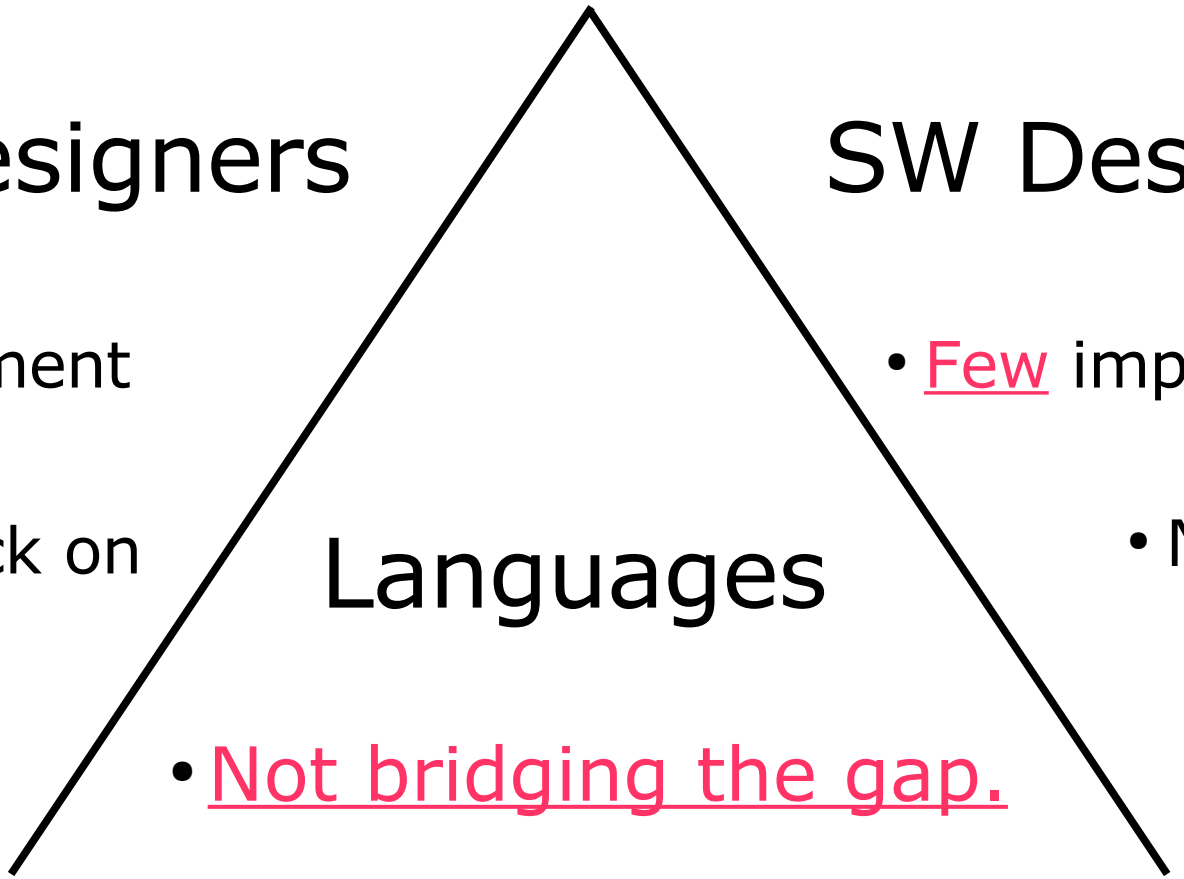
Modern Language Tools and 754R

E. Jason Riedy
UC Berkeley

Current State:



- Can implement anything!
- No feedback on trade-offs.

- Few implementation options.
- No access to features.

- Not bridging the gap.

- What can 754R do?

- Current 754 support is ad-hoc.
  - C99, Fortran 2003 provide different descriptions for same model.
  - Many languages provide **no** semantics.
  - Compilers provide less...

- 754R: Provide a language for languages.
  - Not LIA: Describe 754 arithmetic, not all possible arithmetics.
  - Use modern language tools: Type theory and inferencing.

Typing from 20k Feet

- Precisions ≈ data types

$$\mathrm{Prec} = \{\mathrm{single}, \mathrm{double}, \ldots\}$$

- Operations ≈ function types

$$+ \in \{\tau \times \tau \to \tau | \tau \in \mathrm{Prec}\}$$

- *Expression evaluation rules* ⊂ *typing rules*

$$\frac{A, S \vdash x : \alpha, y : \alpha}{A, S \vdash x + y : \alpha}$$

Impact on 754R

- Provides a sound base for definitions.
- Could define typing hierarchy and "literal" type for wide expression evaluation.
  - Assists interval arithmetic!
- Models modes and flags:
  - $+ : \tau \times \tau \times \mathbf{modes} \rightarrow \tau \times \mathbf{flags}$
- Possible problems:
  - Comparison operators and wide eval?
  - Compiler support?