

1 Overview

1.1 Location `$<AMDAPPSDKSamplesInstallPath>\samples\opencl\cpp_cl\1.x`

1.2 How to Run See the *Getting Started* guide for how to build samples. You first must compile the sample.

Use the command line to change to the directory where the executable is located. The pre-compiled sample executable is at

`$<AMDAPPSDKSamplesInstallPath>\samples\opencl\bin\x86\` for 32-bit builds, and
`$<AMDAPPSDKSamplesInstallPath>\samples\opencl\bin\x86_64\` for 64-bit builds.

Type the following command(s).

1. `EigenValue`
Calculates the eigenvalues of a tridiagonal symmetric matrix of size 64x64.
2. `EigenValue -h`
This prints the help file.

1.3 Command Line Options Table 1 lists, and briefly describes, the command line options.

Table 1 Command Line Options

Short Form	Long Form	Description
-h	--help	Shows all command options and their respective meaning.
	--device	Devices on which the program is to be run. Acceptable values are <code>cpu</code> or <code>gpu</code> .
-q	--quiet	Quiet mode. Suppresses all text output.
-e	--verify	Verify results against reference implementation.
-t	--timing	Print timing.
	--dump	Dump binary image for all devices.
	--load	Load binary image and execute on device.
-d	--deviceId	Select deviceId to be used (0 to N-1, where N is the number of available devices).
	--flags	Specify compiler flags to build the kernel.
-p	--platformId	Select platformId to be used (0 to N-1, where N is the number of available platform).
-v	--version	AMD APP SDK version string.
-x	--length	Length of diagonal of the square matrix.
-i	--iterations	Number of iterations for kernel execution.

2 Introduction

The sample calculates the eigenvalues of a tridiagonal symmetric matrix of the form:

```
1 2 0 0
2 4 5 0
0 5 6 7
0 0 7 7
```

In this matrix, the diagonal elements are [1 4 6 7], and its length is the same as the size of the square matrix. The off-diagonal elements are [2 5 7], and its length is one less than the size of the square matrix.

3 Implementation Details

The input for the algorithm is a symmetric tridiagonal matrix. This also works for any symmetric real matrix because it can be reduced to a symmetric tridiagonal matrix, as explained in section 2.1 of reference [1]. In this document, the symmetric tridiagonal matrix is termed “matrix”; The eigenvalues of the matrix are called “eigenvalues.”

All the eigenvalues of the matrix lie in an interval, called the Gerschgorin interval. This is calculated using the method described in Figure 4.3 of reference [2]. This is the starting search space. The number of eigenvalues for any interval are calculated by using a method specified in FICnt_IEEE, Algorithm-4, of reference [2]. This method calculates the number of eigenvalues that are less than a given floating point number. With this method, it is trivial to compute the number of eigenvalues for any interval.

The Gerschgorin interval is initially divided into as many equal intervals as there are eigenvalues. Each of these intervals is then recursively split into as many equal sub-intervals as there are eigenvalues in it. Intervals that do not have eigenvalues are discarded. If the interval has only one eigenvalue, it is bisected, and the half that does not have an eigenvalue is discarded. No bisection is done when the interval length is less than a given tolerance. Either the upper bound or lower bound of this interval can now be treated as an eigenvalue lying within acceptable tolerance.

4 References

1. I. S. Dhillon, A New $O(N^2)$ Algorithm for the Symmetric Tridiagonal Eigenvalue/Eigenvector Problem, Ph.D. Thesis, University of California, Berkeley.
2. J. Demmel, I. Dhillon, and H. Ren, On The Correctness Of Some Bisection-Like Parallel Eigenvalue Algorithms In Floating Point Arithmetic, Trans. Num. Anal. (ETNA), 3, 1996.

Contact

Advanced Micro Devices, Inc.
One AMD Place
P.O. Box 3453
Sunnyvale, CA, 94088-3453
Phone: +1.408.749.4000

For AMD Accelerated Parallel Processing:

URL: developer.amd.com/appsdk
Developing: developer.amd.com/



The contents of this document are provided in connection with Advanced Micro Devices, Inc. ("AMD") products. AMD makes no representations or warranties with respect to the accuracy or completeness of the contents of this publication and reserves the right to make changes to specifications and product descriptions at any time without notice. The information contained herein may be of a preliminary or advance nature and is subject to change without notice. No license, whether express, implied, arising by estoppel or otherwise, to any intellectual property rights is granted by this publication. Except as set forth in AMD's Standard Terms and Conditions of Sale, AMD assumes no liability whatsoever, and disclaims any express or implied warranty, relating to its products including, but not limited to, the implied warranty of merchantability, fitness for a particular purpose, or infringement of any intellectual property right.

AMD's products are not designed, intended, authorized or warranted for use as components in systems intended for surgical implant into the body, or in other applications intended to support or sustain life, or in any other application in which the failure of AMD's product could create a situation where personal injury, death, or severe property or environmental damage may occur. AMD reserves the right to discontinue or make changes to its products at any time without notice.

Copyright and Trademarks

© 2015 Advanced Micro Devices, Inc. All rights reserved. AMD, the AMD Arrow logo, ATI, the ATI logo, Radeon, FireStream, and combinations thereof are trademarks of Advanced Micro Devices, Inc. OpenCL and the OpenCL logo are trademarks of Apple Inc. used by permission by Khronos. Other names are for informational purposes only and may be trademarks of their respective owners.