

# Heterogeneous Computing

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#include <iostream>
#include <algorithm>

using namespace std;

#define N 1024
#define RADIUS 3
#define BLOCK_SIZE 16

__global__ void stencil_1d(int *in, int *out) {
    __shared__ int temp[BLOCK_SIZE * 2 * RADIUS];
    int gindex = threadIdx.x + blockIdx.x * blockDim.x;
    int lindex = threadIdx.x + RADIUS;

    // Read input elements into shared memory
    temp[lindex] = in[gindex];
    if (threadIdx.x < RADIUS) {
        temp[lindex - RADIUS] = in[gindex -
RADIUS];
        temp[lindex + BLOCK_SIZE] =
in[gindex + BLOCK_SIZE];
    }

    // Synchronize (ensure all the data is available)
    __syncthreads();

    // Apply the stencil
    int result = 0;
    for (int offset = -RADIUS; offset <= RADIUS; offset++)
        result += temp[lindex + offset];

    // Store the result
    out[gindex] = result;
}

void fill_ints(int *x, int n) {
    fill_n(x, n, 1);
}

int main(void) {
    int *in, *out; // host copies of a, b, c
    int *d_in, *d_out; // device copies of a, b, c
    int size = (N + 2*RADIUS) * sizeof(int);

    // Alloc space for host copies and setup values
    in = (int *)malloc(size); fill_ints(in, N + 2*RADIUS);
    out = (int *)malloc(size); fill_ints(out, N + 2*RADIUS);

    // Alloc space for device copies
    cudaMalloc((void **)&d_in, size);
    cudaMalloc((void **)&d_out, size);

    // Copy to device
    cudaMemcpy(d_in, in, size,
cudaMemcpyHostToDevice);
    cudaMemcpy(d_out, out, size,
cudaMemcpyHostToDevice);

    // Launch stencil_1d() kernel on GPU
    stencil_1d<<<N/BLOCK_SIZE,BLOCK_SIZE>>>(d_in +
RADIUS, d_out + RADIUS);

    // Copy result back to host
    cudaMemcpy(out, d_out, size,
cudaMemcpyDeviceToHost);

    // Cleanup
    free(in); free(out);
    cudaFree(d_in); cudaFree(d_out);
    return 0;
}
```

parallel fn

serial code

parallel code

serial code

