An Example of the Behavior of the A* Algorithm

Michael A. Goodrich

June 29, 2001

World

Consider the world shown in the following figure. For this world, states are indicated by an ordered

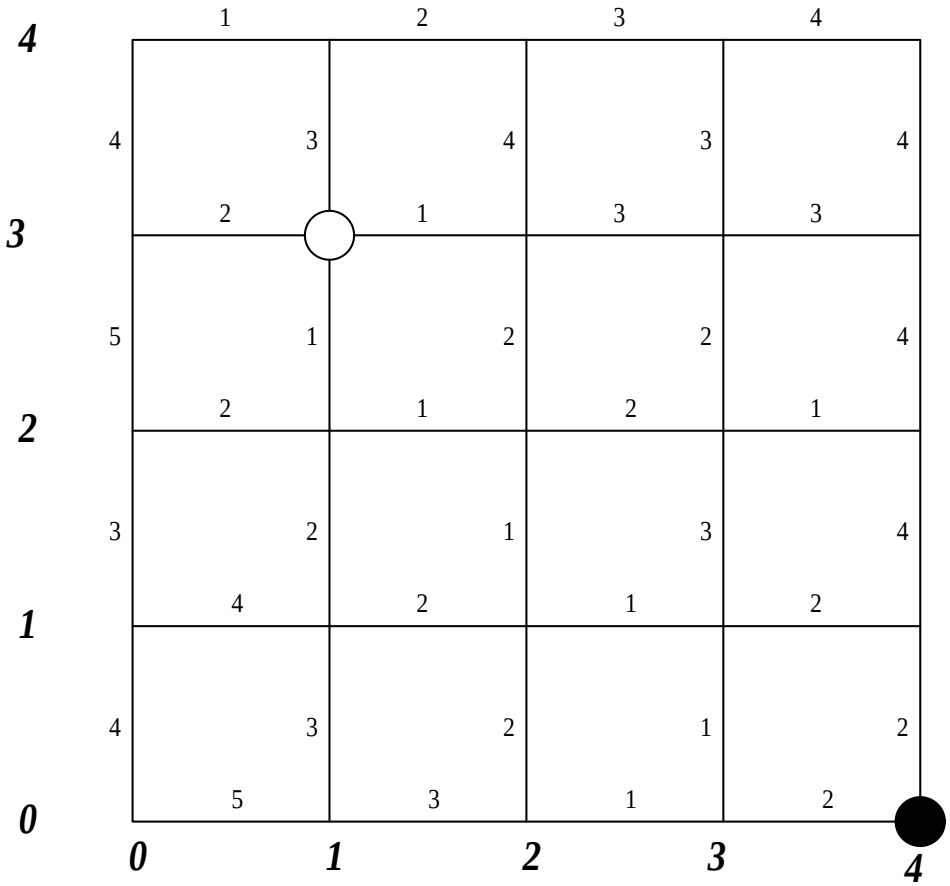

Figure 1: *A route finding world with costs between nodes.*

(x, y) pair; t he goal is placed at state $(1, 3)$ and the agent starts at state $(4, 0)$. The cost to go from one state to another is written next to the line connecting the states; the cost to go from state $(4, 0)$ to state $(4, 1)$ is 2.

Uniform Cost Search

We'll begin by looking at the behavior of uniform cost search through this world. Each node is represented by the state (x, y) and the cost $g(n)$ to reach this node from the starting state.

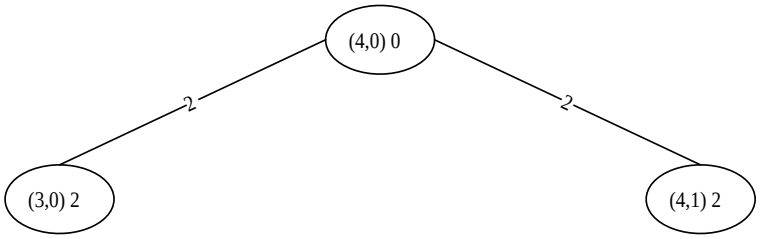

Figure 2: UCS expansion of first node.

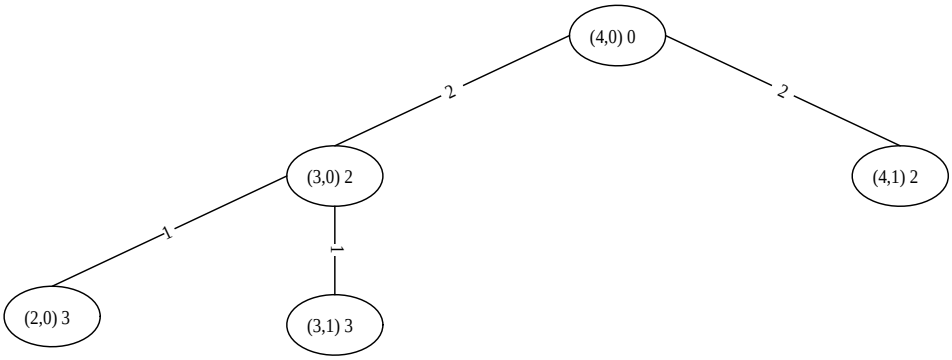

Figure 3: UCS expansion of second node.

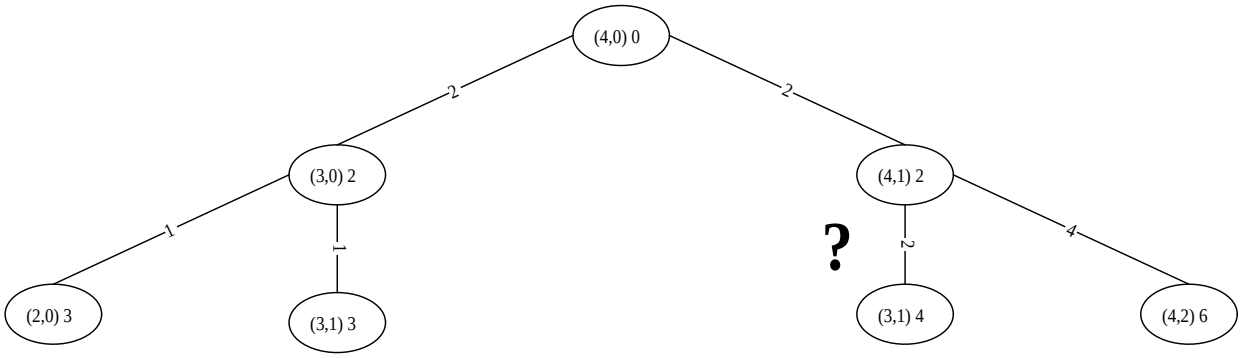

Figure 4: UCS expansion of third node. Note that state (3,1) need not be reexpanded since it was already reached via a lower cost path.

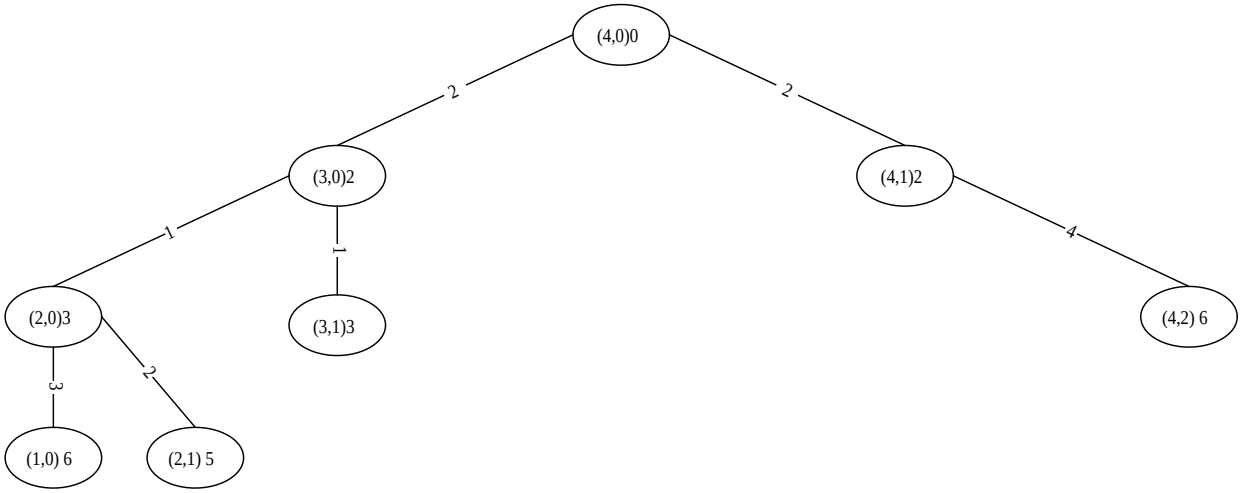

Figure 5: UCS expansion of fourth node.

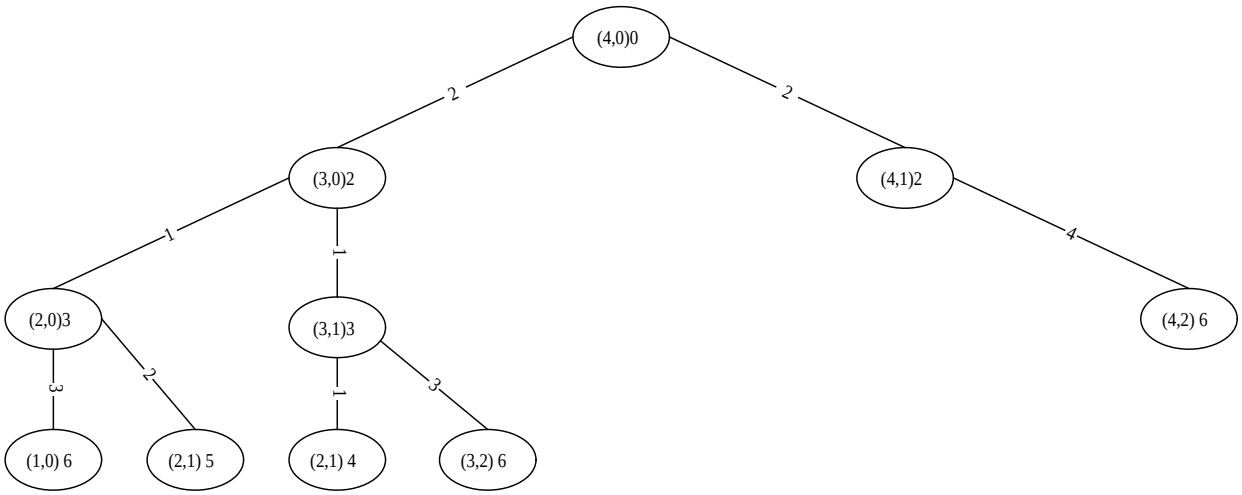

Figure 6: UCS expansion of fifth node.

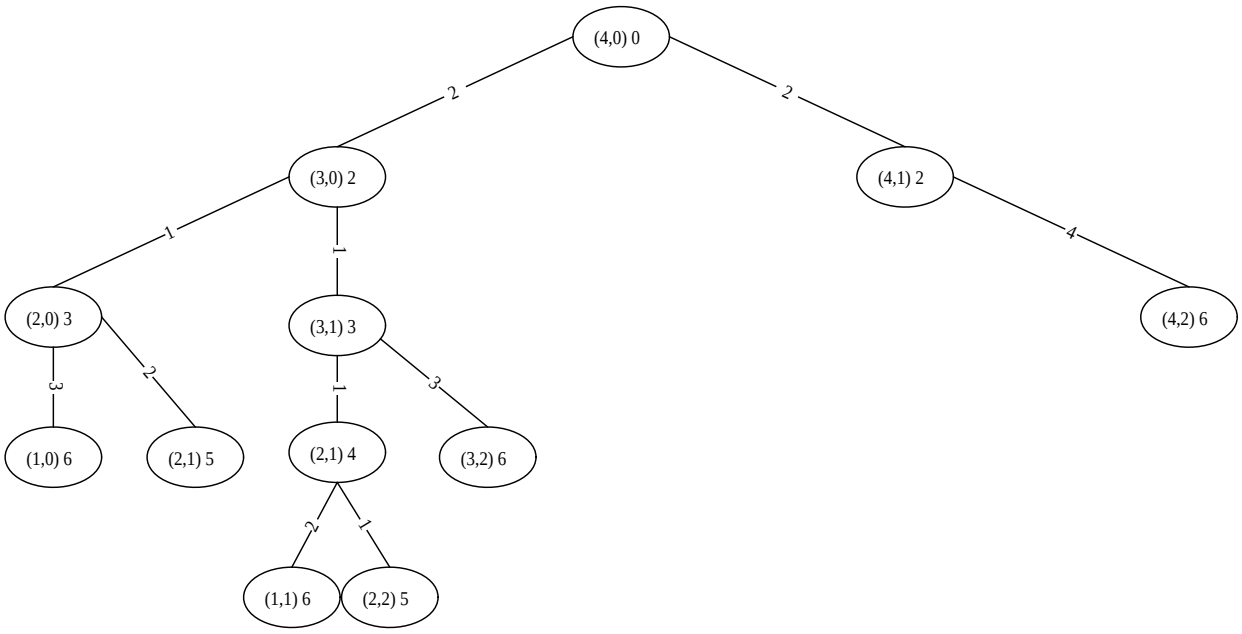

Figure 7: UCS expansion of sixth node.

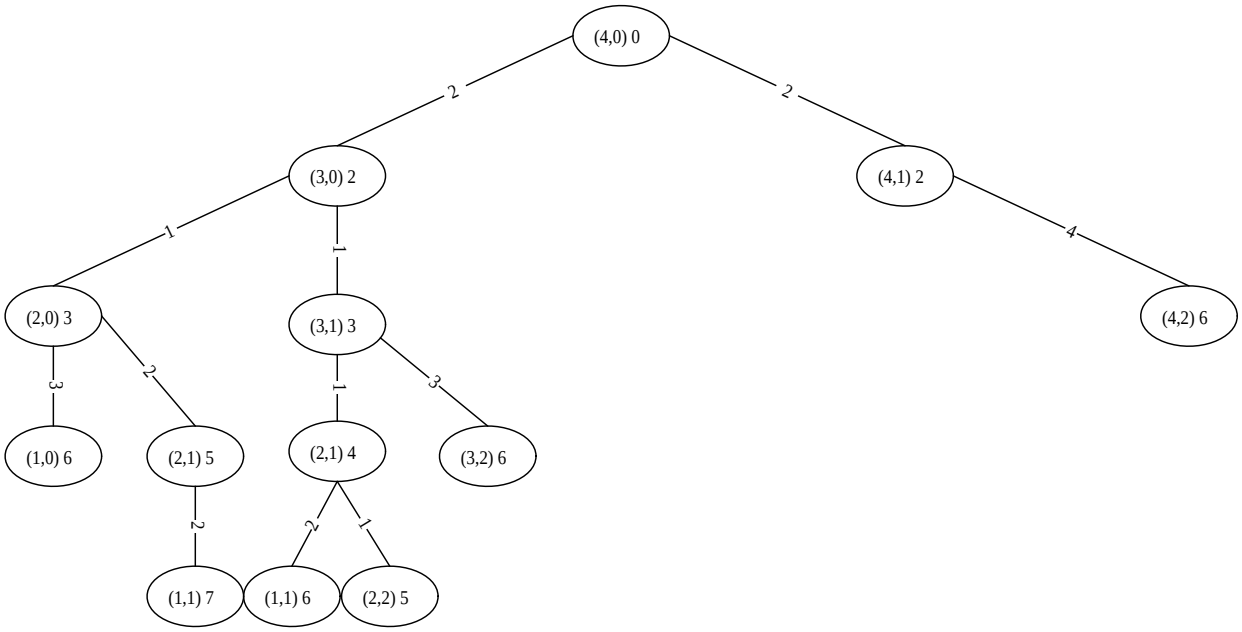

Figure 8: UCS expansion of seventh node. We haven't reached the goal, by we'll stop anyway.

A* Search

We will now look at the behavior of A* search through this world. Each node is represented by the state (x, y) and the estimated minimum cost to reach the goal $g(n) + h(n)$ (i.e., cost-to-arrive plus cost-to-go).

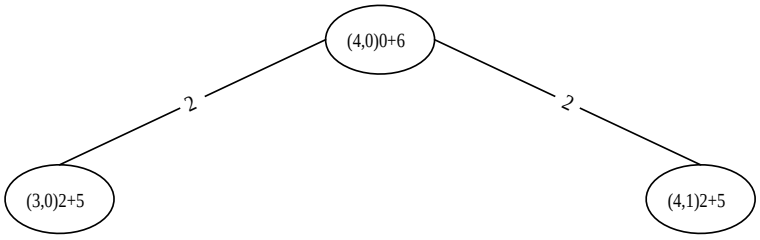

Figure 9: A* expansion of first node.

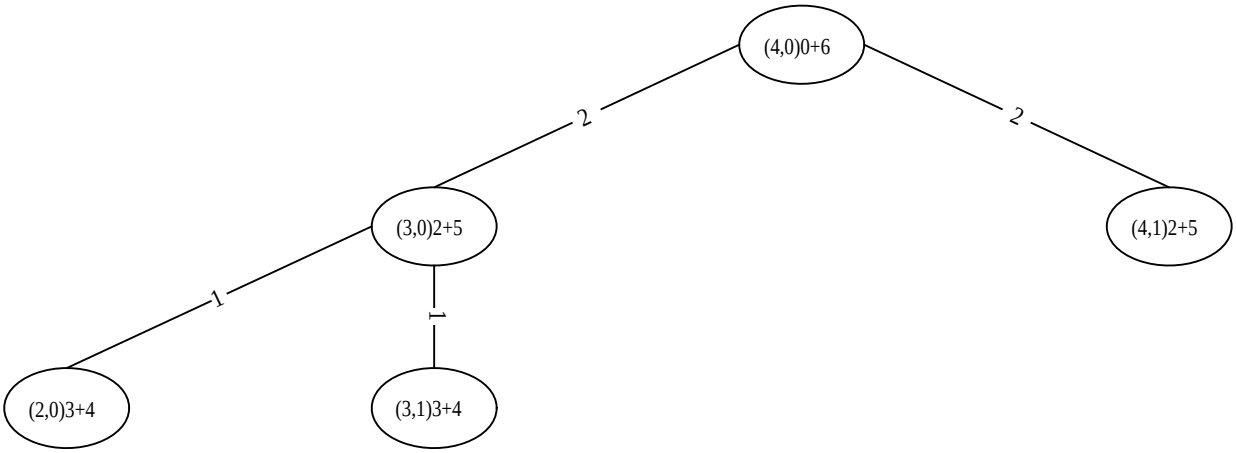

Figure 10: A* expansion of second node.

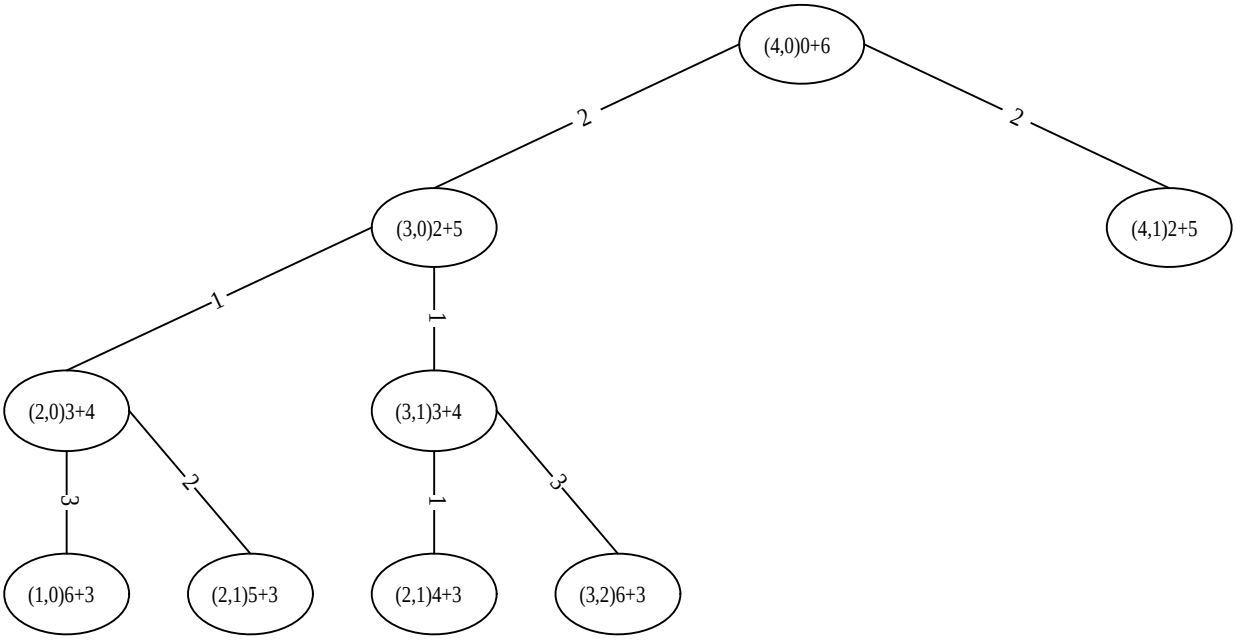

Figure 11: A* expansion of third and fourth nodes.

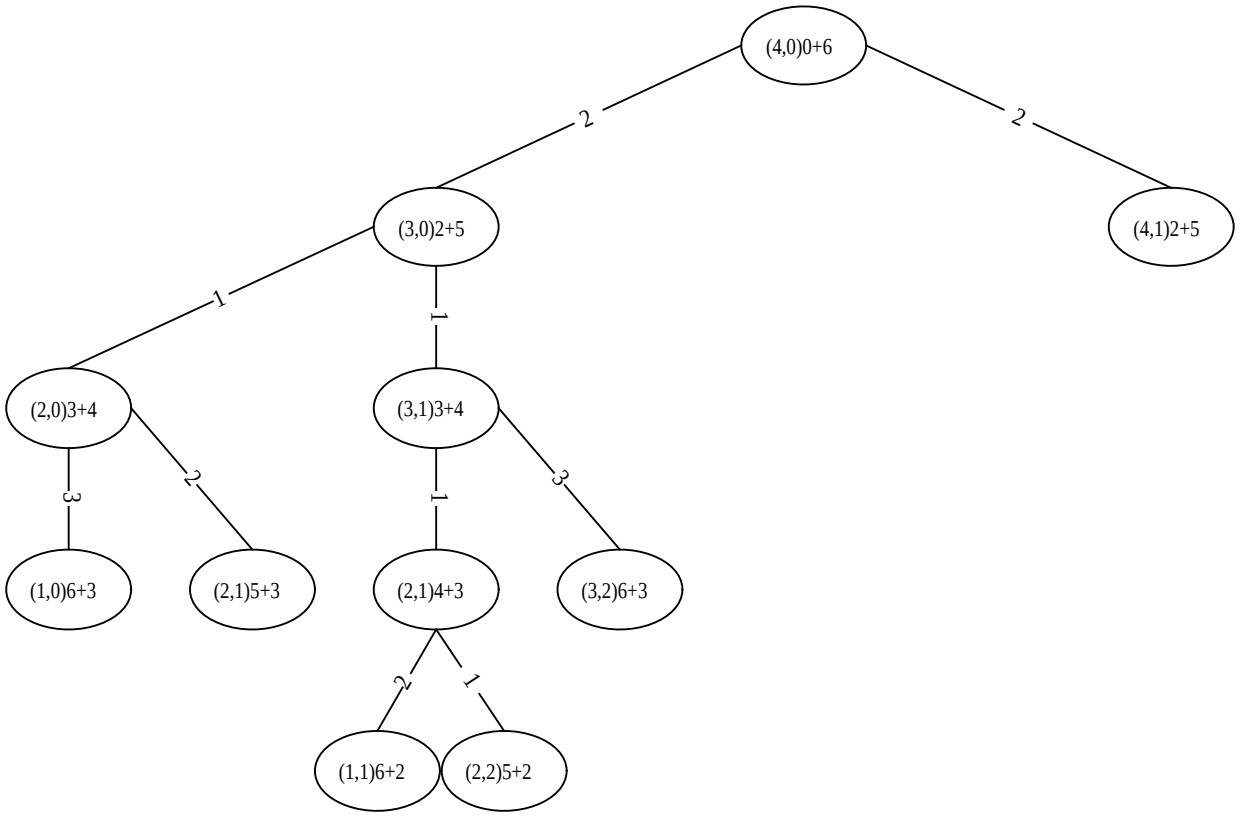

Figure 12: A* expansion of fifth node.

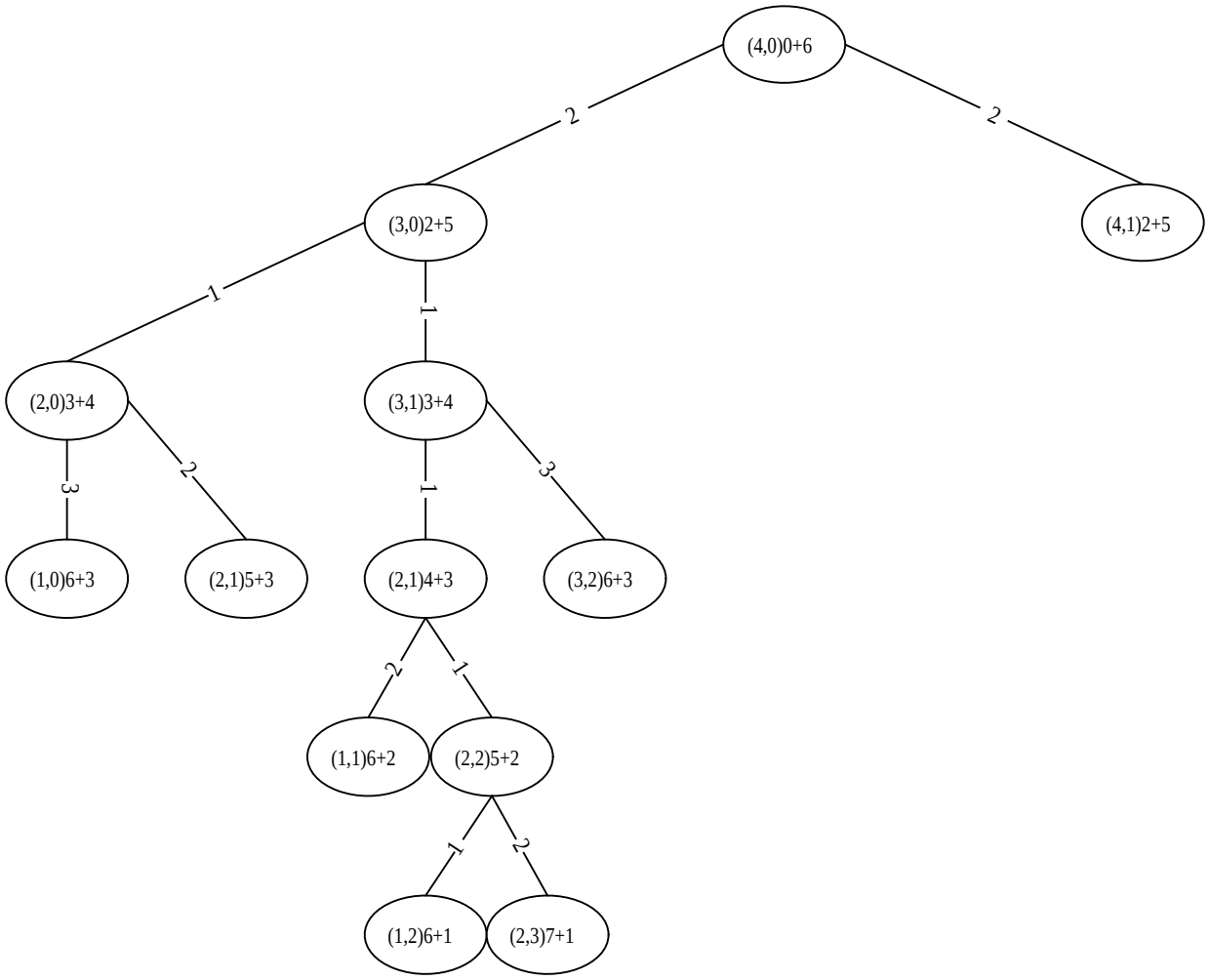

Figure 13: A* expansion of sixth node.

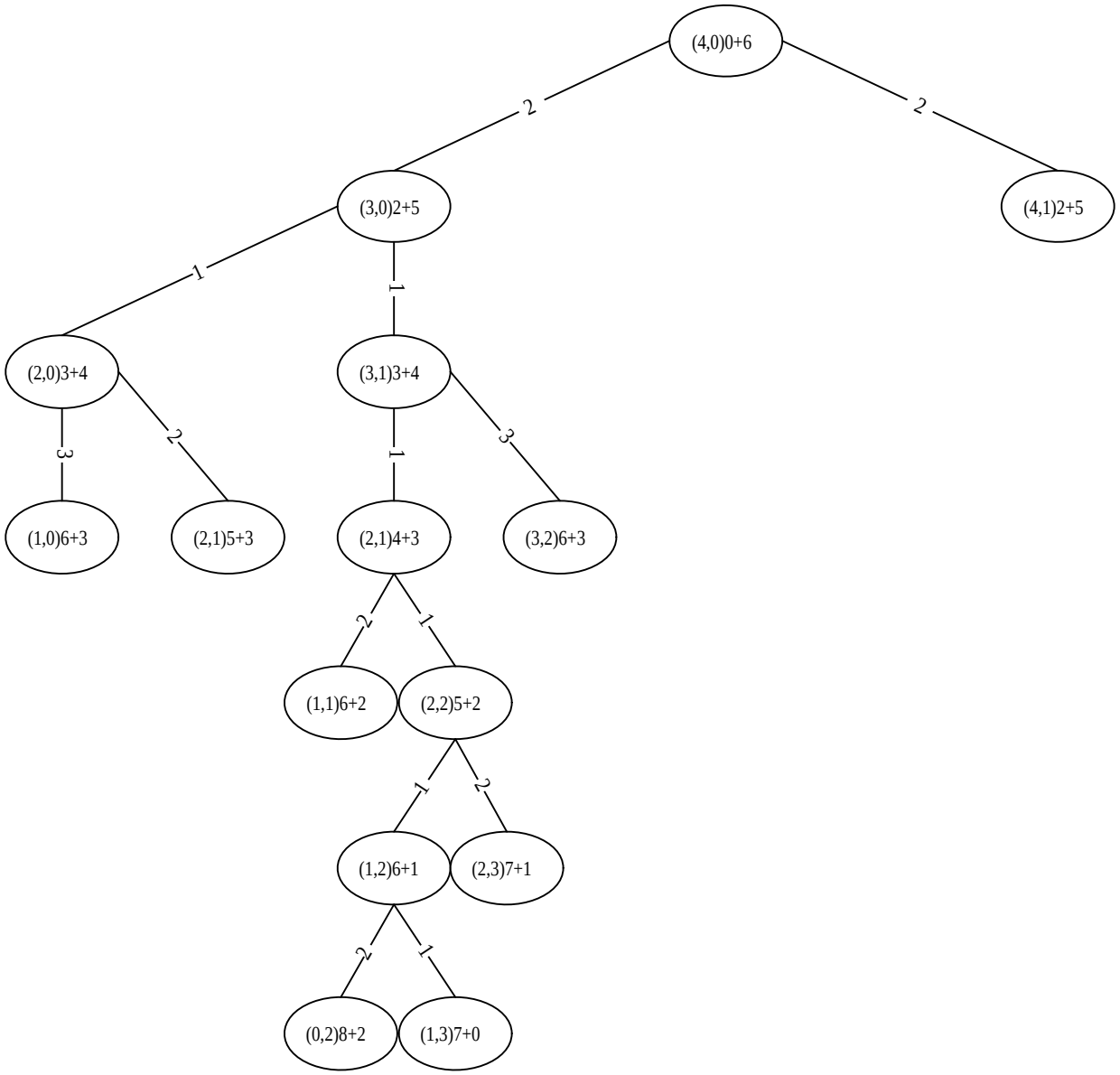

Figure 14: A* expansion of seventh node. Can we stop since we have reached the goal? We don't stop the search until we have expanded the goal node. This happens in the eighth step (since f(n) as minimal cost =7).