Machines are benchmarked by code, not algorithms

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May 11, 2014

Abstract

This article highlights how small modifications to either the source code of a benchmark program or the compilation options may impact its behavior on a specific machine. It argues that for evaluating machines, benchmark providers and users be careful to ensure reproducibility of results based on the machine code actually running on the hardware and not just source code. The article uses color to grayscale conversion of digital images as a running example.

Contents

1 Introduction 2

2 Example 2

2.1 Work definitions ................................................. 3
2.2 Example result report ....................................... 3
2.3 Language and operating software ............................ 3
2.4 I/O overheads .................................................. 5
2.5 Traversal order .................................................. 5
2.6 Loop nesting ..................................................... 7
2.7 Data types and operation widths ......................... 7
2.8 Compiler ......................................................... 11
2.9 Compiler optimizations ................................... 11

3 Summary and conclusion 11
1 Introduction

In computer science, hardware providers use benchmarks to demonstrate their technology. A benchmark suite should be composed so that each of the benchmarks exercises features of the technology in a way that is representative of a larger class of programs. Two desirable properties oppose each other when designing a suite: it should be as concise as possible to minimize the time and effort necessary to run; and as complete as possible so as to evaluate the most features.

Conciseness is easy to measure, even without understanding the suite. In contrast, measuring completeness requires understanding the technology and how the suite exercises its features. To facilitate this, practitioners usually characterize individual benchmarks using general traits, and describe separately how groups of features in the technology are collectively exercised by each trait. For example, a benchmark can be said to be “memory intensive”, with the general understanding that memory intensive programs will exercise the memory subsystem of the computer more than the processor or its I/O facilities.

Meanwhile, another reality of computer science is automatic program transformation. Benchmarks are rarely expressed by their authors in the same language used by the machine to run them. Compilers, and particularly optimization algorithms in compilers, can radically change the structure of a program, depending on configuration or from one version of a compiler to another. This reality entails the main argument of this article: machine features are ultimately exercised by the machine code of benchmark programs, not their source code.

The following corollaries should serve as words of caution for newcomers to the “art” of designing and using benchmarks:

1. a single benchmark program can test different machine features depending on which compiler and optimization options are being used;
2. small code changes to a benchmark that keep the overall function of an algorithm identical can change the set of machine features the program is exercising, depending on compiler and optimizations;
3. it is not sufficient to describe the algorithm or the source code of a benchmark to characterize which features of the technology it exercises.

What to do about this? A gentle reminder seems in order:

1. do not claim directly which machine features a program exercises unless you know the machine code being run;
2. do not use different compilers or optimization settings than those recommended by benchmark providers unless you understand how your choice will impact the machine behavior;
3. do not change a benchmark source code until you understand how changes impact the machine behavior after compilation;
4. if the program code implicitly depends on third-party components at run-time (e.g. operating system services), do not use different components than those recommended by the benchmark providers unless you understand how your choice will impact the machine behavior;
5. when presenting results, ensure both full reproducibility of the results and access to the program sources, compiler sources, operating software and platform specification so that the audience can cross-check the results.

Reproducibility, eg. by making the machine code available, is a general requirement of the scientific method; access to sources is specific to computer science and made necessary by the sheer complexity of duplicating platforms and reverse-engineering machine code to understand what it does.

The rest of this article illustrates this point throughout a running example from digital imaging.

2 Example

A common operation in photography is the conversion of colored pictures into “black&white” or shade of grays. With digital images, a discretization of the image into pixels is assumed. An image is then characterized by a discrete domain of pixel coordinates, and the value at each position in the domain. The “color to grayscale conversion” can be generally described for arbitrary domains using a pixel-to-pixel numerical conversion, for example:

\[ \text{rgb to gray}_{\text{pixel}}(r, g, b) = 0.3 \times r + 0.59 \times g + 0.11 \times b \]
This specific formula accounts for the greater sensitivity of the human eye for green and blue relative to red. Given this pixel conversion function, the conversion of an entire image can then be defined as the application of the function to all pixels in the domain. This general definition is already suitable as an algorithm in a declarative functional language. However, this specification alone is not sufficient to define a benchmark because it does not define any work: a dataset to be operated on, with a specific workload in terms of image size, value types, data structure for pixels, etc.

### 2.1 Work definitions

In general, a work definition includes at least:

- the program implementation, defining both the computation algorithm(s) and the plumbing code that “connects” the algorithms to the environment;
- a description of the program interface of the benchmark which indicates to the user how to run the program, what input it accepts and what output it produces; and
- a set of reference workloads that the benchmark should be run with in order to produce comparable results.

An example work definition can be phrased as follows.

- implementation: the computation algorithm and I/O code are given in Haskell in listing 1. The concrete data structures and the strategy to perform the computation are provided by the Repa and DevIL libraries;
- interface: the input and output file names are given as first and second positional arguments on the command line. Although this specific implementation happens to accept any input image format accepted by the DevIL library, the benchmark interface only mandates binary PPM input and binary PGM output;
- workloads: the benchmark should be run on input images of the sizes given in table 1. These sizes have been chosen to span a logarithmic range from 10 to 200M pixels, with multiples of both binary and decimal powers.

### 2.2 Example result report

The performance of this benchmark on the author’s workstation is pictured in fig. 1. This graph reports the minimum execution time from five runs for each of the input sizes in table 1. The title of the graph reports the platform where the program was run.

Since the execution time is expected to be linear in its input size, a more direct impression of the performance can be obtained by normalizing, i.e. dividing the observed execution time by the input size. As the result in fig. 2 shows, this program’s performance increases with the input size until approximately size 10000, beyond which the performance stays stable at around 6\(\mu\)s/pixel.

### 2.3 Language and operating software

Both the programming language, its compiler and the surrounding operating software impact the performance of a given algorithm.

Consider for example the alternate C implementation of the previous benchmark, given in listings 2 and 3. This can be compiled with either listing 8 to use the same DevIL library as the Haskell code from listing 1 for image I/O, or using listing 9 to use POSIX system calls for I/O instead.

As the results in fig. 3 show, there are large performance differences depending on which software stack is used. In this example, the C implementation using the same image I/O routines (DevIL) is about 10\(\times\) faster than the Haskell implementation. When using the same C code but the POSIX I/O routines instead of DevIL, another gain of 40\(\times\) is possible.

These differences are commonly called abstraction overheads, and are frequently accepted by programmers as the necessary price to pay to benefit from the higher-level languages and operating software services.
Performance
Running on MacBookPro7,1 :: OSX 10.6.8 :: Intel Core 2 Duo @ 2.4GHz :: 3MB cache
Haskell, GHC 7.4.2, DevIL I/O

Figure 1: Example performance of the program in listing 1 with image sizes from table 1.

Normalized performance
Running on MacBookPro7,1 :: OSX 10.6.8 :: Intel Core 2 Duo @ 2.4GHz :: 3MB cache
Haskell, GHC 7.4.2, DevIL I/O

Figure 2: Same results as fig. 1 normalized by input size.
Figure 3: Relative performance of different languages and operating software.

2.4 I/O overheads

Benchmark can be broadly classified into purely computational benchmarks, which only measure the performance of a program assuming all the data manipulated is already present “within the system”, and system benchmarks which also include the time to move data in and out of the system. The program presented above belong to the latter category, because the measured time to execute includes the time to load and store images from and to files.

To gain more insight into the behavior of a machine, it is usually desirable, when possible, to separate the I/O from the computation costs. We can do this with the C implementation from listing 2 by removing the body of the computation, leaving only the I/O code. By doing so, we can measure the I/O time in isolation, as demonstrated in fig. 4. Once the I/O time is known, it is possible to isolate the computation time by subtracting the I/O time from the total time.

An example of this separation is given in figs. 5 and 6. As these figures illustrate, when the I/O time dominates (fig. 6) it becomes difficult to extract a meaningful impression of the computation time in isolation. Meanwhile, as shown with fig. 5, the I/O time dominates as long as the working set fits in the cache; when the computation becomes memory-intensive the I/O time becomes comparatively smaller.

2.5 Traversal order

The order in which an algorithm accesses values in the machine’s memory may impact its performance. Consider for example the difference between listing 3 and listing 4. Listing 3 accesses the data in row-major order (RM), i.e. successive inner iterations access contiguous locations in memory. Listing 4 accesses the data in column-major order (CM), i.e. successive inner iterations access items in memory separated by a full row. Example results are given in fig. 7.

As this figure shows, caches can hide the impact of different traversal orders as long as the working set fits entirely in cache. When the working set becomes larger than the cache, the column-major order causes more cache misses and the performance degrades. Conversely, it is possible to deduce the overall cache size of a chip by observing at which working set size the performance of different traversal order diverges.
Figure 4: Relative performance of different I/O methods without computation.

Figure 5: Separate I/O and computation performance (POSIX I/O).
In this situation, the column-major traversal can be said to be more memory-intensive than the row-major traversal, and thus exercises the cache system more.

\section*{2.6 Loop nesting}

Control flow loops are the means in sequential code to apply an operation to the elements of an array. If the array is multi-dimensional, the straightforward encoding uses nested loops (listing 3). However, if the array data is contiguous in memory, it is usually possible to flatten nested loops to a single level, as in listing 5.

Although the resulting machine code performs the same arithmetic operations, and the total number of inner iterations stays the same, flattening can impact performance as shown in fig. 8. In this example, the flattened loop (1D) performs up to 13% faster than the nested loop (2D).

This difference can be explained by either a simpler index computation or a lower number of branch prediction misses. In other words, the nested loop implementation exercises more the integer arithmetic unit and the branch prediction / tolerance facilities of the processor than the flattened loop implementation.

\section*{2.7 Data types and operation widths}

Any numerical computation is translated to concrete machine code that operates on specific data types. A type determines both the representation of values as arrangements of bits, and the concrete implementation of the operations on these values. For a given computational problem, there may be multiple possible choices of types that would yield acceptable numerical results. Each of these possible types, in turn, translates to different machine code and thus different machine behavior.

For example, the general problem described at the start of section 2 can be computed using single precision floating point arithmetic (listing 6) or even integer arithmetic (listing 7) with no result differences visible by the human eye. As the results from fig. 9 show, on this particular machine and for this particular computational problem, the single precision performance can be up to 8% higher than double precision, and the integer performance up to 13% higher.
Figure 7: Relative performance of different traversal orders.
Figure 8: Relative performance of nested and flattened loops.
Figure 9: Relative performance of double precision, single precision and integer arithmetic.
From the perspective of characterization, the floating-point implementations exercises more the support for floating point in the architecture, whereas the integer implementation exercises the integer unit. With a machine without a hardware FPU, the performance difference should be expected to be even more dramatic.

2.8 Compiler

Even when using the same source code and work definition, the choice of compiler to transform the code may have an impact on machine behavior.

As shown by fig. 10 in this particular environment the machine code generated by Clang/LLVM 3.3 performs reliably faster then the code generated by GNU C 4.8 when using double precision floating point arithmetic; whereas for integer arithmetic there is no clear performance ordering between the two.

2.9 Compiler optimizations

Each compiler can transform the source code into machine code in different ways depending on which optimizations are enabled, and their parameters.

An example is given in fig. 11 where the Clang/LLVM compiler is configured with different optimization levels. In this environment, the optimization level “-O3” performs up to 40% better than when no optimization level is specified. However, as illustrated in the graph, for some combinations of input sizes (e.g. 1024x488, at 499712 pixels) the optimization level “-O1” may actually yield better performance than “-O3” (up to 20% better).

3 Summary and conclusion

This article has argued that machine features are ultimately exercised by the machine code of benchmark programs, not their source code. Through a running example from digital imaging, we have seen how the choice of programming language, software tool chain, data layout and traversal order, data types and operations, compiler and compiler optimizations can impact the machine behavior with little or no changes to the benchmark source code.

This presentation is intended as a reminder to practitioners who use benchmarks to evaluate platforms and machines, that they should carefully report all the parameters necessary for a peer to reproduce their results. This report should include details about the tool chain and usage parameters, and not only the source code of the benchmark programs.
Figure 10: Relative performance of code generated by Clang/LLVM and GNU C.
Figure 11: Relative performance of code generated by Clang/LLVM with different optimization levels.
import Data.Array.Repa (computeS, traverse, extent, size)

import Data.Array.Repa.IO.DevIL (readImage, writeImage, runIL, Image(..))

import Data.Array.Repa.Index (Z(..), (:.)(..))

import System.Environment (getArgs)

rgb2gray (r,g,b) = 0.3*r + 0.59*g + 0.11*b

main = do
  [fin, fout] ← getArgs
  (RGB x) ← runIL $ readImage fin
  let y = computeS $ traverse x to2d (cvt rgb2gray)
  runIL $ writeImage fout (Grey y)

  to2d (Z:.i:.j:_.) = Z:.i:.j

  cvt cf f ix = floor $ cf $ rgb f ix
  where
    rgb f ix = (get $ ix:.0, get $ ix:.1, get $ ix:.2)
    where get = fromIntegral . f

Listing 1: Example Haskell program that performs a color to greyscale conversion.

| Size | Pixels | Size | Pixels | Size | Pixels |
|------|--------|------|--------|------|--------|
| 5x2  | 10     | 64x31| 1984   | 512x512| 262144 |
| 4x4  | 16     | 64x32| 2048   | 1024x148| 499712 |
| 5x4  | 20     | 64x64| 4096   | 1024x512| 524288 |
| 8x4  | 32     | 128x39| 4992   | 1024x976| 999424 |
| 8x6  | 48     | 128x64| 8192   | 1024x1024| 1048576|
| 8x8  | 64     | 128x78| 9984   | 2048x976| 1998848|
| 16x6 | 96     | 128x128| 16384 | 2048x1024| 2097152|
| 16x8 | 128    | 256x78| 19968  | 2048x2048| 4194304|
| 16x12| 192    | 256x128| 32768 | 2048x2441| 4999168|
| 16x16| 256    | 256x195| 49920 | 4096x2048| 8388608|
| 32x15| 480    | 256x256| 65536 | 4096x2441| 9998336|
| 32x16| 512    | 512x195| 99840 | 4096x4096| 16777216|
| 32x31| 992    | 512x256| 131072|        |        |
| 32x32| 1024   | 512x390| 199680|        |        |

Table 1: Example reference sizes for a benchmark input.

#include <stdlib.h> // malloc

typedef unsigned char (*rgbimage)[3];
typedef unsigned char *greyimage;

#include "ppm.c" // read_ppm, write_pgm

int main(int argc, char *argv[]) {
  unsinged w, h; rgbimage x; greyimage y;
  x = read_ppm(argv[1], &w, &h);
  y = malloc(w*h);
  write_pgm(argv[2], y, w, h);
  return 0;
}

Listing 2: Example C program that performs a color to greyscale conversion.
#define RGB2GRAY(R, G, B) .3 * R + .59 * G + .11 * B

unsigned i, j;
for (j = 0; j < h; ++j)
    for (i = 0; i < w; ++i)
        y[j*w+i] = RGB2GRAY(x[j*w+i][0], x[j*w+i][1], x[j*w+i][2]);

Listing 3: double2d.c, DP, RM 2D: body of the computation in listing 2

#define RGB2GRAY(R, G, B) .3 * R + .59 * G + .11 * B;

unsigned i, j;
for (i = 0; i < w; ++i)
    for (j = 0; j < h; ++j)
        y[j*w+i] = RGB2GRAY(x[j*w+i][0], x[j*w+i][1], x[j*w+i][2]);

Listing 4: double2dt.c, DP, CM 2D: body of the computation in listing 2

#define RGB2GRAY(R, G, B) .3 * R + .59 * G + .11 * B

unsigned i;
for (i = 0; i < w*h; ++i)
    y[i] = RGB2GRAY(x[i][0], x[i][1], x[i][2]);

Listing 5: double1d.c, DP, 1D: body of the computation in listing 2

#define RGB2GRAY(R, G, B) (3.0f * R + 0.59f * G + 0.11f * B)

unsigned i;
for (i = 0; i < w*h; ++i)
    y[i] = RGB2GRAY(x[i][0], x[i][1], x[i][2]);

Listing 6: float1d.c, SP, 1D: body of the computation in listing 2

#define RGB2GRAY(R, G, B) (30 * R + 59 * G + 11 * B) / 100

unsigned i;
for (i = 0; i < w*h; ++i)
    y[i] = RGB2GRAY(x[i][0], x[i][1], x[i][2]);

Listing 7: int1d.c, integer, 1D: body of the computation in listing 2
```c
#include <IL/il.h> // IL functions

void write_pgm(char *filename, greyimage img, unsigned w, unsigned h) {
  ilTexImage(w, h, 1, 1, IL_LUMINANCE, IL_UNSIGNED_BYTE, img);
  ilSaveImage(filename);
}

rgbimage read_ppm(char *filename, unsigned *w, unsigned *h) {
  ILuint handle;
  ilInit();
  ilGenImages(1, &handle);
  ilBindImage(handle);
  ilLoadImage(filename);
  *w = ilGetInteger(IL_IMAGE_WIDTH);
  *h = ilGetInteger(IL_IMAGE_HEIGHT);
  return (rgbimage)ilGetData();
}

Listing 8: ppm_il.c: interface to image I/O using the DevIL library.

#include <stdio.h> // perror, snprintf
#include <unistd.h> // read, write, close
#include <fcntl.h> // open
#include <sys/mman.h> // mmap
#include <stdlib.h> // strtoul, exit

#define SYS_A(V, N, Call, ...) 
    if ((V = Call(__VA_ARGS__)) == N) { perror(#Call); exit(1); }
#define SYS_dA(V, Call, ...) SYS_A(V, -1, Call, __VA_ARGS__)
#define SYS_d(Call, ...) 
    if (Call(__VA_ARGS__) == -1) { perror(#Call); exit(1); }

void write_pgm(char *filename, greyimage img, unsigned w, unsigned h) {
  int fd, len;
  char buf[64];
  len = snprintf(buf, 64, "P5\n%u/uni2423%u\n255\n", w, h);
  SYS_dA(fd, open, filename, O_WRONLY|O_TRUNC|O_CREAT, 0666);
  SYS_d(write, fd, buf, len);
  SYS_d(write, fd, img, w*h);
  SYS_d(close, fd);
}

rgbimage read_ppm(char *filename, unsigned *w, unsigned *h) {
  int fd, sz; char *p, *data; char buf[64];
  SYS_dA(fd, open, filename, O_RDONLY|O_TRUNC|O_CREAT, 0666);
  SYS_d(write, fd, buf, len);
  SYS_d(write, fd, img, w*h);
  SYS_d(close, fd);
}

Listing 9: ppm_unix.c: interface to image I/O using POSIX functions.

16
Listing 10: plot.gp: GNUplot script used to generate the diagrams in this article.
| Pixels | Avg | Min | Max | Width | Height |
|--------|-----|-----|-----|-------|--------|
| Pixels | Avg | Min | Max | Width | Height |

```latex
\begin{table}
\centering
\begin{tabular}{llllll}
\hline
\end{tabular}
\caption{%s}\label{tab:res:%s}
\end{table}
```

---

**Listing 11: GNUmakefile used to generate the data for the diagrams.**
| Pixels | Avg    | Min    | Max    | Width | Height |
|-------|--------|--------|--------|-------|--------|
| 10    | 0.0013862 | 0.001295 | 0.001686 | 5     | 2      |
| 16    | 0.001486  | 0.001422 | 0.001567 | 4     | 4      |
| 20    | 0.0013946 | 0.00135  | 0.001471 | 5     | 4      |
| 32    | 0.001415  | 0.001323 | 0.001478 | 8     | 4      |
| 48    | 0.0014936 | 0.001336 | 0.001598 | 8     | 6      |
| 64    | 0.0015456 | 0.001468 | 0.001724 | 8     | 8      |
| 96    | 0.0014484 | 0.001368 | 0.001585 | 16    | 6      |
| 128   | 0.001585  | 0.001417 | 0.001697 | 16    | 8      |
| 192   | 0.0016648 | 0.001458 | 0.001819 | 16    | 12     |
| 256   | 0.00165   | 0.001545 | 0.001795 | 16    | 16     |
| 480   | 0.001527  | 0.001445 | 0.001631 | 32    | 15     |
| 512   | 0.001443  | 0.001376 | 0.001493 | 32    | 16     |
| 992   | 0.001426  | 0.001342 | 0.001517 | 32    | 31     |
| 1024  | 0.0015804 | 0.001384 | 0.002083 | 32    | 32     |
| 1984  | 0.001486  | 0.001355 | 0.001616 | 64    | 31     |
| 2048  | 0.0014586 | 0.001436 | 0.001469 | 64    | 32     |
| 4096  | 0.0014974 | 0.001418 | 0.001517 | 64    | 64     |
| 4992  | 0.0015038 | 0.001431 | 0.001665 | 128   | 39     |
| 8192  | 0.0015016 | 0.001524 | 0.001594 | 128   | 64     |
| 9984  | 0.0014896 | 0.001386 | 0.001653 | 128   | 78     |
| 16384 | 0.0015948 | 0.001502 | 0.001717 | 128   | 128    |
| 19968 | 0.001504  | 0.001442 | 0.001614 | 256   | 78     |
| 32768 | 0.0015162 | 0.001484 | 0.001582 | 256   | 128    |
| 49920 | 0.0016716 | 0.001547 | 0.001765 | 256   | 195    |
| 65536 | 0.0015904 | 0.001573 | 0.001604 | 256   | 256    |
| 99840 | 0.0018216 | 0.001724 | 0.001972 | 512   | 195    |
| 131072| 0.001965  | 0.00184  | 0.002151 | 512   | 256    |
| 199680| 0.0023032 | 0.00207  | 0.002633 | 512   | 390    |
| 262144| 0.002405  | 0.002215 | 0.002688 | 512   | 512    |
| 499712| 0.0046076 | 0.002726 | 0.005595 | 1024  | 488    |
| 524288| 0.0115674 | 0.006185 | 0.018067 | 1024  | 512    |
| 999424| 0.021863  | 0.02042  | 0.022241 | 1024  | 976    |
| 1048576| 0.0222758 | 0.022218 | 0.022323 | 1024  | 1024   |
| 1998848| 0.0260388 | 0.025325 | 0.026787 | 2048  | 976    |
| 2097152| 0.0266788 | 0.023063 | 0.027721 | 2048  | 1024   |
| 4194304| 0.0366048 | 0.035857 | 0.037427 | 2048  | 2048   |
| 4999168| 0.0415548 | 0.040989 | 0.042722 | 2048  | 2441   |
| 8388608| 0.0369938 | 0.036359 | 0.037304 | 4096  | 2048   |
| 9998336| 0.0428376 | 0.041531 | 0.045774 | 4096  | 2441   |
| 16777216| 0.1026934 | 0.100651 | 0.105384 | 4096  | 4096   |

Table 2: c-clang-base-unix-empty/summary
| Pixels | Avg  | Min   | Max   | Width | Height |
|--------|------|-------|-------|-------|--------|
| 10     | 0.0014302 | 0.001364 | 0.001482 | 5     | 2      |
| 16     | 0.0015982 | 0.001492 | 0.001683 | 4     | 4      |
| 20     | 0.0014596 | 0.001338 | 0.001626 | 5     | 4      |
| 32     | 0.0015564 | 0.001382 | 0.001733 | 8     | 4      |
| 48     | 0.0015978 | 0.001533 | 0.001679 | 8     | 6      |
| 64     | 0.0015974 | 0.001498 | 0.00176  | 8     | 8      |
| 96     | 0.0014994 | 0.001389 | 0.001598 | 16    | 6      |
| 128    | 0.0015662 | 0.001444 | 0.001682 | 16    | 8      |
| 192    | 0.0015644 | 0.001492 | 0.001647 | 16    | 12     |
| 256    | 0.0014034 | 0.001337 | 0.001465 | 16    | 16     |
| 480    | 0.0016188 | 0.001492 | 0.001748 | 32    | 15     |
| 512    | 0.0014758 | 0.001333 | 0.001618 | 32    | 16     |
| 992    | 0.001501  | 0.001408 | 0.001673 | 32    | 31     |
| 1024   | 0.0016836 | 0.001578 | 0.001864 | 32    | 32     |
| 1984   | 0.0015618 | 0.001417 | 0.001678 | 64    | 31     |
| 2048   | 0.0016128 | 0.001446 | 0.00187  | 64    | 32     |
| 4096   | 0.0015764 | 0.001496 | 0.001736 | 64    | 64     |
| 4992   | 0.0016472 | 0.001548 | 0.001739 | 128   | 39     |
| 8192   | 0.001651  | 0.001464 | 0.001733 | 128   | 64     |
| 9984   | 0.0016694 | 0.001527 | 0.001824 | 128   | 78     |
| 16384  | 0.0018418 | 0.001683 | 0.001956 | 128   | 128    |
| 19968  | 0.0018998 | 0.001811 | 0.001995 | 256   | 78     |
| 32768  | 0.0020082 | 0.001869 | 0.002137 | 256   | 128    |
| 49920  | 0.0021614 | 0.002056 | 0.002338 | 256   | 195    |
| 65536  | 0.002467  | 0.002236 | 0.002948 | 256   | 256    |
| 99840  | 0.002718  | 0.002616 | 0.002932 | 512   | 195    |
| 131072 | 0.0031828 | 0.002895 | 0.003412 | 512   | 256    |
| 199680 | 0.0044898 | 0.004144 | 0.004967 | 512   | 390    |
| 262144 | 0.005367  | 0.004872 | 0.005848 | 512   | 512    |
| 499712 | 0.008919  | 0.007325 | 0.010794 | 1024  | 488    |
| 524288 | 0.0222584 | 0.013031 | 0.025174 | 1024  | 512    |
| 999424 | 0.0323036 | 0.031091 | 0.033689 | 1024  | 976    |
| 1048576| 0.0330452 | 0.032539 | 0.033536 | 1024  | 1024   |
| 1998848| 0.0463276 | 0.046022 | 0.046634 | 2048  | 976    |
| 2097152| 0.0479576 | 0.047376 | 0.048532 | 2048  | 1024   |
| 4194304| 0.0754948 | 0.066893 | 0.079124 | 2048  | 2048   |
| 4999168| 0.0869756 | 0.084773 | 0.089423 | 2048  | 2441   |
| 8388608| 0.1318272 | 0.129927 | 0.133747 | 4096  | 2048   |
| 9998336| 0.156257  | 0.153618 | 0.159581 | 4096  | 2441   |
| 16777216| 0.256308  | 0.252784 | 0.261073 | 4096  | 4096   |

Table 3: c-clang-base-unix-int1d/summary
| Pixels | Avg     | Min     | Max     | Width | Height |
|--------|---------|---------|---------|-------|--------|
| 10     | 0.0014594 | 0.00139 | 0.00161 | 5     | 2      |
| 16     | 0.001498  | 0.001445 | 0.001563 | 4     | 4      |
| 20     | 0.0014568 | 0.001416 | 0.001491 | 5     | 4      |
| 32     | 0.0014814 | 0.00136  | 0.001577 | 8     | 4      |
| 48     | 0.0013826 | 0.001344 | 0.001411 | 8     | 6      |
| 64     | 0.0014394 | 0.001353 | 0.001563 | 8     | 8      |
| 96     | 0.0013904 | 0.001333 | 0.001462 | 16    | 6      |
| 128    | 0.0014576 | 0.00141  | 0.001503 | 16    | 8      |
| 192    | 0.0014982 | 0.001413 | 0.001513 | 32    | 16     |
| 256    | 0.0014872 | 0.001408 | 0.001526 | 32    | 15     |
| 512    | 0.0013802 | 0.001325 | 0.001449 | 32    | 16     |
| 992    | 0.0014756 | 0.001441 | 0.001513 | 32    | 31     |
| 1024   | 0.001469  | 0.001392 | 0.001527 | 32    | 32     |
| 1984   | 0.001428  | 0.001348 | 0.001491 | 64    | 31     |
| 2048   | 0.0014496 | 0.001378 | 0.001513 | 64    | 32     |
| 4096   | 0.0015136 | 0.001452 | 0.001568 | 64    | 64     |
| 4992   | 0.001461  | 0.001418 | 0.001508 | 128   | 39     |
| 8192   | 0.0015428 | 0.001433 | 0.001605 | 128   | 64     |
| 9984   | 0.0014892 | 0.001415 | 0.001538 | 128   | 78     |
| 16384  | 0.001661  | 0.001568 | 0.001737 | 128   | 128    |
| 19968  | 0.0015614 | 0.001486 | 0.001687 | 256   | 78     |
| 32768  | 0.0017076 | 0.001511 | 0.001905 | 256   | 128    |
| 49920  | 0.0016304 | 0.001613 | 0.001646 | 256   | 195    |
| 65536  | 0.0016016 | 0.001569 | 0.001646 | 256   | 256    |
| 99840  | 0.0017068 | 0.001659 | 0.001779 | 512   | 195    |
| 131072 | 0.0018224 | 0.001741 | 0.001886 | 512   | 256    |
| 199680 | 0.0023806 | 0.002064 | 0.002592 | 512   | 390    |
| 262144 | 0.0025998 | 0.002176 | 0.002904 | 512   | 512    |
| 499712 | 0.0036716 | 0.002888 | 0.004395 | 1024  | 488    |
| 524288 | 0.0098236 | 0.004753 | 0.016192 | 1024  | 512    |
| 999424 | 0.022286  | 0.022051 | 0.022402 | 1024  | 976    |
| 1048576| 0.022048  | 0.020388 | 0.022666 | 1024  | 1024   |
| 1998848| 0.0259494 | 0.023757 | 0.027333 | 2048  | 976    |
| 2097152| 0.0277118 | 0.027503 | 0.027954 | 2048  | 1024   |
| 4194304| 0.0349692 | 0.030343 | 0.036794 | 2048  | 2048   |
| 4999168| 0.040798  | 0.038609 | 0.041924 | 2048  | 2441   |
| 8388608| 0.0358476 | 0.035465 | 0.036247 | 4096  | 2048   |
| 9998336| 0.0390578 | 0.038351 | 0.040156 | 4096  | 2441   |
| 16777216| 0.1004596 | 0.09854  | 0.103355 | 4096  | 4096   |

Table 4: c-clang-o1-unix-empty/summary
| Pixels | Avg   | Min   | Max    | Width | Height |
|--------|-------|-------|--------|-------|--------|
| 10     | 0.0014624 | 0.001366 | 0.001593 | 5     | 2      |
| 16     | 0.0016956 | 0.001512 | 0.002112 | 4     | 4      |
| 20     | 0.0015232 | 0.001421 | 0.001605 | 5     | 4      |
| 32     | 0.0014544 | 0.001388 | 0.001624 | 8     | 4      |
| 48     | 0.0015852 | 0.001517 | 0.001652 | 8     | 6      |
| 64     | 0.0014448 | 0.001357 | 0.001574 | 8     | 8      |
| 96     | 0.0015802 | 0.001472 | 0.001697 | 16    | 6      |
| 128    | 0.001517  | 0.00141  | 0.001599 | 16    | 8      |
| 192    | 0.0014906 | 0.001407 | 0.001605 | 16    | 12     |
| 256    | 0.0016178 | 0.001492 | 0.001736 | 16    | 16     |
| 480    | 0.0015232 | 0.001334 | 0.00193  | 32    | 15     |
| 512    | 0.0014658 | 0.001403 | 0.001598 | 32    | 16     |
| 992    | 0.001555  | 0.001459 | 0.001673 | 32    | 31     |
| 1024   | 0.0014768 | 0.001374 | 0.00163  | 32    | 32     |
| 1984   | 0.0016586 | 0.001609 | 0.001747 | 64    | 31     |
| 2048   | 0.001503  | 0.001367 | 0.00163  | 64    | 32     |
| 4096   | 0.0016526 | 0.001559 | 0.00175  | 64    | 64     |
| 4992   | 0.0015192 | 0.001459 | 0.001559 | 128   | 39     |
| 8192   | 0.0017076 | 0.001573 | 0.001908 | 128   | 64     |
| 9984   | 0.0016656 | 0.001596 | 0.001723 | 128   | 78     |
| 16384  | 0.0016672 | 0.001546 | 0.001809 | 128   | 128    |
| 19968  | 0.0018394 | 0.001712 | 0.002011 | 256   | 78     |
| 32768  | 0.001784  | 0.001651 | 0.001932 | 256   | 128    |
| 49920  | 0.0020034 | 0.001868 | 0.002125 | 256   | 195    |
| 65536  | 0.002088  | 0.001985 | 0.002229 | 256   | 256    |
| 99840  | 0.0023442 | 0.002209 | 0.002583 | 512   | 195    |
| 131072 | 0.0024804 | 0.002251 | 0.00282  | 512   | 256    |
| 199680 | 0.0031476 | 0.002907 | 0.003404 | 512   | 390    |
| 262144 | 0.0037512 | 0.003289 | 0.004103 | 512   | 512    |
| 499712 | 0.0060208 | 0.004916 | 0.00689  | 1024  | 488    |
| 524288 | 0.0230936 | 0.021627 | 0.0242   | 1024  | 512    |
| 999424 | 0.0286376 | 0.027709 | 0.029762 | 1024  | 976    |
| 1048576| 0.028526  | 0.028034 | 0.028999 | 1024  | 1024   |
| 1998848| 0.0389484 | 0.038404 | 0.039874 | 2048  | 976    |
| 2097152| 0.0405994 | 0.039878 | 0.041356 | 2048  | 1024   |
| 4194304| 0.061057  | 0.05849  | 0.063393 | 2048  | 2048   |
| 4999168| 0.066658  | 0.065538 | 0.067487 | 2048  | 2441   |
| 8388608| 0.0994106 | 0.094852 | 0.103462 | 4096  | 2048   |
| 9998336| 0.118118  | 0.116988 | 0.118876 | 4096  | 2441   |
| 16777216| 0.1819934 | 0.1781  | 0.184849 | 4096  | 4096   |

Table 5: c-clang-ol-unix-int1d/summary
| Pixels | Avg     | Min     | Max     | Width | Height |
|--------|---------|---------|---------|-------|--------|
| 10     | 0.0030938 | 0.002669 | 0.003804 | 5     | 2      |
| 16     | 0.0027886 | 0.002519 | 0.00292  | 4     | 4      |
| 20     | 0.0028598 | 0.002593 | 0.003175 | 5     | 4      |
| 32     | 0.0026324 | 0.002522 | 0.002769 | 8     | 4      |
| 48     | 0.002688  | 0.002388 | 0.002895 | 8     | 6      |
| 64     | 0.0028188 | 0.002722 | 0.002977 | 8     | 8      |
| 96     | 0.002798  | 0.002628 | 0.003018 | 16    | 6      |
| 128    | 0.002772  | 0.002652 | 0.002861 | 16    | 8      |
| 192    | 0.0027476 | 0.002626 | 0.002886 | 16    | 12     |
| 256    | 0.0027978 | 0.002717 | 0.002937 | 16    | 16     |
| 480    | 0.003189  | 0.002842 | 0.004052 | 32    | 15     |
| 512    | 0.0030602 | 0.002886 | 0.003373 | 32    | 16     |
| 992    | 0.0033292 | 0.003159 | 0.003432 | 32    | 31     |
| 1024   | 0.0030004 | 0.002907 | 0.003211 | 32    | 32     |
| 1984   | 0.0038904 | 0.003713 | 0.004246 | 64    | 31     |
| 2048   | 0.0038656 | 0.003643 | 0.003967 | 64    | 32     |
| 4096   | 0.0050104 | 0.004768 | 0.005289 | 64    | 64     |
| 4992   | 0.0055754 | 0.005388 | 0.005753 | 128   | 39     |
| 8192   | 0.0074466 | 0.007105 | 0.008035 | 128   | 64     |
| 9984   | 0.0085498 | 0.008445 | 0.008655 | 128   | 78     |
| 16384  | 0.0118718 | 0.011601 | 0.012064 | 128   | 128    |
| 19968  | 0.0140644 | 0.013803 | 0.014551 | 256   | 78     |
| 32768  | 0.0208766 | 0.020533 | 0.021432 | 256   | 128    |
| 49920  | 0.0302314 | 0.02995 | 0.030495 | 256   | 195    |
| 65536  | 0.038837  | 0.038649 | 0.039379 | 256   | 256    |
| 99840  | 0.0577934 | 0.057091 | 0.058998 | 512   | 195    |
| 131072 | 0.074207  | 0.0737  | 0.075102 | 512   | 256    |
| 199680 | 0.1273968 | 0.127007 | 0.128073 | 512   | 390    |
| 262144 | 0.161762  | 0.161455 | 0.162801 | 512   | 512    |
| 499712 | 0.2911702 | 0.29026 | 0.293007 | 1024  | 488    |
| 524288 | 0.3044786 | 0.303479 | 0.305146 | 1024  | 512    |
| 999424 | 0.5693138 | 0.567653 | 0.571057 | 1024  | 976    |
| 1048576| 0.5947214 | 0.59223 | 0.599434 | 1024  | 1024   |
| 1998888| 1.1224458 | 1.119447 | 1.126038 | 2048  | 976    |
| 2097152| 1.1723698 | 1.170106 | 1.175108 | 2048  | 1024   |
| 4194304| 2.345104  | 2.339499 | 2.351858 | 2048  | 2048   |
| 4999168| 2.7895248 | 2.784703 | 2.79531  | 2048  | 2441   |
| 8388608| 4.650901  | 4.642141 | 4.65494  | 4096  | 2048   |
| 9998336| 5.57949   | 5.534664 | 5.70067  | 4096  | 2441   |
| 16777216| 9.3506568 | 9.326829 | 9.368743 | 4096  | 4096   |

Table 6: c-clang-o3-il-double2d/summary
| Pixels | Avg     | Min     | Max     | Width | Height |
|--------|---------|---------|---------|-------|--------|
| 10     | 0.0028614 | 0.002416 | 0.003762 | 5     | 2      |
| 16     | 0.002603  | 0.002395 | 0.002835 | 4     | 4      |
| 20     | 0.0026944 | 0.002475 | 0.003013 | 5     | 4      |
| 32     | 0.0027426 | 0.002532 | 0.002856 | 8     | 4      |
| 48     | 0.0026356 | 0.002522 | 0.002878 | 8     | 6      |
| 64     | 0.002729  | 0.002488 | 0.003075 | 8     | 8      |
| 96     | 0.0028868 | 0.002587 | 0.003304 | 16    | 6      |
| 128    | 0.002741  | 0.002462 | 0.003002 | 16    | 8      |
| 192    | 0.0027296 | 0.002625 | 0.002856 | 16    | 12     |
| 256    | 0.0028658 | 0.002682 | 0.003229 | 16    | 16     |
| 480    | 0.0029024 | 0.002735 | 0.003042 | 32    | 15     |
| 512    | 0.0029884 | 0.002833 | 0.003213 | 32    | 16     |
| 992    | 0.0034404 | 0.003053 | 0.003858 | 32    | 31     |
| 1024   | 0.0032878 | 0.003112 | 0.003628 | 32    | 32     |
| 1984   | 0.0038852 | 0.003695 | 0.004162 | 64    | 31     |
| 2048   | 0.0039464 | 0.003746 | 0.004253 | 64    | 32     |
| 4096   | 0.0051052 | 0.004794 | 0.005309 | 64    | 64     |
| 4992   | 0.0055894 | 0.005419 | 0.005763 | 128   | 39     |
| 8192   | 0.0073938 | 0.007169 | 0.007728 | 128   | 64     |
| 9984   | 0.0083842 | 0.008119 | 0.008803 | 128   | 78     |
| 16384  | 0.0119462 | 0.011582 | 0.012285 | 128   | 128    |
| 19968  | 0.013829  | 0.013699 | 0.013976 | 256   | 78     |
| 32768  | 0.0207446 | 0.020411 | 0.021224 | 256   | 128    |
| 49920  | 0.0299368 | 0.029384 | 0.030453 | 256   | 195    |
| 65536  | 0.0384048 | 0.038327 | 0.038543 | 256   | 256    |
| 99840  | 0.0570258 | 0.056526 | 0.057456 | 512   | 195    |
| 131072 | 0.0735488 | 0.073271 | 0.074016 | 512   | 256    |
| 199680 | 0.126947  | 0.126547 | 0.127116 | 512   | 390    |
| 262144 | 0.1606156 | 0.1602   | 0.160871 | 512   | 512    |
| 499712 | 0.2893616 | 0.288918 | 0.290025 | 1024  | 488    |
| 524288 | 0.302117  | 0.301276 | 0.302866 | 1024  | 512    |
| 999424 | 0.5622004 | 0.560459 | 0.563203 | 1024  | 976    |
| 1048576| 0.5891098 | 0.58682  | 0.591316 | 1024  | 1024   |
| 1998848| 1.1134272 | 1.106419 | 1.126347 | 2048  | 976    |
| 2097152| 1.1606344 | 1.156912 | 1.164354 | 2048  | 1024   |
| 4194304| 2.3315858 | 2.328636 | 2.336959 | 2048  | 2048   |
| 4999168| 2.771312  | 2.771907 | 2.781743 | 2048  | 2441   |
| 8388608| 4.6288906 | 4.624046 | 4.638265 | 4096  | 2048   |
| 9998336| 5.506498  | 5.494406 | 5.51931  | 4096  | 2441   |
| 16777216| 9.3742154 | 9.263583 | 9.732905 | 4096  | 4096   |

Table 7: c-clang-o3-il-empty/summary
| Pixels | Avg     | Min     | Max     | Width | Height |
|--------|---------|---------|---------|-------|--------|
| 10     | 0.0015176 | 0.001411 | 0.001592 | 5     | 2      |
| 16     | 0.0014936 | 0.001359 | 0.001604 | 4     | 4      |
| 20     | 0.0014908 | 0.001362 | 0.001679 | 5     | 4      |
| 32     | 0.0015934 | 0.001493 | 0.001767 | 8     | 4      |
| 48     | 0.0015948 | 0.001465 | 0.001732 | 8     | 6      |
| 64     | 0.0015158 | 0.001444 | 0.001595 | 8     | 8      |
| 96     | 0.0015378 | 0.001469 | 0.001581 | 16    | 6      |
| 128    | 0.001646  | 0.001555 | 0.001744 | 16    | 8      |
| 192    | 0.0016568 | 0.001563 | 0.001687 | 32    | 16     |
| 256    | 0.0016218 | 0.00153  | 0.001679 | 64    | 31     |
| 480    | 0.0014772 | 0.001387 | 0.001599 | 64    | 64     |
| 4996   | 0.0014958 | 0.001414 | 0.001661 | 32    | 32     |
| 9984   | 0.0018006 | 0.001709 | 0.001843 | 64    | 64     |
| 19968  | 0.0019014 | 0.001812 | 0.001888 | 256   | 78     |
| 32768  | 0.001966  | 0.001840 | 0.001767 | 256   | 128    |
| 49920  | 0.0020784 | 0.002021 | 0.002195 | 256   | 195    |
| 65536  | 0.0021692 | 0.001955 | 0.00238  | 256   | 256    |
| 99840  | 0.0025544 | 0.002363 | 0.002874 | 512   | 195    |
| 131072 | 0.0026178 | 0.002506 | 0.002818 | 512   | 256    |
| 199680 | 0.0036118 | 0.003082 | 0.003889 | 512   | 390    |
| 262144 | 0.004152  | 0.003791 | 0.004455 | 512   | 512    |
| 499712 | 0.0068146 | 0.005608 | 0.008474 | 1024  | 488    |
| 524288 | 0.0228782 | 0.022176 | 0.023958 | 1024  | 512    |
| 999424 | 0.0281636 | 0.026574 | 0.029567 | 1024  | 976    |
| 1048576| 0.0298138 | 0.028936 | 0.030408 | 1024  | 1024   |
| 1998848| 0.0404544 | 0.038182 | 0.042113 | 2048  | 976    |
| 2097152| 0.042433  | 0.041778 | 0.042925 | 2048  | 1024   |
| 4194304| 0.063698  | 0.062337 | 0.064691 | 2048  | 2048   |
| 4999168| 0.0724326 | 0.071054 | 0.073824 | 2048  | 2441   |
| 8388608| 0.1083028 | 0.100587 | 0.112977 | 4096  | 2048   |
| 9998336| 0.1289222 | 0.127197 | 0.131232 | 4096  | 2441   |
| 16777216| 0.2078441 | 0.204441 | 0.212719 | 4096  | 4096   |

Table 8: c-clang-o3-unix-double1d/summary
| Pixels | Avg   | Min   | Max    | Width | Height |
|--------|-------|-------|--------|-------|--------|
| 10     | 0.0014584 | 0.001363 | 0.0016  | 5     | 2      |
| 16     | 0.0015004 | 0.001564 | 0.0016  | 4     | 4      |
| 20     | 0.0015534 | 0.001472 | 0.0016  | 5     | 4      |
| 32     | 0.001557  | 0.001497 | 0.0016 | 8     | 4      |
| 48     | 0.0014506 | 0.001346 | 0.001546 | 8    | 6      |
| 64     | 0.0015804 | 0.001413 | 0.0016 | 8     | 8      |
| 96     | 0.0015498 | 0.001459 | 0.001613 | 16   | 6      |
| 128    | 0.0015962 | 0.001473 | 0.001656 | 16   | 8      |
| 192    | 0.0014516 | 0.001426 | 0.001507 | 16   | 12     |
| 256    | 0.0015906 | 0.001493 | 0.001683 | 16   | 16     |
| 480    | 0.0015446 | 0.001408 | 0.001671 | 32   | 15     |
| 512    | 0.0016136 | 0.001578 | 0.001672 | 32   | 16     |
| 992    | 0.001525  | 0.001451 | 0.001622 | 32   | 31     |
| 1024   | 0.001593  | 0.001447 | 0.001861 | 32   | 32     |
| 1984   | 0.0015972 | 0.001434 | 0.001698 | 64   | 31     |
| 2048   | 0.001618  | 0.001447 | 0.001889 | 64   | 32     |
| 4096   | 0.001692  | 0.001557 | 0.00189 | 64   | 64     |
| 4996   | 0.0016606 | 0.001541 | 0.00172 | 128  | 39     |
| 8192   | 0.0016338 | 0.001496 | 0.001818 | 128  | 64     |
| 9984   | 0.001683  | 0.001611 | 0.001792 | 128  | 78     |
| 16384  | 0.0017136 | 0.001577 | 0.001927 | 128  | 128    |
| 19968  | 0.0018598 | 0.001668 | 0.002012 | 256  | 78     |
| 32768  | 0.0019884 | 0.0018  | 0.002172 | 256  | 128    |
| 49920  | 0.0021594 | 0.00208 | 0.002267 | 256  | 195    |
| 65536  | 0.002199  | 0.002133 | 0.002397 | 256  | 256    |
| 99840  | 0.0028378 | 0.002495 | 0.003422 | 512  | 195    |
| 131072 | 0.002924 | 0.002811 | 0.003162 | 512  | 256    |
| 199680 | 0.0039948 | 0.003582 | 0.004523 | 512  | 390    |
| 262144 | 0.0048142 | 0.004471 | 0.005192 | 512  | 512    |
| 499712 | 0.0080728 | 0.006251 | 0.010595 | 1024 | 488    |
| 524288 | 0.0108182 | 0.007452 | 0.017111 | 1024 | 512    |
| 999424 | 0.0301736 | 0.029073 | 0.03078 | 1024 | 976    |
| 1048576| 0.030701 | 0.030432 | 0.031062 | 1024 | 1024   |
| 1998848| 0.0419938 | 0.041877 | 0.042271 | 2048 | 976    |
| 2097152| 0.04396 | 0.04324 | 0.046318 | 2048 | 1024   |
| 4194304| 0.0700074 | 0.066876 | 0.074309 | 2048 | 2048   |
| 4999168| 0.078686 | 0.07379 | 0.08188 | 2048 | 2441   |
| 8388608| 0.1214004 | 0.118961 | 0.125023 | 4096 | 2048   |
| 9998336| 0.1415758 | 0.1324  | 0.150185 | 4096 | 4096   |

Table 9: c-clang-o3-unix-double2d/summary
| Pixels | Avg    | Min    | Max    | Width | Height |
|--------|--------|--------|--------|-------|--------|
| 10     | 0.0015334 | 0.001346 | 0.00163 | 5     | 2      |
| 16     | 0.0015126 | 0.001421 | 0.001597 | 4     | 4      |
| 20     | 0.0016036 | 0.001532 | 0.001704 | 5     | 4      |
| 32     | 0.0016424 | 0.001585 | 0.00181 | 8     | 4      |
| 48     | 0.0015418 | 0.001492 | 0.001604 | 8     | 6      |
| 64     | 0.0015788 | 0.001472 | 0.001697 | 8     | 8      |
| 96     | 0.0016068 | 0.00151 | 0.001697 | 16    | 6      |
| 128    | 0.0015532 | 0.001431 | 0.001687 | 16    | 8      |
| 192    | 0.0016342 | 0.00145 | 0.001924 | 16    | 12     |
| 256    | 0.001484  | 0.001405 | 0.001647 | 16    | 16     |
| 480    | 0.0016652 | 0.001464 | 0.001881 | 32    | 15     |
| 512    | 0.001569  | 0.001372 | 0.001666 | 32    | 16     |
| 992    | 0.0015384 | 0.001417 | 0.001619 | 32    | 31     |
| 1024   | 0.001481  | 0.001375 | 0.001726 | 32    | 32     |
| 1984   | 0.0015272 | 0.001424 | 0.001626 | 64    | 31     |
| 2048   | 0.0015894 | 0.001409 | 0.001673 | 64    | 32     |
| 4096   | 0.001718  | 0.001604 | 0.00189 | 64    | 64     |
| 4992   | 0.0018106 | 0.001641 | 0.00203 | 128   | 39     |
| 8192   | 0.0018654 | 0.001711 | 0.002006 | 128   | 64     |
| 9984   | 0.0016874 | 0.001604 | 0.001756 | 128   | 78     |
| 16384  | 0.0018312 | 0.001579 | 0.002059 | 128   | 128    |
| 19968  | 0.0019614 | 0.001772 | 0.002079 | 256   | 78     |
| 32768  | 0.00218   | 0.002068 | 0.002342 | 256   | 128    |
| 49920  | 0.0023692 | 0.002061 | 0.00266 | 256   | 195    |
| 65536  | 0.0023206 | 0.002146 | 0.002473 | 256   | 256    |
| 99840  | 0.0030044 | 0.002684 | 0.003467 | 512   | 195    |
| 131072 | 0.0033824 | 0.003161 | 0.003641 | 512   | 256    |
| 199680 | 0.0041384 | 0.003953 | 0.004286 | 512   | 390    |
| 262144 | 0.0053512 | 0.005005 | 0.005899 | 512   | 512    |
| 499712 | 0.0091248 | 0.007868 | 0.010416 | 1024  | 488    |
| 524288 | 0.0097874 | 0.008554 | 0.011544 | 1024  | 512    |
| 999424 | 0.0340112 | 0.032927 | 0.034901 | 1024  | 976    |
| 1048576| 0.035531  | 0.035199 | 0.03606 | 1024  | 1024   |
| 1998848| 0.0618162 | 0.058926 | 0.066473 | 2048  | 976    |
| 2097152| 0.0620528 | 0.058592 | 0.064776 | 2048  | 1024   |
| 4194304| 0.3670154 | 0.363387 | 0.37202 | 2048  | 2048   |
| 4999168| 0.463144  | 0.441961 | 0.482924 | 2048  | 2441   |
| 8388608| 0.8281012 | 0.791156 | 0.871089 | 4096  | 2048   |
| 9998336| 0.9910372 | 0.95868 | 1.037802 | 4096  | 2441   |
| 16777216| 1.6336186 | 1.601739 | 1.68    | 4096  | 4096   |

Table 10: c-clang-o3-unix-double2dt/summary
| Pixels | Avg   | Min   | Max    | Width | Height |
|--------|-------|-------|--------|-------|--------|
| 10     | 0.0014868 | 0.001328 | 0.001893 | 5     | 2      |
| 16     | 0.0014554 | 0.001374 | 0.001562 | 4     | 4      |
| 20     | 0.0013894 | 0.001336 | 0.001464 | 5     | 4      |
| 32     | 0.0014236 | 0.00133 | 0.001457 | 8     | 4      |
| 48     | 0.0014136 | 0.001323 | 0.001477 | 8     | 6      |
| 64     | 0.0013378 | 0.001303 | 0.001363 | 8     | 8      |
| 96     | 0.0014466 | 0.001402 | 0.001482 | 16    | 6      |
| 128    | 0.0013288 | 0.001317 | 0.001345 | 16    | 8      |
| 192    | 0.0014174 | 0.001349 | 0.001449 | 16    | 12     |
| 256    | 0.0014294 | 0.001379 | 0.001493 | 16    | 16     |
| 480    | 0.001443  | 0.001403 | 0.001518 | 32    | 15     |
| 512    | 0.0014322 | 0.001349 | 0.001543 | 32    | 16     |
| 992    | 0.0014506 | 0.001383 | 0.001491 | 32    | 31     |
| 1024   | 0.0013734 | 0.001364 | 0.001389 | 32    | 32     |
| 1984   | 0.0014948 | 0.001454 | 0.001549 | 64    | 31     |
| 2048   | 0.001417  | 0.001352 | 0.001484 | 64    | 32     |
| 4096   | 0.0015458 | 0.001388 | 0.001658 | 64    | 64     |
| 4992   | 0.0015178 | 0.001406 | 0.001597 | 128   | 39     |
| 8192   | 0.0014478 | 0.001381 | 0.001509 | 128   | 64     |
| 9984   | 0.0015306 | 0.001408 | 0.001716 | 128   | 78     |
| 16384  | 0.0015438 | 0.001474 | 0.001716 | 128   | 128    |
| 19968  | 0.0015432 | 0.001462 | 0.001581 | 256   | 78     |
| 32768  | 0.0015458 | 0.001476 | 0.001604 | 256   | 128    |
| 49920  | 0.0016294 | 0.001574 | 0.001715 | 256   | 195    |
| 65536  | 0.0016212 | 0.00156 | 0.001753 | 256   | 256    |
| 99840  | 0.001713  | 0.001681 | 0.001754 | 512   | 195    |
| 131072 | 0.0021076 | 0.001862 | 0.002332 | 512   | 256    |
| 199680 | 0.0020978 | 0.002002 | 0.002321 | 512   | 390    |
| 262144 | 0.0023818 | 0.002177 | 0.002688 | 512   | 512    |
| 499712 | 0.002971  | 0.002727 | 0.003329 | 1024  | 488    |
| 524288 | 0.0100456 | 0.004709 | 0.016563 | 1024  | 512    |
| 999424 | 0.0220926 | 0.021561 | 0.022296 | 1024  | 976    |
| 1048576| 0.022294  | 0.022666 | 0.022358 | 1024  | 1024   |
| 1998848| 0.026321  | 0.024765 | 0.027103 | 2048  | 976    |
| 2097152| 0.0260974 | 0.022975 | 0.027501 | 2048  | 1024   |
| 4194304| 0.0345832 | 0.02967 | 0.036834 | 2048  | 2048   |
| 4999168| 0.0411714 | 0.041035 | 0.041264 | 2048  | 2441   |
| 8388608| 0.0361848 | 0.035027 | 0.036859 | 4096  | 2048   |
| 9998336| 0.0400812 | 0.039549 | 0.041217 | 4096  | 2441   |
| 16777216| 0.099768  | 0.098302 | 0.101399 | 4096  | 4096   |

Table 11: c-clang-o3-unix-empty/summary
| Pixels | Avg    | Min    | Max    | Width | Height |
|--------|--------|--------|--------|-------|--------|
| 10     | 0.0015476 | 0.001492 | 0.001612 | 5     | 2      |
| 16     | 0.0016224 | 0.001563 | 0.001764 | 4     | 4      |
| 20     | 0.001537  | 0.001446 | 0.001684 | 5     | 4      |
| 32     | 0.0015836 | 0.001435 | 0.001721 | 8     | 4      |
| 48     | 0.0015512 | 0.001431 | 0.001689 | 8     | 6      |
| 64     | 0.0015934 | 0.001504 | 0.001696 | 8     | 8      |
| 96     | 0.001535  | 0.001449 | 0.001648 | 16    | 6      |
| 128    | 0.001587  | 0.001391 | 0.001845 | 16    | 8      |
| 192    | 0.0015204 | 0.001386 | 0.001584 | 16    | 12     |
| 256    | 0.0015664 | 0.001416 | 0.001692 | 16    | 16     |
| 480    | 0.001514  | 0.001351 | 0.001785 | 32    | 15     |
| 512    | 0.0015488 | 0.001428 | 0.001687 | 32    | 32     |
| 992    | 0.0016128 | 0.001451 | 0.001789 | 32    | 31     |
| 1024   | 0.0014926 | 0.001355 | 0.001671 | 32    | 32     |
| 1984   | 0.0015744 | 0.001494 | 0.001656 | 64    | 31     |
| 2048   | 0.0014874 | 0.001398 | 0.001572 | 64    | 32     |
| 4096   | 0.0016112 | 0.001486 | 0.001654 | 64    | 64     |
| 4992   | 0.0015302 | 0.001423 | 0.001674 | 128   | 39     |
| 8192   | 0.0016578 | 0.001517 | 0.001762 | 128   | 64     |
| 9984   | 0.001631  | 0.001466 | 0.001803 | 128   | 78     |
| 16384  | 0.0018496 | 0.001597 | 0.001999 | 128   | 128    |
| 19968  | 0.0017378 | 0.001615 | 0.001841 | 256   | 78     |
| 32768  | 0.0020268 | 0.001973 | 0.002074 | 256   | 128    |
| 49920  | 0.0019714 | 0.001914 | 0.002012 | 256   | 195    |
| 65536  | 0.002174  | 0.002012 | 0.002494 | 256   | 256    |
| 99840  | 0.0025208 | 0.002296 | 0.002725 | 512   | 195    |
| 131072 | 0.002626  | 0.002509 | 0.002897 | 512   | 256    |
| 199680 | 0.0033054 | 0.003132 | 0.003635 | 512   | 390    |
| 262144 | 0.003832  | 0.003615 | 0.004169 | 512   | 512    |
| 499712 | 0.0071364 | 0.005794 | 0.007903 | 1024  | 488    |
| 524288 | 0.0223346 | 0.015853 | 0.024698 | 1024  | 512    |
| 999424 | 0.0281306 | 0.026406 | 0.029472 | 1024  | 976    |
| 1048576| 0.029095  | 0.028885 | 0.029281 | 1024  | 1024   |
| 1998848| 0.0398422 | 0.038995 | 0.040568 | 2048  | 976    |
| 2097152| 0.041057  | 0.040736 | 0.041471 | 2048  | 1024   |
| 4194304| 0.0621102 | 0.060263 | 0.064256 | 2048  | 2048   |
| 4999168| 0.069584  | 0.067825 | 0.071645 | 2048  | 2441   |
| 8388608| 0.1000746 | 0.087548 | 0.14594  | 4096  | 2048   |
| 9998336| 0.1221794 | 0.118968 | 0.125002 | 4096  | 2441   |
| 16777216| 0.1910922 | 0.186842 | 0.195253 | 4096  | 4096   |

Table 12: c-clang-o3-unix-float1d/summary
| Pixels | Avg     | Min     | Max      | Width | Height |
|--------|---------|---------|----------|-------|--------|
| 10     | 0.0015284 | 0.001423 | 0.001707 | 5     | 2      |
| 16     | 0.0015096 | 0.001390 | 0.001776 | 4     | 4      |
| 20     | 0.0015838 | 0.001511 | 0.001626 | 5     | 4      |
| 32     | 0.0015564 | 0.001399 | 0.001852 | 8     | 4      |
| 48     | 0.0015952 | 0.001442 | 0.001748 | 8     | 6      |
| 64     | 0.001532  | 0.001346 | 0.001782 | 8     | 8      |
| 96     | 0.001573  | 0.001418 | 0.001678 | 16    | 6      |
| 128    | 0.0015672 | 0.001433 | 0.001736 | 16    | 8      |
| 192    | 0.0014888 | 0.001414 | 0.001667 | 32    | 12     |
| 256    | 0.0014826 | 0.001432 | 0.001544 | 16    | 16     |
| 480    | 0.0016216 | 0.001428 | 0.001869 | 32    | 15     |
| 512    | 0.0014818 | 0.001414 | 0.00162  | 32    | 16     |
| 992    | 0.0015578 | 0.001407 | 0.001667 | 64    | 31     |
| 1024   | 0.0015774 | 0.001459 | 0.001657 | 32    | 32     |
| 1984   | 0.0016122 | 0.001537 | 0.001735 | 64    | 31     |
| 2048   | 0.0015406 | 0.001412 | 0.001597 | 64    | 32     |
| 4096   | 0.0015542 | 0.001492 | 0.001635 | 64    | 64     |
| 4992   | 0.001742  | 0.001644 | 0.001923 | 128   | 39     |
| 8192   | 0.0015942 | 0.001505 | 0.001702 | 128   | 64     |
| 9984   | 0.0016778 | 0.001541 | 0.001856 | 128   | 78     |
| 16384  | 0.0017966 | 0.001739 | 0.001883 | 128   | 128    |
| 19968  | 0.0018022 | 0.00158  | 0.001967 | 256   | 78     |
| 32768  | 0.0018808 | 0.001741 | 0.002015 | 256   | 128    |
| 49920  | 0.0020012 | 0.001725 | 0.002297 | 256   | 195    |
| 65536  | 0.0021156 | 0.001866 | 0.002574 | 256   | 256    |
| 99840  | 0.0025068 | 0.002233 | 0.002735 | 512   | 195    |
| 131072 | 0.002609  | 0.002288 | 0.003329 | 512   | 256    |
| 199680 | 0.00313   | 0.002748 | 0.003584 | 512   | 390    |
| 262144 | 0.0038226 | 0.003381 | 0.004054 | 512   | 512    |
| 499712 | 0.0072518 | 0.006375 | 0.008562 | 1024  | 488    |
| 524288 | 0.022184  | 0.021806 | 0.022668 | 1024  | 512    |
| 999424 | 0.0282942 | 0.027444 | 0.028935 | 1024  | 976    |
| 1048576| 0.027815  | 0.025846 | 0.02861  | 1024  | 1024   |
| 1998848| 0.0376148 | 0.035205 | 0.039317 | 2048  | 976    |
| 2097152| 0.039361  | 0.038343 | 0.04006  | 2048  | 1024   |
| 4194304| 0.0595208 | 0.058148 | 0.061289 | 2048  | 2048   |
| 4999168| 0.0655952 | 0.064573 | 0.067123 | 2048  | 2441   |
| 8388608| 0.1014334 | 0.099031 | 0.10332  | 4096  | 2048   |
| 9998336| 0.1155188 | 0.113595 | 0.117542 | 4096  | 2441   |
| 16777216| 0.18374  | 0.180268 | 0.186501 | 4096  | 4096   |

Table 13: c-clang-o3-unix-int1d/summary
| Pixels | Avg   | Min   | Max   | Width | Height |
|--------|-------|-------|-------|-------|--------|
| 10     | 0.0015742 | 0.00153  | 0.001674 | 5     | 2      |
| 16     | 0.0015042 | 0.001378  | 0.00168  | 4     | 4      |
| 20     | 0.0016798 | 0.001619  | 0.001771 | 5     | 4      |
| 32     | 0.001663  | 0.001472  | 0.001723 | 8     | 4      |
| 48     | 0.0016186 | 0.001464  | 0.001764 | 8     | 6      |
| 64     | 0.0016888 | 0.001561  | 0.001885 | 8     | 8      |
| 96     | 0.0016822 | 0.001534  | 0.001883 | 16    | 6      |
| 128    | 0.0015466 | 0.001356  | 0.001802 | 16    | 8      |
| 192    | 0.001868  | 0.001633  | 0.002264 | 16    | 12     |
| 256    | 0.0017654 | 0.00165   | 0.001855 | 16    | 16     |
| 480    | 0.001756  | 0.001663  | 0.001867 | 32    | 15     |
| 512    | 0.0018118 | 0.001706  | 0.001988 | 32    | 16     |
| 992    | 0.0016124 | 0.001502  | 0.001752 | 32    | 31     |
| 1024   | 0.0015718 | 0.001493  | 0.001649 | 32    | 32     |
| 1984   | 0.001696  | 0.001521  | 0.001945 | 64    | 31     |
| 2048   | 0.0016138 | 0.001455  | 0.001672 | 64    | 32     |
| 4096   | 0.0018488 | 0.001591  | 0.002006 | 64    | 64     |
| 4992   | 0.0018526 | 0.001771  | 0.001996 | 128   | 39     |
| 8192   | 0.0018554 | 0.001693  | 0.001927 | 128   | 64     |
| 9984   | 0.0018812 | 0.001656  | 0.002109 | 128   | 78     |
| 16384  | 0.0018554 | 0.001672  | 0.002085 | 128   | 128    |
| 19968  | 0.001788  | 0.001659  | 0.001926 | 256   | 78     |
| 32768  | 0.00201   | 0.001874  | 0.002152 | 256   | 128    |
| 49920  | 0.0023124 | 0.002142  | 0.002471 | 256   | 195    |
| 65536  | 0.002615  | 0.002339  | 0.002801 | 256   | 256    |
| 99840  | 0.0032086 | 0.00295   | 0.003498 | 512   | 195    |
| 131072 | 0.0034318 | 0.003341  | 0.003574 | 512   | 256    |
| 199680 | 0.004416  | 0.004213  | 0.004685 | 512   | 390    |
| 262144 | 0.005074  | 0.00523   | 0.005798 | 512   | 512    |
| 499712 | 0.0097924 | 0.007824  | 0.011326 | 1024  | 488    |
| 524288 | 0.0116496 | 0.008447  | 0.019813 | 1024  | 512    |
| 999424 | 0.030933  | 0.030092  | 0.031646 | 1024  | 976    |
| 1048576| 0.0308166 | 0.030419  | 0.031295 | 1024  | 1024   |
| 1998848| 0.044111  | 0.042794  | 0.044722 | 2048  | 976    |
| 2097152| 0.0470242 | 0.046463  | 0.047269 | 2048  | 1024   |
| 4194304| 0.0764382 | 0.075429  | 0.077559 | 2048  | 2048   |
| 4999168| 0.087914  | 0.085358  | 0.092694 | 2048  | 2441   |
| 8388608| 0.1320806 | 0.123878  | 0.138708 | 4096  | 2048   |
| 9998336| 0.1456164 | 0.143222  | 0.147739 | 4096  | 2441   |
| 16777216| 0.2504316 | 0.235671  | 0.263854 | 4096  | 4096   |

Table 14: c-clang-o3-unix2-double2d/summary
| Pixels | Avg      | Min      | Max      | Width | Height |
|--------|----------|----------|----------|-------|--------|
| 10     | 0.0016884| 0.001558 | 0.002037 | 5     | 2      |
| 16     | 0.0017764| 0.001607 | 0.002     | 4     | 4      |
| 20     | 0.0016106| 0.001486 | 0.00183  | 5     | 4      |
| 32     | 0.0015504| 0.001465 | 0.001622 | 8     | 4      |
| 48     | 0.0016602| 0.001563 | 0.001745 | 8     | 6      |
| 64     | 0.0015994| 0.001471 | 0.001777 | 8     | 8      |
| 96     | 0.0016384| 0.001504 | 0.001871 | 16    | 6      |
| 128    | 0.001604 | 0.001497 | 0.001882 | 16    | 8      |
| 192    | 0.0017834| 0.001545 | 0.002014 | 16    | 12     |
| 256    | 0.0016904| 0.001511 | 0.001823 | 16    | 16     |
| 480    | 0.0017136| 0.001483 | 0.002092 | 32    | 15     |
| 512    | 0.0016996| 0.001621 | 0.001772 | 32    | 16     |
| 992    | 0.0021332| 0.001922 | 0.002458 | 32    | 31     |
| 1024   | 0.0018952| 0.00173  | 0.002183 | 32    | 32     |
| 1984   | 0.001881 | 0.001633 | 0.002295 | 64    | 31     |
| 2048   | 0.0020044| 0.001722 | 0.002357 | 64    | 32     |
| 4096   | 0.0020434| 0.001925 | 0.002214 | 64    | 64     |
| 4992   | 0.0020502| 0.001826 | 0.002386 | 128   | 39     |
| 8192   | 0.002019 | 0.001854 | 0.002192 | 128   | 64     |
| 9984   | 0.002282 | 0.0021   | 0.002584 | 128   | 78     |
| 16384  | 0.0022362| 0.001974 | 0.002531 | 128   | 128    |
| 19968  | 0.0023032| 0.002066 | 0.002725 | 256   | 78     |
| 32768  | 0.0022908| 0.002146 | 0.002527 | 256   | 128    |
| 49920  | 0.0025394| 0.002454 | 0.00268  | 256   | 195    |
| 65536  | 0.0026106| 0.002465 | 0.002854 | 256   | 256    |
| 99840  | 0.0028602| 0.002692 | 0.003039 | 512   | 195    |
| 131072 | 0.004063 | 0.003414 | 0.004472 | 512   | 256    |
| 199680 | 0.0042526| 0.003907 | 0.00493  | 512   | 390    |
| 262144 | 0.0054336| 0.004829 | 0.006129 | 512   | 512    |
| 499712 | 0.010347 | 0.008566 | 0.012491 | 1024  | 488    |
| 524288 | 0.0159684| 0.010157 | 0.026783 | 1024  | 512    |
| 999424 | 0.03524  | 0.03382  | 0.036304 | 1024  | 976    |
| 1048576| 0.0341834| 0.033203 | 0.034891 | 1024  | 1024   |
| 1998848| 0.050911 | 0.048256 | 0.05331  | 2048  | 976    |
| 2097152| 0.0509186| 0.048018 | 0.053225 | 2048  | 1024   |
| 4194304| 0.084699 | 0.082635 | 0.085924 | 2048  | 2048   |
| 4999168| 0.094597 | 0.090306 | 0.099331 | 2048  | 2441   |
| 8388608| 0.1519576| 0.147526 | 0.155128 | 4096  | 2048   |
| 9998336| 0.1731964| 0.167239 | 0.181819 | 4096  | 2441   |
| 16777216| 0.2775114| 0.268871 | 0.288245 | 4096  | 4096   |

Table 15: c-gcc-o3-unix-double1d/summary
| Pixels | Avg | Min  | Max  | Width | Height |
|--------|-----|------|------|-------|--------|
| 10     | 0.0015942 | 0.001495 | 0.001832 | 5     | 2      |
| 16     | 0.0015684 | 0.001445 | 0.001764 | 4     | 4      |
| 20     | 0.001737  | 0.001538 | 0.001903 | 5     | 4      |
| 32     | 0.0016498 | 0.001496 | 0.001738 | 8     | 4      |
| 48     | 0.0017384 | 0.001559 | 0.001918 | 8     | 6      |
| 64     | 0.0015548 | 0.001451 | 0.001727 | 8     | 8      |
| 96     | 0.0017344 | 0.001545 | 0.002038 | 16    | 6      |
| 128    | 0.0017298 | 0.001614 | 0.001795 | 16    | 8      |
| 192    | 0.001714  | 0.001647 | 0.001803 | 16    | 12     |
| 256    | 0.001725  | 0.00162  | 0.00182  | 16    | 16     |
| 480    | 0.0014872 | 0.001453 | 0.001528 | 32    | 15     |
| 512    | 0.0014756 | 0.001431 | 0.001531 | 32    | 16     |
| 992    | 0.0015144 | 0.001428 | 0.001541 | 32    | 31     |
| 1024   | 0.0015218 | 0.001463 | 0.001655 | 32    | 32     |
| 1984   | 0.0016216 | 0.001587 | 0.001667 | 64    | 31     |
| 2048   | 0.0016046 | 0.001513 | 0.001696 | 64    | 32     |
| 4096   | 0.0017422 | 0.00158  | 0.00182  | 64    | 64     |
| 4992   | 0.0017202 | 0.001561 | 0.001809 | 128   | 39     |
| 8192   | 0.0016064 | 0.001522 | 0.001676 | 128   | 64     |
| 9984   | 0.0019246 | 0.001783 | 0.002209 | 128   | 78     |
| 16384  | 0.0018426 | 0.001716 | 0.002076 | 128   | 128    |
| 19968  | 0.001999  | 0.00185  | 0.002178 | 256   | 78     |
| 32768  | 0.0019724 | 0.00186  | 0.002075 | 256   | 128    |
| 49920  | 0.002186  | 0.001923 | 0.002377 | 256   | 195    |
| 65536  | 0.00227   | 0.002155 | 0.002427 | 256   | 256    |
| 99840  | 0.0026422 | 0.002539 | 0.002904 | 512   | 195    |
| 131072 | 0.0028816 | 0.002597 | 0.003342 | 512   | 256    |
| 199680 | 0.0032896 | 0.003106 | 0.003495 | 512   | 390    |
| 262144 | 0.0042668 | 0.003888 | 0.004559 | 512   | 512    |
| 499712 | 0.006514  | 0.005469 | 0.007185 | 1024  | 488    |
| 524288 | 0.0171982 | 0.006816 | 0.02348  | 1024  | 512    |
| 999424 | 0.0265278 | 0.025932 | 0.027361 | 1024  | 976    |
| 1048576| 0.0289088 | 0.02836  | 0.029143 | 1024  | 1024   |
| 1998848| 0.0387646 | 0.038396 | 0.038903 | 2048  | 976    |
| 2097152| 0.0400706 | 0.039558 | 0.04065  | 2048  | 1024   |
| 4194304| 0.0618162 | 0.060693 | 0.063196 | 2048  | 2048   |
| 4999168| 0.0715354 | 0.068445 | 0.076321 | 2048  | 2441   |
| 8388608| 0.116873  | 0.112857 | 0.125024 | 4096  | 2048   |
| 9998336| 0.1279668 | 0.12542  | 0.131373 | 4096  | 2441   |
| 16777216| 0.2004758 | 0.196424 | 0.208217 | 4096  | 4096   |

Table 16: c-gcc-o3-unix-int1d/summary
| Pixels | Avg   | Min   | Max   | Width | Height |
|--------|-------|-------|-------|-------|--------|
| 10     | 0.0047228 | 0.0043 | 0.005096 | 5     | 2      |
| 16     | 0.0047542 | 0.004385 | 0.00529 | 4     | 4      |
| 20     | 0.004802   | 0.004429 | 0.005216 | 5     | 4      |
| 32     | 0.0051506  | 0.004829 | 0.005523 | 8     | 4      |
| 48     | 0.0052322  | 0.004889 | 0.005583 | 8     | 6      |
| 64     | 0.0053116  | 0.00493 | 0.006112 | 8     | 8      |
| 96     | 0.0058564  | 0.005648 | 0.006216 | 16    | 6      |
| 128    | 0.0063246  | 0.006185 | 0.006457 | 16    | 8      |
| 192    | 0.0068208  | 0.006395 | 0.0074  | 16    | 12     |
| 256    | 0.0072164  | 0.006806 | 0.007603 | 16    | 16     |
| 480    | 0.0086172  | 0.007713 | 0.009607 | 32    | 15     |
| 512    | 0.008345   | 0.007965 | 0.008634 | 32    | 16     |
| 992    | 0.0118534  | 0.01142 | 0.012573 | 32    | 31     |
| 1024   | 0.0119068  | 0.011527 | 0.012191 | 32    | 32     |
| 1984   | 0.0177034  | 0.017344 | 0.018023 | 64    | 31     |
| 2048   | 0.0180072  | 0.01768  | 0.018613 | 64    | 32     |
| 4096   | 0.03073    | 0.030101 | 0.031897 | 64    | 64     |
| 4992   | 0.0359412  | 0.035481 | 0.036261 | 128   | 39     |
| 8192   | 0.0549972  | 0.05476  | 0.055377 | 128   | 64     |
| 9984   | 0.0659984  | 0.065299 | 0.067556 | 128   | 78     |
| 16384  | 0.1039074  | 0.103778 | 0.10401 | 128   | 128    |
| 19968  | 0.1257842  | 0.125365 | 0.126259 | 256   | 78     |
| 32768  | 0.2050054  | 0.202374 | 0.208976 | 256   | 128    |
| 49920  | 0.3062182  | 0.305786 | 0.306879 | 256   | 195    |
| 65536  | 0.399762   | 0.397993 | 0.401186 | 256   | 256    |
| 99840  | 0.6054232  | 0.604796 | 0.606512 | 512   | 195    |
| 131072 | 0.792189   | 0.791621 | 0.792473 | 512   | 256    |
| 199680 | 1.2247622  | 1.222086 | 1.229689 | 512   | 390    |
| 262144 | 1.6058994  | 1.596077 | 1.61638  | 512   | 512    |
| 499712 | 3.050922   | 3.027957 | 3.088465 | 1024  | 488    |
| 524288 | 3.18597    | 3.174444 | 3.219998 | 1024  | 512    |
| 999424 | 6.0386108  | 6.032733 | 6.046526 | 1024  | 976    |
| 1048576| 6.3397604  | 6.328834 | 6.366426 | 1024  | 1024   |
| 1998848| 12.152556  | 12.081531| 12.265659| 2048  | 976    |
| 2097152| 12.6724314 | 12.631703| 12.752535| 2048  | 1024   |
| 4194304| 26.0175824 | 25.4087  | 27.014179| 2048  | 2048   |
| 4999168| 30.182428  | 30.140131| 30.241431| 2048  | 2441   |
| 8388608| 50.9606652 | 50.626181| 51.547098| 4096  | 2048   |
| 9998336| 60.3789196 | 60.270674| 60.57919 | 4096  | 2441   |
| 16777216| 101.2790164| 101.113425| 101.63851| 4096  | 4096   |

Table 17: hs/summary