

Introduction to Maya Customization

Lanh Hong

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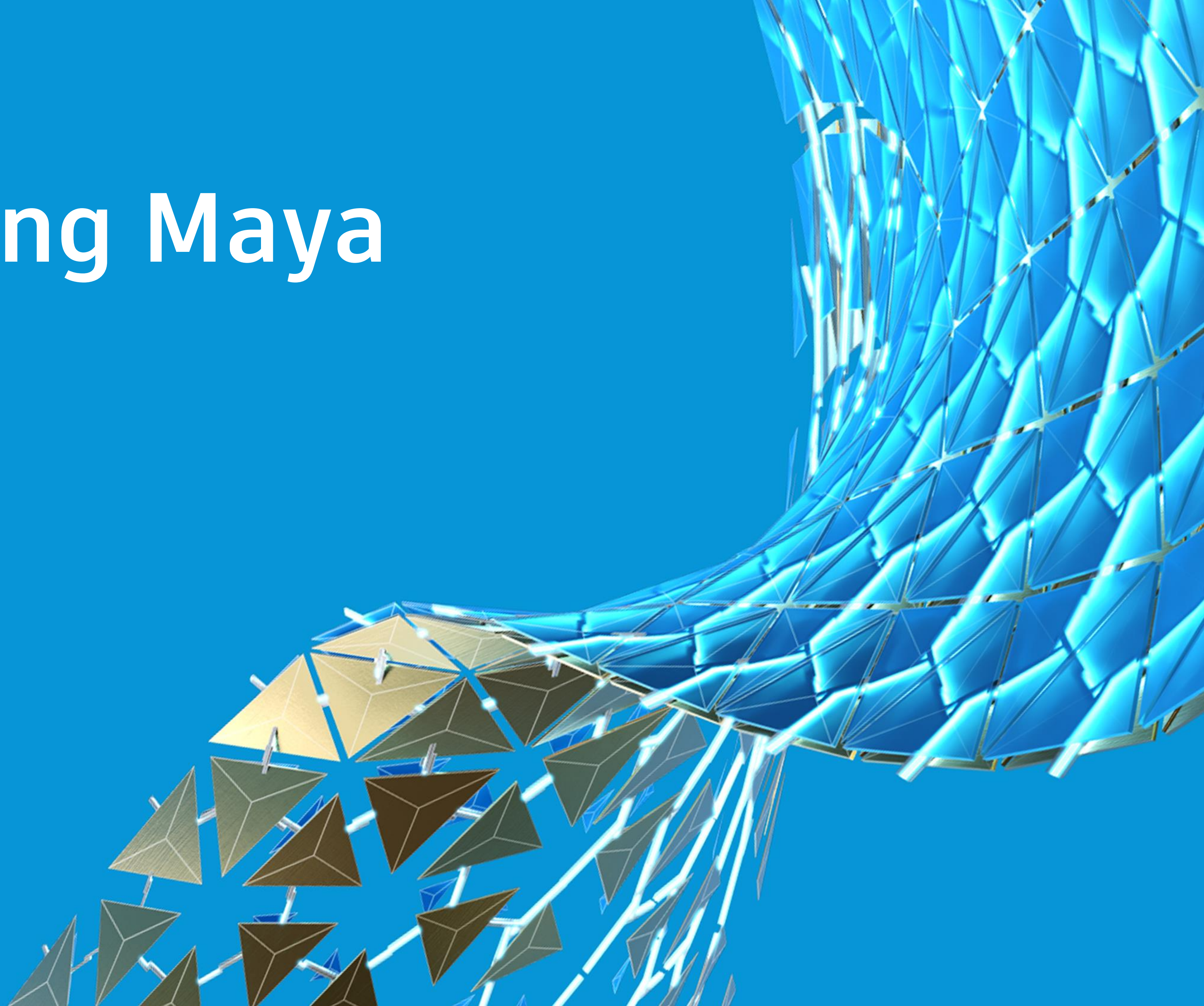


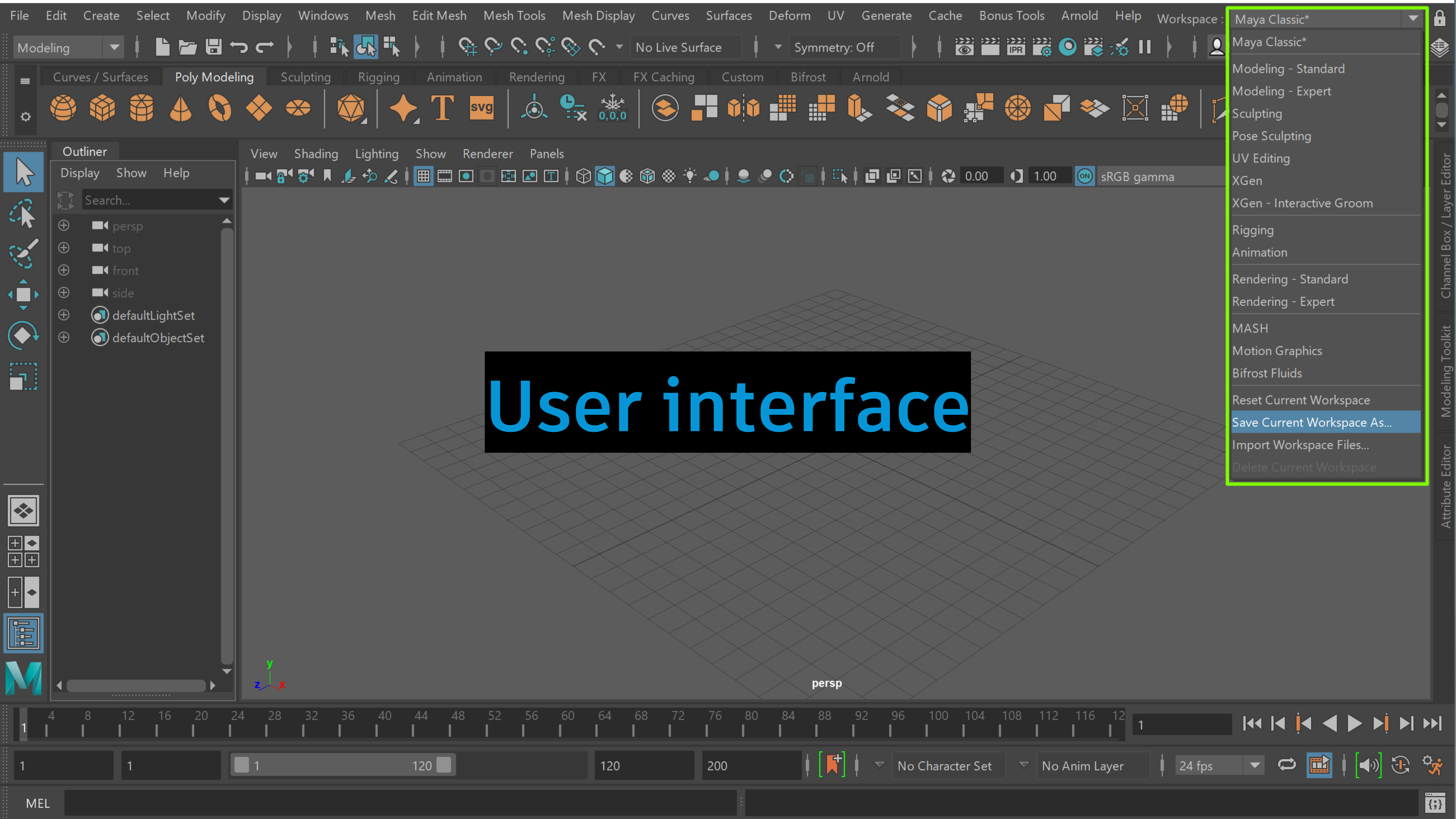
About the speaker

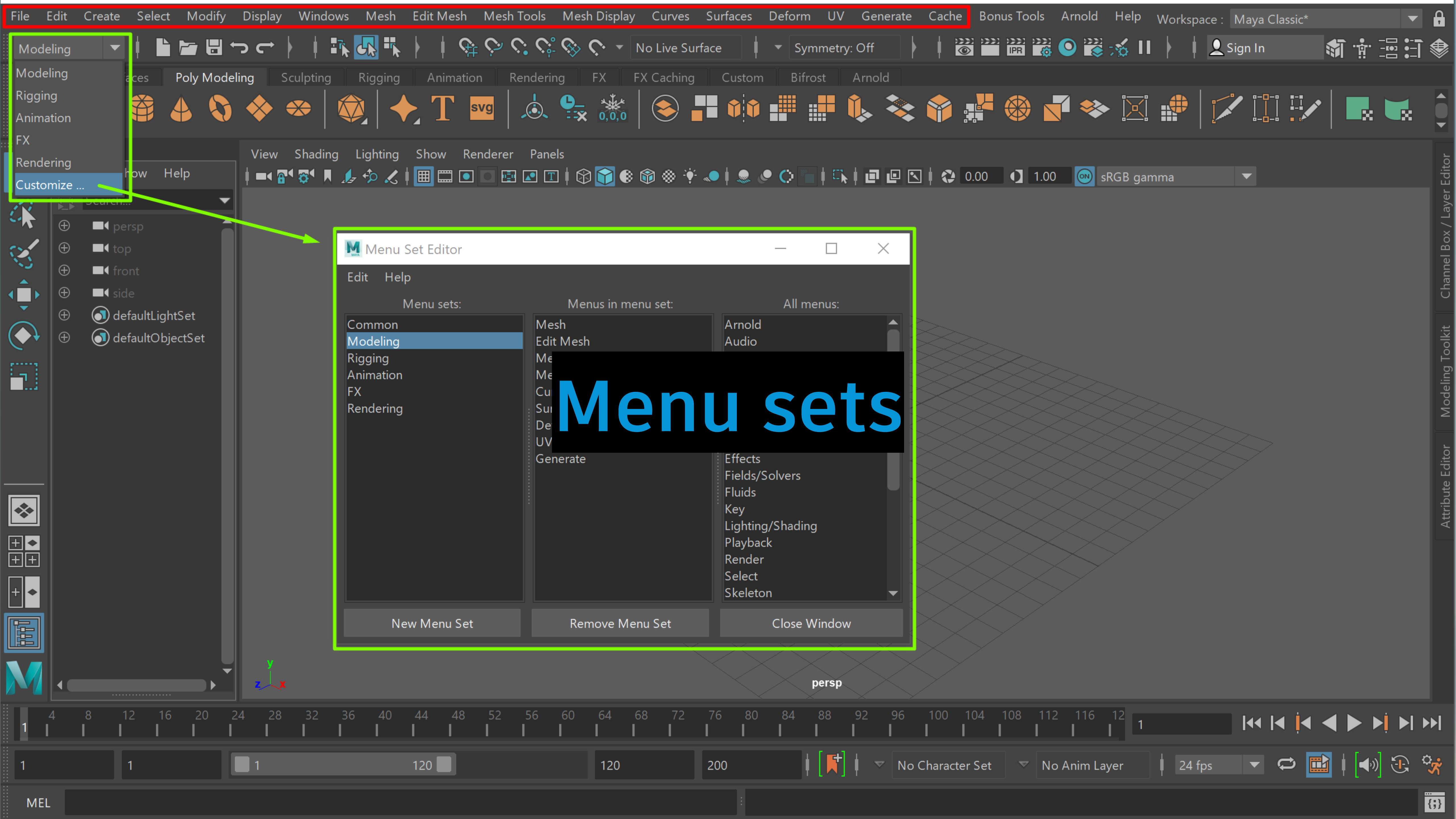
Lanh Hong

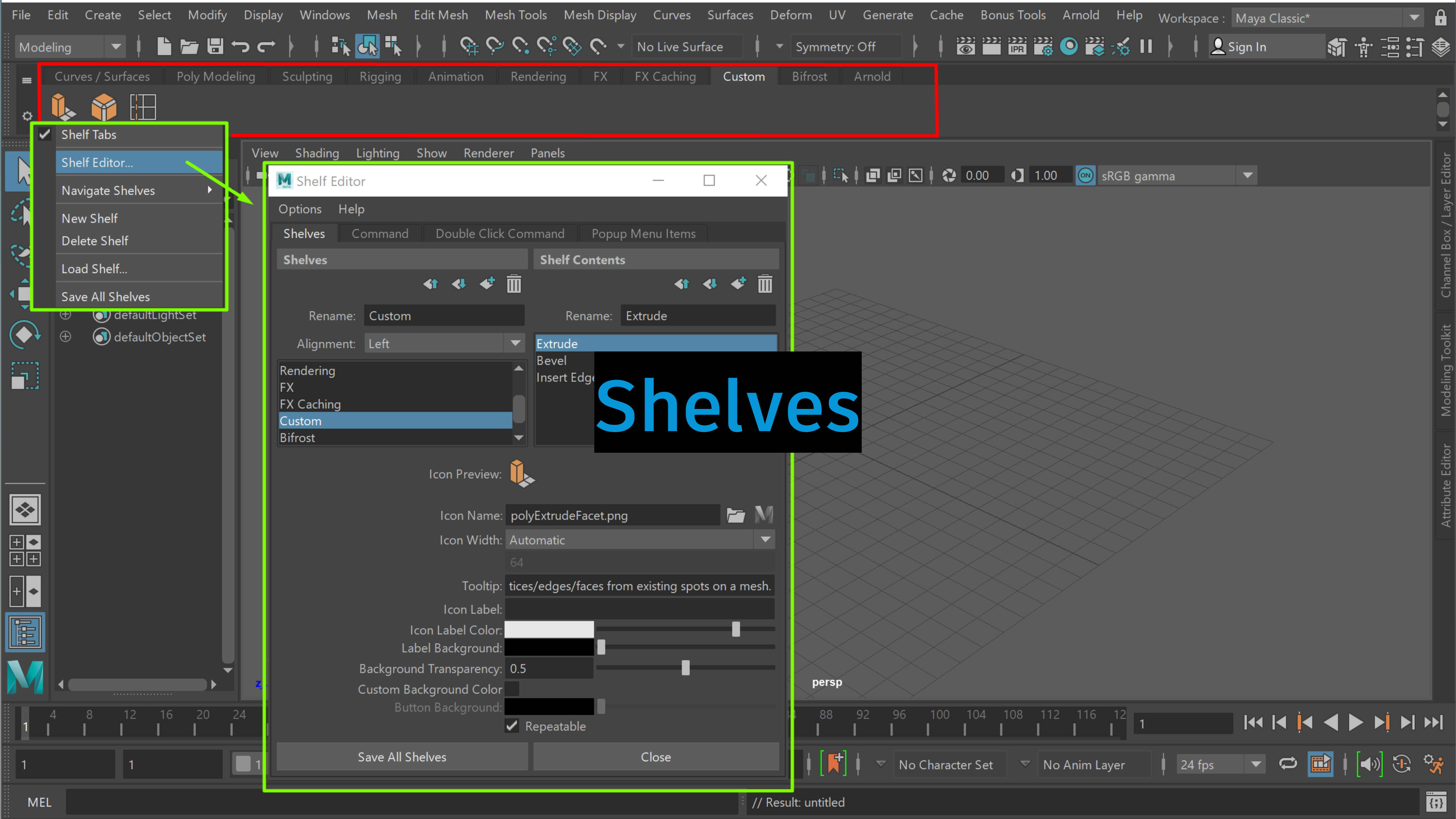
Lanh is part of the Media & Entertainment DevTech team at Autodesk where she provides support for members in the Autodesk Developer Network and customers using the Autodesk Forge web services. She joined Autodesk in 2018 after completing her bachelor's degree in Computer Science from the University of California, Davis. Since then, her primary focus is on helping customers customize and extend Autodesk Maya's functionalities using the Maya API.

Customizing Maya









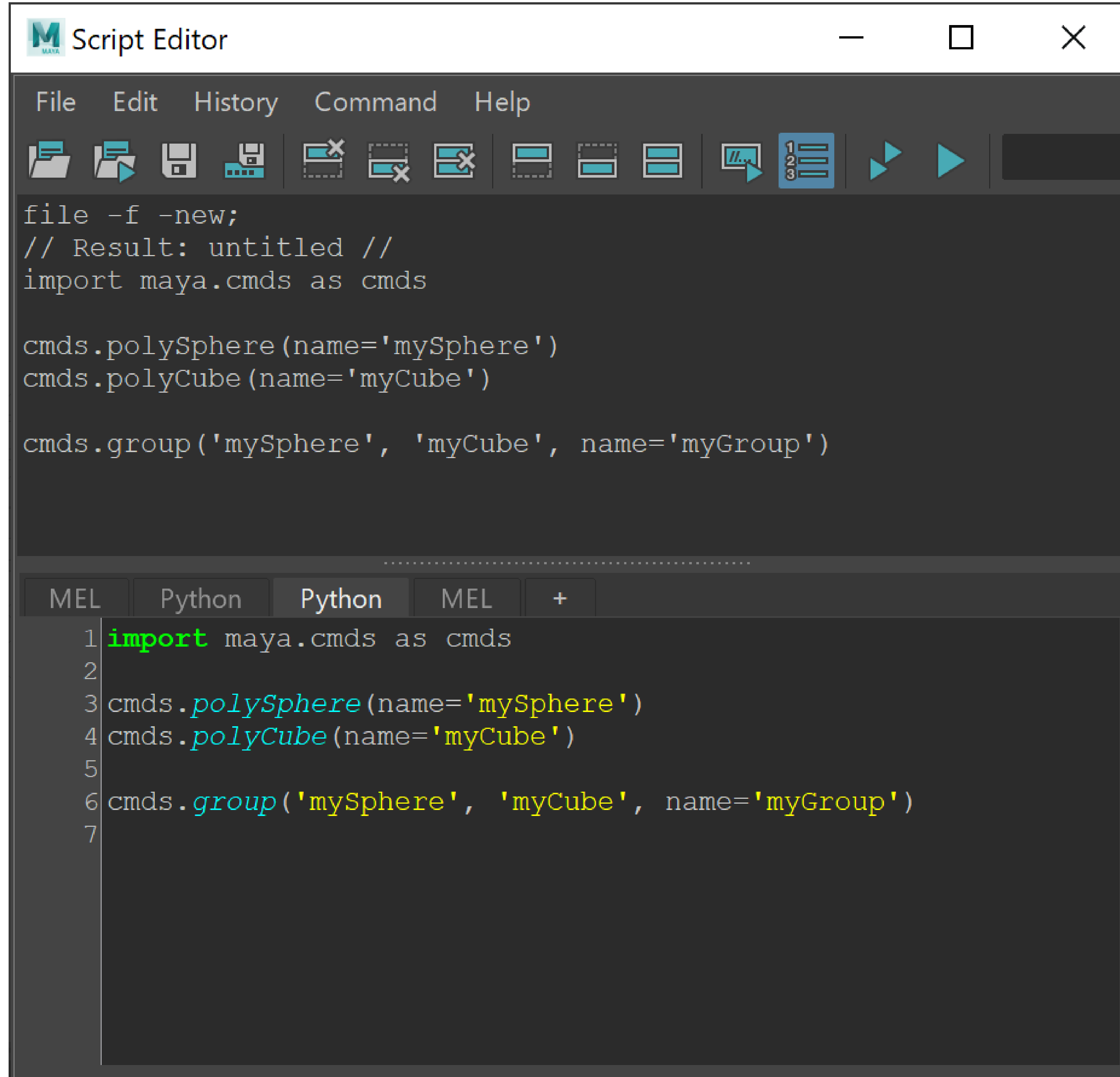
and more!

Customizing Maya Using Programming



Scripts

- Write scripts using MEL or Python
- Comprised of mostly commands
- Execute scripts in the Script Editor

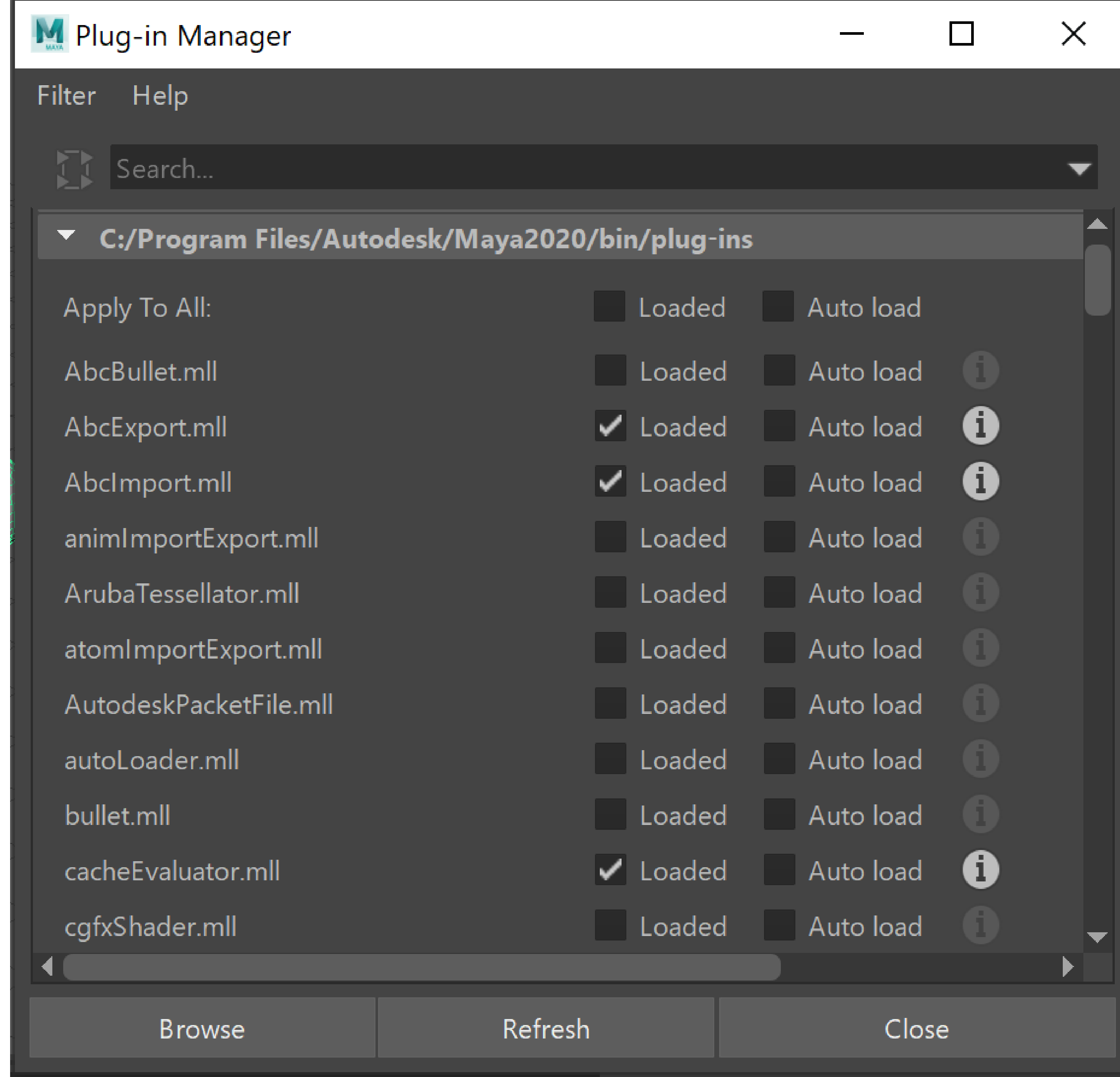


Plug-ins

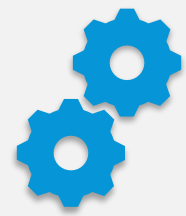
- Develop plug-ins using C++ or Python
- Create tools and features in Maya
- Plug-ins must be loaded before use

Types of Plug-ins

- Commands
- Dependency Graph



Benefits of Customization



Automate repetitive and common tasks



Streamline your workflows



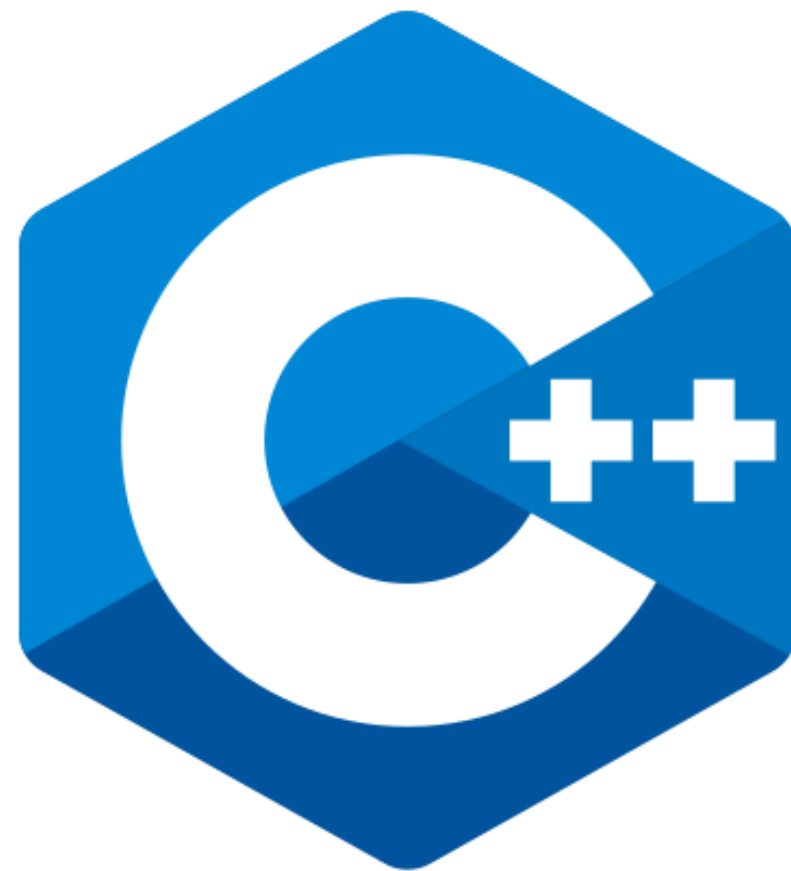
Increase productivity

Programming Languages



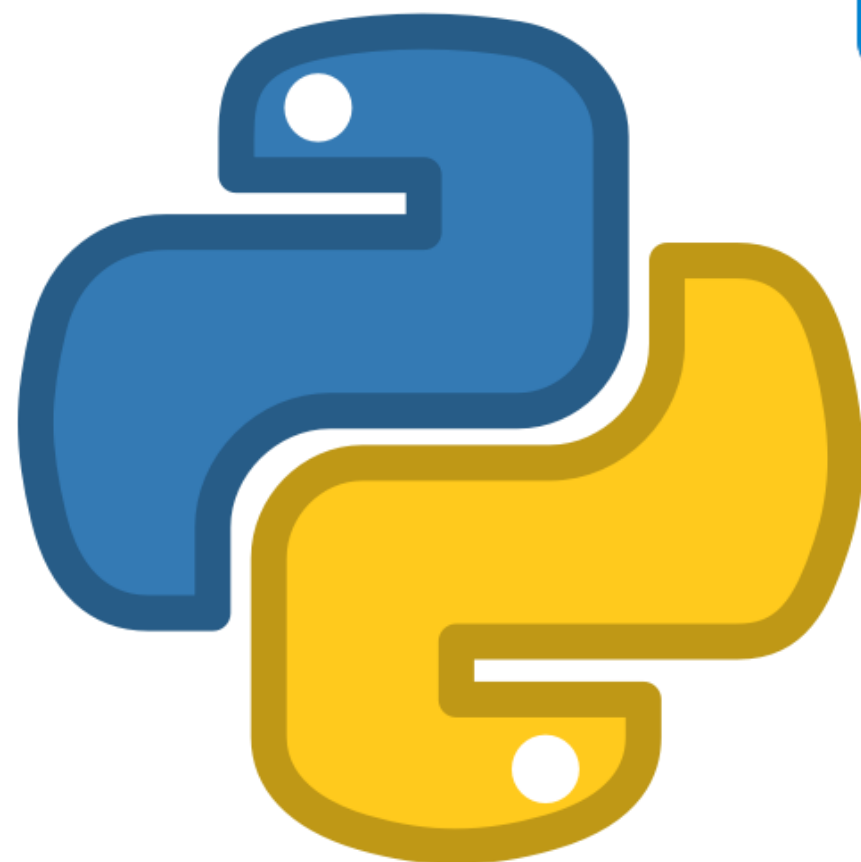
MEL (Maya Embedded Language)

- Commands and scripts
- Maya's interface uses MEL commands



C++

- Plug-in development
- Maya's core and API written in C++
- Fast performance



Python

- Commands, scripts, and plug-in development
- Python commands wraps around MEL commands
- Python API wraps around C++ API

Maya API



Application Programming Interface (API)

API – A way for an application to access and interact with another application

Maya API

- **Provides access to Maya's internal resources**
- **Available in C++ and Python**
- **Maya Python API is a wrapper around the C++ API**
- **Python and C++ APIs are not perfectly mapped**

Maya Python API

- Two Python API versions – 1.0 and 2.0
 - 2.0 API has better performance and more Pythonic
 - Most classes and function names are kept the same
-

Python API 1.0

```
import maya.OpenMaya as om1
```

Python API 2.0

```
import maya.api.OpenMaya as om2  
  
def maya_useNewAPI():  
    pass
```


Maya API Basics

Objects

- Model objects are represented by `MObject`
- Each object has a specific type
- Works together with function sets

Function Sets

- Classes with `MFn` prefix
- Manipulate objects of the same type

Example: `MFnNurbsCurve`

Proxies

- Classes with `MPx` prefix
- Define objects that Maya will be aware about

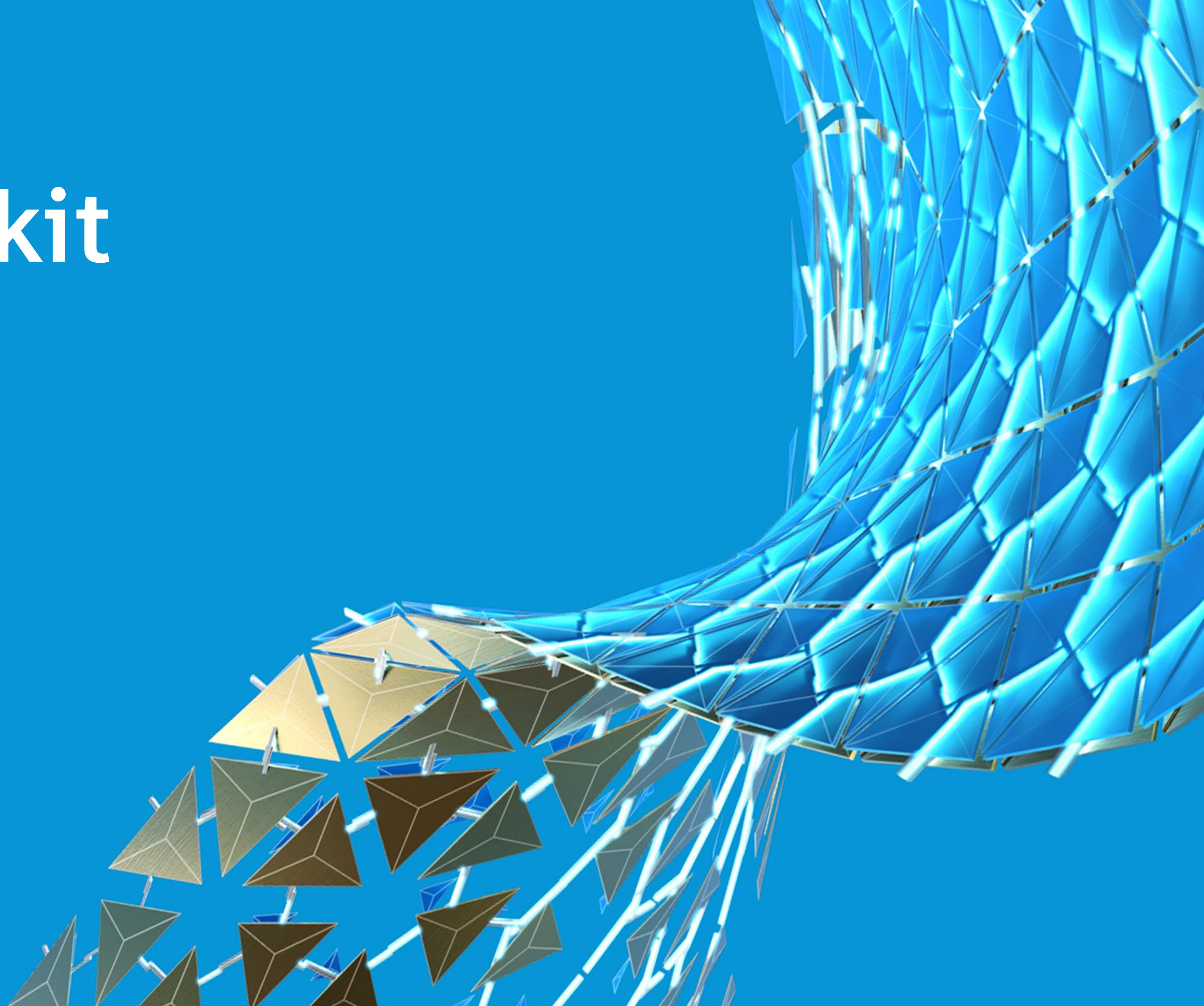
Example: `MPxNode`

Wrappers

- Classes with `M` prefix
- Simple objects that can be manipulated directly

Example: `MVector`

Maya Devkit



Maya Devkit

- Tools and libraries that you need to customize and extend Maya
- Create plug-ins, scripts, and applications using the devkit
- **Download devkit from Maya Developer Center**
 - Choose the devkit for your system, Maya version, and update number

<https://www.autodesk.com/developmaya>

Maya 2020 devkit Downloads

Windows

- [Maya 2020 Update 3 win64 DevKit](#)
- [Maya 2020 Update 2 win64 DevKit](#)
- [Maya 2020 Update 1 win64 DevKit](#)
- [Maya 2020 win64 DevKit](#)

MacOS

- [Maya 2020 Update 3 macos DevKit](#)
- [Maya 2020 Update 2 macos DevKit](#)
- [Maya 2020 Update 1 macos DevKit](#)
- [Maya 2020 macos DevKit](#)

Linux

- [Maya 2020 Update 3 linux64 DevKit](#)
- [Maya 2020 Update 2 linux64 DevKit](#)
- [Maya 2020 Update 1 linux64 DevKit](#)
- [Maya 2020 linux64 DevKit](#)

File Explorer: Lanh Hong > devkitBase > 2020 > devkit > plug-ins > scripted

Name	Date modified	Type	Size
moveCmd.py	8/11/2020 7:49 AM	Python Source File	15 KB
multiPlugInfoCmd.py	8/11/2020 7:49 AM	Python Source File	5 KB
narrowPolyViewer.py	8/11/2020 7:49 AM	Python Source File	12 KB
parentAddedMsgCmd.py	8/11/2020 7:49 AM	Python Source File	5 KB
polyModifier.py	8/11/2020 7:49 AM	Python Source File	53 KB
profilerDump.py	8/11/2020 7:49 AM	Python Source File	12 KB
profilerHTMLView.html	8/11/2020 7:49 AM	Chrome HTML Docu...	1 KB
profilerHTMLView.js	8/11/2020 7:49 AM	JavaScript File	6 KB
pyApiMeshShape.py	8/11/2020 7:49 AM	Python Source File	247 KB
pyBlindDoubleDataCmd.py	8/11/2020 7:49 AM	Python Source File	5 KB
pyBrickShader.py	8/11/2020 7:49 AM	Python Source File	15 KB
pyConvertVerticesToFacesCmd.py	8/11/2020 7:49 AM	Python Source File	5 KB
pyCustomPrimitiveGenerator.py	8/11/2020 7:49 AM	Python Source File	14 KB
pyDepthShader.py	8/11/2020 7:49 AM	Python Source File	14 KB
pyDrawFootPrintbyRenderUtilities.py	8/11/2020 7:49 AM	Python Source File	26 KB
pyFootPrintNode.py	8/11/2020 7:49 AM	Python Source File	12 KB
pyFootPrintNode_GeometryOverride.py	8/11/2020 7:49 AM	Python Source File	14 KB
pyFootPrintNode_GeometryOverride_Animated...	8/11/2020 7:49 AM	Python Source File	15 KB

File Explorer: Lanh Hong > devkitBase > 2020 > devkit > plug-ins

Name	Date modified
AbcBullet	8/11/2020 7:48 AM
AbcExport	8/11/2020 7:48 AM
AbcImport	8/11/2020 7:48 AM
affectsNode	8/11/2020 7:48 AM
animCubeNode	8/11/2020 7:48 AM
animExportUtil	8/11/2020 7:48 AM
animImportExport	8/11/2020 7:48 AM
animInfoCmd	8/11/2020 7:48 AM
anisotropicShader	8/11/2020 7:48 AM
apiDirectionalLightShape	8/11/2020 7:48 AM
apiMeshShape	8/11/2020 7:48 AM
arcLenNode	8/11/2020 7:48 AM
atomImportExport	8/11/2020 7:48 AM
autoLoader	8/11/2020 7:48 AM
backfillShader	8/11/2020 7:48 AM
basicBlendShape	8/11/2020 7:48 AM
basicBlendShapeDeformer	8/11/2020 7:48 AM

Plug-in Samples

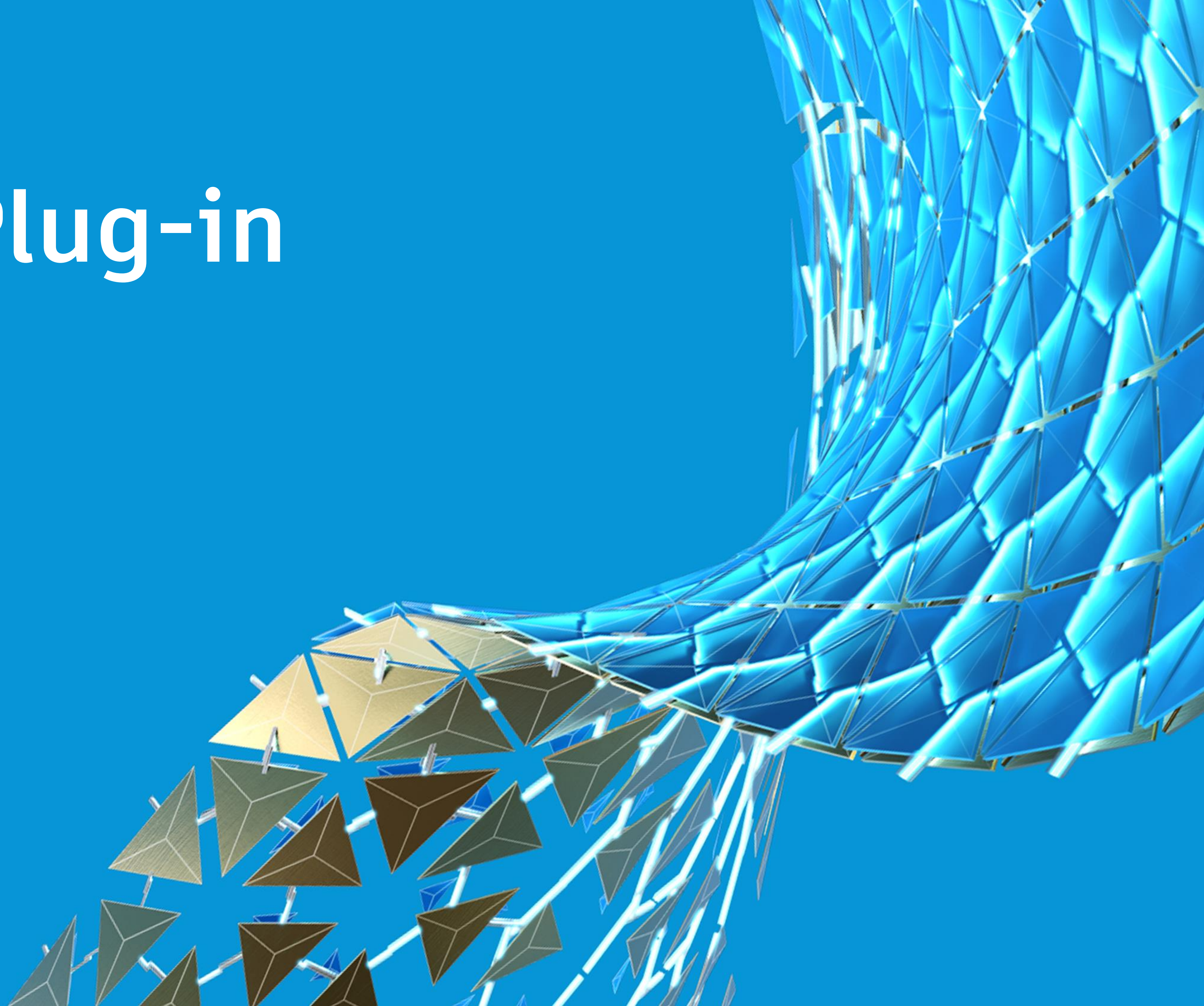
Python plug-in samples

- Located in ...\\devkitBase\\devkit\\plug-ins\\scripted\\ directory
- Plug-ins that start with “py” uses Python API 2.0
- All others use Python API 1.0

C++ plug-in samples

- Located in ...\\devkitBase\\devkit\\plug-ins\\ directory
- C++ plug-ins must be compiled before using

Create a Plug-in



Background

Dependency Graph

- Dependency graph is a network of nodes.
- A node has a set of input and output plugs.
- The node's behavior is to do calculations on the inputs and give the result as output

What are we creating?

- Dependency graph node
- Recreating the arcLenNode C++ devkit sample using Python API 2.0
 - Input – a NURBS curve
 - Compute – get the curve's arc length
 - Output – length

Setup

1. Choose a text editor

2. Download the devkit and set up environment variables

- Follow instructions in the Developer Help documentation (*Maya Developer Help > Setting up your build environment*) – http://help.autodesk.com/view/MAYAUL/2020/ENU///?guid=developer_Maya_SDK_MERGED_Setting_up_your_build_html

3. Register for a node ID block

- Ensure your plug-in does not conflict with other nodes
- Find the link in the Maya Developer Center or click link – <https://mayaid.autodesk.io/>

- + Bifrost Extension for Maya
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 - + Dependency graph plug-ins
 - + Manipulators
 - + Shapes
 - + Writing a Software Shading Node

Installing the Maya Developer Toolkit on a 64bit Windows Environment SHARE

The Maya Developer Toolkit, also referred to as the Maya devkit, is used to create custom plug-ins, scripts, and applications that extend Maya's capabilities.

Requirements

The Maya devkit requires Visual Studio 2017 and CMake.

CMake is available to download from <https://cmake.org/download/>.

Download and Set Up the Developer Toolkit

The Maya devkit is available from The Maya Developer Center.

Scroll to the bottom of the Maya Developer Center page to find the devkit packages. Click on the appropriate link to download the devkit.

1. Unzip the devkit zip package to your `C:\Users\<Username>\` directory, creating the `C:\Users\<Username>\devkitBase\` directory.
2. Create the `C:\Users\<Username>\devkitBase\plug-ins` directory. This will be where you will keep the plug-ins and scripts you create.
3. Create the `plug-ins`, `scripts`, and `icons` directories under `C:\Users\<Username>\devkitBase\plug-ins`.
4. Modify the `C:\Users\<Username>\Documents\maya\<version_number>\Maya.env` file to create three path variables that point to your plug-ins and scripts. Use the `Maya.env` file that corresponds to the version of Maya you are developing for.

```
MAYA_PLUG_IN_PATH=C:\Users\<Username>\devkitBase\plug-ins\plug-ins
MAYA_SCRIPT_PATH=C:\Users\<Username>\devkitBase\plug-ins\scripts
XBMLANGPATH=C:\Users\<Username>\devkitBase\plug-ins\icons
```

Note:

The `C:\Users\<Username>\Documents\maya\<version_number>\` directory is created when Maya is launched for the first time. Launch Maya if you do not see this directory.

Maya will use these paths to automatically discover the plug-ins and scripts in these directories. If these paths are not set, you will need to open Maya's Plug-ins Manager and manually browse to the location of the plug-ins and scripts to load them.

5. Add the `DEVKIT_LOCATION` and `MAYA_LOCATION` environment variables, and modify your `PATH` variable to include the Maya `bin` directory.

Important:

If you have more than one version of Maya installed, only set these variables in the command window where you will be building your plug-ins and applications. Setting them in your user environment variables can result in a conflict with other versions of Maya that are installed on your system.

`DEVKIT_LOCATION` must point to your Maya devkit installation directory.

`MAYA_LOCATION` must point to the location where the version of Maya you are developing for is installed.

Maya is installed to `C:\Program Files\Autodesk\<maya_version>` by default.

```
set DEVKIT_LOCATION=C:\Users\<Username>\devkitBase\
set MAYA_LOCATION="C:\Program Files\Autodesk\<maya_version>"
```

```
arcLenNode.py ×
C: > Users > Lanh Hong > devkitBase > 2020 > plug-ins > _plug-ins > arcLenNode.py
1  import sys
2  import maya.api.OpenMaya as OpenMaya
3  # ... additional imports here ...
4
5  def maya_useNewAPI():
6      """
7      The presence of this function tells Maya that the plugin produces, and
8      expects to be passed, objects created using the Maya Python API 2.0.
9      """
10     pass
11
12 # Plug-in information:
13 kPluginNodeName = 'arcLenNode'          # The name of the node.
14 kPluginNodeClassify = 'utility/general'  # Where this node will be found in the Maya UI.
15 kPluginNodeId = OpenMaya.MTypeId( 0x00136300 ) # A unique ID associated to this node type.
16
17 #####
18 # Plug-in
19 #####
20 class arcLenNode(OpenMaya.MPxNode):
21     # Static variables which will later be replaced by the node's attributes.
22     inputCurve = OpenMaya.MObject()
23     output = OpenMaya.MObject()
24
25     def __init__(self):
26         ''' Constructor. '''
27         OpenMaya.MPxNode.__init__(self)
28
29     def compute(self, pPlug, pDataBlock):
30         '''
31         Node computation method.
32         - pPlug: A connection point related to one of our node attributes (could be an input or an output)
33         - pDataBlock: Contains the data on which we will base our computations.
34         ...
35
36         if( pPlug == arcLenNode.output ):
37             # Obtain the data handles for each attribute
38             inputCurveDataHandle = pDataBlock.inputValue( arcLenNode.inputCurve )
39             outputDataHandle = pDataBlock.outputValue( arcLenNode.output )
40
41             # Extract the actual value associated to our input attribute (we have defined it as a nurbs curve)
42             curve = inputCurveDataHandle.asNurbsCurveTransformed()
43
44             # Get the arc length
45             curveFn = OpenMaya.MFnNurbsCurve( curve )
46             arcLenResult = curveFn.length()
47
48             # Set the output value.
49             outputDataHandle.setFloat( arcLenResult )
50
51             # Mark the output data handle as being clean; it need not be computed given its input.
52             outputDataHandle.setClean()
53         else:
54             return OpenMaya.kUnknownParameter
55
56 #####
```

Create the plug-in

1. Start with a template

- Copy the Python API 2.0 code from the Developer Help documentation (*Maya Developer Help > Maya Python API > Maya Python Plug-in Learning Path > Dependency Graph Plug-in Basics > Dependency Graph Plug-ins*) – http://help.autodesk.com/view/MAYAUL/2020/ENU//?guid=developer_Maya_SDK_MERGED_Maya_Python_API_Maya_Python_Plug_in_Learning_Dependency_Graph_Plug_in_Basics_Dependency_Graph_Plug_ins_html

2. Replace the node ID with your own

3. Change the node name to arcLenNode

4. Modify the input and output attributes

- Input attribute – inputCurve
- Output attribute – output

5. Do the computation

- Use MFnNurbsCurve to get arc length

Test the plug-in

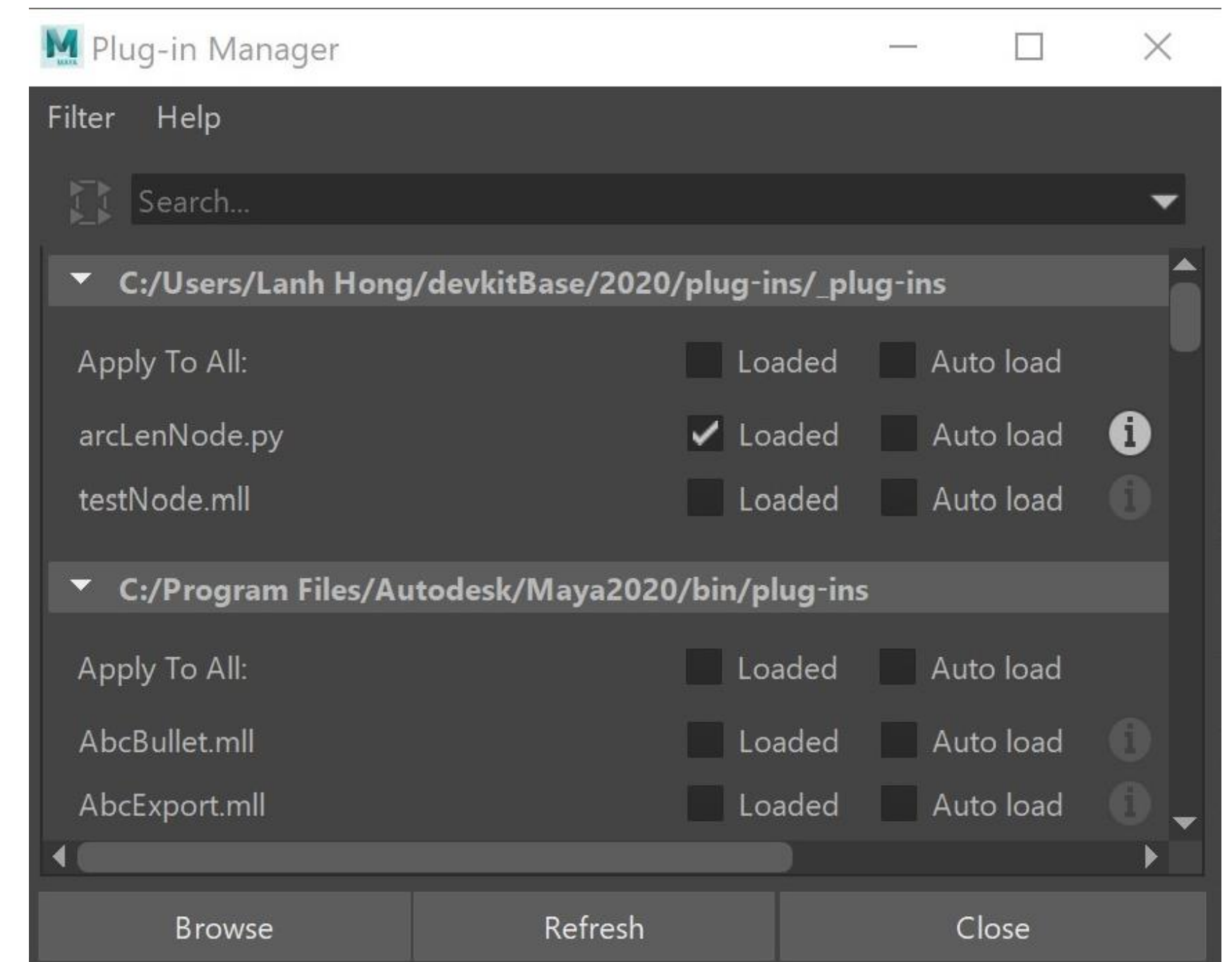
1. Save file in MAYA_PLUG_IN_PATH
2. Open Maya and load the plug-in
3. Test the node by running this script:

```
createNode arcLenNode;
```

```
CreateNURBSCircle;
```

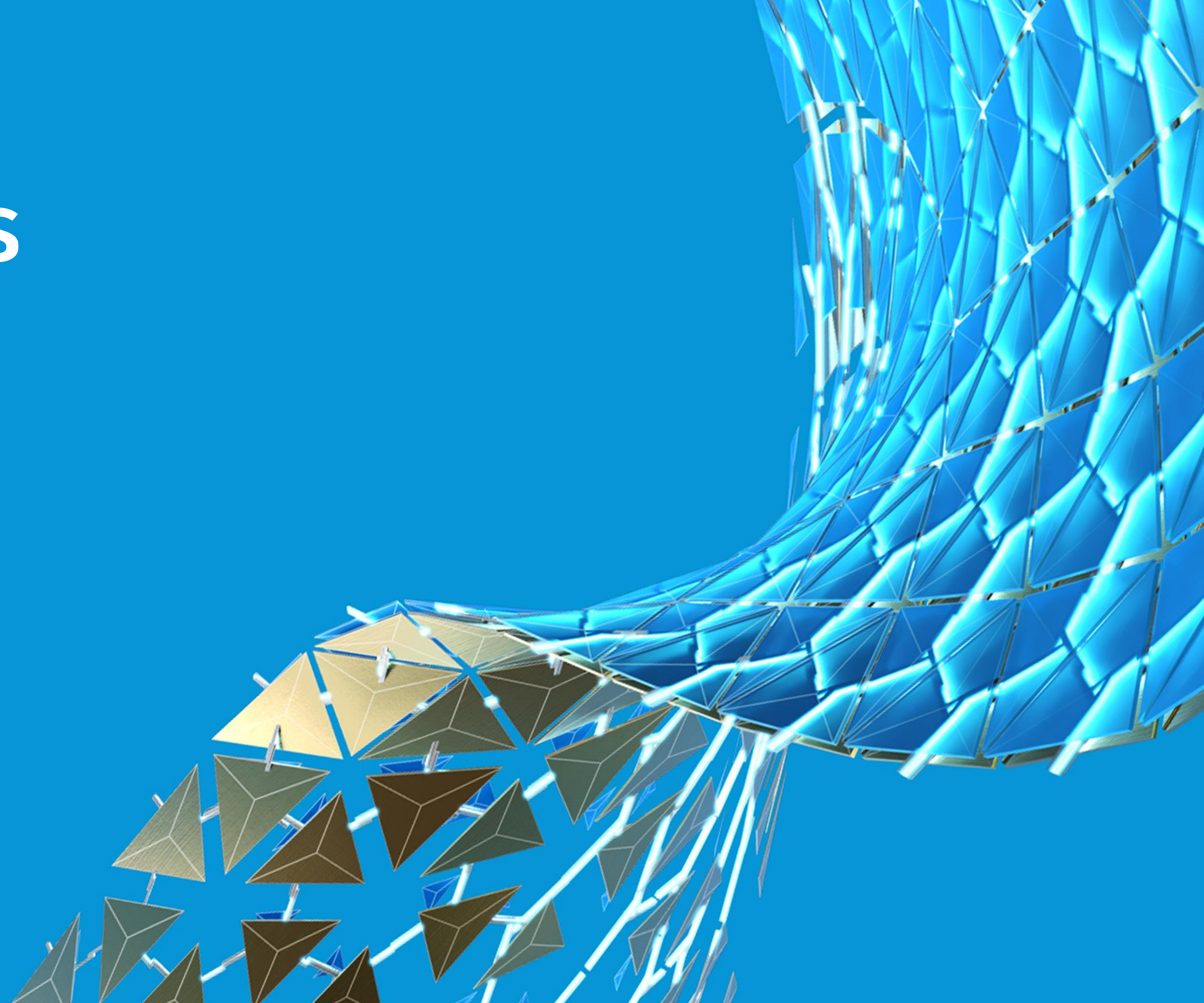
```
connectAttr nurbsCircleShape1.local arcLenNode1.inputCurve;
```

```
getAttr arcLenNode1.output;
```



Demo

Resources



Maya Developer Center

- Devkit download links
- Register for node ID block
- Learning materials and resources

<https://www.autodesk.com/developmaya>

Maya Developer Center

Autodesk Maya provides a rich and powerful API that can be used to automate repetitive tasks, and to extend the core functionality of Maya. This functionality includes customization of 3D modeling, animation, visual effects, rendering, and many other areas. C++, Python, and .NET are supported. The Software Development Kit (SDK) provides extensive functionality and provides code samples and documentation to help get you started developing with the Maya API. [Read more...](#)

Sample Code at Github

Find C#, Python, and C++ sample code at the ADN-DevTech Github organization.

Blogs

Get news, expert tips and insider resources directly from Autodesk software engineers.

- Around-the-Corner - Maya Platform – Cynlfe Faüvel, Zhōng Wu, and Cheng Xi Li
- The AREA bloggers often have interesting insight into Maya and programming topics

Discussion Groups

Take part in active API discussion forums moderated by Autodesk software engineer.

- Autodesk Maya Programming
- Other Maya Forums

Note: Please include the programming language in the subject line. For example, C++, C# or Python. This will help us to handle your posts.

Autodesk App Store

Easily extend the power of Maya and MotionBuilder using apps created for the end user community.

Autodesk Forge

Get easy access to Forge APIs and documentation, tutorials, GitHub samples, support and more for Autodesk cloud-based software and components in your own web and mobile applications.

Improve your experience

- Report a Maya bug
- Suggest a Maya feature

Learning and Documentation

Learn more about Maya API through Maya API documents and samples found in Maya devkit.

Maya API Training Webcasts

A complete API training on developing plug-ins for Maya based on Python (but applies to C++ as well)

- English Videos: [Download](#)
- Training material: [Download](#)

Introduction to Maya Dependency Graph Programming

A self-paced video tutorial demonstrating how to get started with Maya dependency graph programming in C++ and Python.

- English Videos: [Download](#)
- Japanese Videos: [Download](#)
- Chinese Videos: [Download](#)


Documentation and SDK Samples

- Learn more about Maya API through Maya API documents and samples found in Maya devkit. Starting with Maya 2016, the devkit is distributed separately. They can be downloaded from the end of this page. The C++ headers and library continue to be installed with Maya.

Maya Developer Help Documentation

- **Maya API documentation**
- **Code samples and tutorials**
- **C++ and Python API references**

<https://www.autodesk.com/me-sdk-docs>

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Q Enter a keyword

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Maya Developer Help

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Technical Notes

Appendices

C++ API Reference: Maya API Reference

About The Maya devkit

SHARE

The Maya SDK, commonly known as the Maya devkit or simply "the devkit", allows you to extend Maya's capabilities by creating plug-ins for Maya, and standalone applications that use the Maya libraries.

Maya plug-ins are loaded into Maya. They add functionality to Maya either as commands or nodes. A MEL script packaged with your command plug-ins adds a menu item or other interface for accessing the command. Example plug-ins can be found in the `devkit/plug-ins` directory.

Maya standalone applications run independently outside of a running Maya installation, but use the Maya API and framework. Applications can be used to operate on objects in a Maya scene file, for example. Example applications can be found in the `devkit/applications` directory.

The devkit is available from the The Maya Developer Center. It contains C++, Python, and .NET APIs.

Two versions of the Python API are included in the devkit. Python API 1.0 is a version of the C++ API that has been converted to Python, while Python API 2.0 is a port of the API to Python. Python API 2.0 is more pythonic than API 1.0 and contains Python-specific features.

Was this helpful?

☐ Yes | ☐ No

Programming Forum

- Community area
- Share and contribute
- Ask questions

<https://forums.autodesk.com/t5/maya-programming/bd-p/area-b50>



This board

Search



































Maya Programming

Welcome to Autodesk's Maya Forums. Share your knowledge, ask questions, and explore popular Maya SDK topics.

POST TO FORUMS

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	Forum Rules by  nicolasleduc on 11-27-2013 09:31 AM	0 REPLIES	2524 VIEWS	
	How can i control multiple objects with one manipulator by  jonahrnrt yesterday	0 REPLIES	72 VIEWS	
	Shadows with MPxDrawOverride  by  negow Tuesday Latest post yesterday by  negow	1 REPLY	67 VIEWS	
	✓ validateAndSetValue not being called for attributes that are part of a double3 by  jonahrnrt Wednesday Latest post Thursday by  jonahrnrt	2 REPLIES	109 VIEWS	
	✓ Change working units through a script by  gokrishg4 Thursday Latest post Thursday by  mspeer	1 REPLY	52 VIEWS	
	✓ MEL or Python script to convert mesh to nurbs by  cheska_nodado Sunday Latest post Thursday by  amaterasu.qbb	2 REPLIES	90 VIEWS	
	Source for UFE from Maya-Devkit to build with different gcc version by  mhamid3d Thursday	0 REPLIES	33 VIEWS	
	How to change the tick span of the time slider without having to do it from Preference?  by  amaterasu.qbb Thursday	0 REPLIES	47 VIEWS	
	✓ MPxContext is calling setup and cleanup but not doPress  by  jonahrnrt 2 weeks ago Latest post Wednesday by  jonahrnrt	2 REPLIES	215 VIEWS	
	Detecting overlapping Uvs on a certain uvset by  Craig.Lamorte Monday Latest post Tuesday by  mspeer	4 REPLIES	158 VIEWS	











Forums Links

- ➔ Back to Maya Category
- ➔ All Forums
- ➔ All Ideas
- ➔ Help

Trending Topics

- list all default maya nodes?
- Selecting new faces after Boolean Op difference using MEL
- Detecting overlapping Uvs on a certain uvset
- change colour of curve objects
- Custom node stringArray attribute

Top Solution Authors

-   mcw0
-   bradley_henke
-   forrest.brent
-   bsabiston
-   jonahrnrt

➔ View All

Autodesk Developer Network (ADN)

- Developer program
- One-on-one API support
- Licenses included

<https://www.autodesk.com/developer-network/overview>

AUTODESK DEVELOPER NETWORK

The Autodesk Developer Network was created for desktop software developers seeking proven tools and technologies to extend Autodesk products and technologies. The ADN program helps developers use Autodesk's large investments and expertise in design, engineering, and media and entertainment platform technologies.

CONTACT US



Platform technologies

Whether you plan to customize existing Autodesk software, create a plug-in, or tightly integrate Autodesk technology into your workflow and enterprise, and whichever Autodesk platform technology you work with, we are committed to making technology that is accessible to you and supporting your software development. And we can help you reach new customers too—through the [Autodesk App Store](#).

Partner with us

Build your relationship with Autodesk by joining the Autodesk Developer Network. Whether you're new to software development or a professional software developer new to Autodesk platform technologies, a software business start-up or well-established company with a team of full-time professional software developers, we have an ADN membership to suit your needs. Choose from no-cost ADN Open; budget-conscious, higher-touch ADN Standard; or the highest-support ADN Professional.

[Learn more about ADN membership options.](#)

Community

Learn Autodesk platform technologies and get help from fellow software developers under moderation by Autodesk software engineers through Autodesk Developer Network Open (ADN Open). Access API blogs written by expert Autodesk software engineers, active API forums moderated by Autodesk software engineers, how-to websites, YouTube videos, and more.

Cloud and mobile

If you are developing web- or mobile-based solutions, you can access all the information and resources needed to use Autodesk web-based software, components, and APIs on the [Autodesk Forge Developer Portal](#).

Resources

ACCESS AUTODESK SOFTWARE FOR FREE

Trial versions are available for most Autodesk products. Download your free 30-days trial version today. You can obtain Autodesk desktop software for development use on an on-going basis by joining ADN at the Standard or Professional membership level too.

AUTODESK CLOUD TECHNOLOGIES

All the information and resources needed to use Autodesk cloud-based software and components in your own web and mobile applications can be found on the Autodesk Forge Developer Portal. Get easy access to Forge APIs and documentation, tutorials, GitHub samples, support and more.

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