# C interfaces to GALAHAD ROOTS

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**1 GALAHAD C package qpb** 1
1.1 Introduction . . . 1
1.1.1 Purpose . . . 1
1.1.2 Authors . . . 1
1.1.3 Originally released . . . 1
1.1.4 Terminology . . . 2
1.1.5 Method . . . 2
1.1.6 Reference . . . 3
1.1.7 Call order . . . 3
1.1.8 Unsymmetric matrix storage formats . . . 4
1.1.8.1 Dense storage format . . . 4
1.1.8.2 Sparse co-ordinate storage format . . . 4
1.1.8.3 Sparse row-wise storage format . . . 4
1.1.9 Symmetric matrix storage formats . . . 4
1.1.9.1 Dense storage format . . . 4
1.1.9.2 Sparse co-ordinate storage format . . . 5
1.1.9.3 Sparse row-wise storage format . . . 5
1.1.9.4 Diagonal storage format . . . 5
1.1.9.5 Multiples of the identity storage format . . . 5
1.1.9.6 The identity matrix format . . . 5
1.1.9.7 The zero matrix format . . . 5

**2 File Index** 7
2.1 File List . . . 7

**3 File Documentation** 9
3.1 galahad_qpb.h File Reference . . . 9
3.1.1 Data Structure Documentation . . . 10
3.1.1.1 struct qpb_control_type . . . 10
3.1.1.2 struct qpb_time_type . . . 14
3.1.1.3 struct qpb_inform_type . . . 14
3.1.2 Function Documentation . . . 15
3.1.2.1 qpb_initialize() . . . 15
3.1.2.2 qpb_read_specfile() . . . 16
3.1.2.3 qpb_import() . . . 16
3.1.2.4 qpb_reset_control() . . . 18
3.1.2.5 qpb_solve_qp() . . . 18
3.1.2.6 qpb_information() . . . 20
3.1.2.7 qpb_terminate() . . . 21

**4 Example Documentation** 23
4.1 qpbt.c . . . 23
4.2 qpbtf.c . . . 25

# Chapter 1

# GALAHAD C package roots

## 1.1 Introduction

### 1.1.1 Purpose

Use classical formulae together with Newton's method to find all the real roots of a real polynomial.

Currently, only the control and inform parameters are exposed; these are provided and used by other GALAHAD packages with C interfaces.

### 1.1.2 Authors

N. I. M. Gould, STFC-Rutherford Appleton Laboratory, England.

C interface, additionally J. Fowkes, STFC-Rutherford Appleton Laboratory.

Julia interface, additionally A. Montoison and D. Orban, Polytechnique Montréal.

### 1.1.3 Originally released

April 2005, C interface January 2022.

### 1.1.4 Method

Littlewood and Ferrari's algorithms are used to find estimates of the real roots of cubic and quartic polynomials, respectively; a stabilized version of the well-known formula is used in the quadratic case. Newton's method is used to further refine the computed roots if necessary. Madsen and Reid's method is used for polynomials whose degree exceeds four.

# Chapter 2

# File Index

## 2.1 File List

Here is a list of all files with brief descriptions:

galahad_roots.h . . . . . ??

# Chapter 3

# File Documentation

## 3.1 galahad_roots.h File Reference

```
#include <stdbool.h>
#include <stdint.h>
#include "galahad_precision.h"
#include "galahad_cfunctions.h"
```

### Data Structures

- struct roots_control_type
- struct roots_inform_type

### 3.1.1 Data Structure Documentation

#### 3.1.1.1 struct roots_control_type

control derived type as a C struct

**Data Fields**

| | | |
|---|---|---|
| bool | f_indexing | use C or Fortran sparse matrix indexing |
| int | error | error and warning diagnostics occur on stream error |
| int | out | general output occurs on stream out |
| int | print_level | the level of output required is specified by print_level |
| real_wp_ | tol | the required accuracy of the roots |
| real_wp_ | zero_coef | any coefficient smaller in absolute value than zero_coef will be regarde to be zero |
| real_wp_ | zero_f | any value of the polynomial smaller in absolute value than zero_f will be regarded as giving a root |
| bool | space_critical | if .space_critical true, every effort will be made to use as little space as possible. This may result in longer computation time |
| bool | deallocate_error_fatal | if .deallocate_error_fatal is true, any array/pointer deallocation error will terminate execution. Otherwise, computation will continue |
| char | prefix[31] | all output lines will be prefixed by .prefix(2:LEN(TRIM(.prefix))-1) where .prefix contains the required string enclosed in quotes, e.g. "string" or 'string' |

#### 3.1.1.2 struct roots_inform_type

inform derived type as a C struct

**Data Fields**

| | | |
|---|---|---|
| int | status | return status. See ROOTS_solve for details |
| int | alloc_status | the status of the last attempted allocation/deallocation |
| char | bad_alloc[81] | the name of the array for which an allocation/deallocation error ocurred |