

Sophie Shen

Software Engineer and Computer Graphics Researcher

Led 1 global, built 6+ commercial SW products; independent research published to Expressive.



About

Like many creative minds, I love adventure. For ten years I have pursued a broad range of software engineering, computer graphics projects and interests in industry, academia, and as an entrepreneur:

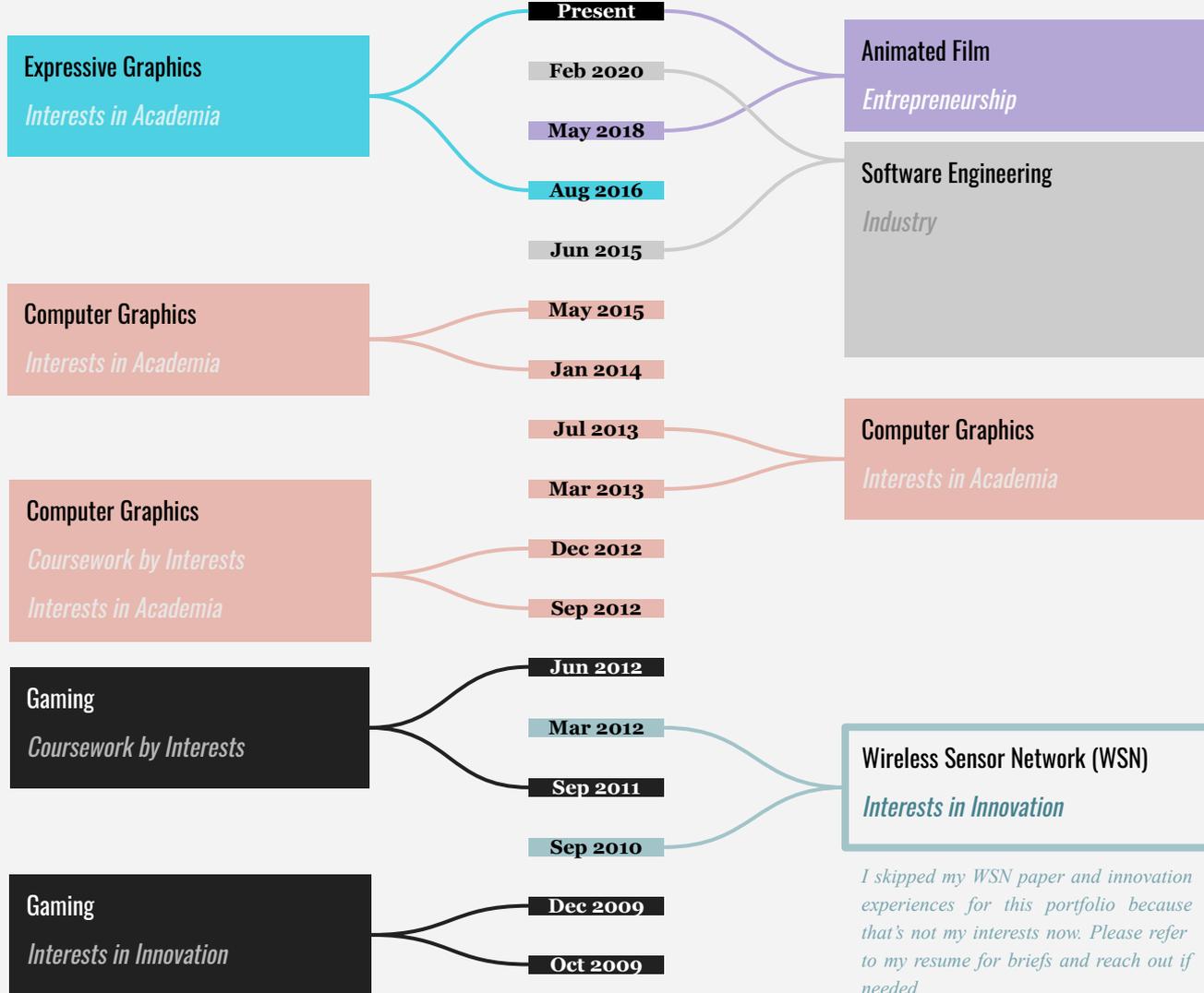
- 4.75 years professional software engineering for commercial digital products at Originate, mentored by Alex Quin.
- 3.15 years independent research on Expressive Graphics with a first-authored paper to Expressive 2019.
- 1.5 years entrepreneurship for an animated film from concept with the head of Value Analytics & Design, Sarah von Helfenstein, and NewView.Media, a start-up media studio.
- 2 years academic research on physically-based rendering for my Masters at University of Utah, supervised by Prof. Cem Yuksel.
- 1 year intensive study of industrial-oriented game development on my Bachelors at Beijing Jiaotong University.

This portfolio showcases selected works to demonstrate the above areas.

Software Engineering
Related:



Graphics Related:



I skipped my WSN paper and innovation experiences for this portfolio because that's not my interests now. Please refer to my resume for briefs and reach out if needed.

Industry

Software Engineering Related:

Graphics Related:



Originate

Software Engineer

Jun 2015 - Feb 2020

Concept to Launch of iOS and ML Commercial Products for Goop, Fair, NatGeo AU, etc

Mentor: Alex Quin

Cambridge Innovation Center, Cambridge, MA

Originate designs, builds, and operates transformative technology products. Founded in 2007, Originate brings together the design agency, custom software development, and venture fund models into one firm. This combination allows Originate to partner with both established companies and high-growth startups to launch new web, mobile, and data products that drive growth and accelerate their mission.

My passion at Originate is software engineering for commercial products and the 20% Time to continue my research on Computer Graphics. For software engineering, I focus on the robustness of product via architecting, solid development, performance improvement, and testing. I also enjoy working with dynamic, international agile teams and practicing my favorite language Swift. The 20% Time is introduced in the next section.

My growth and contribution are significant in diverse client projects through software engineering, communication, and teamwork - independently, collaboratively, and remotely.

For the greater good, I found Software Engineering practices transformative. It has greatly helped my independent research on Computer Graphics during the 20% Time. I believe my masters thesis research would have been easier if I applied these practices to error-prone calculations, such as unit testing for matrix transformations in GPU.



A Saturday in 2015 summer in San Francisco, after soccer game with previous Originators. Photo credits: Wes Dasse.

goop

Software Engineer, Originate

Oct 2019 - Jan 2020

[\[App Store\]](#)

Challenge

Independently on iOS for in-app search, backward compatibility, release, for all iPhone devices, iOS 12 and 13, on a global user base.

Achievement

Successfully led and released G. Spotting iOS v3.13.0, featuring in-app search, to App Store, in less time (2.5 months) than planned (3 months).

Agile Team

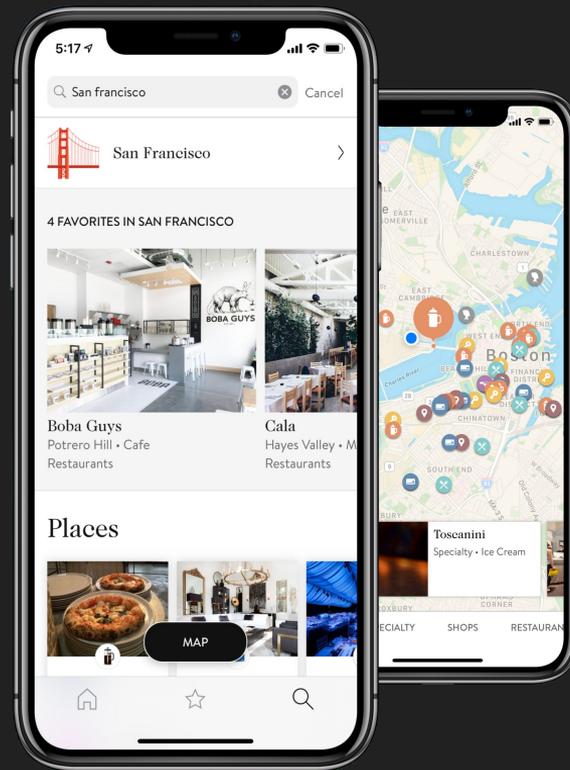
PM and backend team from Goop, search api team from Originate, myself for iOS

Responsibility

- Lead iOS for architecting, feature development, code review, DevOps, and performance
- Suggested, implemented better UX for search than the original design from Goop
- Devised and directed QA, uncovered backend issues and UI issues by iOS 13 black mode
- Authored release instruction for Goop to independently release future versions
- Diagnosed, devised, implemented solution for UX issues of missing favorite data
- Suggested, implemented better map experience with user's real-time location
- Improved map centering with more efficient calculation
- DevOps: fixed CircleCI issues caused by CircleCI upgrade
- Performance analysis for better memory usage, no unstable CPU usage by new features

Skills

- Swift, shell script
- fastlane
- Technical writing
- Communication



Software Engineering
Related:



Graphics Related:



Originate 20% Time

Project Owner, Dopamine Animatec, Originate 20% Time, Originate

Dec 2015 - Feb 2020

Independent research on Computer Graphics focusing on Real-Time Rendering.

Cambridge Innovation Center, Cambridge, MA

Originate 20% Time encourages all Originators to use 20% of their company time to work on their own projects that they are passionate about. It is a great way to learn new skills, explore new domains, and pursue entrepreneurial endeavors. In light of the benefits to the participant, Originate, and to the greater good, Originate tracks plans and deliverables of 20% projects. 20% project belongs to its owner alone. To my best knowledge, this policy was valid 2015 - 2019.

Became independent researcher on Computer Graphics. Motivated by the 20% Time and the entrepreneurial spirit trained in my undergrad at BJTU, I decided to challenge myself for more interesting Computer Graphics topics than graduate research. Luckily, my work was published to Expressive 2019, a top-tier conference in Expressive Graphics.

20% Time benefited back Originate. Thanks to the 20% Time, I was able to author technical instructions for Originate partners, speed up software engineering development, and research for challenge client projects, such as automatic testing strategy for Amgen and a successful customized solution of code signing and notarization for a legacy macOS product.



May 6, 2019. Genoa, Italy. Presenting my paper developed during Originate 20% Time in Expressive 2019. Photo credits: Chiara Eva Catalano.



May 6, 2019. Genoa, Italy. Authors and organizers of Expressive 2019.
Photo credits: Chiara Eva Catalano.

AESTHETICALLY-ORIENTED ATMOSPHERIC SCATTERING

Project Owner, Dopamine Animatec, Originate 20% Time, Originate

Aug 2016 - Feb 2019

[\[Publisher's Page\]](#) [\[Paper\]](#) [\[Slides\]](#)

Abstract

We present Aesthetically-Oriented Atmospheric Scattering (AOAS): an experiment into the feasibility of using real-time rendering as a tool to explore sky styles. AOAS provides an interactive design environment which enables rapid iteration cycles from concept to implementation to preview. Existing real-time rendering techniques for atmospheric scattering struggle to produce non-photorealistic sky styles within any 3D scene. To solve this problem, first, we simplify the geometric representation of atmospheric scattering to a single skydome to leverage the flexibility and simplicity of skydomes in compositing with 3D scenes. Second, we classify the essential and non-essential visual characteristics of the sky and allow AOAS to vary the latter, thus producing meaningful, non-photorealistic sky styles with real-time atmospheric scattering that are still recognizable as skies, but contain artistic stylization. We use AOAS to generate a wide variety of sky examples ranging from physical to highly stylized in appearance. The algorithm can be easily implemented on the GPU, and performs at interactive frame rates with low memory consumption and CPU usage.

Achievement

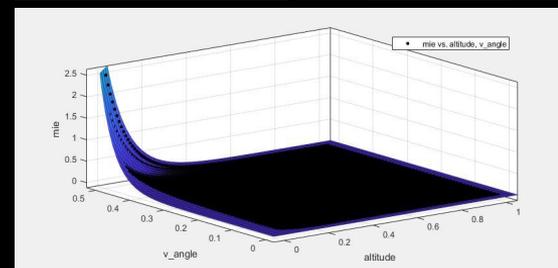
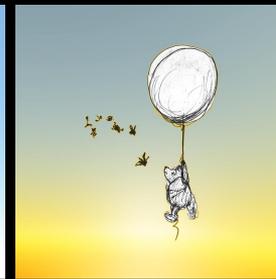
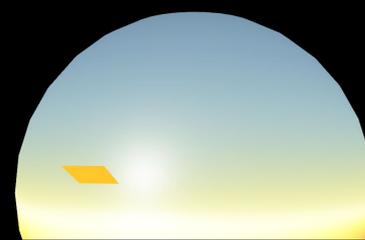
Independent research published to [Expressive 2019](#).

Coauthors

- Konstantin Shkurko encouraged all along from 2016 and contributed the cloud ideas.
- Ian Mallett significantly helped on contribution analysis and writing.

Skills

- C++, GLSL, OpenGL, Python
- MatLab, Blender
- Technical writing





University of Utah

Masters Thesis Research, Graphics and Visualization Track, School of Computing

Jan 2014 - May 2015 (grad)

Research Assistant, School of Computing

Sep 2012 - Dec 2012 (senior)

Graphics Course Projects, School of Computing

Sep 2012 - Dec 2012 (senior)

Salt Lake City, UT

University of Utah - prominent on the birth of Computer Graphics industry. Pioneered by Utah professors like David C. Evans and Ivan Sutherland in the 70s, University of Utah established fundamental Computer Graphics techniques and later inspired its students founded Adobe, Silicon Graphics and Pixar [1]. The school is serious about Graphics education with intensive course projects and strict reviews of MS and PhD research.

My Computer Graphics foundation was established in Graphics course projects such as Ray Tracing for Rendering and Interactive Computer Graphics.

My research ability of Computer Graphics was significantly elevated through Masters Thesis Research, Utah Graphics Lunch Seminar, and Research Assistance experiences.

Software Engineering Related:



Graphics Related:



[1] George Chapman. *Utah inventions: the birth of computer graphics*. KSL. Aug 2015.

SOFT SHADOW MIP-MAPS

Master's Thesis Research, School of Computing, University of Utah | Supervisor: Prof. Cem Yuksel

Apr 2014 - Feb 2016

[\[Publisher's Page\]](#)

Challenge

Solve performance issue for real-time, physically-correct soft shadows.

Contribution

Achieved physically-apparent soft shadows in real-time with shadow mip-maps and a more physically-accurate blocker estimation than Percentage Closer Soft Shadows. This new technique, unfortunately, suffers from light bleeding, which is caused by mip-map interpolation. The disadvantage shows the limits of shadow mip-maps for fully physically-correct soft shadows.

Responsibility

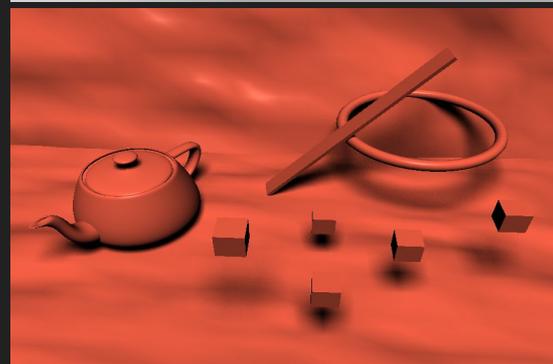
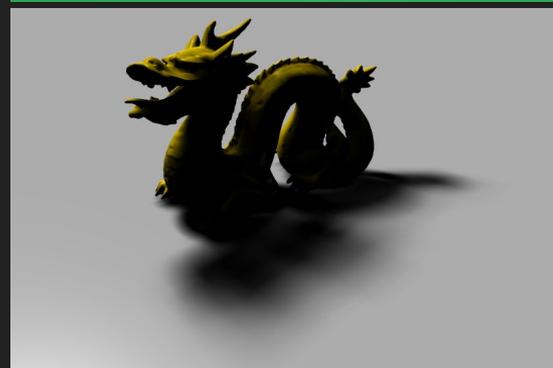
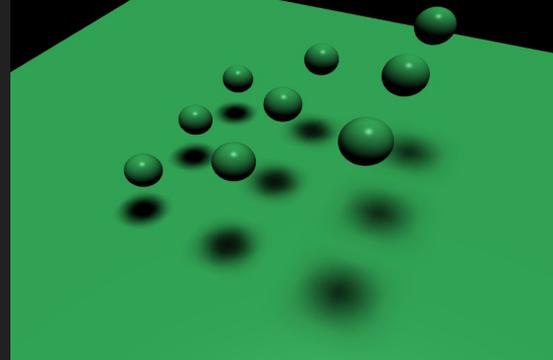
- Work with Cem to devise and develop the technique
- Build the system with related techniques from scratch
- Write the thesis

Implementation

- *Soft Shadow Mip-Maps (C++, OpenGL, GLSL)*
- Related techniques:
 - *Percentage-Closer Soft Shadows (C++, OpenGL, GLSL)*
 - *Variance Soft Shadow Mapping (C++, OpenGL, GLSL)*
 - *Ray-Traced Soft Shadow (C++)*

Skills

- C++
- GLSL
- OpenGL



POISSON DISK SAMPLING

Research Assistant, School of Computing, University of Utah | Supervisor: Prof. Cem Yuksel

Sep 2012 - Dec 2012 (senior)

Challenge

Correctly implement Fast Fourier Transform for poisson disk sample sets, and fully understand radially averaged power spectra to assist Cem's research on power spectrum estimation of poisson disk sampling.

Achievement

Solved the challenge within expected time: 3.5 months.

Responsibility

- Understand 2D Fast Fourier Transform (FFT)
- Understand radially averaged power spectra
- Implemented FFT to generate power spectrum for poisson disk sample sets

Skill

C++

RAY TRACING

CS6620: Ray Tracing for Rendering, University of Utah | Instructor: Prof. Cem Yuksel

Aug 2012 - Dec 2012 (senior)

[\[Project Website\]](#)

Challenge

Implement 12 ray tracing algorithms from scratch and create ray-traced scene for Utah Teapot in the final - Prof. Cem Yuksel's renowned [Teapot Rendering Competition \(TRC\)](#).

Achievement

Winner of [TRC 2012](#), featuring my path tracer with monte carlo global illumination, glossy surfaces, reflections and soft shadows, for my teapot design (mid), inspired by Church of the Light, one of the most famous designs of Japanese architect Tadao Ando.

Implementation

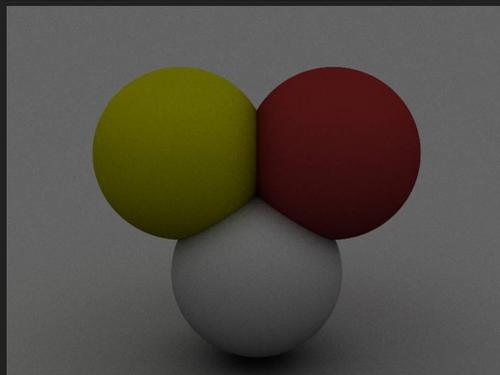
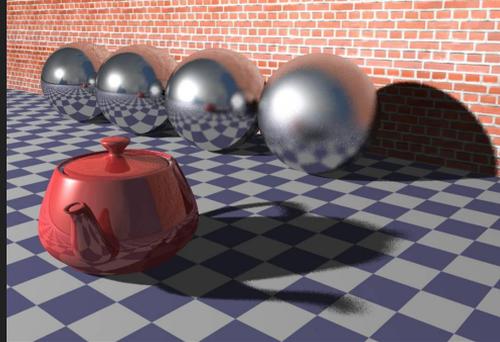
- Path Tracer
- Monte Carlo Global Illumination
- Soft Shadows and Glossy Surfaces
- Antialiasing
- *More on on [Project Website](#)*

Most features are implemented by myself except for:

- *BVH Tree - from course material*
- *Photon Map - from course material*

Skill

C++



TWO-FACE IMAGE-BASED REFRACTION

Final of CS 5610: Interactive Computer Graphics, University of Utah | Instructor: Prof. Charles Hansen

Dec 2012 (senior)

[\[Project Website\]](#)

Challenge

Understand and implement Chris Wyman's Siggraph paper "An Approximate Image-Space Approach for Interactive Refraction" from scratch.

Achievement

90% correctly implemented this paper.

Implementation

OpenGL and GLSL from scratch

Skill

- OpenGL
- GLSL
- C++





Chinese Academy of Sciences

Research Intern, Institute of Automation, Chinese Academy of Sciences | Supervisor: Dr. Huai-Yu Wu

Mar 2013 - Jul 2013 (senior)

Beijing, China

Software Engineering Related:



Graphics Related:



Responsibility

- Assist Refilming (Computer Vision) research by investigating, presenting, and prototyping computer graphics researches.
- Attend weekly research seminar on Computer Vision topics, such as camera and transformation, pattern recognition.

Achievement

R&D on soft shadow techniques to insert and remove shadows in real pictures:

- Implemented PCF in GLSL
- Implemented Spherical Harmonic Exponentiation in C++

R&D on refilming to insert pictures to real pictures:

- Generated depth data of real pictures with depth recovering tools
- Insert another picture to a picture with the generated depth data of the picture

Successfully presented state-of-art spherical-harmonic-based soft shadow techniques and my prototype of a Siggraph paper on real-time soft shadows.

Skill

- C++
- GLSL
- OpenGL



Beijing Jiaotong University

Gaming Courseworks, School of Software Engineering

Sep 2011 - Jun 2012 (junior)

Software Innovation Contest, School of Software Engineering

Oct 2009 - Mar 2010 (freshmen)

Beijing, China

Beijing Jiaotong University (BJTU) is a national key university in mainland China. Founded in 1896, it is one of the three origins of the Jiaotong University and prominent university in the world in Transportation Science and Technology [1].

School of Software Engineering (SSE) is one of the National Pilot Software Engineering Schools among 37 universities first accredited by Ministry of Education. Found in 2003, SSE insists on reform and innovation. It offers students unique education by emphasizing on industry-oriented, real-world project capacity, team spirit and hands-on practical experience to match industry requirements. It also offers diverse programs for students to explore their passions, such as student exchange programs with European and American universities and University Student Innovation Programs. SSE's graduates, most of whom work in government departments, financial institutions, IT enterprises and research institutes, keep the employment rate 100% for eight consecutive years [2].

Became strong at Software Engineering and Game Development R&D. Despite the fun and craziness of industrial-oriented trainings in finals for programming and language skills, database, etc, I chose the Computer Games track instead of the other option - Software Engineering - in junior year's track specification of SSE. It became the key to bridge me to Computer Graphics research in my masters. This section showcases selected gaming projects to highlight my interests and ability of game development R&D.

Software Engineering Related:



Graphics Related:



[1] Beijing Jiaotong University. *General Information*.

[2] MASTERSTUDIES. *Beijing Jiaotong University - School of Software Engineering*.

QUADTREE-BASED LEVEL OF DETAILS (LOD) TERRAIN FOR 3D RACING GAME

Semester Project Training IV: Game Practice, School of Software Engineering, Beijing Jiaotong University

Yu Gu (team lead), **Yang Shen**, Zilin Zhou

Jun 2012 (junior)

[\[CSDN Blog \(Mandarin\)\]](#)

Challenge

- For the team: develop 3D racing game from scratch with 30 fps in 18 days.
- For me: build a level-of-details terrain to achieve 30 fps in addition to performance drains by textures and models of skies, trees, houses, waters, and reflections; correctly connect different-sized quadtree nodes to fix terrain leaks.

Achievement

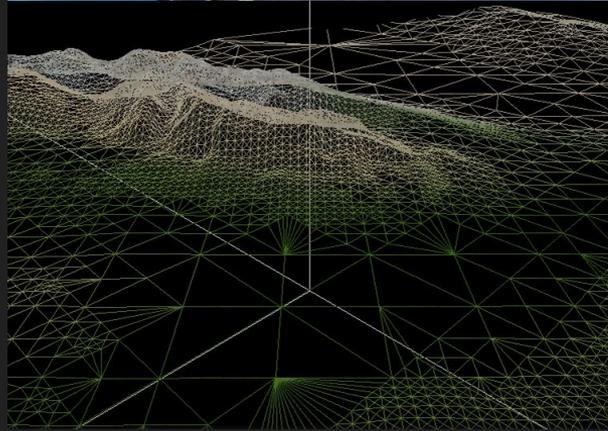
Achieved 170 fps for the performance (up) from 14 fps. Fixed leaf leak with Hoffman code; designed and developed the LOD based on Quadtree. Pre-calculated lod terrain vertices for different camera positions used in the 3D racing game. More tech detail for fixing the leak is on my [CSDN Blog \(Mandarin\)](#).

Responsibility

- Fix leaf leaks
- Develop the static LOD terrain in C++ from scratch

Skill

C++



PATH SEARCH FOR 3D GAME EDITOR

Final project of Game Tools Development & Game Engine Analysis and Design class, School of Software Engineering, Beijing Jiaotong University
Yu Gu (team lead), **Yang Shen**, Zilin Zhou
Dec 2011 - Nov 2011 (junior)

About Wrote the path search feature for interactive editing for the 3D game editor we built for the final.

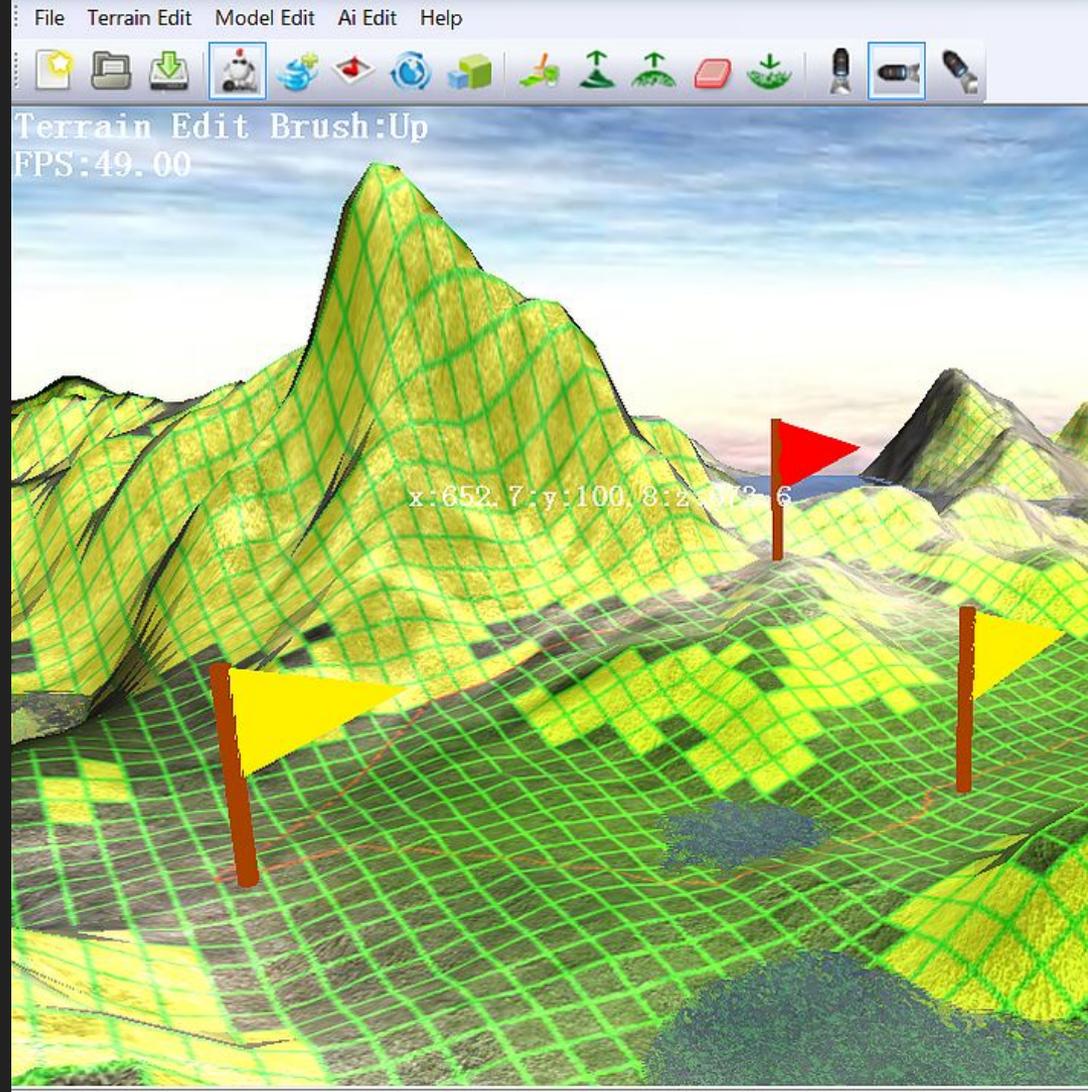
Responsibility

- Team member of a three-member team
- Implemented path searching feature

Implementation

- A* search to search the most optimized path
- Bazier curves to interpolate the optimized path

Skill C++



MODELING

Final Project of the Game Art Foundation class, School of Software Engineering, Beijing Jiaotong University

Yang Shen

Jun 2011 (junior)

Responsibility

Build a 3D castle from scratch in 3ds Max in 2 weeks.

Skill

3ds Max



WILD CAT

2009 Software Innovation Contest, School of Software Engineering, Beijing Jiaotong University

Yang Shen (team lead), Huijun Lu, Xiaoyu Li

Nov 2009 - Jan 2010 (freshmen)

The first 2D game in my life after studied C programming for 4 months and first time as team lead:

- Huijun Lu: gameplay design, UI design
- Xiaoyu Li: collision detection
- Me: team lead, R&D, development, assist UI design and gameplay design

Achievement

2nd prize among 14+ teams.

Gameplay

User controls the direction of the protagonist, our lovely wild cat, to finish the track in limited time by eating up all stars and avoiding the rotating windmill. The cat moves faster as eating more starts and slower if hit by the windmill.

YouTube

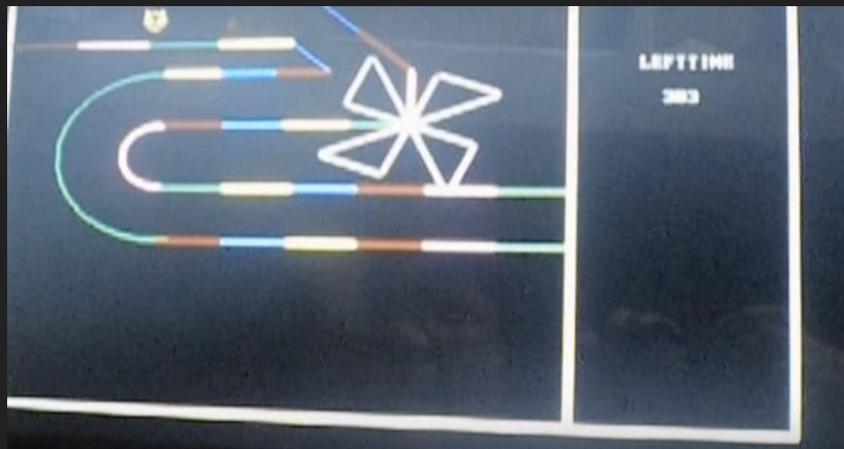
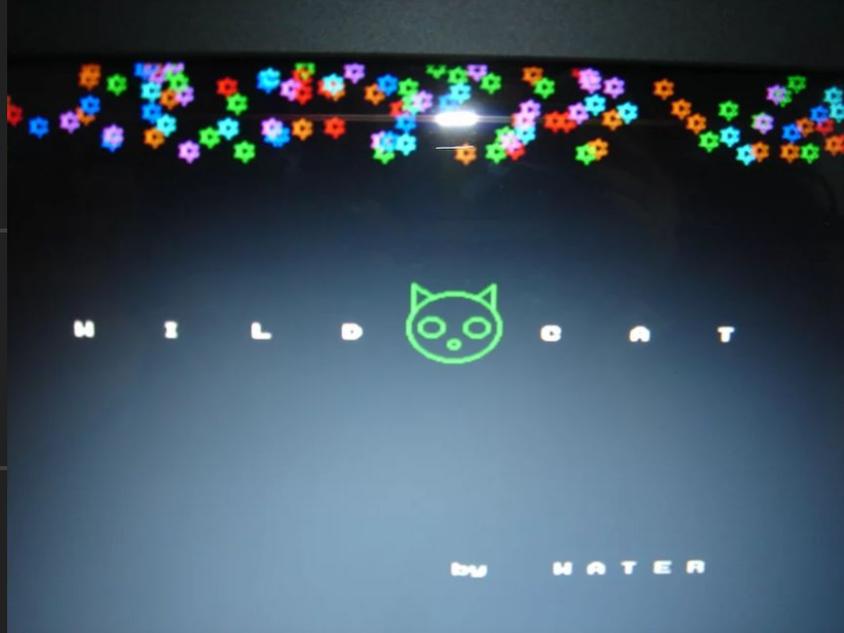
[\[Lost due to timeout\]](#) [\[Win\]](#) [\[Lost because didn't eat all starts\]](#)

Implementation

- Self-study game development and figure out game loop, user input, rendering with `<graphics.h>`, and collision detection by reading books and 2D game code
- Game loop, rendering, animated cat, animated windmill, and collision detection from scratch using `<graphics.h>`

Skill

- C
- `<graphics.h>`



Software Engineering
Related:



Graphics Related:



***For privacy concerns, I can't disclose much about our startup.
Please feel free to reach out if there is a need to know.***

Cofounder, <the startup name is kept private>

Oct 2019 - Present

Cambridge, MA

Elevate Prominent Values of Animation Film with Cofounder Sarah von Helfenstein.

Advisor - Design, Value Analytics & Design

Dec 2018 - Present

Cambridge, MA

Advisory on Ready-to-Implement Solution to Convey Valuation Insights in Animated Film.

Self Study Animated Film, <name of the film is kept private>

May 2018 - Dec 2018

Cambridge, MA

Advisory on Ready-to-Implement Solutions to Convey Valuation Insights in Animated Film for Value Analytics & Design.



Beijing Jiaotong University

“Novel Team” Graduation Photography, School of Software Engineering

Jun 2013

Beijing, China

Core team I led for two National-Level University Student Innovation Programs in sophomore and junior. We focused on innovation in Wireless Sensor Networks for positioning and forest fire coverage. Besides of responsibilities as the team lead, I devised an algorithm for precise WSN positioning with efficient battery usage that was published to IEEE and developed visualization systems using OpenGL (for positioning) and DirectX (for forest fire coverage simulation). We succeeded the final defense in March 2012 on behalf of School of Software Engineering. Our research and innovation experiences have helped my team members admitted by top schools in Mainland China and another boy to Brown University for their masters. I chose to pursue Computer Graphics research for my masters in University of Utah.



Jul 2013, School of Software Engineer, Beijing Jiaotong University. Left to right: Bo Zhang (Tsinghua University), Shiqiang Li (Peking University), me, Pengpeng Lin (Peking University). Photo credits: Zhidong Wu (Brown University).

Thank you

Sophie Shen

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Software Engineering and Computer
Games, BJTU

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