1. **SimpleScalar** is a set of tools that allows the simulation of PISA (Portable ISA) architecture, similar to the MIPS IV, with several degrees of detail / speed. The tool set includes, in addition to the simulators, compilers, assemblers and linkers for the simulated architecture.

   1.1. Compile the **SimpleScalar** tools for your system using the simplesim-3.0 package available at moodle.

   1.2. Run the **SimpleScalar** binary benchmarks **dhry.ss**, and **prime.ss** (simplified versions of the "dhrystone" and "prime" benchmarks used in the first lesson) using the simulator **sim-profile** with the option **–iclass**. Take note of the number of instructions executed as well as of the distribution by classes of instructions.

   1.3. Repeat the previous step for **dhri_opt.ss** and **prime_opt.ss** (optimized versions of "dhrystone" and "prime" benchmarks).

   1.4. Determine the speedup obtained through optimization (assuming the CPI is 1).

2. Use the **SimpleScalar** simulator **sim-bpred** to test several architectures of branch predictors.

   2.1. Run the **sim-bpred** program and check the meaning of its command line parameters. Show which parameters allow the simulation of the following predictors:

   2.1.1. Taken predictor. ./run-cc1.sh -bpred taken

   2.1.2. Bimodal predictor with 512 entries. ./run-cc1.sh -bpred bimod -bpred:bimod 512

   2.1.3. Global history predictor with a Branch History Register (BHR) of 10 bits.
   ./run-cc1.sh -bpred 2lev -bpred:2lev 1 1024 10 0

   2.1.4. Gshare predictor with 8 bits history. ./run-cc1.sh -bpred 2lev -bpred:2lev 1 256 8 1

   2.1.5. Two levels predictor with 512 entries of 10 bits in the first level and 1024 entries in the second level. ./run-cc1.sh -bpred 2lev -bpred:2lev 512 1024 10 1

   2.1.6. Hybrid predictor that combines the previous predictor with a bimodal predictor of 2048 entries, using a 256 input table to select the predictor to be used.
   ./run-cc1.sh -bpred comb -bpred:bimod 2048 -bpred:2lev 512 1024 10 1 -bpred:comp 256

   2.2. The script **run-cc1.sh**, available in package **run-cc1.tgz**, accepts the same parameters of the **sim-bpred** simulator. This script runs the simulator **sim-bred** using one benchmark of the SPEC95 package.

   2.2.1. Check the prediction success rates for the taken and not taken static predictors.

   2.2.2. Analyze the evolution of the prediction success rate of a bimodal predictor varying the number of entries between 8 and 32K.

2.2.3. Analyze the differences between the rates of correct prediction for "gselect" and "gshare" predictors, varying the number of entries of the 2nd level table between 8 and 32K (3 to 15 bits).

2.2.4. Try to find the best branch predictor configuration, between those that are possible to simulate with the **sim-bpred**, fulfilling a maximum storage bit budget of 4Kbits +10%.