Exam Assignments 7

Three Vectorization Clauses

1. `aligned`

> Usage: `aligned(list[: alignment])`

This clause can be used to allow optimizations when using aligned arrays. Using this clause when the given arrays are not aligned can cause unexpected behaviour.

`list` is a comma-separated list of variable names that point to arrays, and `alignment` specifies the number of bytes that the arrays are aligned to.

2. `safelen`

> Usage: `safelen(len)`

This clause sets a maximum vector length to use. It is for example neccessary to use when there are data dependencies between loop iterations.

`len` is the maximum vector length in bytes.

3. `reduction`

> Usage: `reduction(reduction-identifier:list)`

This clause can be used to perform a vectorized reduction in the following for loop.

`reduction-identifier` specifies the binary operation to use when reducing values. (Allowed operators are `+`, `-`, `*`, `&`, `|`, `^`, `&&`, and `||`) `list` is a comma-separated list of variable names, each of which will get reduced.

Intrinsics vs. Guided Vectorization

Intrinsics

Pros

- Performace portable (performance should be similar for all compilers)

- Full control for the programmer

Cons

- Not code portable (intrinsics differ between architectures)
- Messy code
- Harder to use

Guided Vectorization

Pros

- Code portable
- Easy to use

Cons

- Not performance portable (different compilers will optimize differently)
- Dependent on the compiler to notice opportunities for optimization

Vector Intrinsics Advantages over Assembly

- Programmer doesn't have to worry about registers explicitly
- Intrinsic functions are more portable between compilers and different OSs
- When used correctly, the same performance is achieved, since intrinsics have direct counterparts in assembly
- Easier to learn and use
- Leads to more readable code

AVX2 Vectors

- `__m256` is a vector of 8 32-bit floats.
- `__m256d` is a vector of 4 64-bit doubles.
- `__m256i` is a vector of unsigned or signed integers (The concrete data type is specified by the intrinsic functions that are used on the vector.)