Algorithm Engineering
16 December 2020 – time 45 minutes

Question #1 [ranks 4+5]. Construct a Treap by inserting in the given order the following sequence of pairs: <10,1>, <5,3>, <20,3>, <15,4>, <30,6>, <12,6>, <17,10>, use a MIN-heap over the y-coordinate (i.e. the priority). The x-coordinate is the key.

a. Show the final Treap
b. Show the rotations induced by the insertion of the pair <13,2>, and the final Treap so obtained.

Question #2 [ranks 5]. Simulate the Reservoir algorithm by drawing m=2 items from a sequence of length n=6: [a, b, c, d, e, f], and assuming that at every step the random integers extracted by the algorithm are [3, 1, 4, 2].

Question #3 [ranks 3+3]. Given the symbols {a,b,c,d,e,f,g} occurring in a text with frequencies f(a) = f(d) = f(e) = f(f) = 0.1, f(b) = 0.28, f(c) = 0.11, f(g)= 0.21.

- Compute FC[] and SYMB[] tables of the Canonical Huffman code
- Decode the first 2 symbols of the compressed sequence: 11001….

Question #4 [ranks 5]. Given: p(a) = 1/8, p(b) = ¼, p(c) = 5/8. Specify which is the length in bits of the text T = aabbaa, if it is compressed via Arithmetic coding. *(Hint: work with negative powers of two.)*

Question #5 [rank 5]. Given the binary strings S={aaaaa, aacaaaa, aacaaba, bb}. Build the Patricia Tree for S and show how to search for the lexicographic position of the string P=aacbba among the strings of the set S.