Computer Animation

Lab 4 - A1 Forward Kinematics

COMP 477

Background

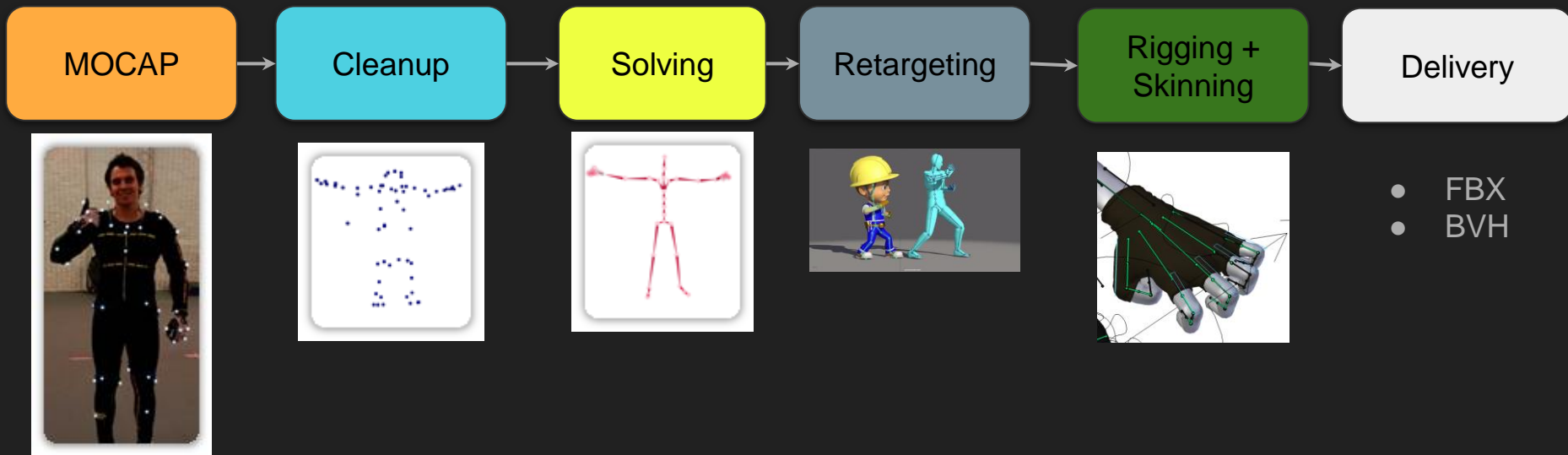What is forward kinematics?

How is it useful?

How is it used in games?

Let's take a look at where it fits in a game pipeline...

Game Animation Pipeline

Computer Animation pipelines vary drastically by studio. Typically for a AAA game, the pipeline will resemble the following:

Preprocessing

MOCAP → Cleanup → Solving → Retargeting → Rigging + Skinning → Delivery
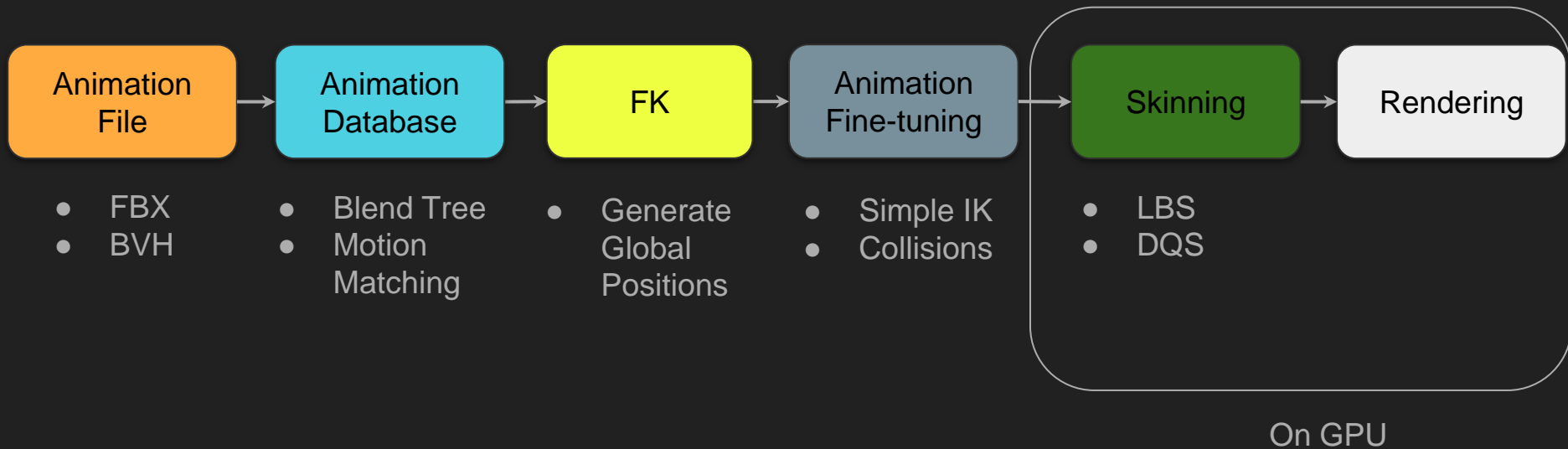
- FBX
- BVH

Game Animation Pipeline

The result of the pipeline is a character animation file stored a standardized format (**FBX**, **BVH**, etc.) Formats vary, but typically we store need the following information:

- Skeletal Structure:
  - "At-rest" joint lengths
  - "Pre-rotations"
  - Hierarchical Information (parent indices)
- Skinning Information:
  - Vertex-joint correspondances (*typically max 4 joints per vertex*)
  - Skinning weights

- Animation Information
  - Per-frame joint rotations
  - Per-frame joint translations
    - Usually only the root

Game Animation Pipeline

In-Engine

| Animation File | → | Animation Database | → | FK | → | Animation Fine-tuning | → | Skinning | → | Rendering |

- FBX
- BVH

- Blend Tree
- Motion Matching

- Generate Global Positions

- Simple IK
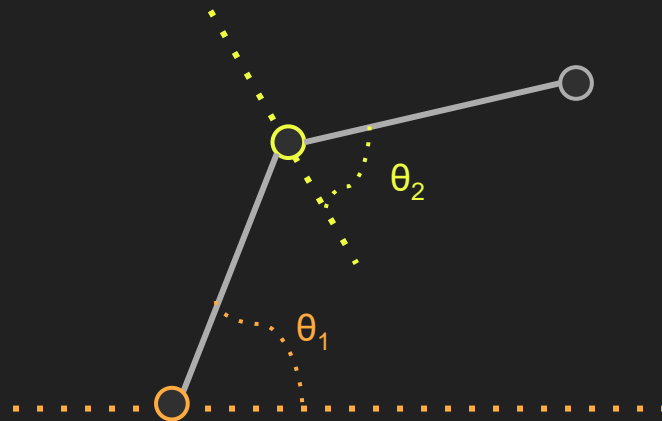- Collisions

- LBS
- DQS

On GPU

Assignment 1: Intro

Goal:

Implement Forward Kinematics

Instructions:

https://moodle.concordia.ca/moodle/pluginfile.php/5155229/mod_resource/content/0/A1.pdf

Github:

https://github.com/tiperiu/COMP477_A1

Assignment 1: Implementation

Essentially, you'll need to write an "FK" function, which:

Takes in:

- Local Joint Rotations, Joint Lengths
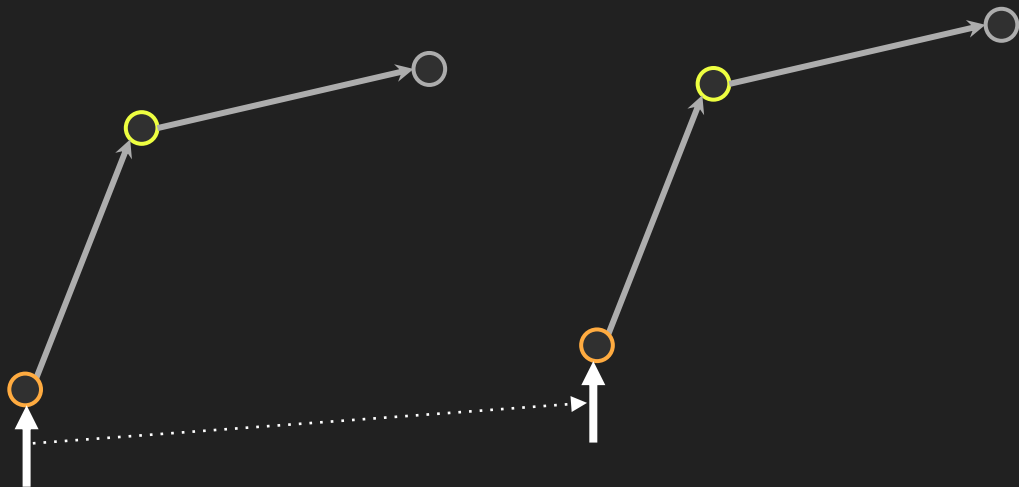
Spits out:

- Global Joint Positions

The course "Forward Kinematics" slides will be useful for this assignment

Assignment 1: Expected Behavior

Once in *"Showtime"* mode, the user can drag individual joints. Two different behaviors are expected:

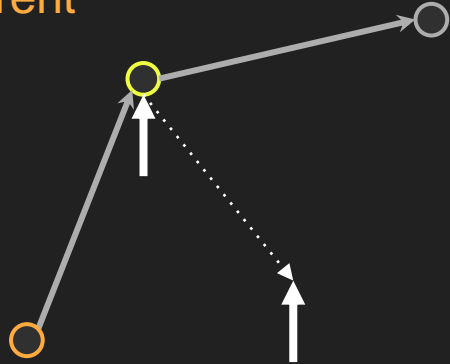If the root joint*(joint with no parents)* is dragged, the whole structure moves rigidly as follows:

Assignment 1: Expected Behavior

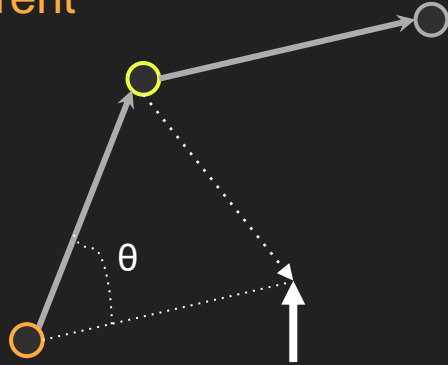Once in *"Showtime"* mode, the user can drag individual joints. Two different behaviors are expected:

If the any other joint is dragged, it, along with all the joints "under" it, rotate around the joint's parent

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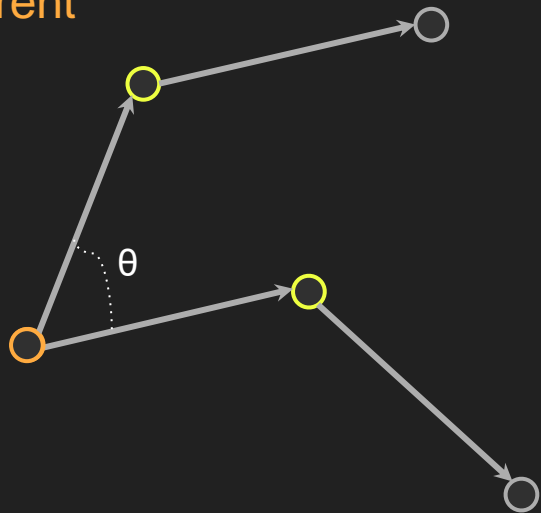If the any other joint is dragged, it, along with all the joints "under" it, rotate around the joint's parent

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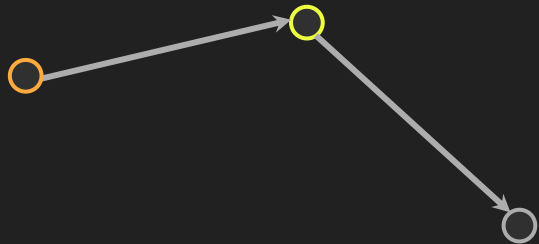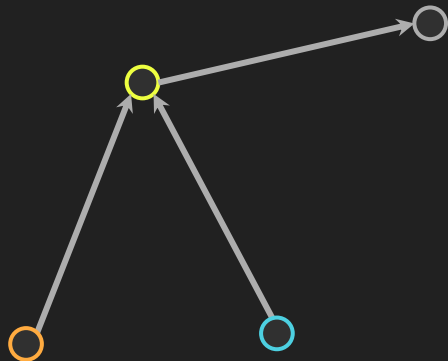Once in *"Showtime"* mode, the user can drag individual joints. Two different behaviors are expected:

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Assignment 1: Expected Behavior

Note that you **don't** need to worry about the case where a joint has multiple parents (and subsequently, the case where a hierarchy has multiple roots)

Further Reading

Useful blog post covering FK in Unity:

https://www.alanzucconi.com/2017/04/06/implementing-forward-kinematics/