Technical University of Cluj-Napoca
Faculty of Automation and Computer Science

Parallel Programming

Laboratory 2

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Problem 1: Perfect numbers

```
divisible(X, Y) :-
    0 is X mod Y, !.
divisible(X, Y) :-
    Y =< sqrt(X),
    divisible(X, Y+1).

isPrime(2) :-
    true, !.
isPrime(X) :-
    X < 2, !,
    false.
isPrime(X) :-
    not(divisible(X, 2)).

getPrimesFromRange(B, B, R, R) :- !.
getPrimesFromRange(A, B, ACC, R) :-
    A =< B,
    isPrime(A), !,
    AA is A + 1,
    getPrimesFromRange(AA, B, [A|ACC], R).
getPrimesFromRange(A, B, ACC, R) :-
    A =< B,
    AA is A + 1,
    getPrimesFromRange(AA, B, ACC, R).

getPrimesFromRange(FROM, TO, R):-
    getPrimesFromRange(FROM, TO, [], R).

log2(N, R) :-
    R is log(N) / log(2).

getPerfectNumbers([], _, R, R):- !.
getPerfectNumbers([H|T], L, ACC, R):-
    MP is 2**H - 1,
    isPrime(MP),
    PN is MP * (MP + 1) / 2,
    PN =< L, !,
    getPerfectNumbers(T, L, [PN|ACC], R).
```

```
getPerfectNumbers([_|T], L, ACC, R):-
    getPerfectNumbers(T, L, ACC, R).

getPerfectNumbers(N, R):-
    log2(N, LN),
    M is round((LN + 1) / 2) + 1,
    getPrimesFromRange(1, M, P),
    getPerfectNumbers(P, N, [], R).

% CALL: get_time(T0), getPerfectNumbers(1000000000000000000, R), get_time(T1), T
is T1 - T0.
```

```
PROBLEMS   OUTPUT   TERMINAL   DEBUG CONSOLE

1 ?- consult('perfect_numbers.pl')
.
true.

2 ?- get_time(T0), getPerfectNumbers(1000000000000000000, R), get_time(T1), T is T1 - T0.
T0 = 1645733796.843049,
R = [6, 28, 496, 8128, 33550336, 8589869056, 137438691328],
T1 = 1645733796.963014,
T = 0.1199648380279541.

3 ?-
```

Problem 2: Entropy

```
cntOneBits(0, L, L) :- !.
cntOneBits(R, IL, L) :-
    DR is R // 2,
    RR is R mod 2,
    % write(RR), nl,
    RR = 1, !,
    IIL is IL + 1,
    cntOneBits(DR, IIL, L).
cntOneBits(R, IL, L) :-
    DR is R // 2,
    cntOneBits(DR, IL, L).

countOneBitsInValue(V, R) :-
    cntOneBits(V, 0, R).

computeOnesAndZerosFromArray(N, N, O, O, Z) :-
```

```
    Z is (N * 8) - O.
computeOnesAndZerosFromArray(N, I, OI, O, Z) :-
    NI is I + 1,
    random(0, 256, R),
    countOneBitsInValue(R, V),
    NOI is OI + V,
    computeOnesAndZerosFromArray(N, NI, NOI, O, Z).

log2(N, R) :-
    R is log(N) / log(2).

computeEntropy(N, O, Z, R) :-
    T is N * 8,
    OPerT is O / T,
    ZPerT is Z / T,
    log2(OPerT, LOPerT),
    log2(ZPerT, LZPerT),
    R is -OPerT * LOPerT - ZPerT * LZPerT.

computeEntropy(N, R) :-
    computeOnesAndZerosFromArray(N, 0, 0, O, Z),
    computeEntropy(N, O, Z, R).
```

```
PROBLEMS  OUTPUT  TERMINAL  DEBUG CONSOLE

For built-in help, use ?- help(Topic). or ?- apropos(Word).

1 ?- consult('lab2.pl').
true.

2 ?- get_time(T0), computeEntropy(100000, R), get_time(T1), Time is T1 - T0.
T0 = 1645734251.111899,
R = 0.9999987192065225,
T1 = 1645734251.771996,
Time = 0.6600971221923828 .

3 ?-
```