Introduction

- From the course description:
  “This course covers the component technologies used in implementing modern programming languages, shows their integration into a system, and discusses connections between the structure of programming languages and their implementations.”

- Questions we will explore
  - How does a piece of program text end up getting executed on a machine?
  - What is the difference between a physical machine and a virtual machine?
  - How and when is a program transformed into a form amenable to machine execution?
  - How are various programming language features mapped to the capabilities of the machine?
  - What are the mathematical underpinnings of program translation?

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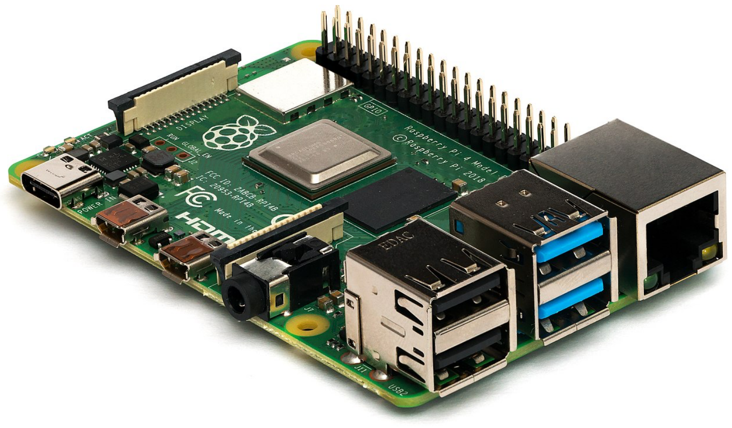
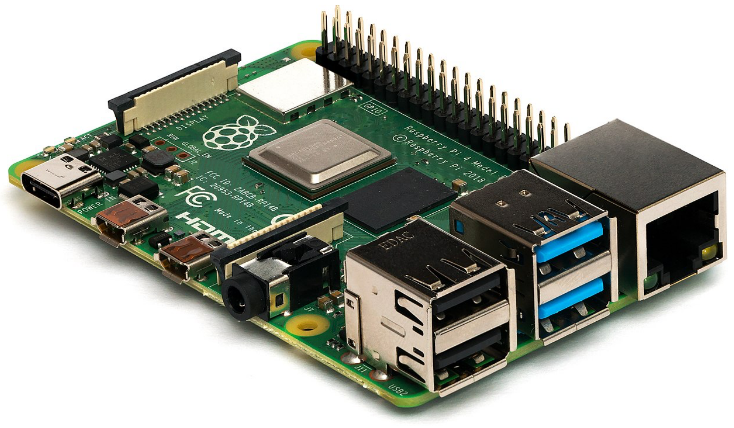
- Analysis framework
  - Cost: Generally time, space, or energy.
  - Benefit: High performance, low memory use, energy efficiency, portability.
  - Risk: Correctness, security.

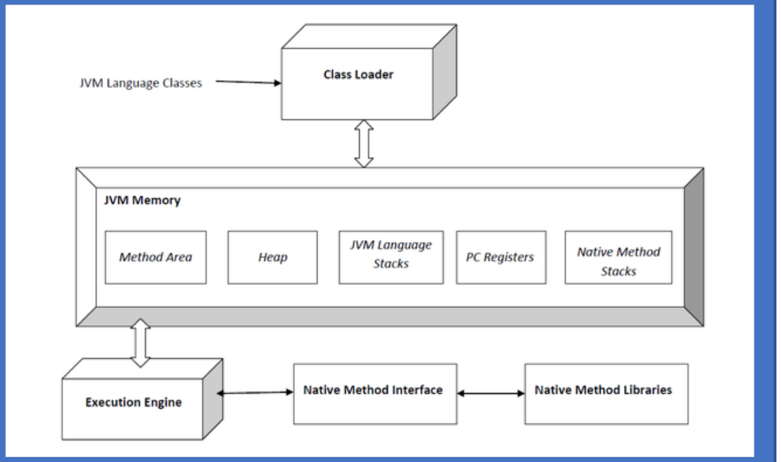
Execution Models



Physical Machine

Execution Models


Physical Machine



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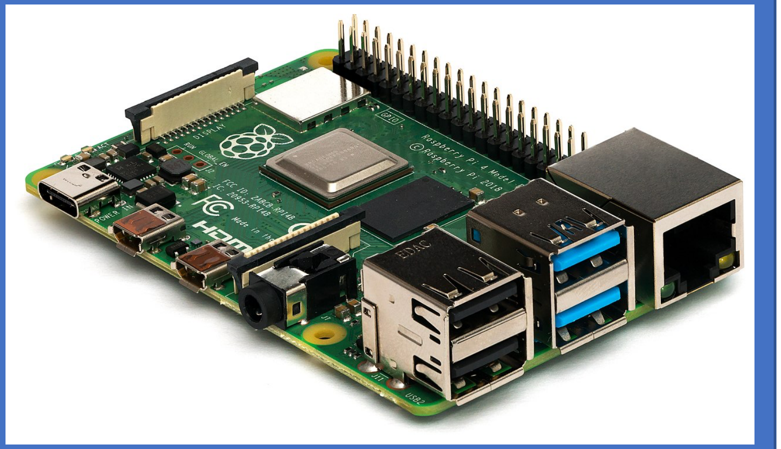
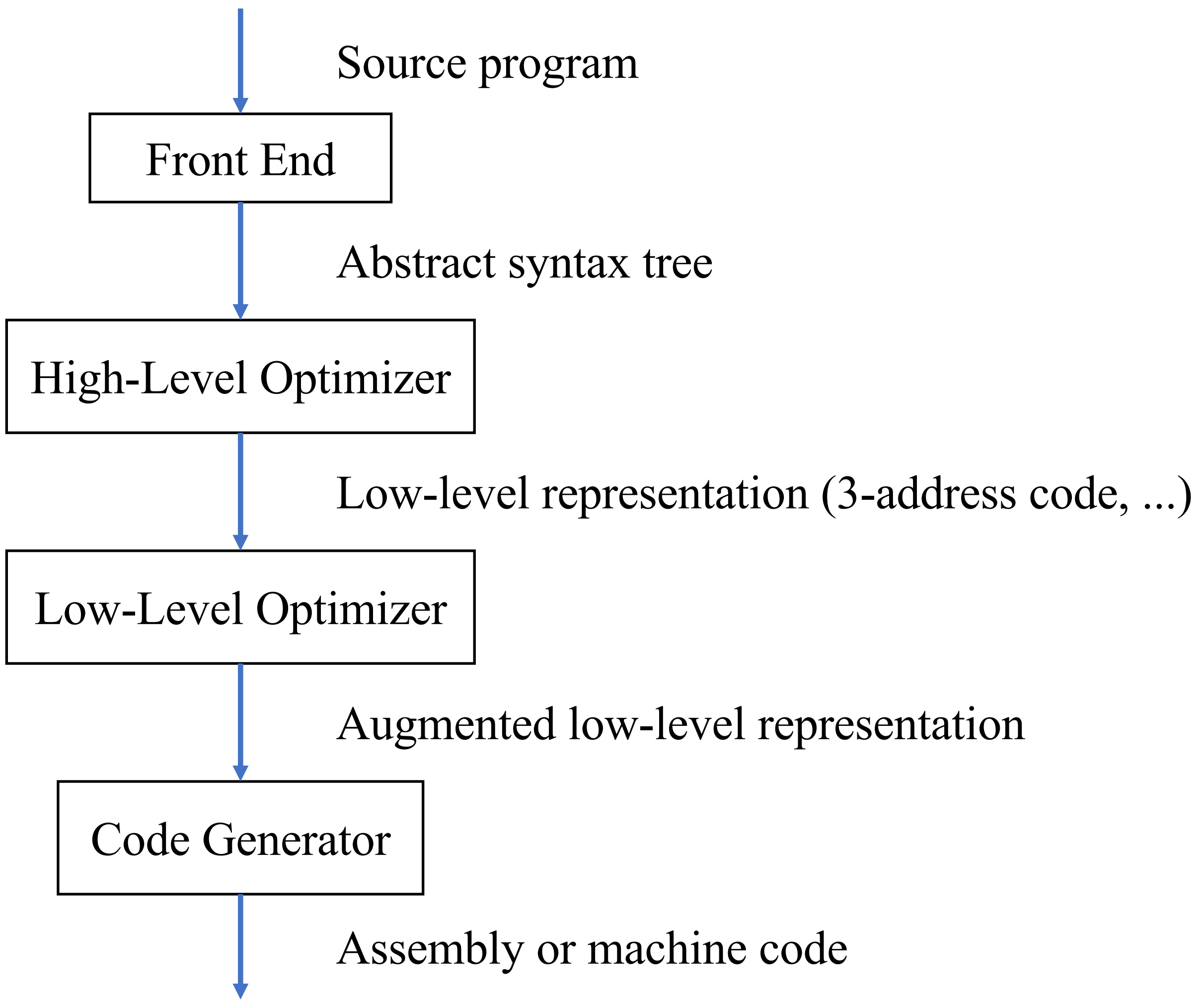
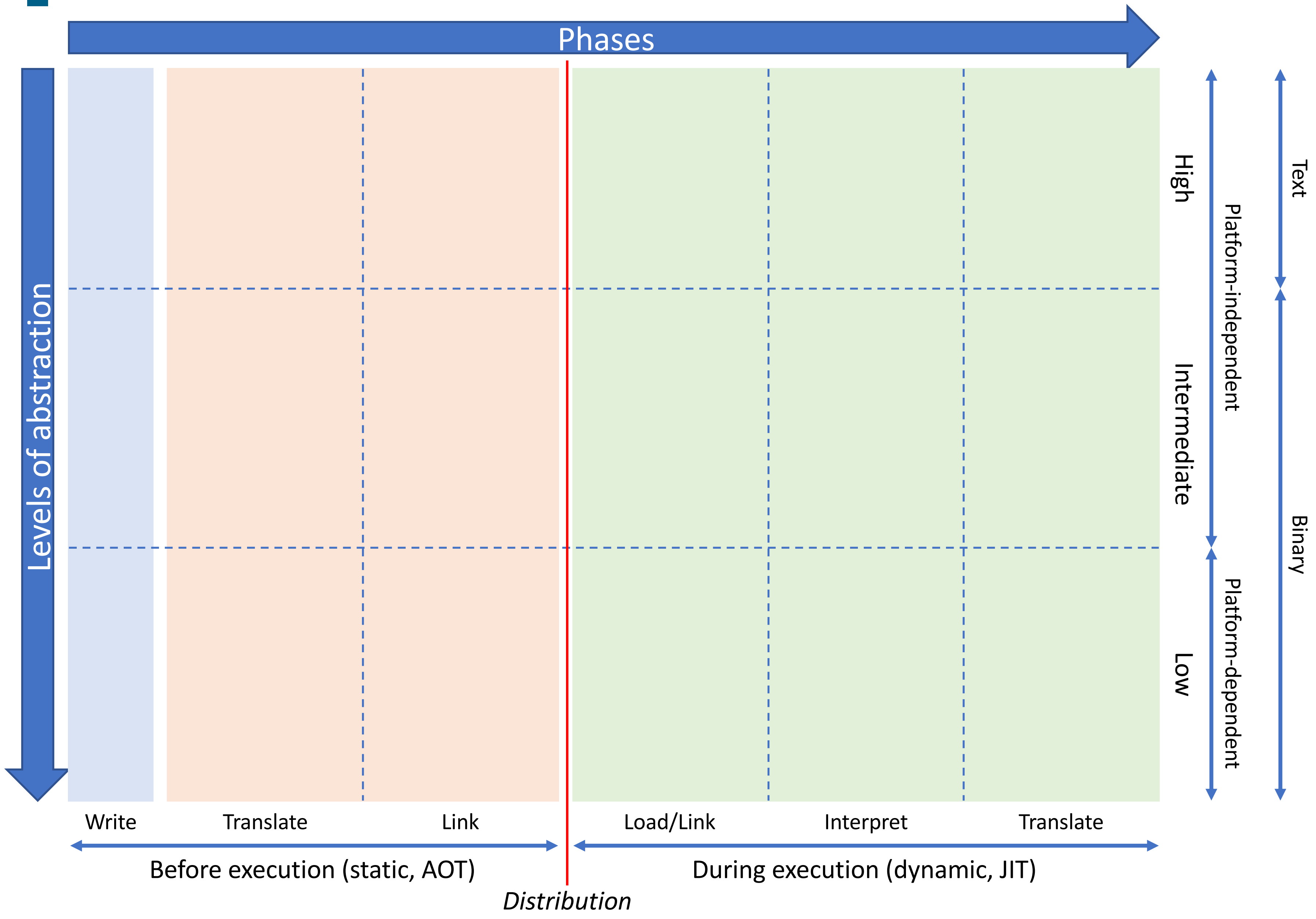

Virtual Machine

Transformation Techniques and Workflow



Binding Time: What Happens When



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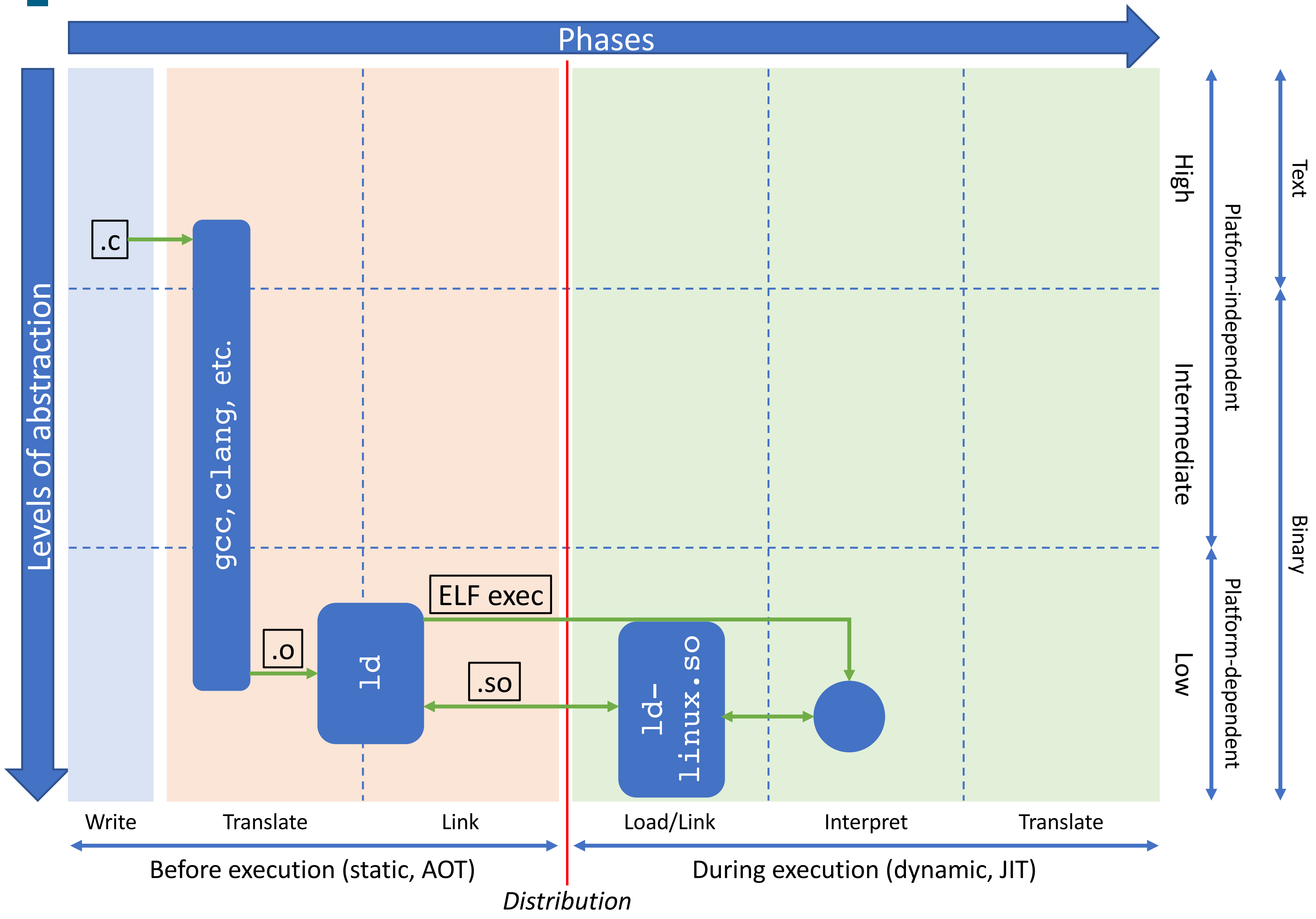

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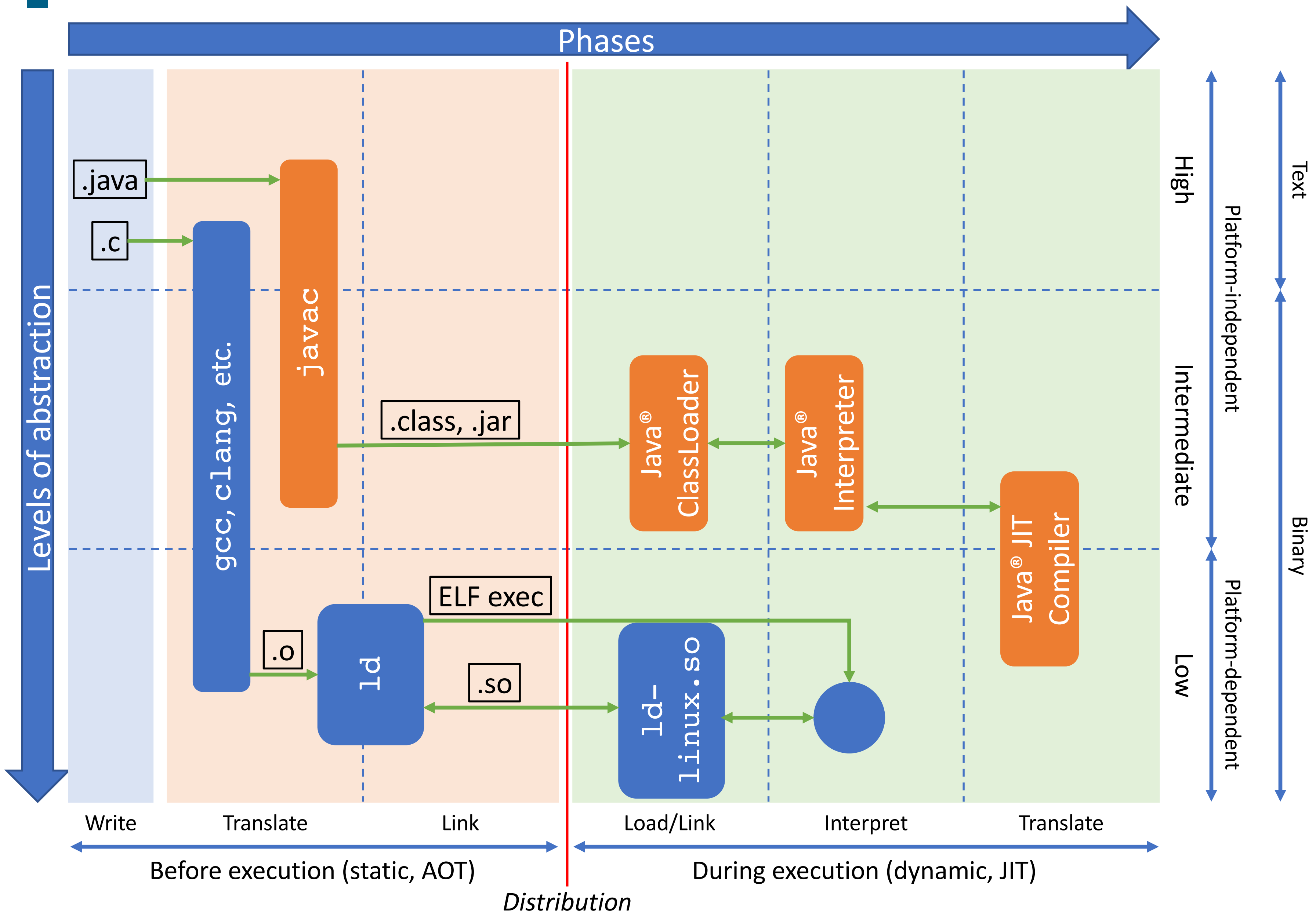

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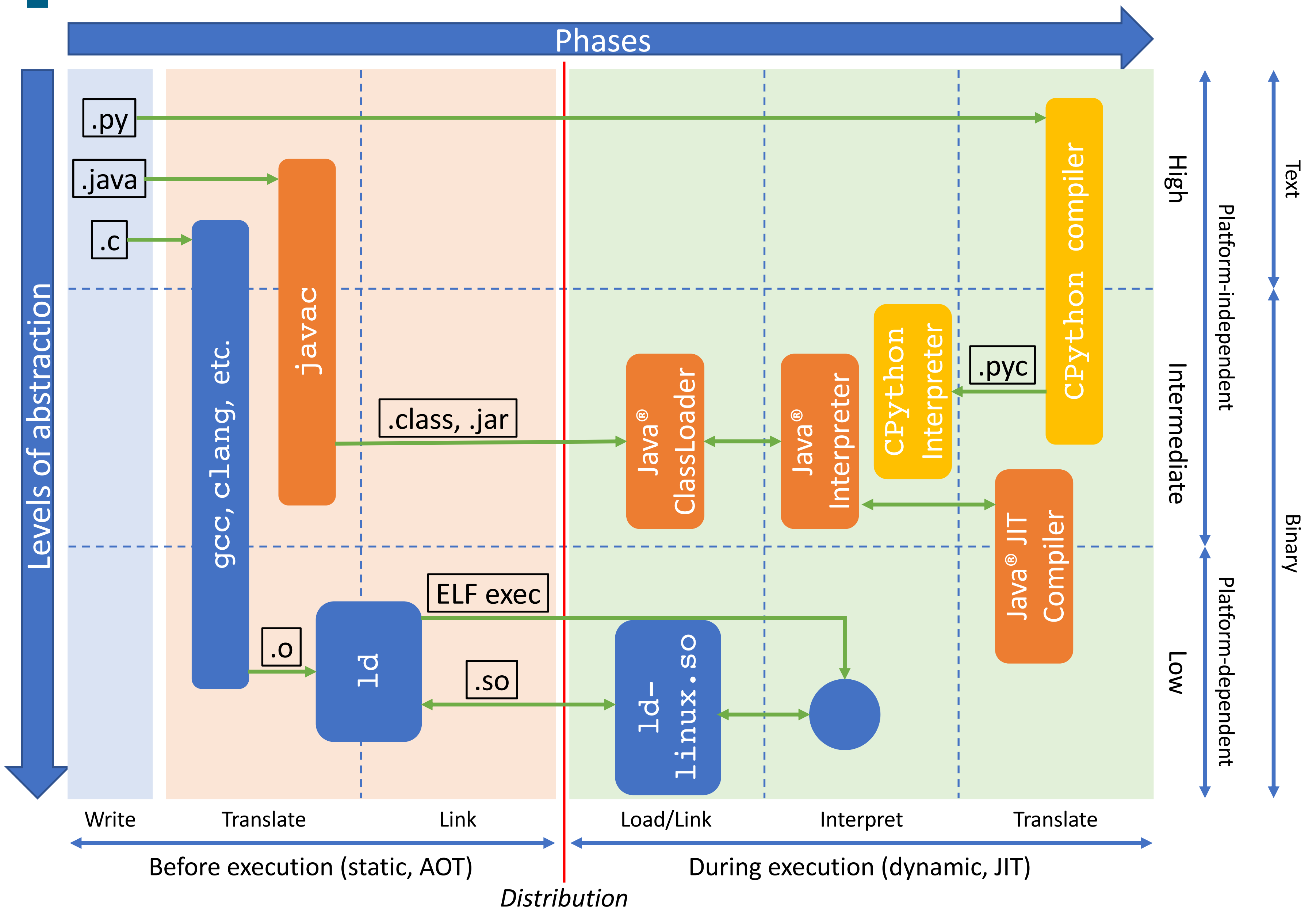

Languages, Grammars, Recognizers

- Language
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- Recognizer
  - A recognizer $\mathcal{R}(\mathcal{L}, w)$ is an automaton (i.e., machine) that can decide whether $w \in \mathcal{L}$.