BSTNode

```
class BSTNode(object):
    """A node in the vanilla BST tree."""

    def __init__(self, parent, k):
        """Creates a node.

        Args:
            parent: The node’s parent.
            k: The key of the node.
        """
        self.key = k
        self.parent = parent
        self.left = None
        self.right = None
```

```
    def find(self, k):
        """Finds and returns the node with key k from the subtree
           rooted at this
        node.

        Args:
            k: The key of the node we want to find.
        """
        if k == self.key:
            return self
        elif k < self.key:
            if self.left is None:
                return None
            else:
                return self.left.find(k)
        else:
            if self.right is None:
                return None
            else:
                return self.right.find(k)
```

```
    def find_min(self):
        """Finds the node with the minimum key in the subtree rooted
            at this
        node.

        Returns:
            The node with the minimum key.
        """
        current = self
        while current.left is not None:
            current = current.left
        return current
```

```python
    def next_larger(self):
        """Returns the node with the next larger key (the successor)
            in the BST.
        """
        if self.right is not None:
            return self.right.find_min()
        current = self
        while current.parent is not None and current is current.
            parent.right:
            current = current.parent
        return current.parent
```

```python
    def insert(self, node):
        """Inserts a node into the subtree rooted at this node.

        Args:
            node: The node to be inserted.
        """
        if node is None:
            return
        if node.key < self.key:
            if self.left is None:
                node.parent = self
                self.left = node
            else:
                self.left.insert(node)
        else:
            if self.right is None:
                node.parent = self
                self.right = node
            else:
                self.right.insert(node)
```

```python
    def delete(self):
        """Deletes and returns this node from the BST."""
        if self.left is None or self.right is None:
            if self is self.parent.left:
                self.parent.left = self.left or self.right
                if self.parent.left is not None:
                    self.parent.left.parent = self.parent
            else:
                self.parent.right = self.left or self.right
                if self.parent.right is not None:
                    self.parent.right.parent = self.parent
            return self
        else:
            s = self.next_larger()
            self.key, s.key = s.key, self.key
            return s.delete()
```

BST

```
class BST(object):
    def __init__(self):
        self.root = None

    def find(self, k):
        return selft.root and self.root.find(k)

    def find_min(self):
        """Returns the minimum node of this BST."""
        return self.root and self.root.find_min()

    def insert(self, k):
        node = BSTNode(None, k)
        if self.root is None:
            # The root's parent is None.
            self.root = node
        else:
            self.root.insert(node)
```

```
    def delete(self, k):
        """Deletes and returns a node with key k if it exists from
           the BST.

        Args:
            k: The key of the node that we want to delete.
        """
        node = self.find(k)
        if node is None:
            return None
        if node is self.root:
            pseudoroot = BSTNode(None, 0)
            pseudoroot.left = self.root
            self.root.parent = pseudoroot
            deleted = self.root.delete()
            self.root = pseudoroot.left
            if self.root is not None:
                self.root.parent = None
            return deleted
        else:
            return node.delete()
    def next_larger(self, k):
        """Returns the node that contains the next larger (the
           successor) key in
        the BST in relation to the node with key k.

        Args:
            k: The key of the node of which the successor is to be
               found.

        Returns:
            The successor node.
        """
        node = self.find(k)
        return node and node.next_larger()
```

MinBSTNode

```
class MinBSTNode(BSTNode):
    """A node in BST which is augmented to keep track of the node
       with the
    minimum key in the subtree rooted at this node.
    """
    def __init__(self, parent, key):
        super(MinBSTNode, self).__init__(parent, key)
        self.min = self
```