

To recurse, or to iterate?

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Background

- **Algorithms are everywhere**
- **Recursion has problems**



To recurse or to iterate?

- **What are algorithms?**
- **Why do we use recursion?**
- **Can we use iteration instead?**
- **How do we get to iteration?**
- **What are the iteration pitfalls?**



What are algorithms?



What are algorithms?

- **Wikipedia:**

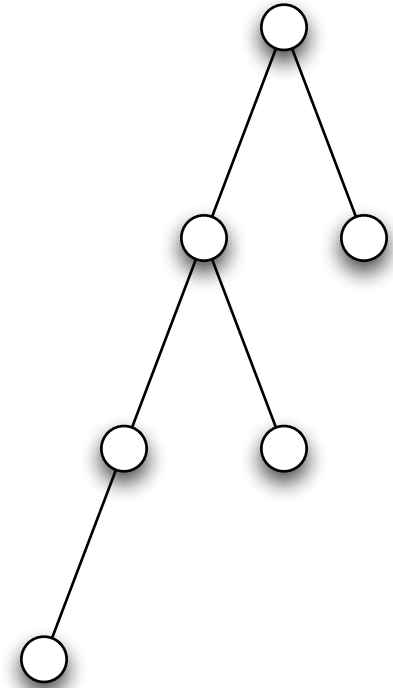
"an algorithm is a sequence of finite instructions, often used for calculation and data processing"



What are algorithms?

- **Recursive**

```
long fib(int n) {  
    return (n <= 2)  
        ? 1  
        : fib(n - 1) + fib(n - 2);  
}
```



- **Iterative**

```
long sum(int n) {  
    long r = 0;  
    for (int i = 0; i < n; i++, r += i);  
    return r;  
}
```



Algorithm Complexity

- **Space vs Time**
- **Three classes**
 - ◆ **Logarithmic**
 - ◆ **Linear**
 - ◆ **Exponential**



Why do we use recursion?



Why do we use recursion?

- **Data is hierarchical**
- **'Natural' recursion**



Troubles with recursion

- **Practical upper limit**
 - ✦ **Java VM throws StackOverflowException**
 - ✦ **Max callstack varies per OS**
- **No compiler optimizations**
 - ✦ **Tail-recursion may use a single frame**
- **Very slow if branching**



Can we use iteration instead?



Can we use iteration instead?

- **Yes.**
 - ✦ **Can even decrease complexity**



Iterative Fibonacci

```
long fib(int n) {  
    int count = 3;  
    long minus1 = 1, minus2 = 1;  
  
    while (count <= n) {  
        long current = minus1 + minus2;  
        minus2 = minus1;  
        minus1 = current;  
        count++;  
    }  
  
    return minus1;  
}
```



Fibonacci numbers

- **Recursive**

- ◆ $n = 44$ in one second

- ◆ Exponential complexity

- **Iterative**

- ◆ $n = 2.000.000.000$ in one second

- ◆ Linear complexity



Can we use iteration instead?

- **But...**
 - ✦ **Usually harder to manage**
 - ✦ **'Simulate' recursion**



How do we get to iteration?

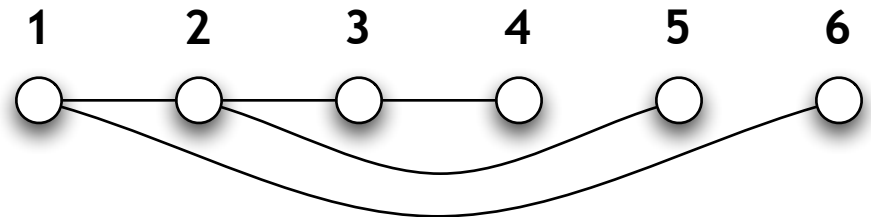
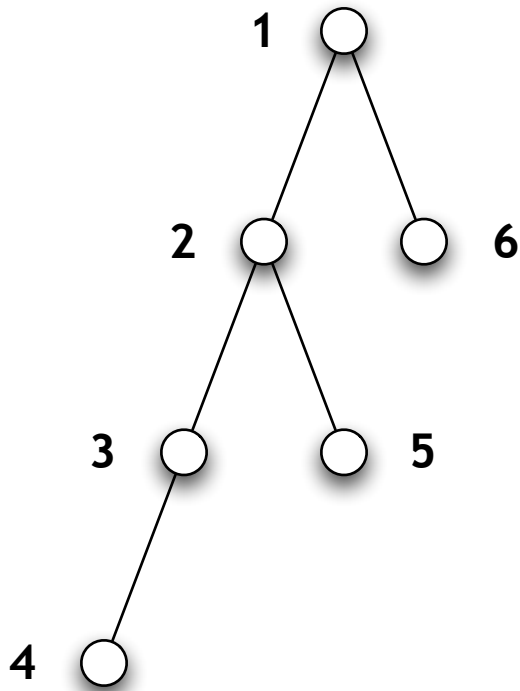


How do we get to iteration?

- **Recursion has four phases**
 - ◆ **Initialization phase**
 - ◆ **Traversal**
 - ◆ **Computation**
 - ◆ **Trackback**
- **'Flatten' the structure**



Flattening the structure



- **TODO: Insert XML processing sample**



What are the iteration pitfalls?



Pitfalls

- **Usually uses more memory**
- **Harder to maintain**
 - ◆ **Document the beast!**
- **May require special datastructures**
- **No gain in small datasets**



Conclusion

- **Recursion has problems**
- **Iteration can be of help**
- **Weigh the need**





Staat voor resultaat

 Java Competence Network
De Javapartij van Nederland