Physics-based Animation

Graduate School of Information Science and Technology 4860-1081

2025 Spring Semester

Congraturations for New Students

- Registration, UTAS, UTOL ….

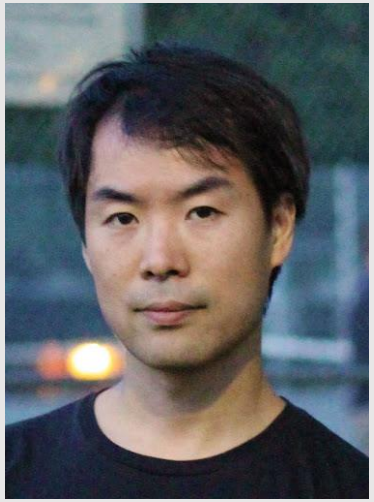
Today's Agenda

- Self-introduction
- Overview of physics-based animation
- Overview of this course
- Overview of assignments
- Slack

- Data structure

Self-Introduction

Short Bio



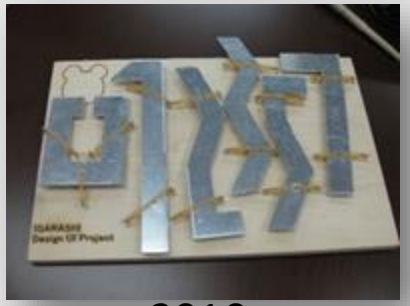
- Associate prof. at creative informatics department

  Computer graphics, especially physics-based simulation, computational design…etc

- Graduated from U-Tokyo (BS/MS/PhD)
- Over 20 years of experience in physics-based simulation
- Research Scientist at
  - Autodesk Research (Canada)
  - Disney Research (Switzerland)

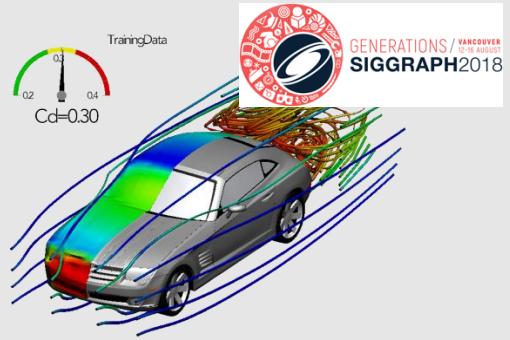
Computation Design & Physics Simulation

- Interactive modeling of functional objects


2010

2012

2016

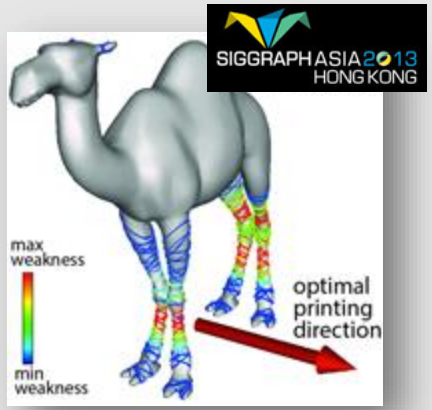


2018

2015

2011

2014



2013

Part of my Research

- Employed in simulator in MAYA [Umetani et al. 2014]

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Overview of Physics-based Animation

What are the Applications?

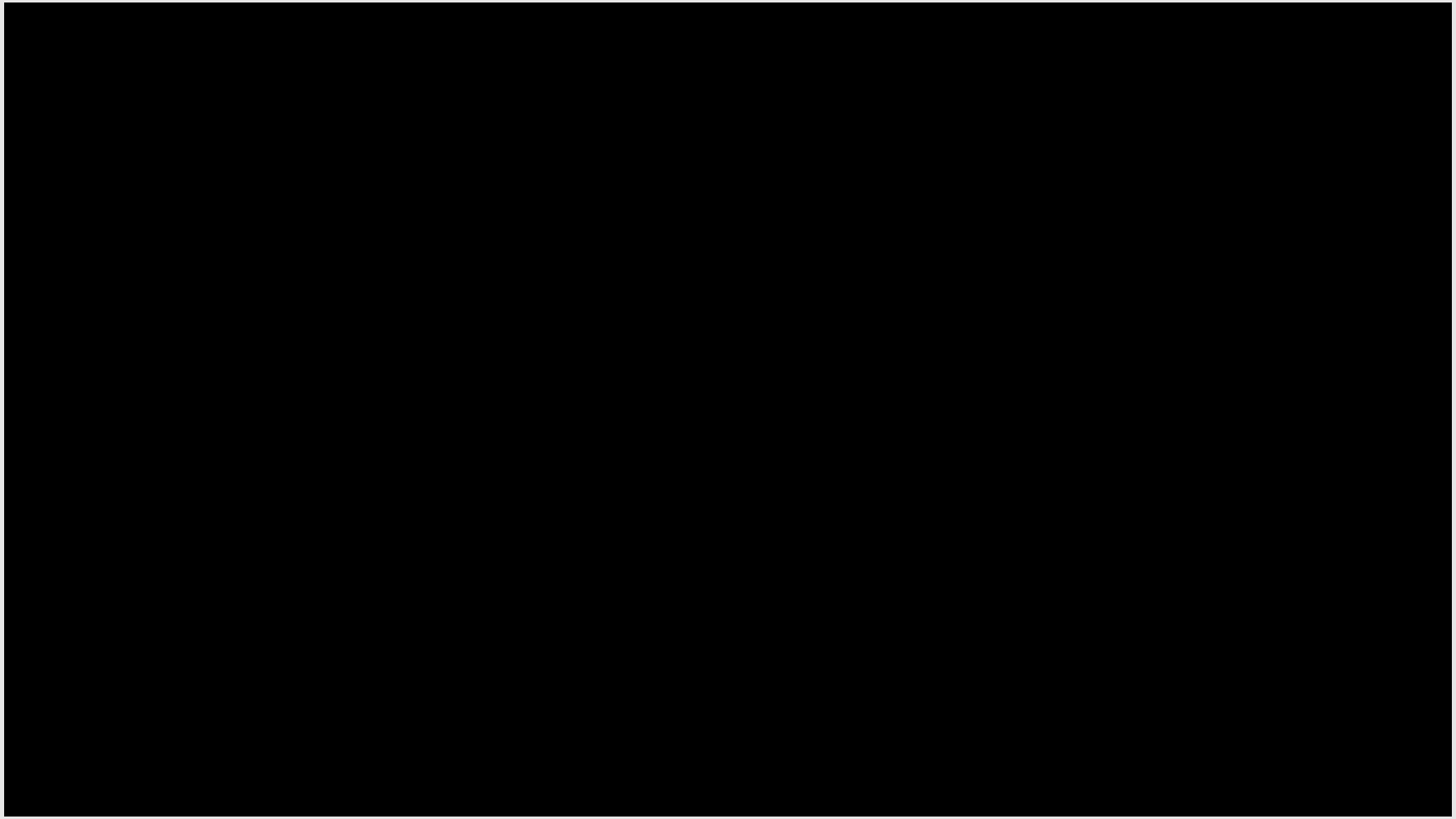
Video Games

Visual Effects / CG Animation

https://www.vfxvoice.com/image-engine-and-the-art-of-the-vfx-breakdown/

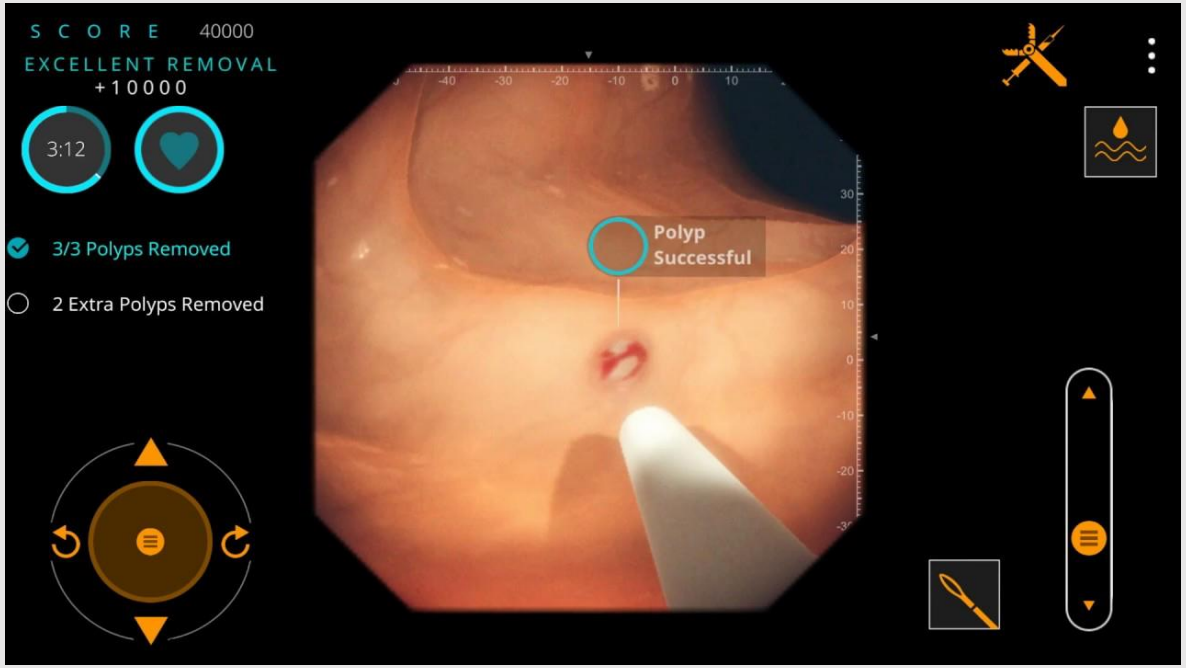
https://www.youtube.com/watch?v=3M9NwvysauI

Physics-based Animation Software



Bifrost for Maya - Autodesk Area

Science, Training and Education

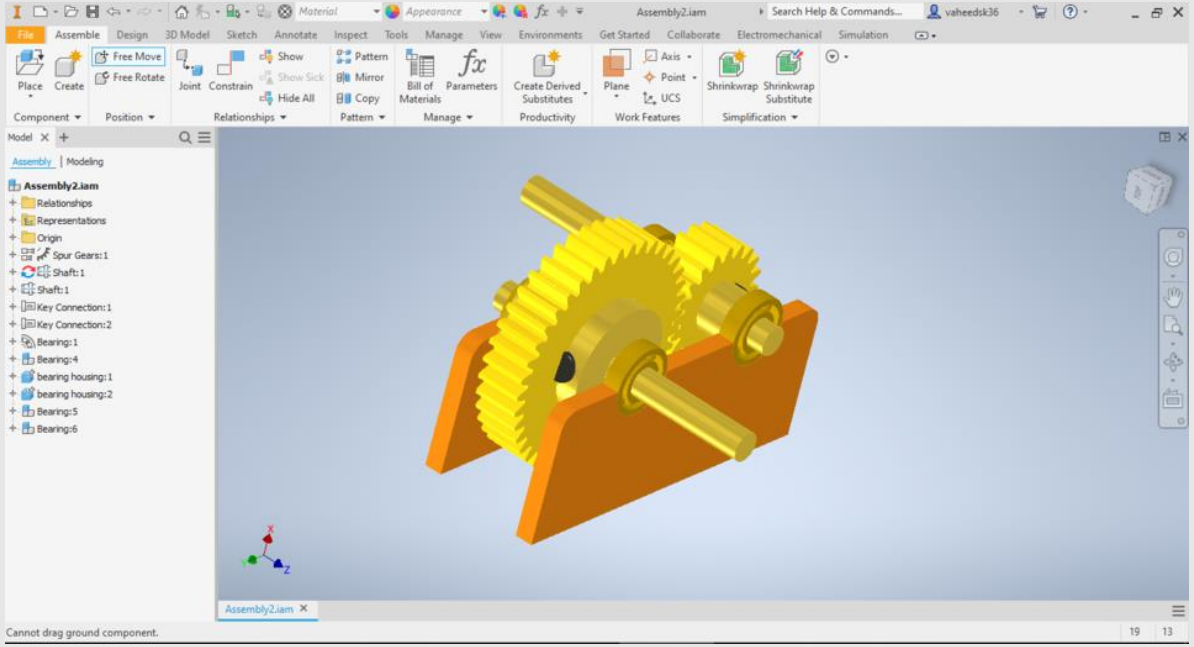


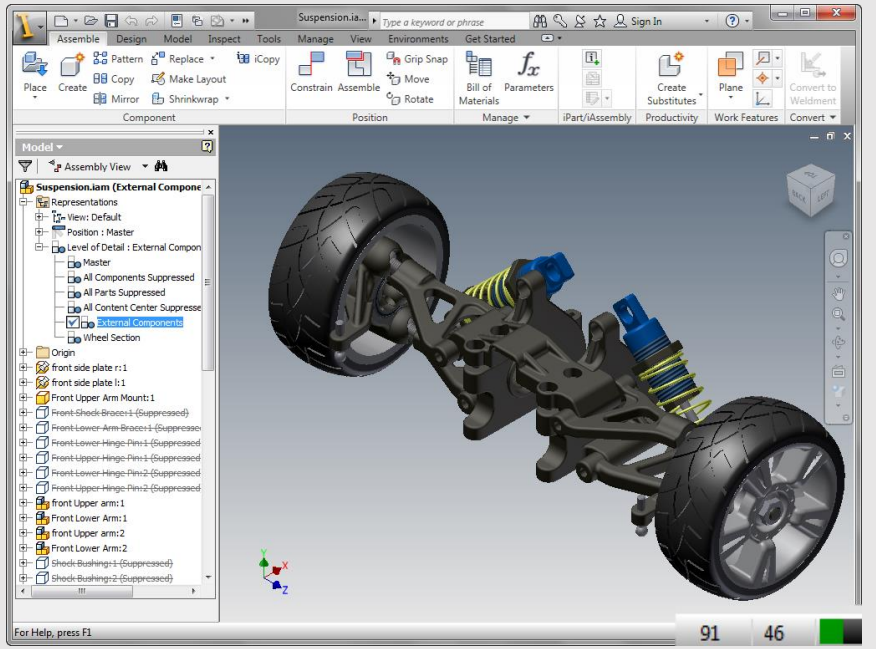
Gastro EX

https://www.youtube.com/watch?v=kxwoVFpNKbQ

Microsoft Flight Simulator 2020

Computer-aided Design (CAD)





Autodesk Inventor

Virtual YouTuber

https://panora.tokyo/panora.tokyo/48622/HPC-index.html

E-Commerce

Personalized Avatars for Realtime Virtual Try-on (SIGGRAPH Asia 2019 Real-Time Live!)
https://www.youtube.com/watch?v=OdPKf0oShr0

So Many Applications and Counting…

- Still in developing
  - new hardware
  - new algorithm
  - new AI

- There are still huge room for improvements
  - Until we achieve the world of “Matrix” movie

Comparison with other Physics Simulation

Physics-based Animation

☹ Not trying to reproduce real-world quantitively

☺ Simplicity (w.r.t. math & code)

☺ Interactivity

☺ Stability

☺ Visually pleasing result

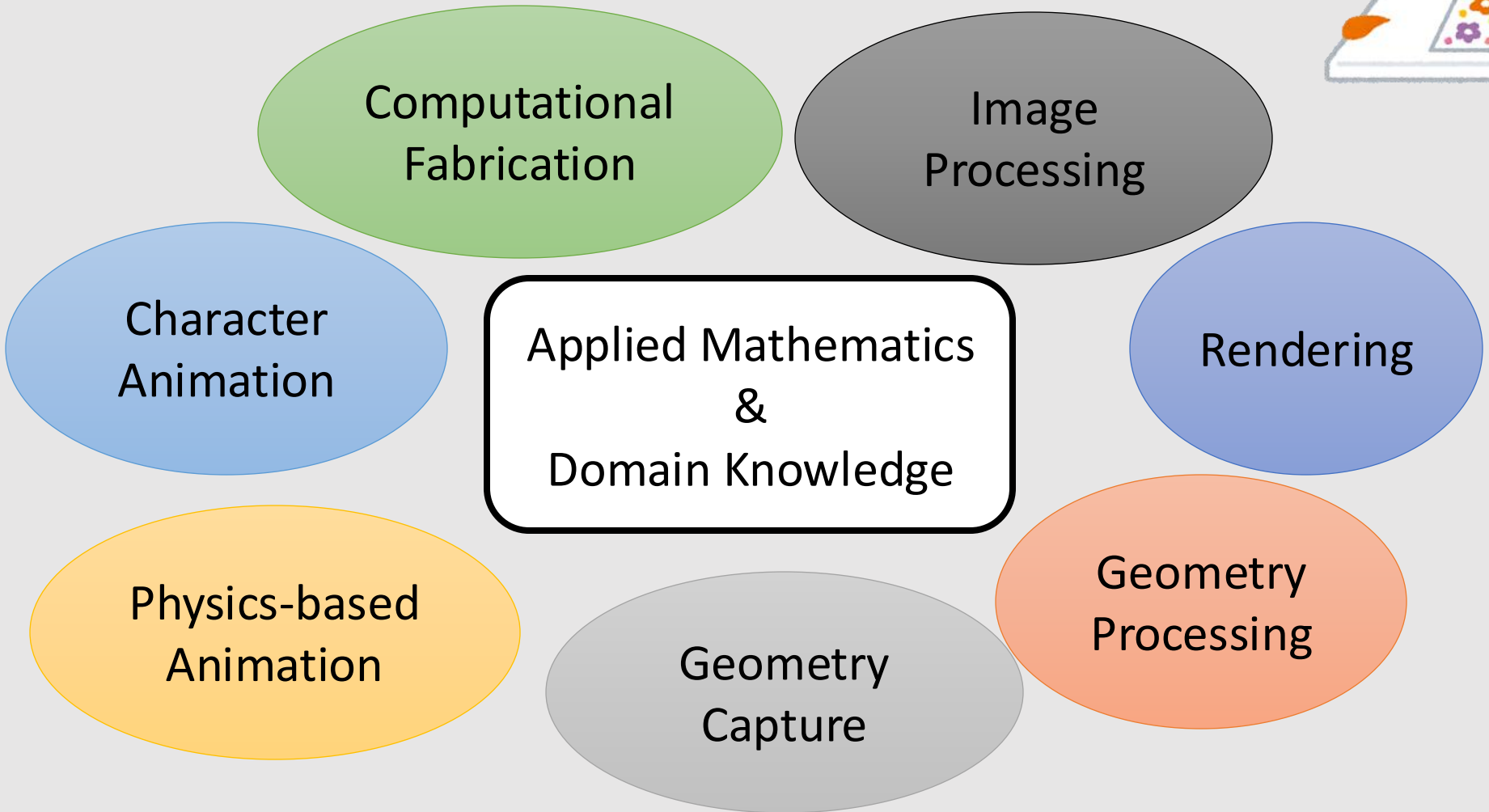
☺ More complicated problem

Scientific / Engineering Sim.

☺ Trying to reproduce real-world data as much as possible

Computer Graphics Research?

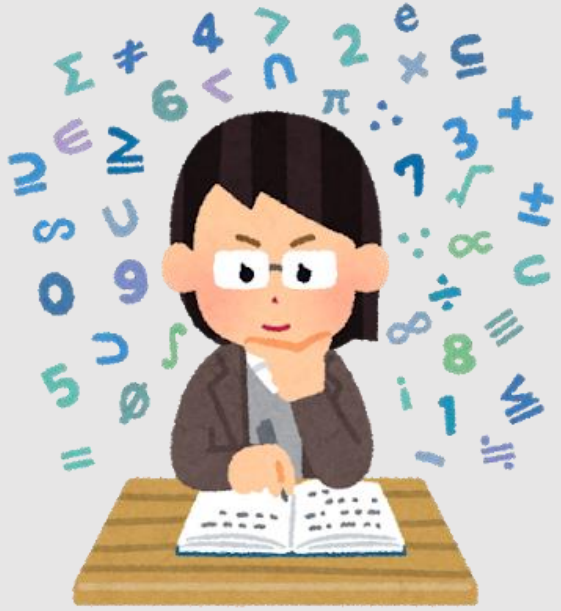
- New technologies to help artists



Overview of this Course

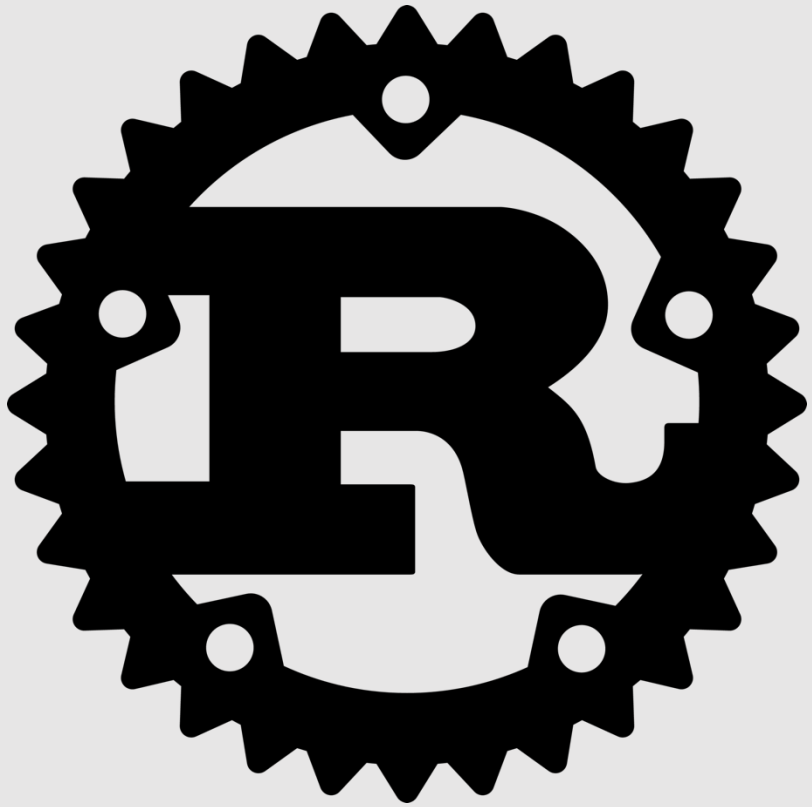
Our Goal: Math & Coding

- Getting familiar with applied mathematics
- Coding based on math equation
- Programming visual application is good for math & coding

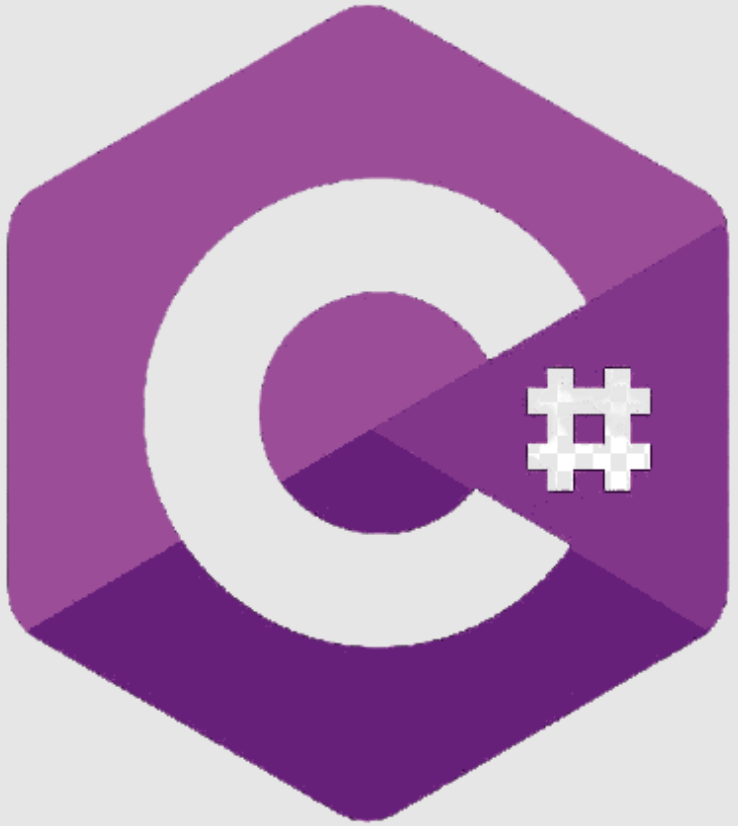


Rust and C# for Programming Languages

The first half



The latter half



What You will Learn in This Course

- Review of applied math
  - Linear Algebra
  - (Multi-variable) Calculus
  - Partial Differential Equation (PDE)
  - Optimization

} useful for many other domains!

- Review of (classical) physics
- Basic programming knowledge (Rust/C#)
- Basic software knowledge (Unity/Blender)
- Git/GitHub

What You will NOT Learn in This Course

- Rust / C# programming detail
- Unity / Blender detail
- Game design / artistic skill

This course is trying to just give you a catalyist (きっかけ，契机) for your further study

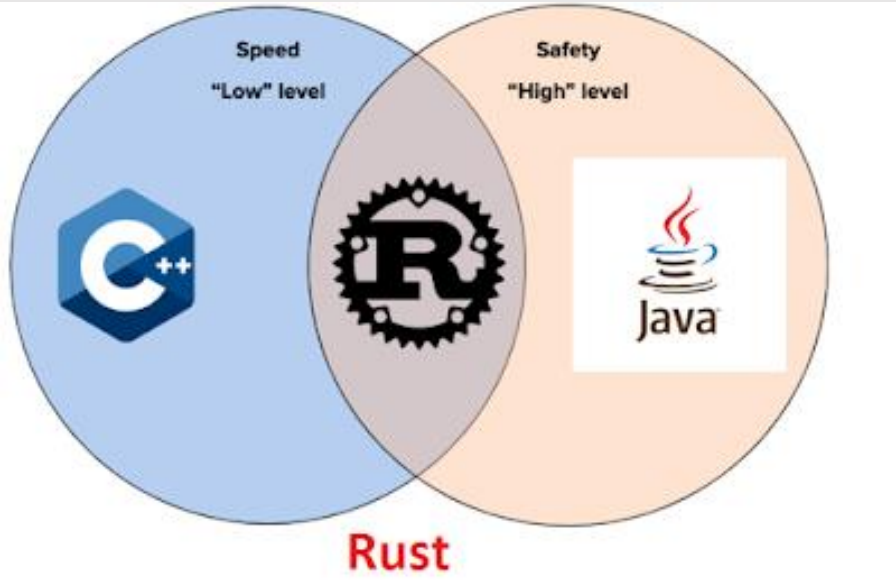
Why Rust (not C++) ?

Advantage of Rust

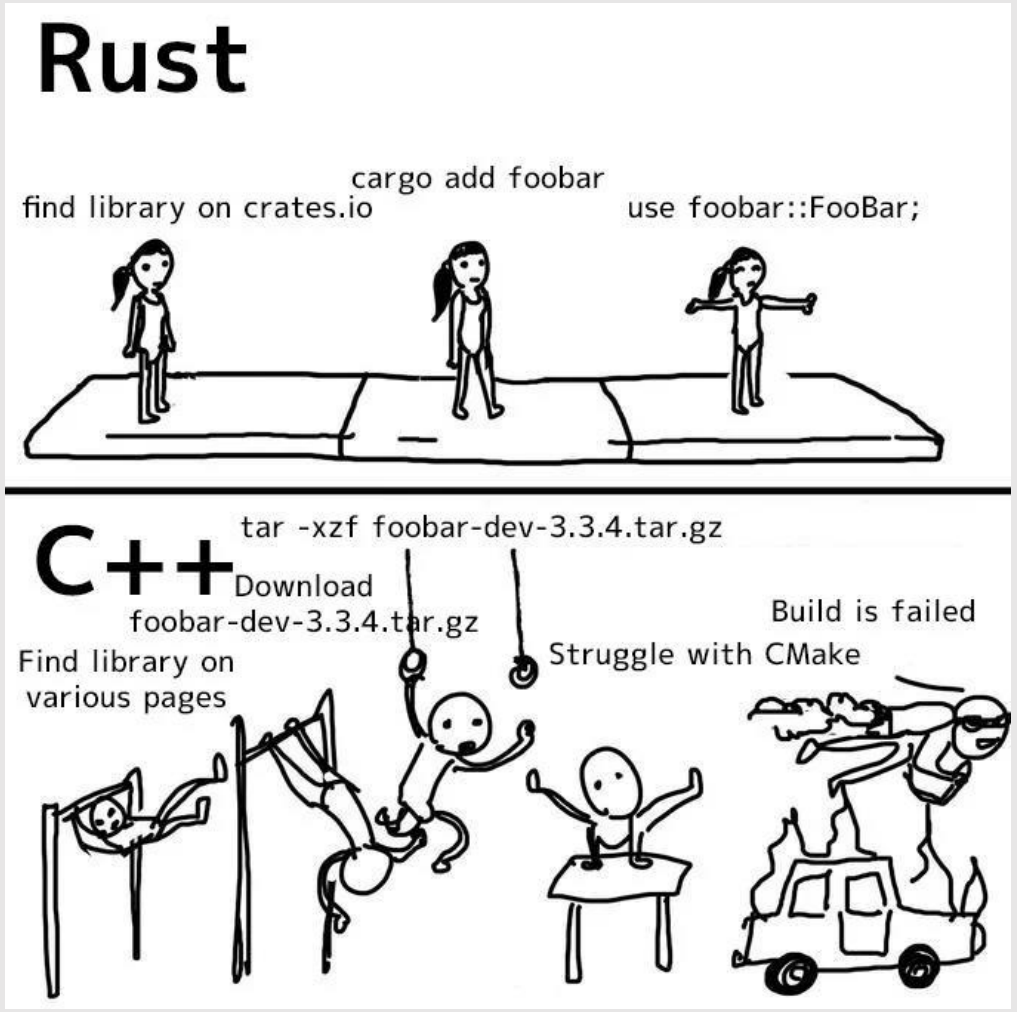
- Fast as C++
- Very secure
- Easy to import other libraries

Disadvantege of Rust

- Not popular choice for graphics research / development
- Difficult compared to Python

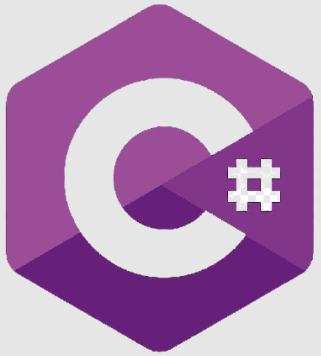


Rust vs C++



https://www.reddit.com/r/ProgrammerHumor/comments/1hnfuvk/whyidliketoavoidusingcpp/?rdt=41480

Why C# / Unity (not C++) ?



Advantage of C#

- You can script for Unity
- Easy language for beginners (very similar to Java)
- Fast compared to Python

Disadvantage of C#

- Only useful for Unity?
- Slow compared to C++ or Rust

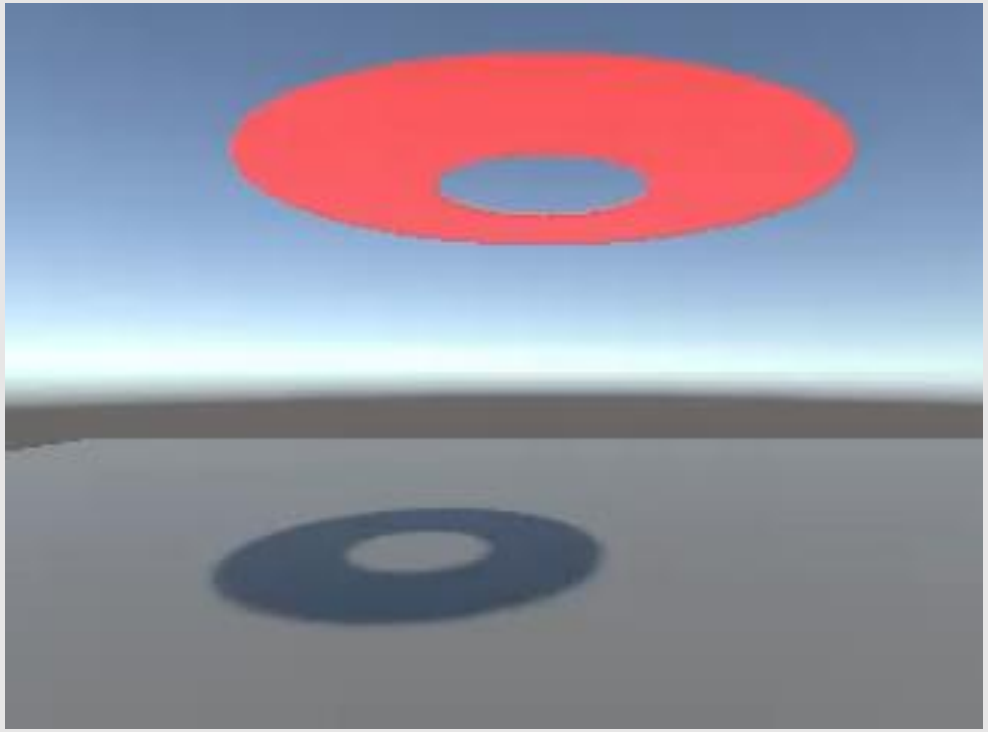
Grading

- 20% for course participation
  - Attendance is counted based on writing a secret keyword on LMS.
  - The keyword is announced for each lecture.
  - Starting from next lecture

- 80% for assignments
  - Small programming assignment submission by GitHub Classroom
  - Each assignment takes 1~2 hrs. to solve
  - Late submission -> point deduction
  - Scores and their weights are not determined until the end

What Assignment Result Looks Like?

Animation using Unity



Rendering using Blender

Policy for AI Coding

- Yes, ycan use it!
- But try to understand what AI says.

Assignment Submission by Pull Request

- Why GitHub & Pull Request ?
  - Realistic software development scenario
  - More feedback!

- In the next class, I will explain how to set up GitHub repository
- Please create an account on GitHub (if you don’t have one)

What GitHub Classroom Do?

- Creating private repositories for all the students

Repository: pba

https://github.com/PBA-2025/main

Copy & Update

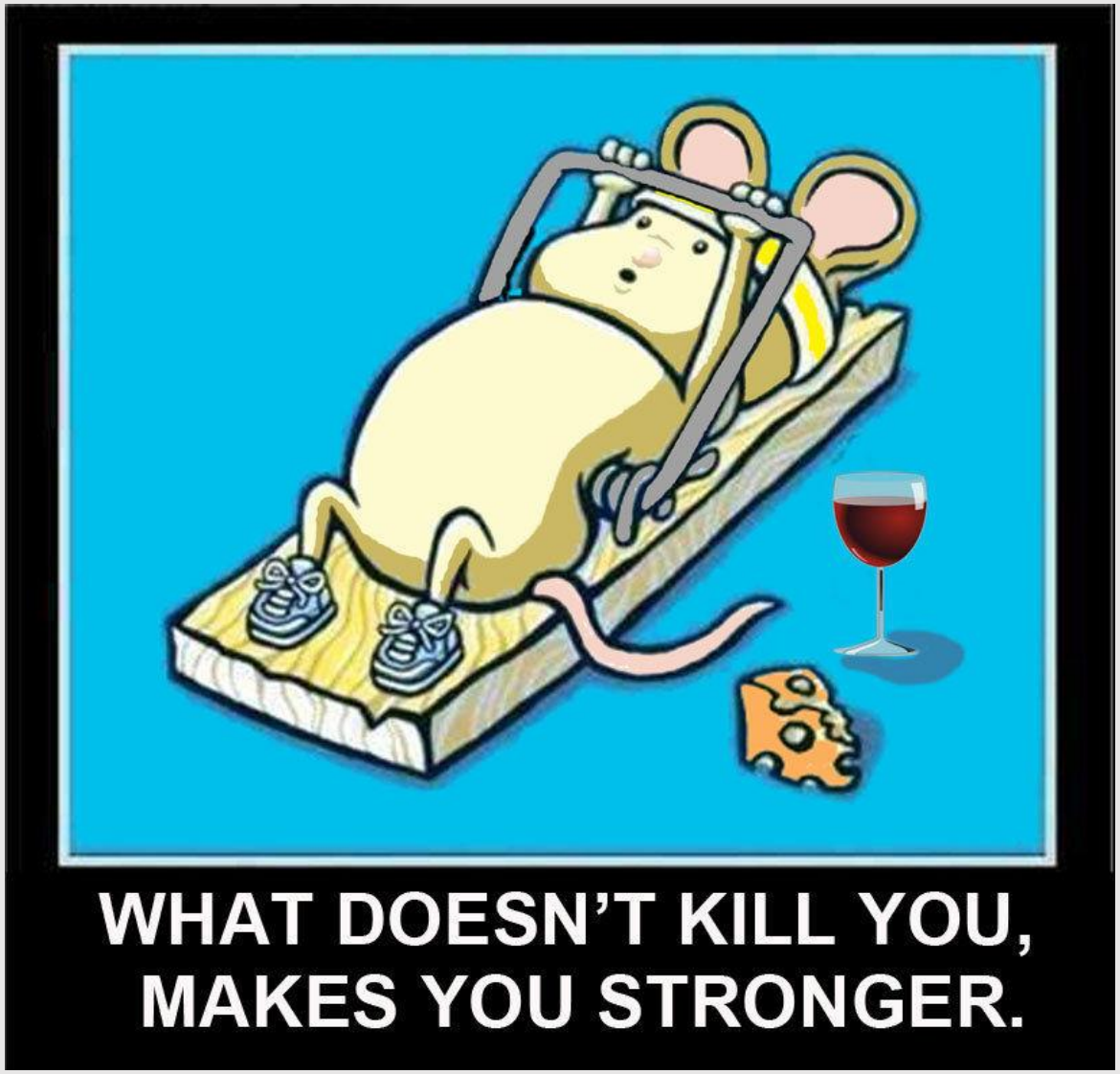
User ID: hoge

Repository: pba-hoge

User ID: huga

Repository: pba-huga

Sounds too Much Work?



Teaching Assistants

Kenji Tojo (D3)

Yuhan Wu (D2)