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TAD<Hash Table>
Hash table={size,table,hashFunction,keyEqualityFunction}
Inv= {$\forall k_1 \forall k_2$ ($k_1 \in$ table(Keys) y k2 $\notin$ table(keys) y $k_1 \neq$ k2 y hashFuction(k_1)$\neq k_1$ y hashFuction(k_2) $\neq$ k2 y hashFuction(k_1) $\neq$ hashFuction(k_2) }
Main operations **Builder →CreationHashTable(**size**)**: size →HashTable **Modifier → Insert(**key , Element**):** HashTable x key x Element →HashTable **Modifier →Remove(key):** HashTable x key x Element →HashTable **Analyzer → Search():** HashTable x Key → Element **Analyzer → Contains():** HashTable x key → boolean **Builder → clone():** HashTable_1→HashTable_2

TAD <Stack>
Stack= {push,pop, peek}
Inv = {Comparator(a,b)=(S={E1,E2,E3…En} S.pop=En) ∧ True }
Main operations **Builder → CreateStack():** → Stack **Modifier → Push(**Element**):** Stack x Element → Stack **Analyzer → Top():** Stack → Element **Modifier → Pop():** Stack → Element y Stack **Analyzer →isEmpty() :** Stack → Element **Analyzer →size() :** → Integer **Builder → clone():** Stack1→Stack2

TAD <Queue>
Queue={offer,poll,front}
Inv={ Comparator(a,b) = (Q={E1, E2,E3,E4…En} ∧ Q.poll=E1) ∧ True }
Main Operations: **Builder → CreateQueue :** →Queue **Analyzer → front():** Queue x Element → Element **Modifier** → Offer(Enqueue): Queue x Element → Queue **Modifier** → Poll(Dequeue): Queue → Element ∧ Queue **Analyzer** → IsEmpty(): Queue→ Boolean **Analyzer →size() :** → n (size) **Builder → clone():** Queue1→Queue2

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TAD <Max Priority Queue>
Priority Queue={size, comparator}
Inv: {comparator(a,b)= True}
Main Operations: **Builder → CreatePriorityQueue():** Element → PriorityQueue **Modifier → Offer(Enqueue)():** Element → PriorityQueue **Analyzer→ Peek(Front)():** PriorityQueue → Element **Modifier → Poll(Dequeue)():** PriorityQueue → Element **Analyzer → Size():** → Integer

TAD <Heap>
Heap ={size, comparator}
Inv: {heap[⌊(i/2)⌋] >= heap[i] ∧ parent>left ∧ parent>right } (assuming it is zero-indexed)
Main Operations: **Builder → CreateHeap():** → heap **Modifier → Heapify():** array → heap **Modifier → Insert():** element, heap → heap **Modifier → Extract():** heap → Element **Analyzer → IsEmpty():** heap → Boolean **Builder → clone():** Heap1→Heap2 **Analyzer →size() :** → Integer (size)

HashTable

CreateHashTable(size) “Creates a new hashTable” pre: size > 0 { post: HashTable }

Insert(key,Element)

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“places value in a key”

pre: HashTable ≠ Nil ∧ key ≠ Nil ∧ Inv=True}

post(HashTable={(,E1), (k2,E2)...(kn-1,En-1)), (key,Elemento)})

Remove(key)

“removes value from key”

pre: HashTable ≠ Nil ∧ key ≠ Nill ∧ Inv=true

{post: HashTable={(,E1), (k2,E2)...(kn-1,En-1))}

Search(key)

“gets value from key”

pre: HashTable ≠ Nil ∧ key ≠ Nill ∧ inv=true}

{post: Element }

Constains(key)

“finds if it has a key”

pre: HashTable ≠ Nil ∧ key ≠ Nill ∧ inv=true}

{post: True (if TasTable has this key)}

Size()

“return the amount of elements in the heap”

pre: HashTable ≠ Nil

{post: size }

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Clone(HashTable1**)**

“Return a clone (an object identical to his “parent”, but has different object reference and a different memory direction)”

pre: HashTable1 ≠ Nil

{post: hashtable2}

Stack

CreateStack():

“Creates a new Stack”

pre: True

{post: Stack}

Push(Element)

“adds a element to the Stack, in the first position”

pre: Element≠nil ∧ Stack≠nil

{post=Stack={E1,E2,E3...En+1}}

Top()

“takes the first element of the Stack”

pre=Stack≠nil

{post: En}

Pop()

“takes and remove the first element of the Stack”

pre=Stack≠nil

{post= En ∧ Stack={E1,E2,E3….En-1}}

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isEmpty()

"If the Stack isEmpty"

pre=Stack≠nil

{post= True if(Stack=Ø) }

Size()

"find and return the Stack size"

pre: Stack≠ Nil

{post: size}

Clone(Stack1**)**

"Return a clone (an object identical to his "parent", but has different object reference and a different memory direction)"

pre: Stack1 ≠ Nil

{post: Stack2}

Queue

CreateQueue()

"Creates a new queue"

pre=True

{post=Queue}

Front(Queue)

"Take the first element of the Queue**"**

pre: (Queue ≠ nill) ∧ !Queue.isEmpty()

{post=E1}

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Offer(Element)

"Add the element in the Queue in the last position"

pre: Queue≠nil ∧ Element≠nil ∧ Queue={E1, E2…En}

{post= Queue=(E1, E2…En-1,Element) }

Poll()

"Take and remove the first element of the Queue**"**

pre: (Queue ≠ nill V Queue={E1, E2,E3,E4…En}) ∧ !Q.isEmpty()

{post= E1 ∧ Queue={E2,E3,E4…En}}

IsEmpty()

"If the QueueisEmpty"

pre: Queue ≠nill

{post=True if(Queue=Ø)}

Size()

"find and return the Queue size"

pre: Queue≠ Nil

{post: size}

Clone(Queue1**)**

"Return a clone (an object identical to his "parent", but has different object reference and a different memory direction)"

pre: Queue1 ≠ Nil

{post: Queue2}

PriorityQueue

CreatePriorityQueue(size):

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“Creates a new priority queue”

{pre: Size ∧ True }

{post: PriorityQueue}

Offer(Element):
“Adds Element to queque”

{pre: Element}

{pos: print PriorityQueque Elements with enquque Element }

Peek()

“print queque ”

{pre: PriorityQueue≠ null}

{pos: prints queque}

Poll()

“Removes Element from queque ”

{pre: PriorityQueue≠ null}

{pos: print PriorityQueque Elements with dequeque Element }

Size()

“find and return the PrioriyQueue size”

pre: PriorityQueue≠ null

{post: size}

Heap

CreateHeap(size**)**

“creates a new heap”

pre: size>0

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{post: heap

Heapify(array)

“it receives an array and turns it into a heap”

pre: True

{post: array.isHeap() = true}

Insert(Element)

“it receives an element and adds it to the heap maintaining the its property”

pre: heap.isHeap()

{post: heap.isHeap() = true}

Extract(heap)

“return and eliminates the first element in the heap”

pre: heap.isHeap()

{post: heap.isHeap() = true ∧ heap.size = heap.size-1}

IsHeap(array)

“return true if the array is a heap, false if it is not”

pre: True

{post: true if it is a heap, false if not}

IsEmpty(heap)

“return true if the heap is empty, false if it is not”

pre: True

{post: true if it is empty, false if not}

Size(heap)

“return the amount of elements in the heap”

pre: True

{post: heap.size}

Clone(Heap1**)**

“Return a clone (an object identical to his “parent”, but has different object reference and a different memory direction)”

pre: Heap1 ≠ Nil

{post: Heap2}