

# Single-thread Performance Evaluation of the latest Intel Platforms

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# Test Platforms and a compiler

KNL

CPU Model Name : Intel(R) Xeon Phi(TM) CPU 7250 @ 1.40GHz  
Compiler : ifort (IFORT) 17.0.0 20160315

SNB

CPU Model Name : Intel(R) Xeon(R) CPU E5-2670 0 @ 2.60GHz  
Compiler : ifort (IFORT) 17.0.0 20160315

HSW

CPU Model Name : Intel(R) Xeon(R) CPU E7-8890 v3 @ 2.50GHz  
Compiler : ifort (IFORT) 17.0.0 20160315

KNC

CPU Model Name : Genuine Intel(R) CPU @ 2.60GHz  
Compiler : ifort (IFORT) 17.0.0 20160315

# Climate KGen Kernels

\* Available from <https://github.com/NCAR/kernelOptimization>

\* Extracted using KGen(<https://github.com/NCAR/KGen>)  
from CESM, HOMME, PORT(RRTMG), and MPAS

- |  |                              |
|--|------------------------------|
| (0) ./advance_clubb_core                                     | (20) ./port/port_binterp     |
| (1) ./CLUBB_adv_clubb_core/kernel                            | (21) ./port/rrtmg_lw_cldprmc |
| (2) ./CLUBB_adv_windm_edscrm/kernel                          | (22) ./port/rrtmg_lw_inatm   |
| (3) ./CLUBB_pdf_closure/kernel                               | (23) ./port/rrtmg_lw_rad     |
| (4) ./CLUBB_pdf_closure_execution_part/kernel                | (24) ./port/rrtmg_lw_rtrnmc  |
| (5) ./homme/homme_div_sphere                                 | (25) ./port/rrtmg_lw_setcoef |
| (6) ./homme/homme_grad_sphere                                | (26) ./port/rrtmg_sw_cldprmc |
| (7) ./homme/homme_laplace_sphere_wk/homme_laplace_sphere_wk  | (27) ./port/rrtmg_sw_inatm   |
| (8) ./homme/homme_laplace_sphere_wk/homme_laplace_sphere_wk2 | (28) ./port/rrtmg_sw_rad     |
| (9) ./homme/homme_laplace_sphere_wk/homme_laplace_sphere_wk3 | (29) ./port/rrtmg_sw_reftra  |
| (10) ./limiter_optim_iter_full                               | (30) ./port/rrtmg_sw_setcoef |
| (11) ./MG2_CAM5_INTEL  | (31) ./port/rrtmg_sw_spcvmc  |
| (12) ./MG2r/opt  | (32) ./port/rrtmg_sw_taumols |
| (13) ./MG2r/opt2   | (33) ./port/rrtmg_sw_vrtqdr  |
| (14) ./MG2r/opt3   | (34) ./preq_hydrostatic      |
| (15) ./MG2r/opt4   | (35) ./preq_omega_ps         |
| (16) ./MG2r/orig   | (36) ./remap_q_ppm           |
| (17) ./MPAS_rrtmg_lw/kernel                                  | (37) ./vlaplace_sphere_wk    |
| (18) ./POP_comp_co3terms                                     | (38) ./vorticity_sphere      |
| (19) ./POP_merged_streamfunction                             | (39) ./WACCM/imp_sol         |
|  | (40) ./WACCM/lu_fac          |

## How to rerun the tests:

```
>> git clone https://github.com/NCAR/kernelOptimization.git  
>> cd kernelOptimization  
>> git checkout [snb_tag_org|hsw_tag_org|knc_tag_org|knl_tag_org]  
>> ./scripts/test_kernels.py .
```

NOTE: It is assumed that you are on one of test platforms.

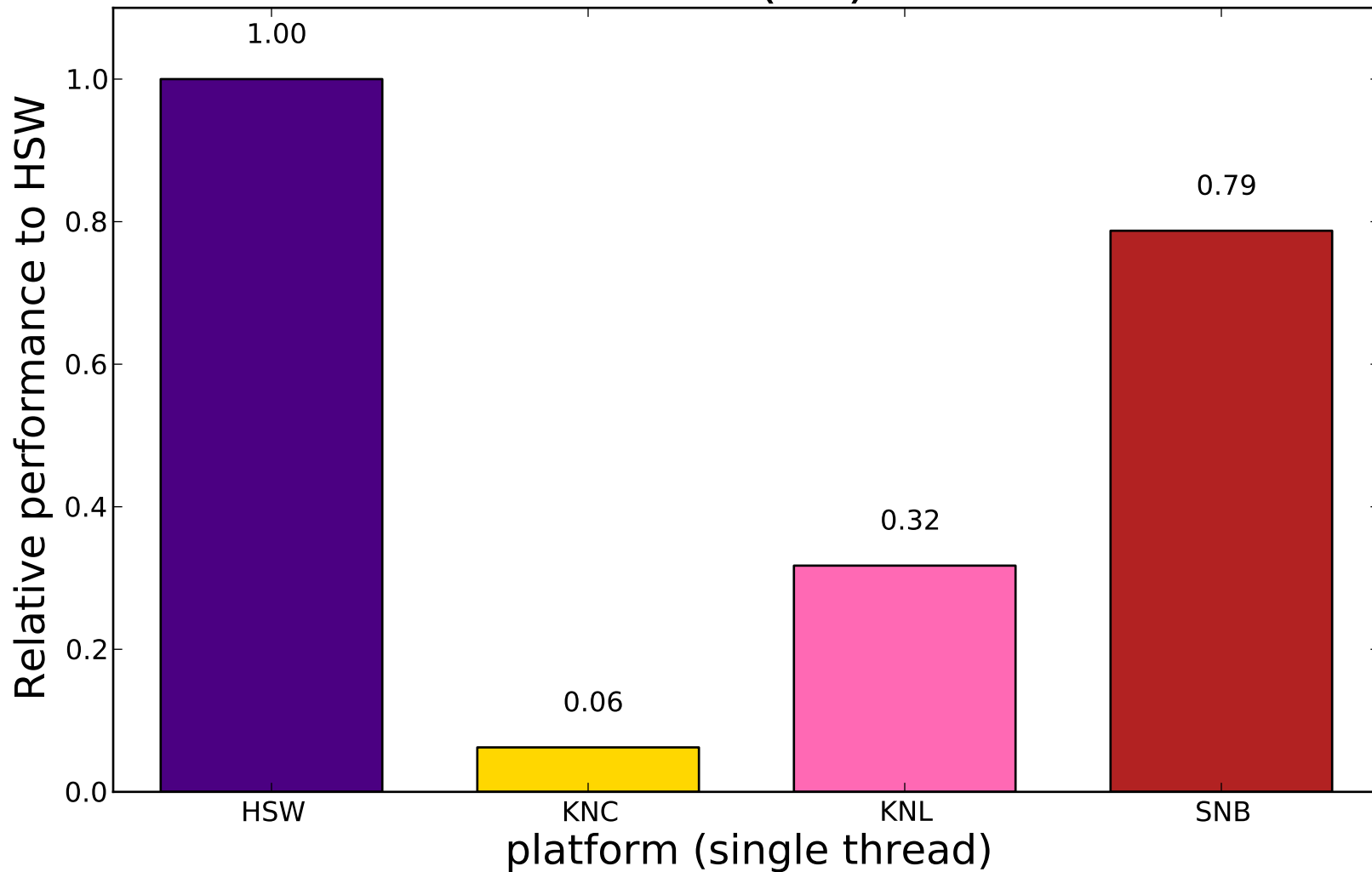
You may need to modify Makefile(s) to fit to your test env.

## Raw test results for this report are available:

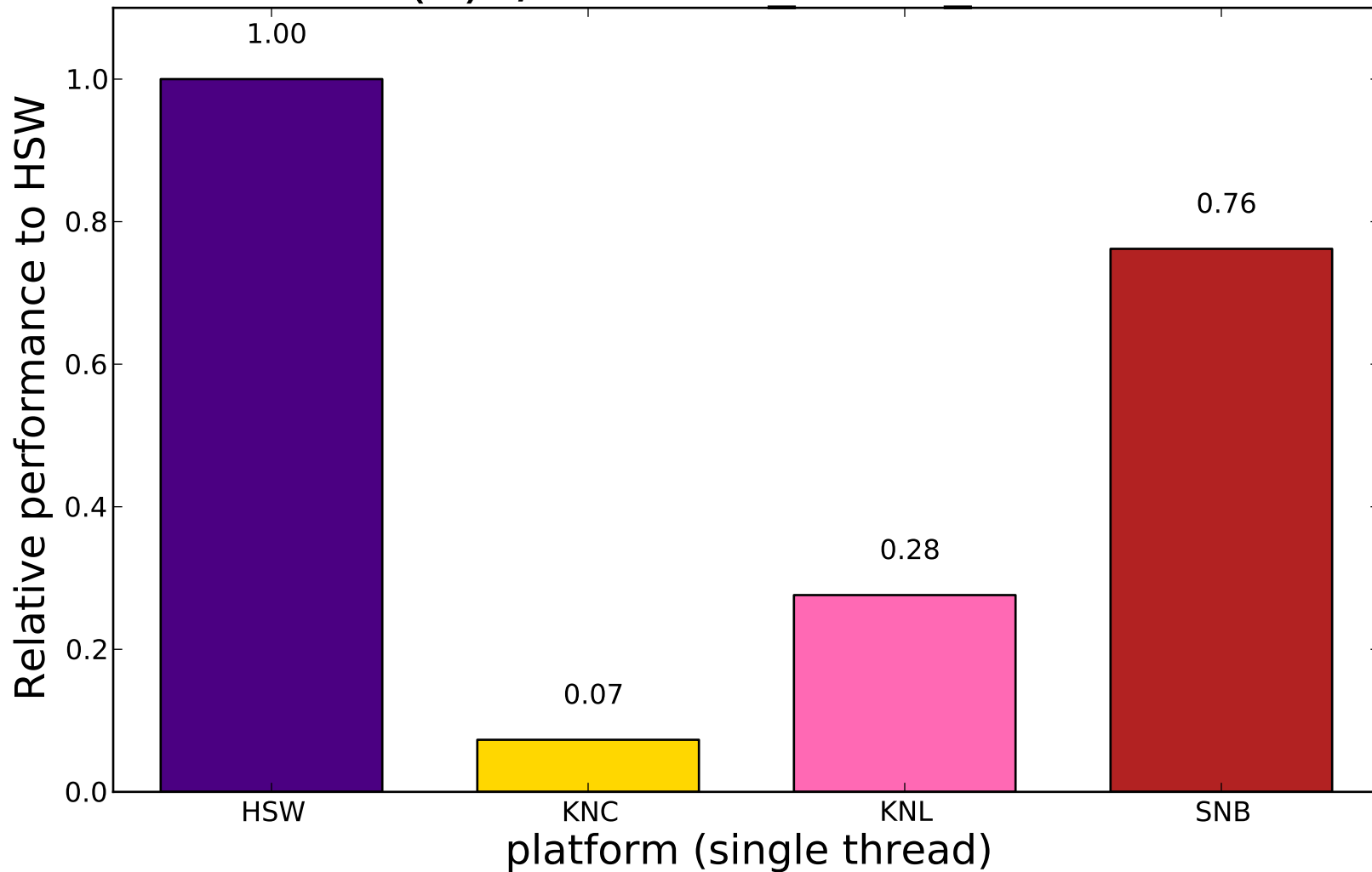
```
>> cd testdata/May_05_2016
```

Performance Comparison to HSW (Single Thread)

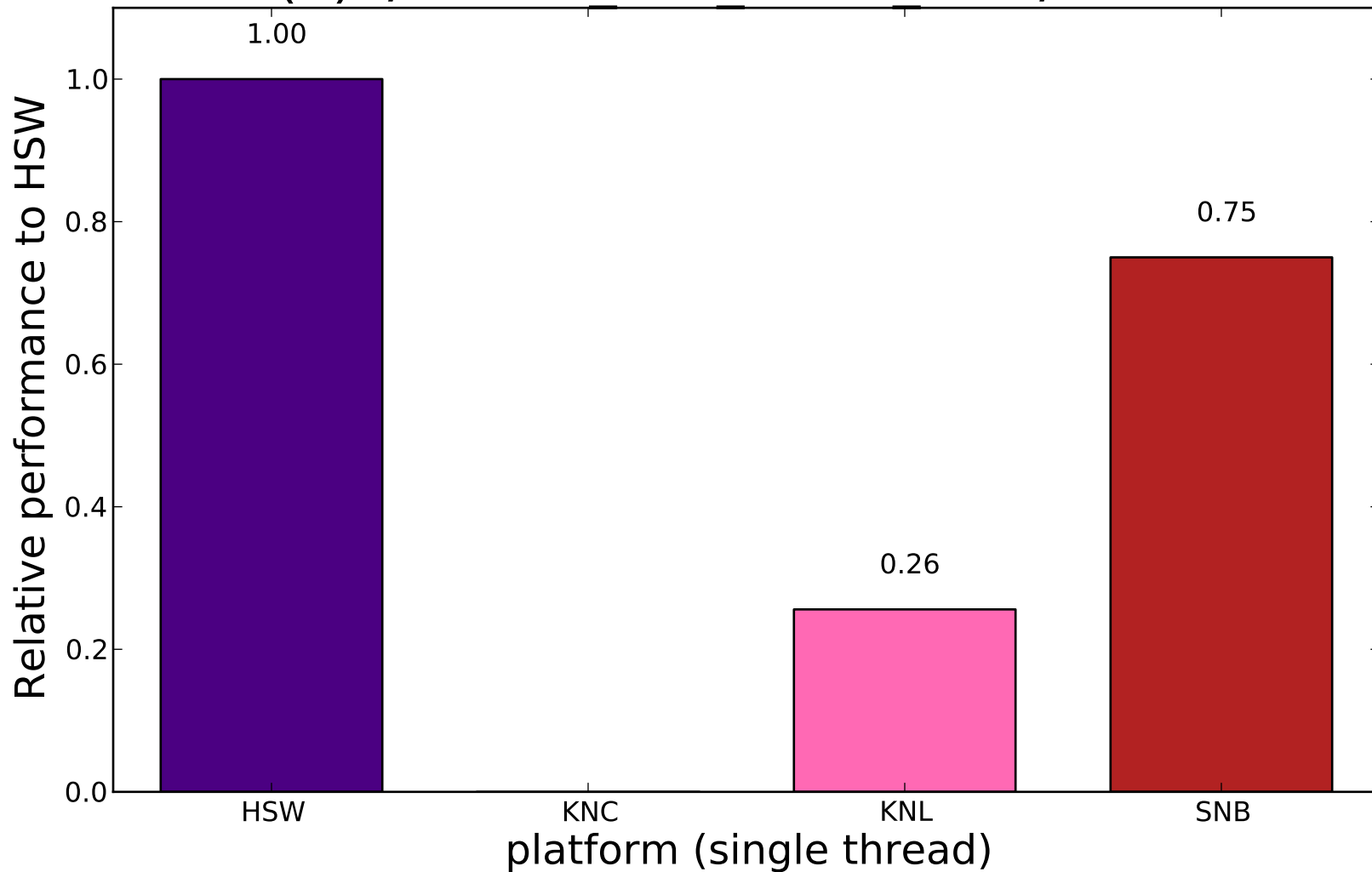
# All KGen kernels(41) - combined



(0) ./advance\_clubb\_core

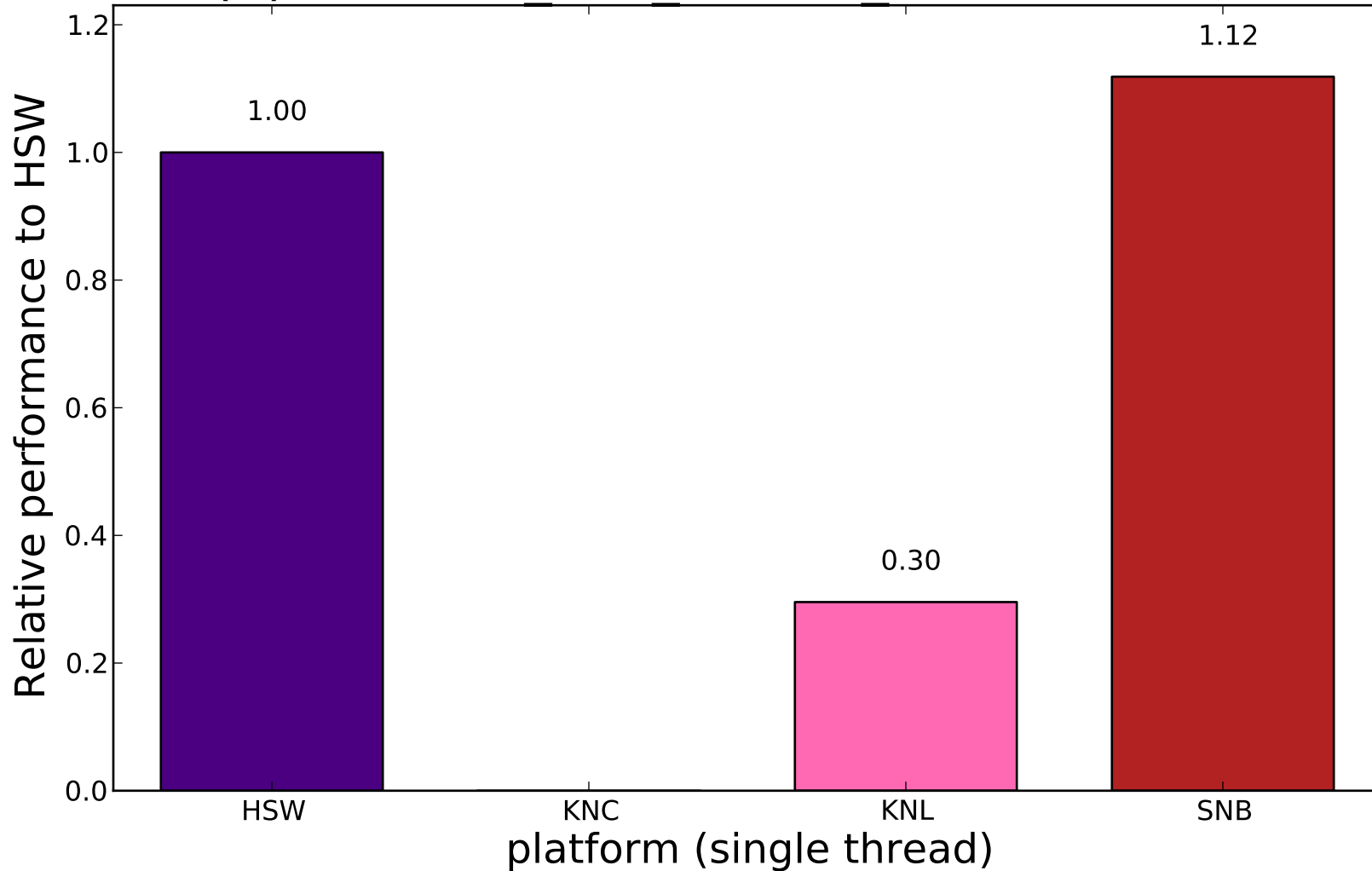


# (1) ./CLUBB adv clubb core/kernel

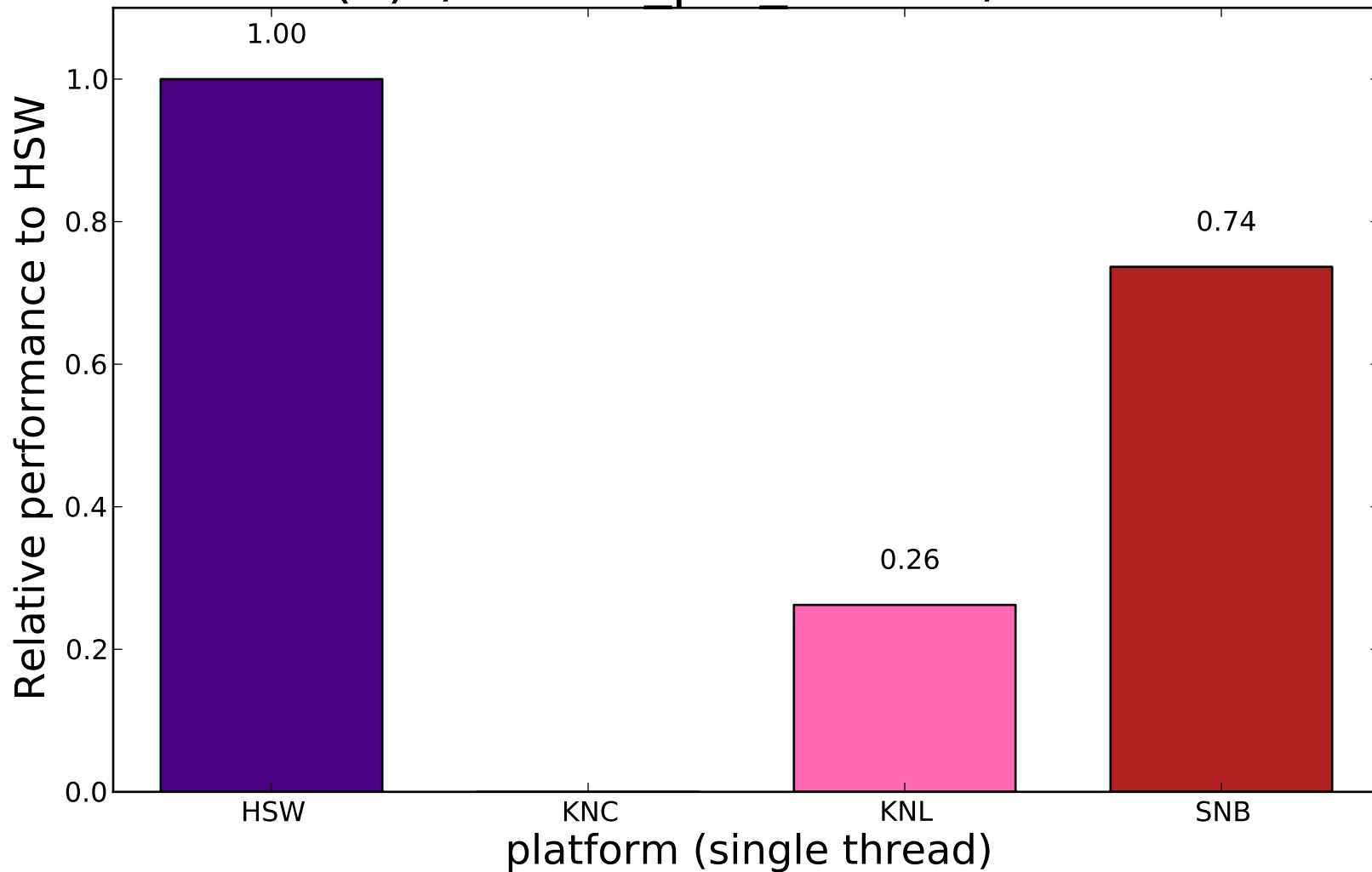




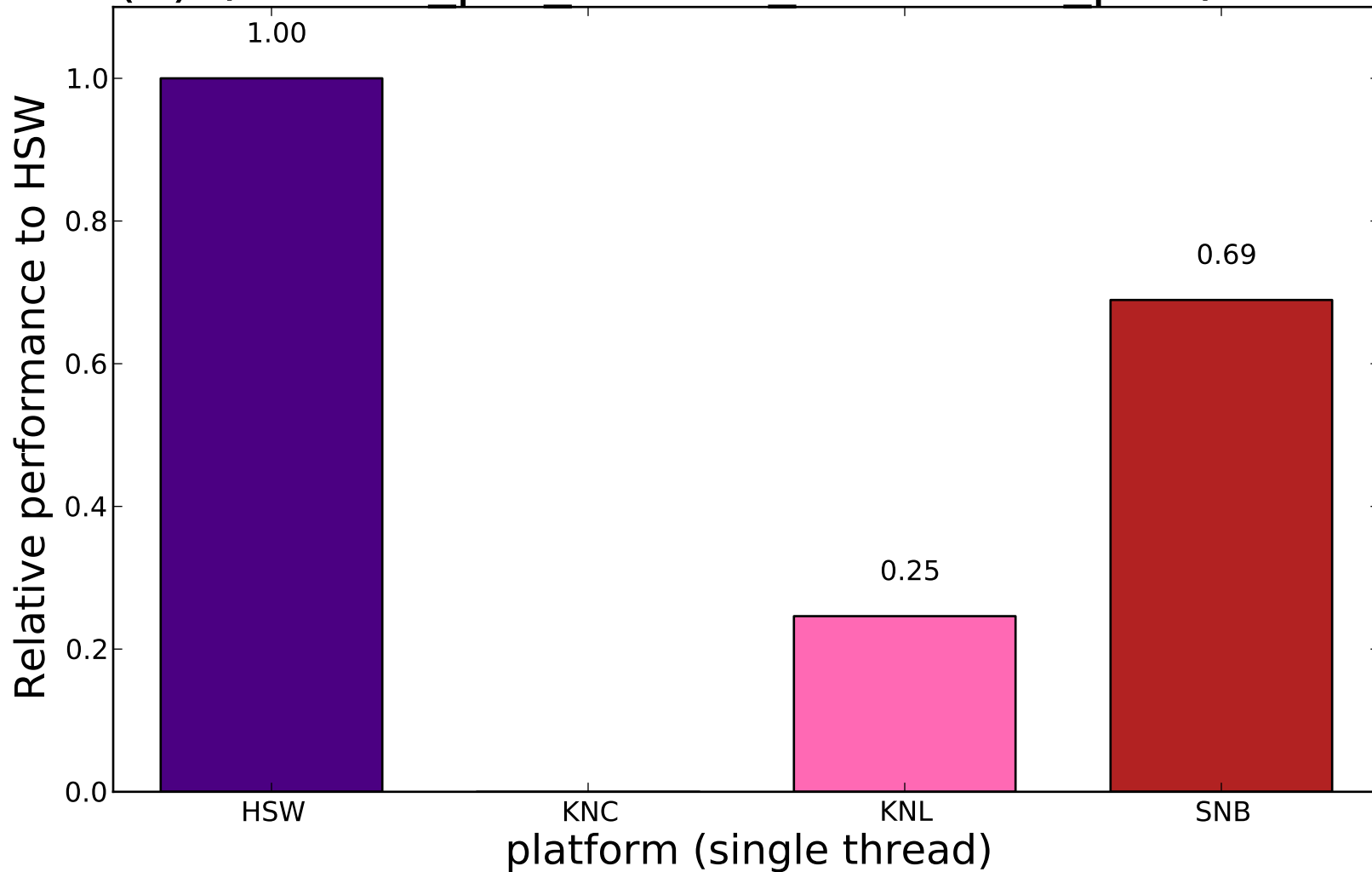
## (2) ./CLUBB\_adv\_windm\_edscirm/kernel



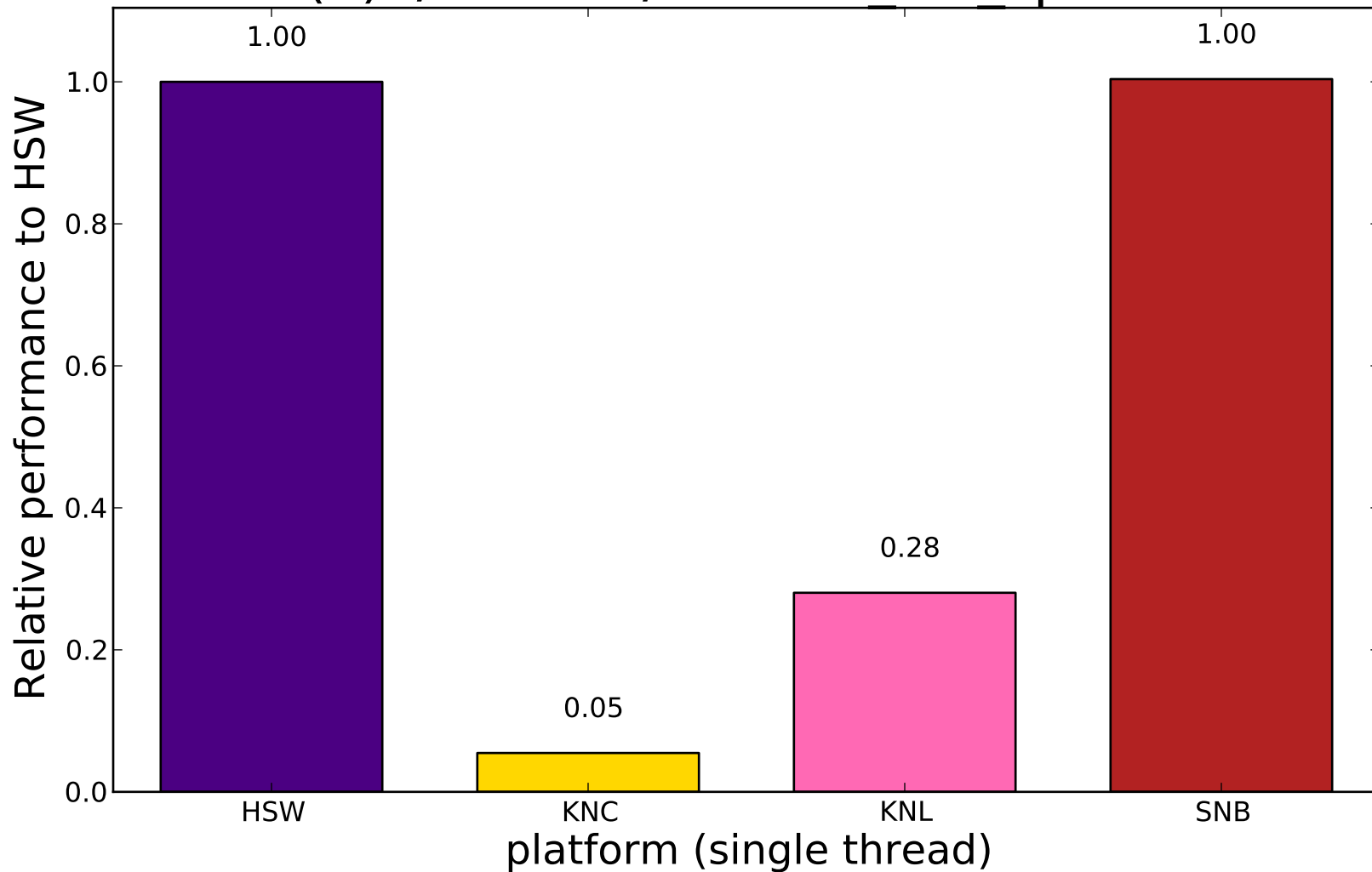
### (3) ./CLUBB\_pdf\_closure/kernel



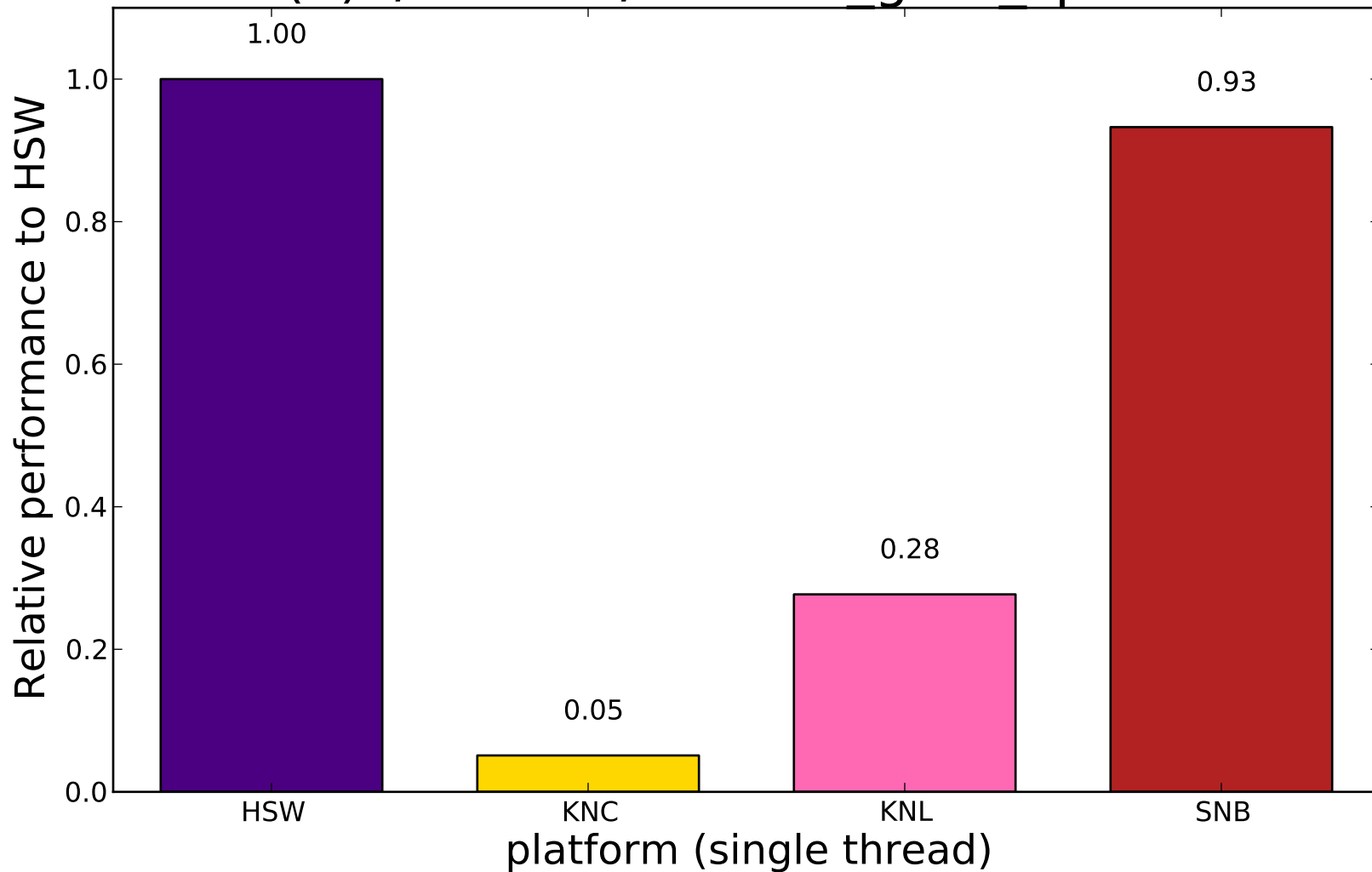
#### (4) ./CLUBB\_pdf\_closure\_execution\_part/kernel



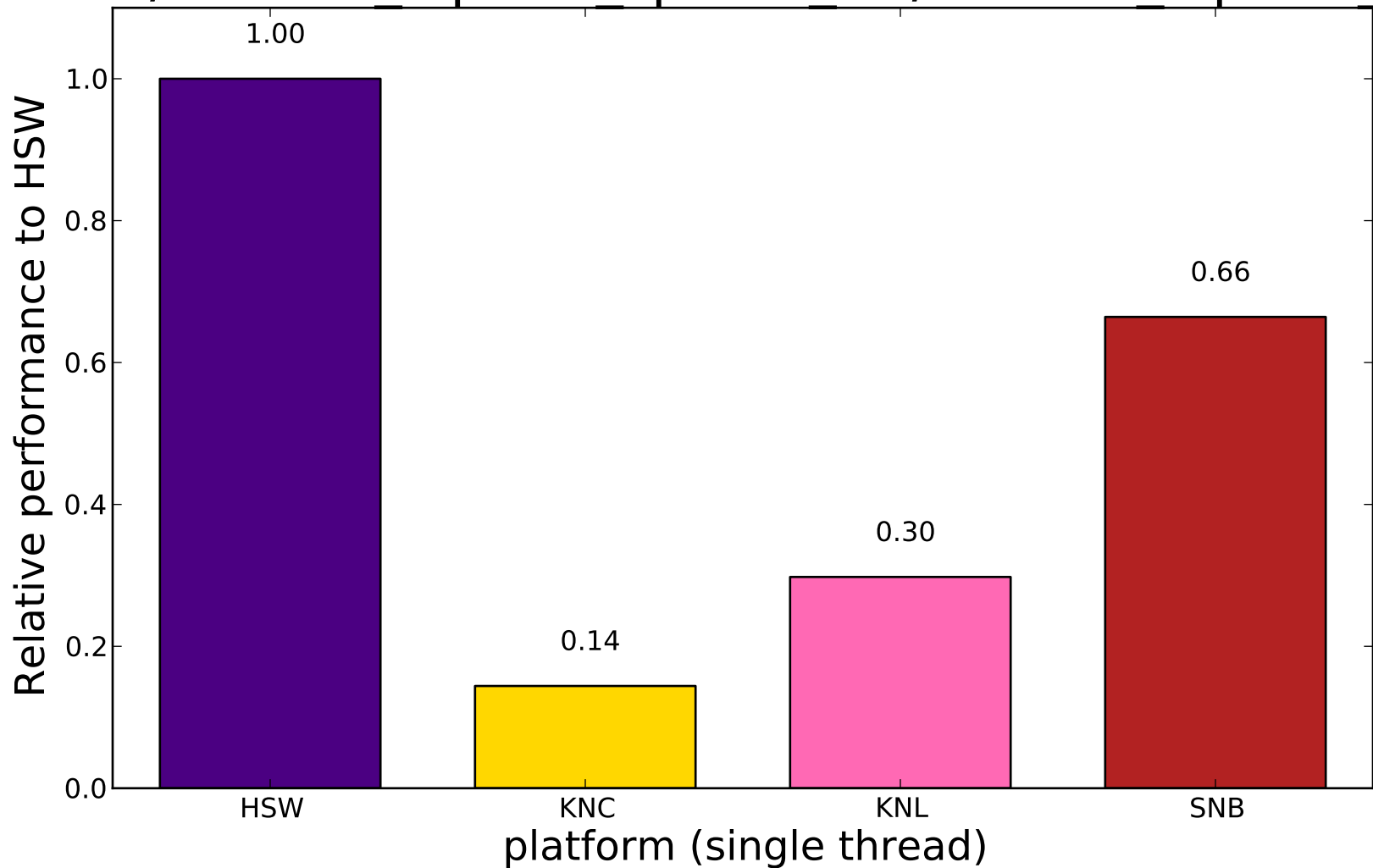
# (5) ./homme/homme div sphere



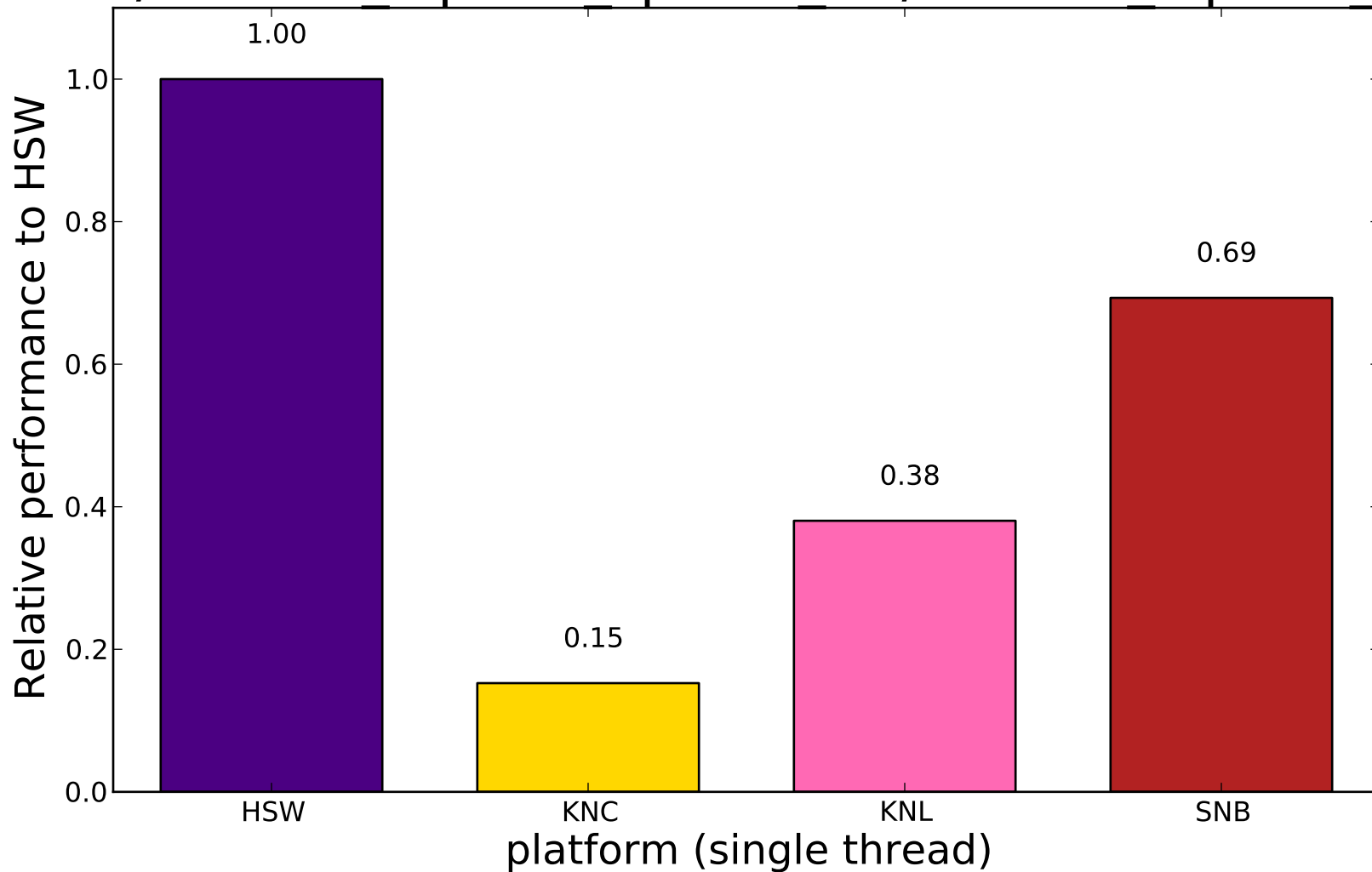
## (6) ./homme/homme\_grad\_sphere



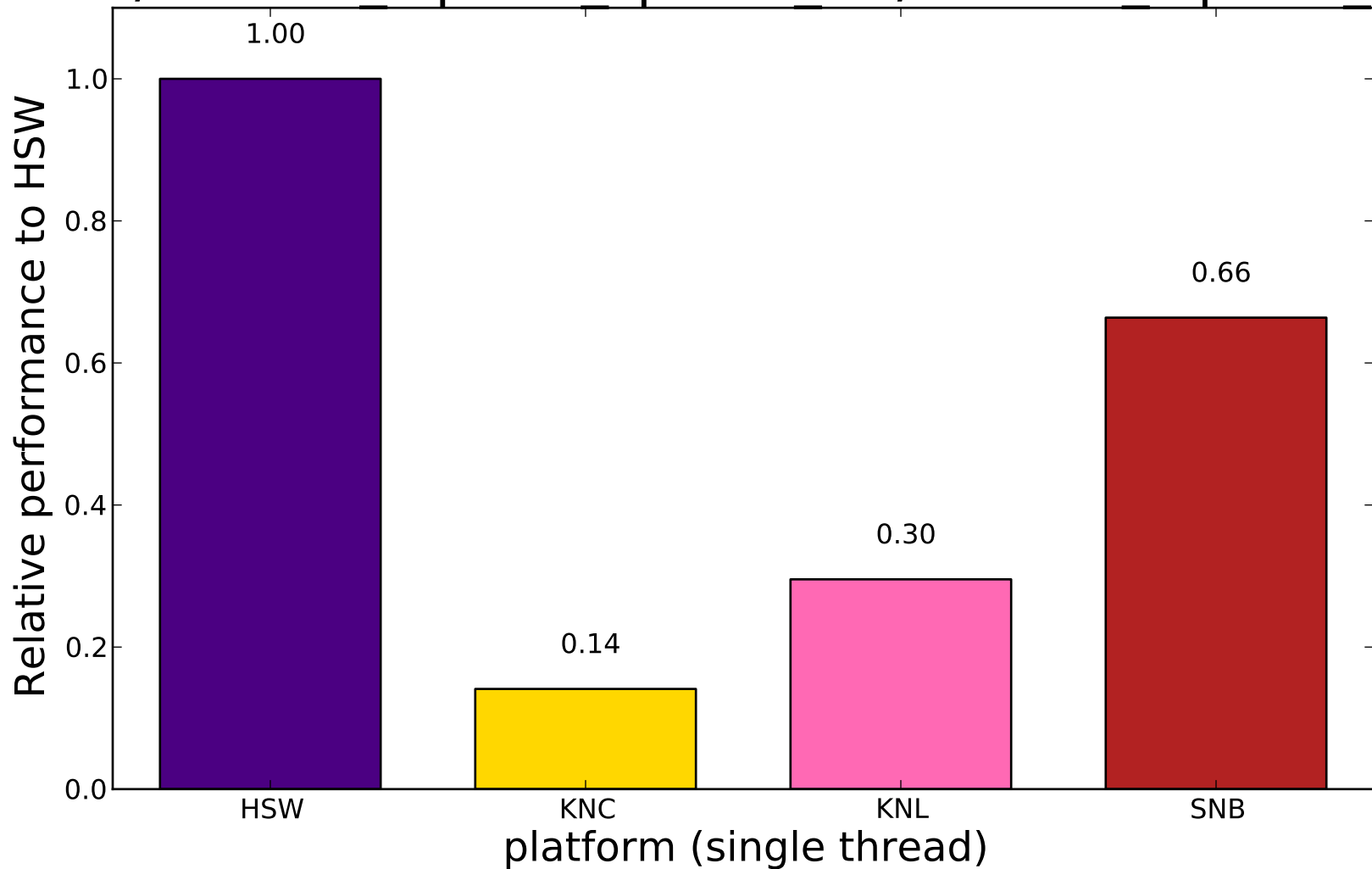
./homme/homme\_laplace\_sphere\_wk/homme\_laplace\_sphere



/homme/homme laplace sphere wk/homme laplace sphere

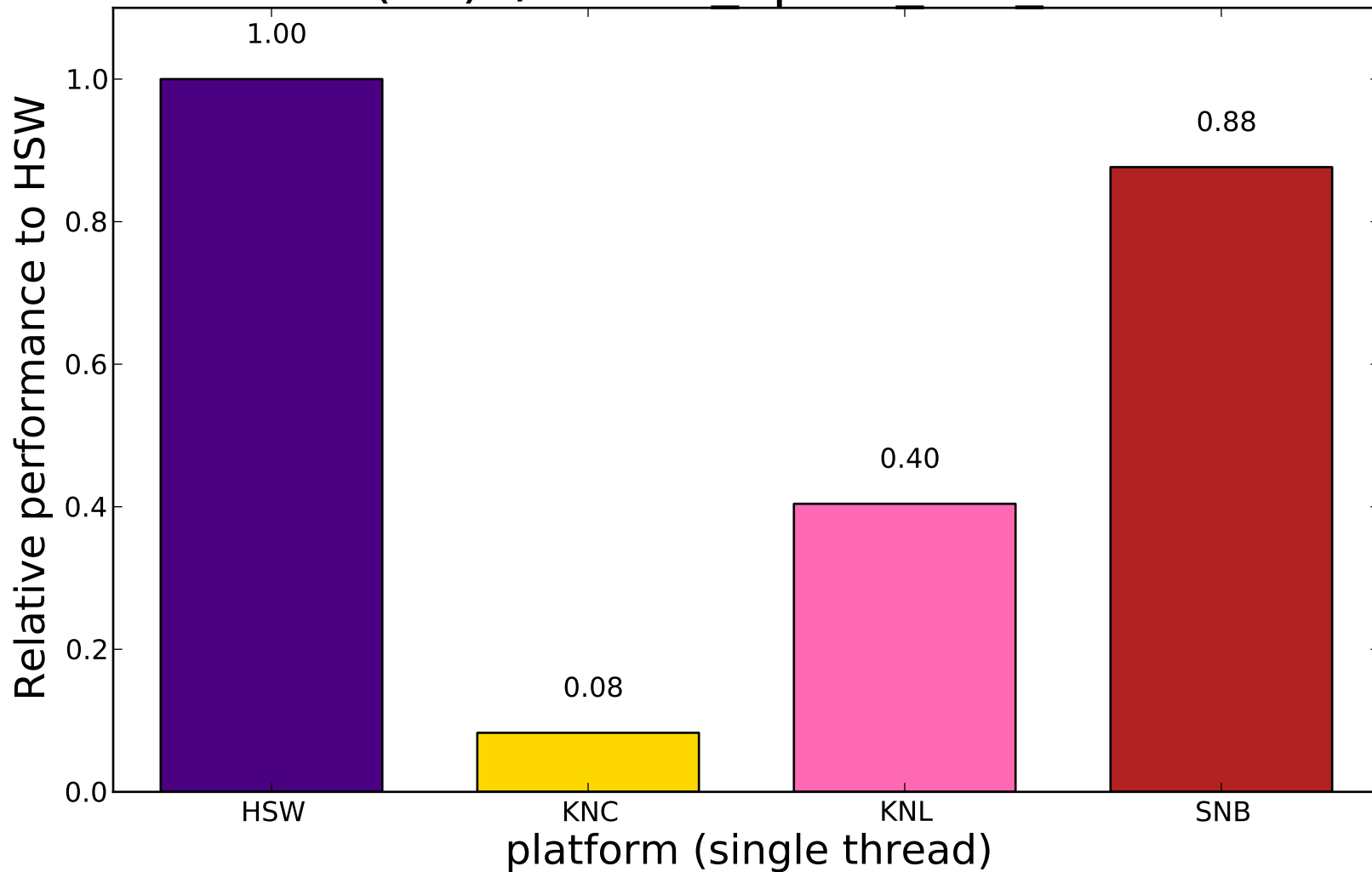


/homme/homme laplace sphere wk/homme laplace sphere

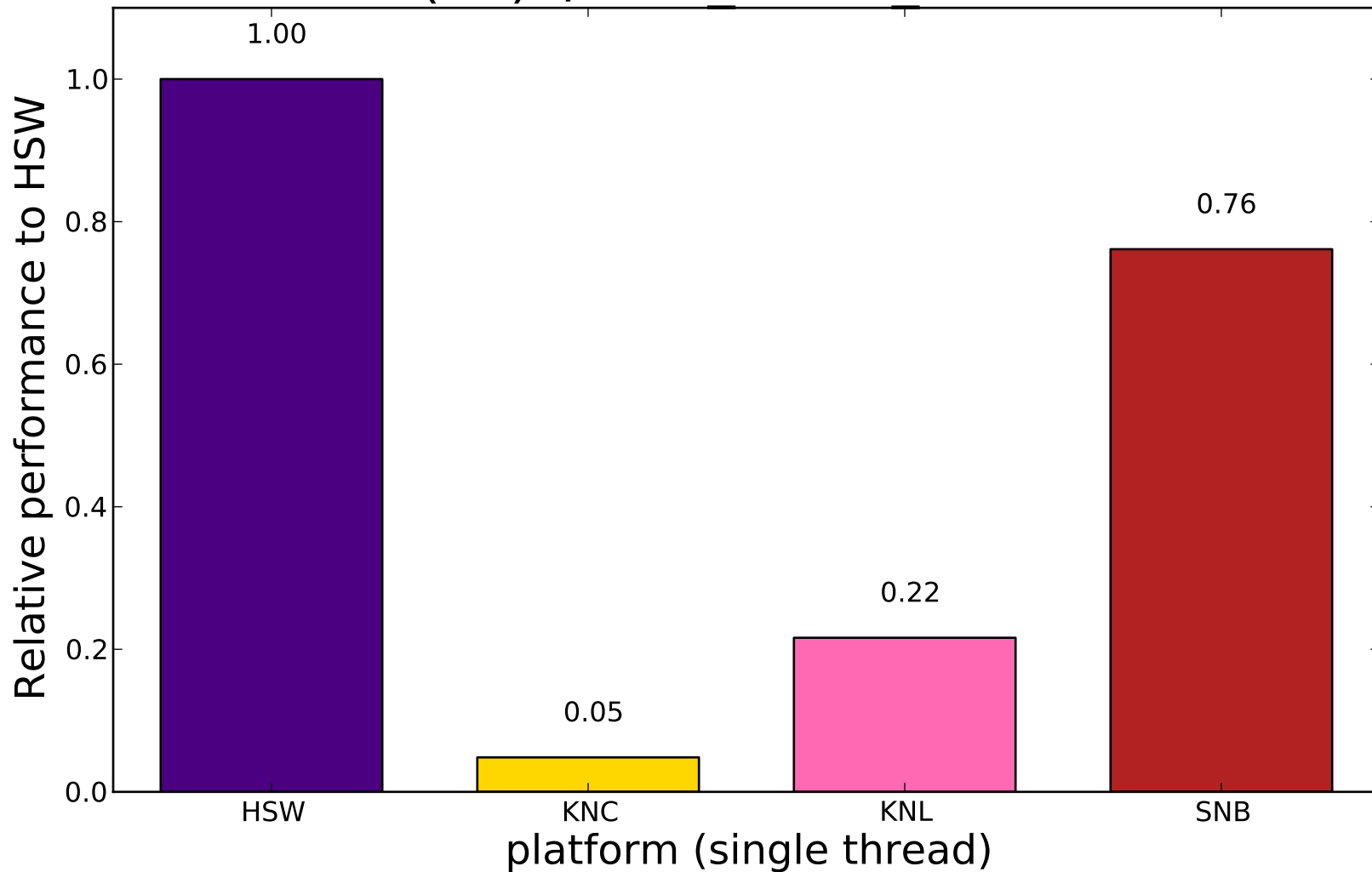




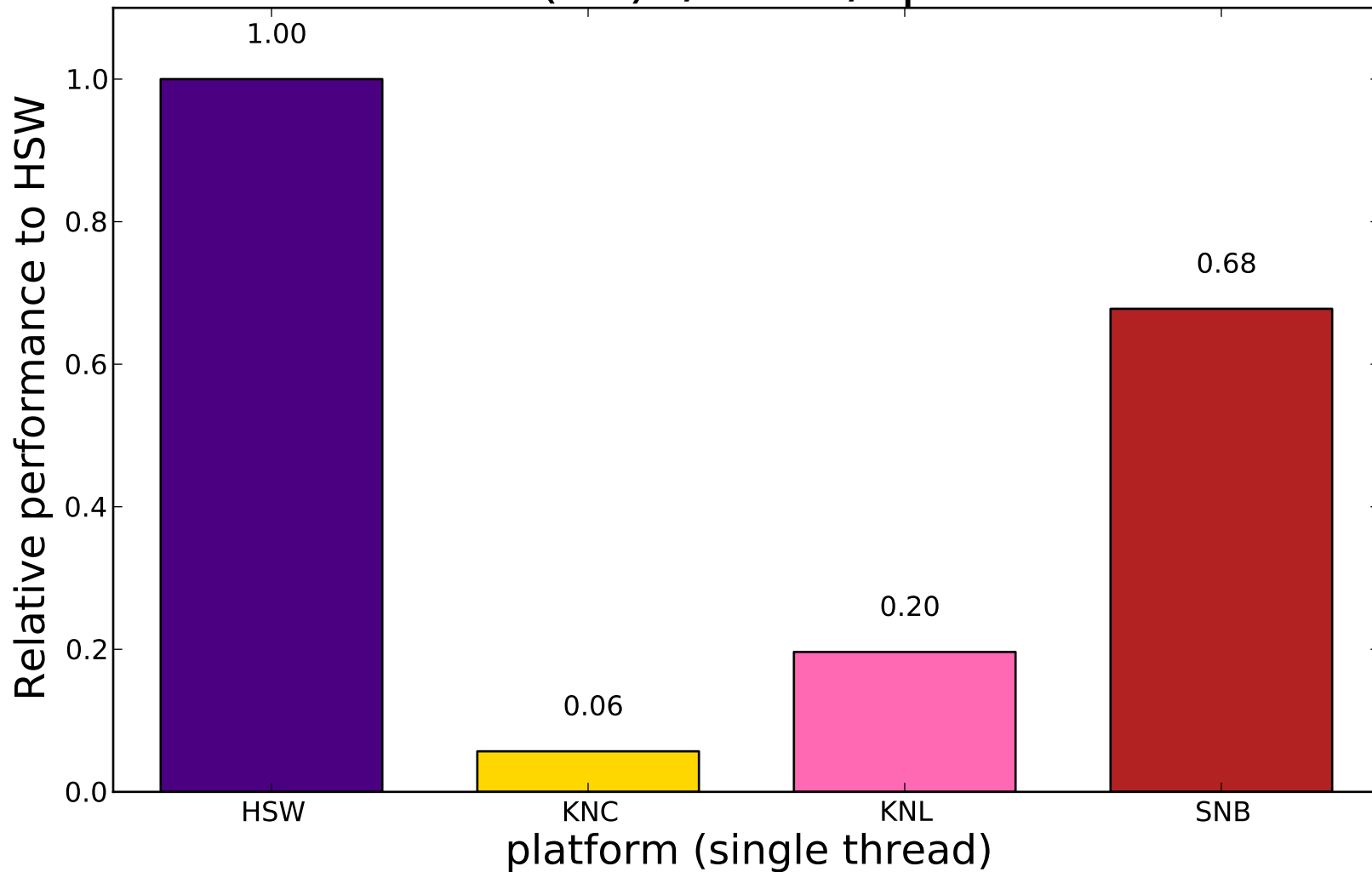
# (10) ./limiter\_optim\_iter\_full



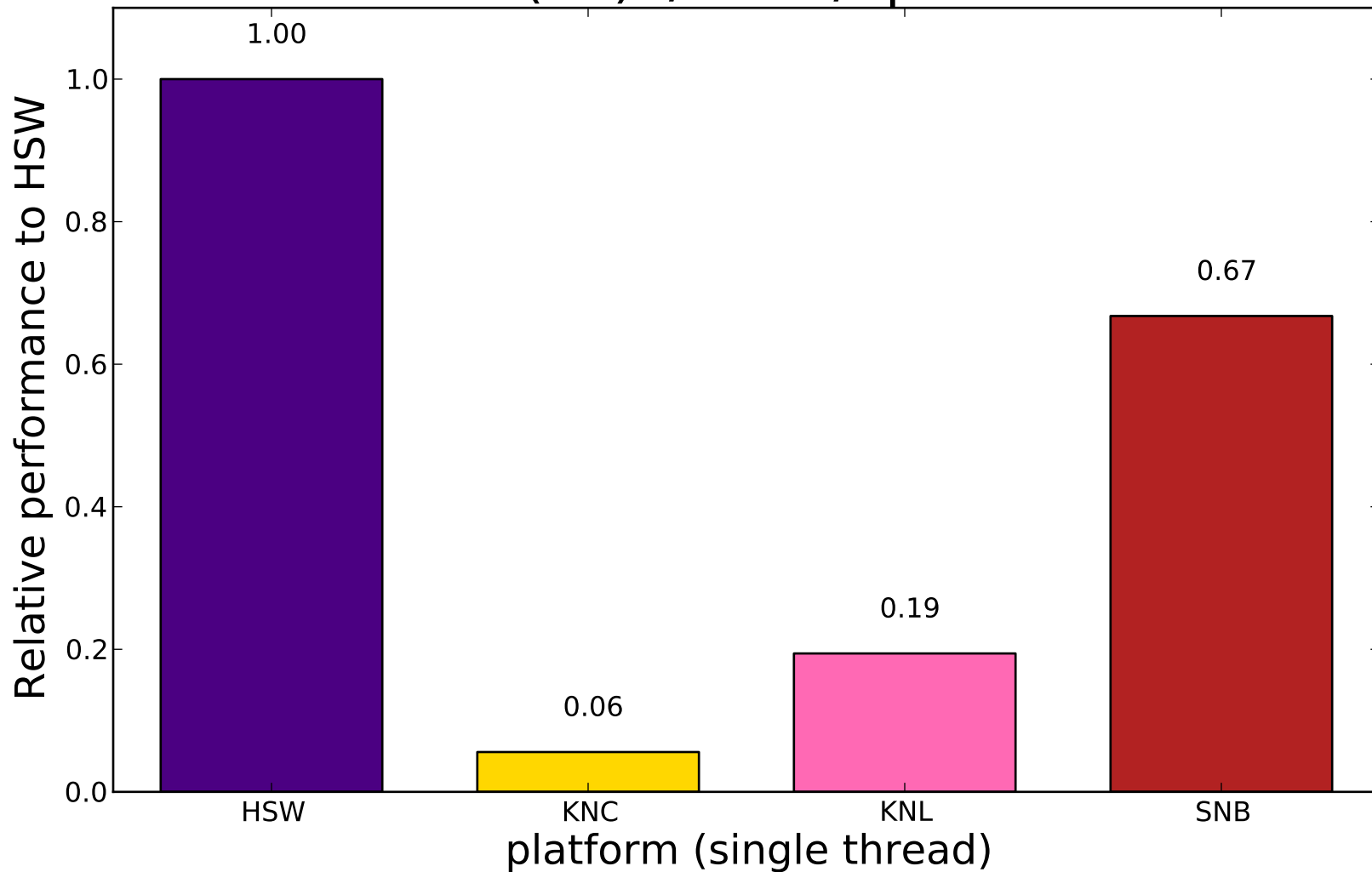
# (11) ./MG2\_CAM5\_INTEL



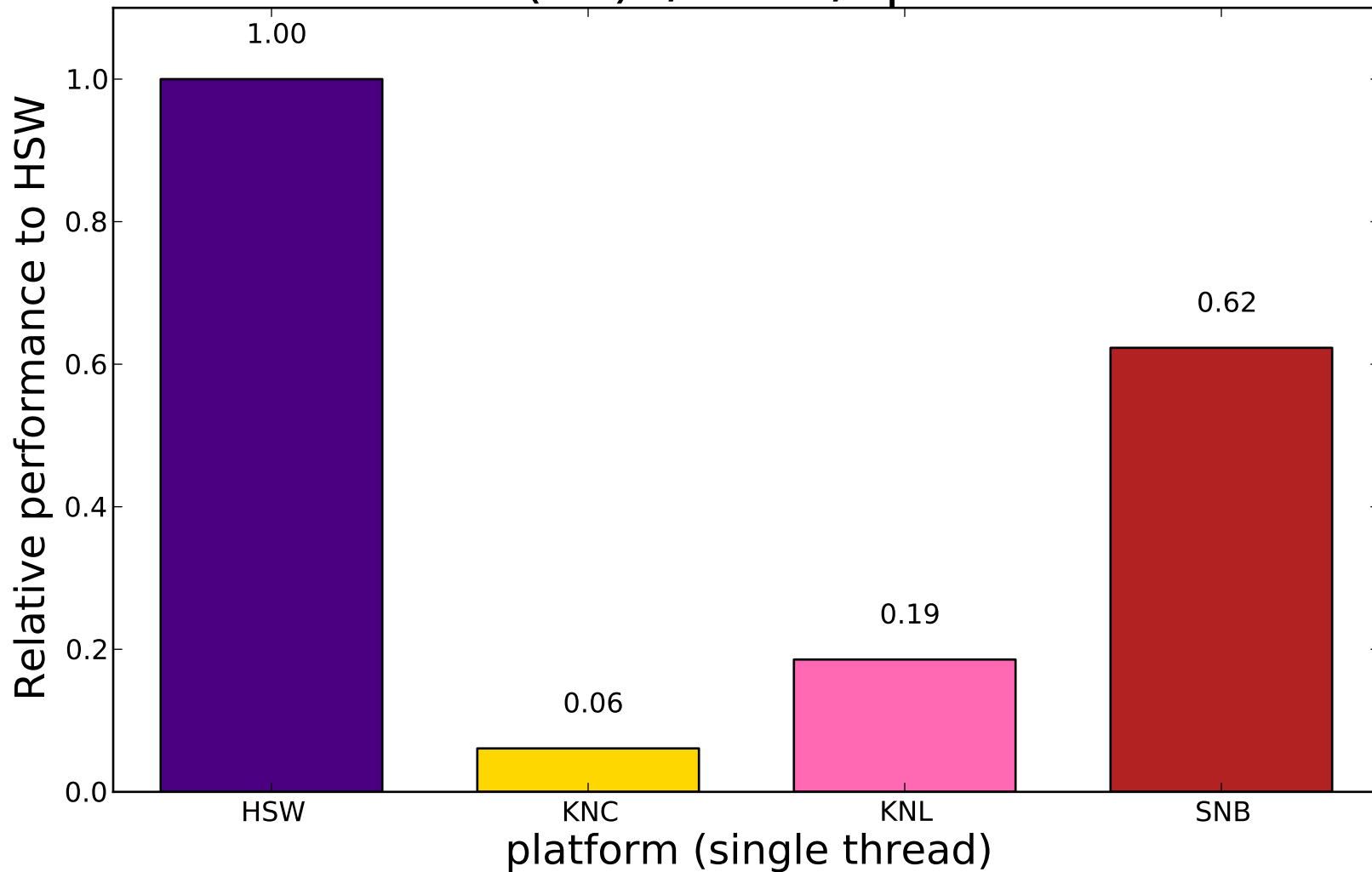
(12) ./MG2r/opt



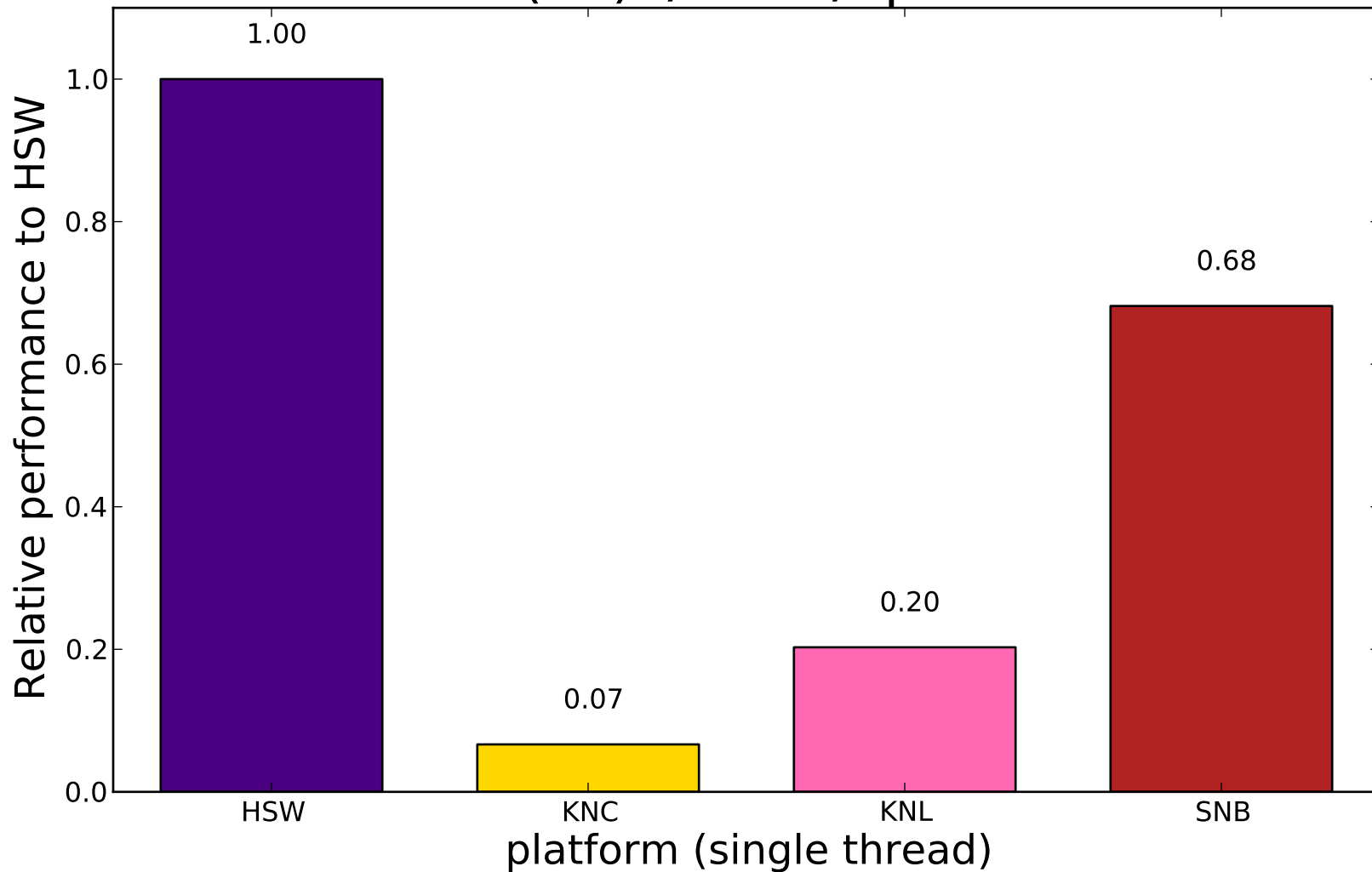
# (13) ./MG2r/opt2



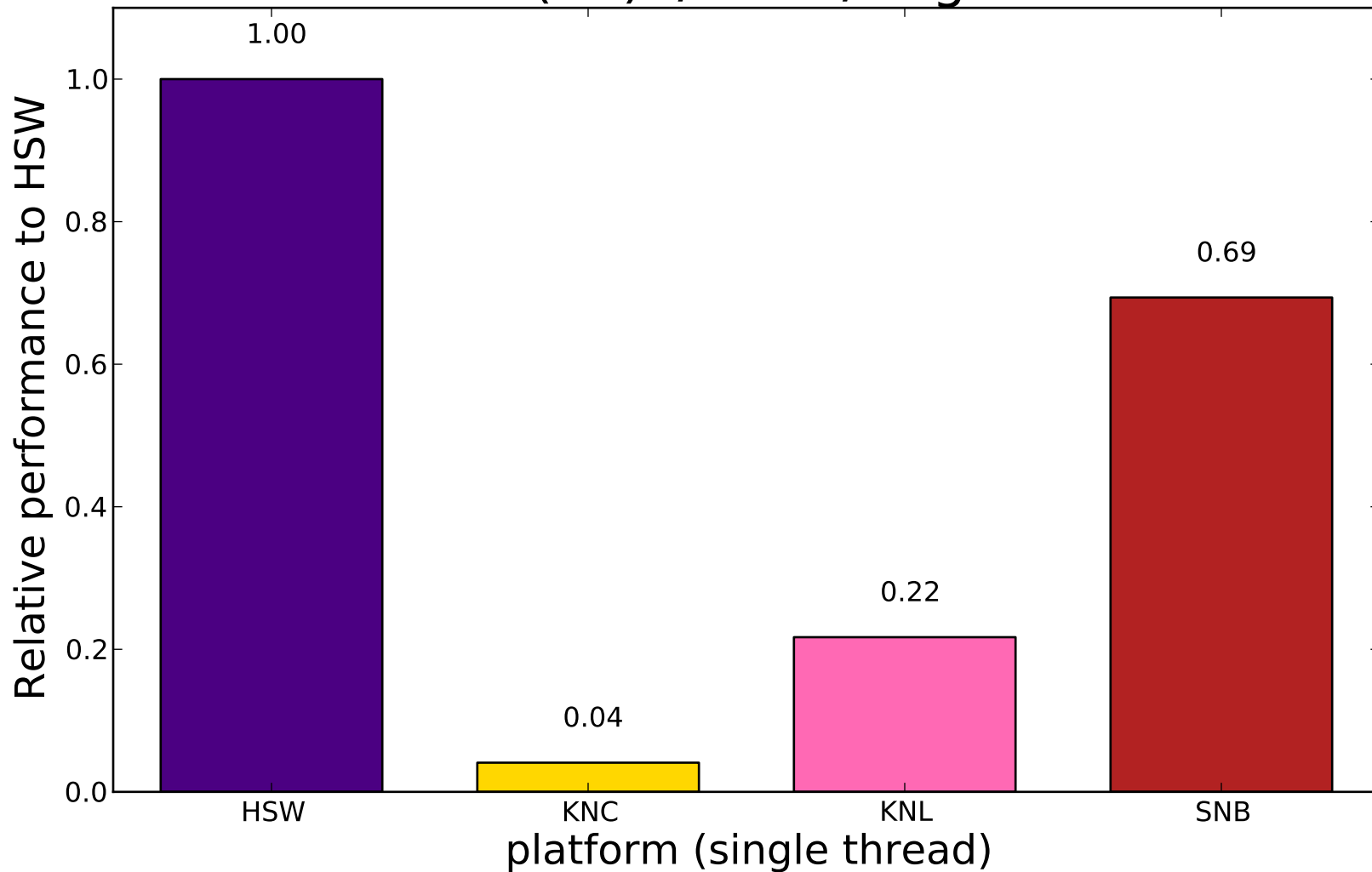
# (14) ./MG2r/opt3



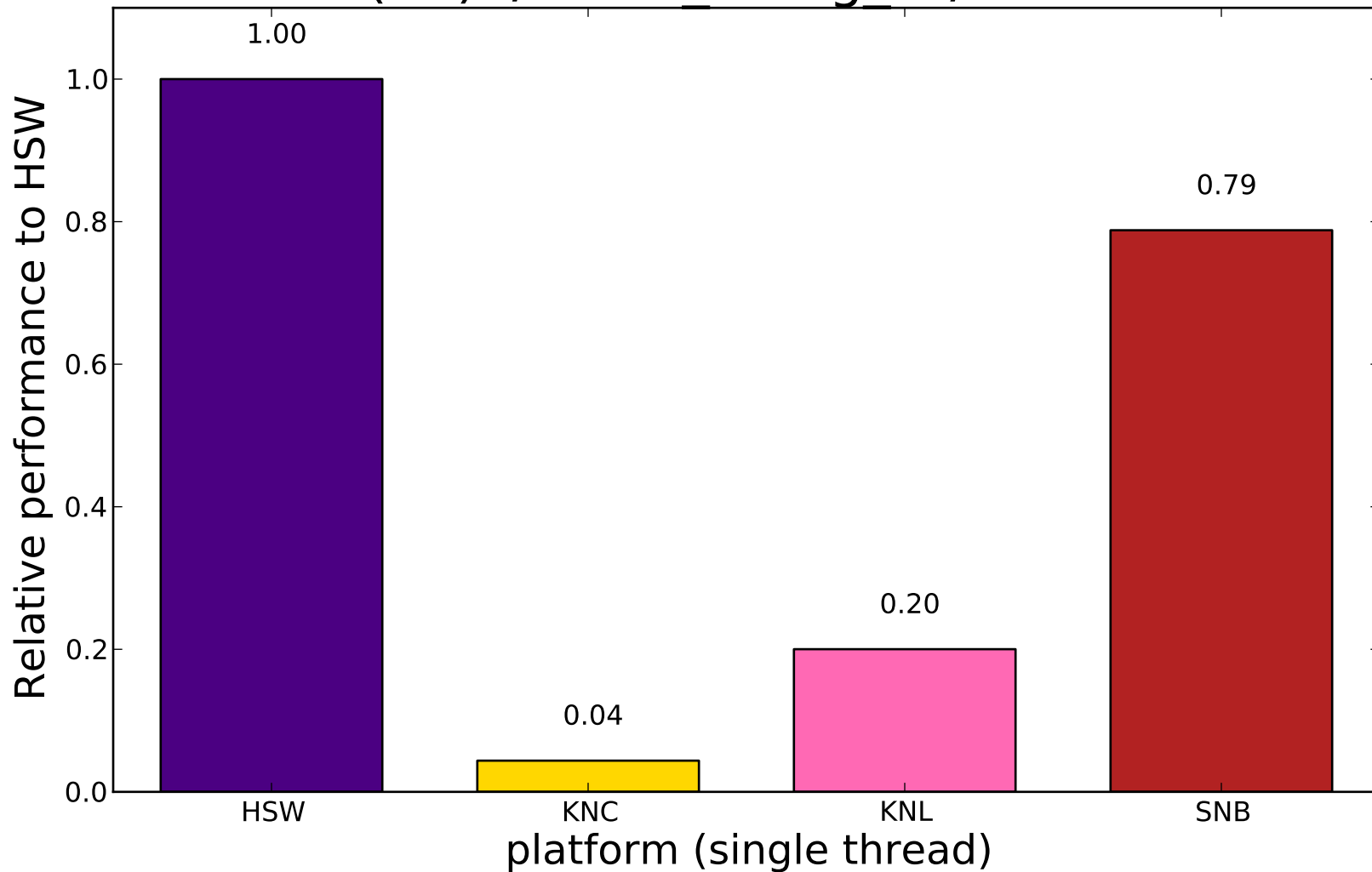
# (15) ./MG2r/opt4



# (16) ./MG2r/orig

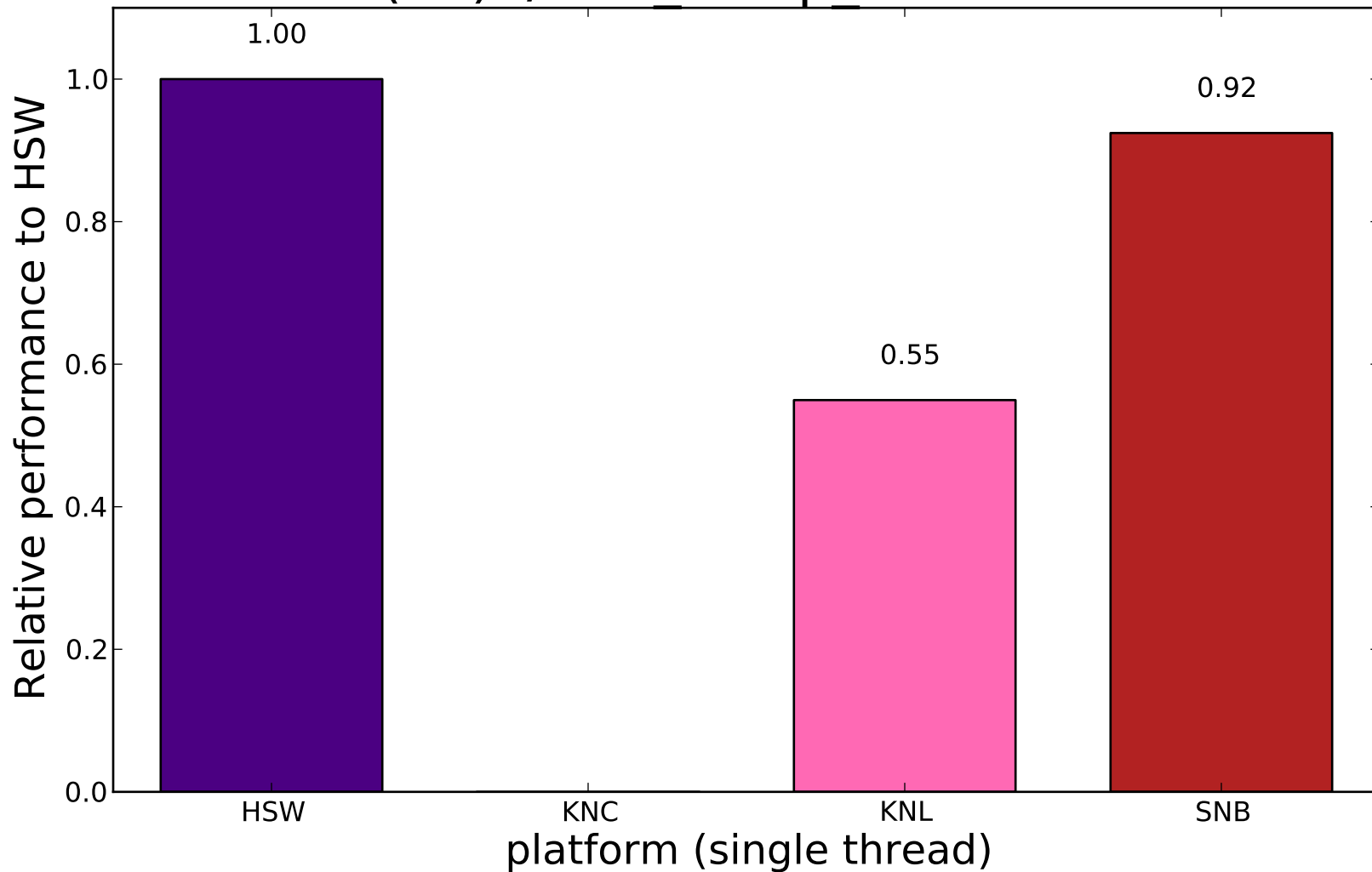


# (17) ./MPAS\_rrtmg\_lw/kernel

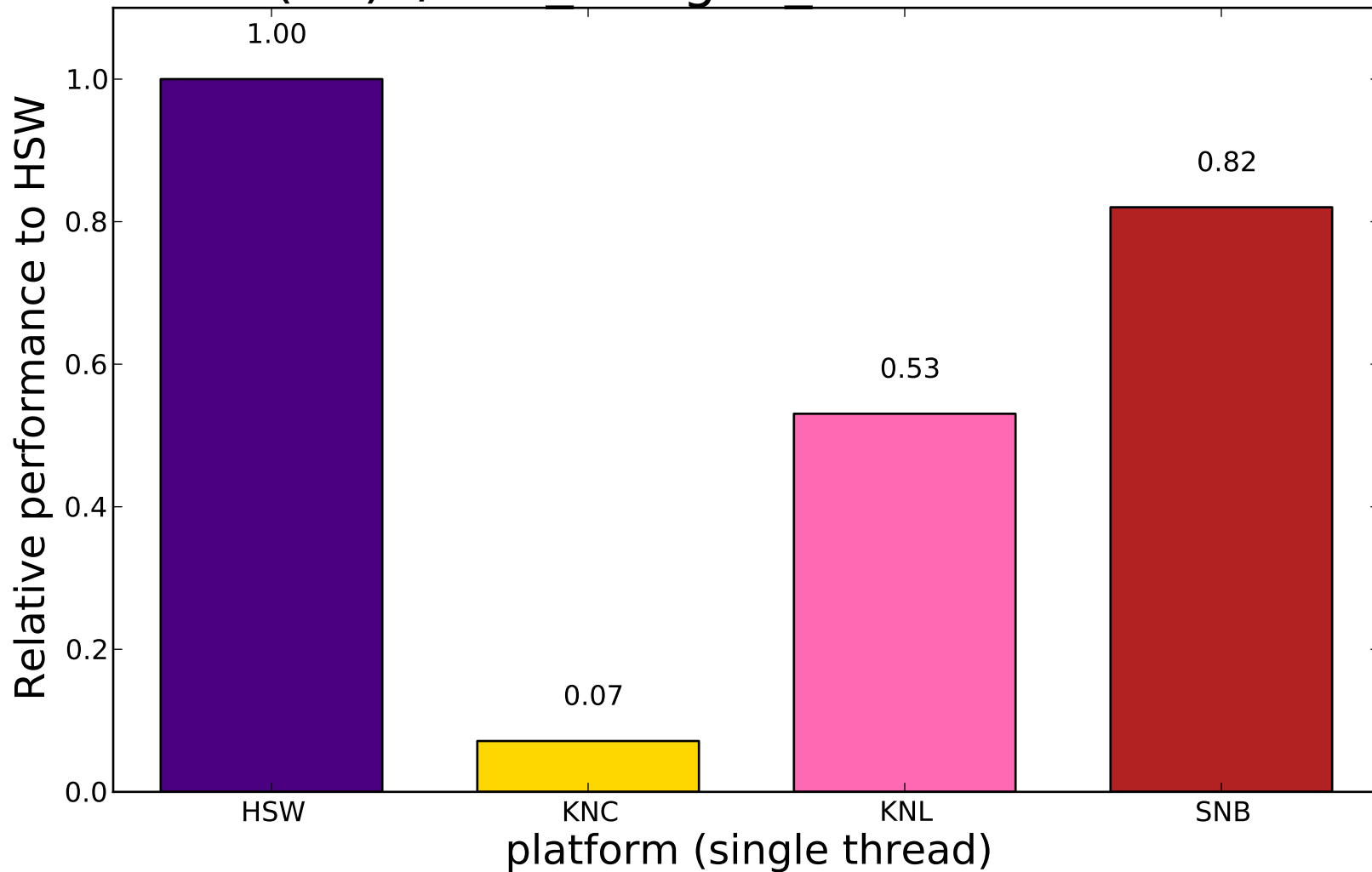




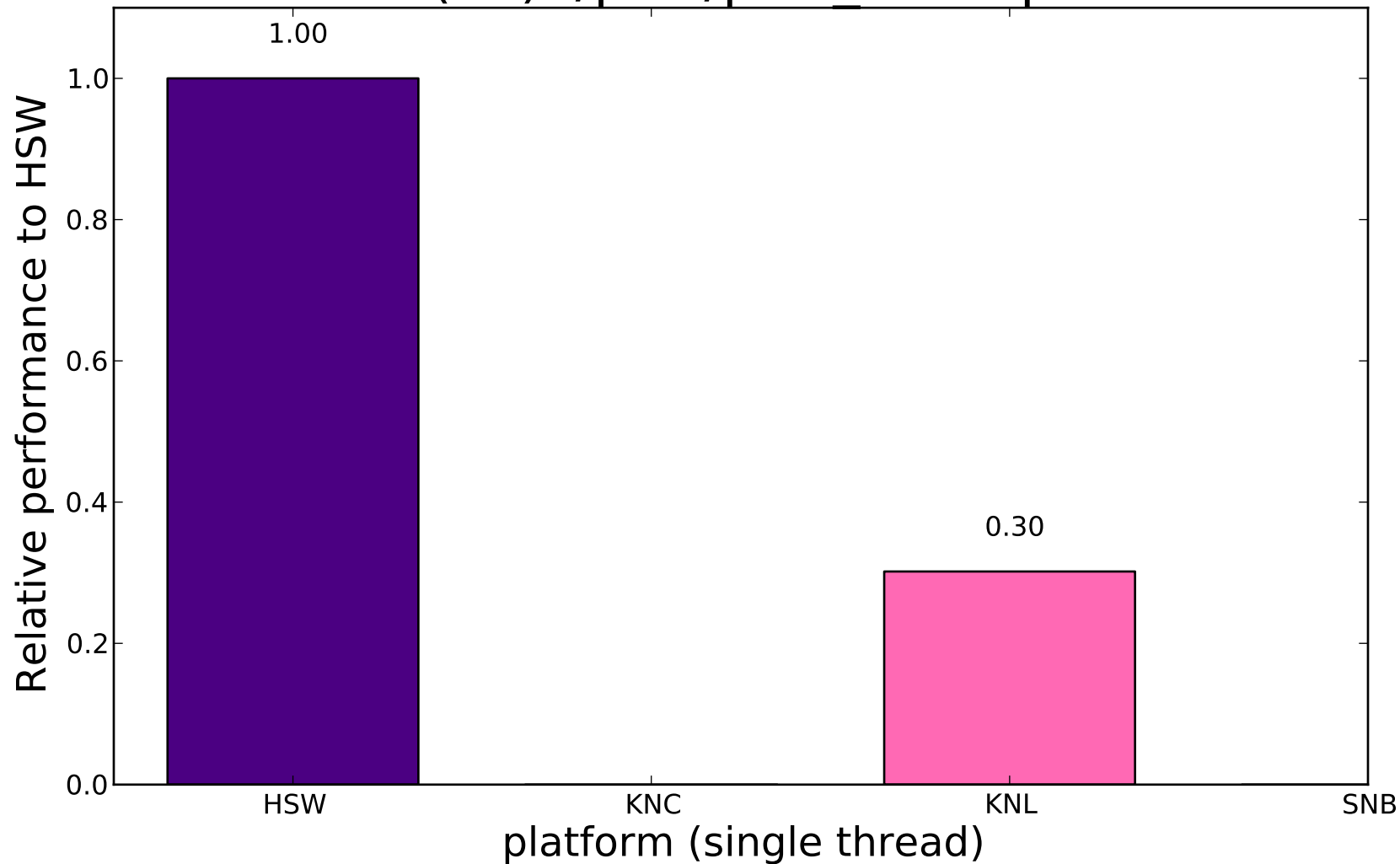
# (18) ./POP\_comp\_co3terms



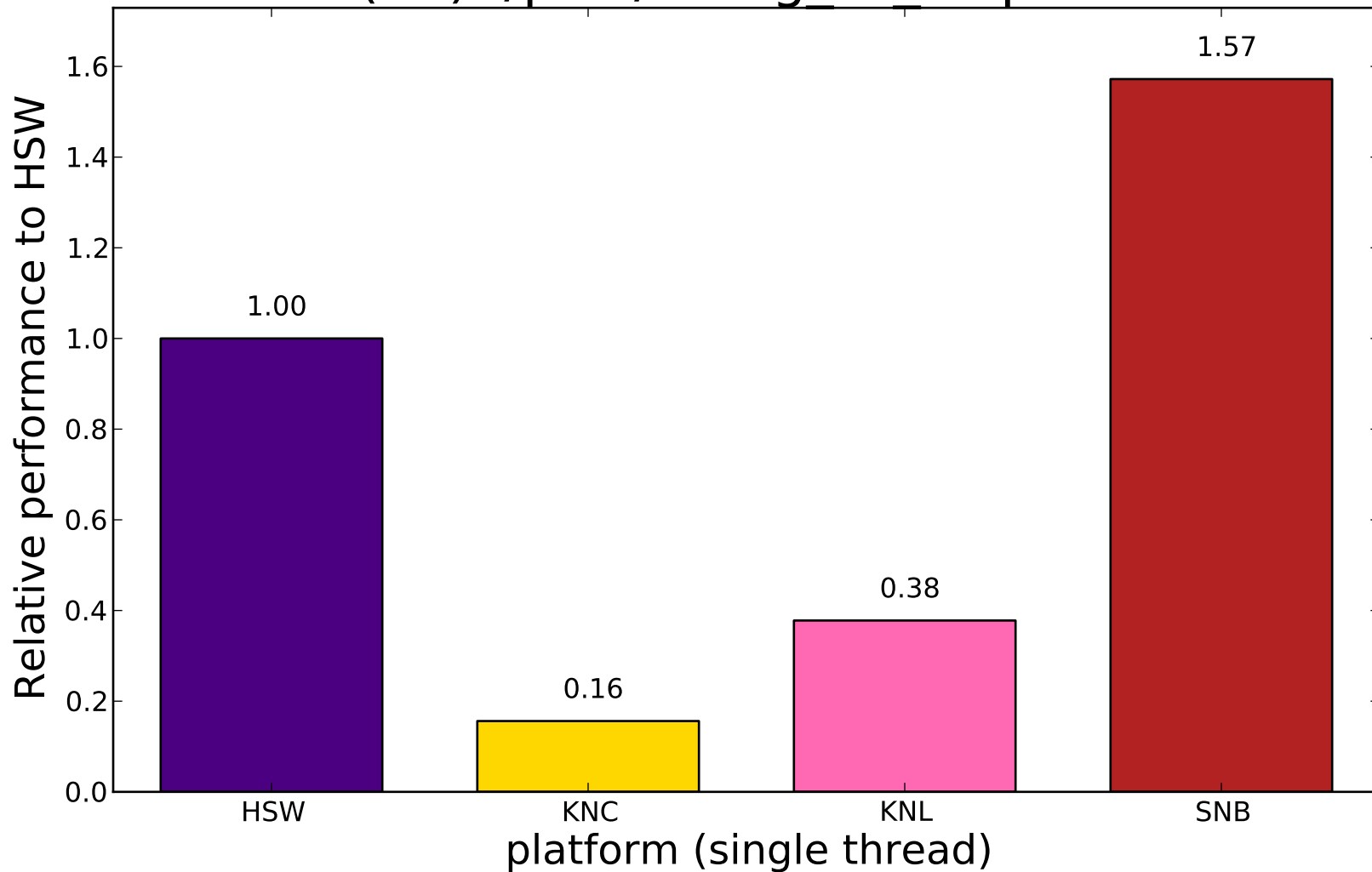
# (19) ./POP\_merged\_streamfunction



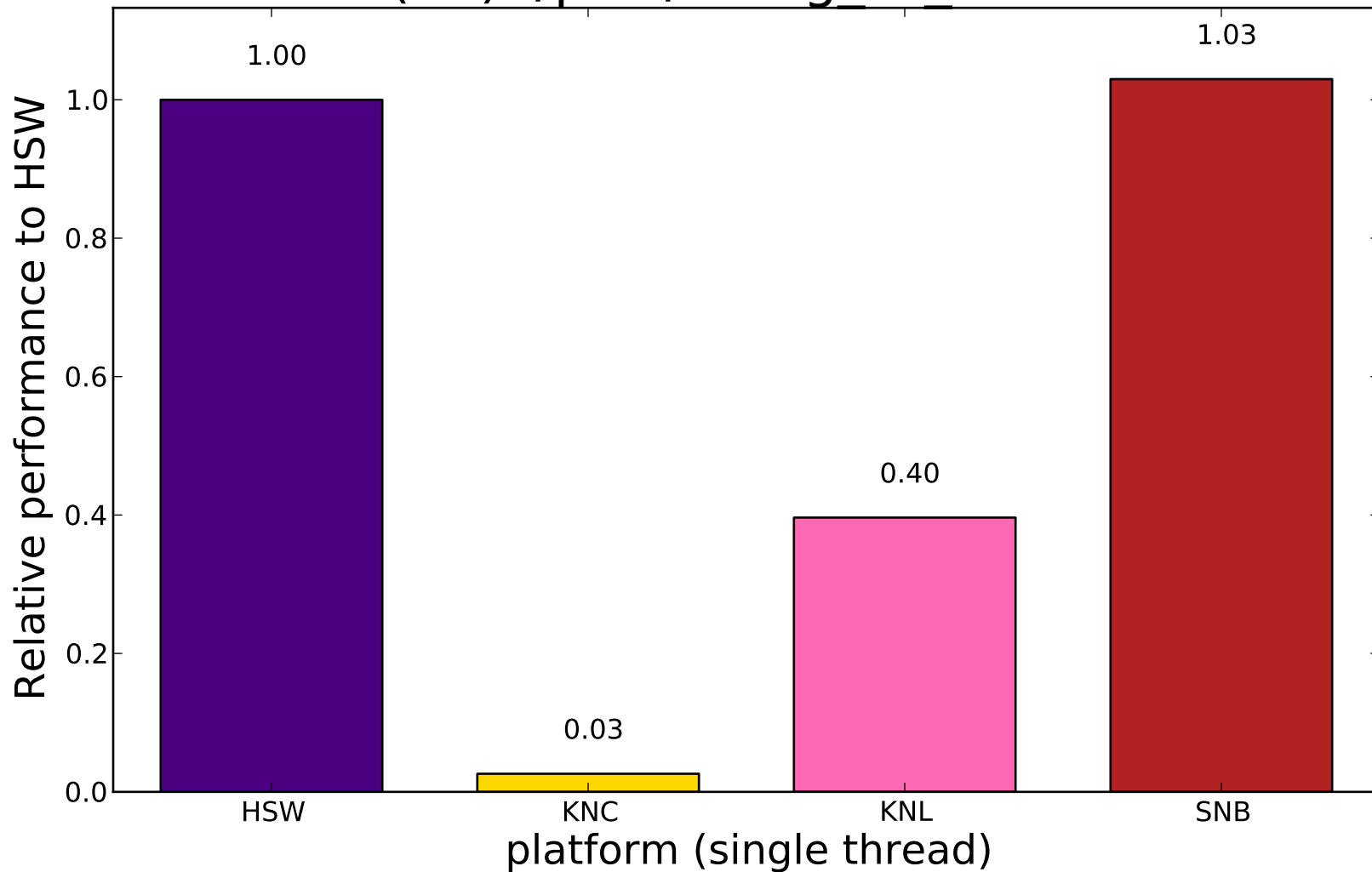
(20) ./port/port\_binterp



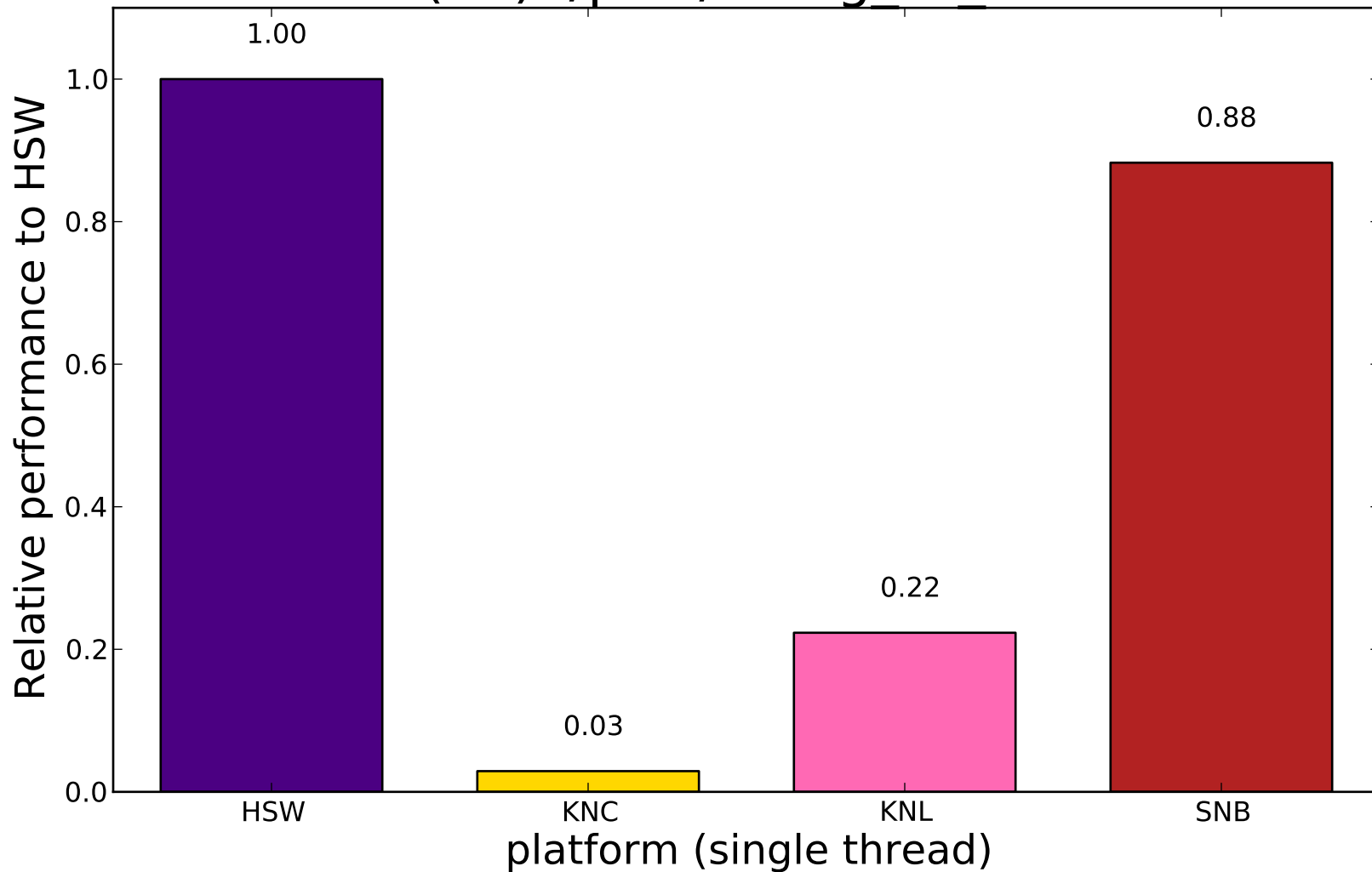
(21) ./port/rrtmg\_lw\_cldprmc



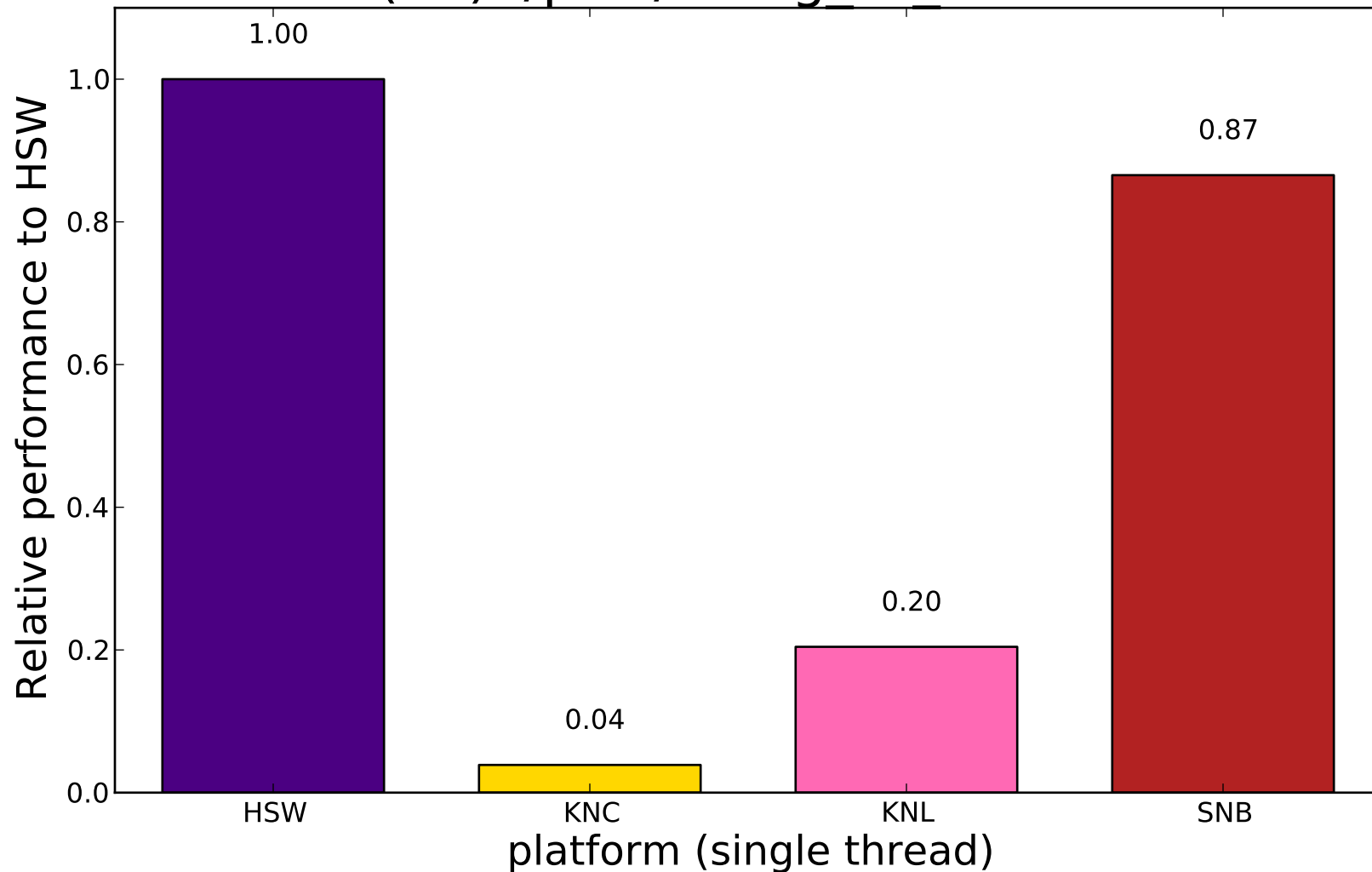
(22) ./port/rrtmg\_lw\_inatm



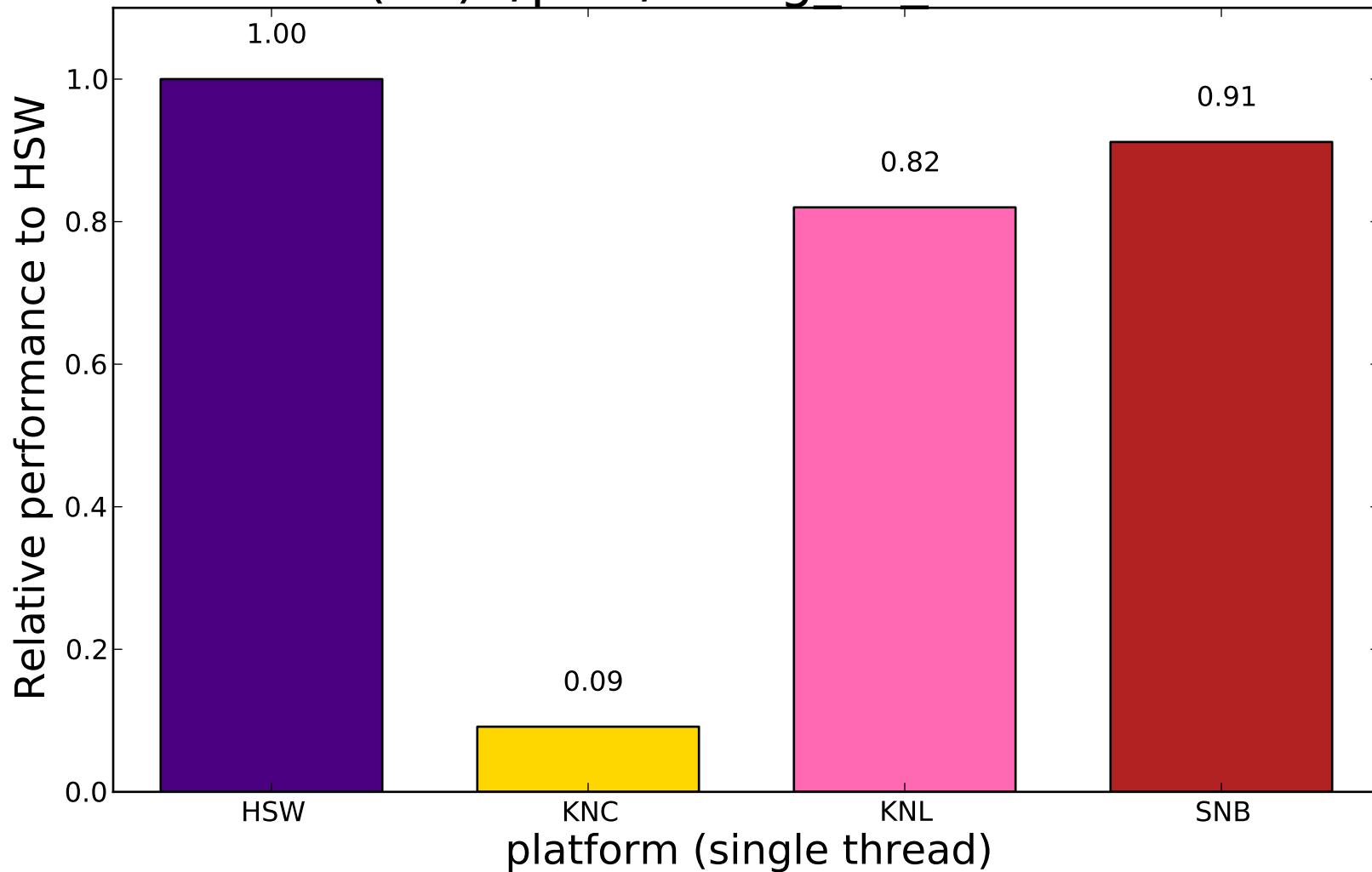
(23) ./port/rrtmg\_lw\_rad



(24) ./port/rrtmg\_lw\_rtrnmc

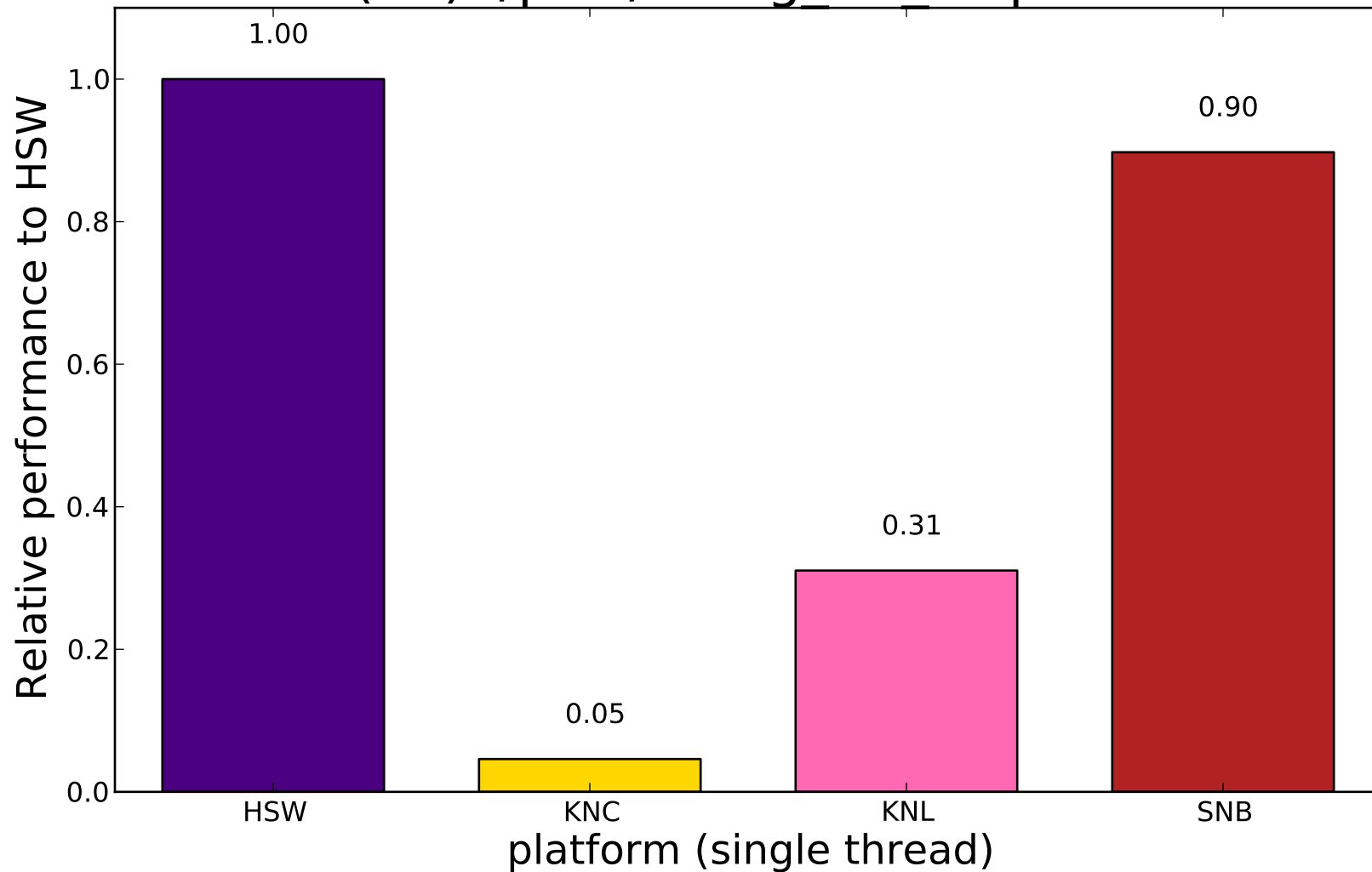


(25) ./port/rrtmg\_lw\_setcoef

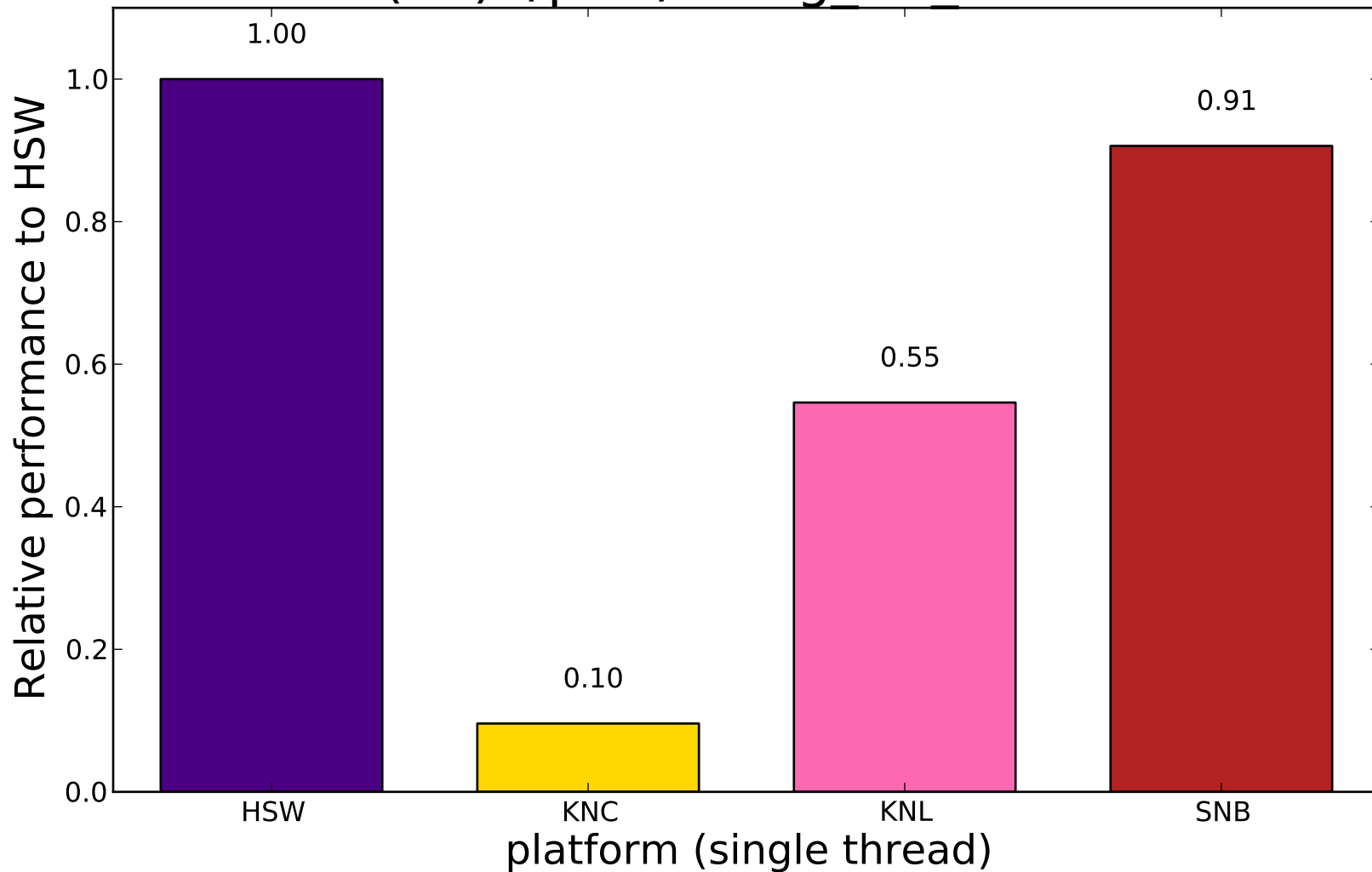




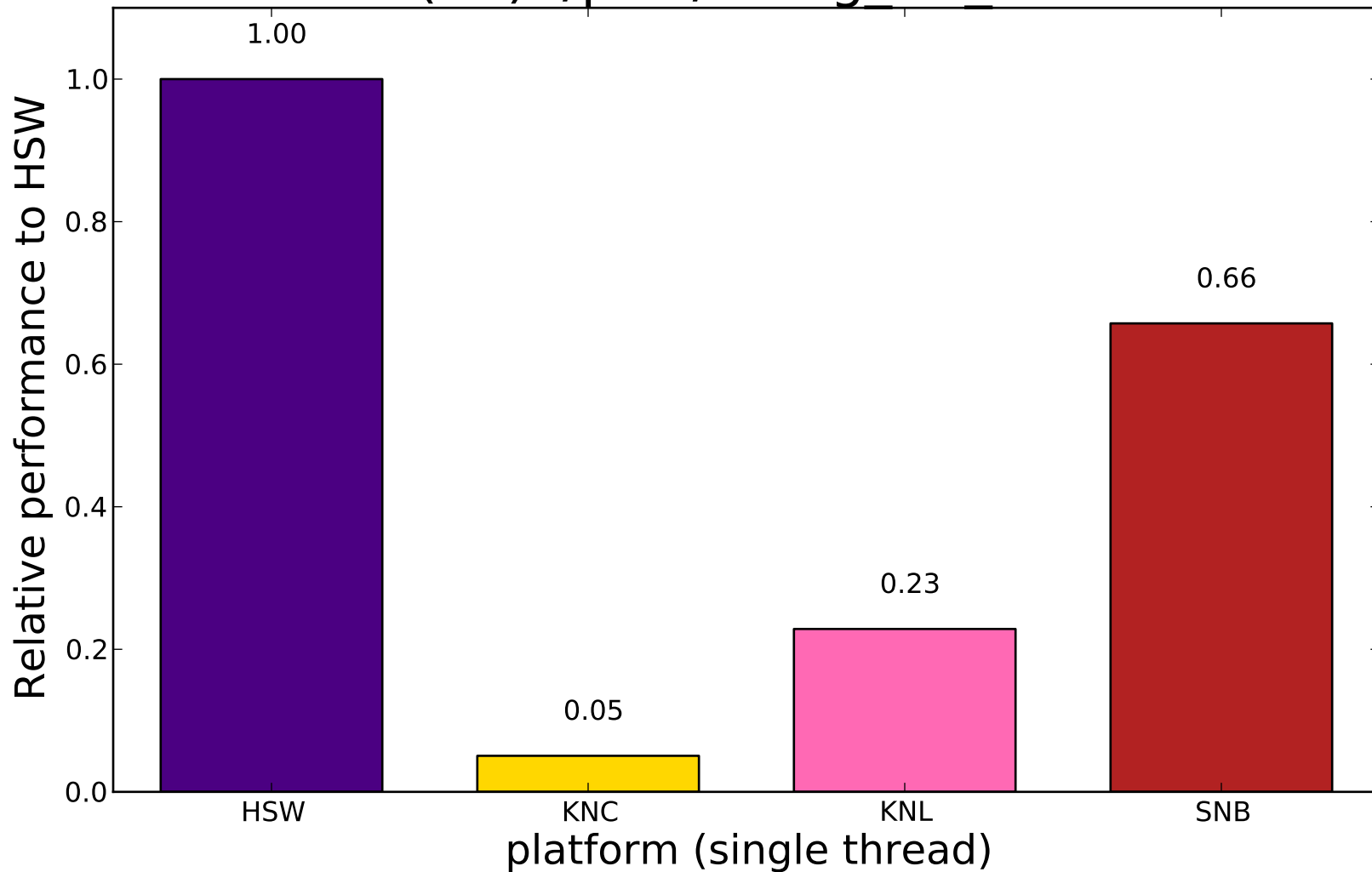
(26) ./port/rrtmg\_sw\_cldprmc



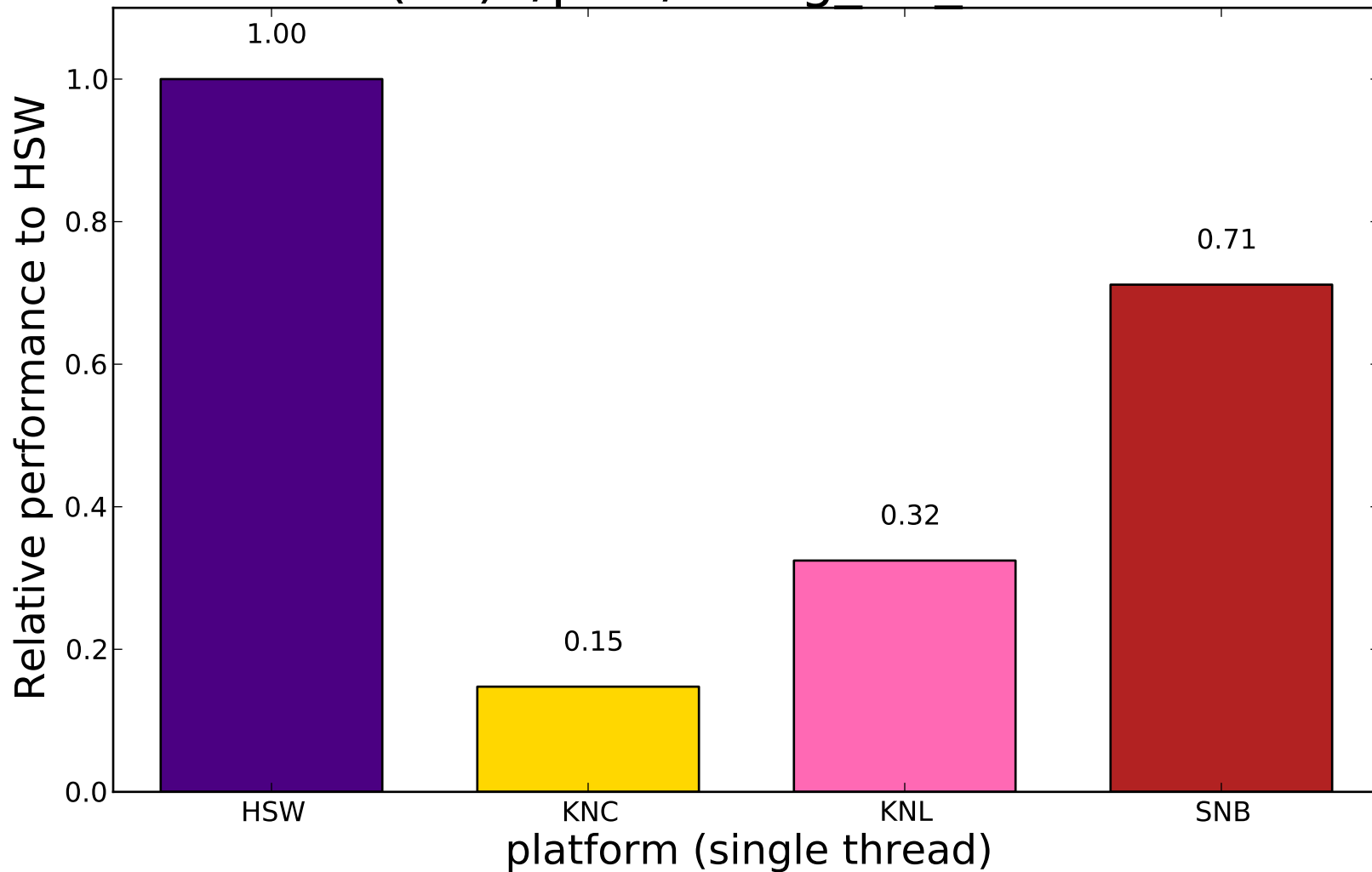
(27) ./port/rrtmg\_sw\_inatm



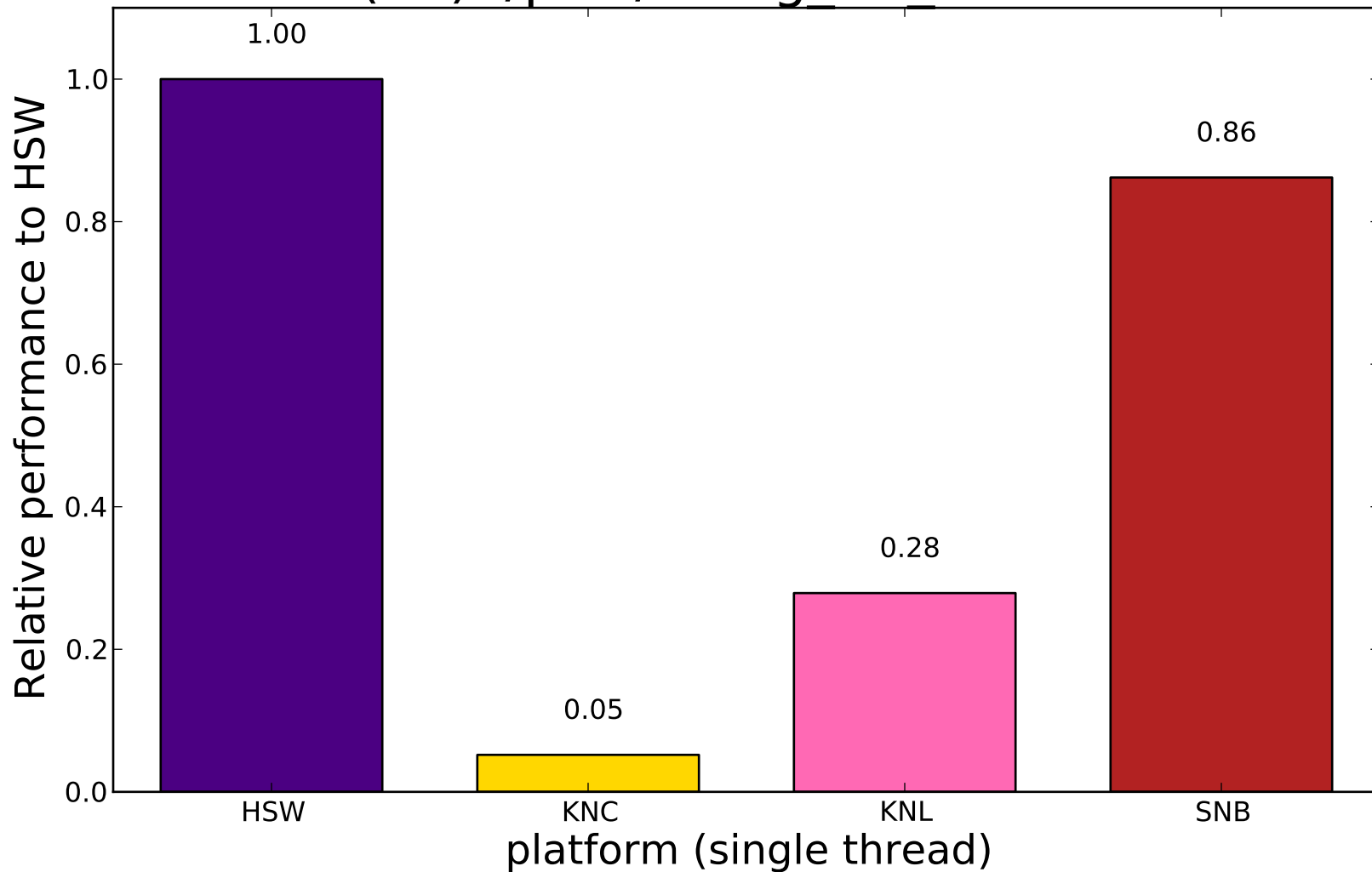
(28) ./port/rrtmg\_sw\_rad



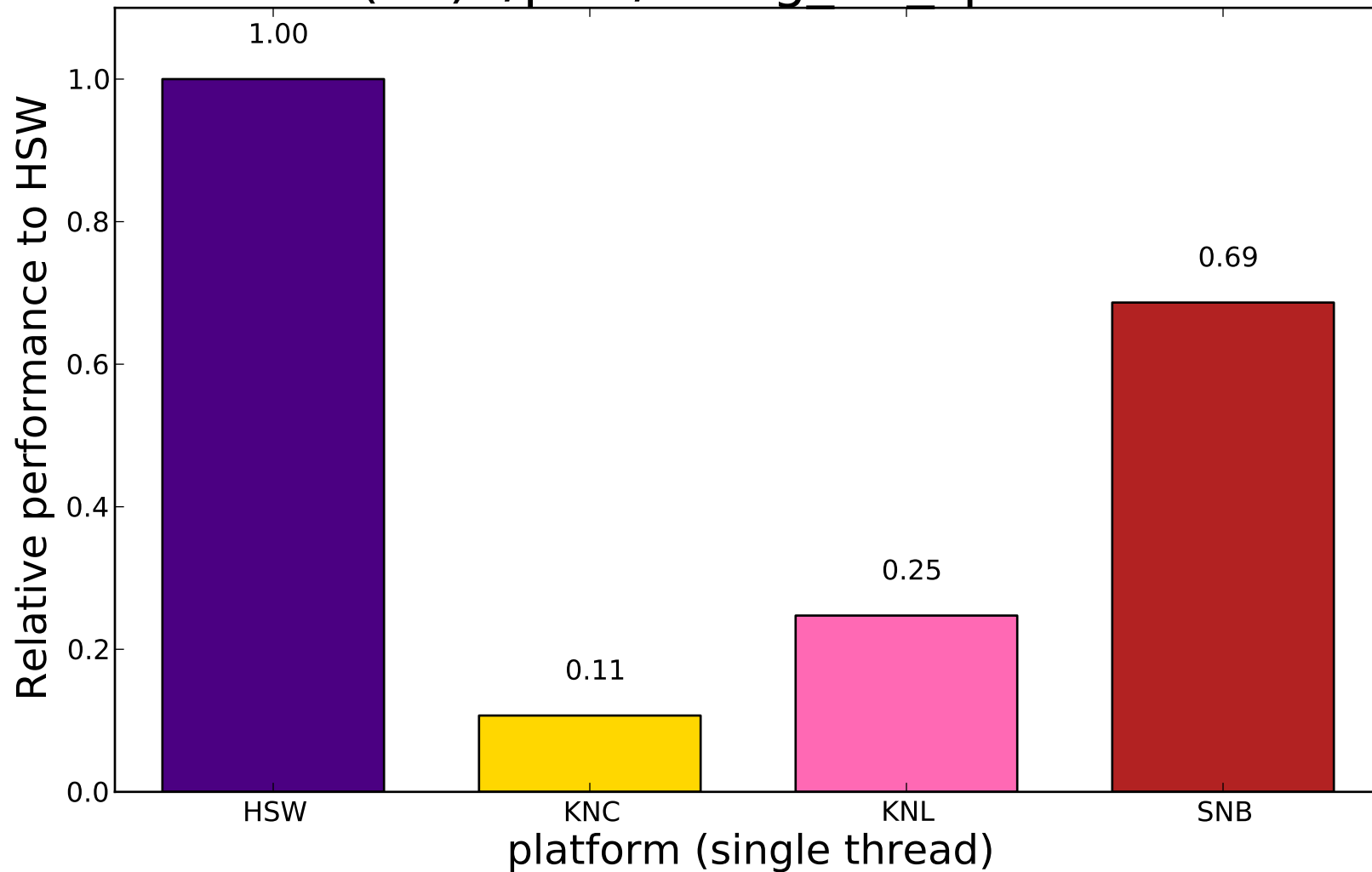
(29) ./port/rrtmg\_sw\_reftra



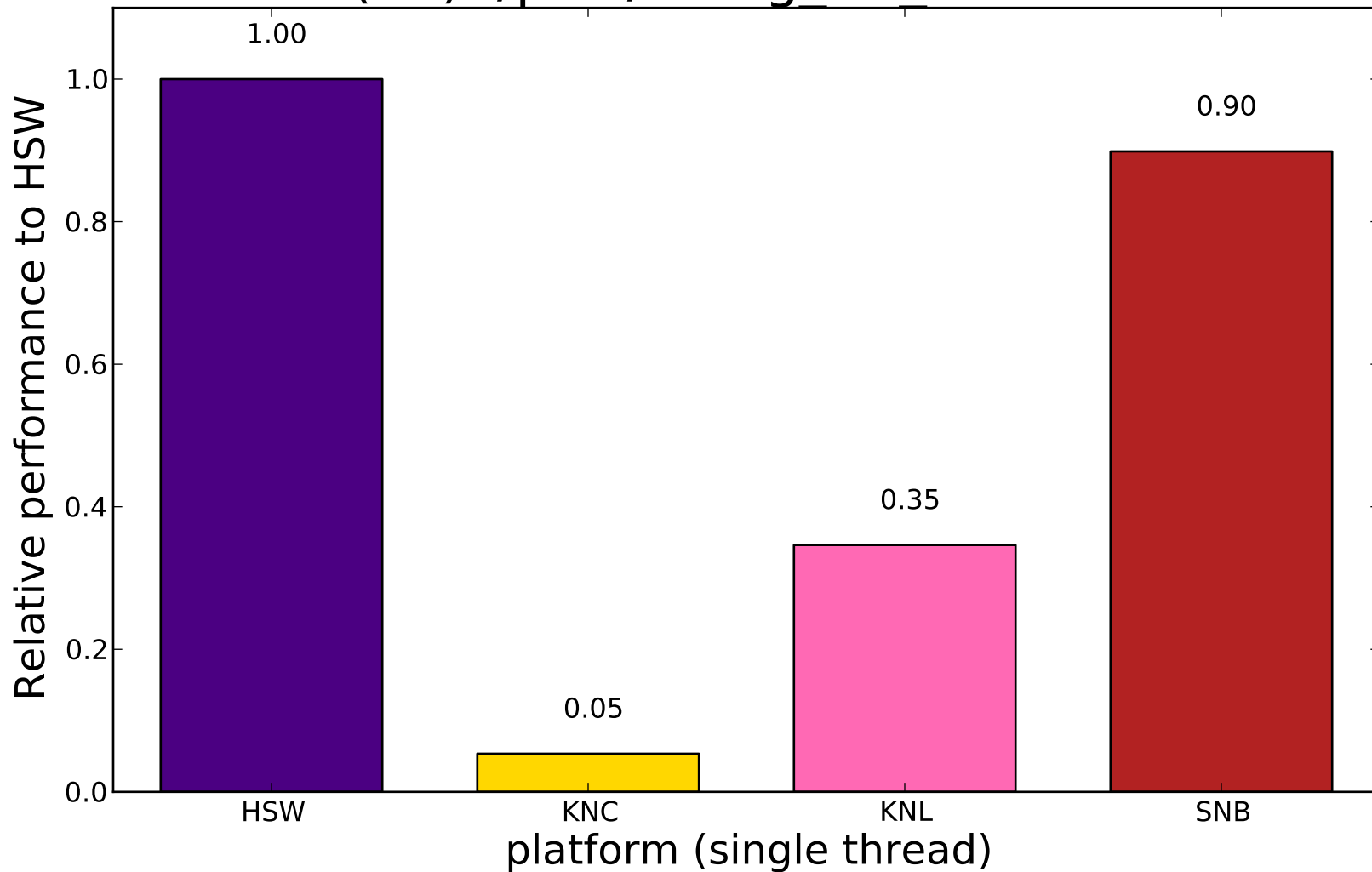
(30) ./port/rrtmg\_sw\_setcoef



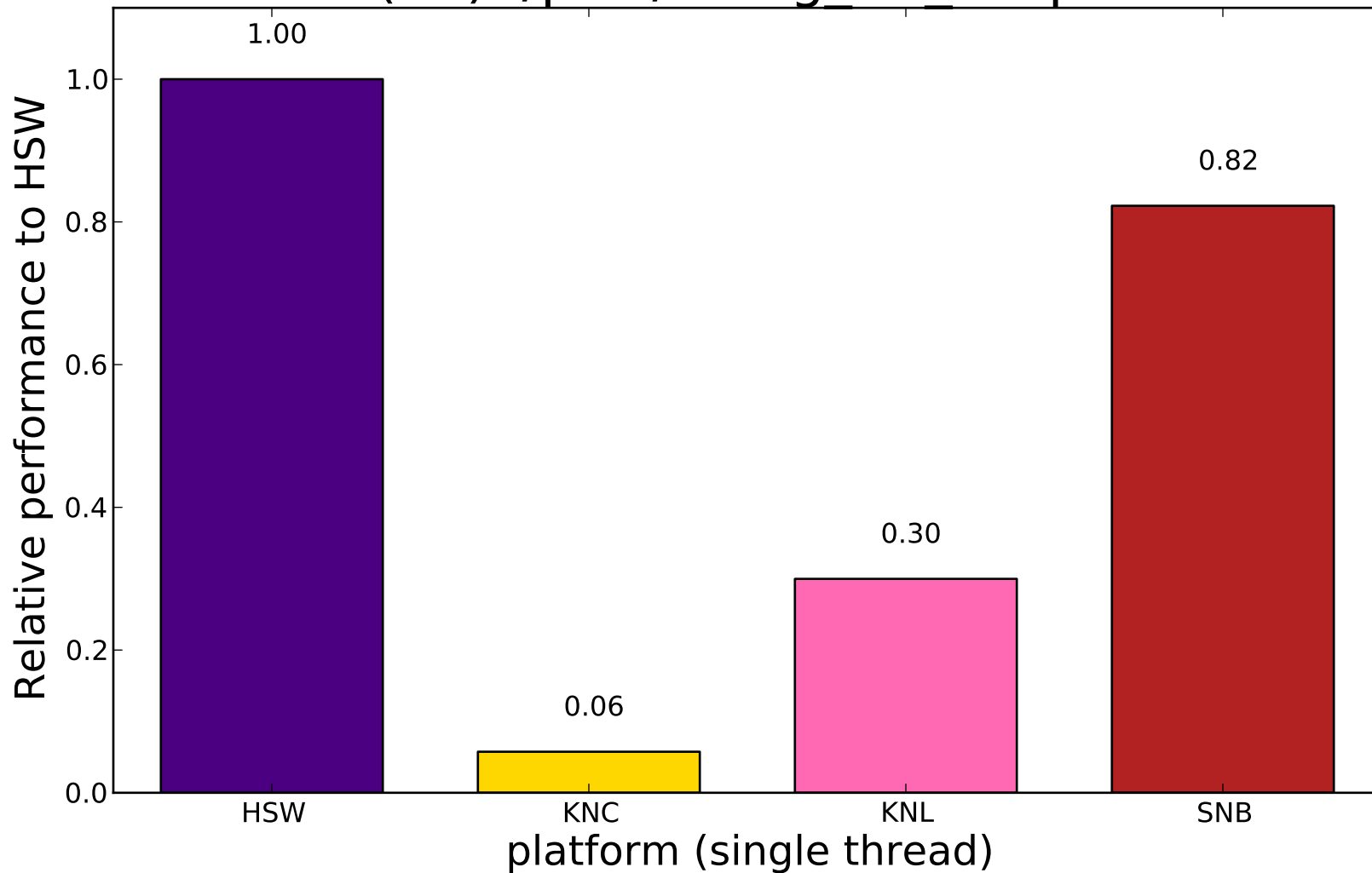
(31) ./port/rrtmg\_sw\_spcvmc



# (32) ./port/rrtmg\_sw\_taumols

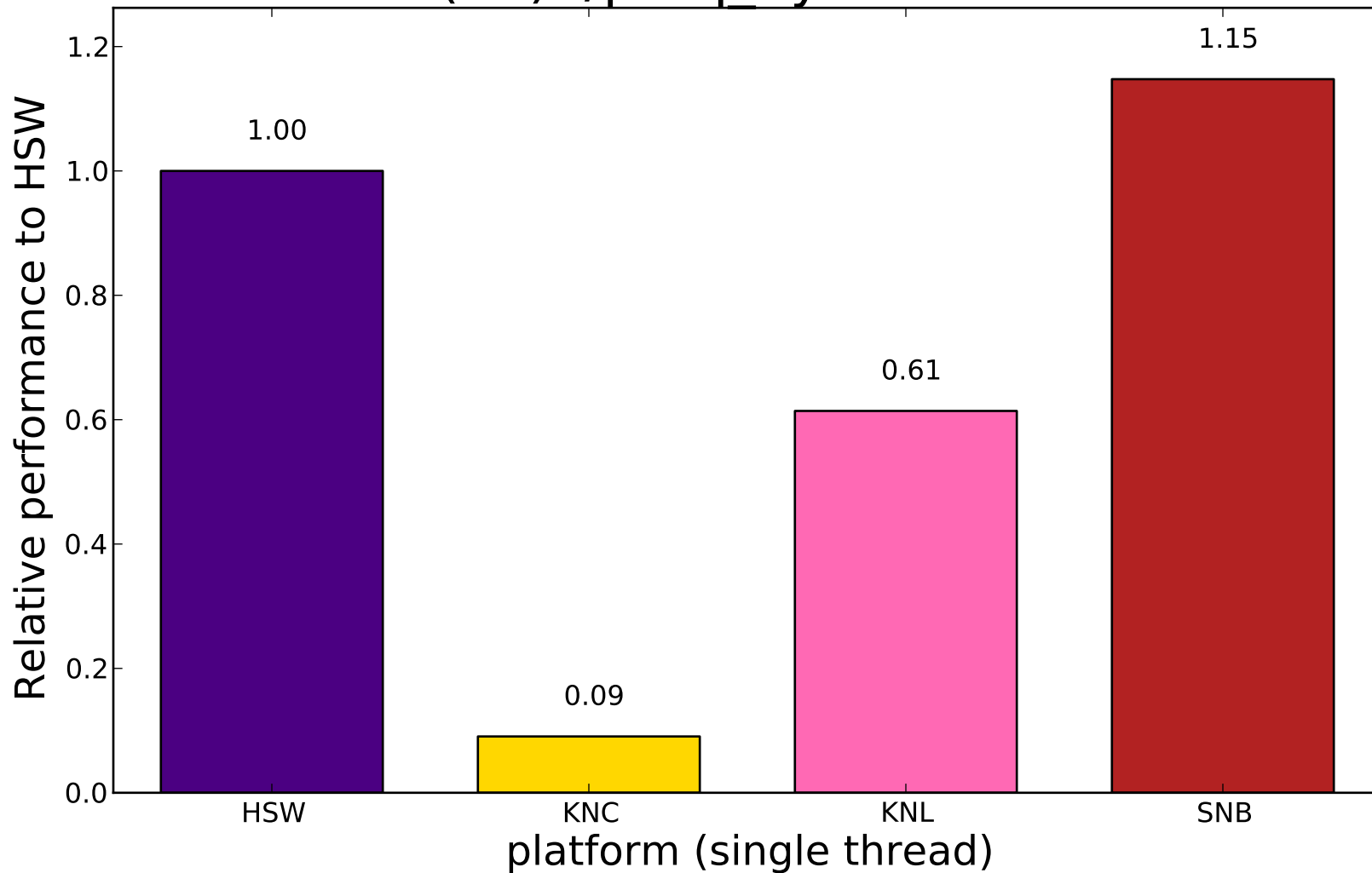


(33) ./port/rrtmg\_sw\_vrtqdr

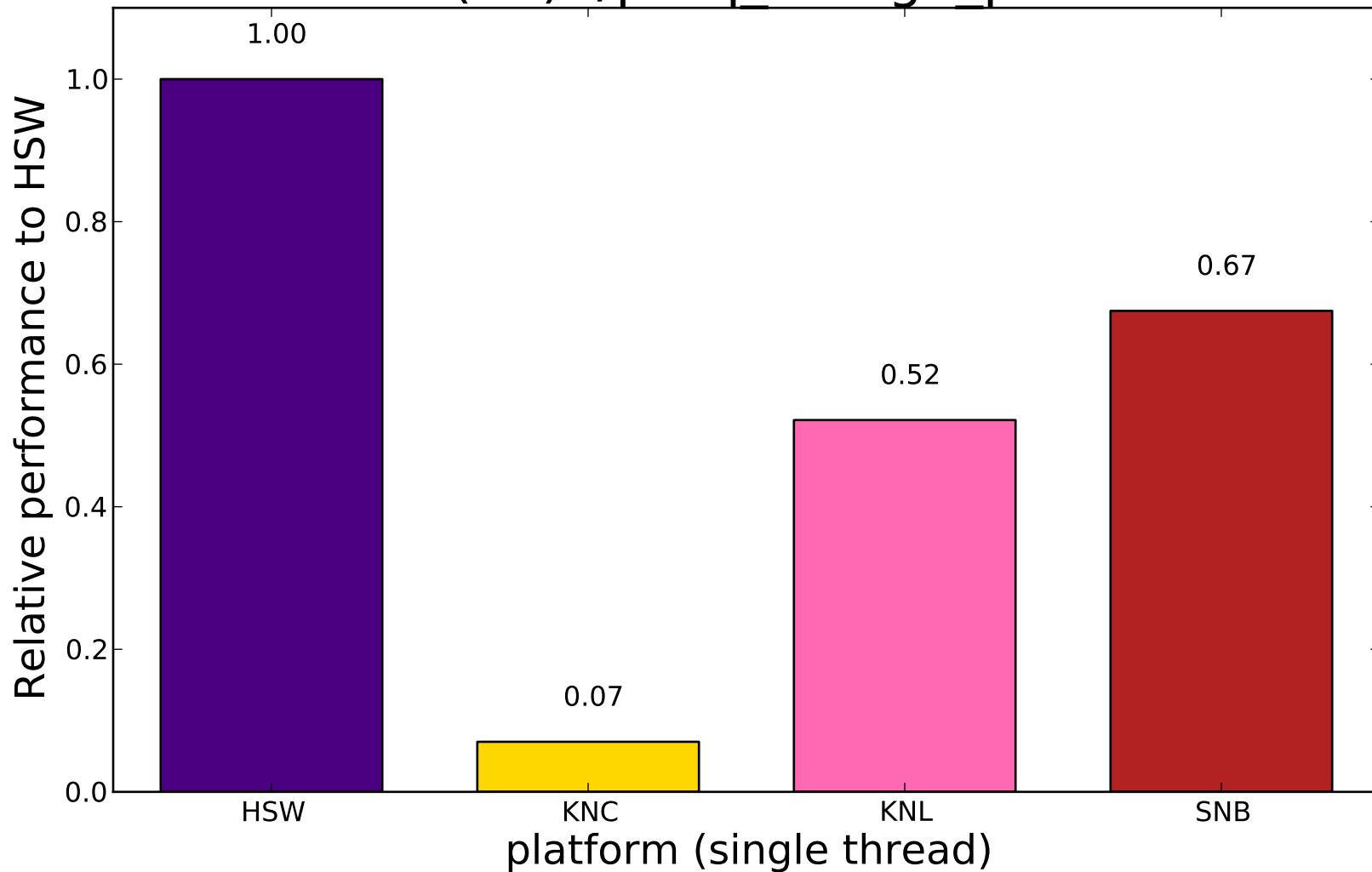




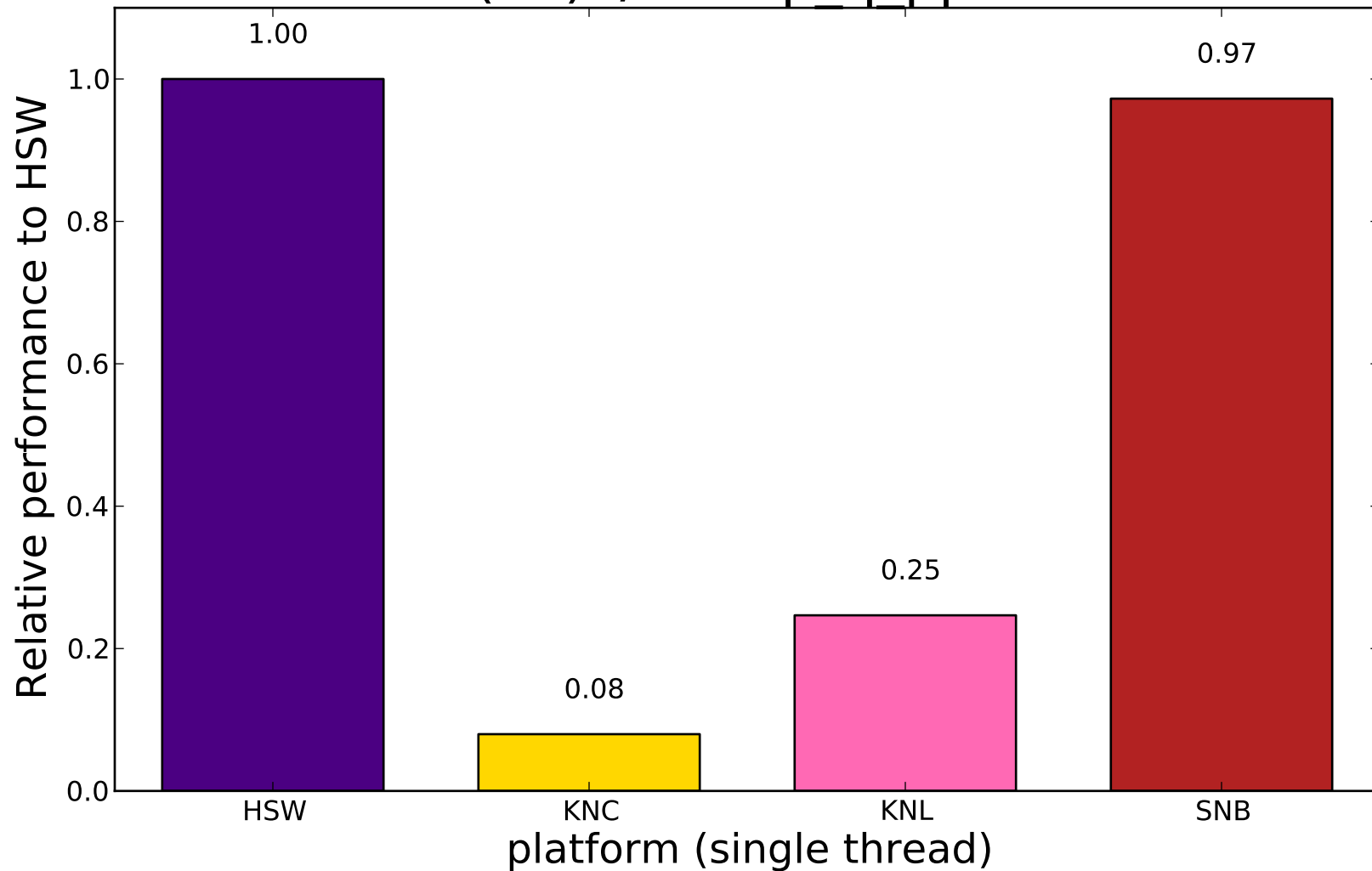
(34) ./preq\_hydrostatic



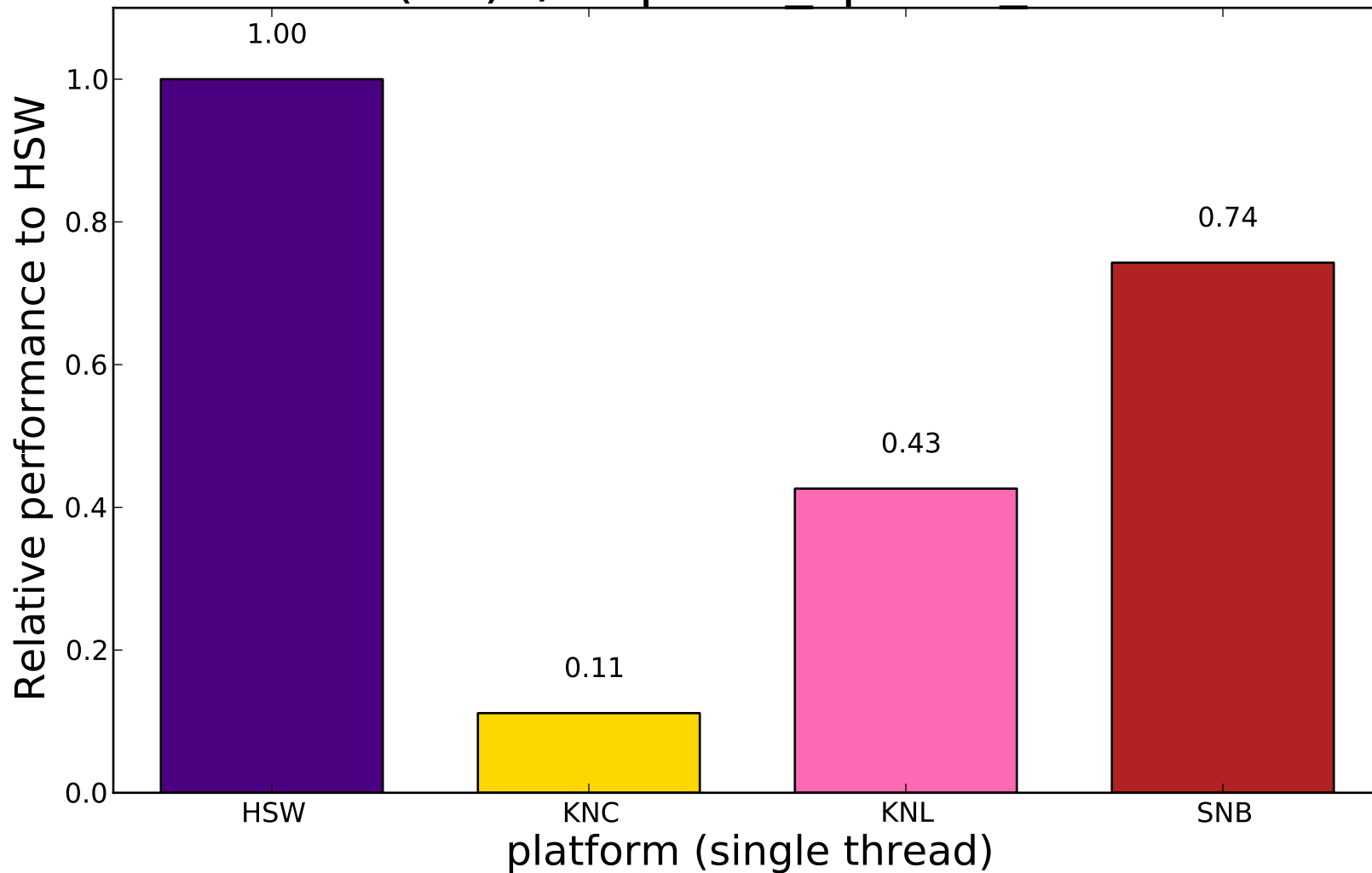
(35) ./preq\_omega\_ps



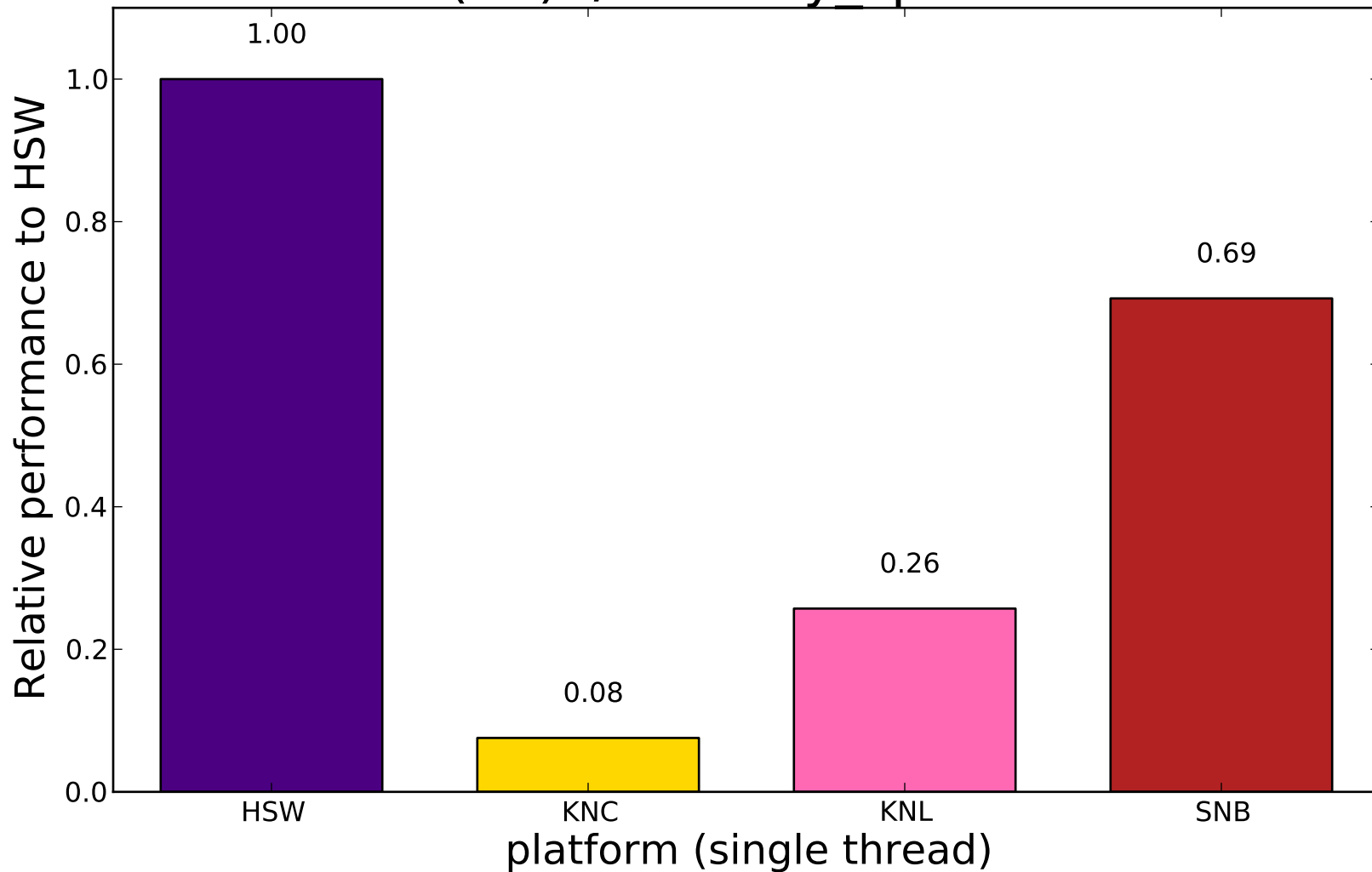
(36) ./remap\_q\_ppm



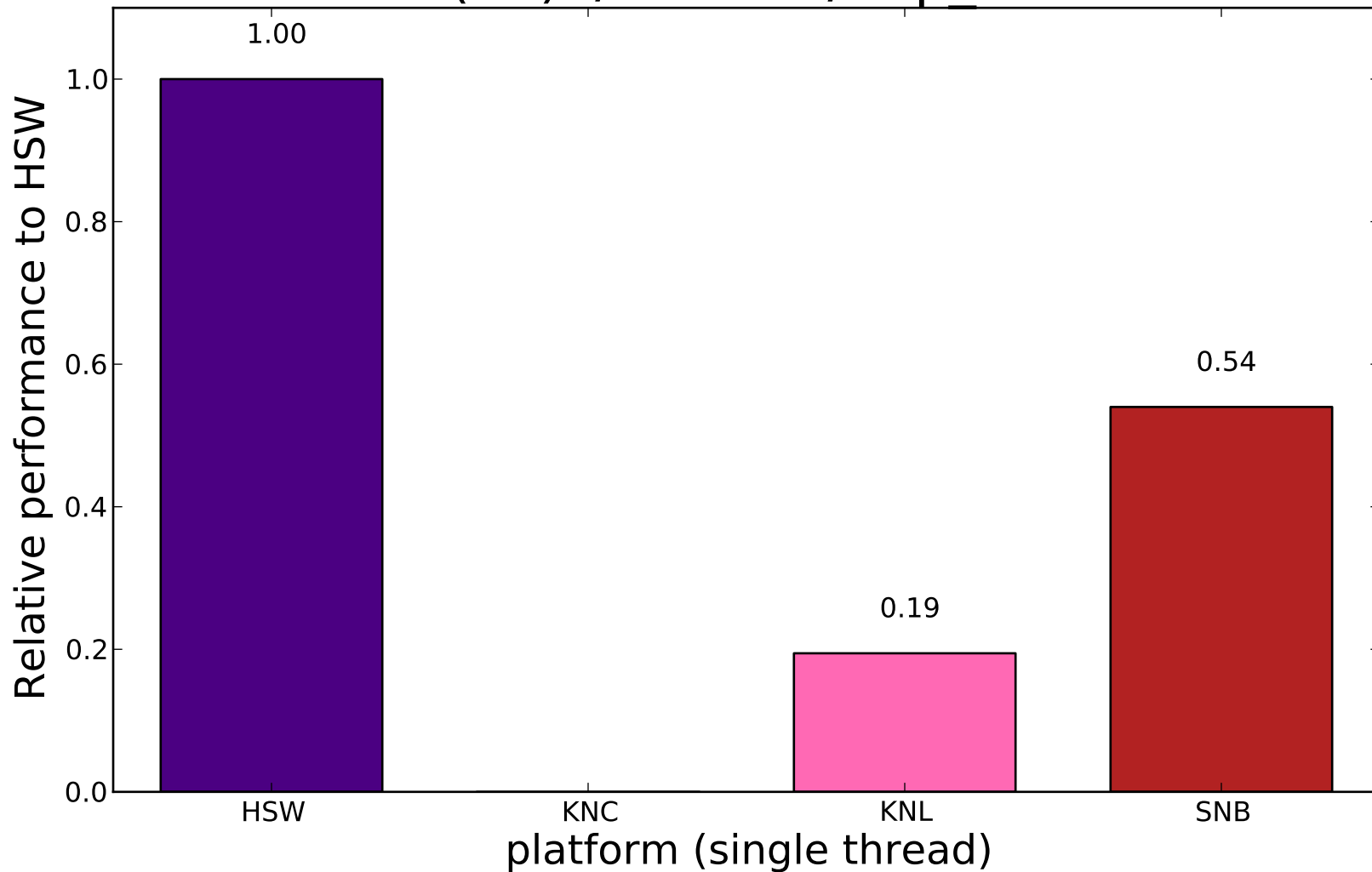
# (37) ./vlaplace\_sphere\_wk



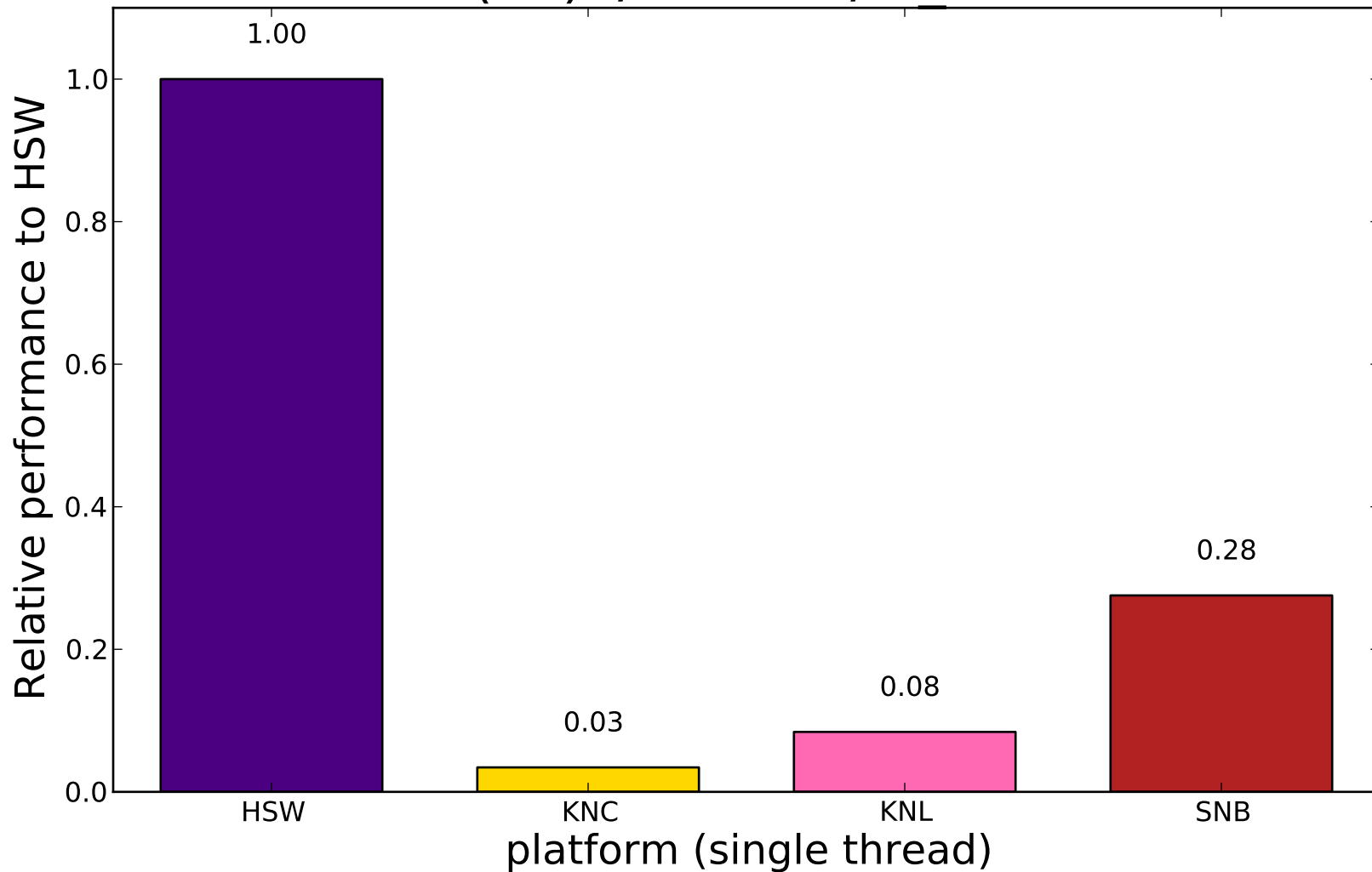
# (38) ./vorticity\_sphere



(39) ./WACCM/imp\_sol



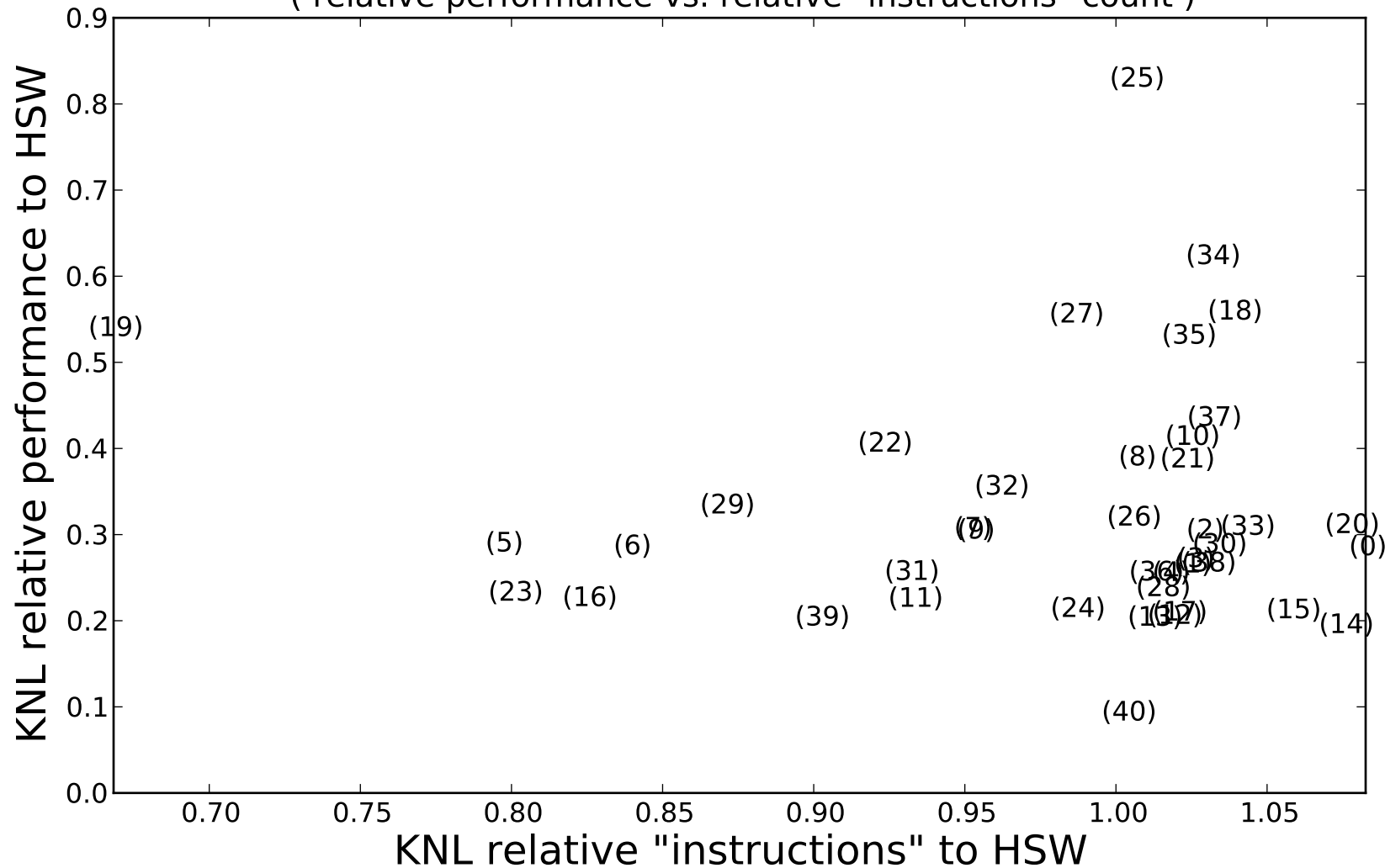
# (40) ./WACCM/lu\_fac



# Cluster Analysis with Linux "perf stat" H/W counters

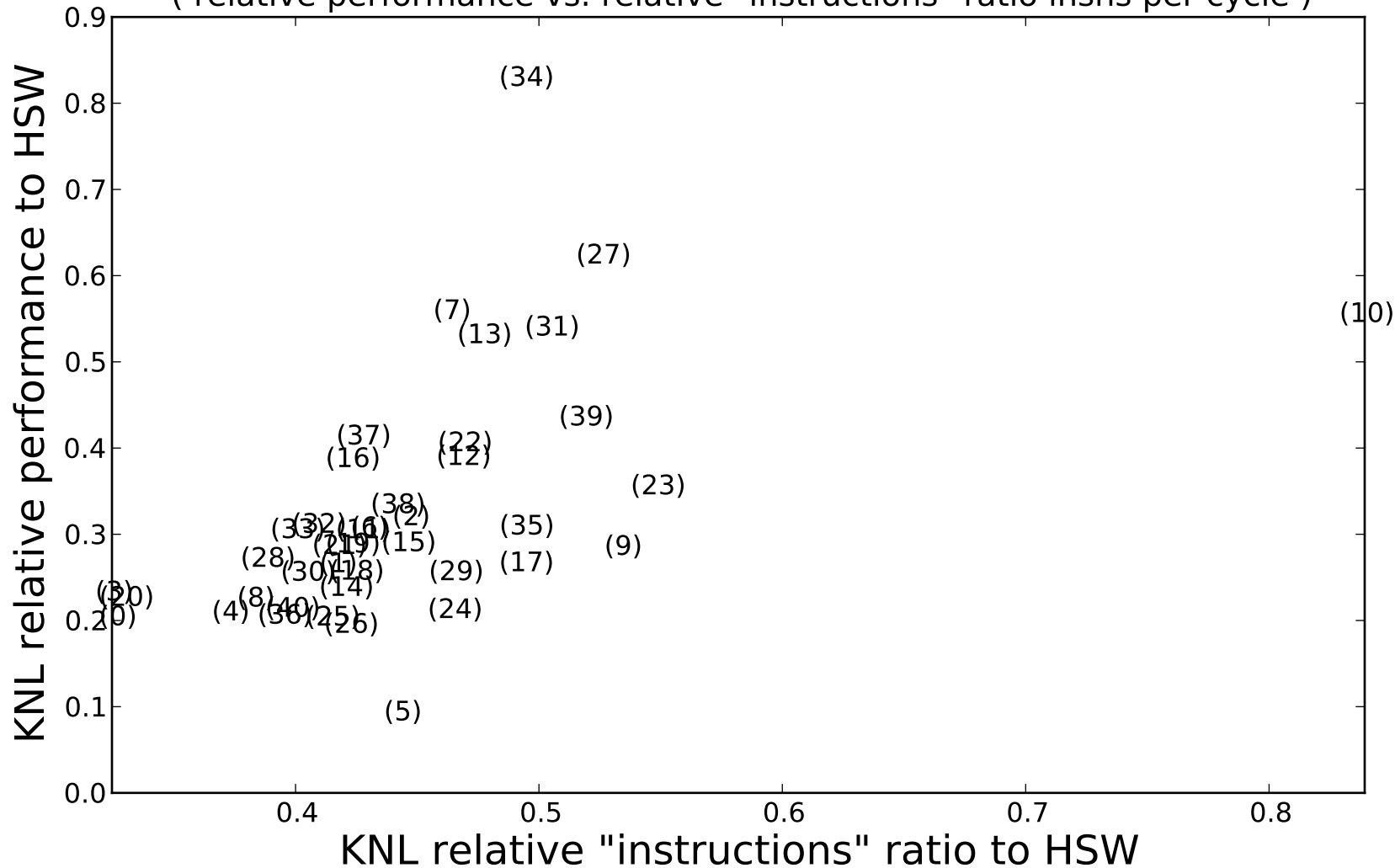


Cluster Analysis of KGen kernels  
( relative performance vs. relative "instructions" count )

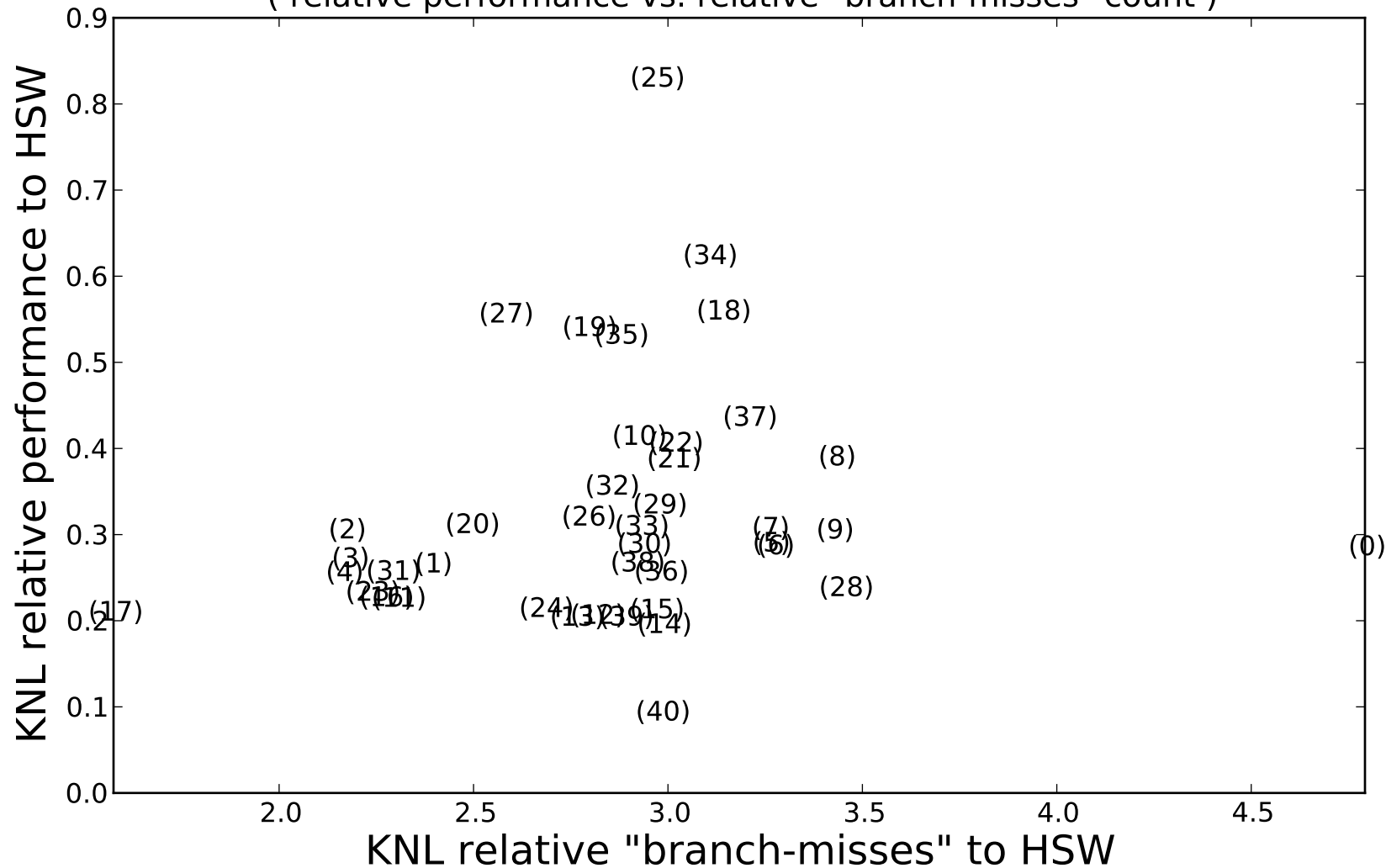


# Cluster Analysis of KGen kernels

( relative performance vs. relative "instructions" ratio insns per cycle )

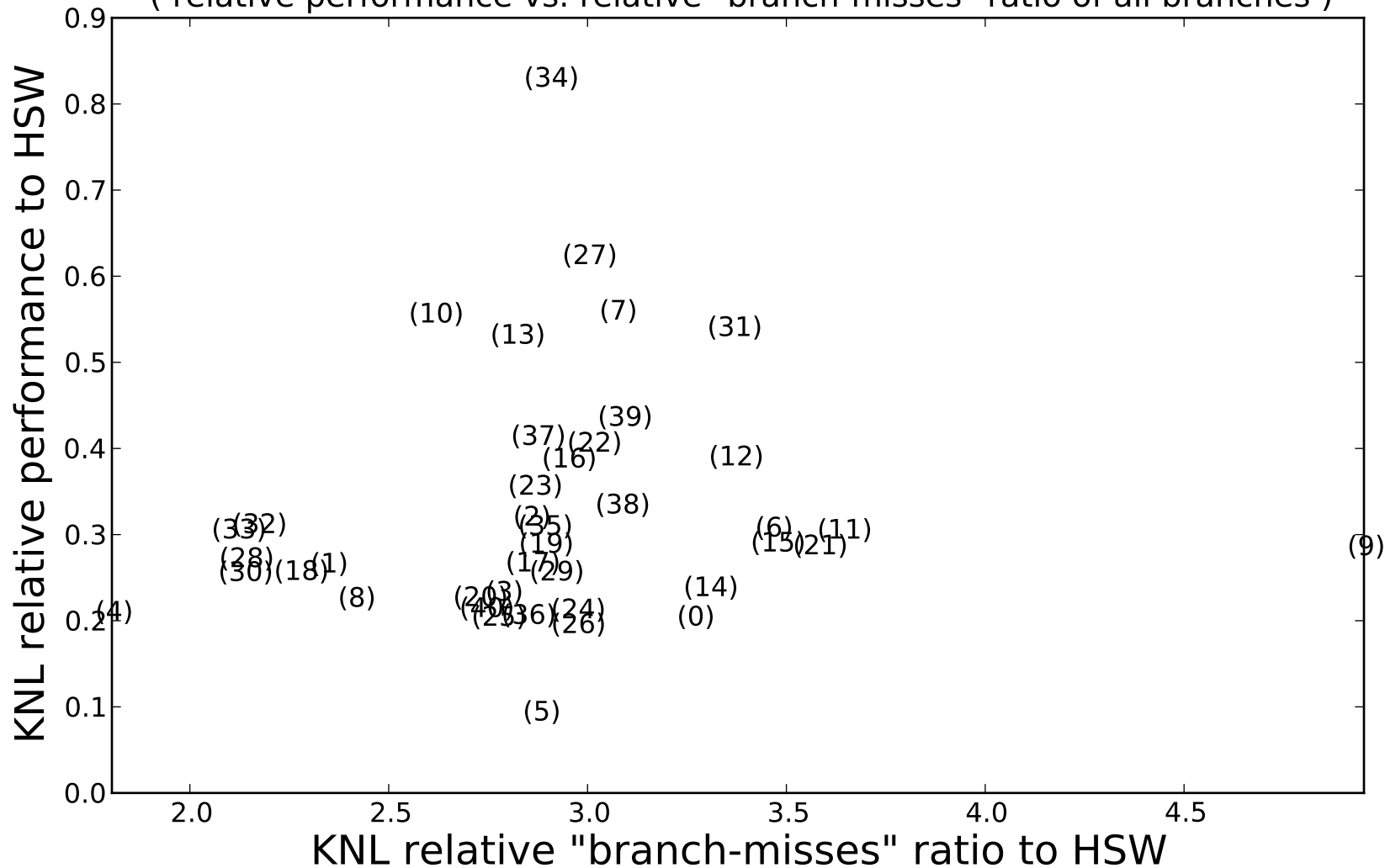


Cluster Analysis of KGen kernels  
( relative performance vs. relative "branch-misses" count )

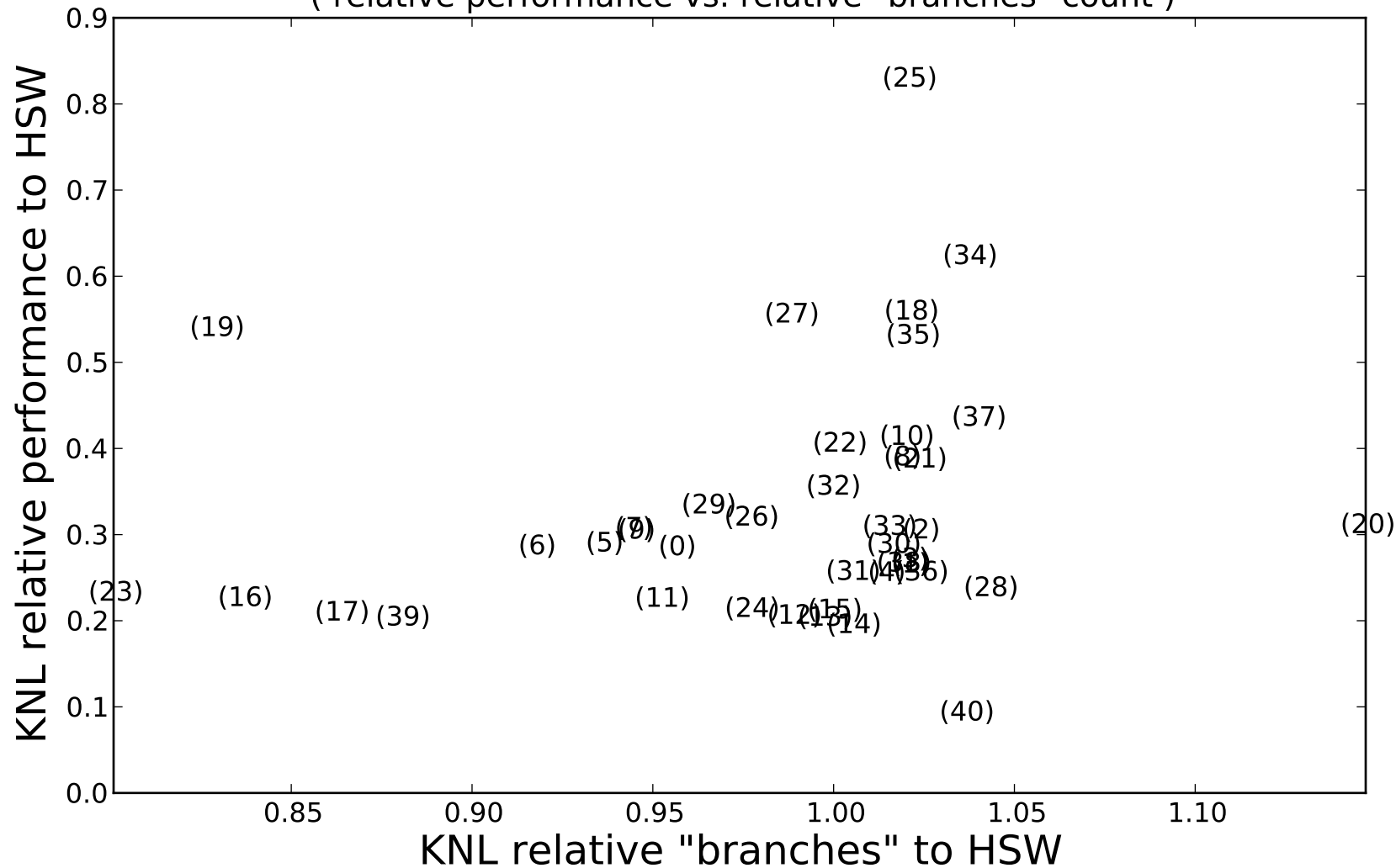


# Cluster Analysis of KGen kernels

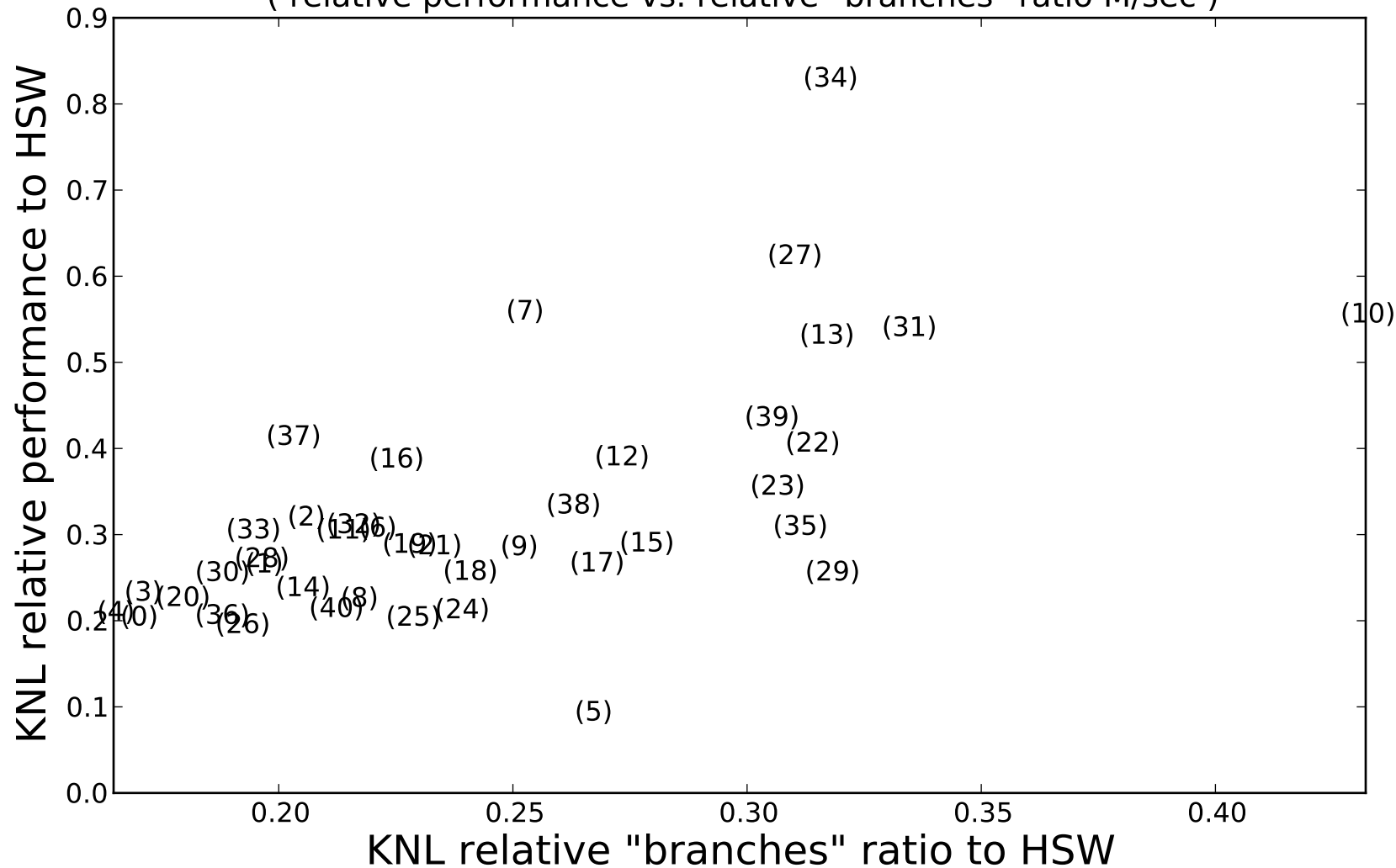
( relative performance vs. relative "branch-misses" ratio of all branches )



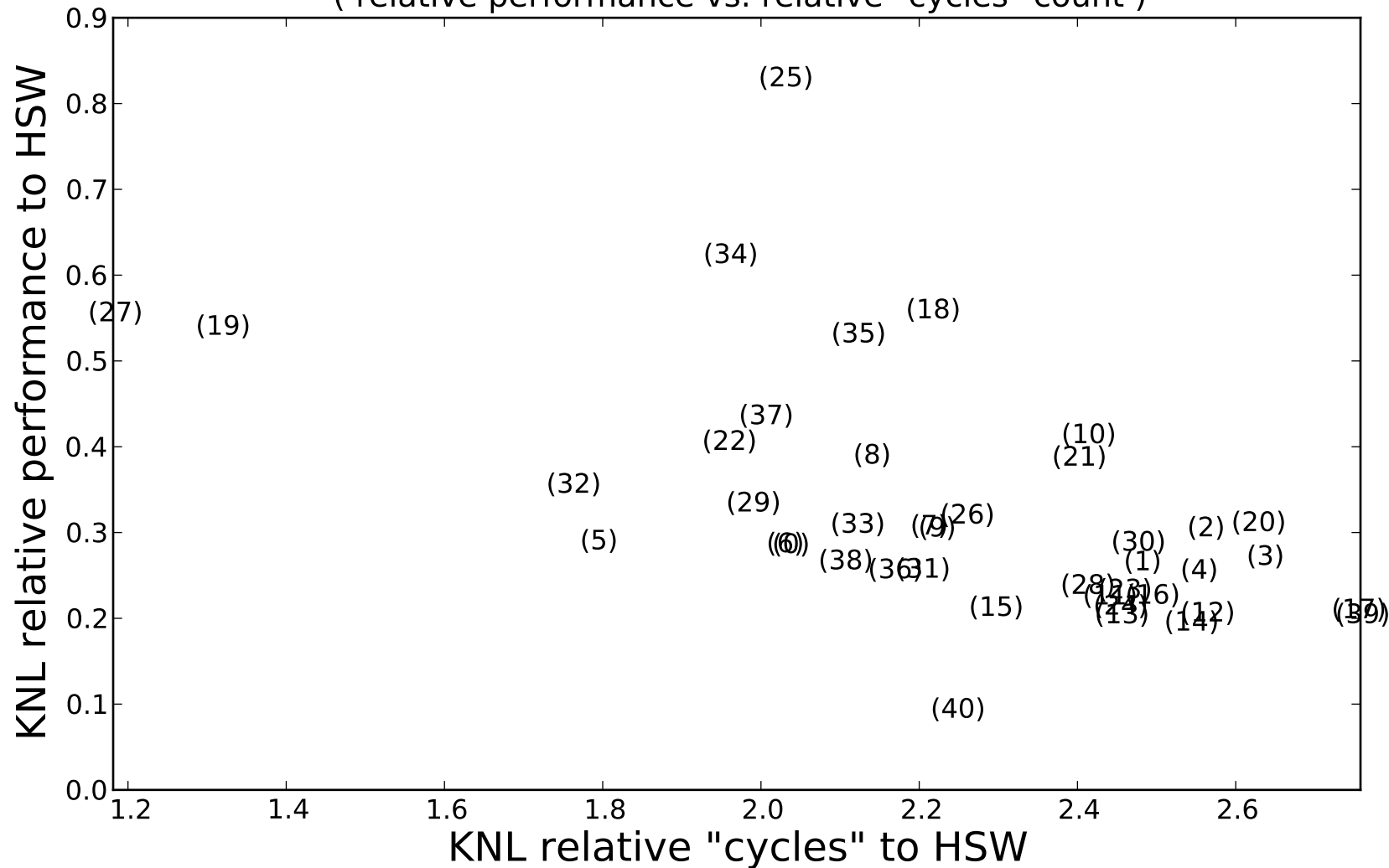
Cluster Analysis of KGen kernels  
( relative performance vs. relative "branches" count )



Cluster Analysis of KGen kernels  
( relative performance vs. relative "branches" ratio M/sec )



Cluster Analysis of KGen kernels  
( relative performance vs. relative "cycles" count )



Cluster Analysis of KGen kernels  
( relative performance vs. relative "cycles" ratio GHz )

