CDAL Informal Documentation

Paul Nickerson

List Methods

iterator begin()

- Creates an iterator which, when dereferenced, returns a mutable reference to the first stored item.
- Passes a pointer to the end slot so that the iterator can do bounds checking

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.
- Passes a pointer to the end slot so that the iterator can do bounds checking

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

CDAL()

- Default constructor - initializes the class by allocating head/tail dummy nodes, then adding an initial node

CDAL(const CDAL& src)

- Copy constructor - starting from uninitialized state, initialize the class by allocating head/tail dummy nodes, then use an iterator to push_bash() each source item into the current list
- If we fail to allocate nodes, throw a bad_alloc exception
- Afterwards, this->size() should equal src.size(). If not, throw a runtime_error

CDAL& operator=(const CDAL& src)

- Copy assignment operator - starting from an arbitrary state, 1) reset to uninialized state by freeing all the items, 2) initialize the class by allocating a number of nodes equal to the source instance's array size, and 3) use an iterator to push_bash() each source item into the current list
- If we fail to allocate nodes, throw a bad_alloc exception
- Returns a reference to *this, the copied-to instance
- Afterwards, this->size() should equal src.size(). If not, throw a runtime_error

void embiggen_if_necessary()

- Called whenever we attempt to increase the list size
- If each array slot in every link is filled and we want to add a new item, allocate and append a new link by transforming the tail node into a usable item array container that points to a freshly-allocated tail node
- If we fail to allocate nodes, throw a bad_alloc exception

void shrink_if_necessary()

- Called whenever we attempt to decrease the list size
- Because we don't want the list to waste too much memory, whenever more than half of the arrays are unused (they would all be at the end of the chain), we deallocate half the arrays by traversing to the last node to keep, then dropping each subsequent node until we reach the tail

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."
- Calls embiggen_if_necessary() to ensure we have space to insert the new item
- 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
- Providing a position greater than the current list size should throw an out-of-range error

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 calling insert() with the position defined as one past the last stored item
- It would be an error if, after pushing, size() returned anything besides one plus the old value returned from size()

T pop_front()

- Wrapper for remove(0)
- Removes the node at item_array[0] and returns its stored item
- If the list is empty then throw an out-of-range error
- It would be an error if, after popping, size() returned anything besides the old value returned from size() minus one

T pop_back()

- Wrapper for remove(size() - 1)
- Removes last stored node, returning its item
- If the list is empty then throw an out-of-range error
- It would be an error if, after popping, size() returned anything besides the old value returned from size() minus one

T remove(size_t position)

- Removes and returns the the element at the specified position, shifting the subsequent elements one position to the "left" by traversing from the specified slot in the node's array to the end of the last node's item array and moving each item to its preceding slot
- May only be called with positions *less than* the current list size
- It would be an error if, after removing, size() returned anything besides the old value returned from size() minus one

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

void clear()

- Removes all elements in the list by setting the counter holding the list size to zero. No further action is taken as it is assumed that the embiggen/shrink methods will handle it

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

CDAL_Iter(ItemLoc const& here)

- Explicit constructor for an iterator which, when dereferenced, will return a mutable reference to the item held at the node and array index described by the here parameter
- Neither item_array nor end_ptr may be null
- end_ptr must be greater than or equal to item_array

CDAL_Iter(const CDAL_Iter& src)

- Copy constructor - sets the current iterator position to the node and array index described by 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

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 and end 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 curr_node->is_dummy

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 current and end iter pointers match between current instance and rhs, otherwise returns false

bool operator!=(const self_type& rhs) const

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

Const Iterator Methods

CDAL_Iter(ItemLoc const& here)

- Explicit constructor for an iterator which, when dereferenced, returns an immutable reference to the item held at the node and array index described by the here parameter

CDAL_Const_Iter(const CDAL_Const_Iter& src)

- Copy constructor - sets the current iterator position to the node and array index described by 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

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 curr_node->is_dummy

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 current and end iter pointers match between current instance and rhs, otherwise returns false

bool operator!=(const self_type& rhs) const

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