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| Pegasus%20-%20Black%20on%20White | Department of Electrical Engineering & Computer Science, CS DivisionCollege of Engineering & Computer ScienceUniversity of Central Florida |
| *Return Form to*: Dr. Mark Heinrich, heinrich@cs.ucf.edu |
| **COP 4934: Computer Science Senior Design** |
| **Proposed Project Description Form\*** |
| (Sponsors who are willing and able are asked to provide a Team Donation of $1500 or more for supplies and the running of the CS Senior Design Program) |
| Will support: Amount TBD Cannot support: |
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| Sponsoring Organization: | AMD Inc. |
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| Mailing Address: | 3501 Quadrangle Blvd, Suite #375, Orlando, FL 32817 |
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| Project Contact: | Mangesh Nijasure | Position: | Senior Member of Technical Staff |
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| Contact Phone: | 407-541-6857 | Fax: |  |
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| Contact E-mail: | mangesh.nijasure@amd.com |
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| Project Title *(working)*: | Index & Vertex Buffer Compression |

*Please feel free to use as much space as needed for each of the sections below.*

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| **Background of Company/Organization**(Provide a brief overview of the company/organization and the specific project location here) |
| AMD delivers unique and unmatched computational capabilities in order to create natural, intelligent and innovative ways for people to interact with the devices they love. We design and manufacturegraphics cards and microprocessors that power millions of the world’s personal computers, tablets, gaming consoles, embedded devices and cloud servers.AMD has a history of making next-generation technology accessible to millions, bringing feature-rich computing solutions to the world at the right price. We also design technology with a higher level of visual computing capabilities than previously imaginable—with features like 3D graphics and UltraHD visual resolution, as well as accurate and reliable voice and facial recognition, touch and gesture control.All major video game console manufacturers use AMD semi-custom technology. Fantasy, imagination and competition come to life in the games of today and tomorrow because creators enjoy unprecedented freedom with technology. We partner with all major console manufacturers, including Sony, Nintendo and Microsoft, to deliver semi-customized processing solutions as unique as the consoles they power. AMD’s semi-custom chip technology is in the groundbreaking new Sony PlayStation® 4 andMicrosoft Xbox® One, driving breathtaking image quality to deliver truly out-of-this-world gaming experiences.AMD’s Orlando office has been in the area since 1998 (initially as ATI Inc). This site primarily focuses on designing Graphics IP that is used in all AMD silicon for discrete graphics, APUs as well as semi-custom solutions like the game consoles. AMD has pursued several research projects/grants with UCF over the years and have a very high number of UCF interns who have transitioned to full time employees.[www.amd.com](http://www.amd.com)  |
| **Statement and Scope of the Problem(s)**(Provide the problem statement here; Please be as specific as possible to help us understand the scope of the problem, and thus the scope of the project, specifically the design content) |
| Most of the rendered geometry in modern day GPUs is supplied as Vertex Buffers which contain the position and attribute information of the vertex and Index Buffers which supply connectivity information which stiches the vertex buffer data into primitives.http://msdn.microsoft.com/en-us/library/windows/desktop/bb147325(v=vs.85).aspxUser applications and games provide a lot of geometry to be rendered each frame and fetching index and vertex buffers is expensive. This requires power, time as well as contention on the memory bandwidth which is shared amongst several clients in the GPU.Any compression scheme that can be applied to these buffers will help alleviate this. Of course this comes with the caveat of needed encoders and decoders to reassemble the original data. |
| **Overall Project Goal(s)**(Describe the overall goals of the project in this space) |
| The overall project goal is to see if we can apply an existing algorithm or come up with a novel way to compress index and vertex buffers for the correct benefit/cost metric.This will also involve deciding whether the encoding/decoding can be on the fly hardware, or offline software or some intermediate approach.Ideally we will be able to incorporate some of the new developed techniques in future GPUs. |
| **Project Objectives**(Enter the project objectives that will help achieve the goals of the project; Please be as specific as possible) |
| The initial phase of the project will involve understanding the type of data contained in each of the buffers and the typical usage models we see (AMD will provide help and guidance with this)The next stage will be to evaluate all relevant current research and techniques for compression and identifying which ones are a good fit for the data in these buffers. Baseline implementations of the most promising ones are expected with analysis on the bandwidth saving versus the cost of compression (encoding/decoding)The final step will be to come up with as many new compression techniques as possible that can be applied to this problem. AMD will be available to help provide direction on which avenues make the most sense (ex: suggest if exploring block based delta compression schemes are the right approach, versus wavelets etc). We expect students to be creative and come up with novel ideas. |
| **Expected Project Deliverables**(Enter the expected project deliverables including, if possible, proposed project tasks; Please be as specific as possible) |
| The expected project deliverables are as follows* Large collected data set of typical index and vertex buffers compiled into a repository and used for all test cases
* Implementation in C/C++ of at least a few of the best fitting current industry standard compression schemes as a baseline
* New algorithms developed to compare against any existing ways
* Performance analysis of each method comparing
	+ Bandwidth reduction
	+ Encoding/Decoding cost (as time or instructions or area if hardware)
* Students are welcome to design hardware encoders/decoders or model them in C/C++
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| **Desired Core Competencies and Experience of Team**(Please list the desired competencies/experience/knowledge needed by the project team members that you feel will facilitate successful project execution; Examples: specific programming language experience, familiarity or expertise in certain web technologies, databases, mobile SDKs, prior classes in certain subject areas, a love of computational complexity and efficient algorithms etc.) |
| These are mandatory* Good critical thinking and creativity
* C/C++ coding skills

These are a plus – AMD will provide mentoring as necessary to cover these* Basic knowledge of computer graphics
* Exposure to compression techniques
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| **Other Special Considerations and Project Requirements**(Please provide any special circumstances, constraints, and requirements needed by the project team members; **Examples**:* University participants must be US Citizens or Permanent Residents,
* All work is to be performed off-campus at a specific site,
* *Interdisciplinary project*: You would like to see CS students teamed with engineering students from one or more of: Computer Engineering, Electrical Engineering, Mechanical Engineering, Industrial Engineering, Civil and Environmental Engineering (please specify)
* All team members and the professor must submit to background checks,
* All team members and the professor must sign non-disclosure agreements
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| All team members and the professor must sign NDAs ( I will send this out later) . Any code/analysis/conclusions produced will remain the intellectual property of AMD Inc. Any public distribution must be authorized by AMD.AMD will provide reference hardware (graphics cards) to enable project execution or provide funds to allow students/faculty to procure the necessary cards. |
| **Project Mentor(s), if different than who is listed above**(Please provide the contact information and title/position for the project mentor(s), who will advise the student team) |
| Please include both the following recipients on any communication/questions regarding the program. Mangesh Nijasure 407-541-6857 mangesh.nijasure@amd.comTodd Martin 407-541-6882 todd.martin@amd.com  |

*\*IMPORTANT NOTE: Proposed projects may not be chosen by student groups. In any one semester the number of potential industry-sponsored, faculty-proposed, or student-funded projects may exceed the number of student teams. If this project proposal is approved by Dr. Heinrich as a potential CS Senior Design project, you or an appropriate representative will be asked to come to class and give a 15-minute project pitch to the students. Keep in mind this is your chance to convince the students why they should pick your proposed project. Think about what is in it for them, what technologies they will get exposed to, what are the broader, enduring, and social impacts of the work, etc. If your project is chosen, you will be notified typically by the 4th week of the semester. If your project is not chosen, you will be notified in the same timeframe and if it makes sense for your timeline, we would love to offer the same project in the next semester.*