

# PSLL Informal Documentation

Paul Nickerson

## List Methods

### **iterator begin()**

- Creates an iterator which, when dereferenced, returns a mutable reference to the first stored item.

### **iterator end()**

- Creates an iterator corresponding to the slot one past the end of the list.
- Used in conjunction with iterator begin() to traverse every item in the list.
- Dereferencing the resulting iterator should throw an error.
- The iterator returned is “list size” increment operations past the incrementor returned by begin()
  - That is, if the list size is zero, then end() == begin()

### **const\_iterator begin() const**

- Creates an iterator which, when dereferenced, returns an immutable reference to the first stored item.

### **const\_iterator end() const**

- Creates an iterator corresponding to the slot one past the end of the list.
- Used in conjunction with const\_iterator begin() to traverse every item in the list.
- Dereferencing the resulting iterator should throw an error.
- The iterator returned is “list size” increment operations past the incrementor returned by begin()
  - That is, if the list size is zero, then end() == begin()

## **T& operator**

- Returns a mutable reference to the item at position *i*, so when the resulting reference is changed, the item should update in the list as well
- Providing a position greater than *or equal to* the current list size should throw an out-of-range error

## **const T& operator const**

- Returns an immutable reference to the item at position *i*, so that the reference cannot be used to change the list's copy of the item
- Providing a position greater than *or equal to* the current list size should throw an out-of-range error

## **PSLL()**

- Default constructor - initializes the head, tail, and free-head dummy nodes

## **PSLL(const PSLL& src)**

- Copy constructor - starting from uninitialized state, initialize the class, then use an iterator to `push_bash()` each source item into the current list
- Afterwards, `this->size()` should equal `src.size()`. If not, throw a `runtime_error`
- The resulting state of the current instance should be independent of the source (ie changing an element on the current instance should not affect the original)

## **PSLL& operator=(const PSLL& src)**

- Copy assignment operator - starting from an arbitrary state, 1) reset to uninitialized state, 2) initialize the class, and 3) use an iterator to `push_bash()` each source item into the current list
- Returns a reference to `*this`, the copied-to instance
- Afterwards, `this->size()` should equal `src.size()`. If not, throw a `runtime_error`
- The resulting state of the current instance should be independent of the source (ie changing an element on the current instance should not affect the original)

## **T replace(const T& element, size\_t position)**

- Replaces the currently-stored element at the specified position with a copy of the specified element
- Returns a copy of the item that was stored at the specified position
- Providing a position greater than *or equal to* the current list size should throw an out-of-range error
- The `size()` of the list should remain unchanged before and after

### **void insert(const T& element, size\_t position)**

- Inserts a copy of the specified element to the list at the specified position, shifting the element originally at that and those in subsequent positions one position to the “right.”
- List size gets incremented by 1
- May be called with a position one past the last stored item, in which case the new item becomes the last
  - In this case we pass the element to `push_back()`, which can do  $O(1)$  insert
  - For `position < size()`, we do a  $O(N)$  traversal to the specified position
- Providing a position greater than the current list size should throw an out-of-range error
- If a new node cannot be procured due to memory constraints, an error message is outputted to `stderr` and `std::bad_alloc` is thrown

### **void push\_front(const T& element)**

- Inserts a new item to the front of the list by calling `insert(element, 0)`, incrementing the list size by one
- It would be an error if, after pushing, `size()` returned anything besides one plus the old value returned from `size()`

### **void push\_back(const T& element)**

- Inserts a new item to the back of the list by converting the current tail to a non-dummy node containing the item and adds a new tail
- If a new node cannot be procured due to memory constraints, an error message is outputted to `stderr` and `std::bad_alloc` is thrown
- It would be an error if, after pushing, `size()` returned anything besides one plus the old value returned from `size()`

### **T pop\_front()**

- Removes the node at `head->next` and returns its stored item
- Points `head->next` to the node which the removed node pointed to
- Decrements the list size
- If the list is empty then throw an out-of-range error
- It would be a `runtime_error` if, after checking that the list is non-empty and prior to popping, `head->next == tail`. This would indicate internal list state corruption.

### **T pop\_back()**

- Removes the node at position `(size() - 1)`, returning its stored item
- Points `preceding_node->next` to the tail

- Decrements the list size
- If the list is empty then throw an out-of-range error
- It would be a `runtime_error` if, after checking that the list is non-empty and prior to popping, `head->next == tail`. This would indicate internal list state corruption.

### **T remove(size\_t position)**

- Removes and returns the the element at the specified position, shifting the subsequent elements one position to the “left.”
- May only be called with positions *less than* the current list size
- It would be a `runtime_error` if, after checking that the list is non-empty and prior to removing, `head->next == tail`. This would indicate internal list state corruption.

### **T item\_at(size\_t position) const**

- A wrapper for operator[] which return a copy of the item at position `i`, so when the resulting reference is changed, the item should not update in the list
- Providing a position greater than *or equal to* the current list size should throw an out-of-range error

### **bool is\_empty() const**

- Returns true IIF `size() == 0`

### **size\_t size() const**

- Returns value of the counter which tracks the number of items stored in the array
- If the item quantity counter is zero, then `head->next` should `== tail`. If not, an error should be thrown indicating corrupt internal state
- If the item quantity counter is nonzero, then `head->next` should `!= tail`. If not, an error should be thrown indicating corrupt internal state

### **void clear()**

- Removes all elements in the list by calling `pop_front()` until `is_empty()` returns true

### **bool contains(const T& element, bool equals(const T& a, const T& b)) const**

- Returns true IFF one of the elements of the list matches the specified element.
- Uses an iterator to traverse the list

- At each position, calls the equals callback function. If that returns true, stop iterating and return true
- If the end position is reached before the item is found, return false
- It would be a `runtime_error` if an item was inserted and calling `contains()` with that item returned false, which would indicate internal state corruption
- It would be a `runtime_error` if an item existed in one list and then, after making a copy of that list, the copy did not contain the item (internal state corruption)

**`std::ostream& print(std::ostream& out) const`**

- Passes a string of the form `[item1,item2,item3]` to the provided output stream
- If the list contains no items, passes to the output stream
- It would be an error if `print()` yielded different results from two lists which should be the same (eg constructed the same, copied, assigned, etc)

## Iterator Methods

**`explicit PSLL_Iter(Node* start)`**

- Explicit constructor for an iterator which, when dereferenced, will return a mutable reference to the item held at start
- start can be tail, which signals that the iterator points to the end of the list
- start *cannot* be null, otherwise throw a `runtime_error` because, since only the current class can call this constructor (Node is private), `start==nullptr` indicates internal state corruption

**`PSLL_Iter(const PSLL_Iter& src)`**

- Copy constructor - sets the iterator's current position to that of src
- Afterwards, `operator==(src)` should return true, otherwise throw a `runtime_error` indicating state corruption

**`reference operator*() const`**

- Returns a mutable reference to the item held at the current iterator position
- It would be an error if the client properly attempted to change the value of the returned reference and the stored item value did not change
- When the client attempts to dereference an end iterator, the iterator should throw an out-of-range error

### **pointer operator->() const**

- Returns a pointer to the item held at the current iterator position by returning the value of operator\*() with the address-of operator applied
- The same validation measures apply here as to operator\*()

### **self\_reference operator==(const self\_type& src)**

- Changes the current iterator position to that of src
- Afterwards, operator==(src) should return true, otherwise throw a runtime\_error indicating state corruption
- Returns a reference to current instance

### **self\_reference operator++()**

- Prefix increment operator - increments the current iterator then returns it as a reference
- Should throw an out-of-range error if we're at the end of the list, ie current\_node->is\_dummy==true

### **self\_type operator++(int)**

- Postfix increment operator - creates a pre-incremented copy of the current instance, increments the current iterator (calls prefix operator directly, so its sanity checks apply to this method), then returns the copied instance

### **bool operator==(const self\_type& rhs) const**

- Returns true IIF the currently-held node pointer is the same as rhs's, otherwise returns false

### **bool operator!=(const self\_type& rhs) const**

- Returns true IIF operator==( ) returns false, otherwise returns true

## **Const Iterator Methods**

### **explicit PSLC\_Const\_Iter(Node\* start)**

- Explicit constructor for an iterator which, when dereferenced, will return an immutable reference to the item held at start
- start can be tail, which signals that the iterator points to the end of the list

- start *cannot* be null, otherwise throw a runtime\_error because, since only the current class can call this constructor (Node is private), start==nullptr indicates internal state corruption

### **PSLL\_Const\_Iter(const PSLL\_Const\_Iter& src)**

- Copy constructor - sets the iterator's current position to that of src
- Afterwards, operator==(src) should return true, otherwise throw a runtime\_error indicating state corruption

### **reference operator\*() const**

- Returns an immutable reference to the item held at the current iterator position
- The const keyword in the reference typedef guarantees that code which attempts to modify the referenced item will not compile
- When the client attempts to dereference an end iterator, the iterator should throw an out-of-range error

### **pointer operator->() const**

- Returns a pointer to the item held at the current iterator position by returning the value of operator\*() with the address-of operator applied
- The same validation measures apply here as to operator\*()
- The const keyword in the pointer typedef guarantees that code which attempts to modify the referenced item will not compile

### **self\_reference operator=(const self\_type& src)**

- Changes the current iterator position to that of src
- Afterwards, operator==(src) should return true, otherwise throw a runtime\_error indicating state corruption
- Returns a reference to current instance

### **self\_reference operator++()**

- Prefix increment operator - increments the current iterator then returns it as a reference
- Should throw an out-of-range error if we're at the end of the list, ie current\_node->is\_dummy==true

**self\_type operator++(int)**

- Postfix increment operator - creates a pre-incremented copy of the current instance, increments the current iterator (calls prefix operator directly, so its sanity checks apply to this method), then returns the copied instance

**bool operator==(const self\_type& rhs) const**

- Returns true IIF the currently-held node pointer is the same as rhs's, otherwise returns false

**bool operator!=(const self\_type& rhs) const**

- Returns true IIF operator==( ) returns false, otherwise returns true