Lecture 1:

There is an optimal solution for the Knapsack Problem.

Let $T$ be any optimal solution to the problem. By taking the value of $T$ at each appropriate point, we can construct $T'$.

If we exchange quantities given to $T$ with those given to $T'$, then $T'$ will have the same or higher knapsack weight as $T$.

Therefore, $T'$ is a feasible solution.

Goals:

- "Finish" proving Huffman's algorithm is optimal
- Understand Knapsack Problem
- Review Dynamic Programming Approach
- Built-world accessibility barriers

Diagram:

```
  a
  b
  c
  d
  e
  f
  g
  h
  i
  j
```

Table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

Algorithm:

1. Divide and conquer.
2. Divide into subproblems.
3. Combine subproblems.

Complexity:

- $O(n^3)$ for dynamic programming.