



# Compiling Image Processing Applications for Many-Core Accelerators

Pierre Guillou

## ► To cite this version:

| Pierre Guillou. Compiling Image Processing Applications for Many-Core Accelerators. Journées de seconde année de l'Ecole Doctorale, Jun 2015, Paris, France. hal-01178938

HAL Id: hal-01178938

<https://minesparis-psl.hal.science/hal-01178938>

Submitted on 21 Jul 2015

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Compiling Image Processing Applications for Many-Core Accelerators

Pierre Guillou – CRI MINES ParisTech, PSL Research University

## Image Processing

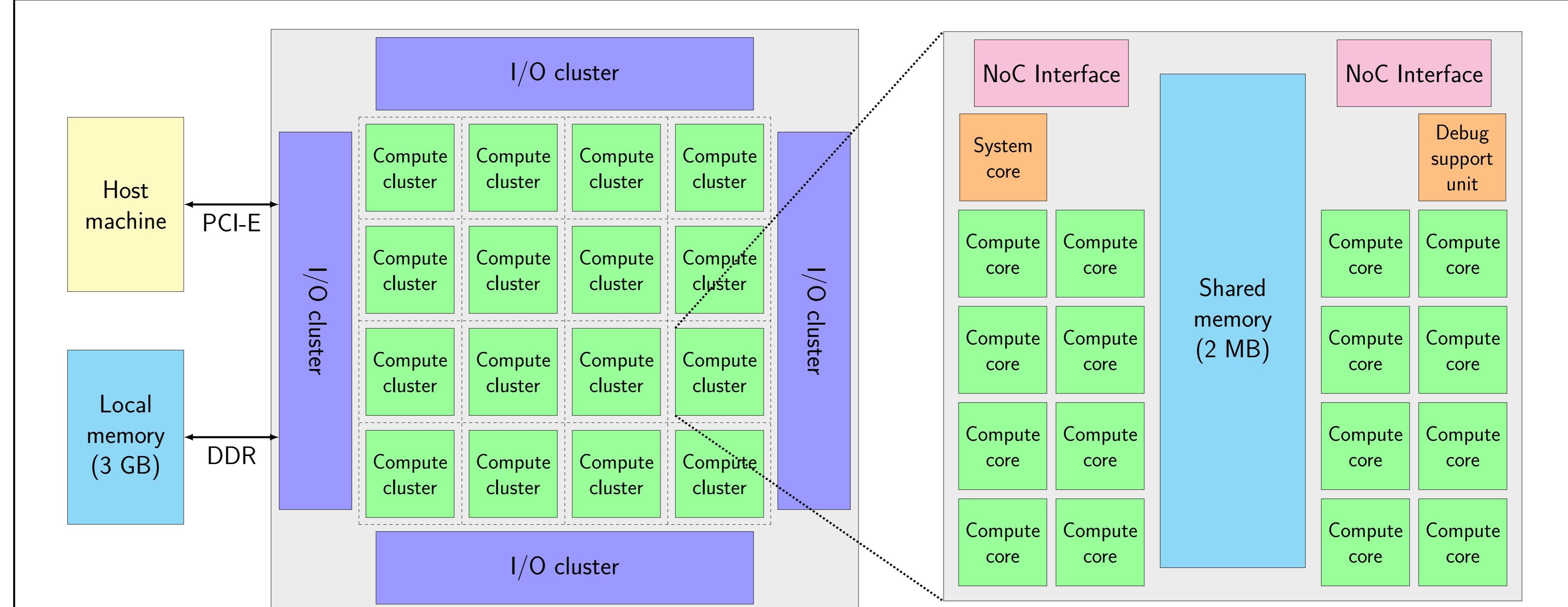
image analysis: detect geometrical structures in an image  
 mathematical morphology: image analysis theory and technique based on lattices theory

## Mathematical Morphology Base Operators

- arithmetic operators
  - unary ( $\otimes$  parameter, 1 input image)
  - binary ( $\otimes \otimes$  pixel, 2 input images)
  - $+ - \times \div \min \max = \& | \sim$
- morphological operators
  - stencils
  - neighbor selection + min/max/avg
- reduction operators
  - global max/min/sum
- other operators
  - threshold, mask, log<sub>2</sub>, ...

⇒ Sigma-C agent library

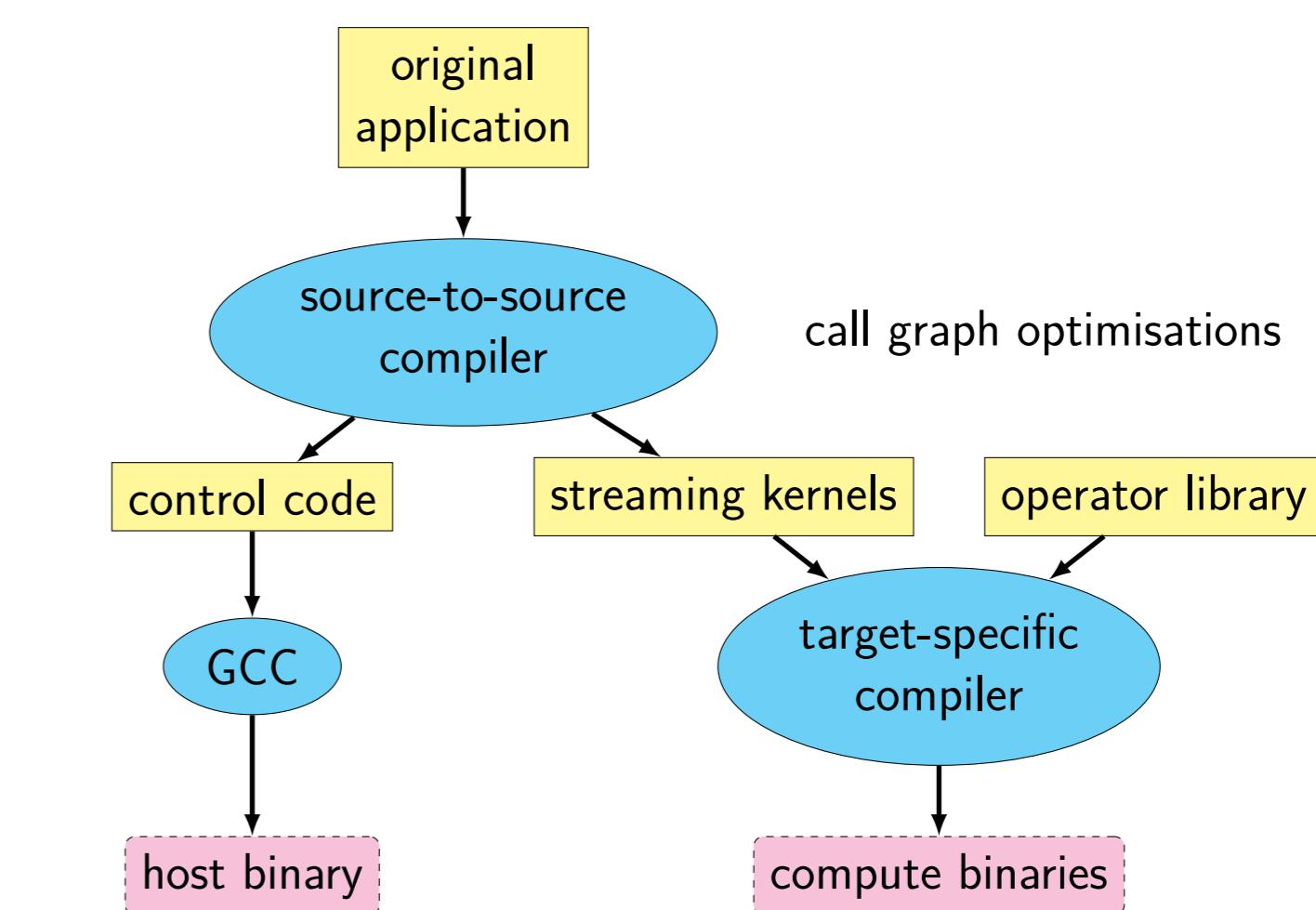
## The MPPA-256 Chip



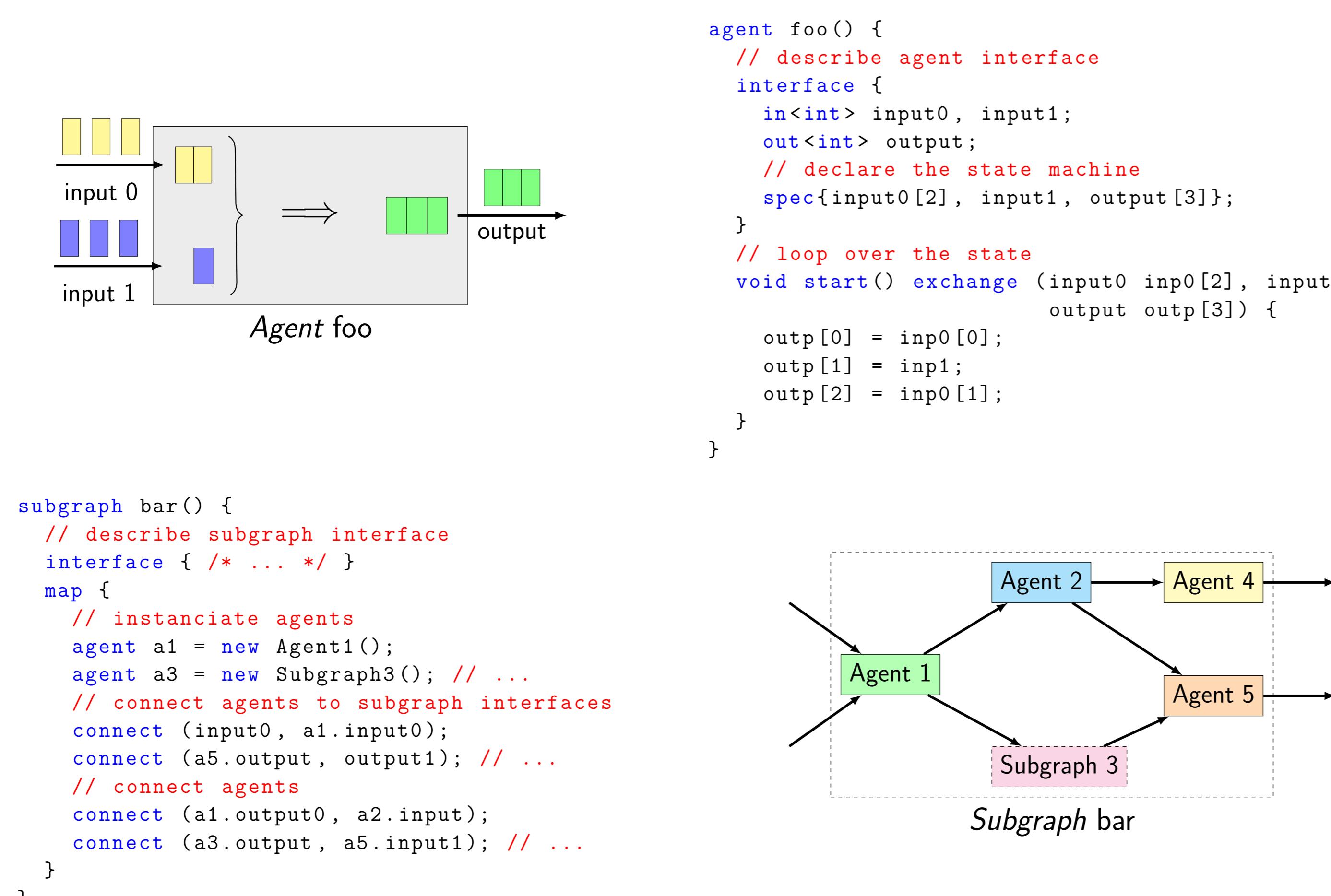
## Example: Licence Plate Extraction



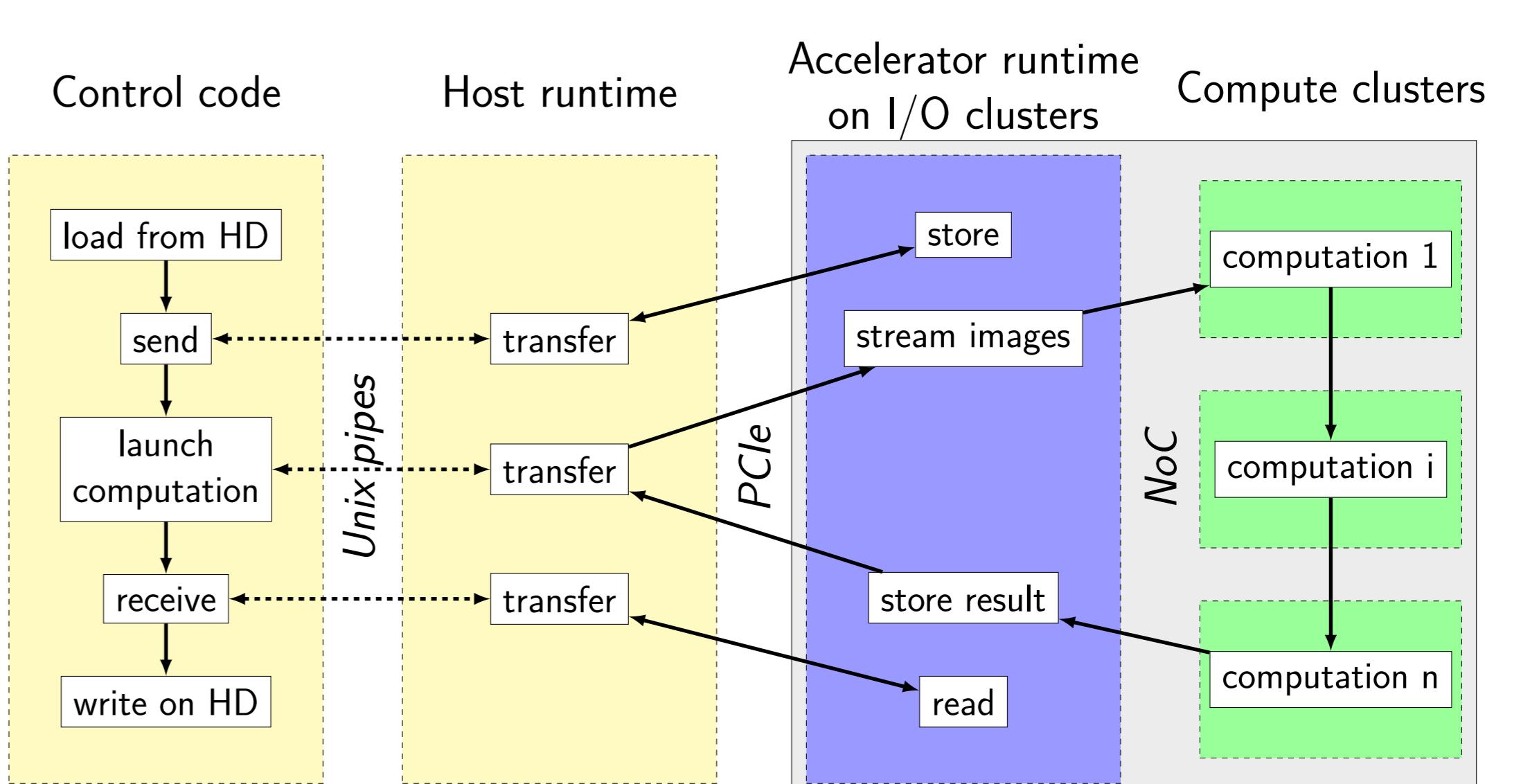
## Compilation Chain



## Sigma-C, a Dataflow Programming Language



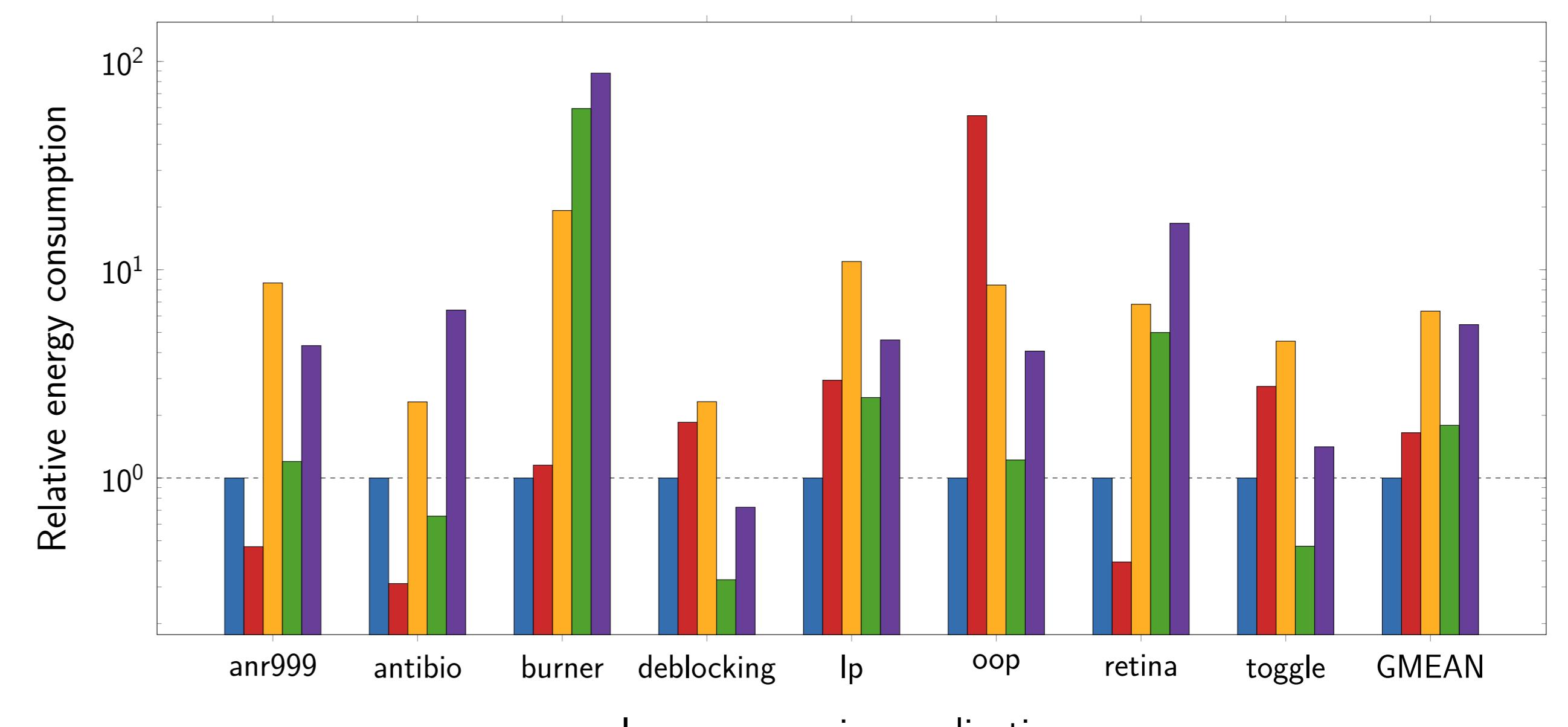
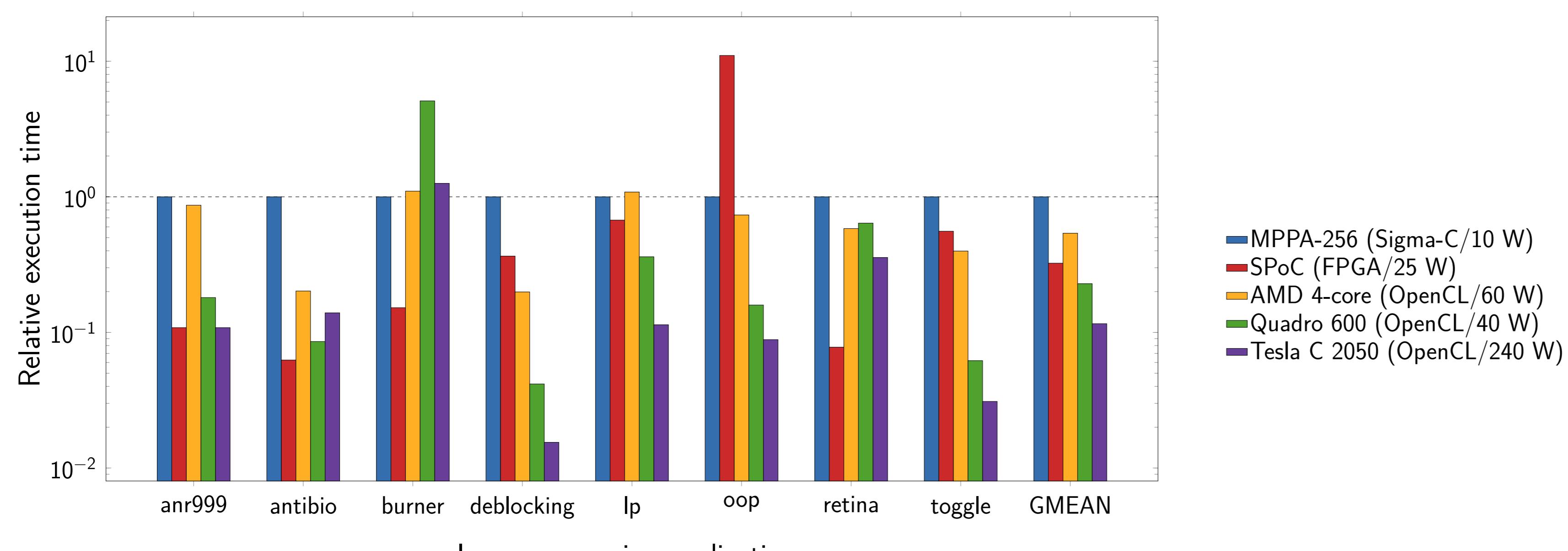
## Runtime Environment



## Optimisations

- unrolling of converging loops
- arithmetic operators aggregation
- generation of kernel-specific convolutions
- data parallelization for compute-intensive operators

## Results: Execution Times and Energy Consumption (MPPA-256 = 1, lower is better)



## Future Work

- Other programming models:
  - Pthreads/OpenMP on compute clusters, communication library between clusters
  - OpenCL via local memory pagination
- Improve data-parallelism to take better advantage of the current architecture
- Implement more complex algorithms: watershed, arrow, labelling, minima, ...

## References

- Pierre Guillou, Fabien Coelho, and François Irigoin.  
 Automatic Streamization of Image Processing Applications.  
 The 27th International Workshop on Languages and Compilers for Parallel Computing (LCPC), 2014.  
 Available at <http://www.cri.ensmp.fr/classement/doc/A-570.pdf>.

