Intro: Computing Runtimes

Daniel Kane

Department of Computer Science and Engineering
University of California, San Diego

Data Structures and Algorithms
Algorithmic Toolbox

Learning Objectives

- Describe some of the issues involved with computing the runtime of an actual program.
- Understand why finding exact runtimes is a problem.

Outline

Runtime Analysis

Function FibList(n)

```
create an array F[0...n]
```
$F[0] \leftarrow 0$
$F[1] \leftarrow 1$
```
for i from 2 to n:
```
$\quad F[i] \leftarrow F[i-1] + F[i-2]$
```
return F[n]
```

Runtime Analysis

Function FibList(n)

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return $F[n]$

$2n + 2$ lines of code. Does this really describe the runtime of the algorithm?

Individual Lines

Function FibList(n)

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$F[0] \leftarrow 0$
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return $F[n]$

Depends on memory management system.

Individual Lines

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Assignment.

Individual Lines

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Assignment.

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Increment, comparison, branch.

Individual Lines

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Lookup, assignment, addition of big integers.

Individual Lines

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$F[0] \leftarrow 0$
$F[1] \leftarrow 1$
for i from 2 to n:
    $F[i] \leftarrow F[i-1] + F[i-2]$
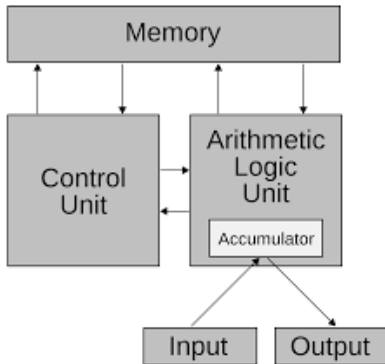return $F[n]$

Lookup, return.

Outline

Computing Runtime

To figure out how long this simple program would actually take to run on a real computer, we would also need to know things like:
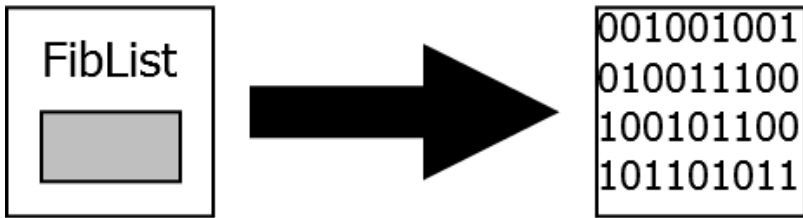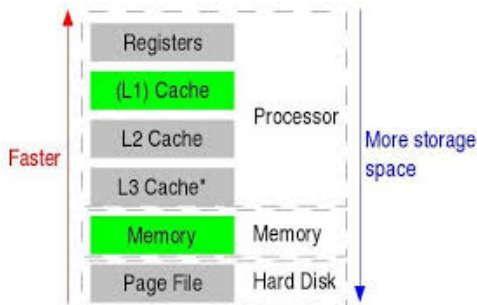
Speed of the Computer

The System Architecture

The Compiler Being Used

Details of the Memory Hierarchy

Problem

- Figuring out accurate runtime is a huge mess

Problem

- Figuring out accurate runtime is a huge mess
- In practice, you might not even know some of these details

Goal

Want to:

- Measure runtime without knowing these details.
- Get results that work for large inputs.