN BENNETT