**ANYDSL:**
**A COMPILER-FRAMEWORK FOR DOMAIN-SPECIFIC LIBRARIES (DSLs)**

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**Motivation**

- Many-Core HW is everywhere
  - But cannot be programmed well

![Intel Haswell Architecture](image)

**Traditional Programs run only on a single core**

Intel Haswell Architecture (1.4B Transistors)

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**Embedding of DSLs in Impala**

- Separation of concerns through code refinement
  - Higher-order functions
  - Partial evaluation
  - Triggered code generation

**Application Developer**

```plaintext
fn main() {
  let img = load("dragon.png");
  let blurred = gaussian_blur(img);
}
```

**DSL Developer**

```plaintext
fn gaussian_blur(field: Field) -> Field {
  let stencil: Stencil = { /* ... */ };
  let mut out: Field = { /* ... */ };
  for x, y in @iterate(out) {
    out.data(x, y) = apply_stencil(x, y, field, stencil);
  }
  out
}
```

**Machine Expert**

```plaintext
fn iterate(field: Field, body: fn(int, int) -> ()) -> () {
  let grid = (field.cols, field.rows, 1);
  let block = (128, 1, 1);
  with nvvm(grid, block) {
    let x = nvvm_tid_x() + nvvm_ntid_x() * nvvm_ctaid_x();
    let y = nvvm_tid_y() + nvvm_ntid_y() * nvvm_ctaid_y();
    body(x, y);
  }
}
```

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**AnyDSL Architecture**

- Computer Vision DSL
- Physics DSL
- Ray Tracing DSL
- Parallel Runtime DSL
- ... (Developer)

**Layered DSL Specifications**
- AnyDSL Unified Program Representation
- AnyDSL Compiler Framework (Thorin)
- Various HW Back Ends

**Stincilla**

- A DSL for stencil codes
  - Example: Gaussian blur filter
    - Reference: OpenCV 3.0
    - Intel CPU: 40% faster
    - Intel GPU: 25% faster
    - AMD GPU: 50% faster
    - NVIDIA GPU: 45% faster
    - Up to 10x shorter code

**RaTrace**

- A DSL for ray traversal
  - 11% faster than Embree (on average, Core i7-4790)
  - 17% faster than Aila et al. (on average, GTX 970)
  - 1/10th of coding time (according to Halstead measures)