HNCO
Visualization of Walsh transforms
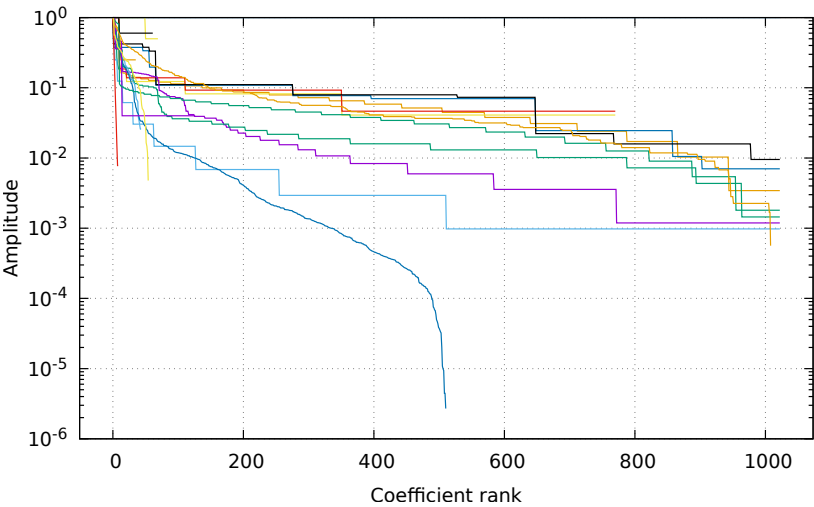# of various functions defined on bit vectors

May 20, 2020

Abstract

This document proposes a visualization of Walsh (or Fourier) transforms of various functions defined on bit vectors (hypercube) of size $n = 10$. For each function, two graphics are displayed. In the first one, coefficients of the Walsh transform are sorted in decreasing order of amplitude and normalized relatively to the largest amplitude. The second graphics displays the energy (sum of squares of coefficients) as a function of the feature Hamming weight. This can be thought of as a power spectrum. The coefficient of the feature zero has been filtered out. Coefficients c such that $0 < |c/c_{\max}| < 10^{-10}$ have also been filtered out as they mostly result from accumulated errors in floating point arithmetic.
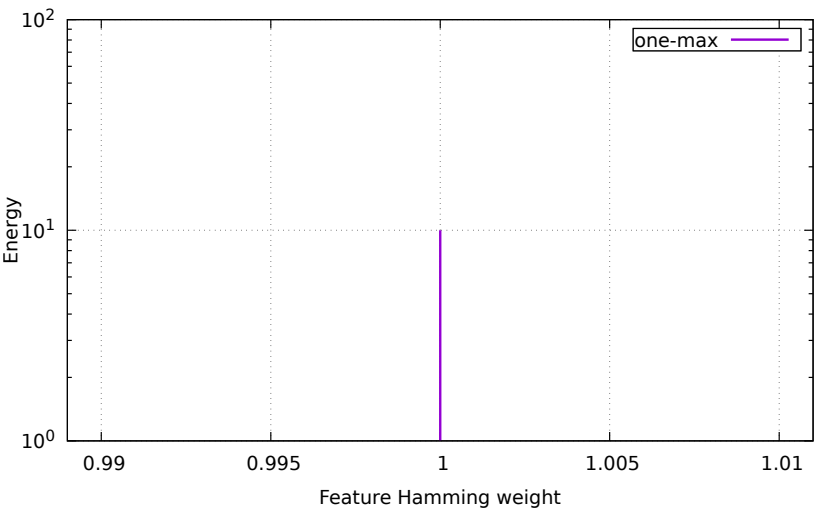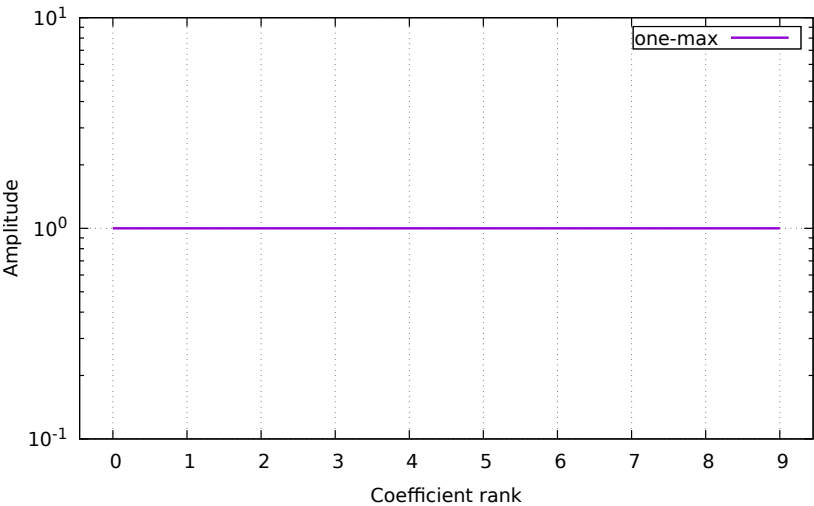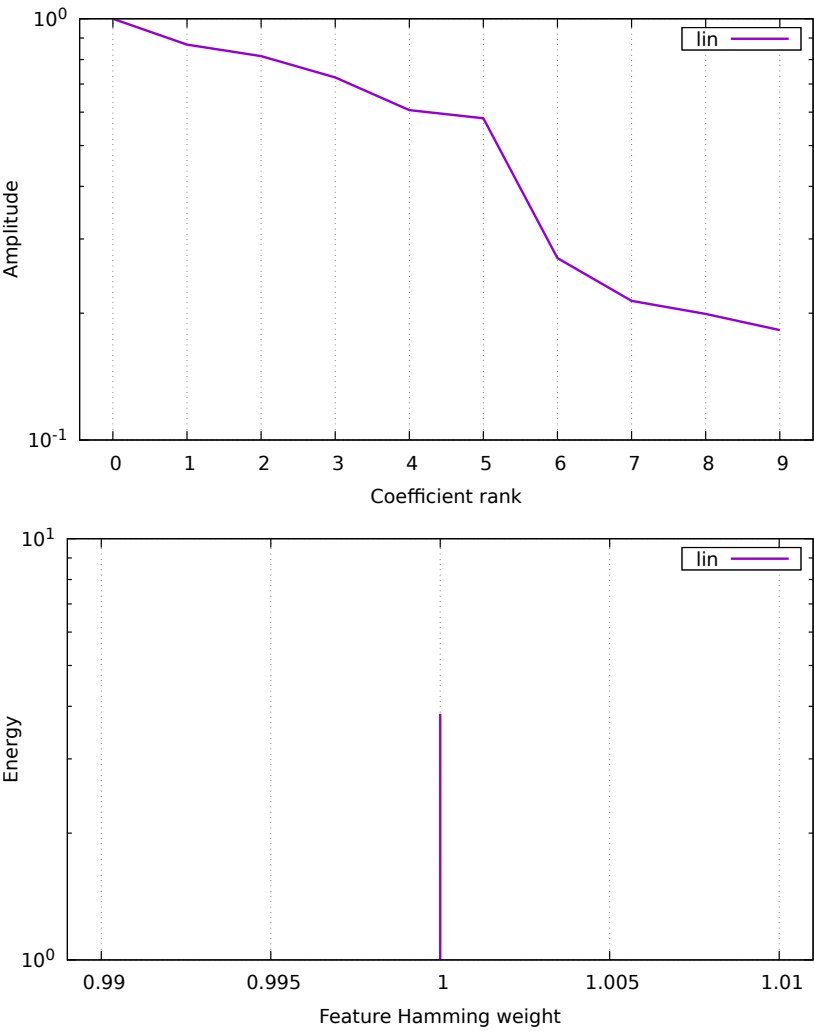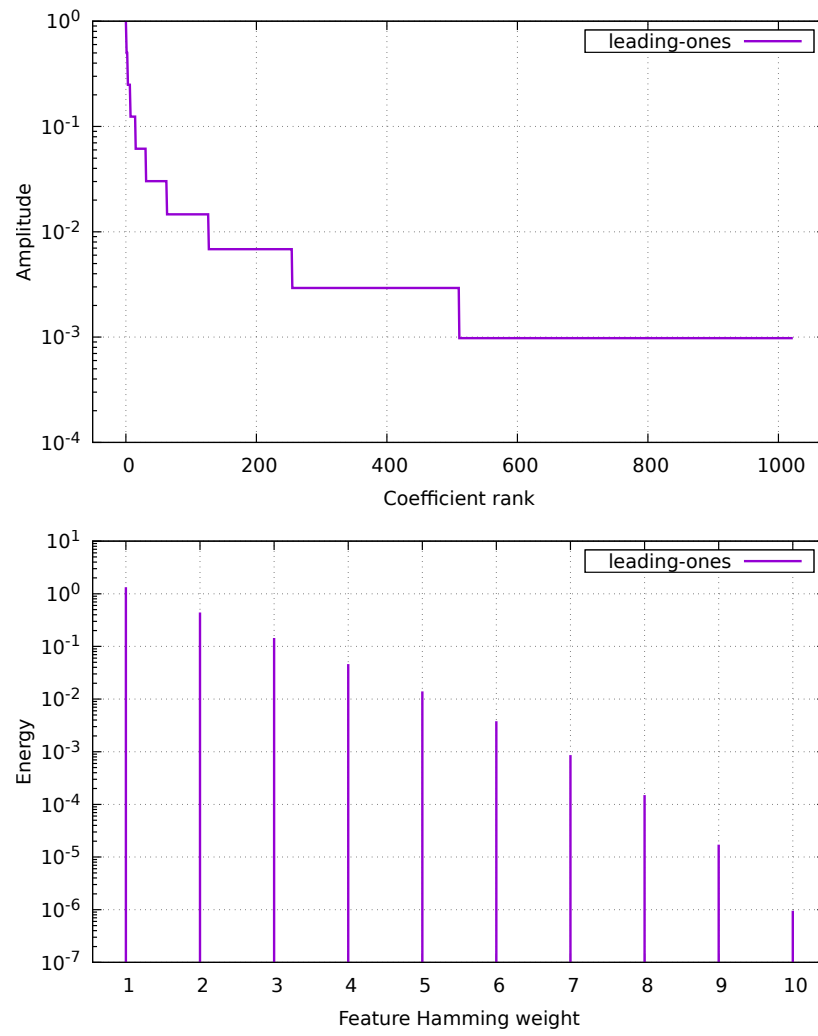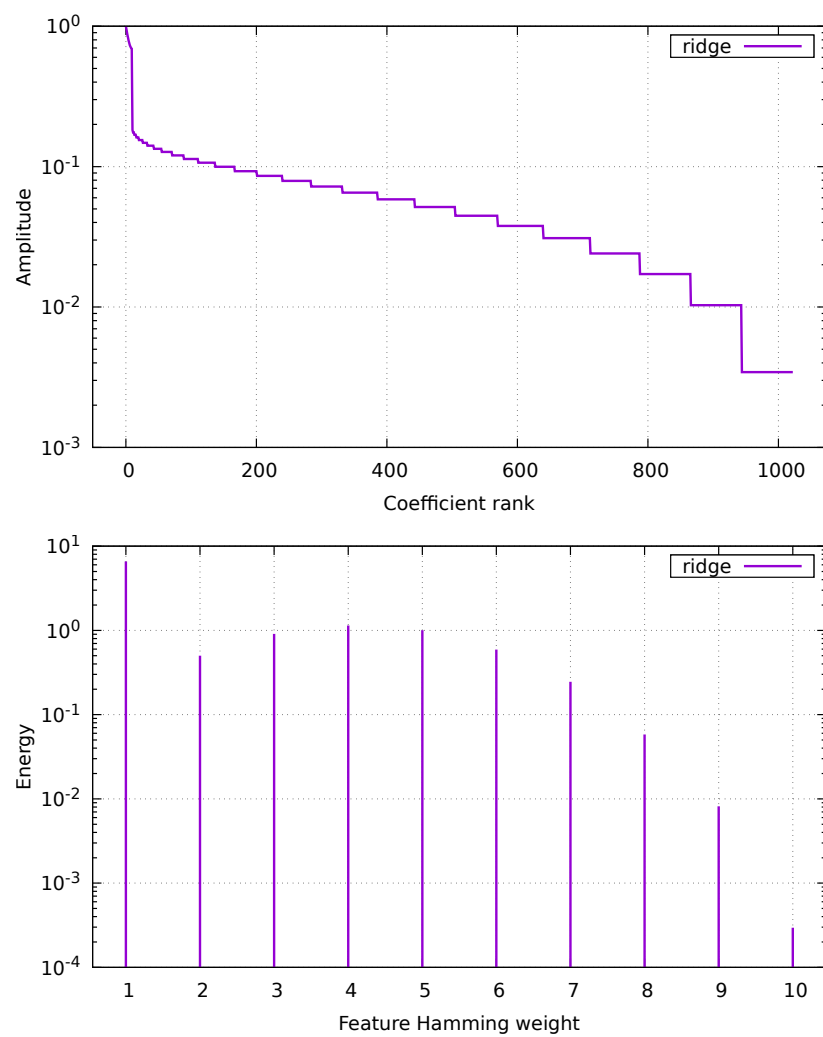
Contents

1   All functions

2   one-max

3 lin

4 leading-ones

5 ridge

6 jmp-2
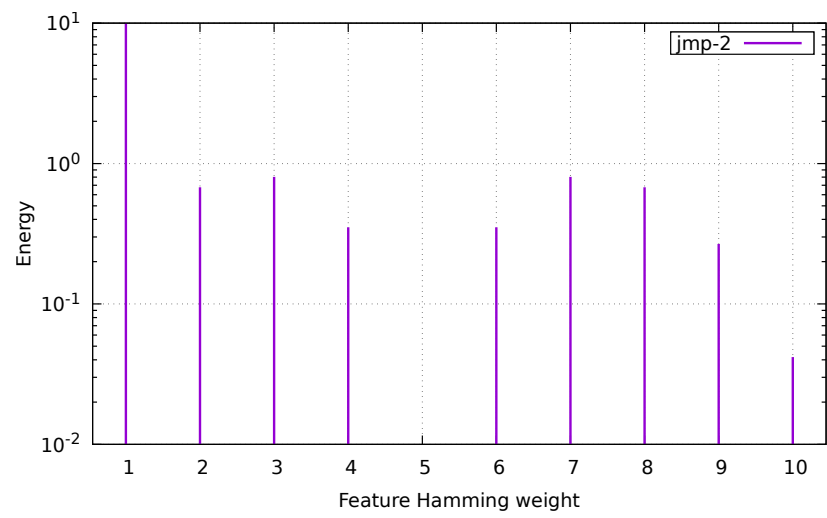
7 jmp-4
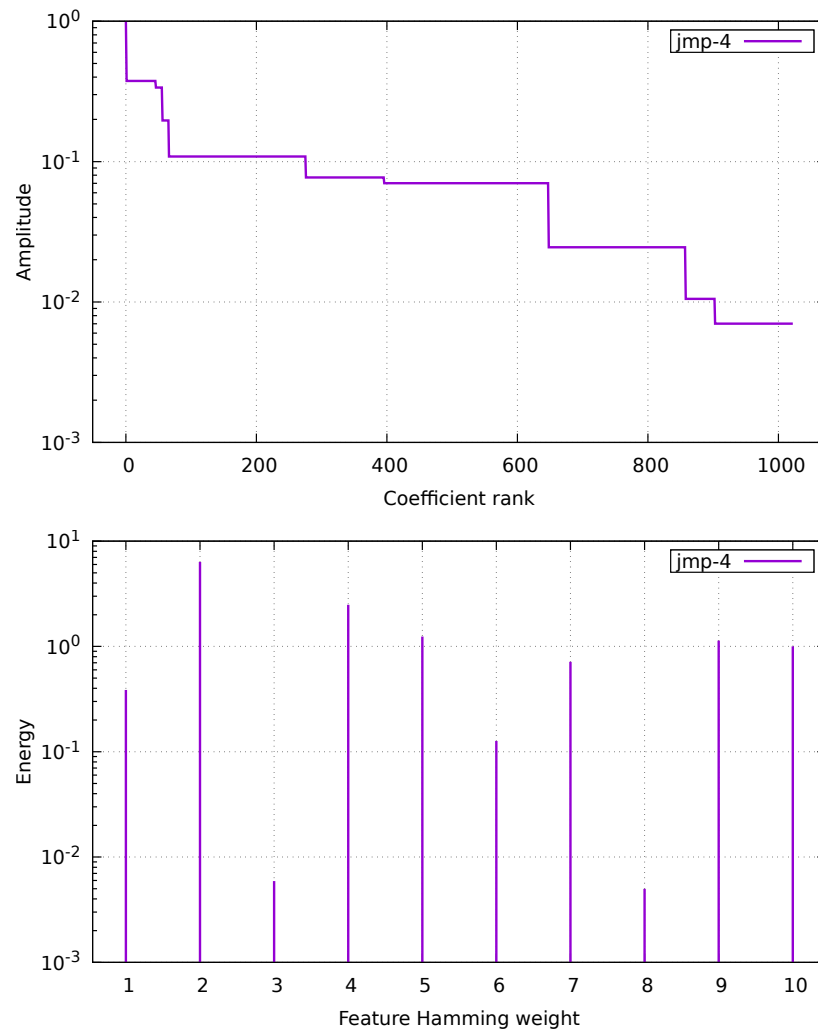
8 djmp-2

9   djmp-4

10 fp-2

11   fp-4

12   nk

13   max-sat

14   labs

15   ep

16   cancel

17 trap

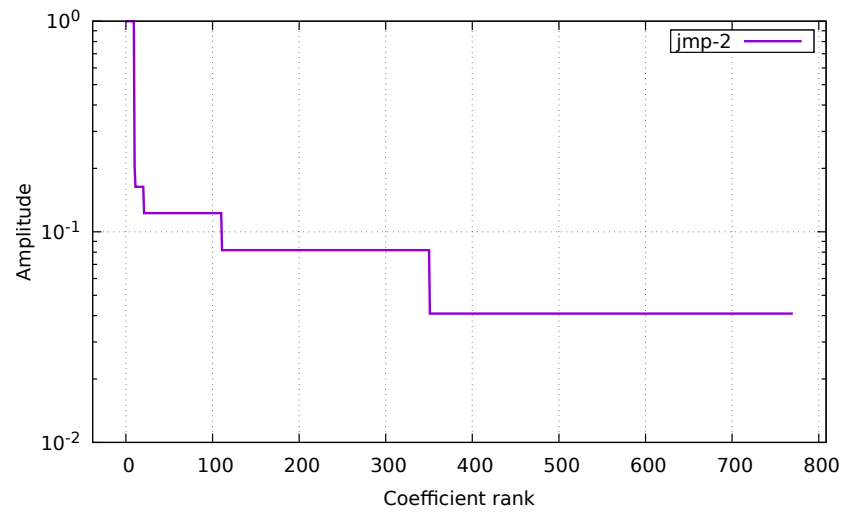# 18 hiff

19   plateau

20 needle

21 long-path

22 walsh2
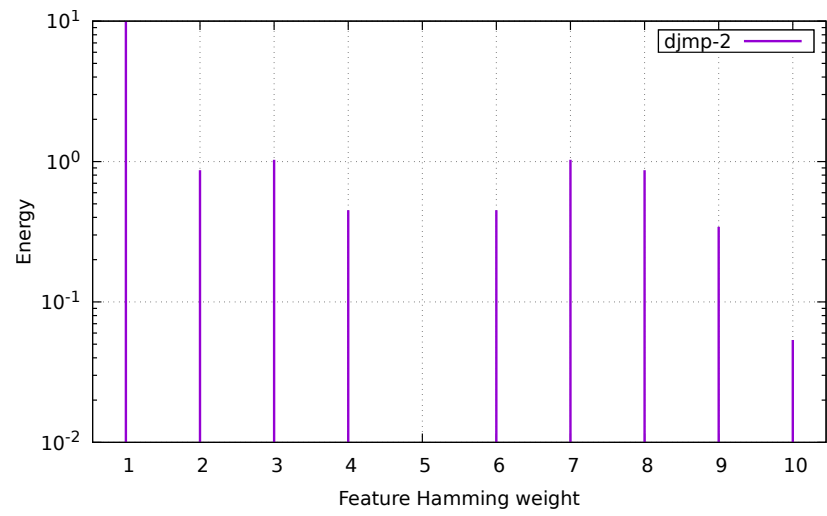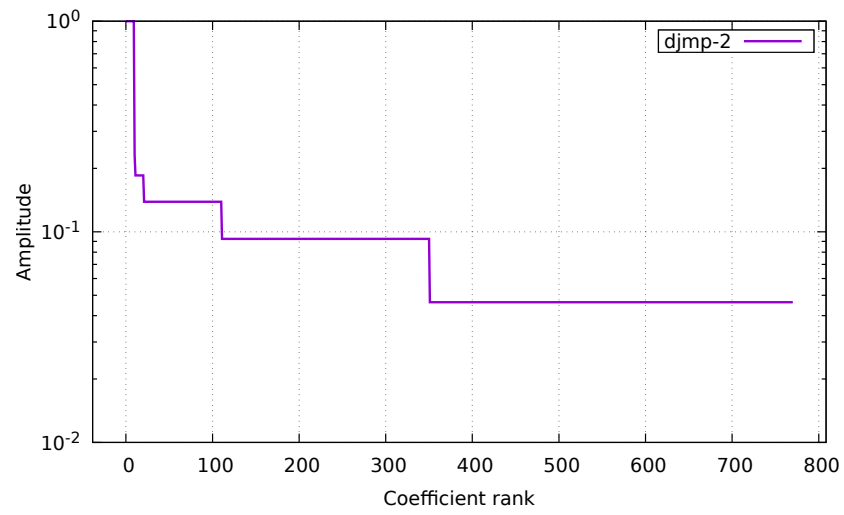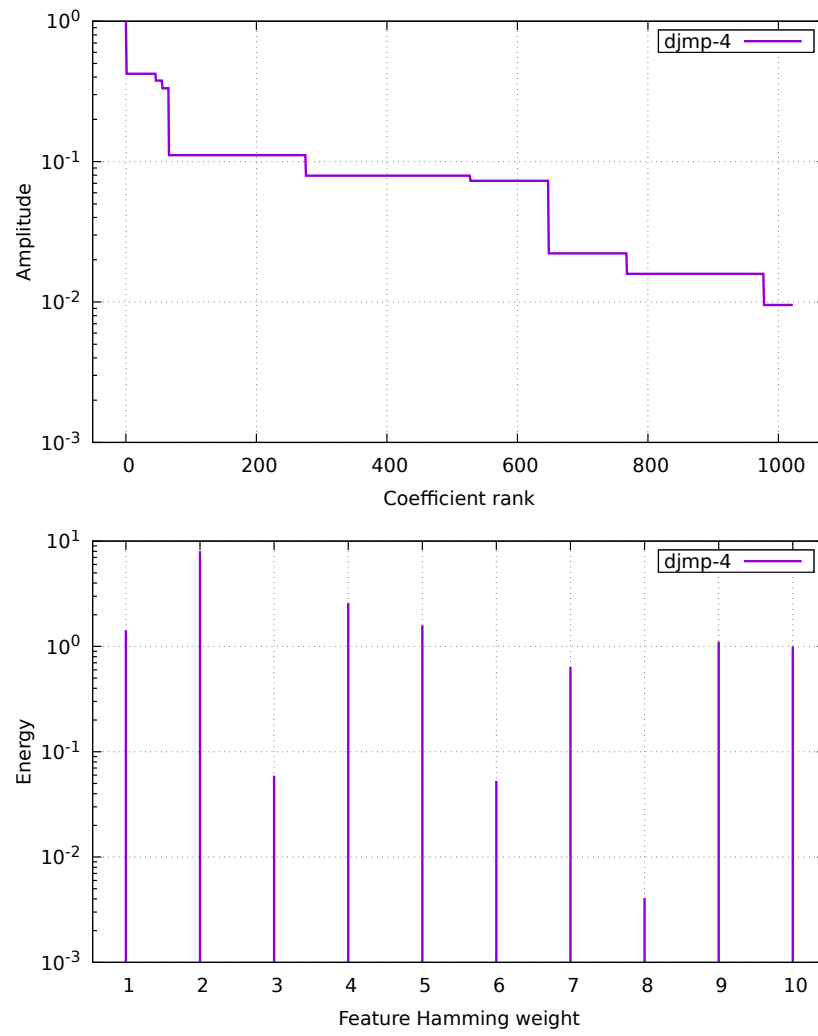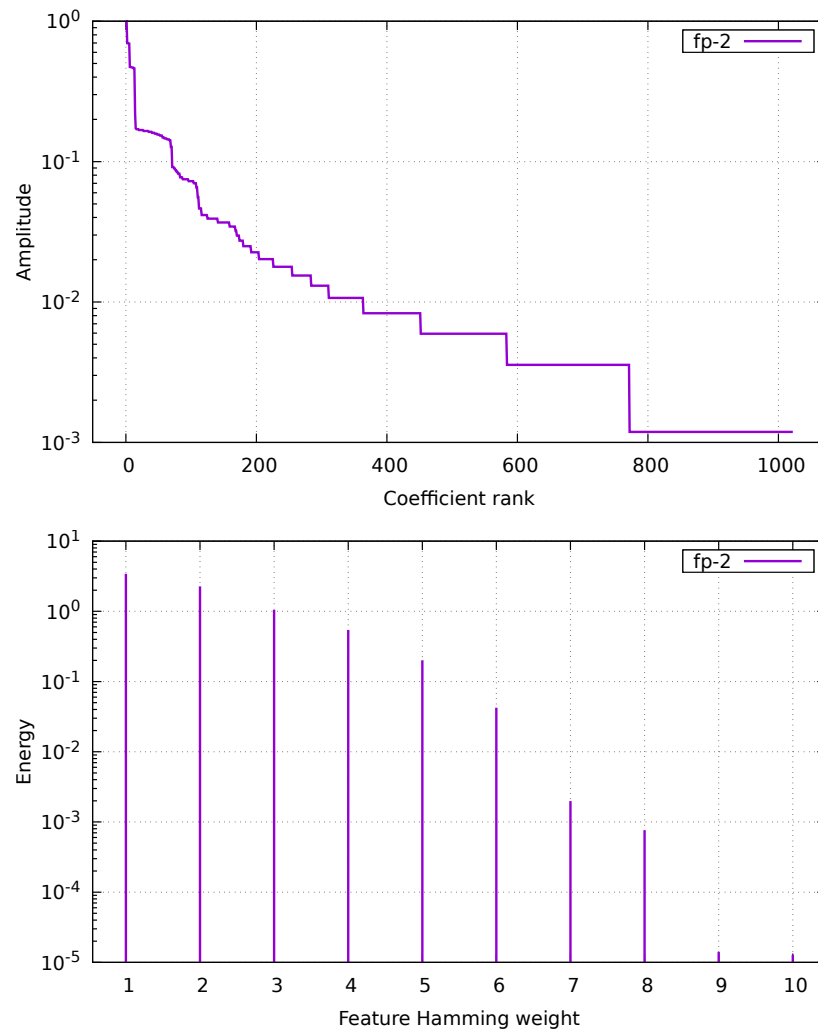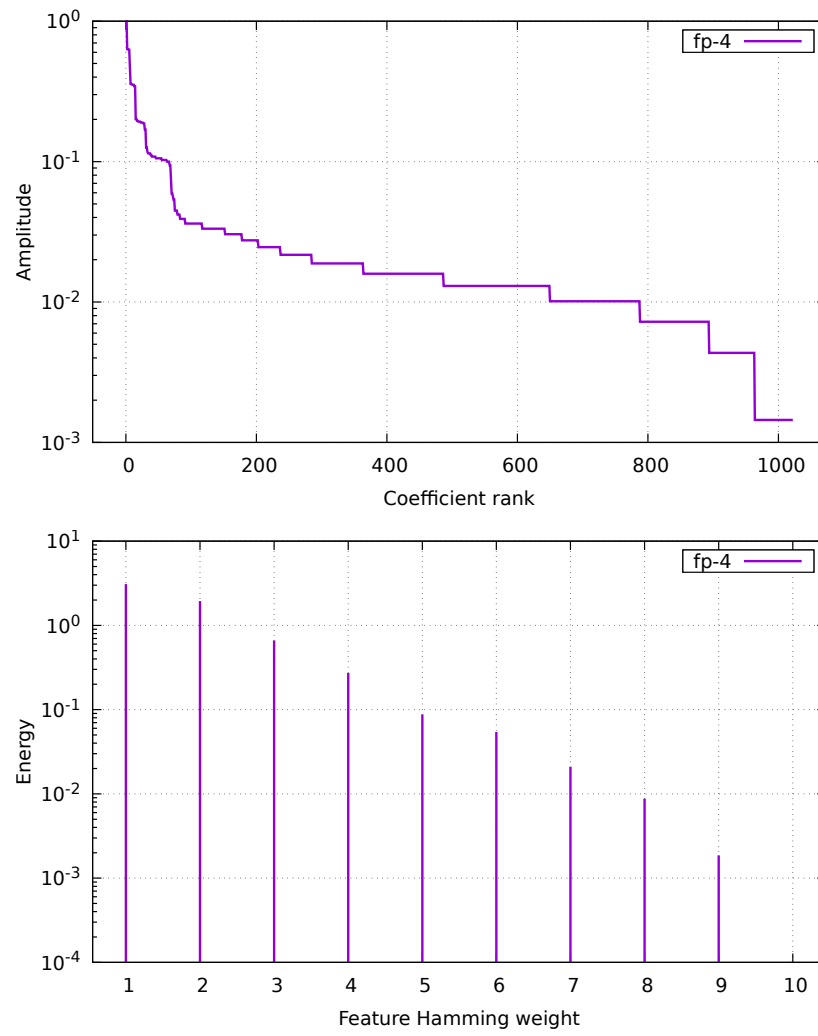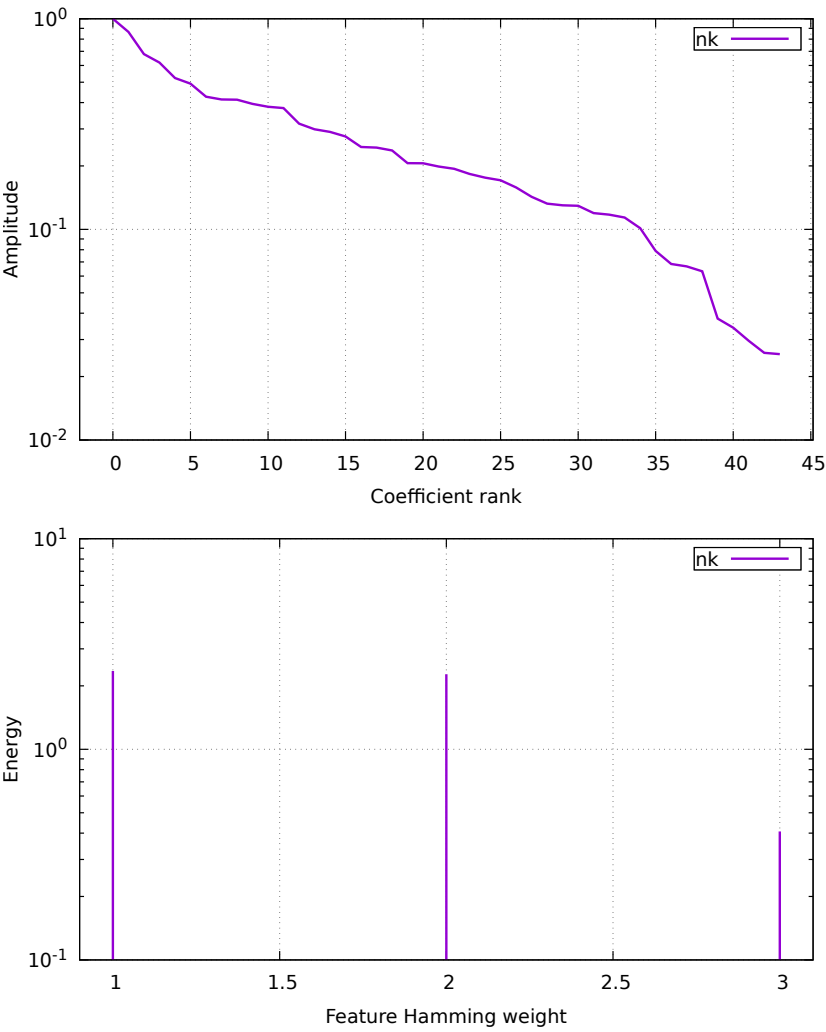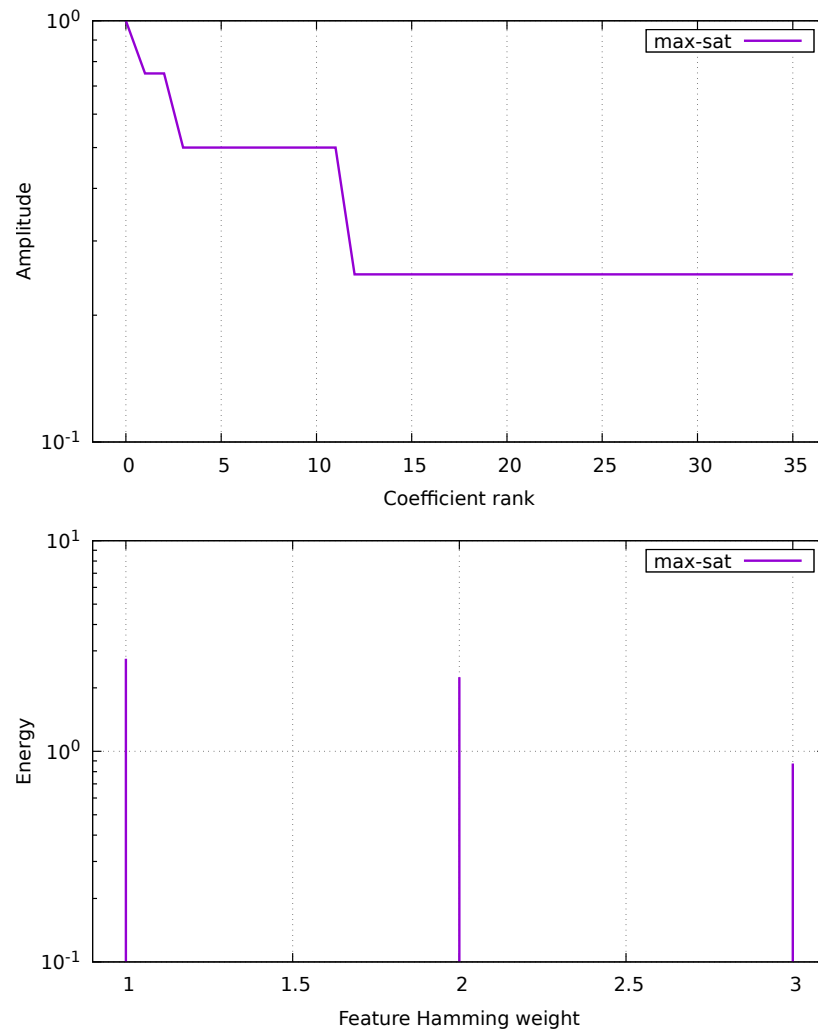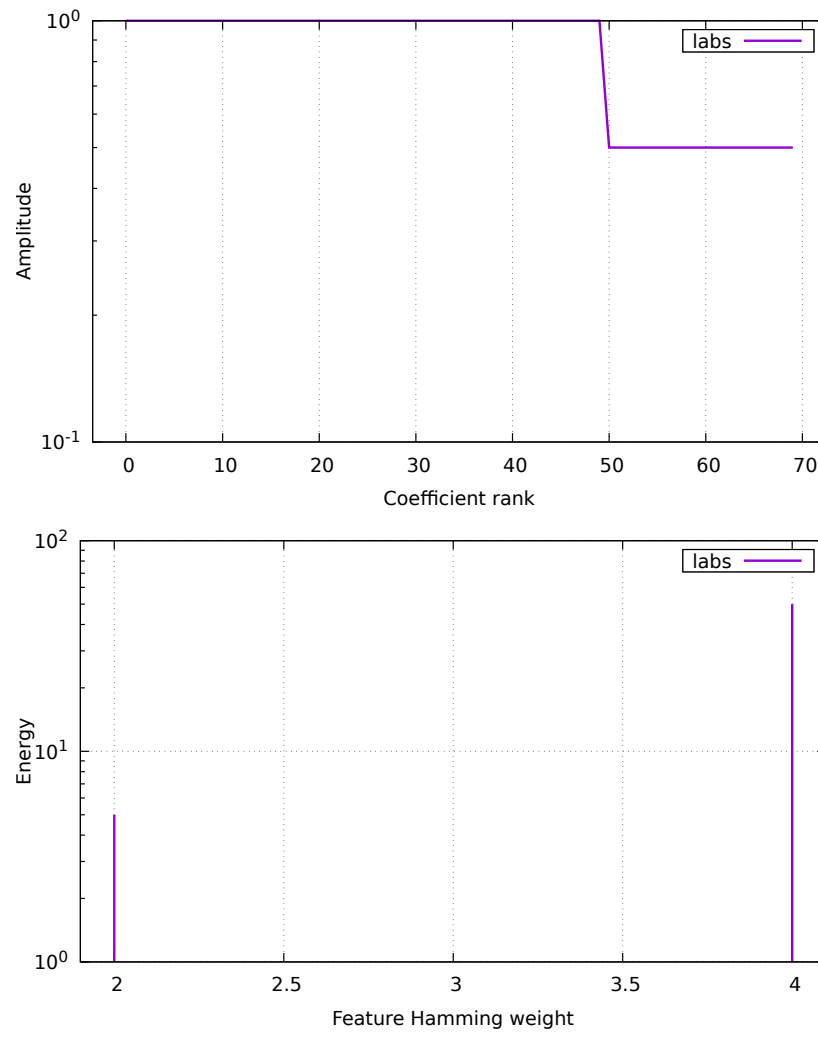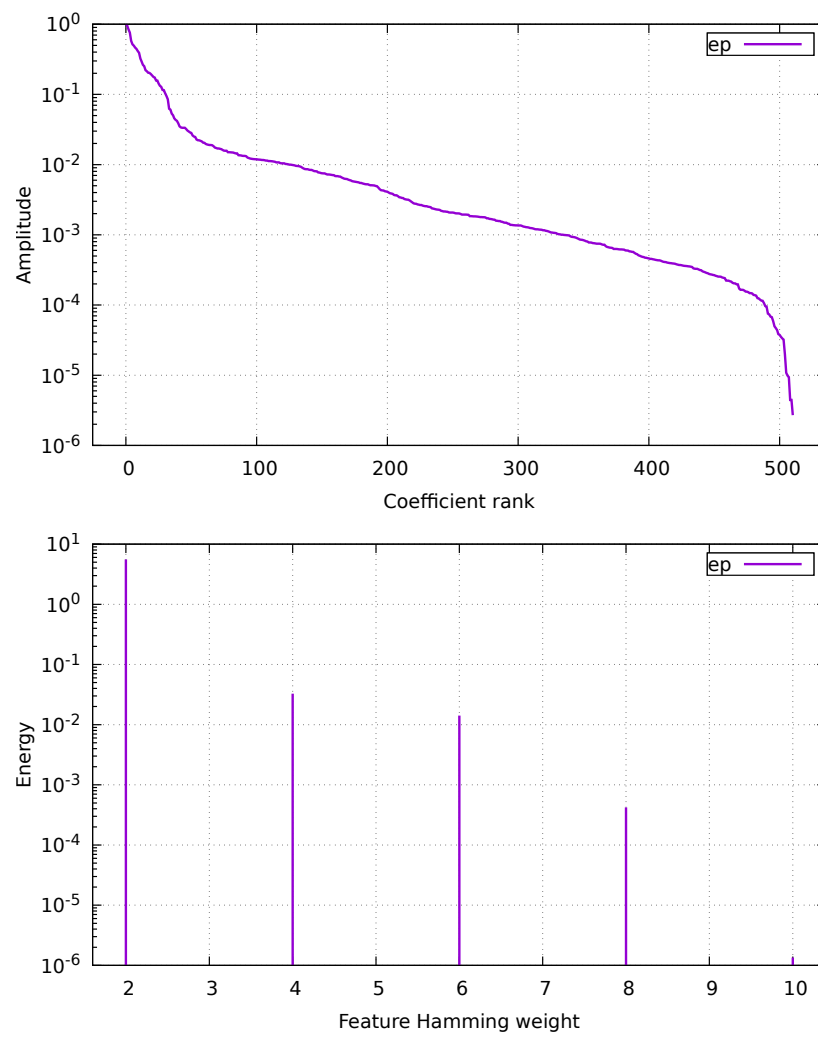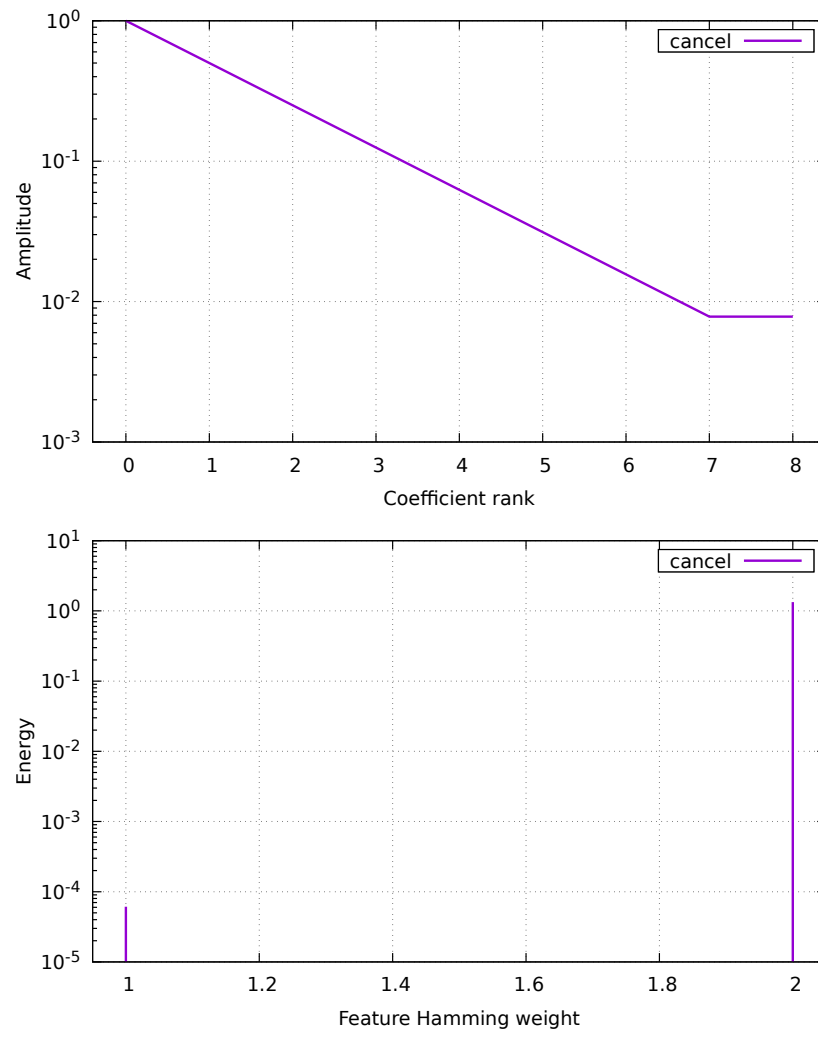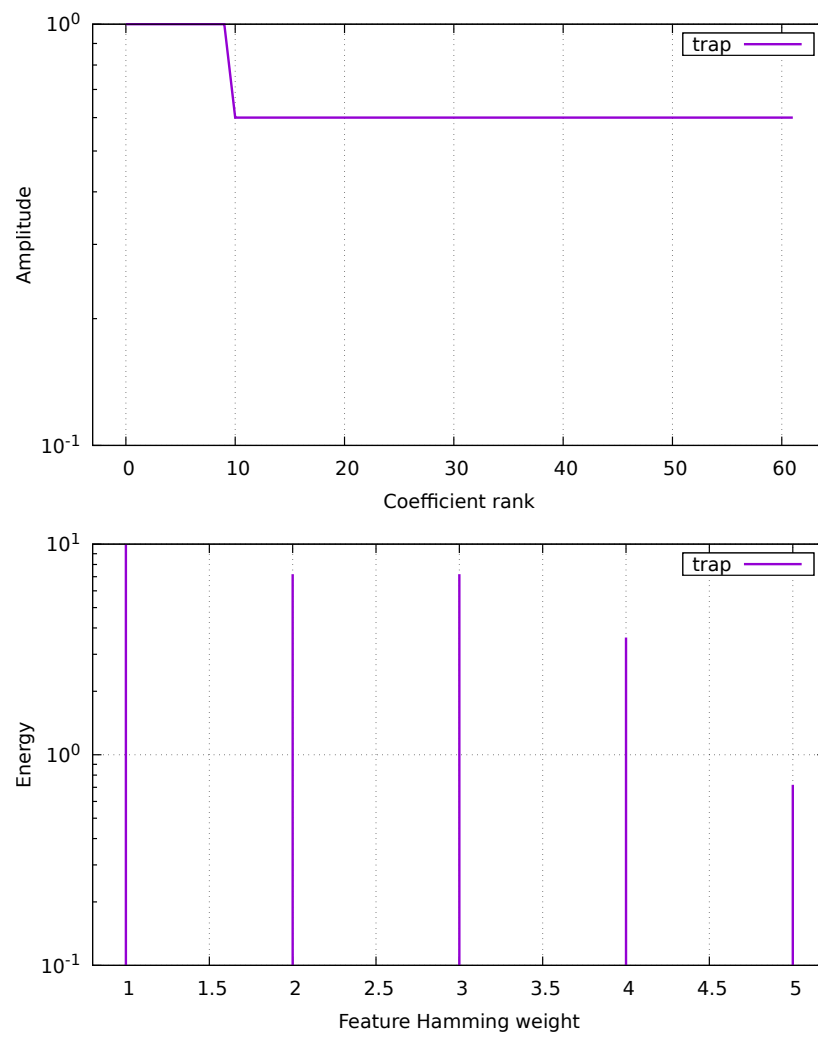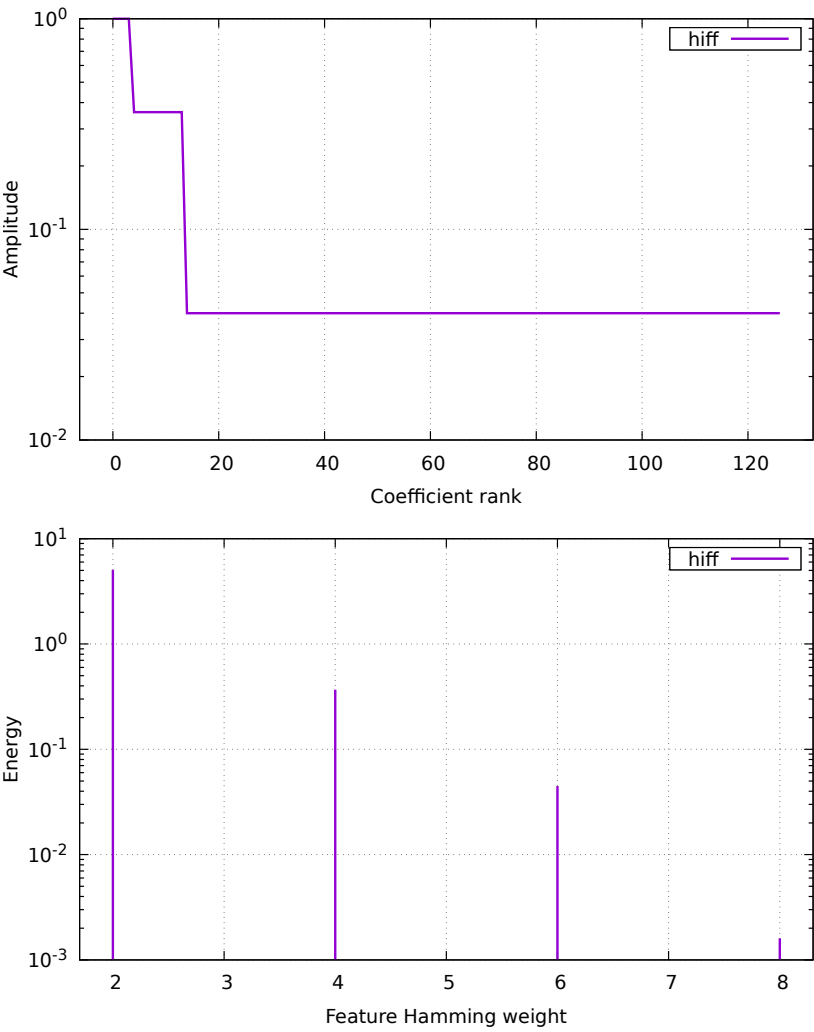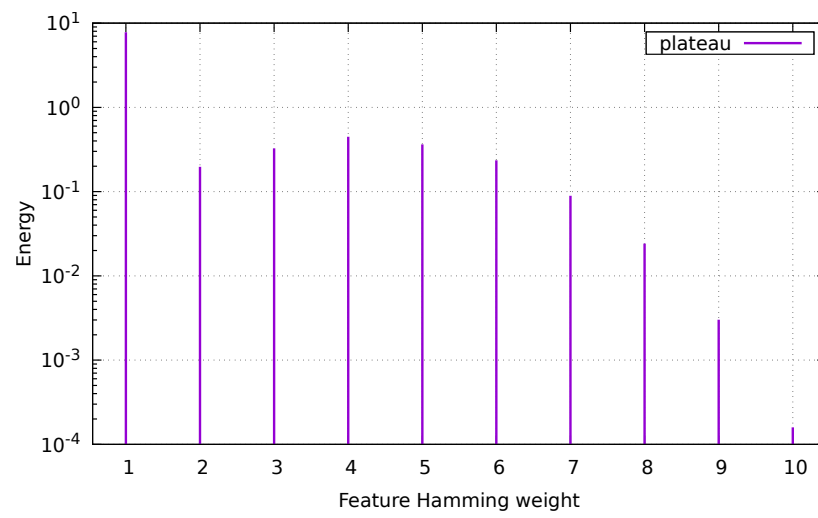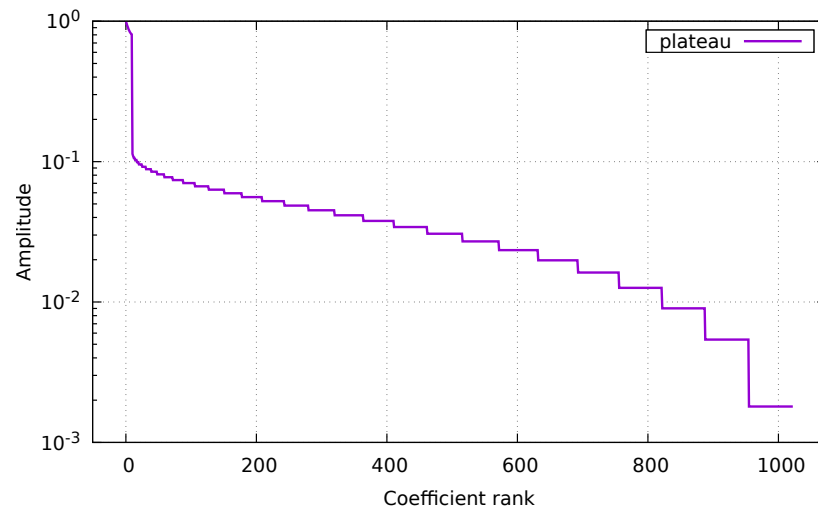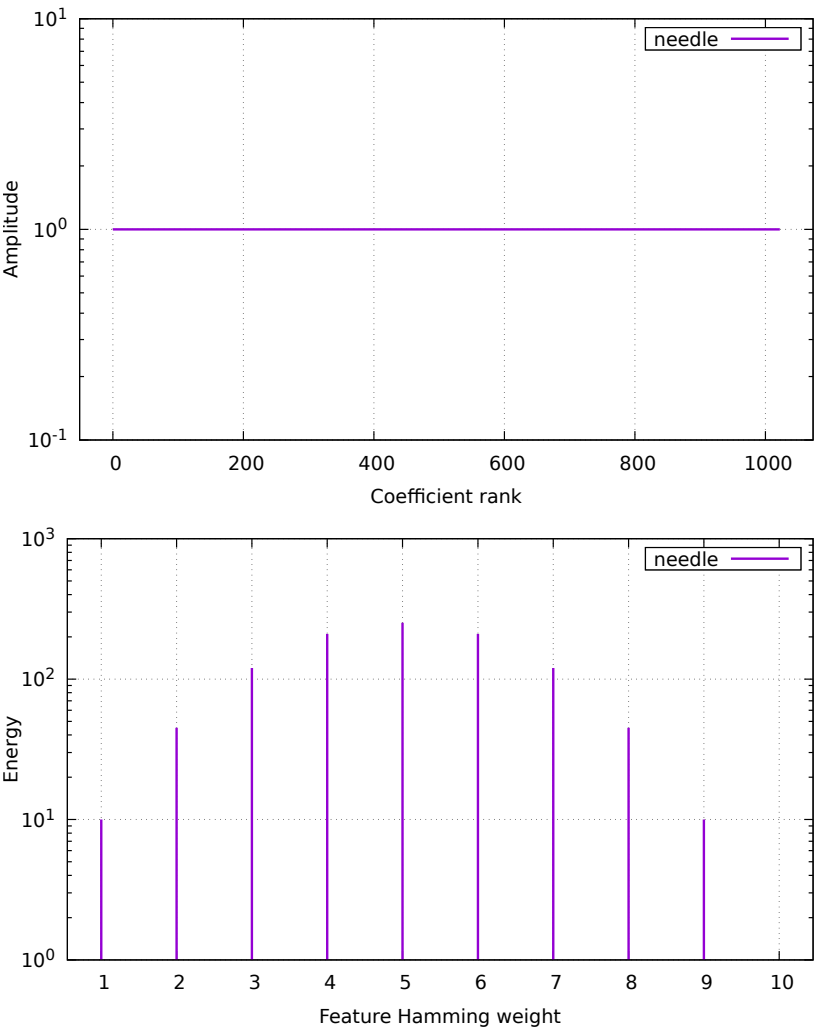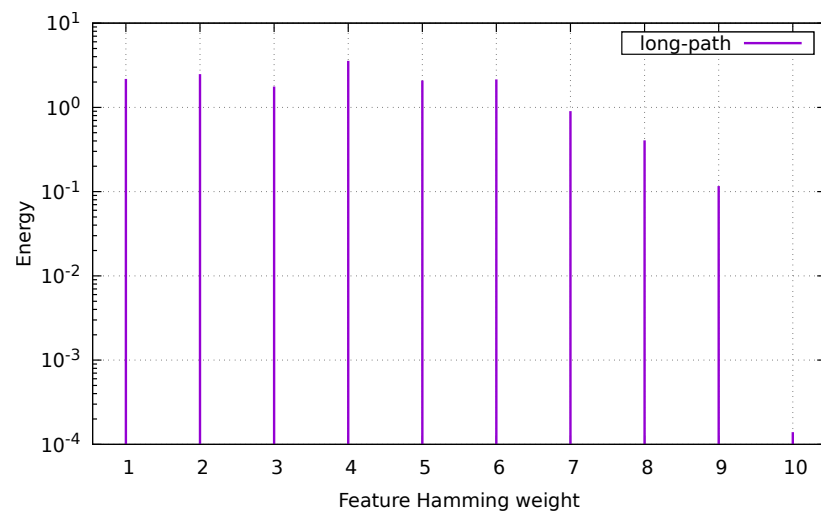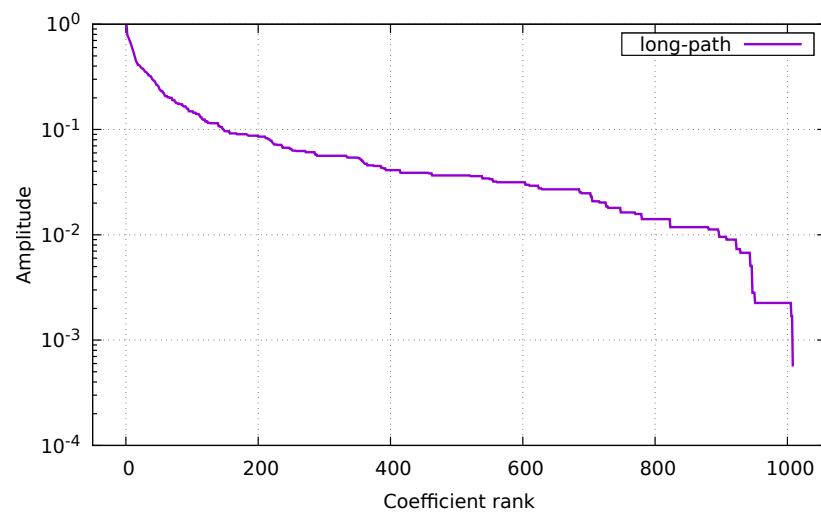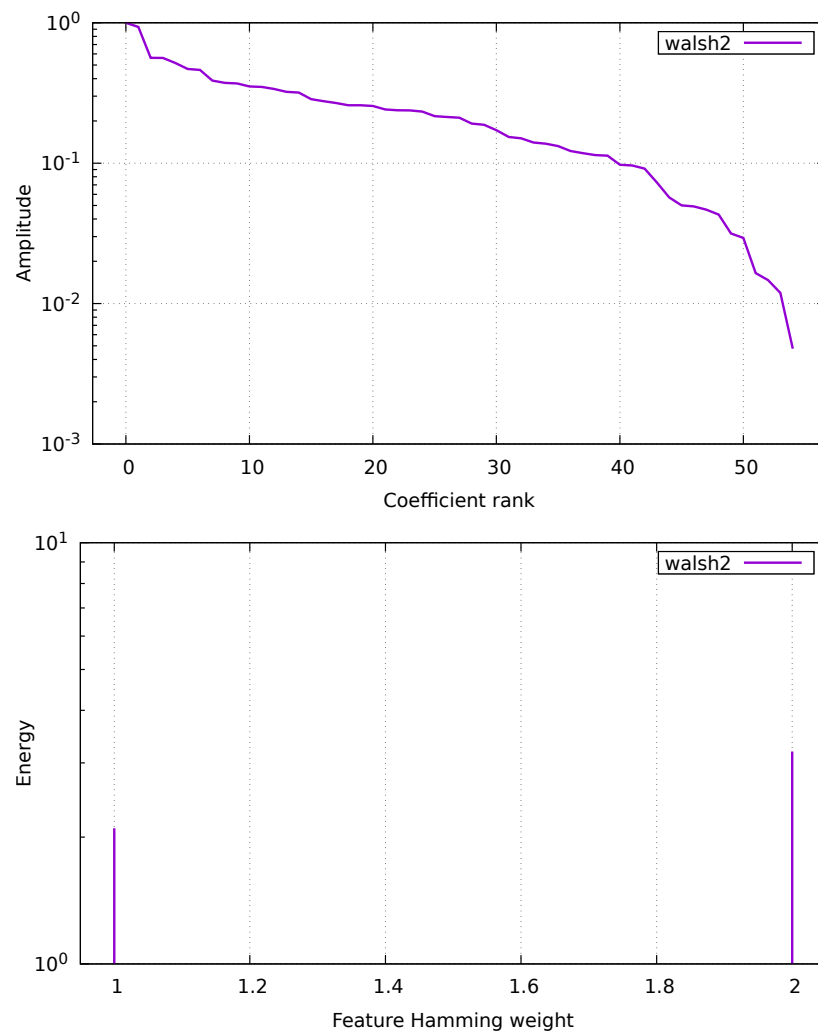
A Plan

```
{
    "exec": "hnco",
    "opt": "--fn-walsh-transform -b 0 -s 10",
    "parallel": true,
    "results": "results",
    "graphics": "graphics",
    "report": "report",
    "functions": [
        {
            "id": "one-max",
            "opt": "-F 0"
        },
        {
            "id": "lin",
            "opt": "-F 1 -p instances/lin.10"
        },
        {
            "id": "leading-ones",
            "opt": "-F 10"
        },
        {
            "id": "ridge",
            "opt": "-F 11"
        },
        {
```

```json
        "id": "jmp-2",
        "opt": "-F 30 -t 2"
    },
    {

        "id": "jmp-4",
        "opt": "-F 30 -t 4"
    },
    {

        "id": "djmp-2",
        "opt": "-F 31 -t 2"
    },
    {

        "id": "djmp-4",
        "opt": "-F 31 -t 4"
    },
    {

        "id": "fp-2",
        "opt": "-F 40 -t 2"
    },
    {

        "id": "fp-4",
        "opt": "-F 40 -t 4"
    },
    {

        "id": "nk",
        "opt": "-F 60 -p instances/nk.10.2"
    },
    {

        "id": "max-sat",
        "opt": "-F 70 -p instances/ms.10.3.10"
    },
    {

        "id": "labs",
        "opt": "-F 80"
    },
    {

        "id": "ep",
        "opt": "-F 90 -p instances/ep.10"
    },
    {

        "id": "cancel",
        "opt": "-F 100 -s 9"
    },
    {

        "id": "trap",
        "opt": "-F 110 --fn-num-traps 2"
    },
    {

        "id": "hiff",
        "opt": "-F 120 -s 8"
    },
    {

        "id": "plateau",
        "opt": "-F 130"
    },
    {

        "id": "needle",
        "opt": "-F 20"
    },
    {
        "id": "long-path",
        "opt": "-F 140"
    },
```

```
      {
          "id": "walsh2",
          "opt": "-F 162 -p instances/walsh2.10"
      }
    ]
}
```

B   Default parameters

```
# algorithm = 100
# bm_mc_reset_strategy = 1
# bm_num_gs_cycles = 1
# bm_num_gs_steps = 100
# bm_sampling = 1
# budget = 10000
# bv_size = 100
# description_path = description.txt
# ea_lambda = 100
# ea_mu = 10
# expression = x
# fn_name = noname
# fn_num_traps = 10
# fn_prefix_length = 2
# fn_threshold = 10
# function = 0
# ga_crossover_bias = 0.5
# ga_crossover_probability = 0.5
# ga_tournament_size = 10
# hea_bit_herding = 0
# hea_num_seq_updates = 100
# hea_reset_period = 0
# hea_sampling_method = 0
# hea_weight = 1
# learning_rate = 0.001
# map = 0
# map_input_size = 100
# map_path = map.txt
# map_ts_length = 10
# map_ts_sampling_mode = 0
# mutation_probability = 1
# neighborhood = 0
# neighborhood_iterator = 0
# noise_stddev = 1
# num_iterations = 0
# num_threads = 1
# path = function.txt
# pn_mutation_probability = 1
# pn_neighborhood = 0
# pn_radius = 2
# population_size = 10
# pv_log_num_components = 5
# radius = 2
# real_expression = (1-x)^2+100*(y-x^2)^2
# real_lower_bound = -2
# real_num_bits = 8
# real_upper_bound = 2
# results_path = results.json
# rls_patience = 50
# sa_beta_ratio = 1.2
# sa_initial_acceptance_probability = 0.6
# sa_num_transitions = 50
# sa_num_trials = 100
```

```
# seed = 0
# selection_size = 1
# solution_path = solution.txt
# target = 100
# print_defaults
# last_parameter
# exec_name = hnco
# version = 0.14
# Generated from hnco.json
```