TESTING PROGRAMS WITH HIGHLY CONSTRAINED INPUTS

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INPUT PROCESSING STEPS

Programs typically process inputs in **distinct steps**, with increasing constraints on **input correctness**.

```
(P1): VBq-"7.6arK w;zu%6$K>%OT                Lexical Error
(P2): && float += % " ( ; == [                Syntactic Error
(P3): int main() { return i; }                Semantic Error
(P4): int main() { return 0; }                Fully Valid
```

MEASURES

Input Correctness

Adherence to Format

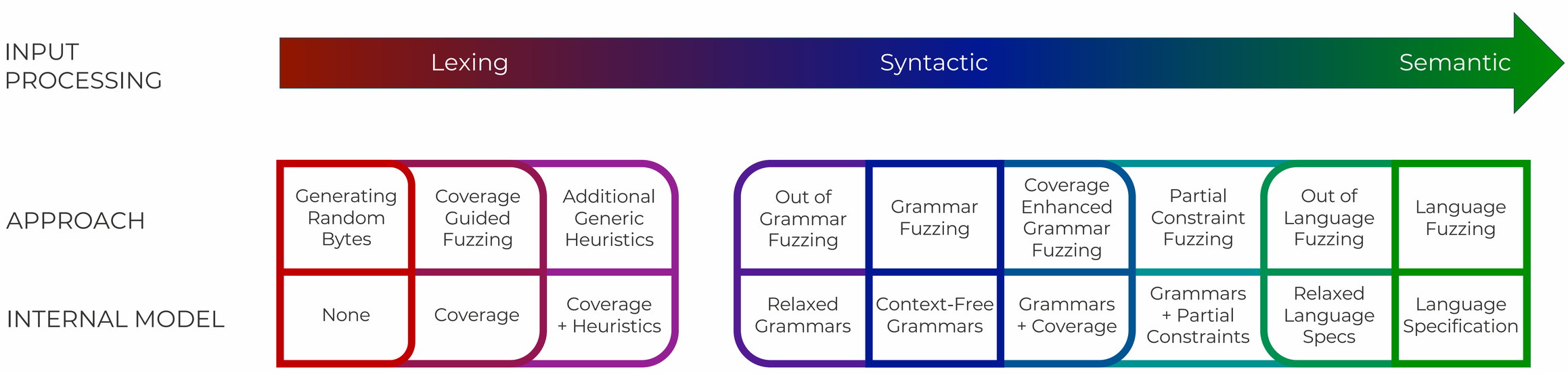
- Distance from **Specification**
- Failure Step in **Implementation**

Input Interestingness

Distance to Boundaries

- **Syntactically**: Structural Extremes
- **Semantically**: Equivalence Class Boundaries

APPROACH CATEGORIZATION



INITIAL EXPERIMENTS

Distribution of inputs across failure steps, as measured on the C compiler **clang** with different approaches.

Fuzzing Approach	Seeds	Other	Lexing	Syntactic	Semantic	Valid
Coverage Guided	❌	0.001	0.566	0.362	0.066	0.0048
	✅	0.000	0.357	0.317	0.316	0.0101
Out of Grammar	❌	0.054	0.293	0.164	0.489	0.0006
	✅	0.054	0.292	0.164	0.489	0.0007
Grammar	❌	0.008	0.397	0.231	0.364	0.0010
	✅	0.008	0.396	0.230	0.365	0.0012
Coverage Grammar	❌	0.000	0.000	0.571	0.429	0.0000
	✅	0.000	0.003	0.553	0.444	0.0000

None of the tested approaches reliably **produce valid inputs**.

FUTURE WORK

- Measure input correctness distribution on **more targets**
- **Combine** measures with other measures such as coverage
- **Out of language fuzzing**: Invalidate constraints
- Extend grammars for **partial constraint fuzzing**
- Generate inputs with high **input interestingness**

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