PBMath

P. Baillehache

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Contents

Introduction

PBMath is C library providing mathematical structures and functions.

The `Vec` structure and its function can be used to manipulate vectors of float values.

1 Interface

```
// ============ PBMATH.H ================

#ifndef PBMATH_H
#define PBMATH_H

// ================= Include =================

#include <stdlib.h>
#include <stdio.h>
#include <math.h>
#include <string.h>
#include <stdbool.h>

// ================= Define ==================
```

```
#define PBMATH_EPSILON 0.0000001

void VecTypeUnsupported(void*t, ...);
#define VecClone(V) _Generic((V), \
  VecFloat*: VecFloatClone, \
  default: VecTypeUnsupported)(V)
#define VecLoad(V, S) _Generic((V), \
  VecFloat**: VecFloatLoad, \
  default: VecTypeUnsupported)(V, S)
#define VecSave(V, S) _Generic((V), \
  VecFloat*: VecFloatSave, \
  default: VecTypeUnsupported)(V, S)
#define VecFree(V) _Generic((V), \
  VecFloat**: VecFloatFree, \
  default: VecTypeUnsupported)(V)
#define VecPrint(V, S) _Generic((V), \
  VecFloat*: VecFloatPrintDef, \
  default: VecTypeUnsupported)(V, S)
#define VecGet(V, I) _Generic((V), \
  VecFloat*: VecFloatGet, \
  default: VecTypeUnsupported)(V, I)
#define VecSet(V, I, VAL) _Generic((V), \
  VecFloat*: VecFloatSet, \
  default: VecTypeUnsupported)(V, I, VAL)
#define VecCopy(V, W) _Generic((V), \
  VecFloat*: VecFloatCopy, \
  default: VecTypeUnsupported)(V, W)
#define VecDim(V) _Generic((V), \
  VecFloat*: VecFloatDim, \
  default: VecTypeUnsupported)(V)


// ================= Data structure ===================

// Vector of float values
typedef struct VecFloat {
  // Dimension
  int _dim;
  // Values
  float *_val;
} VecFloat;

// ================ Functions declaration ====================

// Create a new VecFloat of dimension 'dim'
// Values are initalized to 0.0
// Return NULL if we couldn't create the VecFloat
VecFloat* VecFloatCreate(int dim);

// Clone the VecFloat
// Return NULL if we couldn't clone the VecFloat
VecFloat* VecFloatClone(VecFloat *that);

// Load the VecFloat from the stream
// If the VecFloat is already allocated, it is freed before loading
// Return 0 in case of success, or:
// 1: invalid arguments
// 2: can't allocate memory
// 3: invalid data
// 4: fscanf error
int VecFloatLoad(VecFloat **that, FILE *stream);
```

```
// Save the VecFloat to the stream
// Return 0 upon success, or
// 1: invalid arguments
// 2: fprintf error
int VecFloatSave(VecFloat *that, FILE *stream);

// Free the memory used by a VecFloat
// Do nothing if arguments are invalid
void VecFloatFree(VecFloat **that);

// Print the VecFloat on 'stream' with 'prec' digit precision
// Do nothing if arguments are invalid
void VecFloatPrint(VecFloat *that, FILE *stream, int prec);
void VecFloatPrintDef(VecFloat *that, FILE *stream);

// Return the i-th value of the VecFloat
// Index starts at 0
// Return 0.0 if arguments are invalid
float VecFloatGet(VecFloat *that, int i);

// Set the i-th value of the VecFloat to v
// Index starts at 0
// Do nothing if arguments are invalid
void VecFloatSet(VecFloat *that, int i, float v);

// Return the dimension of the VecFloat
// Return 0 if arguments are invalid
int VecFloatDim(VecFloat *that);

// Copy the values of 'w' in 'that' (must have same dimensions)
// Do nothing if arguments are invalid
void VecFloatCopy(VecFloat *that, VecFloat *w);

#endif
```

2 Code

```
// ============ PBMATH.C ================

// ================= Include =================

#include "pbmath.h"

// ================= Define ==================


// ================ Functions implementation ====================

// Create a new Vec of dimension 'dim'
// Values are initalized to 0.0
// Return NULL if we couldn't create the Vec
VecFloat* VecFloatCreate(int dim) {
  // Check argument
  if (dim <= 0)
    return NULL;
  // Allocate memory
  VecFloat *that = (VecFloat*)malloc(sizeof(VecFloat));
  //If we could allocate memory
```

```
  if (that != NULL) {
    // Allocate memory for values
    that->_val = (float*)malloc(sizeof(float) * dim);
    // If we couldn't allocate memory
    if (that->_val == NULL) {
      // Free memory
      free(that);
      // Stop here
      return NULL;
    }
    // Set the default values
    that->_dim = dim;
    for (int i = dim; i--;)
      that->_val[i] = 0.0;
  }
  // Return the new VecFloat
  return that;
}

// Clone the VecFloat
// Return NULL if we couldn't clone the VecFloat
VecFloat* VecFloatClone(VecFloat *that) {
  // Check argument
  if (that == NULL)
    return NULL;
  // Create a clone
  VecFloat *clone = VecFloatCreate(that->_dim);
  // If we could create the clone
  if (clone != NULL) {
    // Clone the properties
    for (int i = that->_dim; i--;)
      clone->_val[i] = that->_val[i];
  }
  // Return the clone
  return clone;
}

// Load the VecFloat from the stream
// If the VecFloat is already allocated, it is freed before loading
// Return 0 in case of success, or:
// 1: invalid arguments
// 2: can't allocate memory
// 3: invalid data
// 4: fscanf error
int VecFloatLoad(VecFloat **that, FILE *stream) {
  // Check arguments
  if (that == NULL || stream == NULL)
    return 1;
  // If 'that' is already allocated
  if (*that != NULL) {
    // Free memory
    VecFloatFree(that);
  }
  // Read the number of dimension
  int dim;
  int ret = fscanf(stream, "%d", &dim);
  // If we coudln't fscanf
  if (ret == EOF)
    return 4;
  if (dim <= 0)
    return 3;
  // Allocate memory
```

```
  *that = VecFloatCreate(dim);
  // If we coudln't allocate memory
  if (*that == NULL) {
    return 2;
  }
  // Read the values
  for (int i = 0; i < dim; ++i) {
    fscanf(stream, "%f", (*that)->_val + i);
    // If we coudln't fscanf
    if (ret == EOF)
      return 4;
  }
  // Return success code
  return 0;
}

// Save the VecFloat to the stream
// Return 0 upon success, or:
// 1: invalid arguments
// 2: fprintf error
int VecFloatSave(VecFloat *that, FILE *stream) {
  // Check arguments
  if (that == NULL || stream == NULL)
    return 1;
  // Save the dimension
  int ret = fprintf(stream, "%d ", that->_dim);
  // If we coudln't fprintf
  if (ret < 0)
    return 2;
  // Save the values
  for (int i = 0; i < that->_dim; ++i) {
    ret = fprintf(stream, "%f ", that->_val[i]);
    // If we coudln't fprintf
    if (ret < 0)
      return 2;
  }
  fprintf(stream, "\n");
  // If we coudln't fprintf
  if (ret < 0)
    return 2;
  // Return success code
  return 0;
}

// Free the memory used by a VecFloat
// Do nothing if arguments are invalid
void VecFloatFree(VecFloat **that) {
  // Check argument
  if (that == NULL || *that == NULL)
    return;
  // Free memory
  free((*that)->_val);
  free(*that);
  *that = NULL;
}

// Print the VecFloat on 'stream' with 'prec' digit precision
// Do nothing if arguments are invalid
void VecFloatPrint(VecFloat *that, FILE *stream, int prec) {
  // Check arguments
  if (that == NULL || stream == NULL)
    return;
```

```
  // Create the format string
  char format[20] = {'\0'};
  sprintf(format, "%%.%df", prec);
  // Print the values
  fprintf(stream, "<");
  for (int i = 0; i < that->_dim; ++i) {
    fprintf(stream, format, that->_val[i]);
    if (i < that->_dim - 1)
      fprintf(stream, ",");
  }
  fprintf(stream, ">");
}
void VecFloatPrintDef(VecFloat *that, FILE *stream) {
  VecFloatPrint(that, stream, 3);
}

// Return the i-th value of the VecFloat
// Index starts at 0
// Return 0.0 if arguments are invalid
float VecFloatGet(VecFloat *that, int i) {
  // Check argument
  if (that == NULL || i < 0 || i >= that->_dim)
    return 0.0;
  // Return the value
  return that->_val[i];
}

// Set the i-th value of the VecFloat to v
// Index starts at 0
// Do nohting if arguments are invalid
void VecFloatSet(VecFloat *that, int i, float v) {
  // Check argument
  if (that == NULL || i < 0 || i >= that->_dim)
    return;
  // Set the value
  that->_val[i] = v;
}

// Return the dimension of the VecFloat
// Return 0 if arguments are invalid
int VecFloatDim(VecFloat *that) {
  // Check argument
  if (that == NULL)
    return 0;
  // Return the dimension
  return that->_dim;
}

// Copy the values of 'w' in 'that' (must have same dimensions)
// Do nothing if arguments are invalid
void VecFloatCopy(VecFloat *that, VecFloat *w) {
  // Check argument
  if (that == NULL || w == NULL || that->_dim != w->_dim)
    return;
  // Copy the values
  memcpy(that->_val, w->_val, sizeof(float) * that->_dim);
}
```

3 Makefile

```
OPTIONS_DEBUG=-ggdb -g3 -Wall
OPTIONS_RELEASE=-O3
OPTIONS=$(OPTIONS_DEBUG)

all : main

main: main.o pbmath.o Makefile
gcc $(OPTIONS) main.o pbmath.o -o main -lm

main.o : main.c pbmath.h Makefile
gcc $(OPTIONS) -c main.c

pbmath.o : pbmath.c pbmath.h Makefile
gcc $(OPTIONS) -c pbmath.c

clean :
rm -rf *.o main

valgrind :
valgrind -v --track-origins=yes --leak-check=full --gen-suppressions=yes --show-leak-kinds=all ./main
```

4 Usage

```
#include <stdlib.h>
#include <stdio.h>
#include <time.h>
#include <string.h>
#include "pbmath.h"

int main(int argc, char **argv) {
  // Create a vector of dimension 3
  VecFloat *v = VecFloatCreate(3);
  // If we couldn't create the vector
  if (v == NULL) {
    fprintf(stderr, "VecCreate failed\n");
    return 1;
  }
  // Print the vector
  VecPrint(v, stdout);
  fprintf(stdout, "\n");
  // Set the 2nd value to 1.0
  VecSet(v, 1, 1.0);
  // Print the vector
  VecPrint(v, stdout);
  fprintf(stdout, "\n");
  // Save the vector
  FILE *f = fopen("./vec.txt", "w");
  if (f == NULL) {
    fprintf(stderr, "fopen failed\n");
    return 2;
  }
  int ret = VecSave(v, f);
  if (ret != 0) {
    fprintf(stderr, "VecSave failed (%d)\n", ret);
    return 3;
  }
  fclose(f);
```

```
  // Load the vector
  f = fopen("./vec.txt", "r");
  if (f == NULL) {
    fprintf(stderr, "fopen failed\n");
    return 4;
  }
  VecFloat *w = NULL;
  ret = VecLoad(&w, f);
  if (ret != 0) {
    fprintf(stderr, "VecLoad failed (%d)\n", ret);
    return 5;
  }
  fclose(f);
  // Get the dimension and values of the loaded vector
  fprintf(stdout, "%d ", VecDim(w));
  for (int i = 0; i < VecDim(w); ++i)
    fprintf(stdout, "%f ", VecGet(w, i));
  fprintf(stdout, "\n");
  // Change the values of the loaded vector and print it
  VecSet(w, 0, 2.0);
  VecSet(w, 2, 3.0);
  VecPrint(w, stdout);
  fprintf(stdout, "\n");
  // Copy the loaded vector into the first one and print th first one
  VecCopy(v, w);
  VecPrint(v, stdout);
  fprintf(stdout, "\n");
  // Free memory
  VecFree(&w);
  VecFree(&v);
  // Return success code
  return 0;
}
```

Output:

```
<0.000,0.000,0.000>
<0.000,1.000,0.000>
3 0.000000 1.000000 0.000000
<2.000,1.000,3.000>
<2.000,1.000,3.000>
```

vec.txt:

```
3 0.000000 1.000000 0.000000
```