Aufgabe 1 - „Behälter“ Vector als ADT

**Lösungsidee:**Wie bei dem Beispiel wo die Größe des Feldes erst zur Laufzeit fixiert wird ein Feld auf die gleiche Weise erstellen, allerdings immer wenn die Größe überschritten werden sollte, wird die Funktion GrowVector aufgerufen, die die Kapazität des Feldes verdoppelt und somit auch den allokierten Speicher und die Werte des alten Vektors in den neuen kopiert.

**Zeitaufwand: ~**1h 45min

**Code:**

unit VectorUnit;

interface

type

  Vector = Pointer;

procedure InitVector(var v: Vector);

procedure DisposeVector(var v: Vector);

procedure Add(var v: Vector; val: Integer);

procedure SetElementAt(var v: Vector; pos: Integer; val: Integer);

function ElementAt(v: Vector; pos: Integer): Integer;

procedure RemoveElementAt(var v: Vector; pos: Integer);

function Size(v: Vector): Integer;

function Capacity(v: Vector): Integer;

implementation

// using MaxInt for the intArray here so i dont have to disable rangecheck

// error everytime i try to access the array if i used array[0..0] instead.

// There is no allocation of more memory as a consequence because i manually

// set the memory with capacity \* SizeOf(Integer) so there shouldnt be a

// problem, also i choose MaxInt because my count and capacity are int anyway

type

  IntArray = array[0..MaxInt] of Integer;

  PIntArray = ^IntArray;

  VecRec = record

    data: PIntArray;

    count: Integer;

    capacity: Integer;

  end;

  PVector = ^VecRec;

procedure InitVector(var v: Vector);

var

  pv: PVector;

begin

  new(pv);

  pv^.count := 0;

  pv^.capacity := 1;

  GetMem(pv^.data, pv^.capacity \* SizeOf(Integer));

  if pv^.data = nil then

  begin

    WriteLn('Error: Heap overflow.');

    Halt(1);

  end;

  v := pv;

end;

procedure DisposeVector(var v: Vector);

var

  pv: PVector;

begin

  pv := PVector(v);

  FreeMem(pv^.data, pv^.capacity \* SizeOf(Integer));

  Dispose(v);

end;

procedure GrowVector(var v: VecRec);

var

  newCapacity: longInt;

  newData: PIntArray;

  i: Integer;

begin

  newCapacity := v.capacity \* 2;

  if newCapacity >= MaxInt then

  begin

    WriteLn('Error: Vector overflow.');

    Halt(1);

  end;

  GetMem(newData, newCapacity \* SizeOf(Integer));

  for i := 0 to v.count - 1 do

    newData^[i] := v.data^[i];

  FreeMem(v.data, v.capacity \* SizeOf(Integer));

  v.data := newData;

  v.capacity := newCapacity;

end;

procedure Add(var v: Vector; val: Integer);

var

  pv: PVector;

begin

  pv := PVector(v);

  if pv^.count = pv^.capacity then

    GrowVector(pv^);

  pv^.data^[pv^.count] := val;

  Inc(pv^.count);

end;

procedure SetElementAt(var v: Vector; pos: Integer; val: Integer);

var

  pv: PVector;

begin

  pv := PVector(v);

  if (pos < 0) or (pos >= pv^.count) then

  begin

    WriteLn('Error: Index out of range.');

    Halt(1);

  end;

  pv^.data^[pos] := val;

end;

function ElementAt(v: Vector; pos: Integer): Integer;

var

  pv: PVector;

begin

  pv := PVector(v);

  if (pos < 0) or (pos >= pv^.count) then

  begin

    WriteLn('Error: Index out of range.');

    Halt(1);

  end;

  ElementAt := pv^.data^[pos];

end;

procedure RemoveElementAt(var v: Vector; pos: Integer);

var

  i: Integer;

  pv: PVector;

begin

  pv := PVector(v);

  if (pos < 0) or (pos >= pv^.count) then

  begin

    WriteLn('Error: Index out of range.');

    Halt(1);

  end;

  for i := pos to pv^.count - 2 do

    pv^.data^[i] := pv^.data^[i + 1];

  Dec(pv^.count);

end;

function Size(v: Vector): Integer;

var

  pv: PVector;

begin

  pv := PVector(v);

  Size := pv^.count;

end;

function Capacity(v: Vector): Integer;

var

  pv: PVector;

begin

  pv := PVector(v);

  Capacity := pv^.capacity;

end;

end.

Eine mögliche Verbesserung meines Codes wäre den Vektor wieder zu verkleinern, wenn der Count kleiner als die Hälfte von der Kapazität ist, oder den Vektor nicht jedes Mal ums doppelte zu vergrößern sondern eine bessere gewählten wert zu verwenden. Aber das ist immer usecase spezifisch, je nachdem, was man mit dem Vektor anfangen will.

**Test Code:**

program VectorTests;

uses VectorUnit;

var

  v: Vector;

begin

  // Initialize an empty vector

  InitVector(v);

  // Test adding elements

  WriteLn('Test adding elements:');

  writeln('0 elements - size: ', Size(v), ', capacity: ', Capacity(v));

  Add(v, 1);

  writeln('1 element - size: ', Size(v), ', capacity: ', Capacity(v));

  Add(v, 2);

  writeln('2 elements - size: ', Size(v), ', capacity: ', Capacity(v));

  Add(v, 3);

  writeln('3 elements - size: ', Size(v), ', capacity: ', Capacity(v));

  Add(v, 4);

  writeln('4 elements - size: ', Size(v), ', capacity: ', Capacity(v));

  Add(v, 5);

  writeln('5 elements - size: ', Size(v), ', capacity: ', Capacity(v));

  WriteLn;

  WriteLn;

  // Test getting and setting elements

  WriteLn('Test getting and setting elements:');

  WriteLn('Element at position 2: ', ElementAt(v, 2)); // should print 3

  SetElementAt(v, 2, 6);

  WriteLn('Element at position 2 after setting it to 6: ', ElementAt(v, 2)); // should print 6

  WriteLn;

  WriteLn;

  // Test removing elements

  WriteLn('Test removing elements:');

  WriteLn('Vector size before removing an element: ', Size(v)); // should print 5

  RemoveElementAt(v, 2);

  WriteLn('Vector size after removing an element: ', Size(v)); // should print 4

  WriteLn('Element at position 2 after removing element at position 2: ', ElementAt(v, 2)); // should print 4

  WriteLn;

  WriteLn;

  // Test disposing of vector

  DisposeVector(v);

end.

**Test Ausgabe:**

Ein Bild, das Text enthält.

Automatisch generierte Beschreibung