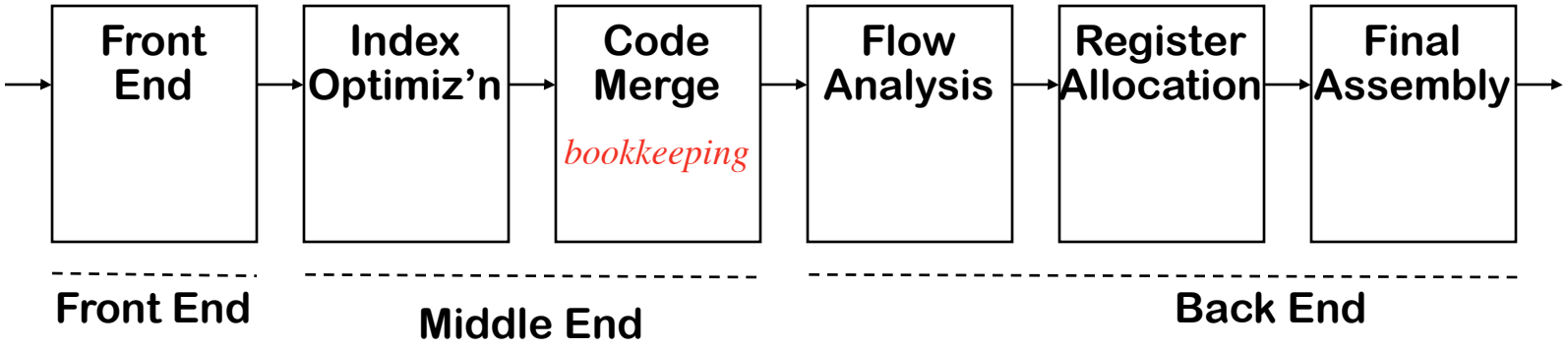
Historic Compilers

Classic Compilers



1957: The FORTRAN Automatic Coding System

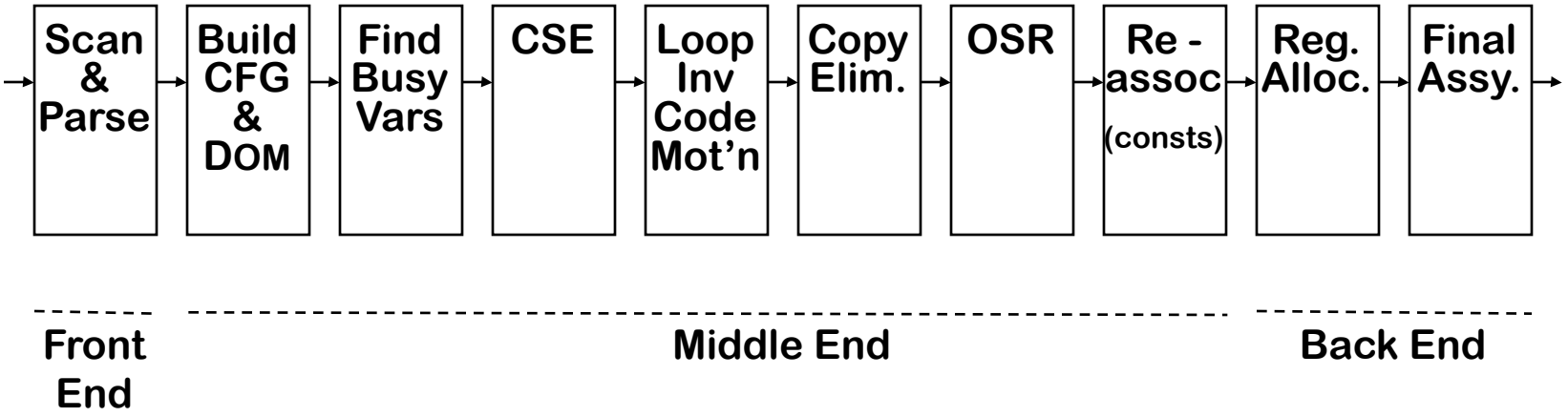
- Six passes in a fixed order
- Generated good code

  Assumed unlimited index registers

  Code motion out of loops, with ifs and gotos

  Did flow analysis & register allocation

Classic Compilers

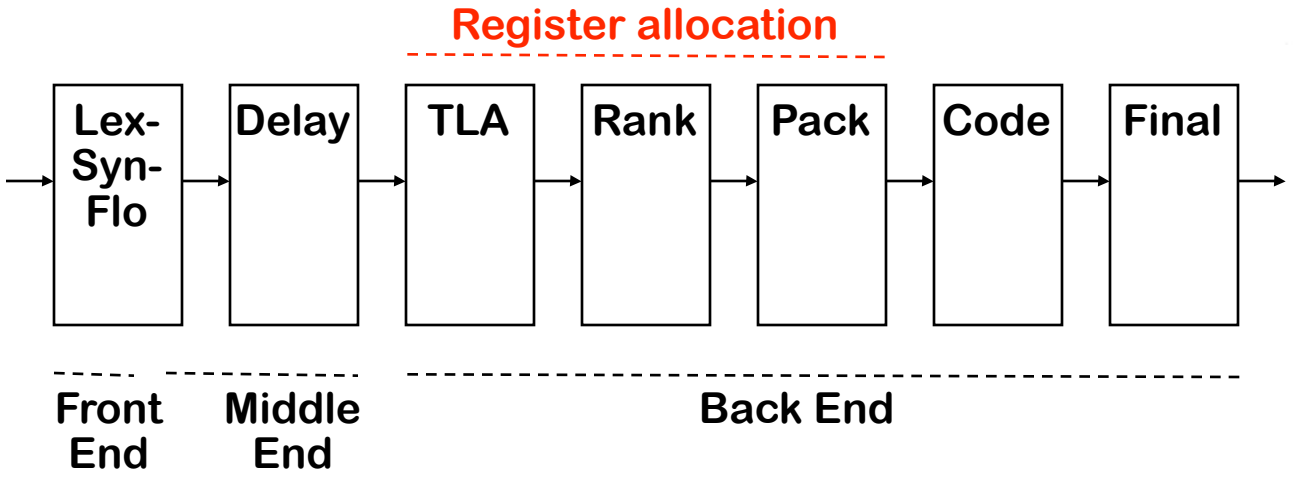


1969: IBM's FORTRAN H Compiler

- Used low-level IR (quads), identified loops with dominators
- Focused on optimizing loops ("inside out" order)

  Passes are familiar today
- Simple front end, simple back end for IBM 370

Classic Compilers



1975: BLISS-11 compiler (Wulf et al., CMU)

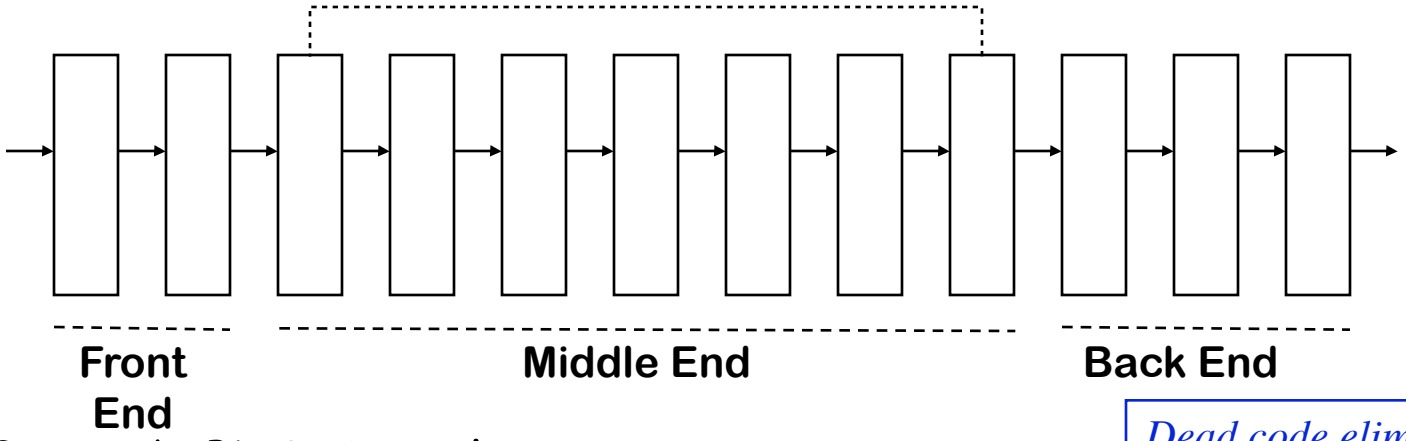
Basis for early VAX & Tartan Labs compilers

- The great compiler for the PDP-11
- Seven passes in a fixed order
- Focused on code shape & instruction selection

  LexSynFlo did preliminary flow analysis

  Final included a grab-bag of peephole optimizations

Classic Compilers



1980: IBM's PL.8 Compiler

- Many passes, one front end, several back ends
- Collection of 10 or more passes

Dead code elimination
Global cse
Code motion
Constant folding
Strength reduction
Value numbering
Dead store elimination
Code straightening
Trap elimination
Algebraic reassociation

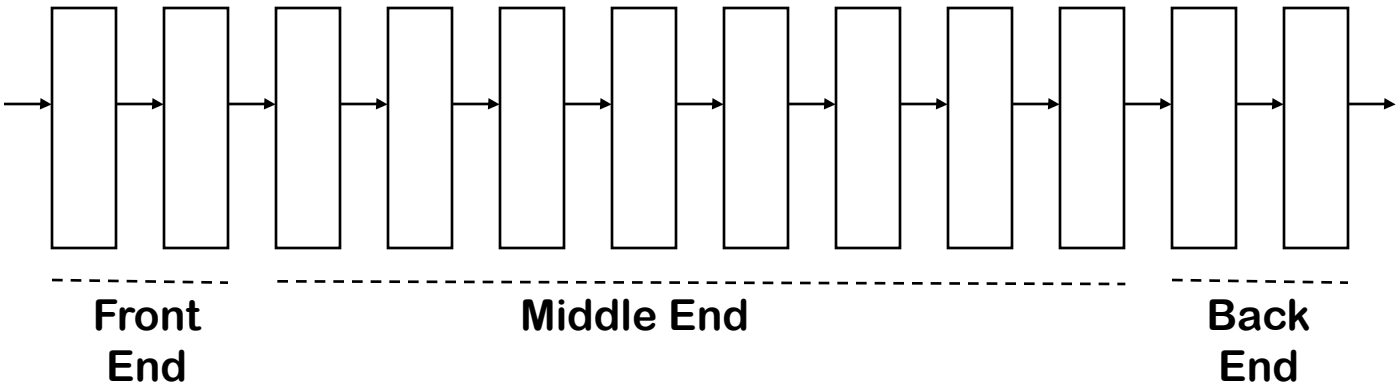
Repeat some passes and analyses

Represent complex operations at 2 levels

Below machine-level IR

Multi-level IR has become common wisdom

Classic Compilers

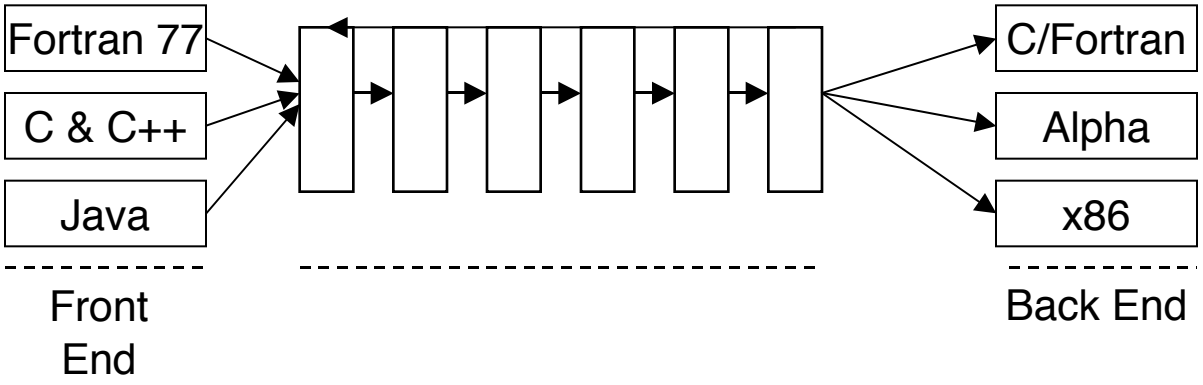


1986: HP's PA-RISC Compiler

- Several front ends, an optimizer, and a back end
- Four fixed-order choices for optimization (9 passes)
- Coloring allocator, instruction scheduler, peephole optimizer

Classic Compilers

1999: The SUIF Compiler System



Another classically-built compiler

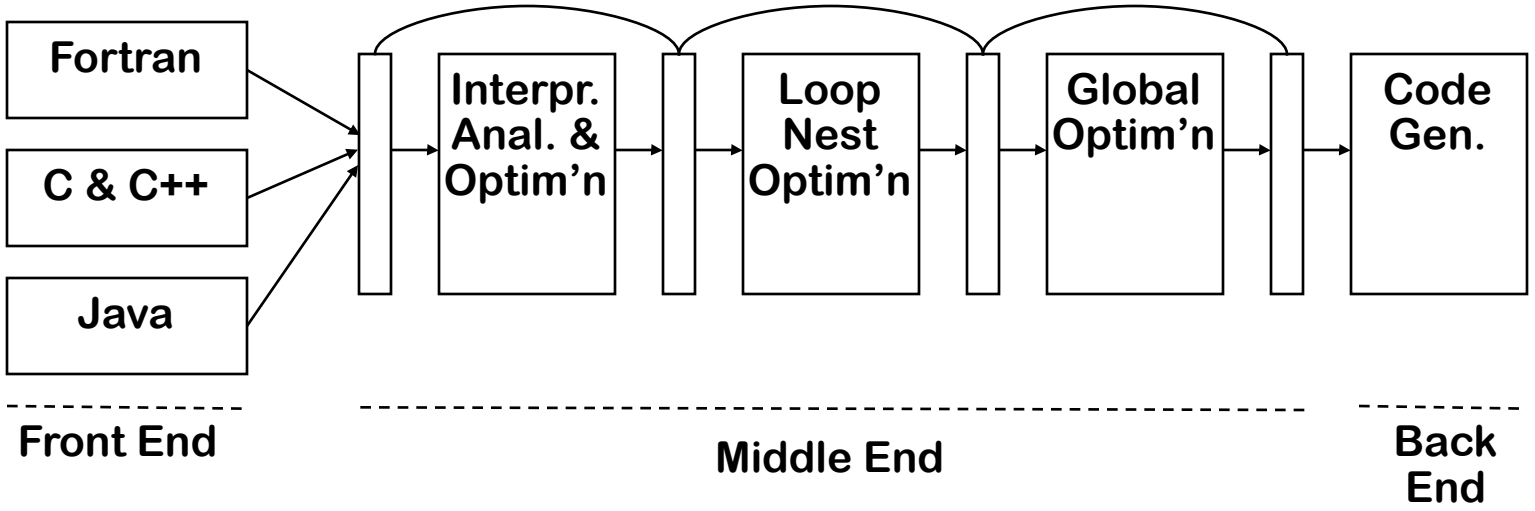
- 3 front ends, 3 back ends
- 18 passes, configurable order
- Two-level IR (High SUIF, Low SUIF)
- Intended as research infrastructure

SSA construction
Dead code elimination
Partial redundancy elimination
Constant propagation
Global value numbering
Strength reduction
Reassociation
Instruction scheduling
Register allocation

Data dependence analysis
Scalar & array privitization
Reduction recognition
Pointer analysis
Affine loop transformations
Blocking
Capturing object definitions
Virtual function call elimination
Garbage collection

Classic Compilers

2000: The SGI Pro64 Compiler (now Open64 from Intel)

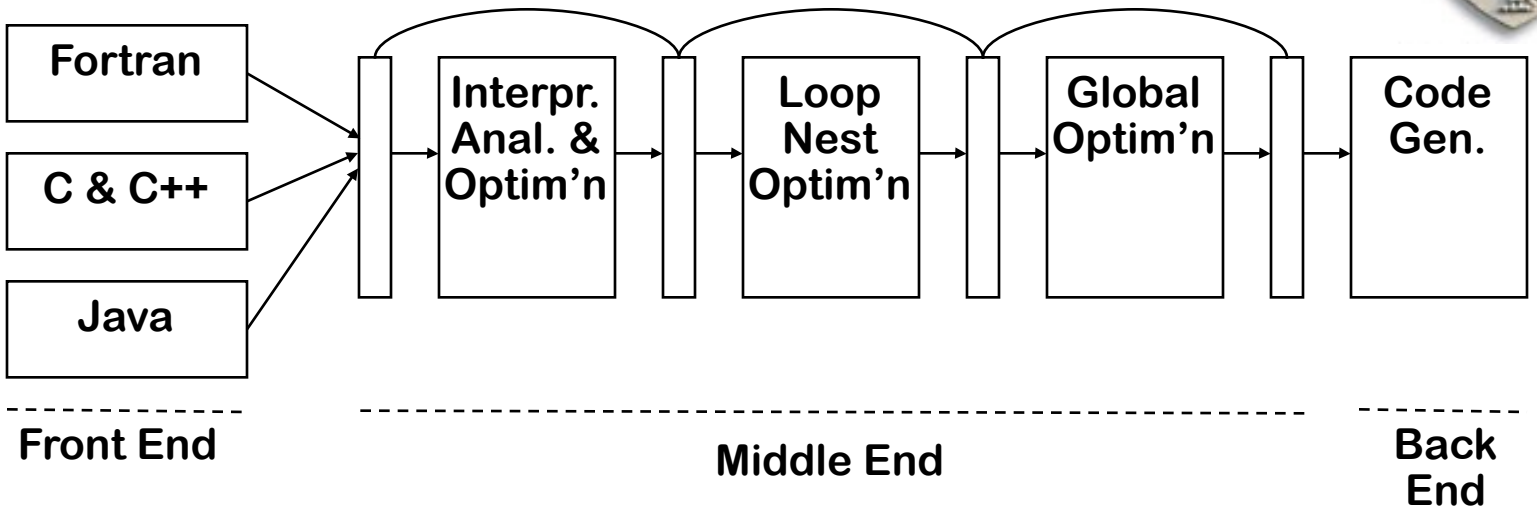


Open source optimizing compiler for IA 64

- 3 front ends, 1 back end
- Five-levels of IR
- Gradual lowering of abstraction level

Classic Compilers

2000: The SGI Pro64 Compiler (now Open64 from Intel)



Interprocedural
Classic analysis
Inlining (user & library code)
Cloning (constants & locality)
Dead function elimination
Dead variable elimination

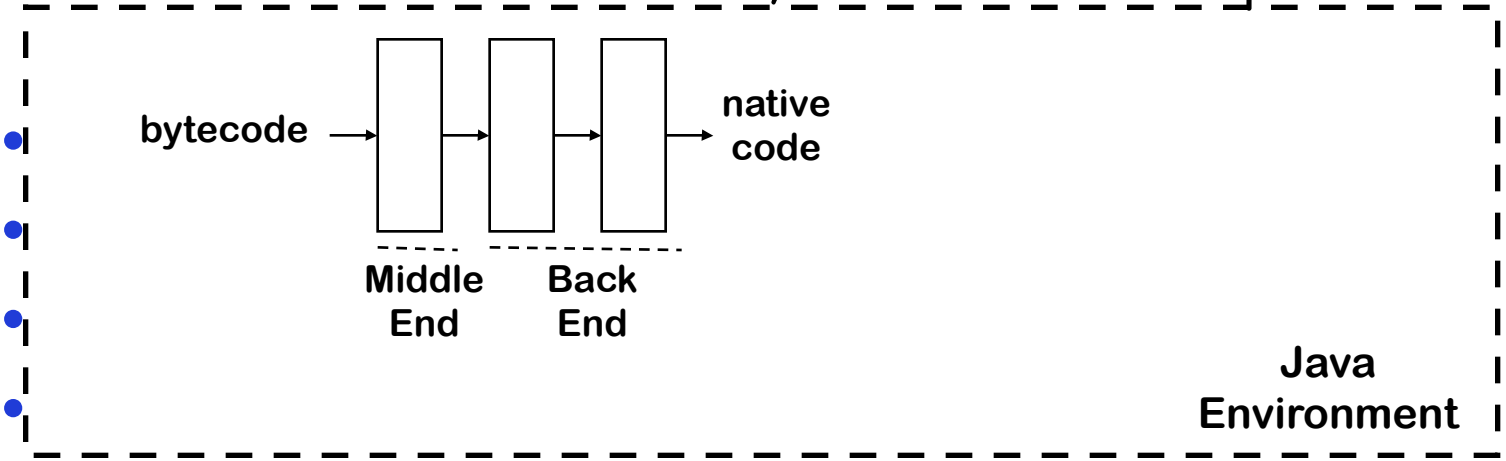
Global Optimization
SSA-based analysis & opt'n
Constant propagation, PRE,
OSR+LFTR, DVNT, DCE
(also used by other phases)

Loop Nest Optimization
Dependence analysis
Parallelization
Loop transformations (fission, fusion, interchange, peeling, tiling, unroll & jam)
Array privitization

Code Generation
If conversion & predication
Code motion
Scheduling (inc. sw pipelining)
Allocation
Peephole optimization

Classic Compilers

Even a 2000 JIT fits the mold, albeit with fewer passes



- Front end tasks are handled elsewhere
- Few (if any) optimizations
  - Avoid expensive analysis
  - Emphasis on generating native code
  - Compilation must be profitable