

MacchiatoBin: Marvell ARMADA 8040:
4x Cortex-A72 @ 1300MHz, 4GB DDR4 @ 1600MT/s (12.8GB/s)

```
blu@macchiato:~/proj/test-cl$ POCL_DEBUG=0 LD_LIBRARY_PATH=/usr/local/lib ./test_cl
platform 0:
  CL_PLATFORM_PROFILE: 0x7f94e2b201
  CL_PLATFORM_VERSION: FULL_PROFILE
  CL_PLATFORM_NAME: OpenCL 1.2 pocl 0.15-pre, LLVM 4.0.1
  CL_PLATFORM_VENDOR: Portable Computing Language
  CL_PLATFORM_EXTENSIONS: The pocl project
  device 0: empty
    CL_DEVICE_TYPE: 0x162fa660
    CL_DEVICE_VENDOR_ID: CL_DEVICE_TYPE_CPU
    CL_DEVICE_MAX_COMPUTE_UNITS: 5045
    CL_DEVICE_MAX_WORK_ITEM_DIMENSIONS: 4
    CL_DEVICE_MAX_WORK_GROUP_SIZE: 3
    CL_DEVICE_MAX_WORK_ITEM_SIZES: 4096
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_CHAR: 4096 4096 4096
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_SHORT: 16
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_INT: 8
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_LONG: 4
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_FLOAT: 2
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_DOUBLE: 4
    CL_DEVICE_MAX_CLOCK_FREQUENCY: 1300
    CL_DEVICE_ADDRESS_BITS: 64
    CL_DEVICE_MAX_READ_IMAGE_ARGS: 128
    CL_DEVICE_MAX_WRITE_IMAGE_ARGS: 128
    CL_DEVICE_MAX_MEM_ALLOC_SIZE: 1073741824
    CL_DEVICE_IMAGE2D_MAX_WIDTH: 8192
    CL_DEVICE_IMAGE2D_MAX_HEIGHT: 8192
    CL_DEVICE_IMAGE3D_MAX_WIDTH: 2048
    CL_DEVICE_IMAGE3D_MAX_HEIGHT: 2048
    CL_DEVICE_IMAGE3D_MAX_DEPTH: 2048
    CL_DEVICE_IMAGE_SUPPORT: true
    CL_DEVICE_MAX_PARAMETER_SIZE: 1024
    CL_DEVICE_MAX_SAMPLERS: 16
    CL_DEVICE_MEM_BASE_ADDR_ALIGN: 128
    CL_DEVICE_MIN_DATA_TYPE_ALIGN_SIZE: 16
    CL_DEVICE_SINGLE_FP_CONFIG: CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST
    CL_DEVICE_GLOBAL_MEM_CACHE_TYPE: CL_NONE
    CL_DEVICE_GLOBAL_MEM_CACHELINE_SIZE: 0
    CL_DEVICE_GLOBAL_MEM_CACHE_SIZE: 0
    CL_DEVICE_GLOBAL_MEM_SIZE: 2904201216
    CL_DEVICE_MAX_CONSTANT_BUFFER_SIZE: 16777216
    CL_DEVICE_MAX_CONSTANT_ARGS: 8
    CL_DEVICE_LOCAL_MEM_TYPE: CL_GLOBAL
    CL_DEVICE_LOCAL_MEM_SIZE: 16777216
    CL_DEVICE_ERROR_CORRECTION_SUPPORT: false
    CL_DEVICE_PROFILING_TIMER_RESOLUTION: 1
    CL_DEVICE_ENDIAN_LITTLE: true
    CL_DEVICE_AVAILABLE: true
    CL_DEVICE_COMPILER_AVAILABLE: true
    CL_DEVICE_EXECUTION_CAPABILITIES: CL_EXEC_KERNEL CL_EXEC_NATIVE_KERNEL
    CL_DEVICE_QUEUE_PROPERTIES: CL_QUEUE_PROFILING_ENABLE
    CL_DEVICE_NAME: pthread-cortex-a72
    CL_DEVICE_VENDOR: ARM
    CL_DRIVER_VERSION: 0.15-pre
    CL_DEVICE_PROFILE: FULL_PROFILE
    CL_DEVICE_VERSION: OpenCL 1.2 pocl HSTR: pthread-aarch64-unknown-linux-gnu-cortex-a72
    CL_DEVICE_EXTENSIONS: cl_khr_byte_addressable_store cl_khr_global_int32_base_atomics
cl_khr_global_int32_extended_atomics cl_khr_local_int32_base_atomics cl_khr_local_int32_extended_atomics cl_khr_3d_image_writes
cl_khr_fp16 cl_khr_fp64
  CL_DEVICE_PLATFORM: 0x7f94e2b201
  CL_DEVICE_PREFERRED_VECTOR_WIDTH_HALF: 8
  CL_DEVICE_HOST_UNIFIED_MEMORY: true
  CL_DEVICE_NATIVE_VECTOR_WIDTH_CHAR: 16
  CL_DEVICE_NATIVE_VECTOR_WIDTH_SHORT: 8
  CL_DEVICE_NATIVE_VECTOR_WIDTH_INT: 4
  CL_DEVICE_NATIVE_VECTOR_WIDTH_LONG: 2
  CL_DEVICE_NATIVE_VECTOR_WIDTH_FLOAT: 4
  CL_DEVICE_NATIVE_VECTOR_WIDTH_DOUBLE: 2
  CL_DEVICE_NATIVE_VECTOR_WIDTH_HALF: 8
  CL_DEVICE_OPENCL_C_VERSION: OpenCL C 1.2 pocl
  CL_DEVICE_DOUBLE_FP_CONFIG: CL_FP_DENORM CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF CL_FP_FMA CL_FP_CORRECTLY_ROUNDED_DIVIDE_SQRT
  CL_DEVICE_LINKER_AVAILABLE: true
  CL_DEVICE_BUILT_IN_KERNELS: empty
  CL_DEVICE_IMAGE_MAX_BUFFER_SIZE: 67108864
  CL_DEVICE_IMAGE_MAX_ARRAY_SIZE: 2048
  CL_DEVICE_PARENT_DEVICE: 0
  CL_DEVICE_PARTITION_MAX_SUB_DEVICES: 4
  CL_DEVICE_PARTITION_PROPERTIES: CL_DEVICE_PARTITION_EQUALLY CL_DEVICE_PARTITION_BY_COUNTS
  CL_DEVICE_PARTITION_AFFINITY_DOMAIN: none
  CL_DEVICE_PARTITION_TYPE: n/a
```

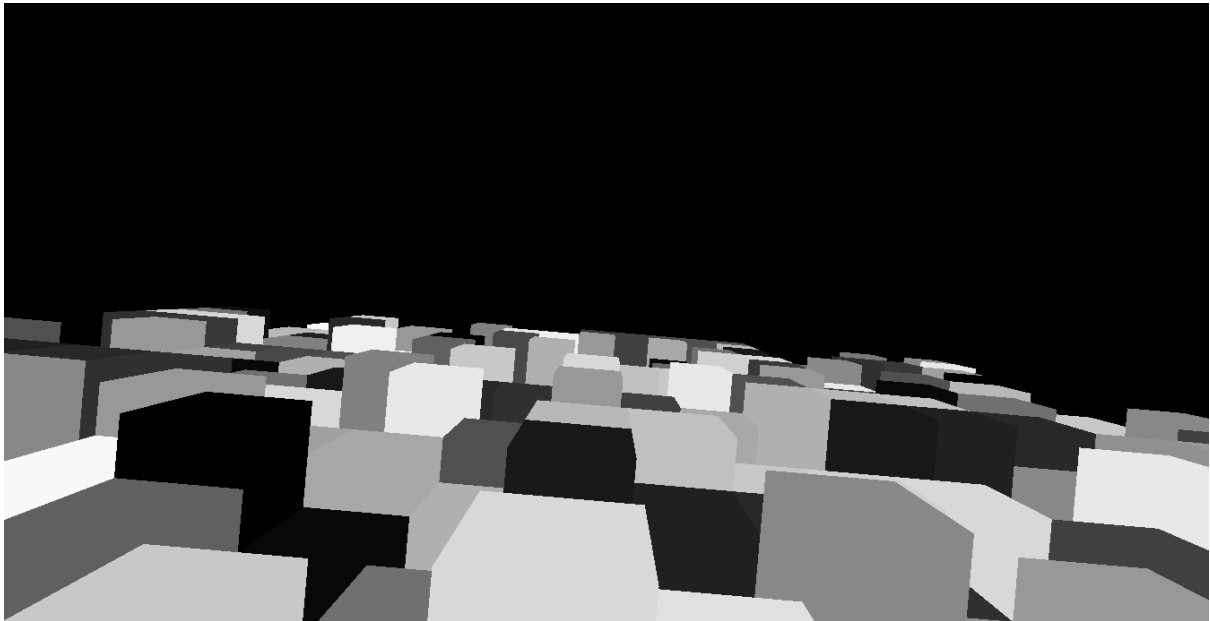
```
CL_DEVICE_REFERENCE_COUNT:          1
CL_DEVICE_PREFERRED_INTEROP_USER_SYNC:  true
CL_DEVICE_PRINTF_BUFFER_SIZE:      1048576
```

```
blu@macchiato:~/proj/prob_7$ POCL_DEBUG=0 LD_LIBRARY_PATH=/usr/local/lib ./problem_4 -device 0 -frames 100
./problem_4: /usr/local/lib/libOpenCL.so.1: no version information available (required by ./problem_4)
kernel preferred workgroup size multiple: 8
total frames rendered: 100
elapsed time: 13.140890 s
average FPS: 7.609835
```

POCL patched to use aarch64 fp min/max ASIMD instructions:

```
blu@macchiato:~/proj/prob_7$ POCL_DEBUG=0 POCL_AFFINITY=1 LD_LIBRARY_PATH=/usr/local/lib ./problem_4 -device 0 -frames 100
./problem_4: /usr/local/lib/libOpenCL.so.1: no version information available (required by ./problem_4)
kernel preferred workgroup size multiple: 8
total frames rendered: 100
elapsed time: 10.293058 s
average FPS: 9.715286
```

Sample frame from the raytraced sequence:



And for reference, the [original CG2 2014 demo](#): non-OpenCL CPU version with ambient occlusion; OpenGL-based Gaussian blur; logos and text added on post.

POCL 0.15-pre, LLVM 5.0.0:

blu@macchiato:~/proj/test-cl\$ POCL_DEBUG=0 LD_LIBRARY_PATH=/usr/local/lib ./test_cl

```
platform 0: 0x7fb7844ec1
  CL_PLATFORM_PROFILE: FULL_PROFILE
  CL_PLATFORM_VERSION: OpenCL 1.2 pocl 0.15-pre, LLVM 5.0.0svn-r318608
  CL_PLATFORM_NAME: Portable Computing Language
  CL_PLATFORM_VENDOR: The pocl project
  CL_PLATFORM_EXTENSIONS: empty
device 0: 0x342e44d0
  CL_DEVICE_TYPE: CL_DEVICE_TYPE_CPU
  CL_DEVICE_VENDOR_ID: 5045
  CL_DEVICE_MAX_COMPUTE_UNITS: 4
  CL_DEVICE_MAX_WORK_ITEM_DIMENSIONS: 3
  CL_DEVICE_MAX_WORK_GROUP_SIZE: 4096
  CL_DEVICE_MAX_WORK_ITEM_SIZES: 4096 4096 4096
  CL_DEVICE_PREFERRED_VECTOR_WIDTH_CHAR: 16
  CL_DEVICE_PREFERRED_VECTOR_WIDTH_SHORT: 8
  CL_DEVICE_PREFERRED_VECTOR_WIDTH_INT: 4
  CL_DEVICE_PREFERRED_VECTOR_WIDTH_LONG: 2
  CL_DEVICE_PREFERRED_VECTOR_WIDTH_FLOAT: 4
  CL_DEVICE_PREFERRED_VECTOR_WIDTH_DOUBLE: 2
  CL_DEVICE_MAX_CLOCK_FREQUENCY: 1300
  CL_DEVICE_ADDRESS_BITS: 64
  CL_DEVICE_MAX_READ_IMAGE_ARGS: 128
  CL_DEVICE_MAX_WRITE_IMAGE_ARGS: 128
  CL_DEVICE_MAX_MEM_ALLOC_SIZE: 1073741824
  CL_DEVICE_IMAGE2D_MAX_WIDTH: 8192
  CL_DEVICE_IMAGE2D_MAX_HEIGHT: 8192
  CL_DEVICE_IMAGE3D_MAX_WIDTH: 2048
  CL_DEVICE_IMAGE3D_MAX_HEIGHT: 2048
  CL_DEVICE_IMAGE3D_MAX_DEPTH: 2048
  CL_DEVICE_IMAGE_SUPPORT: true
  CL_DEVICE_MAX_PARAMETER_SIZE: 1024
  CL_DEVICE_MAX_SAMPLERS: 16
  CL_DEVICE_MEM_BASE_ADDR_ALIGN: 128
  CL_DEVICE_MIN_DATA_TYPE_ALIGN_SIZE: 16
  CL_DEVICE_SINGLE_FP_CONFIG: CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST
  CL_DEVICE_GLOBAL_MEM_CACHE_TYPE: CL_NONE
  CL_DEVICE_GLOBAL_MEM_CACHELINE_SIZE: 0
  CL_DEVICE_GLOBAL_MEM_CACHE_SIZE: 0
  CL_DEVICE_GLOBAL_MEM_SIZE: 2904201216
  CL_DEVICE_MAX_CONSTANT_BUFFER_SIZE: 16777216
  CL_DEVICE_MAX_CONSTANT_ARGS: 8
  CL_DEVICE_LOCAL_MEM_TYPE: CL_GLOBAL
  CL_DEVICE_LOCAL_MEM_SIZE: 16777216
  CL_DEVICE_ERROR_CORRECTION_SUPPORT: false
  CL_DEVICE_PROFILING_TIMER_RESOLUTION: 1
  CL_DEVICE_ENDIAN_LITTLE: true
  CL_DEVICE_AVAILABLE: true
  CL_DEVICE_COMPILER_AVAILABLE: true
  CL_DEVICE_EXECUTION_CAPABILITIES: CL_EXEC_KERNEL CL_EXEC_NATIVE_KERNEL
  CL_DEVICE_QUEUE_PROPERTIES: CL_QUEUE_PROFILING_ENABLE
  CL_DEVICE_NAME: pthread-cortex-a72
  CL_DEVICE_VENDOR: ARM
  CL_DRIVER_VERSION: 0.15-pre
  CL_DEVICE_PROFILE: FULL_PROFILE
  CL_DEVICE_VERSION: OpenCL 1.2 pocl HSTR: pthread-aarch64-unknown-linux-gnu-cortex-a72
  CL_DEVICE_EXTENSIONS: cl_khr_byte_addressable_store cl_khr_global_int32_base_atomics
cl_khr_global_int32_extended_atomics cl_khr_local_int32_base_atomics cl_khr_local_int32_extended_atomics cl_khr_3d_image_writes
cl_khr_fp16 cl_khr_fp64
  CL_DEVICE_PLATFORM: 0x7fb7844ec1
  CL_DEVICE_PREFERRED_VECTOR_WIDTH_HALF: 8
  CL_DEVICE_HOST_UNIFIED_MEMORY: true
  CL_DEVICE_NATIVE_VECTOR_WIDTH_CHAR: 16
  CL_DEVICE_NATIVE_VECTOR_WIDTH_SHORT: 8
  CL_DEVICE_NATIVE_VECTOR_WIDTH_INT: 4
  CL_DEVICE_NATIVE_VECTOR_WIDTH_LONG: 2
  CL_DEVICE_NATIVE_VECTOR_WIDTH_FLOAT: 4
  CL_DEVICE_NATIVE_VECTOR_WIDTH_DOUBLE: 2
  CL_DEVICE_NATIVE_VECTOR_WIDTH_HALF: 8
  CL_DEVICE_OPENCL_C_VERSION: OpenCL C 1.2 pocl
  CL_DEVICE_DOUBLE_FP_CONFIG: CL_FP_DENORM CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF CL_FP_FMA CL_FP_CORRECTLY_ROUNDED_DIVIDE_SQRT
  CL_DEVICE_LINKER_AVAILABLE: true
  CL_DEVICE_BUILT_IN_KERNELS: empty
  CL_DEVICE_IMAGE_MAX_BUFFER_SIZE: 67108864
  CL_DEVICE_IMAGE_MAX_ARRAY_SIZE: 2048
  CL_DEVICE_PARENT_DEVICE: 0
  CL_DEVICE_PARTITION_MAX_SUB_DEVICES: 4
  CL_DEVICE_PARTITION_PROPERTIES: CL_DEVICE_PARTITION_EQUALLY CL_DEVICE_PARTITION_BY_COUNTS
  CL_DEVICE_PARTITION_AFFINITY_DOMAIN: none
  CL_DEVICE_PARTITION_TYPE: n/a
  CL_DEVICE_REFERENCE_COUNT: 1
  CL_DEVICE_PREFERRED_INTEROP_USER_SYNC: true
```

CL_DEVICE_PRINTF_BUFFER_SIZE:

1048576

POCL patched to use aarch64 fp min/max ASIMD instructions:

olimex@teres:~/proj/interview/prob_7\$ POCL_DEBUG=0 LD_LIBRARY_PATH=/usr/local/lib ./problem_4 -device 0 -frames 100

./problem_4: /usr/local/lib/libOpenCL.so.1: no version information available (required by ./problem_4)

kernel preferred workgroup size multiple: 8

total frames rendered: 100

elapsed time: 7.037946 s

average FPS: 14.208692

blu@macchiato:~/proj/interview/prob_7\$ POCL_DEBUG=0 POCL_AFFINITY=1 LD_LIBRARY_PATH=/usr/local/lib ./problem_4 -device 0 -frames 100

./problem_4: /usr/local/lib/libOpenCL.so.1: no version information available (required by ./problem_4)

kernel preferred workgroup size multiple: 8

total frames rendered: 100

elapsed time: 4.435987 s

average FPS: 22.542899

MacBook 13-inch Mid-2010: Core2 Duo P8600
2x Penryn @ 2400MHz, 4GB DDR3 @ 1066MT/s (8.53GB/s)

Apple's native OCL stack:

```
blu:test-cl user$ ./test-cl
platform 0:
    CL_PLATFORM_PROFILE:          FULL_PROFILE
    CL_PLATFORM_VERSION:         OpenCL 1.2 (May 26 2017 12:59:48)
    CL_PLATFORM_NAME:            Apple
    CL_PLATFORM_VENDOR:          Apple
    CL_PLATFORM_EXTENSIONS:      cl_APPLE_SetMemObjectDestructor cl_APPLE_ContextLoggingFunctions
cl_APPLE_clut cl_APPLE_query_kernel_names cl_APPLE_gl_sharing cl_khr_gl_event
device 0:
    CL_DEVICE_TYPE:               CL_DEVICE_TYPE_CPU
    CL_DEVICE_VENDOR_ID:          4294967295
    CL_DEVICE_MAX_COMPUTE_UNITS:  2
    CL_DEVICE_MAX_WORK_ITEM_DIMENSIONS: 3
    CL_DEVICE_MAX_WORK_GROUP_SIZE: 1024
    CL_DEVICE_MAX_WORK_ITEM_SIZES: 1024 1 1
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_CHAR: 16
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_SHORT: 8
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_INT: 4
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_LONG: 2
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_FLOAT: 4
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_DOUBLE: 2
    CL_DEVICE_MAX_CLOCK_FREQUENCY: 2400
    CL_DEVICE_ADDRESS_BITS:       64
    CL_DEVICE_MAX_READ_IMAGE_ARGS: 128
    CL_DEVICE_MAX_WRITE_IMAGE_ARGS: 8
    CL_DEVICE_MAX_MEM_ALLOC_SIZE: 1073741824
    CL_DEVICE_IMAGE2D_MAX_WIDTH:  8192
    CL_DEVICE_IMAGE2D_MAX_HEIGHT: 8192
    CL_DEVICE_IMAGE3D_MAX_WIDTH:  2048
    CL_DEVICE_IMAGE3D_MAX_HEIGHT: 2048
    CL_DEVICE_IMAGE3D_MAX_DEPTH:  2048
    CL_DEVICE_IMAGE_SUPPORT:       true
    CL_DEVICE_MAX_PARAMETER_SIZE:  4096
    CL_DEVICE_MAX_SAMPLERS:        16
    CL_DEVICE_MEM_BASE_ADDR_ALIGN: 1024
    CL_DEVICE_MIN_DATA_TYPE_ALIGN_SIZE: 128
    CL_DEVICE_SINGLE_FP_CONFIG:    CL_FP_DENORM CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF CL_FP_FMA CL_FP_CORRECTLY_ROUNDED_DIVIDE_SORT
    CL_DEVICE_GLOBAL_MEM_CACHE_TYPE: CL_READ_WRITE_CACHE
    CL_DEVICE_GLOBAL_MEM_CACHELINE_SIZE: 3145728
    CL_DEVICE_GLOBAL_MEM_CACHE_SIZE: 64
    CL_DEVICE_GLOBAL_MEM_SIZE:       4294967296
    CL_DEVICE_MAX_CONSTANT_BUFFER_SIZE: 65536
    CL_DEVICE_MAX_CONSTANT_ARGS:     8
    CL_DEVICE_LOCAL_MEM_TYPE:         CL_GLOBAL
    CL_DEVICE_LOCAL_MEM_SIZE:         32768
    CL_DEVICE_ERROR_CORRECTION_SUPPORT: false
    CL_DEVICE_PROFILING_TIMER_RESOLUTION: 1
    CL_DEVICE_ENDIAN_LITTLE:          true
    CL_DEVICE_AVAILABLE:              true
    CL_DEVICE_COMPILER_AVAILABLE:      true
    CL_DEVICE_EXECUTION_CAPABILITIES: CL_EXEC_KERNEL CL_EXEC_NATIVE_KERNEL
    CL_DEVICE_QUEUE_PROPERTIES:        CL_QUEUE_PROFILING_ENABLE
    CL_DEVICE_NAME:                   Intel(R) Core(TM)2 Duo CPU      P8600  @ 2.40GHz
    CL_DEVICE_VENDOR:                 Intel
    CL_DRIVER_VERSION:                1.1
    CL_DEVICE_PROFILE:                FULL_PROFILE
    CL_DEVICE_VERSION:                OpenCL 1.2
    CL_DEVICE_EXTENSIONS:              cl_APPLE_SetMemObjectDestructor cl_APPLE_ContextLoggingFunctions
cl_APPLE_clut cl_APPLE_query_kernel_names cl_APPLE_gl_sharing cl_khr_gl_event cl_khr_fp64 cl_khr_global_int32_base_atomics
cl_khr_global_int32_extended_atomics cl_khr_local_int32_base_atomics cl_khr_local_int32_extended_atomics cl_khr_byte_addressable_store
cl_khr_int64_base_atomics cl_khr_int64_extended_atomics cl_khr_3d_image_writes cl_khr_image2d_from_buffer cl_APPLE_fp64_basic_ops
cl_APPLE_fixed_alpha_channel_orders cl_APPLE_biased_fixed_point_image_formats cl_APPLE_command_queue_priority
    CL_DEVICE_PLATFORM:             0x7fff0000
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_HALF: 0
    CL_DEVICE_HOST_UNIFIED_MEMORY:   true
    CL_DEVICE_NATIVE_VECTOR_WIDTH_CHAR: 16
    CL_DEVICE_NATIVE_VECTOR_WIDTH_SHORT: 8
    CL_DEVICE_NATIVE_VECTOR_WIDTH_INT: 4
    CL_DEVICE_NATIVE_VECTOR_WIDTH_LONG: 2
    CL_DEVICE_NATIVE_VECTOR_WIDTH_FLOAT: 4
    CL_DEVICE_NATIVE_VECTOR_WIDTH_DOUBLE: 2
    CL_DEVICE_NATIVE_VECTOR_WIDTH_HALF: 0
    CL_DEVICE_OPENCL_C_VERSION:      OpenCL C 1.2
    CL_DEVICE_DOUBLE_FP_CONFIG:      CL_FP_DENORM CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF CL_FP_FMA
    CL_DEVICE_LINKER_AVAILABLE:      true
    CL_DEVICE_BUILT_IN_KERNELS:       empty
    CL_DEVICE_IMAGE_MAX_BUFFER_SIZE: 65536
    CL_DEVICE_IMAGE_MAX_ARRAY_SIZE:  2048
```

```

CL_DEVICE_PARENT_DEVICE: 0x800
CL_DEVICE_PARTITION_MAX_SUB_DEVICES: 0
CL_DEVICE_PARTITION_PROPERTIES: none
CL_DEVICE_PARTITION_AFFINITY_DOMAIN: none
CL_DEVICE_PARTITION_TYPE: n/a
CL_DEVICE_REFERENCE_COUNT: 1
CL_DEVICE_PREFERRED_INTEROP_USER_SYNC: true
CL_DEVICE_PRINTF_BUFFER_SIZE: 1048576
device 1: 0x1022600
CL_DEVICE_TYPE: CL_DEVICE_TYPE_GPU
CL_DEVICE_VENDOR_ID: 16918016
CL_DEVICE_MAX_COMPUTE_UNITS: 6
CL_DEVICE_MAX_WORK_ITEM_DIMENSIONS: 3
CL_DEVICE_MAX_WORK_GROUP_SIZE: 512
CL_DEVICE_MAX_WORK_ITEM_SIZES: 512 512 64
CL_DEVICE_PREFERRED_VECTOR_WIDTH_CHAR: 1
CL_DEVICE_PREFERRED_VECTOR_WIDTH_SHORT: 1
CL_DEVICE_PREFERRED_VECTOR_WIDTH_INT: 1
CL_DEVICE_PREFERRED_VECTOR_WIDTH_LONG: 1
CL_DEVICE_PREFERRED_VECTOR_WIDTH_FLOAT: 1
CL_DEVICE_PREFERRED_VECTOR_WIDTH_DOUBLE: 0
CL_DEVICE_MAX_CLOCK_FREQUENCY: 950
CL_DEVICE_ADDRESS_BITS: 32
CL_DEVICE_MAX_READ_IMAGE_ARGS: 128
CL_DEVICE_MAX_WRITE_IMAGE_ARGS: 8
CL_DEVICE_MAX_MEM_ALLOC_SIZE: 134217728
CL_DEVICE_IMAGE2D_MAX_WIDTH: 4096
CL_DEVICE_IMAGE2D_MAX_HEIGHT: 4096
CL_DEVICE_IMAGE3D_MAX_WIDTH: 2048
CL_DEVICE_IMAGE3D_MAX_HEIGHT: 2048
CL_DEVICE_IMAGE3D_MAX_DEPTH: 2048
CL_DEVICE_IMAGE_SUPPORT: true
CL_DEVICE_MAX_PARAMETER_SIZE: 4352
CL_DEVICE_MAX_SAMPLERS: 16
CL_DEVICE_MEM_BASE_ADDR_ALIGN: 1024
CL_DEVICE_MIN_DATA_TYPE_ALIGN_SIZE: 128
CL_DEVICE_SINGLE_FP_CONFIG: CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF
CL_DEVICE_GLOBAL_MEM_CACHE_TYPE: CL_NONE
CL_DEVICE_GLOBAL_MEM_CACHELINE_SIZE: 0
CL_DEVICE_GLOBAL_MEM_CACHE_SIZE: 0
CL_DEVICE_GLOBAL_MEM_SIZE: 268435456
CL_DEVICE_MAX_CONSTANT_BUFFER_SIZE: 65536
CL_DEVICE_MAX_CONSTANT_ARGS: 9
CL_DEVICE_LOCAL_MEM_TYPE: CL_LOCAL
CL_DEVICE_LOCAL_MEM_SIZE: 16384
CL_DEVICE_ERROR_CORRECTION_SUPPORT: false
CL_DEVICE_PROFILING_TIMER_RESOLUTION: 1000
CL_DEVICE_ENDIAN_LITTLE: true
CL_DEVICE_AVAILABLE: true
CL_DEVICE_COMPILER_AVAILABLE: true
CL_DEVICE_EXECUTION_CAPABILITIES: CL_EXEC_KERNEL
CL_DEVICE_QUEUE_PROPERTIES: CL_QUEUE_PROFILING_ENABLE
CL_DEVICE_NAME: GeForce 320M
CL_DEVICE_VENDOR: NVIDIA
CL_DRIVER_VERSION: 10.2.37 310.90.10.05b54
CL_DEVICE_PROFILE: FULL_PROFILE
CL_DEVICE_VERSION: OpenCL 1.0
CL_DEVICE_EXTENSIONS: cl_APPLE_SetMemObjectDestructor cl_APPLE_ContextLoggingFunctions
cl_APPLE_clut cl_APPLE_query_kernel_names cl_APPLE_gl_sharing cl_khr_gl_event cl_khr_byte_addressable_store
cl_khr_global_int32_base_atomics cl_khr_global_int32_extended_atomics cl_khr_local_int32_base_atomics
cl_khr_local_int32_extended_atomics
CL_DEVICE_PLATFORM: 0x7fff0000

```

```

blu:prob_7 user$ ./problem_4 -device 1 -frames 100
kernel preferred workgroup size multiple: 32
total frames rendered: 100
elapsed time: 2.136814 s
average FPS: 46.798655

```

```

blu:prob_7 user$ ./problem_4 -device 0 -frames 100
kernel preferred workgroup size multiple: 1
total frames rendered: 100
elapsed time: 43.265707 s
average FPS: 2.311299

```

POCL 0.15-pre, LLVM 4.0.1:

blu:test-cl user\$ LD_LIBRARY_PATH=/usr/local/lib ./test_cl

```
platform 0:
  CL_PLATFORM_PROFILE:          FULL_PROFILE
  CL_PLATFORM_VERSION:          OpenCL 1.2 pocl 0.15-pre, LLVM 4.0.1
  CL_PLATFORM_NAME:             Portable Computing Language
  CL_PLATFORM_VENDOR:           The pocl project
  CL_PLATFORM_EXTENSIONS:       empty
  device 0:
    CL_DEVICE_TYPE:              CL_DEVICE_TYPE_CPU
    CL_DEVICE_VENDOR_ID:         32902
    CL_DEVICE_MAX_COMPUTE_UNITS: 2
    CL_DEVICE_MAX_WORK_ITEM_DIMENSIONS: 3
    CL_DEVICE_MAX_WORK_GROUP_SIZE: 4096
    CL_DEVICE_MAX_WORK_ITEM_SIZES: 4096 4096 4096
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_CHAR: 16
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_SHORT: 8
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_INT: 4
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_LONG: 2
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_FLOAT: 4
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_DOUBLE: 2
pocl warning: encountered incomplete implementation in /Users/user/proj/pocl/lib/CL/clGetDeviceInfo.c:122
  CL_DEVICE_MAX_CLOCK_FREQUENCY: 0
  CL_DEVICE_ADDRESS_BITS:        64
  CL_DEVICE_MAX_READ_IMAGE_ARGS: 128
  CL_DEVICE_MAX_WRITE_IMAGE_ARGS: 128
  CL_DEVICE_MAX_MEM_ALLOC_SIZE:  1073741824
  CL_DEVICE_IMAGE2D_MAX_WIDTH:   8192
  CL_DEVICE_IMAGE2D_MAX_HEIGHT:  8192
  CL_DEVICE_IMAGE3D_MAX_WIDTH:   2048
  CL_DEVICE_IMAGE3D_MAX_HEIGHT:  2048
  CL_DEVICE_IMAGE3D_MAX_DEPTH:   2048
  CL_DEVICE_IMAGE_SUPPORT:       true
  CL_DEVICE_MAX_PARAMETER_SIZE:  1024
  CL_DEVICE_MAX_SAMPLERS:        16
  CL_DEVICE_MEM_BASE_ADDR_ALIGN: 128
  CL_DEVICE_MIN_DATA_TYPE_ALIGN_SIZE: 16
  CL_DEVICE_SINGLE_FP_CONFIG:    CL_FP_DENORM CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF CL_FP_CORRECTLY_ROUNDED_DIVIDE_SQRT
  CL_DEVICE_GLOBAL_MEM_CACHE_TYPE: CL_READ_WRITE_CACHE
  CL_DEVICE_GLOBAL_MEM_CACHELINE_SIZE: 64
  CL_DEVICE_GLOBAL_MEM_CACHE_SIZE: 32768
  CL_DEVICE_GLOBAL_MEM_SIZE:       3221225472
  CL_DEVICE_MAX_CONSTANT_BUFFER_SIZE: 16777216
  CL_DEVICE_MAX_CONSTANT_ARGS:     8
  CL_DEVICE_LOCAL_MEM_TYPE:        CL_GLOBAL
  CL_DEVICE_LOCAL_MEM_SIZE:        16777216
  CL_DEVICE_ERROR_CORRECTION_SUPPORT: false
  CL_DEVICE_PROFILING_TIMER_RESOLUTION: 1000
  CL_DEVICE_ENDIAN_LITTLE:         true
  CL_DEVICE_AVAILABLE:             true
  CL_DEVICE_COMPILER_AVAILABLE:    true
  CL_DEVICE_EXECUTION_CAPABILITIES: CL_EXEC_KERNEL CL_EXEC_NATIVE_KERNEL
  CL_DEVICE_QUEUE_PROPERTIES:      CL_QUEUE_PROFILING_ENABLE
  CL_DEVICE_NAME:                  pthread
  CL_DEVICE_VENDOR:                Unknown x86
  CL_DRIVER_VERSION:               0.15-pre
  CL_DEVICE_PROFILE:               FULL_PROFILE
  CL_DEVICE_VERSION:               OpenCL 1.2 pocl HSTR: pthread-x86_64-apple-macosx10.12.0-pennryn
  CL_DEVICE_EXTENSIONS:             cl_khr_byte_addressable_store cl_khr_global_int32_base_atomics
cl_khr_global_int32_extended_atomics cl_khr_local_int32_base_atomics cl_khr_local_int32_extended_atomics cl_khr_3d_image_writes
cl_khr_fp64 cl_khr_int64_base_atomics cl_khr_int64_extended_atomics
  CL_DEVICE_PLATFORM:              0x10d9cd610
  CL_DEVICE_PREFERRED_VECTOR_WIDTH_HALF: 8
  CL_DEVICE_HOST_UNIFIED_MEMORY:   true
  CL_DEVICE_NATIVE_VECTOR_WIDTH_CHAR: 16
  CL_DEVICE_NATIVE_VECTOR_WIDTH_SHORT: 8
  CL_DEVICE_NATIVE_VECTOR_WIDTH_INT: 4
  CL_DEVICE_NATIVE_VECTOR_WIDTH_LONG: 2
  CL_DEVICE_NATIVE_VECTOR_WIDTH_FLOAT: 4
  CL_DEVICE_NATIVE_VECTOR_WIDTH_DOUBLE: 2
  CL_DEVICE_NATIVE_VECTOR_WIDTH_HALF: 8
  CL_DEVICE_OPENCL_C_VERSION:      OpenCL C 1.2 pocl
  CL_DEVICE_DOUBLE_FP_CONFIG:      CL_FP_DENORM CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF CL_FP_FMA CL_FP_CORRECTLY_ROUNDED_DIVIDE_SQRT
  CL_DEVICE_LINKER_AVAILABLE:      true
  CL_DEVICE_BUILT_IN_KERNELS:      empty
  CL_DEVICE_IMAGE_MAX_BUFFER_SIZE: 67108864
  CL_DEVICE_IMAGE_MAX_ARRAY_SIZE: 2048
  CL_DEVICE_PARENT_DEVICE:         0x0
  CL_DEVICE_PARTITION_MAX_SUB_DEVICES: 2
  CL_DEVICE_PARTITION_PROPERTIES:   CL_DEVICE_PARTITION_EQUALLY CL_DEVICE_PARTITION_BY_COUNTS
  CL_DEVICE_PARTITION_AFFINITY_DOMAIN: none
  CL_DEVICE_PARTITION_TYPE:        n/a
```

CL_DEVICE_REFERENCE_COUNT:	1
CL_DEVICE_PREFERRED_INTEROP_USER_SYNC:	true
CL_DEVICE_PRINTF_BUFFER_SIZE:	1048576

```
blu:prob_7 user$ LD_LIBRARY_PATH=/usr/local/lib ./problem_4 -device 0 -frames 100
kernel preferred workgroup size multiple: 8
total frames rendered: 100
elapsed time: 8.639305 s
average FPS: 11.575005
```

Xeon Dual-socket server: 2x Xeon E5-2687W
16x Sandy Bridge @ 3100MHz, 32GB 2x DDR3 @ 1600MT/s (25.6GB/s)

Intel's native OCL stack:
~/proj/prob_7\$./problem_4 -platform 1 -device 0 -frames 100
kernel preferred workgroup size multiple: 128
total frames rendered: 100
elapsed time: 1.057699 s
average FPS: 94.544823

Hypothetical Qualcomm Centriq 2400 server: Centriq 2400
48x Falkor @ 2200MHz-2600MHz, 6x DDR4 @ 2667MT/s (128GB/s)

Note: assumed linearly scaling from the ARMADA 8040 measured performance; in practice the single-thread part of the test will impede the linear scaling.

```
$ echo "scale=4; 48 * 2.2 / (4 * 1.3) * 7.61" | bc
154.5408
$ echo "scale=4; 48 * 2.6 / (4 * 1.3) * 7.61" | bc
182.6400
```

POCL patched to use aarch64 fp min/max ASIMD instructions:

```
$ echo "scale=2; 48 * 2.2 / (4 * 1.3) * 9.72" | bc
197.31
$ echo "scale=2; 48 * 2.6 / (4 * 1.3) * 9.72" | bc
233.28
```

POCL 0.15-pre LLVM 5.0.0, patched to use aarch64 fp min/max ASIMD instructions:

```
$ echo "scale=2; 48 * 2.2 / (4 * 1.3) * 22.54" | bc
457.56
$ echo "scale=2; 48 * 2.6 / (4 * 1.3) * 22.54" | bc
540.96
```

Odroid-N2: Amlogic S922X:

4x Cortex-A73 @ 1.8GHz, 2x Cortex-A53 @ 1.896GHz, Mali-G52 MP2 (2x3) @ 750MHz, 4GB LPDDR4 @ 2640MT/s (10.56GB/s)

blu@odroid:~/proj/test-cl\$./test_cl

```
platform 0:
  CL_PLATFORM_PROFILE:      FULL_PROFILE
  CL_PLATFORM_VERSION:      OpenCL 2.0 git.c8adb9.122c9daed32dbba4b3056f41a2f23c58
  CL_PLATFORM_NAME:         ARM Platform
  CL_PLATFORM_VENDOR:       ARM
  CL_PLATFORM_EXTENSIONS:   cl_khr_global_int32_base_atomics cl_khr_global_int32_extended_atomics
cl_khr_local_int32_base_atomics cl_khr_local_int32_extended_atomics cl_khr_byte_addressable_store cl_khr_3d_image_writes
cl_khr_int64_base_atomics cl_khr_int64_extended_atomics cl_khr_fp16 cl_khr_icd cl_khr_egl_image cl_khr_image2d_from_buffer
cl_khr_depth_images cl_khr_subgroups cl_khr_create_command_queue cl_arm_core_id cl_arm_printf cl_arm_thread_limit_hint
cl_arm_non_uniform_work_group_size cl_arm_import_memory cl_arm_shared_virtual_memory
  device 0:
    CL_DEVICE_TYPE:          CL_DEVICE_TYPE_GPU
    CL_DEVICE_VENDOR_ID:     1913782272
    CL_DEVICE_MAX_COMPUTE_UNITS: 2
    CL_DEVICE_MAX_WORK_ITEM_DIMENSIONS: 3
    CL_DEVICE_MAX_WORK_GROUP_SIZE: 384
    CL_DEVICE_MAX_WORK_ITEM_SIZES: 384 384 384
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_CHAR: 16
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_SHORT: 8
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_INT: 4
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_LONG: 2
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_FLOAT: 4
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_DOUBLE: 0
    CL_DEVICE_MAX_CLOCK_FREQUENCY: 750
    CL_DEVICE_ADDRESS_BITS: 64
    CL_DEVICE_MAX_READ_IMAGE_ARGS: 128
    CL_DEVICE_MAX_WRITE_IMAGE_ARGS: 64
    CL_DEVICE_MAX_MEM_ALLOC_SIZE: 971913216
    CL_DEVICE_IMAGE2D_MAX_WIDTH: 65536
    CL_DEVICE_IMAGE2D_MAX_HEIGHT: 65536
    CL_DEVICE_IMAGE3D_MAX_WIDTH: 65536
    CL_DEVICE_IMAGE3D_MAX_HEIGHT: 65536
    CL_DEVICE_IMAGE3D_MAX_DEPTH: 65536
    CL_DEVICE_IMAGE_SUPPORT: true
    CL_DEVICE_MAX_PARAMETER_SIZE: 1024
    CL_DEVICE_MAX_SAMPLERS: 16
    CL_DEVICE_MEM_BASE_ADDR_ALIGN: 1024
    CL_DEVICE_MIN_DATA_TYPE_ALIGN_SIZE: 128
    CL_DEVICE_SINGLE_FP_CONFIG: CL_FP_DENORM CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF CL_FP_FMA
    CL_DEVICE_GLOBAL_MEM_CACHE_TYPE: CL_READ_WRITE_CACHE
    CL_DEVICE_GLOBAL_MEM_CACHELINE_SIZE: 64
    CL_DEVICE_GLOBAL_MEM_CACHE_SIZE: 131072
    CL_DEVICE_GLOBAL_MEM_SIZE: 3887652864
    CL_DEVICE_MAX_CONSTANT_BUFFER_SIZE: 65536
    CL_DEVICE_MAX_CONSTANT_ARGS: 8
    CL_DEVICE_LOCAL_MEM_TYPE: CL_GLOBAL
    CL_DEVICE_LOCAL_MEM_SIZE: 32768
    CL_DEVICE_ERROR_CORRECTION_SUPPORT: false
    CL_DEVICE_PROFILING_TIMER_RESOLUTION: 1000
    CL_DEVICE_ENDIAN_LITTLE: true
    CL_DEVICE_AVAILABLE: true
    CL_DEVICE_COMPILER_AVAILABLE: true
    CL_DEVICE_EXECUTION_CAPABILITIES: CL_EXEC_KERNEL
    CL_DEVICE_QUEUE_PROPERTIES: CL_QUEUE_OUT_OF_ORDER_EXEC_MODE_ENABLE CL_QUEUE_PROFILING_ENABLE
    CL_DEVICE_NAME: Mali-G52
    CL_DEVICE_VENDOR: ARM
    CL_DRIVER_VERSION: 2.0
    CL_DEVICE_PROFILE: FULL_PROFILE
    CL_DEVICE_VERSION: OpenCL 2.0 git.c8adb9.122c9daed32dbba4b3056f41a2f23c58
    CL_DEVICE_EXTENSIONS: cl_khr_global_int32_base_atomics cl_khr_global_int32_extended_atomics
cl_khr_local_int32_base_atomics cl_khr_local_int32_extended_atomics cl_khr_byte_addressable_store cl_khr_3d_image_writes
cl_khr_int64_base_atomics cl_khr_int64_extended_atomics cl_khr_fp16 cl_khr_icd cl_khr_egl_image cl_khr_image2d_from_buffer
cl_khr_depth_images cl_khr_subgroups cl_khr_create_command_queue cl_arm_core_id cl_arm_printf cl_arm_thread_limit_hint
cl_arm_non_uniform_work_group_size cl_arm_import_memory cl_arm_shared_virtual_memory
    CL_DEVICE_PLATFORM: 0x62c890
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_HALF: 8
    CL_DEVICE_HOST_UNIFIED_MEMORY: true
    CL_DEVICE_NATIVE_VECTOR_WIDTH_CHAR: 4
    CL_DEVICE_NATIVE_VECTOR_WIDTH_SHORT: 2
    CL_DEVICE_NATIVE_VECTOR_WIDTH_INT: 1
    CL_DEVICE_NATIVE_VECTOR_WIDTH_LONG: 1
    CL_DEVICE_NATIVE_VECTOR_WIDTH_FLOAT: 1
    CL_DEVICE_NATIVE_VECTOR_WIDTH_DOUBLE: 0
    CL_DEVICE_NATIVE_VECTOR_WIDTH_HALF: 2
    CL_DEVICE_OPENCL_C_VERSION: OpenCL C 2.0 git.c8adb9.122c9daed32dbba4b3056f41a2f23c58
    CL_DEVICE_DOUBLE_FP_CONFIG: none
    CL_DEVICE_LINKER_AVAILABLE: true
    CL_DEVICE_BUILT_IN_KERNELS: empty
    CL_DEVICE_IMAGE_MAX_BUFFER_SIZE: 65536
```

CL_DEVICE_IMAGE_MAX_ARRAY_SIZE:	2048
CL_DEVICE_PARENT_DEVICE:	0
CL_DEVICE_PARTITION_MAX_SUB_DEVICES:	0
CL_DEVICE_PARTITION_PROPERTIES:	none
CL_DEVICE_PARTITION_AFFINITY_DOMAIN:	none
CL_DEVICE_PARTITION_TYPE:	n/a
CL_DEVICE_REFERENCE_COUNT:	1
CL_DEVICE_PREFERRED_INTEROP_USER_SYNC:	false
CL_DEVICE_PRINTF_BUFFER_SIZE:	1048576

```
blu@odroid:~/proj/cg2_2014_demo/prob_7$ ./problem_4 -frames 100
kernel preferred workgroup size multiple: 8
device max work-item sizes: 384 384 384
total frames rendered: 100
elapsed time: 1.995514 s
average FPS: 50.112401
```

NanoPi-M4: Rockchip RK3399:

2x Cortex-A72 @ 1.8GHz, 4x Cortex-A53 @ 1.42GHz, Mali-T860 MP4 @ 800MHz, 4GB LPDDR3 @ 1600MT/s (12.8GB/s)

```
platform 0:                                0x7f89651fb0
  CL_PLATFORM_PROFILE:                     FULL_PROFILE
  CL_PLATFORM_VERSION:                     OpenCL 1.2 v1.r14p0-01re10-git(966ed26).f44c85cb3d2ceb87e8be88e7592755c3
  CL_PLATFORM_NAME:                       ARM Platform
  CL_PLATFORM_VENDOR:                     ARM
  CL_PLATFORM_EXTENSIONS:                  cl_khr_global_int32_base_atomics cl_khr_global_int32_extended_atomics
cl_khr_local_int32_base_atomics cl_khr_local_int32_extended_atomics cl_khr_byte_addressable_store cl_khr_3d_image_writes cl_khr_fp64
cl_khr_int64_base_atomics cl_khr_int64_extended_atomics cl_khr_fp16 cl_khr_gl_sharing cl_khr_icd cl_khr_egl_event cl_khr_egl_image
cl_khr_image2d_from_buffer cl_arm_core_id cl_arm_printf cl_arm_thread_limit_hint cl_arm_non_uniform_work_group_size cl_arm_import_memory
  device 0:                                0x7f896207f0
    CL_DEVICE_TYPE:                        CL_DEVICE_TYPE_GPU
    CL_DEVICE_VENDOR_ID:                   140517376
    CL_DEVICE_MAX_COMPUTE_UNITS:           4
    CL_DEVICE_MAX_WORK_ITEM_DIMENSIONS:    3
    CL_DEVICE_MAX_WORK_GROUP_SIZE:        256
    CL_DEVICE_MAX_WORK_ITEM_SIZES:        256 256 256
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_CHAR: 16
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_SHORT: 8
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_INT:   4
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_LONG:  2
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_FLOAT: 4
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_DOUBLE: 2
    CL_DEVICE_MAX_CLOCK_FREQUENCY:         800
    CL_DEVICE_ADDRESS_BITS:                64
    CL_DEVICE_MAX_READ_IMAGE_ARGS:         128
    CL_DEVICE_MAX_WRITE_IMAGE_ARGS:        8
    CL_DEVICE_MAX_MEM_ALLOC_SIZE:          999073792
    CL_DEVICE_IMAGE2D_MAX_WIDTH:           65536
    CL_DEVICE_IMAGE2D_MAX_HEIGHT:          65536
    CL_DEVICE_IMAGE3D_MAX_WIDTH:           65536
    CL_DEVICE_IMAGE3D_MAX_HEIGHT:          65536
    CL_DEVICE_IMAGE3D_MAX_DEPTH:           65536
    CL_DEVICE_IMAGE_SUPPORT:               true
    CL_DEVICE_MAX_PARAMETER_SIZE:          1024
    CL_DEVICE_MAX_SAMPLERS:                16
    CL_DEVICE_MEM_BASE_ADDR_ALIGN:         1024
    CL_DEVICE_MIN_DATA_TYPE_ALIGN_SIZE:    128
    CL_DEVICE_SINGLE_FP_CONFIG:            CL_FP_DENORM CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF CL_FP_FMA
    CL_DEVICE_GLOBAL_MEM_CACHE_TYPE:       CL_READ_WRITE_CACHE
    CL_DEVICE_GLOBAL_MEM_CACHELINE_SIZE:   64
    CL_DEVICE_GLOBAL_MEM_CACHE_SIZE:       262144
    CL_DEVICE_GLOBAL_MEM_SIZE:             3996295168
    CL_DEVICE_MAX_CONSTANT_BUFFER_SIZE:    65536
    CL_DEVICE_MAX_CONSTANT_ARGS:           8
    CL_DEVICE_LOCAL_MEM_TYPE:              CL_GLOBAL
    CL_DEVICE_LOCAL_MEM_SIZE:              32768
    CL_DEVICE_ERROR_CORRECTION_SUPPORT:     false
    CL_DEVICE_PROFILING_TIMER_RESOLUTION:   1000
    CL_DEVICE_ENDIAN_LITTLE:               true
    CL_DEVICE_AVAILABLE:                   true
    CL_DEVICE_COMPILER_AVAILABLE:           true
    CL_DEVICE_EXECUTION_CAPABILITIES:      CL_EXEC_KERNEL
    CL_DEVICE_QUEUE_PROPERTIES:            CL_QUEUE_OUT_OF_ORDER_EXEC_MODE_ENABLE CL_QUEUE_PROFILING_ENABLE
    CL_DEVICE_NAME:                        Mali-T860
    CL_DEVICE_VENDOR:                      ARM
    CL_DRIVER_VERSION:                     1.2
    CL_DEVICE_PROFILE:                     FULL_PROFILE
    CL_DEVICE_VERSION:                     OpenCL 1.2 v1.r14p0-01re10-git(966ed26).f44c85cb3d2ceb87e8be88e7592755c3
    CL_DEVICE_EXTENSIONS:                  cl_khr_global_int32_base_atomics cl_khr_global_int32_extended_atomics
cl_khr_local_int32_base_atomics cl_khr_local_int32_extended_atomics cl_khr_byte_addressable_store cl_khr_3d_image_writes cl_khr_fp64
cl_khr_int64_base_atomics cl_khr_int64_extended_atomics cl_khr_fp16 cl_khr_gl_sharing cl_khr_icd cl_khr_egl_event cl_khr_egl_image
cl_khr_image2d_from_buffer cl_arm_core_id cl_arm_printf cl_arm_thread_limit_hint cl_arm_non_uniform_work_group_size cl_arm_import_memory
    CL_DEVICE_PLATFORM:                    0x7f89651fb0
    CL_DEVICE_PREFERRED_VECTOR_WIDTH_HALF:  8
    CL_DEVICE_HOST_UNIFIED_MEMORY:          true
    CL_DEVICE_NATIVE_VECTOR_WIDTH_CHAR:     16
    CL_DEVICE_NATIVE_VECTOR_WIDTH_SHORT:    8
    CL_DEVICE_NATIVE_VECTOR_WIDTH_INT:      4
    CL_DEVICE_NATIVE_VECTOR_WIDTH_LONG:     2
    CL_DEVICE_NATIVE_VECTOR_WIDTH_FLOAT:    4
    CL_DEVICE_NATIVE_VECTOR_WIDTH_DOUBLE:   2
    CL_DEVICE_NATIVE_VECTOR_WIDTH_HALF:     8
    CL_DEVICE_OPENCL_C_VERSION:             OpenCL C 1.2
v1.r14p0-01re10-git(966ed26).f44c85cb3d2ceb87e8be88e7592755c3
  CL_DEVICE_DOUBLE_FP_CONFIG:             CL_FP_DENORM CL_FP_INF_NAN CL_FP_ROUND_TO_NEAREST CL_FP_ROUND_TO_ZERO
CL_FP_ROUND_TO_INF CL_FP_FMA
    CL_DEVICE_LINKER_AVAILABLE:            true
    CL_DEVICE_BUILT_IN_KERNELS:            empty
    CL_DEVICE_IMAGE_MAX_BUFFER_SIZE:       65536
    CL_DEVICE_IMAGE_MAX_ARRAY_SIZE:       2048
```

CL_DEVICE_PARENT_DEVICE:	0
CL_DEVICE_PARTITION_MAX_SUB_DEVICES:	0
CL_DEVICE_PARTITION_PROPERTIES:	none
CL_DEVICE_PARTITION_AFFINITY_DOMAIN:	none
CL_DEVICE_PARTITION_TYPE:	n/a
CL_DEVICE_REFERENCE_COUNT:	1
CL_DEVICE_PREFERRED_INTEROP_USER_SYNC:	false
CL_DEVICE_PRINTF_BUFFER_SIZE:	1048576

```
blu@nanopim4:/mnt/proj/cg2_2014_demo/prob_7$ LD_LIBRARY_PATH=/usr/local/lib/ ./problem_4 -frames 100
kernel preferred workgroup size multiple: 4
device max work-item sizes: 256 256 256
total frames rendered: 100
elapsed time: 2.384069 s
average FPS: 41.945092
```