How to Write Offload Code on Xeon Phi

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2014-10-17

What is Offload Mode

- The “mode” we are talking about is the way Xeon and Xeon Phi communicate.
- Basically there’re 2 communication mode on Xeon Phi:
  - *Native*: We run the code directly on Xeon Phi.
  - *Offload*: Mainly on Xeon; Some part of the codes and data will be uploaded to Xeon Phi.

When to Use Offload Mode?

- Sometimes, some parts of the code will perform better on Xeon than Xeon Phi:
  - Each core of Xeon Phi has low frequency. (Highly paralleled)
  - Not good at dealing with if-else.
- Then split our work based on their nature.

Offload Routine

- First of all, compiler needs to know where will be offloaded.
- Then **allocate** data space on Xeon Phi card, decide **when** and **how** to pass data. At last, when to free the space.

OpenMP Offload(1)

- First of all, we need to use OpenMP pragma to mark the offload region:

```
#pragma offload target(mic:0)
{
     [offload body]
}
```

OpenMP Offload (2)

- Next, we need to specify the data allocation and transfer method

On Host

```
int *A = (int *) mm_malloc(sizeof(int) * ASIZE);
```

Allocate data on MIC card

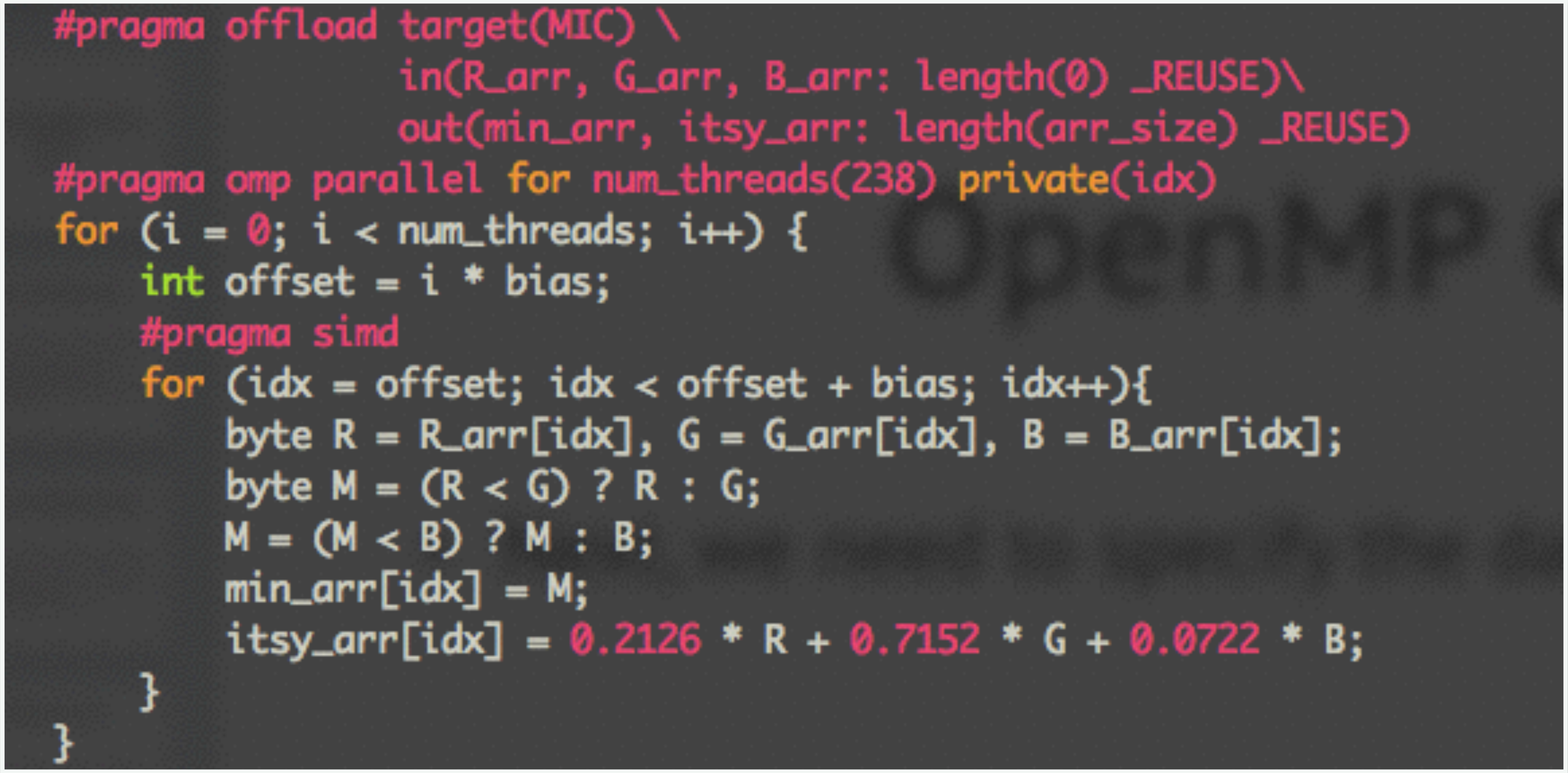
```
#pragma offload_transfer target(mic:0) in(A:length(ASIZE) ALLOC)
```

Pass the data pointer to MIC card

```
#pragma offload target(mic:0) in(A:length(0) REUSE)
```

OpenMP Offload (3)

Example:



```
#pragma offload target(MIC) \
                in(R_arr, G_arr, B_arr: length(0) _REUSE)\
                out(min_arr, itsy_arr: length(arr_size) _REUSE)
#pragma omp parallel for num_threads(238) private(idx)
for (i = 0; i < num_threads; i++) {
    int offset = i * bias;
    #pragma simd
    for (idx = offset; idx < offset + bias; idx++){
        byte R = R_arr[idx], G = G_arr[idx], B = B_arr[idx];
        byte M = (R < G) ? R : G;
        M = (M < B) ? M : B;
        min_arr[idx] = M;
        itsy_arr[idx] = 0.2126 * R + 0.7152 * G + 0.0722 * B;
    }
}
```

How to Design?

Don't do allocation and transfer all the time.

Tricky Things

- **export OFFLOAD_REPORT=1,2,3..** to get more detailed output
- when you launch the program for the first time, MIC cards need to be initialized, do not count that time.
- I’ve put a demo under my dir