CS6843: Program Analysis

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Moodle: courses.iitm.ac.in/course/view.php?id=1868

Jan 2018

What is Program Analysis?

For an end-goal identify “interesting aspects” of a program's representation.

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For an end-goal

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of a program's representation.

Checking security

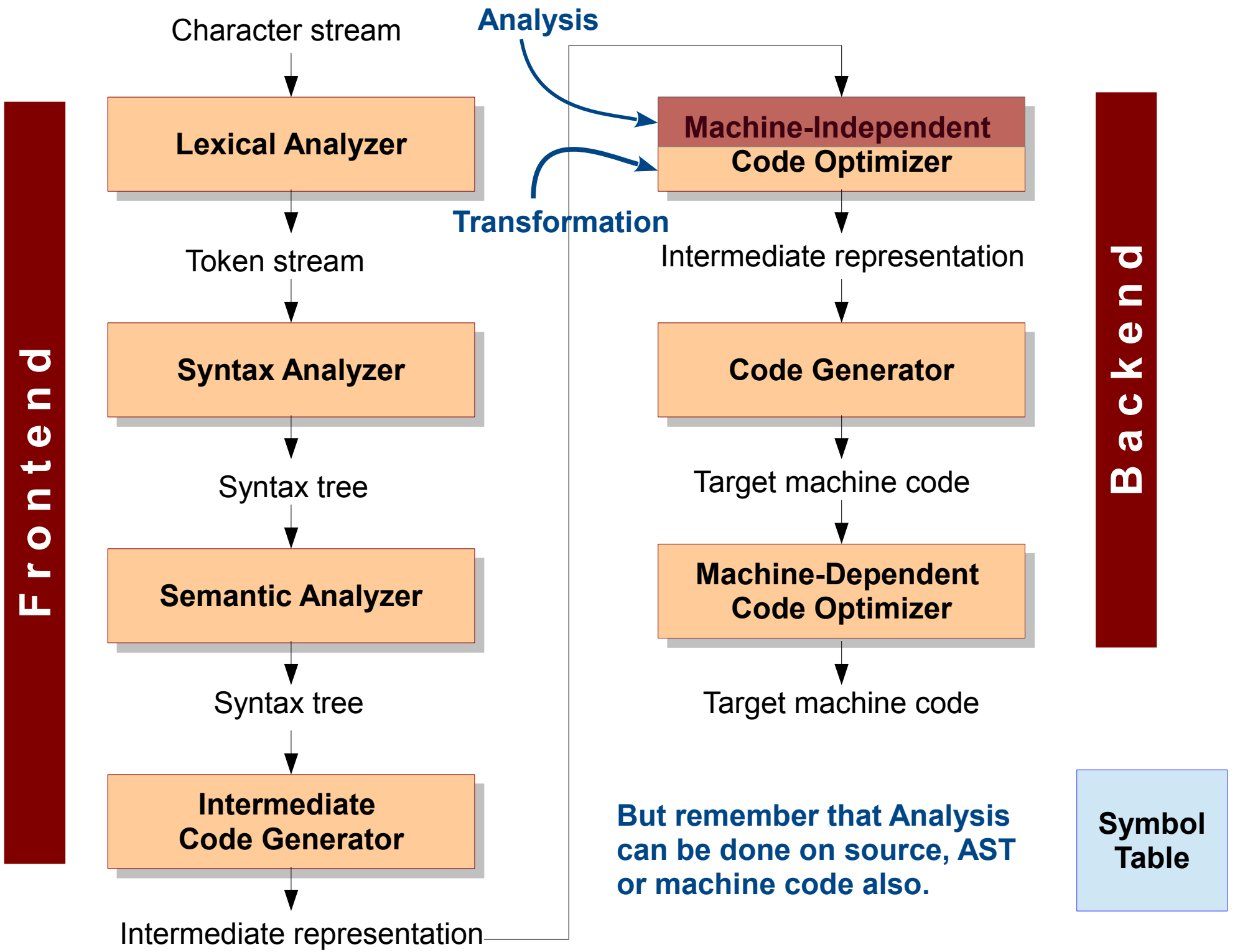
Array index range

Source, AST, binary, executed instruction

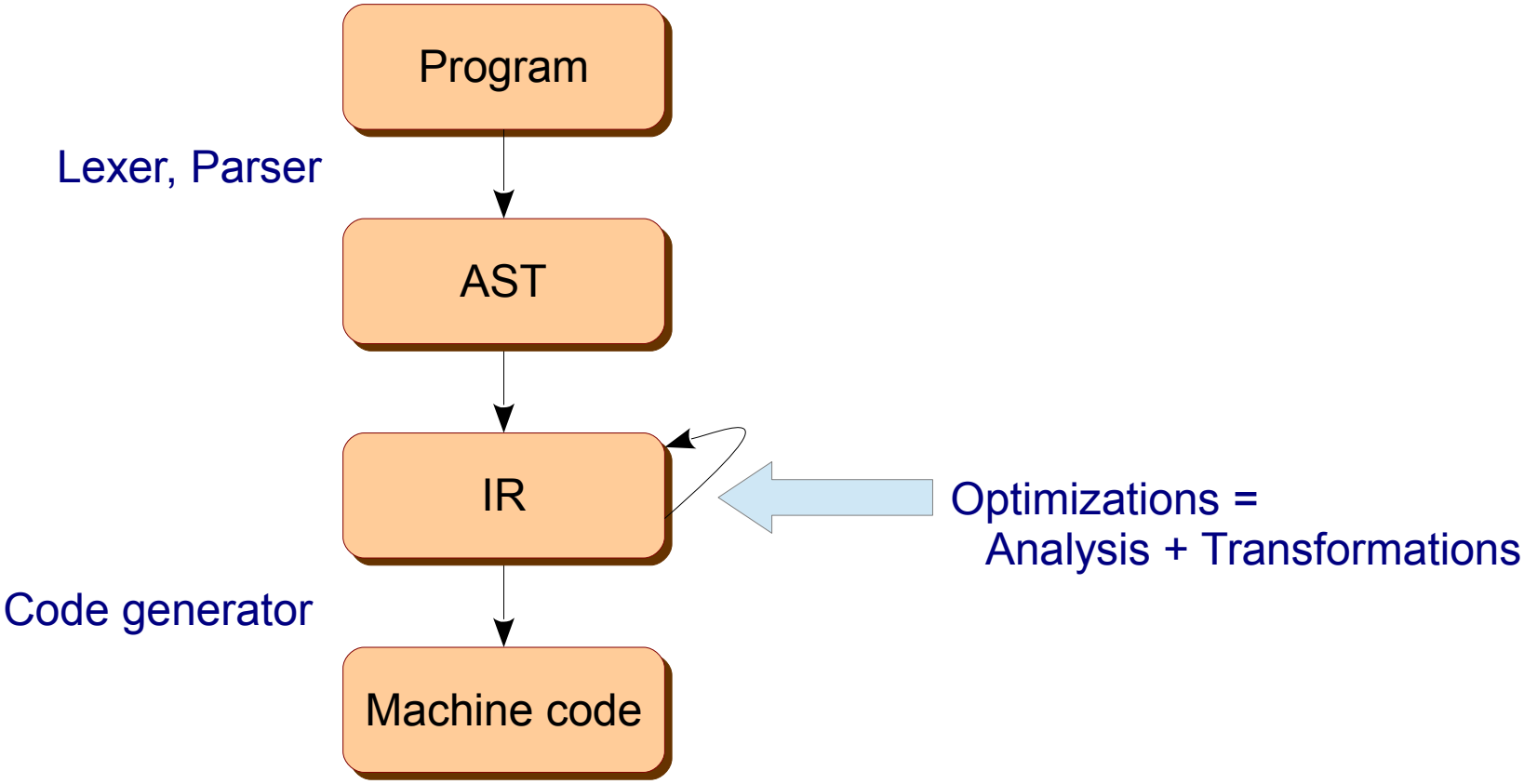
Examples

End goal	Interesting aspect
Dead code elimination	Reachability
Constant propagation	use-def
Security	Array index range, dangling pointers
Parallelization	Data dependence, SIMD opportunities
Debugging	Slice
Cache performance	Memory access pattern
Memory reduction	Live ranges
...	...

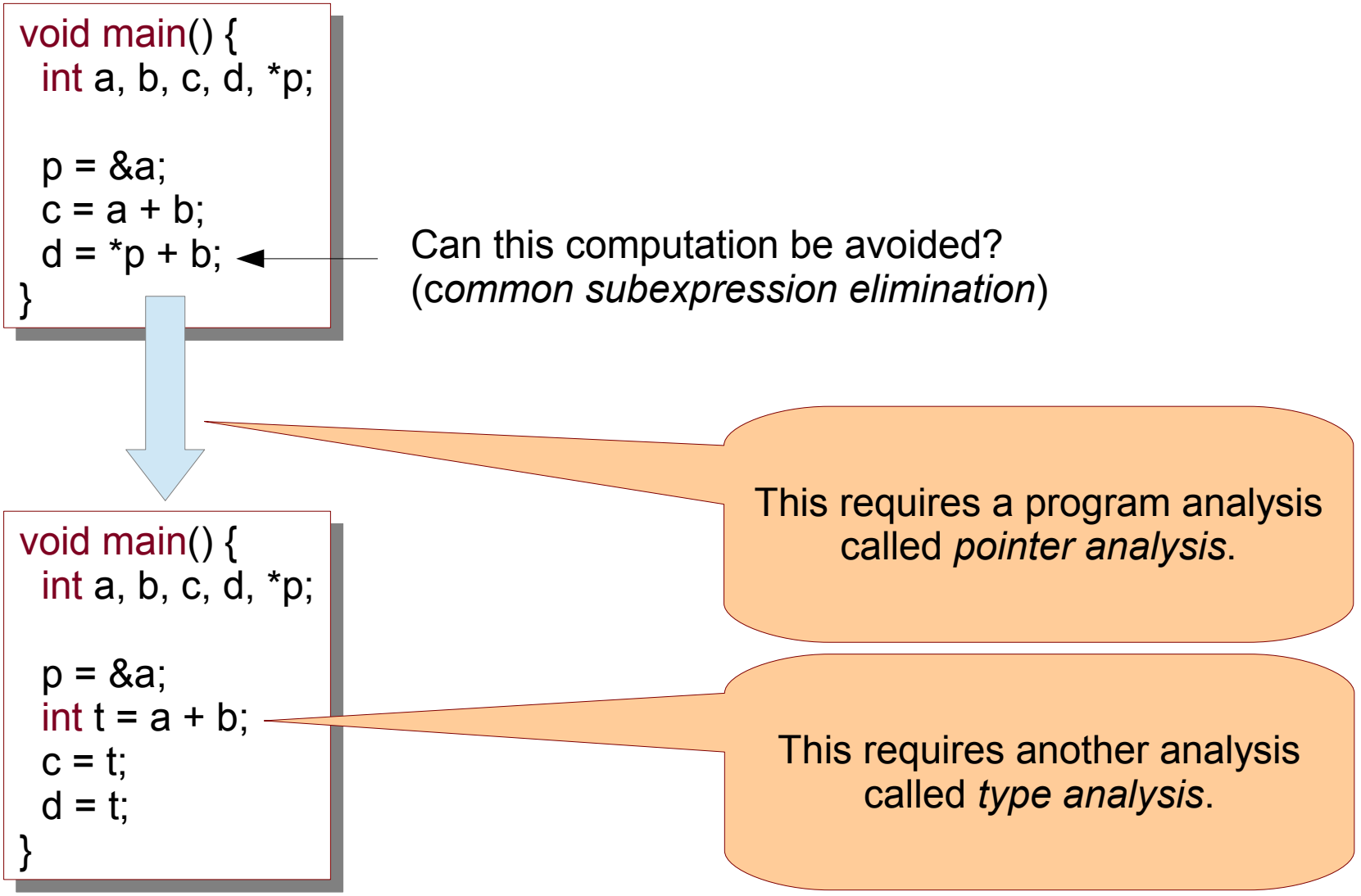
Program Analysis is often a pre-cursor to Optimization.


Character stream
Lexical Analyzer
Token stream
Syntax Analyzer
Syntax tree
Semantic Analyzer
Syntax tree
Intermediate Code Generator
Intermediate representation
Frontend
Analysis
Transformation
Machine-Independent Code Optimizer
Intermediate representation
Code Generator
Target machine code
Machine-Dependent Code Optimizer
Target machine code
Backend
But remember that Analysis can be done on source, AST or machine code also.
Symbol Table

Compiler Organization



Example Three

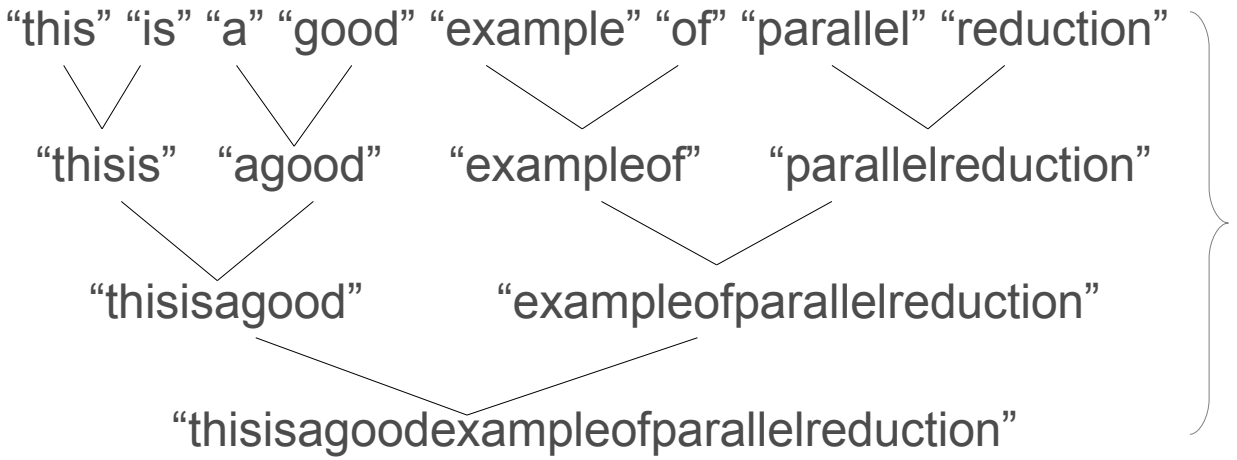


Example Two

```
*sresult = 0;

for (ii = 0; ii < nn; ++ii) {
  strcat(sresult, str[ii]);
}
```

Can you parallelize this code?

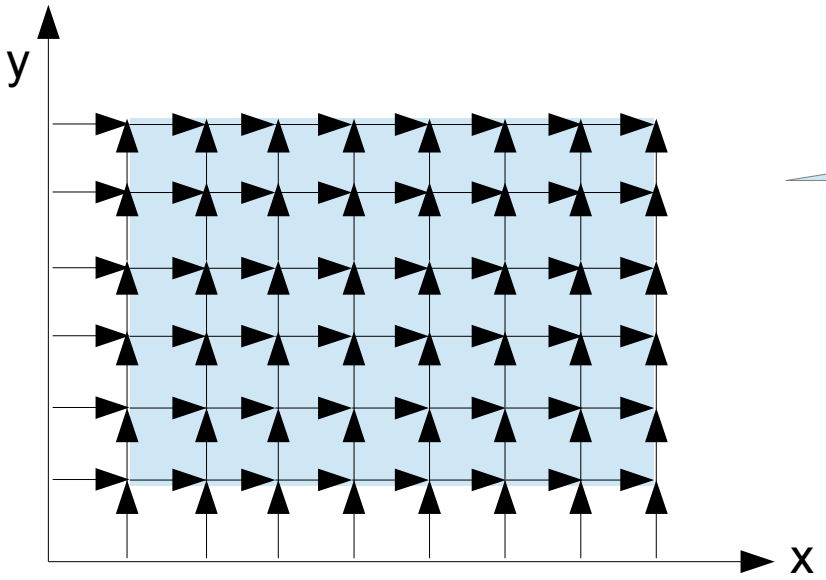


Requires *semantic analysis* to figure out that *strcat* performs an **associative** operation.

Example One

```
for (x = 1; x < M; ++x)
  for (y = 1; y < N; ++y)
    a[x, y] = a[x – 1, y] + a[x, y – 1];
```

Can you parallelize iterations?



Requires
loop dependence analysis

In This Course

7. Dynamic Analysis (DYN)
6. Shape Analysis (SHA)
5. Program Slicing (SLI)
4. Parallelization (PAR)
3. Security Analysis (SEC)
2. Pointer Analysis (PTR)
1. Data Flow Analysis (DFA)

Support material

- These slides
- Scribes
- Online tools

Logistics

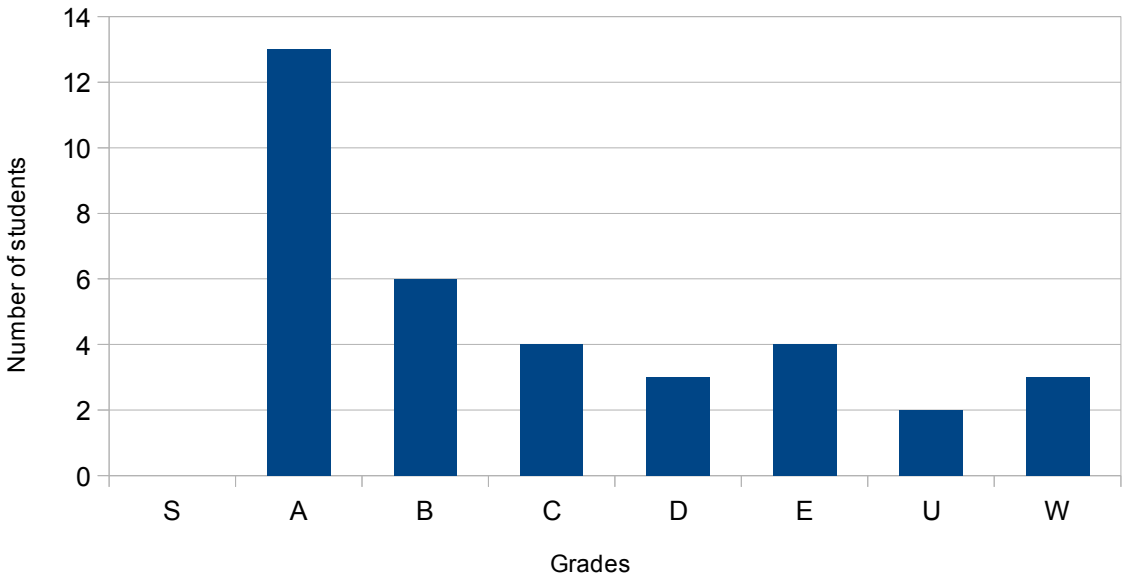
- Moodle for submissions, announcements, discussions
  - Your responsibility to subscribe to it.
- Evaluation:
  - assignments (50%)
  - midsem (25%)
  - endsem (25%)
- C slot (Mon 10, Tue 9, Wed 8, Fri 12).
- Room CS 26.

Assignments

- Four programming assignments (50%).
  - 5 + 10 + 15 + 20
- Assignments would be in LLVM.
- You should work individually.
- A1 is due this Sunday.
- You have this week to suggest me any date changes for A2, A3, A4.

Grading

- S >= 95
- A >= 80
- B >= 70
- C >= 60
- D >= 50
- E >= 40



2017 PA evaluation

Course Schedule

Month	Lectures	Evaluations
JAN	DFA	A1
FEB	PTA, PAR	A2
MAR	SEC, DYN	A3, MIDSEM
APR	SHA, SLI	A4
MAY		ENDSEM

MidSem and EndSem will have mutually exclusive topics.

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