# Operational Semantics

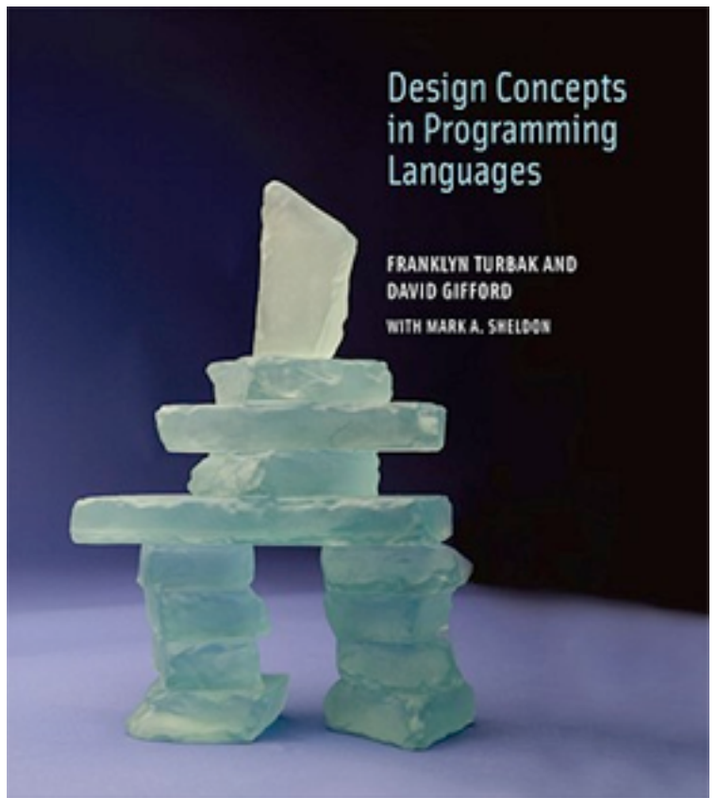
A4M36TPJ, 2013/2014

# Overview

- Introduction
- Small-step Operational Semantics (SOS)
- Big-step Operational Semantics (BOS)

# References

- Franklyn Turbak, David Gifford, Mark A. Sheldon:
  *Design Concepts in Programming Languages*,
  The MIT Press, 2008, ISBN: 978-0262201759




- https://edux.feld.cvut.cz/courses/A4M36TPJ

# Programming Languages

1. Syntax — the *form*...
2. Semantics — the *meaning*...
3. Pragmatics — the *implementation*...

...of programming languages

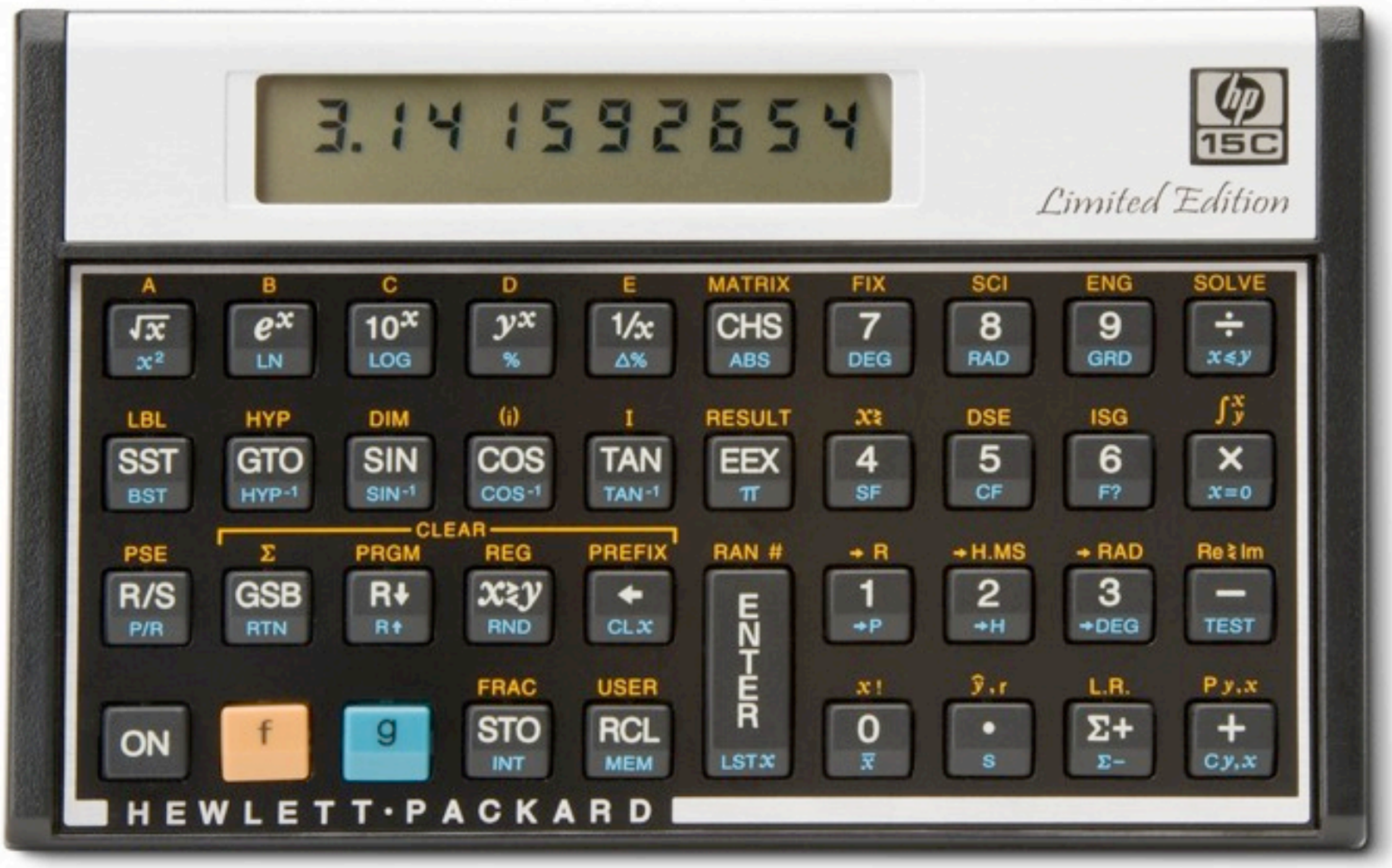
# Abstract Machine

1. Code component
2. State component

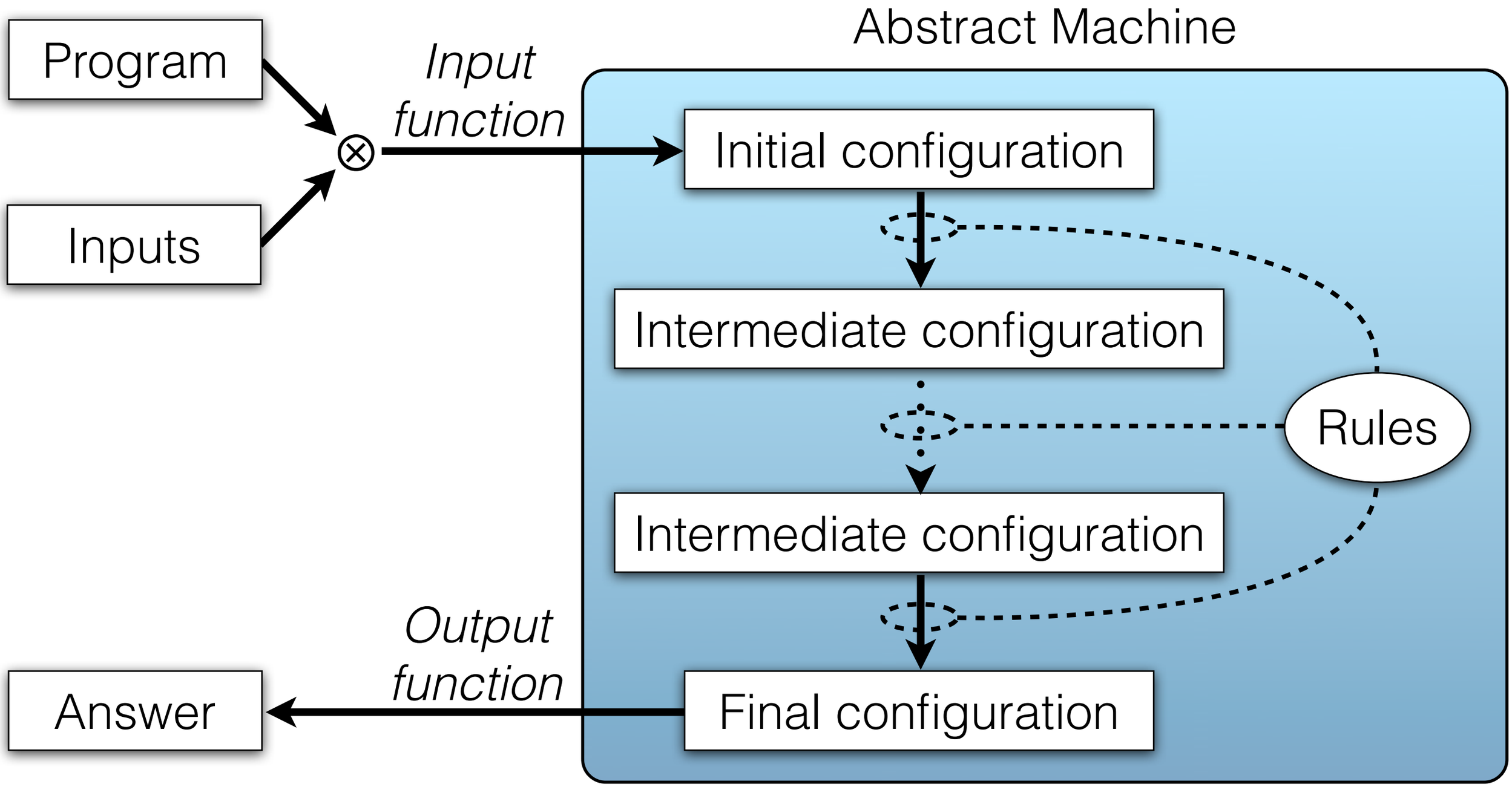
# Operational Execution

- Program ⊗ Inputs → Input function
- Initial configuration
- *(Intermediate configurations...)*
- Final configuration
- Output function → Answer

# Configuration



# The OS "game board"



# Example Language - Syntax

$$Expr ::= Num \mid$$
$$\triangle Expr \mid$$
$$Expr \odot Expr$$

Num is a predefined set of integer numbers (a.k.a. Z).

# Expressions

$$Expr = \{\ldots, 0, 1, 2, \ldots, \triangle 0, \triangle 1, \triangle 2, \ldots, 0 \odot 0, 0 \odot 1, 0 \odot 2, \ldots, (\triangle 0) \odot 0,$$
$$(\triangle 0) \odot 1, (\triangle 0) \odot 2, 0 \odot (\triangle 0), 0 \odot (\triangle 1), 0 \odot (\triangle 2), \triangle(0 \odot 0), \triangle(0 \odot 1),$$
$$\triangle(0 \odot 2), \ldots\}$$

# Small-step Operational Semantics

$$n, n' \in Num \qquad e, e_1, e_2, e' \in Expr$$

$$\frac{}{\triangle n \Rightarrow -n}$$

$$\frac{}{n \odot n' \Rightarrow n + n'}$$

$$\frac{e \Rightarrow e'}{\triangle e \Rightarrow \triangle e'}$$

$$\frac{e_1 \Rightarrow e'}{e_1 \odot e_2 \Rightarrow e' \odot e_2}$$

$$\frac{e_2 \Rightarrow e'}{e_1 \odot e_2 \Rightarrow e_1 \odot e'}$$