

## PA7 – Advanced SIMD

### Student Information

**Integrity Policy:** All university integrity and class syllabus policies have been followed. I have neither given, nor received, nor have I tolerated others' use of unauthorized aid.

I understand and followed these policies:                      Yes                      No

Name:

Date:

### Submission Details

Final **Changelist** number:

Verified build:                      Yes                      No

Number Tests Passed:

Required Configurations:

Discussion (What did you learn):

## Verify Builds

- Follow the Piazza procedure on submission
  - Verify your submission compiles and works at the changelist number.
- Verify that only MINIMUM files are submitted
  - No – Generated files
    - \*.pdb, \*.suo, \*.sdf, \*.user, \*.obj, \*.exe, \*.log, \*.pdb, \*.db, \*.user
    - Anything that is generated by the compiler should not be included
  - No – Generated directories
    - /Debug, /Release, /Log, /ipch, /.vs
- Typical files project files that are required
  - \*.sln, \*.cpp, \*.h
  - \*.vcxproj, \*.vcxproj.filters, CleanMe.bat

## Standard Rules

### Submit multiple times to Perforce

- Submit your work as you go to perforce several times (at least 5)
  - As soon as you get something working, submit to perforce
  - Have reasonable check-in comments
    - Points will be deducted if minimum is not reached

### Write all programs in cross-platform C++

- Optimize for execution speed and robustness
- Working code doesn't mean full credit

### Submission Report

- Fill out the submission Report
  - No report, no grade

### Code and project needs to compile and run

- Make sure that your program compiles and runs
  - Warning level ALL ...
  - NO Warnings or ERRORS
    - Your code should be squeaky clean.
  - Code needs to work "as-is".
    - No modifications to files or deleting files necessary to compile or run.
  - All your code must compile from perforce with no modifications.
    - Otherwise it's a 0, no exceptions

### Project needs to run to completion

- If it crashes for any reason...
  - It will not be graded and you get a 0

### No Containers

- NO STL allowed {Vector, Lists, Sets, etc...}
  - No automatic containers or arrays
  - You need to do this the old fashion way - **YOU EARNED IT**

### Leave Project Settings

- Do NOT change the project or warning level
  - Any changing of level or suppression of warnings is an integrity issue

### Simple C++

- No modern C++
  - No Lambdas, Autos, templates, etc...
  - No Boost
- NO Streams
  - Used fopen, fread, fwrite...
- No code in MACROS
  - Code needs to be in cpp files to see and debug it easy
- **Exception:**
  - implicit problem needs templates

### Leaking Memory

- If the program leaks memory
  - There is a deduction of 20% of grade
- If a class creates an object using new/malloc
  - It is responsible for its deletion
- Any **MEMORY** dynamically allocated that isn't freed up is **LEAKING**
  - Leaking is **HORRIBLE**, so you lose points

### No Debug code or files disabled

- Make sure the program is returned to the original state
  - If you added debug code, please return to original state
- If you disabled file, you need to re-enable the files
  - All files must be active to get credit.
  - Better to lose points for unit tests than to disable and lose all points

### No Adding files to this project

- This project will work "as-is" do not add files...
- Grading system will overwrite project settings and will ignore any student's added files and will returned program to the original state

### UnitTestFixture file (if provided) needs to be set by user

- Grading will be on the UnitTestFixture settings
  - Please explicitly set which tests you want graded... no regrading if set incorrectly

## Due Dates

- See Piazza for due date and time
- Submit program performance in your student directory assignment supplied.
- Fill out your this **Submission Report** and commit to performance
  - **ONLY** use Adobe Reader to fill out form, all others will be rejected.
  - Fill out the form and discussion for full credit.

## Goals

- Learn
  - SIMD, Intrinsics
    - Add Proxies to change ordering
    - Rearrange instructions for Latency and Throughput (repeat)
  - Show off, you can program vector code!
- MMX - SSE4.1 allowed
  - No AVX or more advanced SIMD intrinsics allowed

## Assignments

- Please **VERIFY** the correct builds for each project
- **Optimize *Box::Collide* function**
  - Convert all methods to use intrinsics SIMD instructions
    1. Remember the key is to manually call all necessary simd functions in ONE big function. Do not call external functions... call the \_mm simd functions
    2. Rearrange for Latency and Throughput(Repeat)
  - Test the code with data provided that
    1. Modify and compile the new SIMD class (Box\_SIMD, Vect4D\_SIMD, Sphere\_SIMD).
    2. Please verify that the new class creates the same output.
  - Run the test in Debug and Release
- **Optimize *Row and Col Major* programs.**
  - a. Both the Row and Col should have roughly the same time in Release.
    - i. This requires a **proxy** before you do the SIMD conversion.
    - ii. Feel free to create a special proxy for Row Major and another for Col Major before you write the respective SIMD code.
      1. That should help greatly
      2. Share your times on Piazza

## Validation

*Simple checklist to make sure that everything is submitted correctly*

- Is the project compiling and running without any errors or warnings?
- Does the project run **ALL** the unit tests execute without crashing?
- Is the submission report filled in and submitted to performe?
- Follow the verification process for performe
  - Is all the code there and compiles “as-is”?
  - No extra files
- Is the project leaking memory?

## Hints

Most assignments will have hints in a section like this.

- Look at the lecture notes!
  - A lot of good ideas in there.
  - The code in the examples work.
- It’s a puzzle
  - Keep trying to work at piecing the instructions together
  - Amazing manual
    - <https://software.intel.com/sites/landingpage/IntrinsicsGuide/#>
- Use the FORUMs
  - This is much harder than the last assignment.
  - See me during office hours.
  - Read, explore, ask questions in class