AUTODESK UNIVERSITY

From In-House to Off-the-Shelf: USD at Animal Logic

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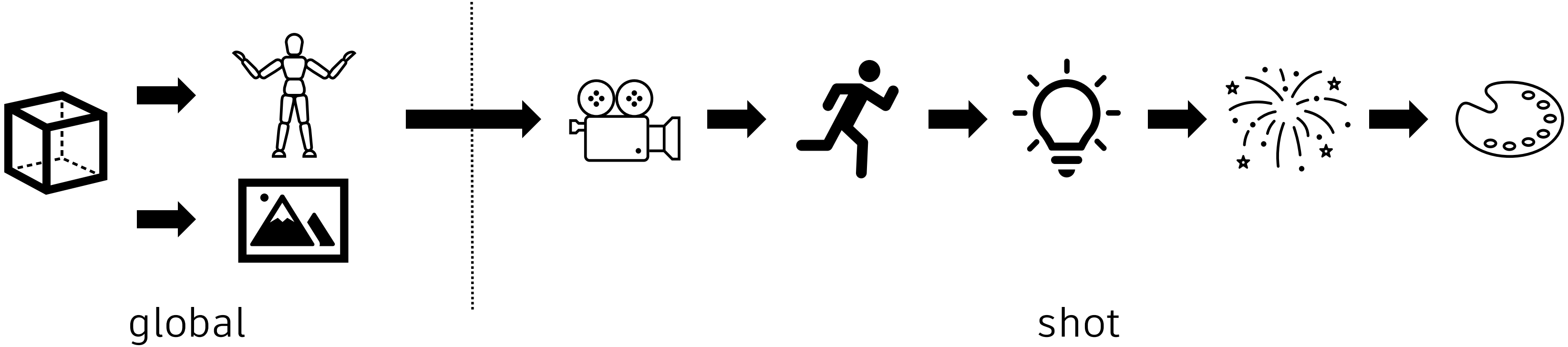
Learning objectives

1. Understand the production challenges that USD solves and the history behind its integration at Animal Logic
2. Learn about the collaboration between Animal Logic, Autodesk, BlueSky, Luma Pictures and Pixar behind USD plugin in Maya
3. Understand how USD workflows have been integrated into Maya at Animal Logic
4. Get a glimpse into the future of USD workflows at Autodesk

Production challenges

Production pipeline anatomy

- Departments



- Assets' lifecycle: build | work | publish | review | deliver

Animal Logic Studios

- Founded in 1991 in Sydney, Australia, Animal Logic is celebrating it's 30th Anniversary this year
- Over three decades, Animal Logic has worked on television commercials, VFX projects (The Matrix, The Great Gatsby, Guardians of the Galaxy Vol. 2), feature animation (The LEGO Movie Franchise and Happy Feet) and hybrid films (Peter Rabbit 1 & 2)
- Animation studios in Sydney, Australia and Vancouver, Canada
- Currently employs over 700 artists, technicians and support staff
- The two studios are currently working on multiple feature animation projects

Some challenges to solve

(from a pipeline perspective)

Working at scale

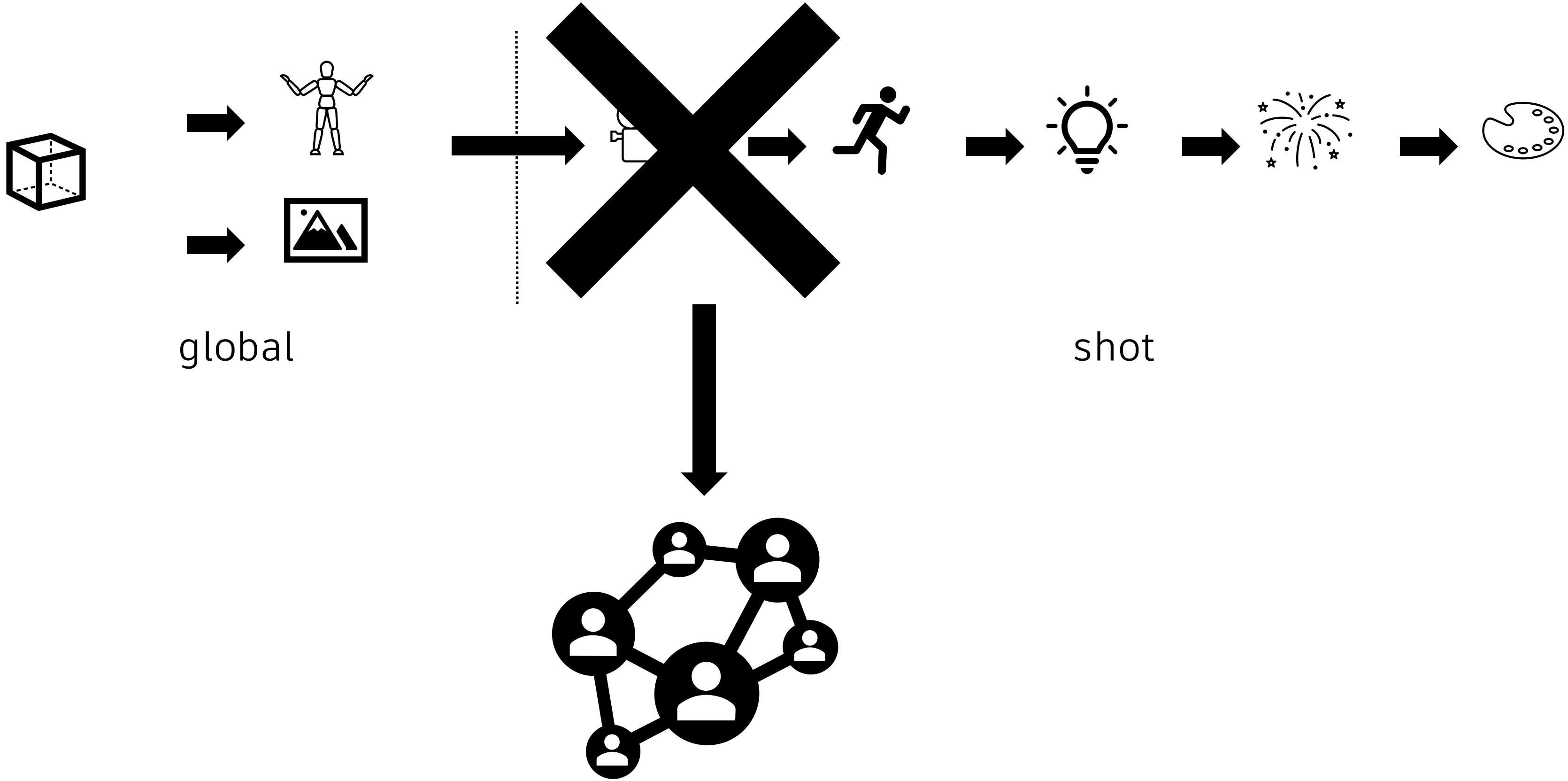
Parallelisation
Increased throughput
Decreased production times

Efficiency
Increased iterations rate
Increased quality

Reusability
Decreased costs

Production pipeline anatomy

It should look more like this…



USD
(Pixar)

Universal…

- Continuously evolving technologies and workflows
  - New softwares, discontinued ones
  - Proprietary software stack
  - Emerging technologies
- Decoupling scene description from applications
  - Faster integration
  - More room for Innovation

...Scene Description

USD is much more than Alembic

- Non destructive representation of layered opinions
  - Parallelisation
  - Reusability
- Highly efficient in memory scenegraph representation
  - Efficiency
- Rendering framework
  - Efficiency

Structuring

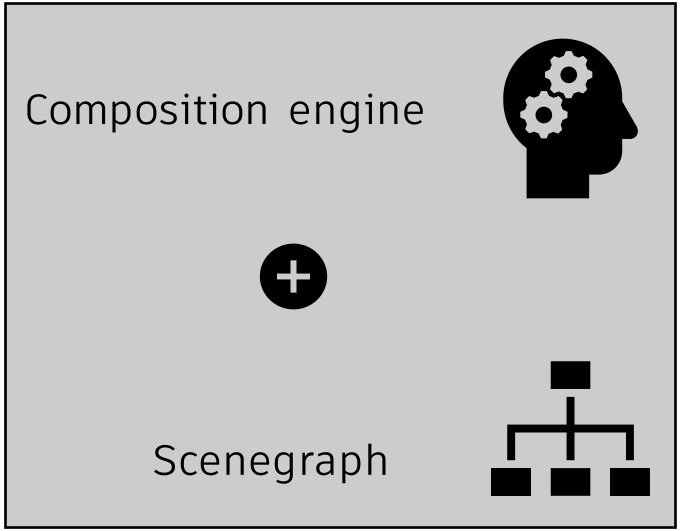
Scene composition

Composition arcs
e.g., the whole "Entity/Fragment" system in use at Animal

Layers and opinions
e.g., animation points cache

Variants
e.g., low/high level geometrical representation

Live Authoring



Composition engine

Scenegraph

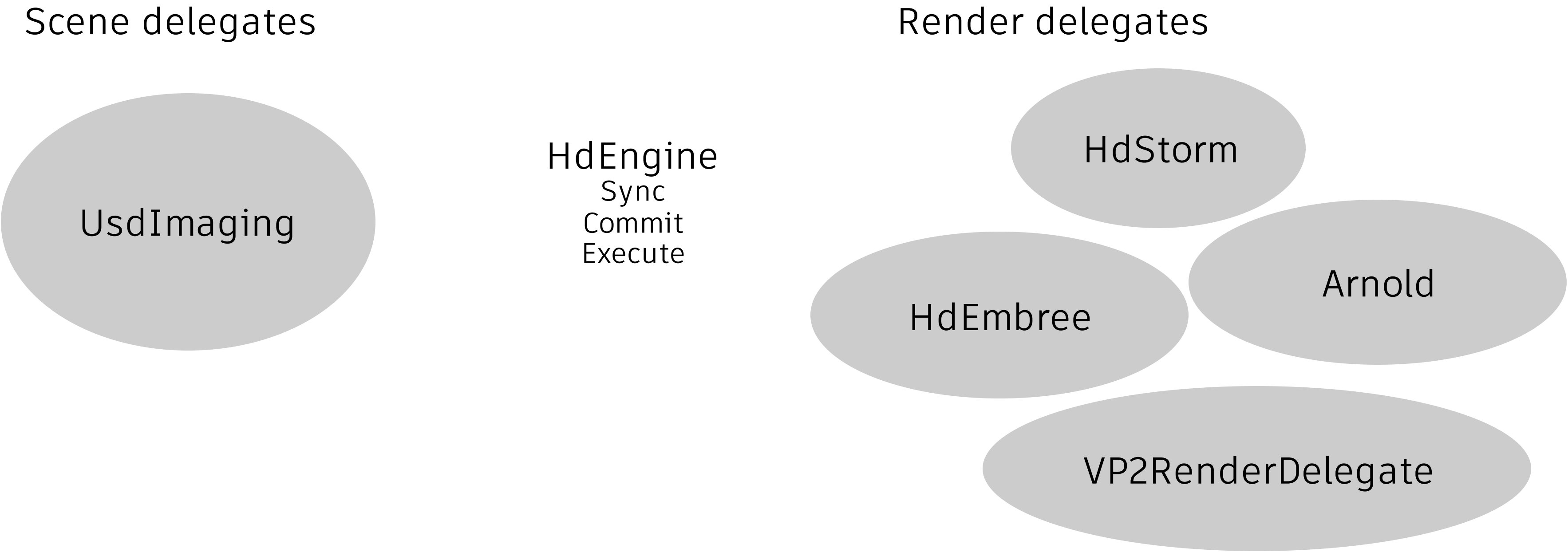
(Stage, i.e. "composed view")

- Variant switch
- Edit target selection
- Property edition

Viewing

Hydra

A rendering framework connecting scene description and renderers



Scene delegates

UsdImaging

HdEngine
Sync
Commit
Execute

Render delegates

HdStorm

HdEmbree

Arnold

VP2RenderDelegate

USD integration timeline

- Early prototype of CSD late 2015
- Replaced by USD mid 2016: Animation 2.0 kick-off
  - Peter Rabbit 1 (early 2018): first show using USD (via A20)
- Pipeline 4 kick-off mid 2018
  - Peter Rabbit 2 (early 2020): first show fully run on USD
- Lego Movie 2 (late 2019): last show fully run without USD
- Late 2020: USD technical migration is complete, workflow migration starts

From AL_USDMaya to maya-usd

Maya at Animal Logic

- Main DCC application, used by the following departments:
  - Modelling
  - Rigging
  - Previz
  - Layout
  - Animation

USD integration in Maya

PxrUsdMaya

- Static I/O (~Alembic)
    - Import
    - Export
- ProxyShape (live connection to USD)
    - MPxSurface shape
    - USD stage connection
    - More oriented towards Maya scene assemblies and multi-proxyShape support

USD integration in Maya

Static I/O

Good

- Non disruptive
- Good for low-level, i.e. “techvar”, assets
- Just plain old Maya!

Not So Good

- USD high level concepts are lost
- Not suited for higher-level, i.e., containers

USD integration in Maya

ProxyShape

Good

- Preserved USD high-level concepts
- Out of the box access to Hydra

Not So Good

- Bridging data models
- Needs a render delegate for a full integration

Bridging data models

First Attempt

- Hierarchy
- Selection
- Transformation

First approach was the combination of custom transform nodes, handling selection and transformation. Additional proprietary widgets would manage stage edition.

Another workflow was added, a "push/pull" hybrid scenario in which USD primitives are "pushed" to maya, edited and "pulled" back to USD.

AL_USDMaya

v0

Development started on 2016, used on Peter Rabbit 1

Translator Plugins

✓

MPxDrawOverride/Storm proxyShape

✓ ✗

Custom Transform Nodes

✗

Successes and challenges

Mixed results!

- Animation was the most successful integration
- Layout was "ok"
  - Needs full integration of USD objects in VP2
- Environment authoring was the most distressful for artists because of new and unstable toolsets
  - Cross functional teams approach needed

Open Sourcing AL_USDMaya

At Siggraph 2017

Good

- External contributions
- Improved code quality
- Improved CI/CD

Not So Good

- Git workflow (using git subtree)
- Community management

maya-usd

pxrUsdMaya or AL_USDMaya

- 2018: agreement between Animal Logic, Autodesk and Pixar to create an official plugin, maya-usd
  - Based on pxrUsdMaya
  - Both legacy plugins migrated from AnimalLogic / Pixar to Autodesk/maya-usd
  - Core libmayaUsd
  - Autodesk
    - Implemented the VP2 proxy render delegate
    - UFE integration
    - Lion's share of migration's heavy lifting

Bridging data models

Take 2

- UFE (Universal Front End)
- DCC agnostic (it is not limited to Maya!)
- Hierarchy, Selection, Transformation, Undo management
- Handlers for:
  - DCC (e.g., Maya)
  - Plugin runtimes (e.g., USD)
- Observer pattern for notifications

Collaboration

- Huge undertaking: various partners with different needs
- Technical Steering Committee (TSC) to coordinate the transition
    - Recurrent meetings
    - Priorities discussed collaboratively
    - Large development went through several phases, including white papers and draft PRs, e.g., transformation stack API
- Shout-out to Customer charter meetings

Migration retrospective

Good

- Open mindedness
- Transparency
- Iterative process

Not So Good

- Less velocity / nimble progress
- Added inertia between dev and users
- Timezones challenges

AL_USDMaya

v1

Currently in production

Translator Plugins

✓

VP2 render delegate

✓

UFE

✓ ⊗

Challenges we're looking at

- Proceduralim in USD
- Realtime HQ Renderer
- Cloud integration/AR

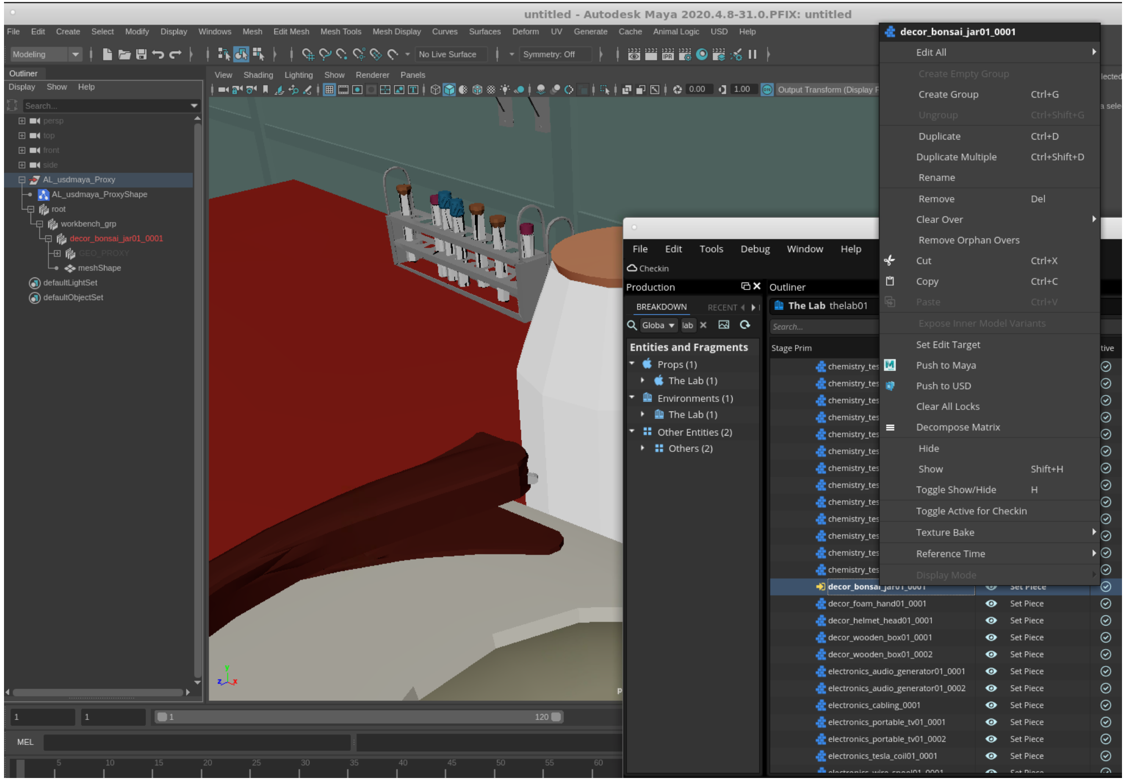
Examples

ALab

- https://animallogic.com/usd-alab/
- https://groups.google.com/g/usd-alab-interest

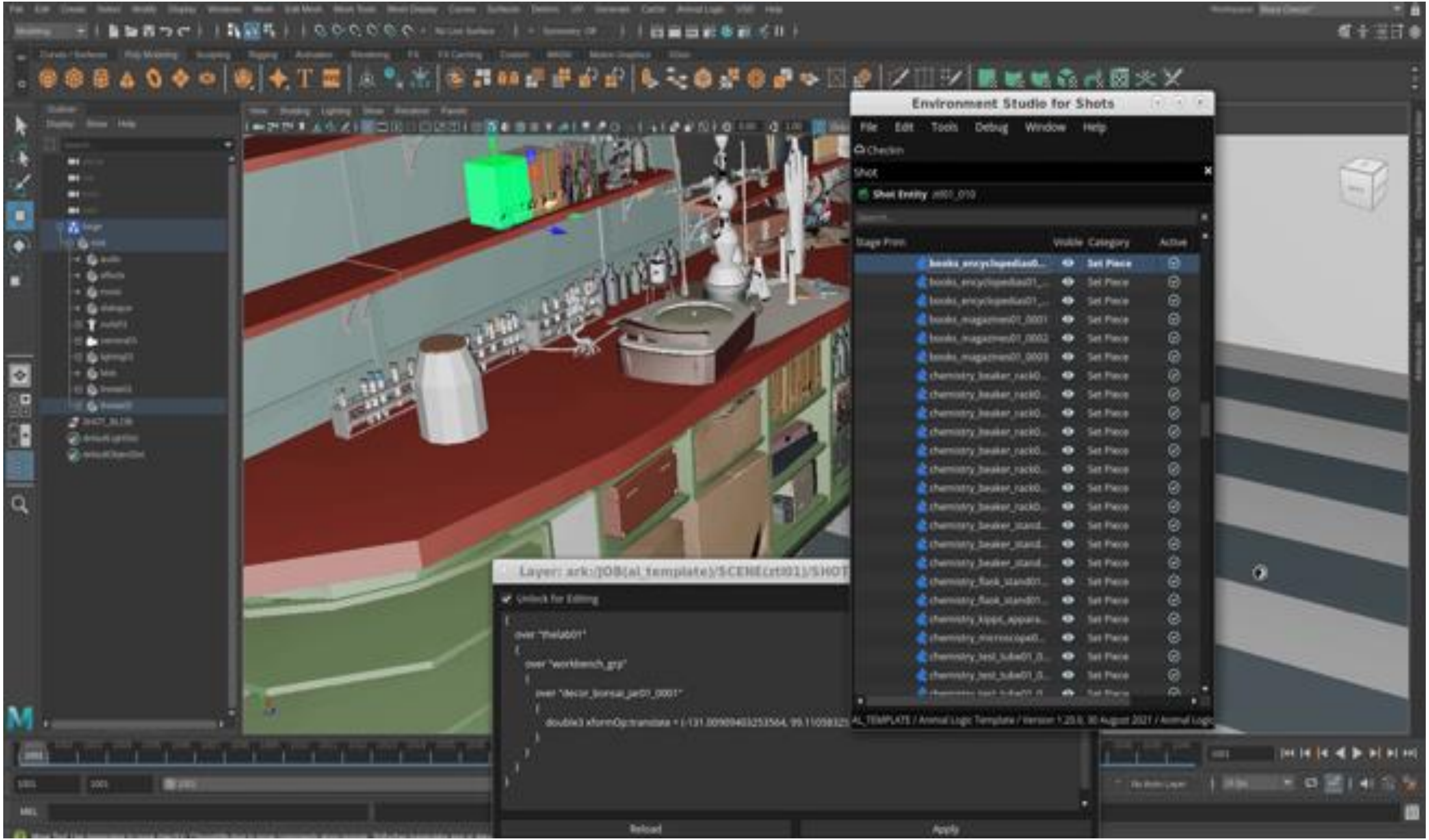
Push/Pull

- Environment Studio 2
- AL_USDMaya cmds
- Python code



Set dressing

- Environment Studio 2
- Transformation, display mode, visibility, active/inactive
- Edit Target Management: selection based on pipeline-based rules



Stage Prim	Visible	Category	Active
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books_encyclopedias01_...	👁	Set Piece	✓
books_encyclopedias01_...	👁	Set Piece	✓
books_magazines01_0001	👁	Set Piece	✓
books_magazines01_0002	👁	Set Piece	✓
books_magazines01_0003	👁	Set Piece	✓
chemistry_beaker_rack0...	👁	Set Piece	✓
chemistry_beaker_rack0...	👁	Set Piece	✓
chemistry_beaker_rack0...	👁	Set Piece	✓
chemistry_beaker_rack0...	👁	Set Piece	✓
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chemistry_beaker_stand...	👁	Set Piece	✓
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chemistry_flask_stand01...	👁	Set Piece	✓
chemistry_flask_stand01...	👁	Set Piece	✓
chemistry_kipps_appara...	👁	Set Piece	✓
chemistry_microscope0...	👁	Set Piece	✓
chemistry_test_tube01_0...	👁	Set Piece	✓
chemistry_test_tube01_0...	👁	Set Piece	✓
chemistry_test_tube01_0...	👁	Set Piece	✓

AL_TEMPLATE / Animal Logic Template / Version 1.20.0, 30 August 2021 / Animal Logic

Layer: ark:/JOB(al_template)/SCENE(zt001)/SHOT

☑ Unlock for Editing

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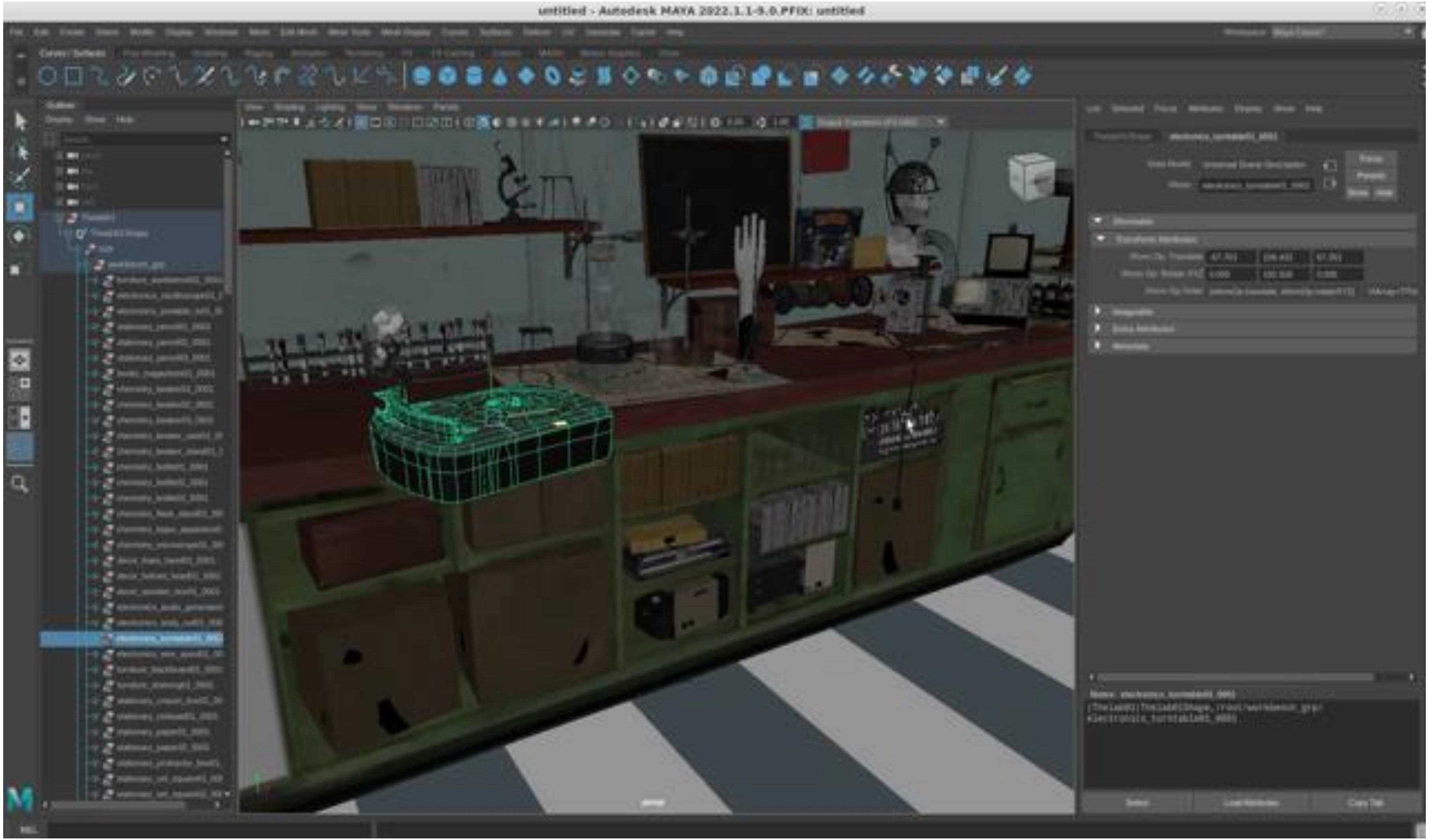
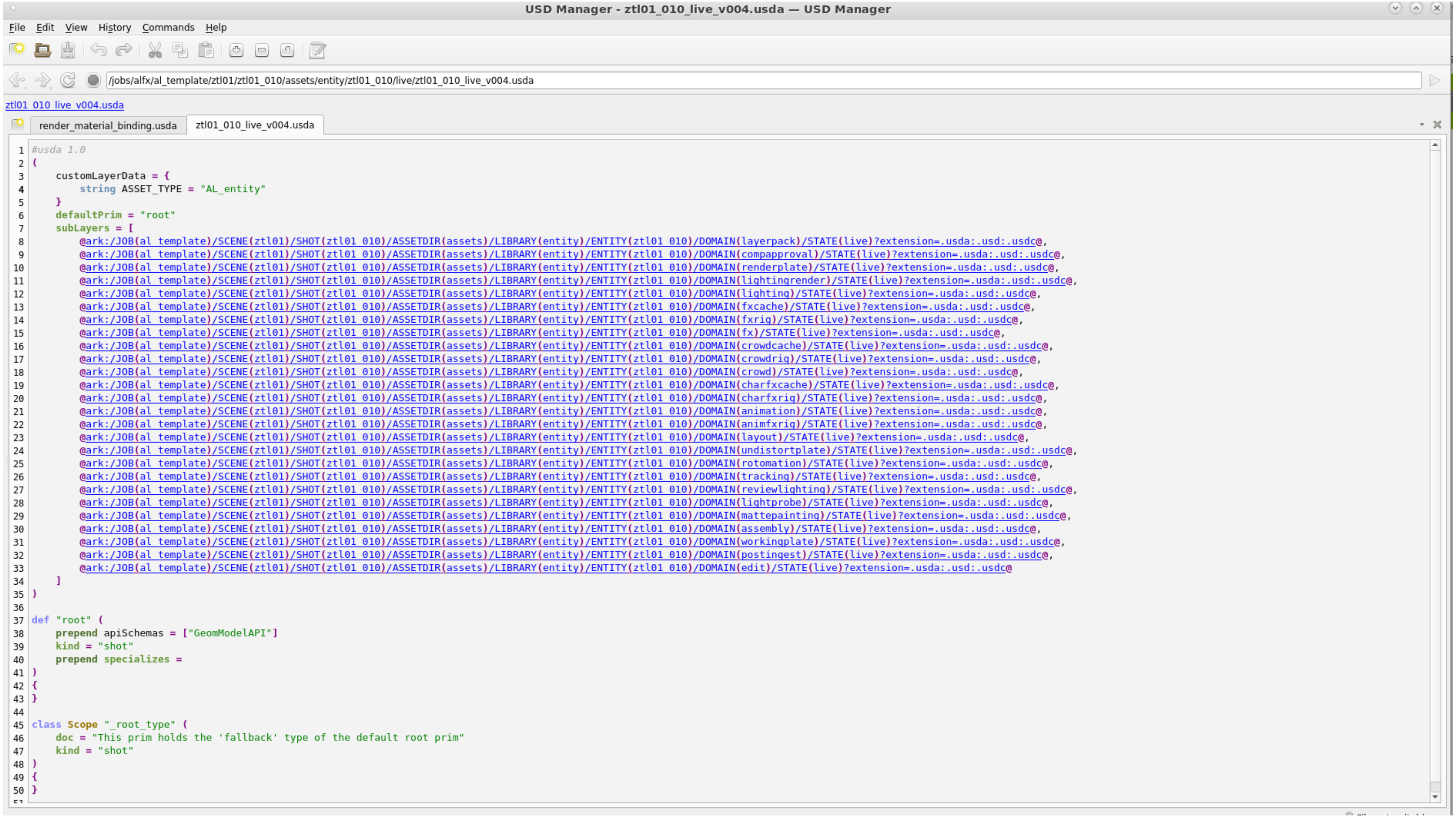


untitled - Autodesk MAYA 2022.1.1-9.0.PFIX: untitled

Rig to anim cache variant switch

- Forge 2
- Sparse animation cache overriding points brought in by the global asset
- Rig imported using a maya reference translator
- Python translators assemble the bindings and motion
- USD variant selection to switch from one to the other


USD Manager - ztl01_010_live_v004.usda — USD Manager
File
Edit
View
History
Commands
Help
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}

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)
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}
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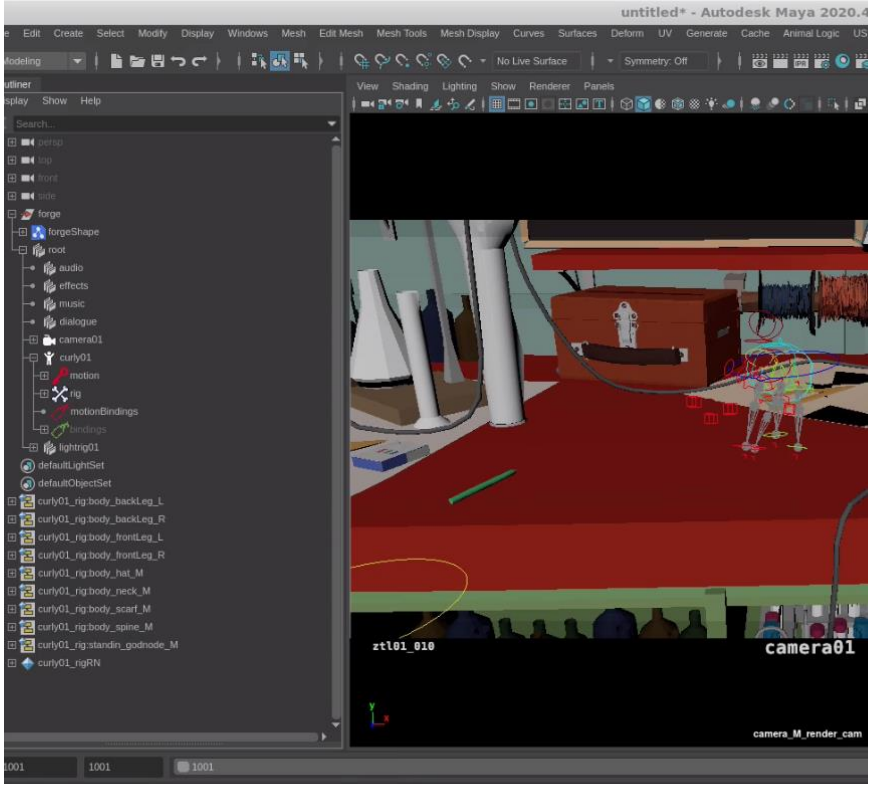
Rig to cache switch


untitled* - Autodesk Maya 2020.4
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No Live Surface
Symmetry: Off
View Shading Lighting Show Renderer Panels
persp
top
front
side
forge
forgeShape
root
audio
effects
music
dialogue
camera01
curly01
motion
rig
motionBindings
bindings
lightrig01
defaultLightSet
defaultObjectSet
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curly01_rig:body_scarf_M
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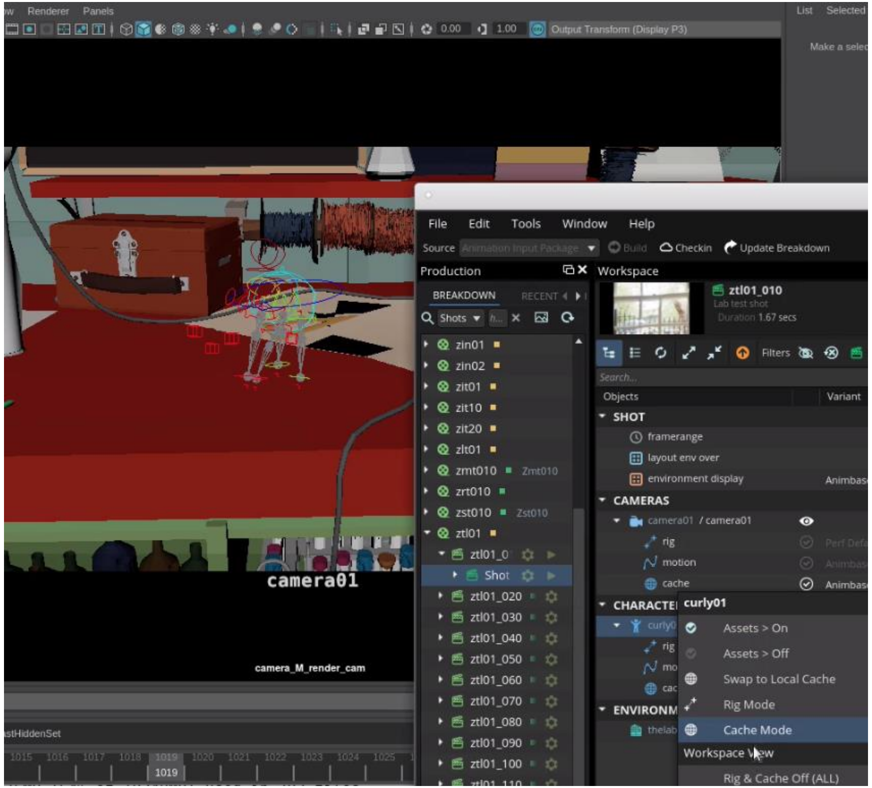

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