Assignment 2

- gameState.getNumAgents() = number of ghosts + pacman
- gameState.getLegalActions(agent)
  - when agent == 0 then these are pacman moves
  - agent in [1, gameState.getNumAgents()-1] then these are ghost moves
- All ghosts are min players, pacman is max player.

- Search starts with agent==0 (pacman's move)
- depth is increased by 1 whenever pacman has a turn.
- self.depth is number of moves pacman can play before we terminate the search (i.e., when pacman is about to make its self.depth+1 turn move we stop search and view that position to be terminal (returning either the utility if it is terminal state, or a heuristic estimate if it is not)

Alpha-Beta Pruning Implemenation

```
AlphaBeta(pos,alpha,beta): #return best move for player(pos)
                           #and MAX's value for pos
  best_move = None
  if terminal(pos):
    return best_move, utility(pos)
  if player(pos) == MAX: value = -infinity
  if player(pos) == MIN: value = infinity
  for move in actions(pos):
    nxt_pos = result(pos, move)
    nxt_val,nxt_move = AlphaBeta(nxt_pos, alpha, beta)
    if player(pos) == MAX:
      if value < nxt_val: value, best_move = nxt_val, move
      if value >= beta: return best_move, value
      alpha = max(alpha, value)
    if player(pos) == MIN:
      if value > nxt_value: value, best_move = nxt_val, move
      if value <= alpha: return best_move, value
      beta = min(beta, value)
  return best_move, value
```

- Max nodes pass the beta value they received to all children (beta is not updated.
- alpha starts out as the passed value, and is updated as each child is solved to be the maximum of current value and the value of the just solved child---maximum(passed value, all solved children)

- Min nodes pass the alpha value they received to all children (alpha is not updated.
- beta starts out as the passed value and is updated as each child is solved to be the minimum of the current value and the value of the just solved child---minimum(passed value, all solved children)

- Max returns the maximum value of any solved child
- Min returns the minimum value of any solved child

Visualization of Depth-First Minimax