LAPP
Laboratoire d'Annecy de Physique des Particules

Introduction : Compilation

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ESCAPE
cta cherenkov telescope array
cnrs
UNIVERSITÉ SAVOIE MONT BLANC

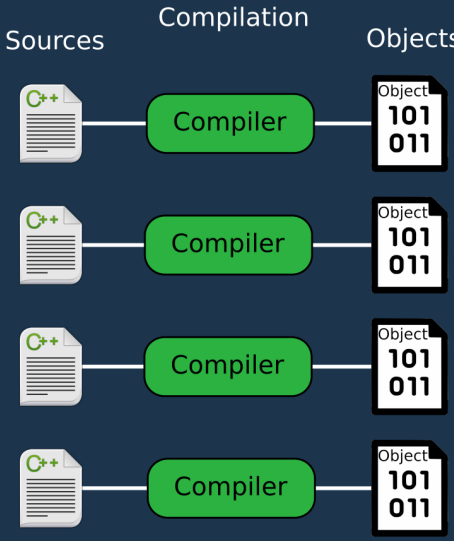
Compilation : From Text to Binary

Compilation : From Text to Binary

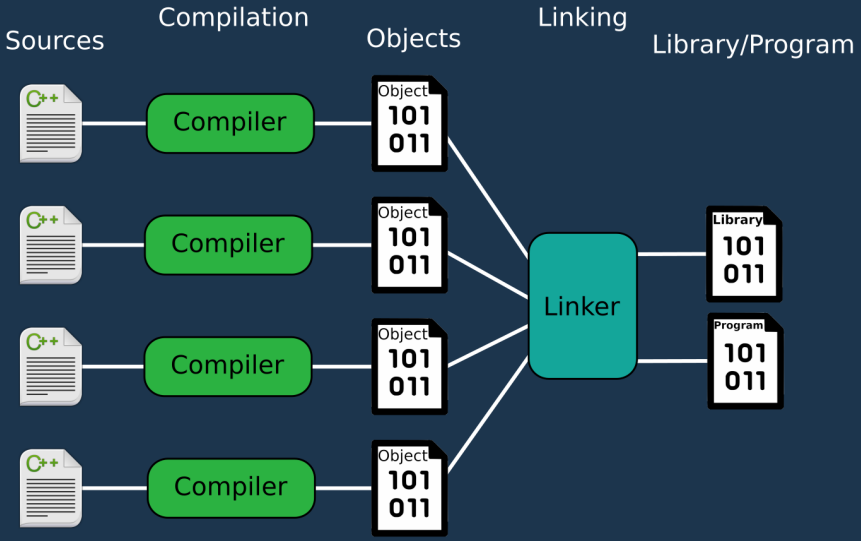
Sources



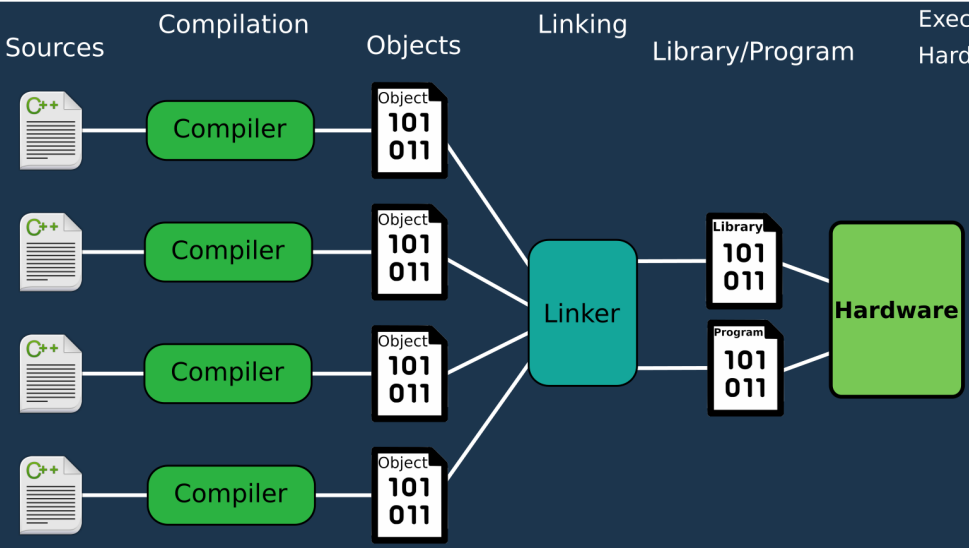

Compilation : From Text to Binary



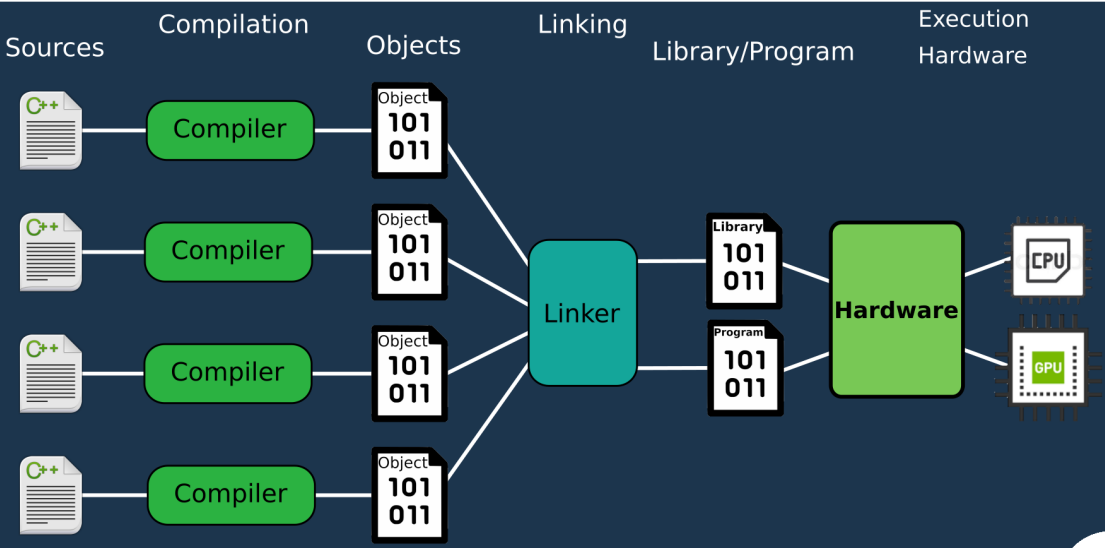
Compilation : From Text to Binary



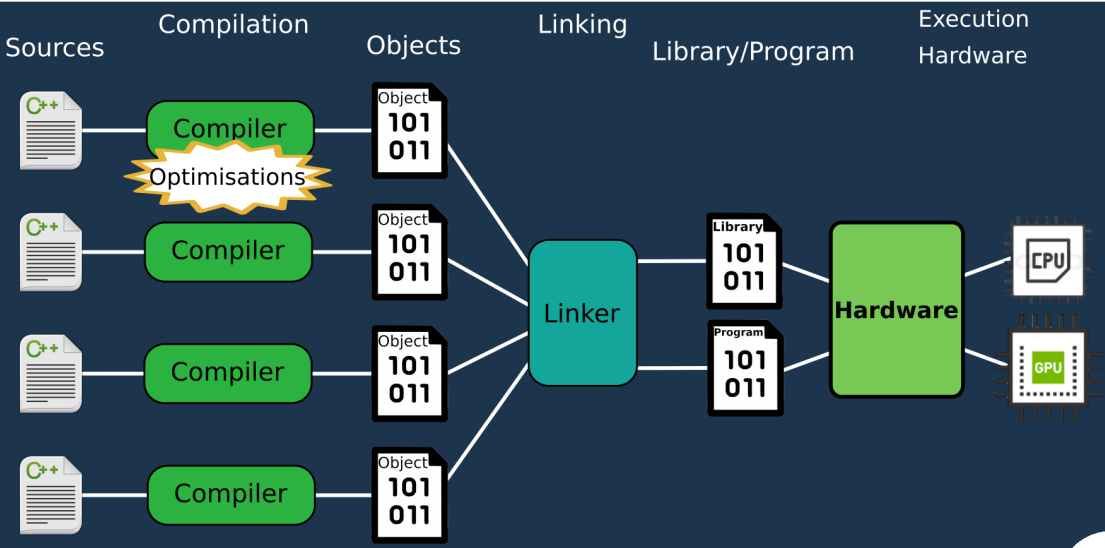
Compilation : From Text to Binary



Compilation : From Text to Binary



Compilation : From Text to Binary



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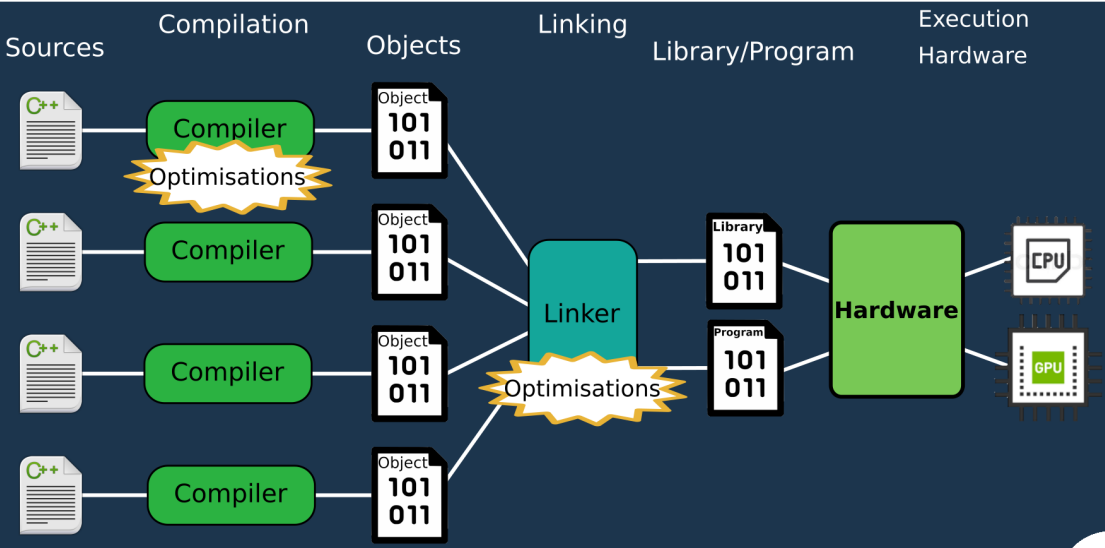

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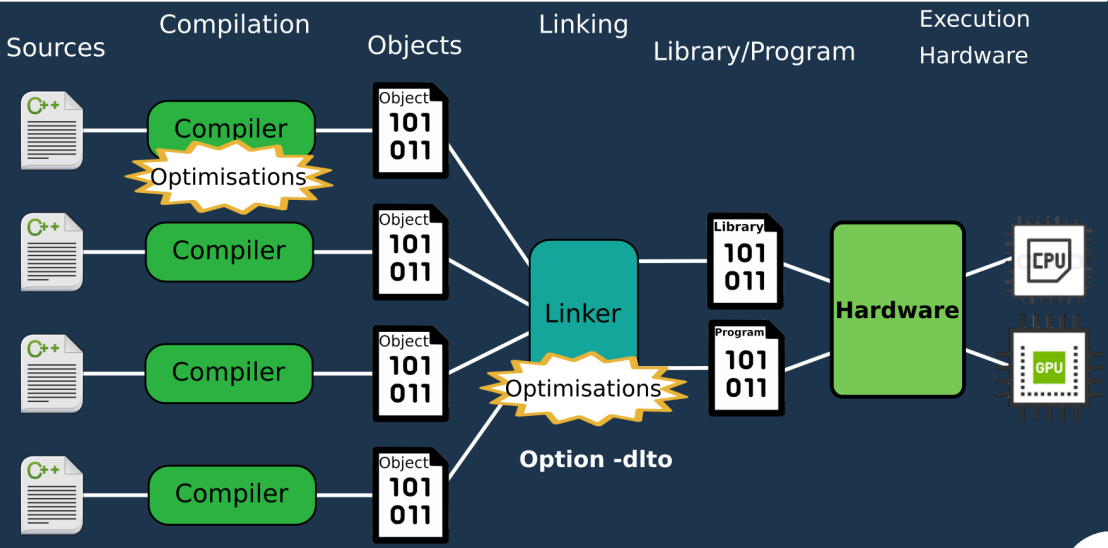


Compiler workflow

Compiler workflow

Languages

Fortran

Compiler workflow

Languages

Fortran

Binaries

Compiler workflow

Languages

Front-End

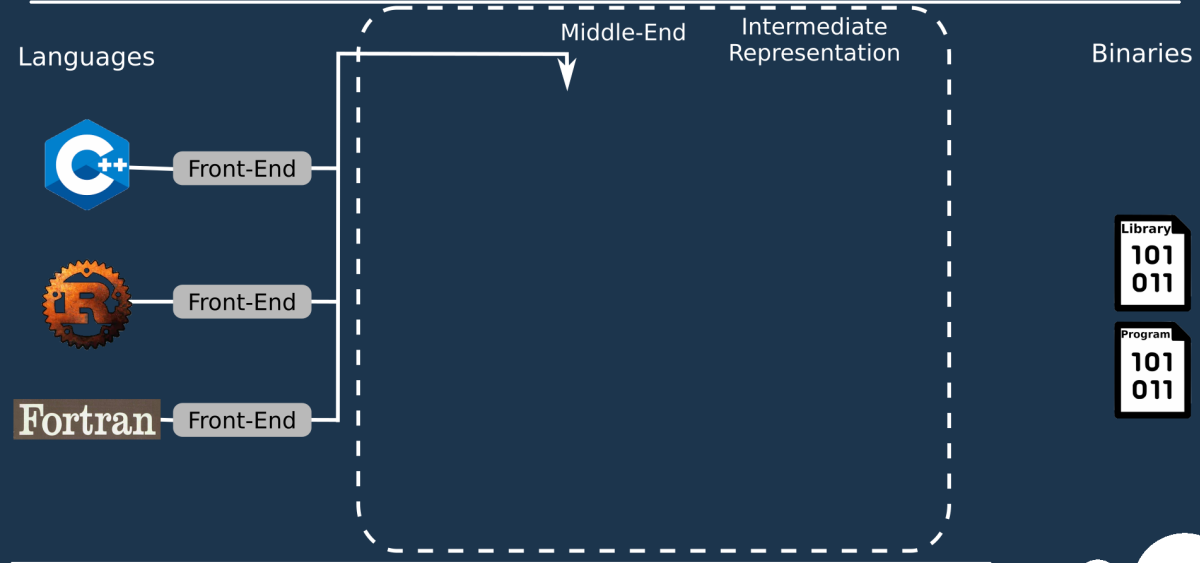
Front-End

Fortran

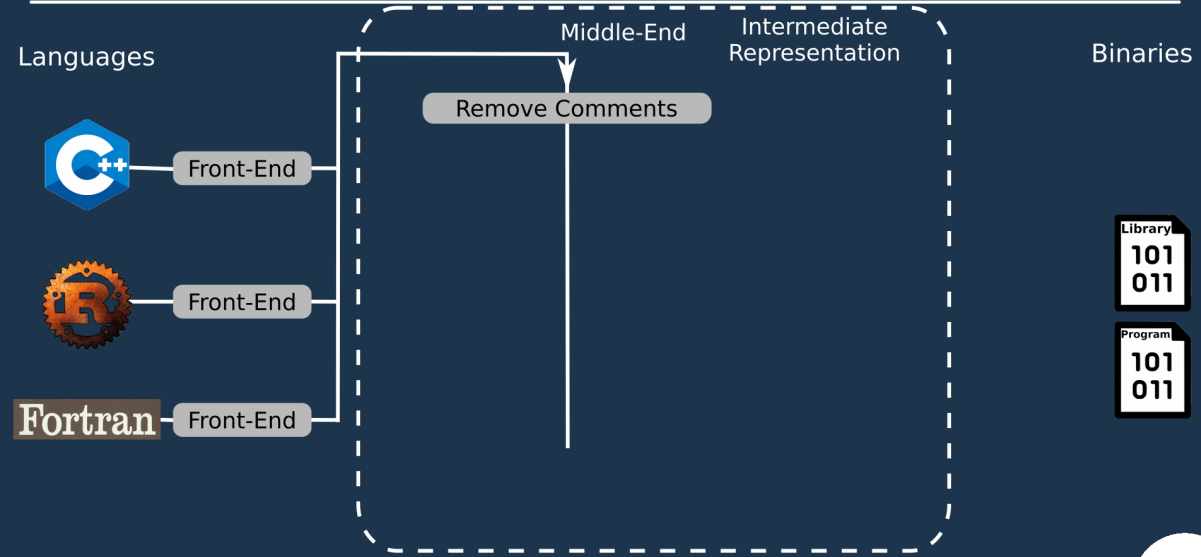
Front-End

Binaries

Compiler workflow



Compiler workflow



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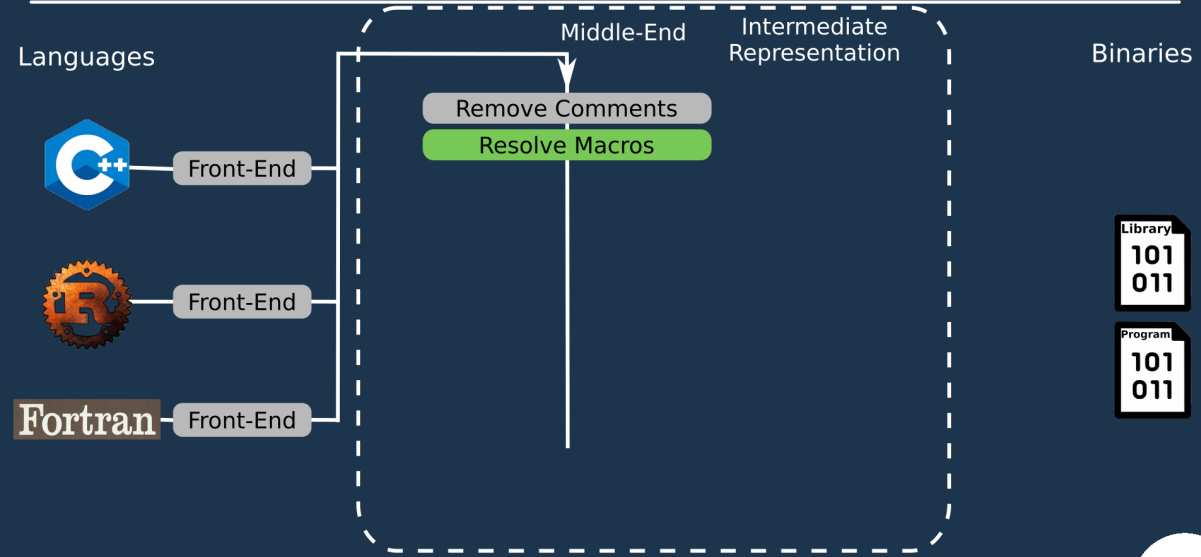

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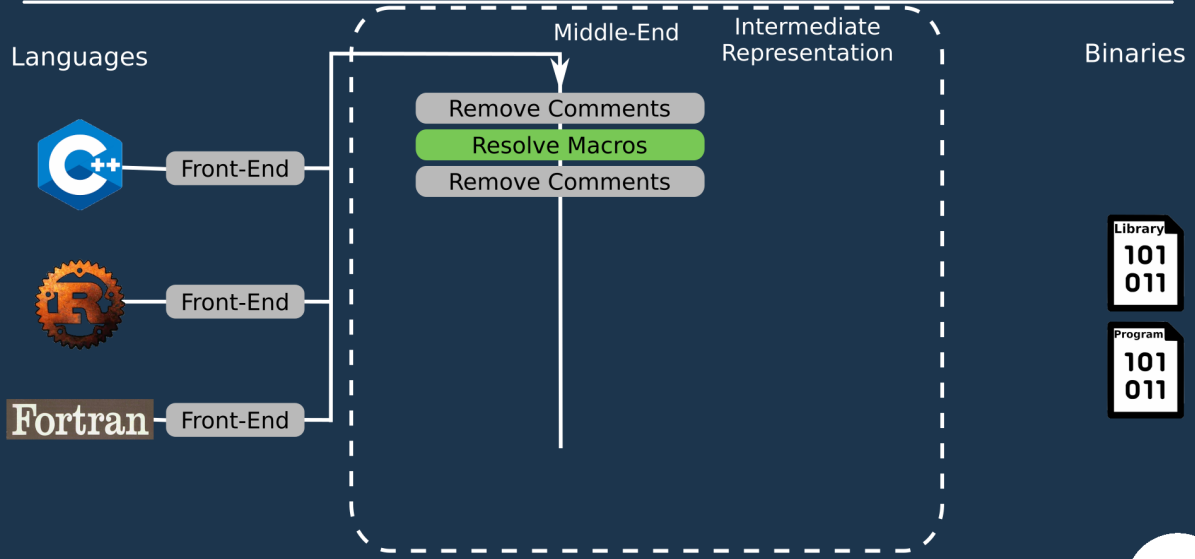

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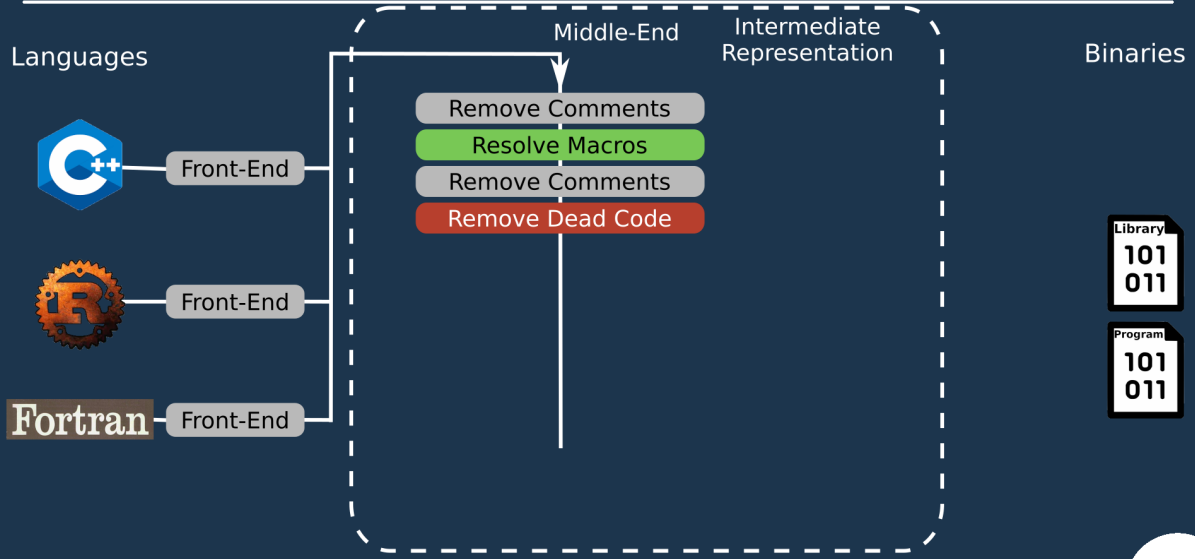

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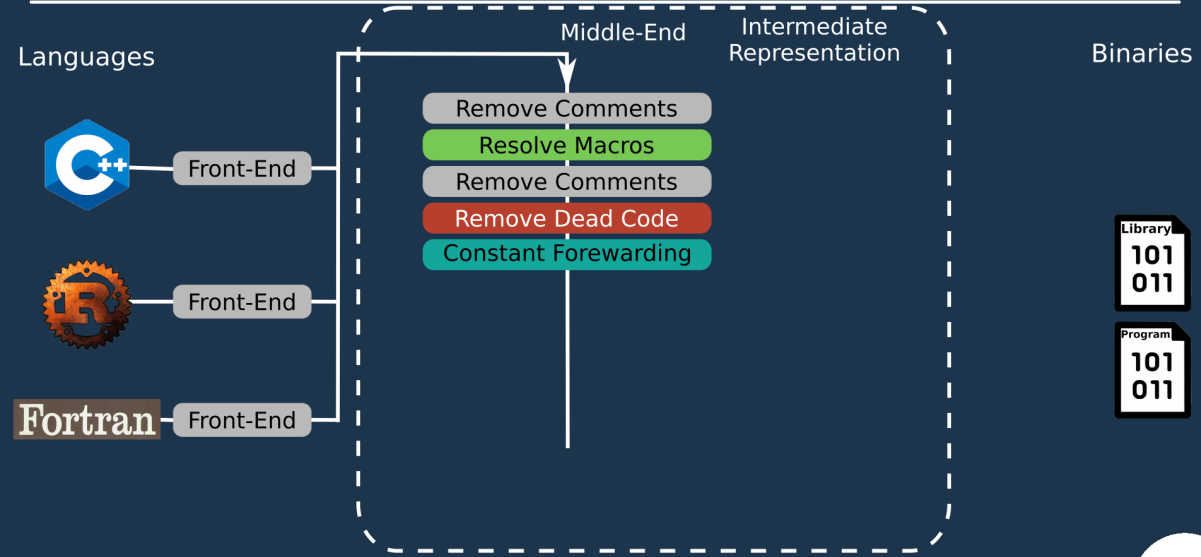

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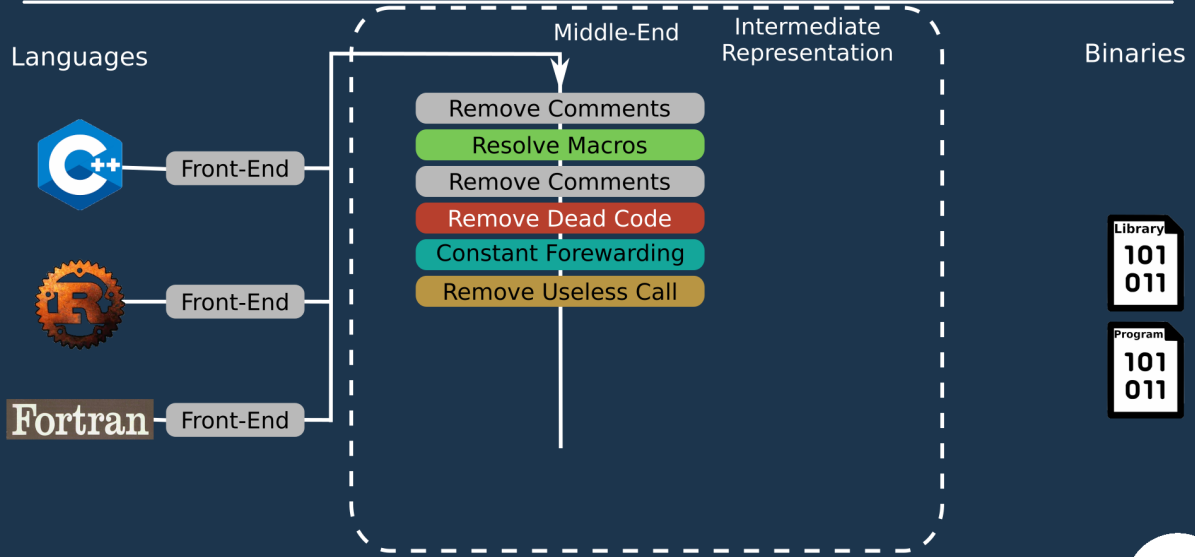

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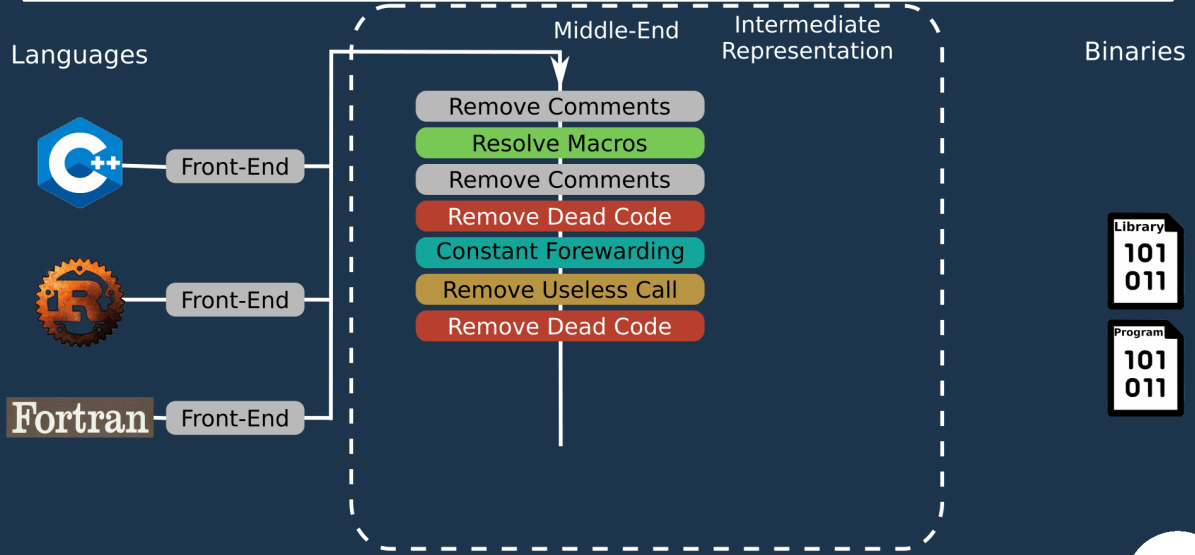

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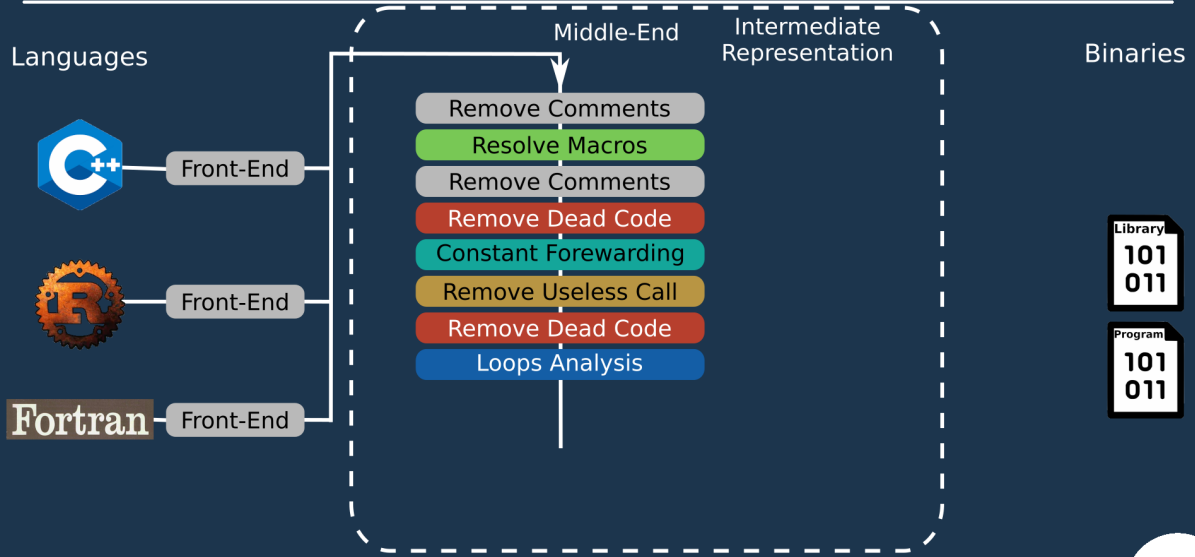

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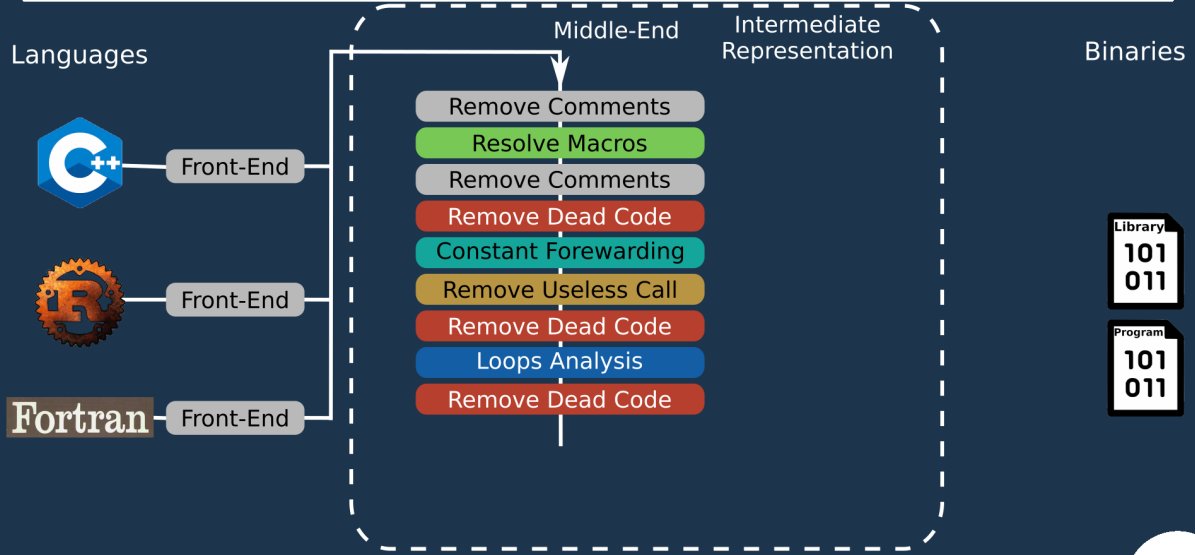

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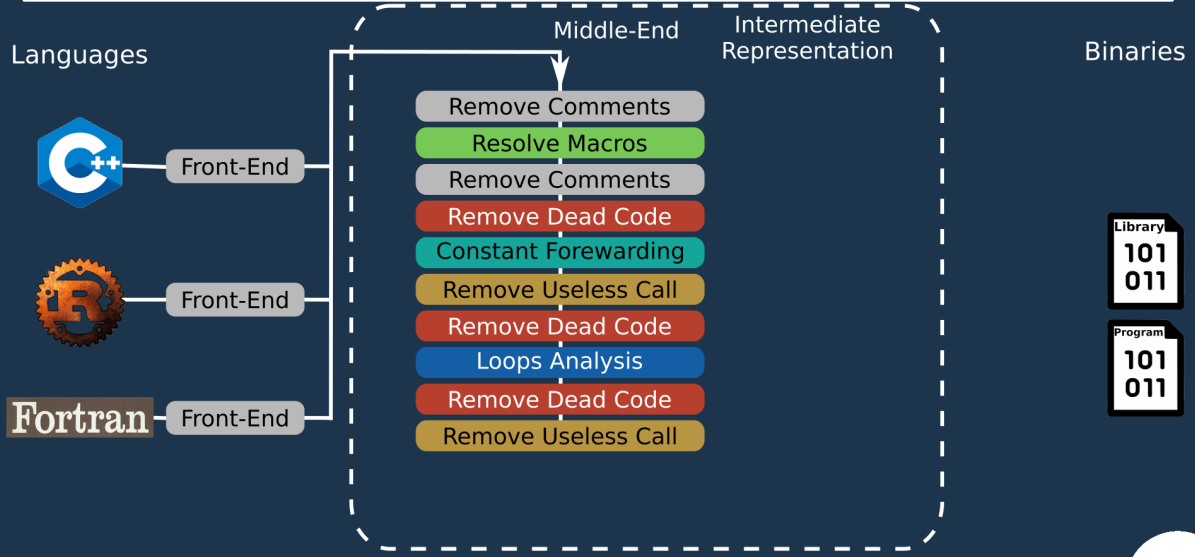

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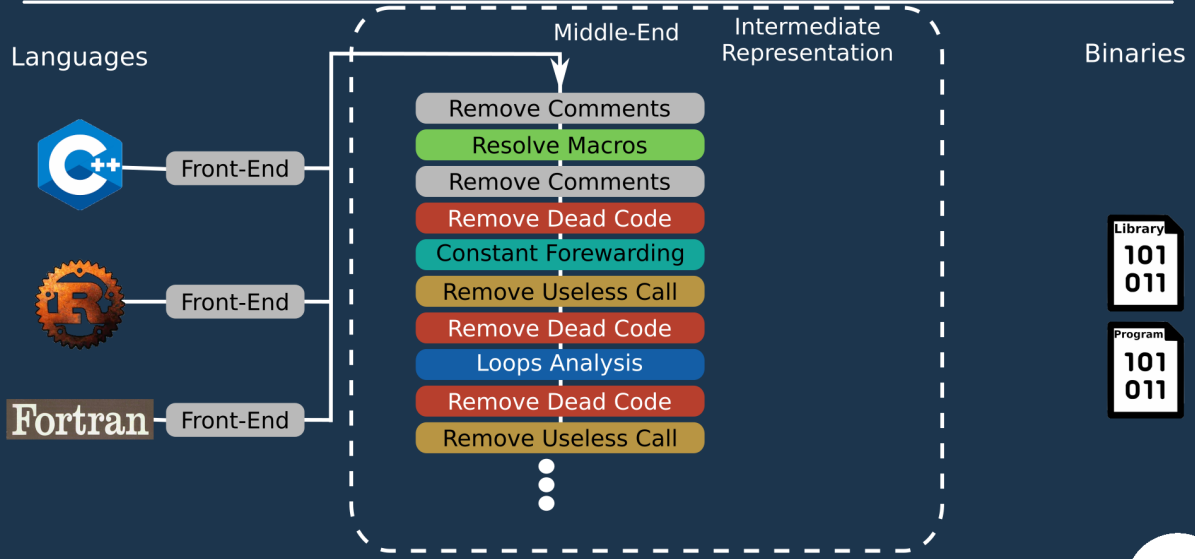

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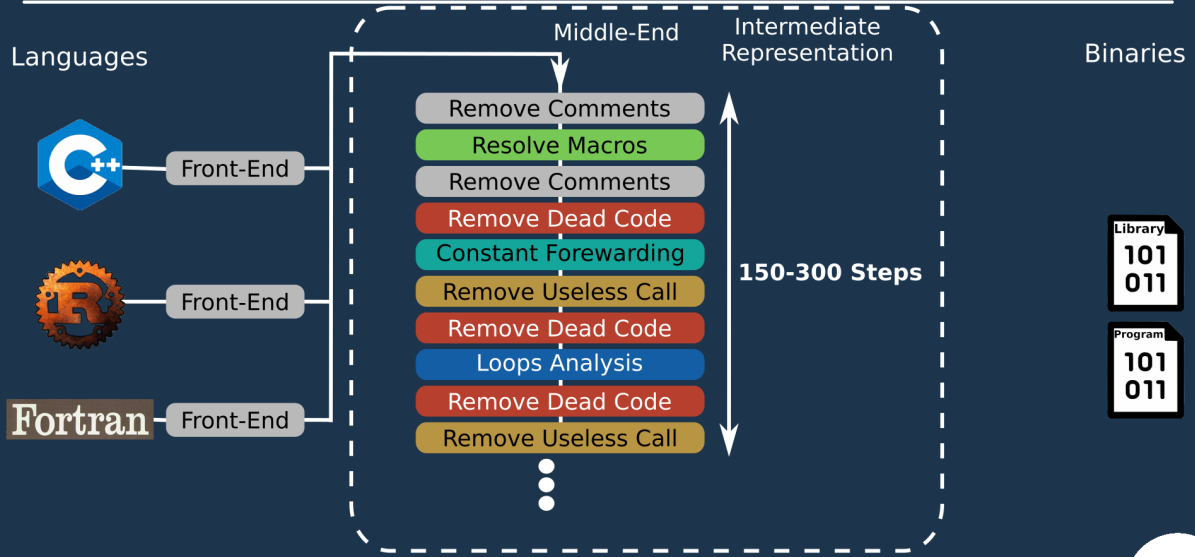

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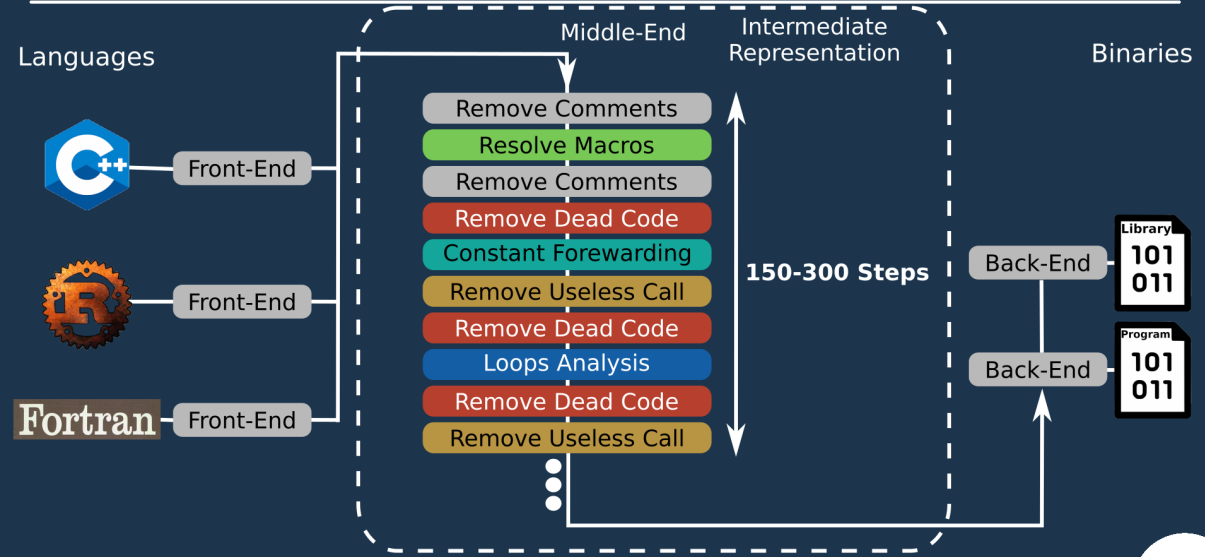

Compilation options

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- **-O3**
  - More function inlining, loop unrolling, partial vectorization...
- **-Ofast**
  - Disregard strict standards compliance. Enable **-ffast-math**, stack size is hardcoded to 32 768 bytes (borrowed from **gfortran**). **Possibly degrades the computation accuracy.**

Examples

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```
float square(float x){
»       return x*x;
}
int main(){
»       float y(42.0f);
»       std::cout << square(y) << std::endl;
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Constant expression solving

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int main(){
»       std::cout << 1764.0f << std::endl;
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No more :
- **Function call**
- **Multiplication**
- **Variable declaration**

Loop Unrolling

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```
void hadamard(float* tabRes, const float * tabX, const float * tabY, size_t nbElement){
	for(size_t i(0lu); i < nbElement; ++i){
		tabRes[i] = tabX[i]*tabY[i];
	}
}
```

Base

Loop Unrolling

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```

Base

```
void hadamard(float* tabRes, const float * tabX, const float * tabY, size_t nbElement){
	for(size_t i(0lu); i < nbElement; i += 2lu){
		tabRes[i] = tabX[i]*tabY[i];
		tabRes[i + 1] = tabX[i + 1]*tabY[i + 1];
	}
}
```

Loop unrolled 2 times

Loop Unrolling

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Increase Computing in Iteration

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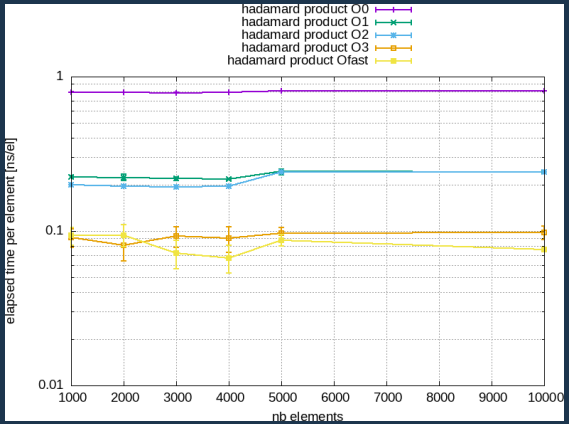
```
void hadamard(float* tabRes, const float * tabX, const float * tabY, size_t nbElement){
	for(size_t i(0lu); i < nbElement; i += 4lu){
		tabRes[i] = tabX[i]*tabY[i];
		tabRes[i + 1] = tabX[i + 1]*tabY[i + 1];
		tabRes[i + 2] = tabX[i + 2]*tabY[i + 2];
		tabRes[i + 3] = tabX[i + 3]*tabY[i + 3];
	}
}
```

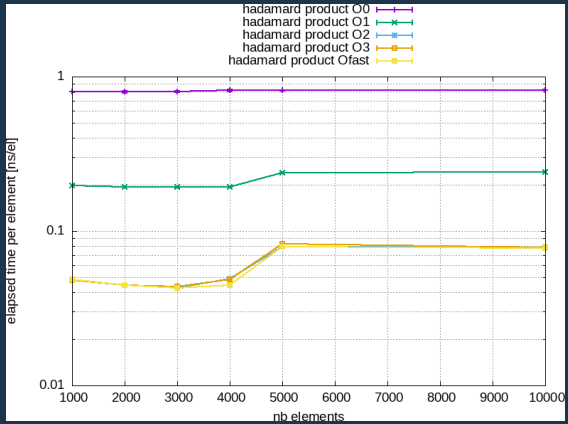
Loop unrolled 4 times

The Hadamard product : Basic Options

G++ 11

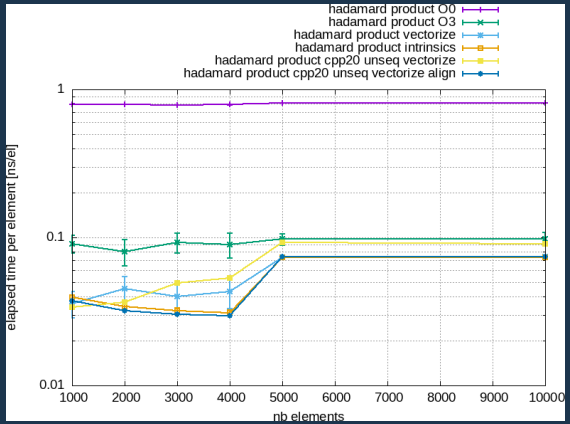


CLang++ 14



The Hadamard product : Vectorization

G++ 11



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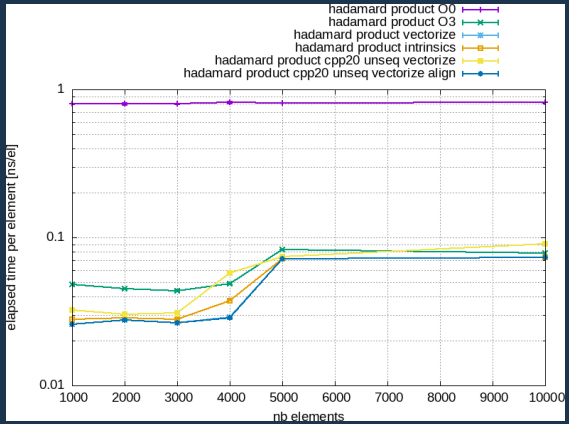

Conclusion

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- Use **both** compilers
- Test **compilation options**
- Check with **Maqao** and **Valgrind**
- Check with **Performance Tests** (**MicroBenchmark**)