# IE 495 Lecture 13

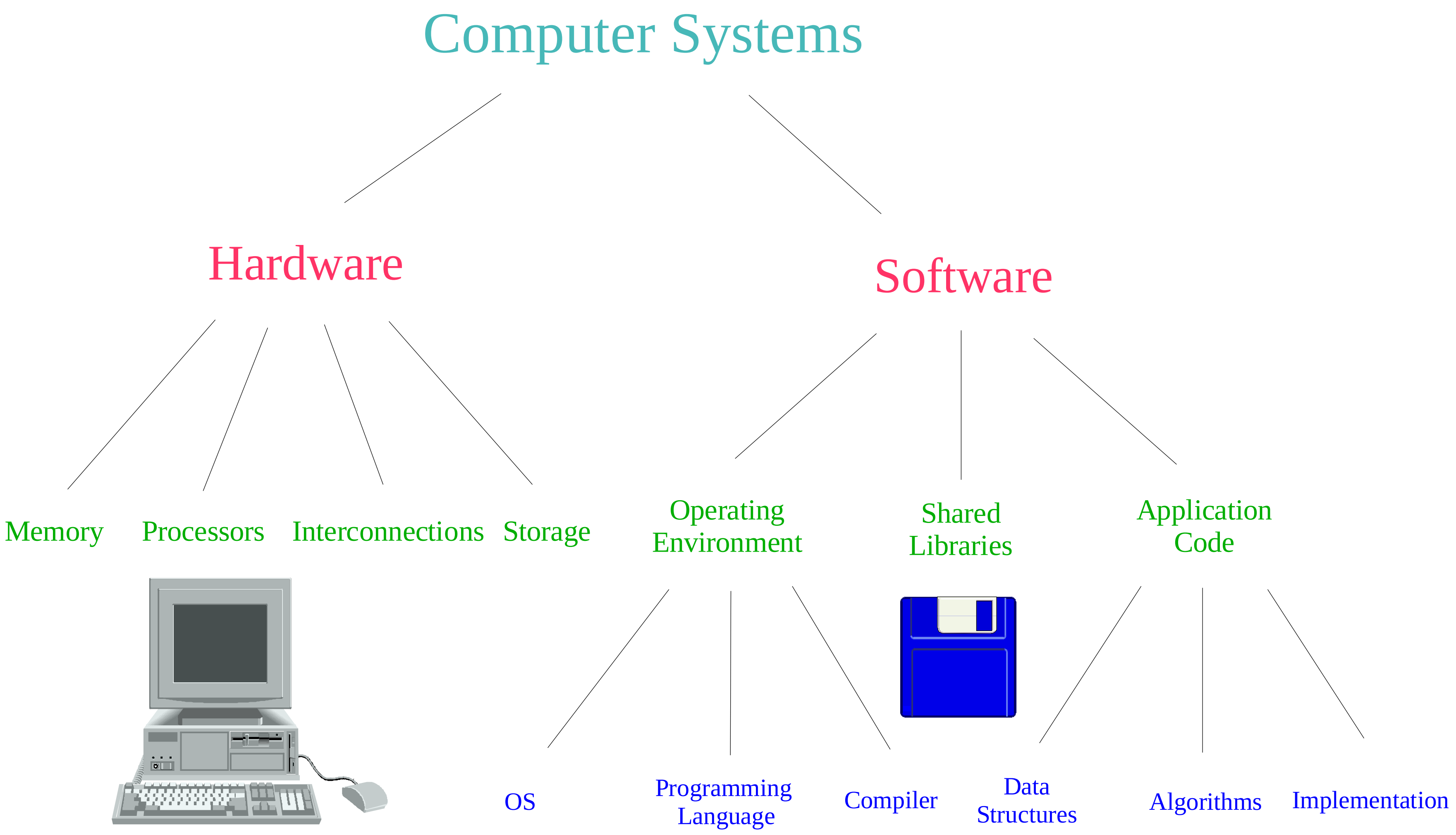
October 12, 2000

# Reading for This Lecture

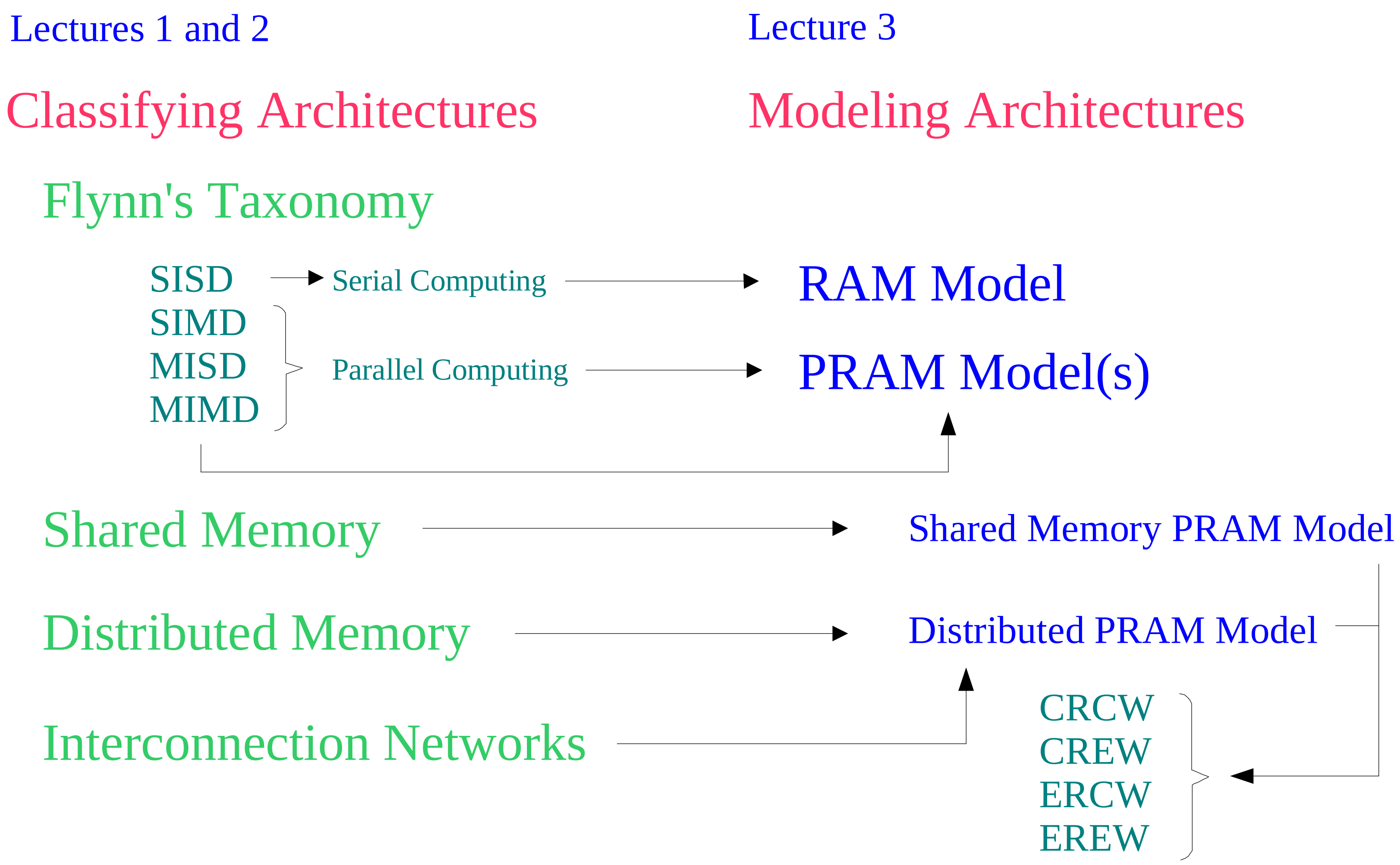
- Primary
  - Horowitz and Sahni, Chapter 4

# Course Recap

# Our View of the World



# Classifying and Modeling Architectures



# Analyzing Architectures and Algorithms

Lecture 2

## Analyzing Architectures

## Interconnection Networks

Performance Measures

Graph Properties

Degree
Bisection Width
Communication Diameter
Connectivity Matrix
Adjacency Matrix

Time to Perform Operations

Semigroup operations
Sorting operations

Lecture 3 and 4

## Analyzing Algorithms

## Asymptotic Analysis

Modeling Assumptions
Classifying Algorithms

Orders of Magnitude → Order Relations/ Equivalence Classes
Polynomial/Exponential
Time Complexity
Space Complexity

Induction and Recursion

Master Theorem

# Design, and Analysis of Parallel Algorithms

- Scalability
- Performance Measures
- Design Issues
- Implementation
  - OpenMP
  - PVM

# Basic Data Structures

- Stacks, Lists, and Queues
- Heaps
- Hashing
- Graphs
- Analysis
- Implementation

# Second Half of the Course

- Greedy Algorithms and Matroids
- Graph Algorithms
- Search Algorithms/Divide-and-Conquer
  - Branch and Bound
  - IP
- Matrix Algorithms/Numerical Algorithms
  - Numerical Analysis

# Greedy Algorithms

# Basic Algorithm

```
A is an array of the inputs
S = ∅;
for (i = 0; i < n; i++){
   x = SELECT(A);
   if (feasible(UNION(S, x))){
      S = UNION(S, x);
   }
}
```

# Basic Data Structures

- SELECT

- UNION

# Fractional Knapsack Problem

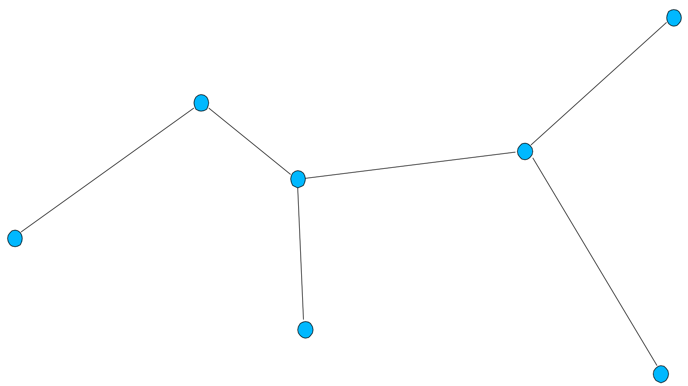
- We are given n objects.
- Each object has a weight $w_i$ and a profit $p_i$.
- We also have a knapsack with capacity $M$.
- Objective: Fill the knapsack as profitably as possible.
- We allow fractional objects.
- Algorithm
- Analysis

# Job Sequencng with Deadlines

- We are given a set of $n$ jobs.
- Each job takes one unit of time.
- Each job has a deadline $d_i$ and a profit $p_i$.
- Objective: A feasible schedule that maximizes profit.
- Algorithm
- Analysis

# Spanning Trees

- We are given a graph $G = (V, E)$.
- A spanning tree of $E$ is a *maximal acyclic subgraph* $(V, T)$ of $G$.
- A spanning tree always has $|V|-1$ edges (why?).



# Minimum Spanning Tree

- We associate a weight $w_e$ with each edge $e$.
- Objective: Find a spanning tree of minimum weight.
- Applications

# Prim's Algorithm

*S is the set of nodes in the tree*

```
S = {0}
for (i = 0; i < n; i++){
  SELECT i ∉ S nearest to S;
  S = UNION(S, i);
}
```

# Analysis of Prim's Algorithm

- Correctness
- Optimality
- Implementation
- Complexity

# Kruskal's Algorithm

*T is the set of edges in the tree*

```
T = Ø

for (i = 0; i < m; i++){
  SELECT the cheapest edge e
  if (feasible(UNION(T, e)){
     UNION(T, e);

}
```

# Analysis of Kruskal's Algorithm

- Correctness
- Optimality
- Implementation
- Complexity