

# Computing Systems R&D Lab

Department of Informatics Engineering (DEI)

Presented by:

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# Computing Systems R&D Lab Organization

This Lab is organized in  
**three main research  
groups:**

- **SPECS:** Special-Purpose Computing Systems, Languages and Tools
- **DECS:** Distributed and Embedded Computing Systems
- Mobile and Distributed Computing

On addressing complex problems with Informatics Engineering tools

On Researching and Developing new technology and new techniques

Close contact with Industry

# Current Lab Members

João M.P. Cardoso  
PhD, Prof.



Ali Azarian  
PhD student



Pedro Pinto  
PhD student



Ricardo Nobre  
PhD student



Pedro Souto  
PhD, Prof.



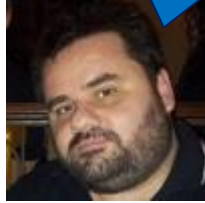
João Bispo  
Pos-Doc



Tiago Carvalho  
PhD student



Adriano Sanches  
PhD student



Luís Reis  
PhD student



Miguel P.  
Monteiro  
PhD, Prof.



# Work Topics of Post-Docs and PhD Students

I am working on task-level pipelining techniques



I am working on runtime-aware compiler techniques



I am working on techniques to identify sequences of compiler optimizations



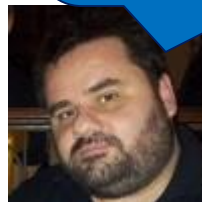
I am working on a MATLAB to C compiler



I am working on runtime Java improvements



I am working on techniques to map more efficiently computations to FPGAs

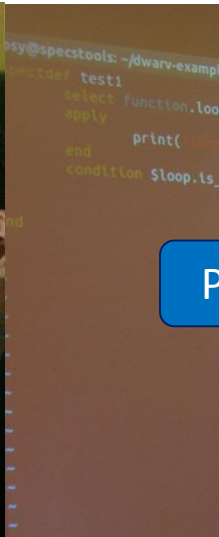


I am starting my PhD on multitarget OpenCL generation



# Team activities

Programming...



Relaxing...



Preparing Conferences...



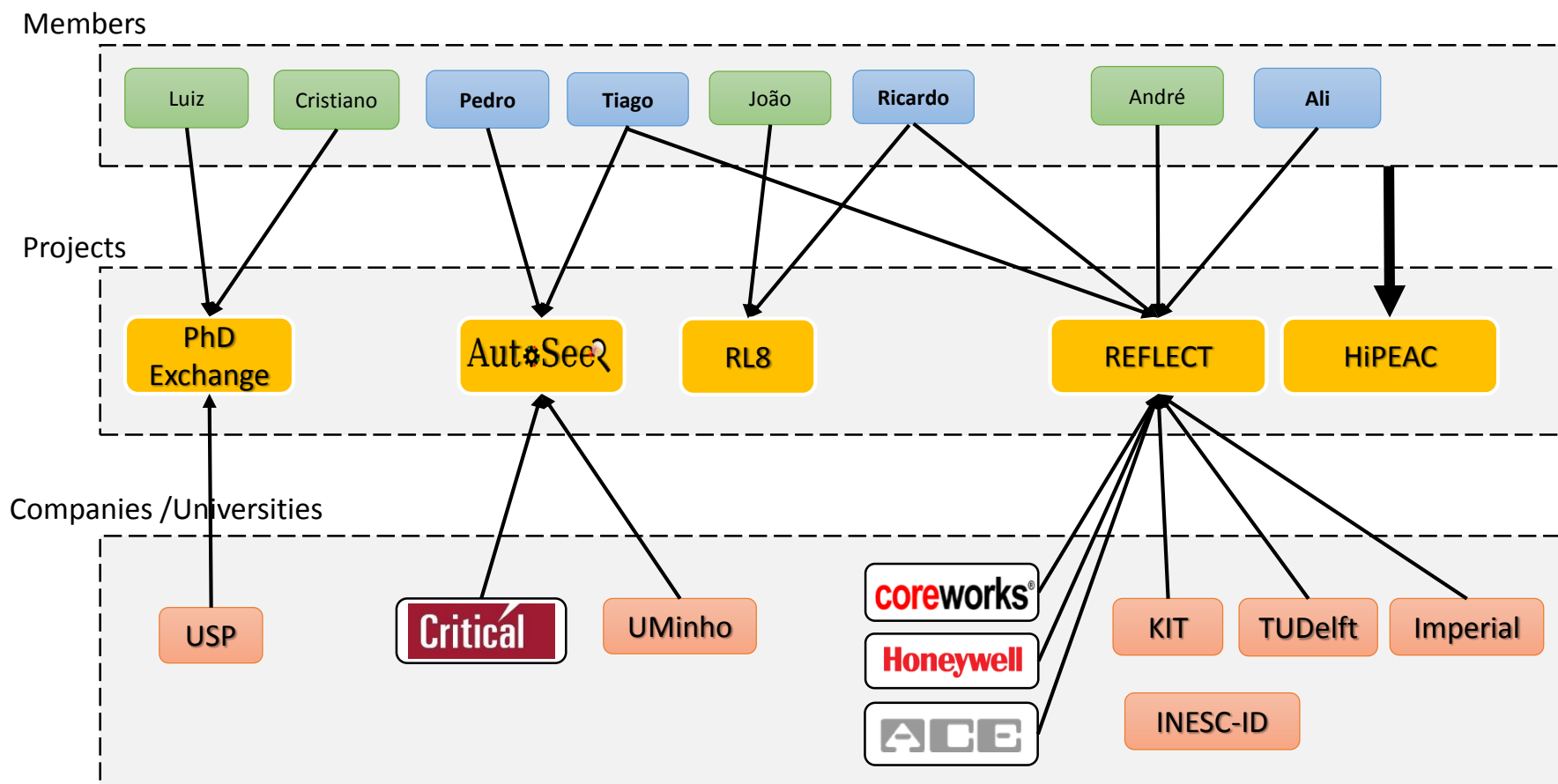
Presenting...



Participating in panels...



# Projects/Collaborations (2012-2014)



# Accelerate! ▶▶

- Development cycles (tools, domain-specific languages)
- Execution of applications (compiler techniques, hardware acceleration)



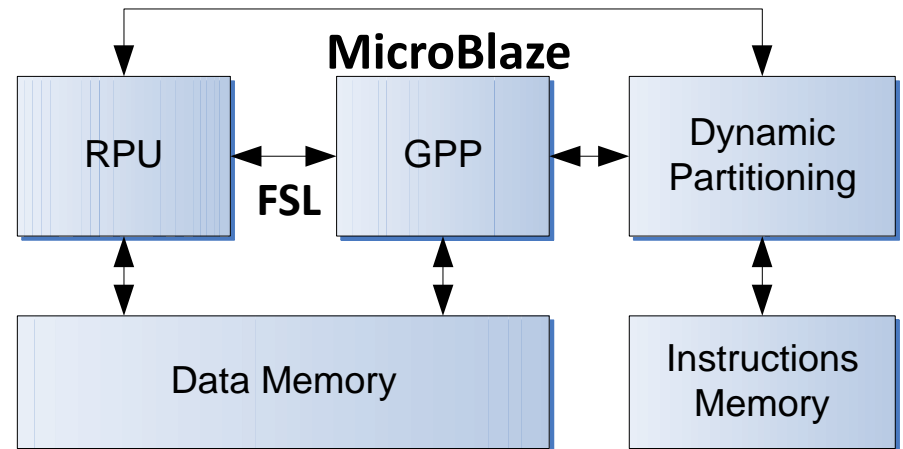
to accelerate changes  
to accelerate achievements  
to accelerate innovation

# Binary Acceleration with Megablocks

- Proposed loop-like pattern in the trace of a program (Megablock)
- Detects and moves automatically computation from CPU to specialized hardware (RPU)
- Prototype that profiles and generates HW offline, moves computation at runtime

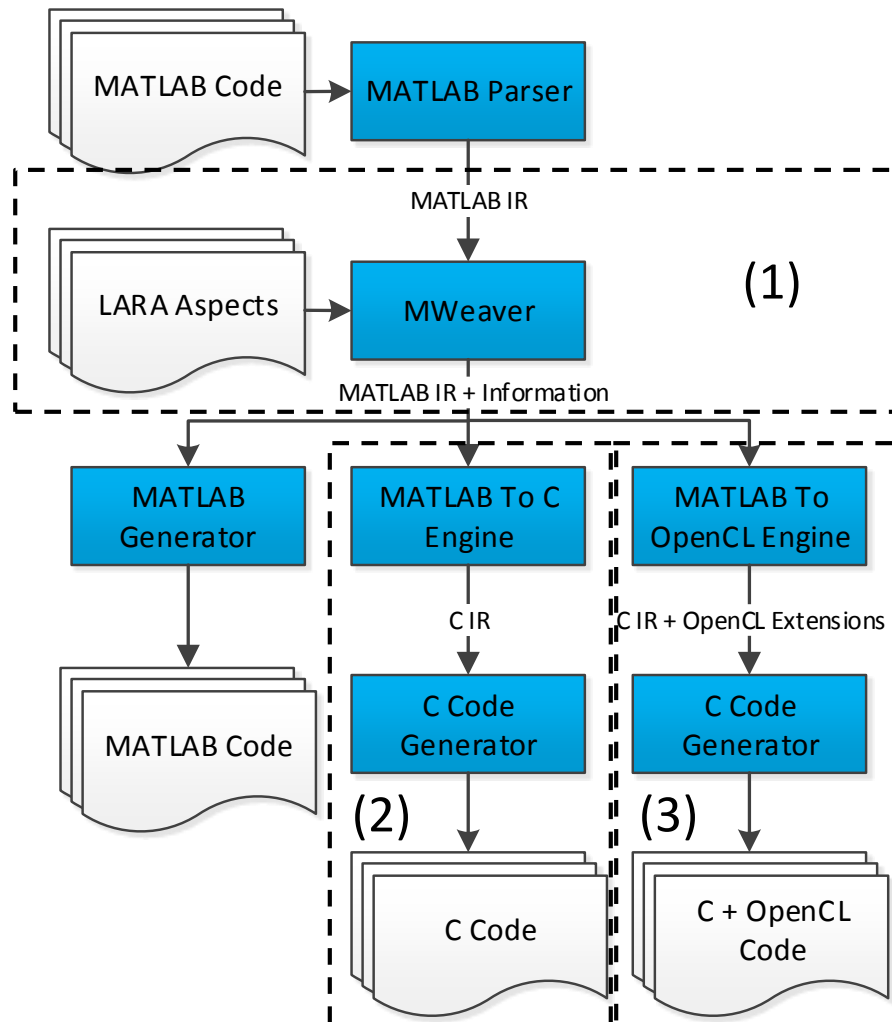
Megablock  
Pattern

```
...  
0x00000194 sra r5, r5  
-----  
0x00000180 andi r3, r5, 1  
0x00000184 addik r4, r4, 1  
0x00000188 addk r7, r7, r3  
0x0000018C xori r18, r4, 32  
0x00000190 bneid r18, -16  
0x00000194 sra r5, r5  
-----  
0x00000180 andi r3, r5, 1  
0x00000184 addik r4, r4, 1  
0x00000188 addk r7, r7, r3  
0x0000018C xori r18, r4, 32  
0x00000190 bneid r18, -16  
0x00000194 sra r5, r5  
0x00000180 andi r3, r5, 1  
...  
...
```





# Matisse - MATLAB to C Compiler



## MATLAB Weaver (1)

- Transforms MATLAB IR
- LARA Aspects:
  - Adds information (types, shapes)
  - Code Instrumentation
  - Transformations

## MATLAB To C Engine (2)

- Specializes MATLAB to C
- Type-inference, code transformation, optimizations...

## MATLAB To OpenCL Engine (3)

- Extension to MATLAB to C engine
- Luís Reis master thesis



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