Terms

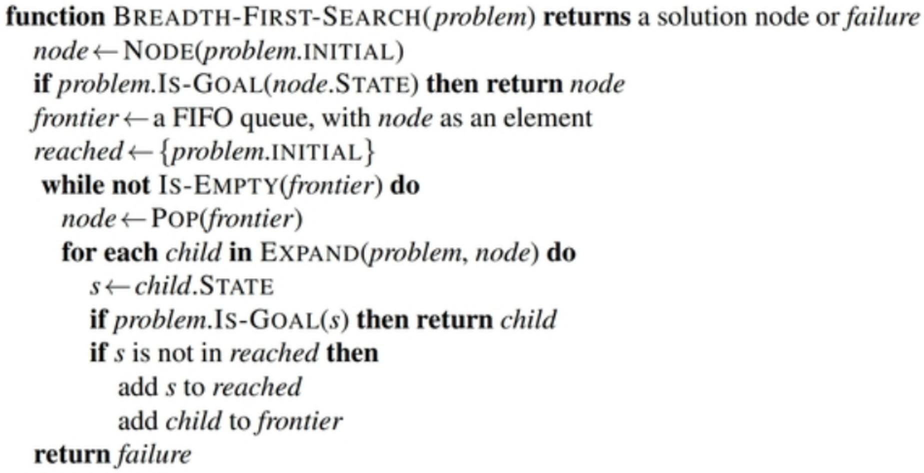
- **Node:** A node is a data structure that represents a node in the search tree. The search tree is not the same thing as the (tree or graph) of the search space. A node has
  - a state
  - a parent (pointer/reference to the node in the tree that generated this one)
  - an action (the action that was applied to the parent's state to generate this node; often can be omitted from this data structure)
  - path-cost: the total cost of the path from the initial state to this node (aka g(node) or g(n))
- **Frontier**: The data structure that holds nodes we have yet to expand, usually sorted by f(n) via priority queue, though can be a stack or plain queue as well.
- **Reached**: a map/dictionary that stores which states have been "reached" (have had nodes generated for them).

Best-first-search algorithm

```
BEST-FIRST-SEARCH(problem, f)
    node ← a new node corresponding to the initial state
    frontier ← a priority queue of nodes ordered by f(n), initialized to contain only node
    reached ← a map from states to nodes with one entry mapping the initial state to the node above
    while not IS-EMPTY(frontier):
        node ← pop(frontier)  // remove lowest cost node from frontier (smallest f)
        if IS-GOAL(node.state), then return node
        for each child in EXPAND(node):
            s ← child.state
            if s is not in reached or child.path-cost < reached[s].path-cost:
                reached[s] ← child
                add child to frontier
    return failure
```

```
EXPAND(node) // returns a list or set of nodes
    make an empty list or set to hold the child nodes
    s ← node.state
    for each action in ACTIONS(s):
        s' ← RESULT(s, action)
        cost ← node.path-cost + ACTION-COST(s, action, s')
        add new Node(state=s', parent=node, action=action, path-cost=cost) to list or set of child nodes
    return the list or set of child nodes
```

Breadth-first search



```
function BREADTH-FIRST-SEARCH(problem) returns a solution node or failure
  node ← NODE(problem.INITIAL)
  if problem.IS-GOAL(node.STATE) then return node
  frontier ← a FIFO queue, with node as an element
  reached ← {problem.INITIAL}
  while not IS-EMPTY(frontier) do
    node ← POP(frontier)
    for each child in EXPAND(problem, node) do
      s ← child.STATE
      if problem.IS-GOAL(s) then return child
      if s is not in reached then
        add s to reached
        add child to frontier
  return failure
```