Usage Checker

This notebook demonstrates how to check the usage of node definitions for node libraries.

The utility scans one or more libraries * Each definition is examined to see if it is implemented as a node graph. * If it is the list of nodes it uses is returned. * For each node that is used a list of node definitions that use it is returned. * A list of definitions which are not implemented as graphs as well as a list of nodes that are missing implementations are returned.

The utility also provides usage rate for node definitions and a hint of complexity of a node definition which uses other nodes by providing a count of the number of unique nodes it uses.

In [ ]:
```
import MaterialX as mx
import mtlxutils.mxfile as mxf
from IPython.display import display_markdown

stdlib = mx.createDocument()
searchPath = mx.getDefaultDataSearchPath()
libraryFolders = mx.getDefaultDataLibraryFolders()
try:
    libFiles = mx.loadLibraries(libraryFolders, searchPath, stdlib)
    print('Loaded %s standard library definitions for version %s' % (len(stdlib.getNodeDefs()), m
except mx.Exception as err:
    print('Failed to load standard library definitions: "', err, '"')

doc = mx.createDocument()
doc.importLibrary(stdlib)
```

```
Loaded 767 standard library definitions for version 1.38.9
```

Utility Methods

In [ ]:
```
def getNodeDefUsage(doc, libraryFilter=None):

    # List of nodes used by another node
    nodes_use = dict()
    nodes_used_by = dict()
    nongraph_nodes = []
    unimplemented = []

    for nodedef in doc.getNodeDefs():
        found = True
        if libraryFilter:
            found = False
            for lib in libraryFilter:
                if lib in nodedef.getSourceUri():
                    found = True
                    break
        if not found:
            continue

        nodename = nodedef.getNodeString()
        impl = nodedef.getImplementation()
        if impl:
            nodes_use_list = []
            for node in impl.getChildrenOfType(mx.Node):
```

```
                #print('scan:', node.getName())
                nd = node.getNodeDef()
                if nd:
                    ns = nd.getNodeString()
                    if ns not in nodes_use_list:
                        nodes_use_list.append(ns)

                    # Look for ns key in nodes_used_by dictionary
                    if ns not in nodes_used_by:
                        nodes_used_by[ns] = []

                    if nodename not in nodes_used_by[ns]:
                        nodes_used_by[ns].append(nodename)
                else:
                    print('Skip unknown node type: ', node.getName())

            if len(nodes_use_list) > 0:
                nodes_use[nodename] = nodes_use_list
            else:
                if nodename not in nongraph_nodes:
                    nongraph_nodes.append(nodename)
        else:
            if nodename not in unimplemented:
                unimplemented.append(nodename)

    # Sort
    nongraph_nodes = sorted(nongraph_nodes)
    unimplemented = sorted(unimplemented)
    nodes_use = {k: v for k, v in sorted(nodes_use.items(), key=lambda item: len(item[1]), rever
    nodes_used_by = {k: v for k, v in sorted(nodes_used_by.items(), key=lambda item: len(item[1]

    return nodes_use, nodes_used_by, nongraph_nodes, unimplemented

def printNodeDefUsage(nodes_use, nodes_used_by, nongraph_nodes, unimplemented):
    #
    result = '| Node Definition | Uses |\n| --- | --- |'
    for nu in nodes_use:
        if (len(nodes_use[nu]) > 0):
            result += '\n| %s | %d nodes: %s |' % (nu, len(nodes_use[nu]), ', '.join(sorted(node
    display_markdown(result, raw=True)

    result = '| Node Definition | Used by |\n| --- | --- |'
    for nu in nodes_used_by:
        if (len(nodes_used_by[nu]) > 0):
            result += '\n| %s | %d nodes: %s |' % (nu, len(nodes_used_by[nu]), ', '.join(sorted(
    display_markdown(result, raw=True)

    if len(nongraph_nodes) > 0:
        result = '| Non-Graph Nodes: %d |\n| --- |\n' % (len(nongraph_nodes))
        result += '|' + ', '.join(nongraph_nodes) + '|'
        display_markdown(result, raw=True)

    if (len(unimplemented) > 0):
        result = '| Unimplemented Nodes %d |\n| --- |\n' % (len(unimplemented))
        #for nu in unimplemented:
        #    result += '\n| %s |' % (nu)
        result += '|' + ', '.join(unimplemented) + '|'
        display_markdown(result, raw=True)
```

Node Usages Results for "Standard Library"

In [ ]:
```
nodes_use, nodes_used_by, nongraph_nodes, unimplemented = getNodeDefUsage(doc, ['stdlib', 'nprli

printNodeDefUsage(nodes_use, nodes_used_by, nongraph_nodes, unimplemented)
```

Node Definition	Uses
triplanarprojection	13 nodes: absval, add, clamp, combine2, divide, dotproduct, extract, image, multiply, normalize, power, separate3, switch
unifiednoise2d	12 nodes: add, cellnoise2d, combine3, fractal3d, multiply, noise2d, range, rotate2d, separate2, subtract, switch, worleynoise2d
gooch_shade	11 nodes: add, divide, dotproduct, max, mix, multiply, normal, normalize, power, reflect, viewdirection
tiledcircles	11 nodes: add, circle, combine2, convert, divide, ifequal, ifgreater, max, modulo, multiply, subtract
tiledcloverleafs	11 nodes: add, cloverleaf, combine2, convert, divide, ifequal, ifgreater, max, modulo, multiply, subtract
tiledhexagons	11 nodes: add, combine2, convert, divide, hexagon, ifequal, ifgreater, max, modulo, multiply, subtract
unifiednoise3d	10 nodes: add, cellnoise3d, fractal3d, multiply, noise3d, range, rotate3d, subtract, switch, worleynoise3d
hexagon	10 nodes: absval, clamp, combine2, constant, dotproduct, ifgreater, min, multiply, sqrt, subtract
crosshatch	10 nodes: add, combine2, convert, ifequal, ifgreater, line, max, modulo, multiply, subtract
grid	9 nodes: absval, add, convert, ifequal, ifgreater, min, modulo, multiply, subtract
range	8 nodes: absval, clamp, divide, ifequal, multiply, power, remap, sign
line	7 nodes: clamp, distance, divide, dotproduct, ifgreater, multiply, subtract
checkerboard	6 nodes: dotproduct, floor, mix, modulo, multiply, subtract
refract	6 nodes: add, dotproduct, ifgreater, multiply, sqrt, subtract
facingratio	5 nodes: absval, dotproduct, ifequal, invert, multiply
cloverleaf	5 nodes: add, circle, combine2, max, subtract
place2d	5 nodes: add, divide, rotate2d, subtract, switch
hsvadjust	5 nodes: add, convert, hsvtorgb, multiply, rgbtohsv
colorcorrect	5 nodes: colorcorrect, combine3, combine4, separate3, separate4
tiledimage	4 nodes: divide, image, multiply, subtract
randomfloat	4 nodes: cellnoise2d, combine2, convert, range
circle	4 nodes: dotproduct, ifgreater, multiply, subtract
safepower	4 nodes: absval, multiply, power, sign
ramp4	3 nodes: clamp, extract, mix
trianglewave	3 nodes: absval, modulo, subtract
reflect	3 nodes: dotproduct, multiply, subtract
contrast	3 nodes: add, multiply, subtract
overlay	3 nodes: combine4, overlay, separate4
randomcolor	2 nodes: convert, randomcolor
bump	2 nodes: heighttonormal, normalmap
distance	2 nodes: magnitude, subtract
saturate	2 nodes: luminance, mix
convert	2 nodes: convert, surface_unlit
extract	2 nodes: switch, swizzle
noise2d	1 nodes: noise2d

Node Definition	Uses
noise3d	1 nodes: noise3d
fractal3d	1 nodes: fractal3d
smoothstep	1 nodes: smoothstep
separate2	1 nodes: swizzle
separate3	1 nodes: swizzle
separate4	1 nodes: swizzle

Node Definition	Used by
multiply	24 nodes: checkerboard, circle, colorcorrect, contrast, crosshatch, facingratio, gooch_shade, grid, hexagon, hsvadjust, line, overlay, randomfloat, range, reflect, refract, safepower, tiledcircles, tiledcloverleafs, tiledhexagons, tiledimage, triplanarprojection, unifiednoise2d, unifiednoise3d
subtract	21 nodes: checkerboard, circle, cloverleaf, colorcorrect, contrast, crosshatch, distance, grid, hexagon, line, overlay, place2d, reflect, refract, tiledcircles, tiledcloverleafs, tiledhexagons, tiledimage, trianglewave, unifiednoise2d, unifiednoise3d
add	16 nodes: cloverleaf, colorcorrect, contrast, crosshatch, gooch_shade, grid, hsvadjust, place2d, randomcolor, refract, tiledcircles, tiledcloverleafs, tiledhexagons, triplanarprojection, unifiednoise2d, unifiednoise3d
dotproduct	9 nodes: checkerboard, circle, facingratio, gooch_shade, hexagon, line, reflect, refract, triplanarprojection
divide	9 nodes: gooch_shade, line, place2d, range, tiledcircles, tiledcloverleafs, tiledhexagons, tiledimage, triplanarprojection
convert	9 nodes: convert, crosshatch, grid, hsvadjust, randomcolor, randomfloat, tiledcircles, tiledcloverleafs, tiledhexagons
ifgreater	9 nodes: circle, crosshatch, grid, hexagon, line, refract, tiledcircles, tiledcloverleafs, tiledhexagons
combine2	8 nodes: cloverleaf, crosshatch, hexagon, randomfloat, tiledcircles, tiledcloverleafs, tiledhexagons, triplanarprojection
absval	7 nodes: facingratio, grid, hexagon, range, safepower, trianglewave, triplanarprojection
ifequal	7 nodes: crosshatch, facingratio, grid, range, tiledcircles, tiledcloverleafs, tiledhexagons
modulo	7 nodes: checkerboard, crosshatch, grid, tiledcircles, tiledcloverleafs, tiledhexagons, trianglewave
max	6 nodes: cloverleaf, crosshatch, gooch_shade, tiledcircles, tiledcloverleafs, tiledhexagons
mix	5 nodes: checkerboard, gooch_shade, overlay, ramp4, saturate
power	5 nodes: colorcorrect, gooch_shade, range, safepower, triplanarprojection
switch	5 nodes: extract, place2d, triplanarprojection, unifiednoise2d, unifiednoise3d
clamp	5 nodes: hexagon, line, ramp4, range, triplanarprojection
range	5 nodes: colorcorrect, randomcolor, randomfloat, unifiednoise2d, unifiednoise3d
combine3	4 nodes: colorcorrect, overlay, randomcolor, unifiednoise2d
swizzle	4 nodes: extract, separate2, separate3, separate4
extract	3 nodes: convert, ramp4, triplanarprojection
separate3	3 nodes: colorcorrect, overlay, triplanarprojection
fractal3d	3 nodes: fractal3d, unifiednoise2d, unifiednoise3d
normalize	2 nodes: gooch_shade, triplanarprojection
image	2 nodes: tiledimage, triplanarprojection
noise2d	2 nodes: noise2d, unifiednoise2d
noise3d	2 nodes: noise3d, unifiednoise3d
cellnoise2d	2 nodes: randomfloat, unifiednoise2d
rotate2d	2 nodes: place2d, unifiednoise2d
hsvtorgb	2 nodes: hsvadjust, randomcolor
circle	2 nodes: cloverleaf, tiledcircles

Node Definition	Used by
min	2 nodes: grid, hexagon
sqrt	2 nodes: hexagon, refract
sign	2 nodes: range, safepower
separate4	2 nodes: colorcorrect, overlay
combine4	2 nodes: colorcorrect, overlay
invert	1 nodes: facingratio
normal	1 nodes: gooch_shade
viewdirection	1 nodes: gooch_shade
reflect	1 nodes: gooch_shade
worleynoise2d	1 nodes: unifiednoise2d
separate2	1 nodes: unifiednoise2d
cellnoise3d	1 nodes: unifiednoise3d
worleynoise3d	1 nodes: unifiednoise3d
rotate3d	1 nodes: unifiednoise3d
ceil	1 nodes: randomcolor
randomfloat	1 nodes: randomcolor
randomcolor	1 nodes: randomcolor
floor	1 nodes: checkerboard
distance	1 nodes: line
constant	1 nodes: hexagon
line	1 nodes: crosshatch
cloverleaf	1 nodes: tiledcloverleafs
hexagon	1 nodes: tiledhexagons
heighttonormal	1 nodes: bump
normalmap	1 nodes: bump
magnitude	1 nodes: distance
smoothstep	1 nodes: smoothstep
remap	1 nodes: range
rgbtohsv	1 nodes: hsvadjust
luminance	1 nodes: saturate
contrast	1 nodes: colorcorrect
saturate	1 nodes: colorcorrect
hsvadjust	1 nodes: colorcorrect
colorcorrect	1 nodes: colorcorrect
ifgreatereq	1 nodes: overlay
overlay	1 nodes: overlay

Node Definition	Used by
surface_unlit	1 nodes: convert

Non-Graph Nodes: 99

absval, acos, add, ambientocclusion, asin, atan2, bitangent, blur, burn, ceil, cellnoise2d, cellnoise3d, clamp, combine2, combine3, combine4, constant, convert, cos, creatematrix, crossproduct, determinant, difference, disjointover, divide, dodge, dot, dotproduct, exp, floor, fractal3d, frame, geomcolor, geompropvalue, heighttonormal, hsvtorgb, ifequal, ifgreater, ifgreatereq, image, in, inside, invert, invertmatrix, ln, luminance, magnitude, mask, matte, max, min, minus, mix, modulo, multiply, noise2d, noise3d, normal, normalize, normalmap, out, outside, over, plus, position, power, premult, ramplr, ramptb, remap, rgbtohsv, rotate2d, rotate3d, round, screen, sign, sin, smoothstep, splitlr, splittb, sqrt, subtract, surface_unlit, surfacematerial, switch, swizzle, tan, tangent, texcoord, time, transformmatrix, transformnormal, transformpoint, transformvector, transpose, unpremult, viewdirection, worleynoise2d, worleynoise3d

Unimplemented Nodes 3

arrayappend, curveadjust, volumematerial

Node Usage Results for "pbrlib, bxdf"

In [ ]:
```
nodes_use, nodes_used_by, nongraph_nodes, unimplemented = getNodeDefUsage(doc, ['pbrlib', 'bxdf'

printNodeDefUsage(nodes_use, nodes_used_by, nongraph_nodes, unimplemented)
```

Node Definition	Uses
open_pbr_surface	28 nodes: add, clamp, convert, dielectric_bsdf, divide, generalized_schlick_bsdf, generalized_schlick_edf, ifgreater, layer, luminance, max, min, mix, multiply, normalize, oren_nayar_diffuse_bsdf, power, rotate3d, roughness_anisotropy, sheen_bsdf, sign, sqrt, subsurface_bsdf, subtract, surface, thin_film_bsdf, translucent_bsdf, uniform_edf
standard_surface	26 nodes: add, artistic_ior, clamp, conductor_bsdf, convert, dielectric_bsdf, divide, generalized_schlick_edf, ifgreater, layer, luminance, max, mix, multiply, normalize, oren_nayar_diffuse_bsdf, power, rotate3d, roughness_anisotropy, sheen_bsdf, subsurface_bsdf, subtract, surface, thin_film_bsdf, translucent_bsdf, uniform_edf
gltf_pbr	22 nodes: add, anisotropic_vdf, convert, dielectric_bsdf, divide, extract, generalized_schlick_bsdf, ifequal, ifgreatereq, layer, ln, max, min, mix, multiply, oren_nayar_diffuse_bsdf, roughness_anisotropy, sheen_bsdf, subtract, surface, thin_film_bsdf, uniform_edf
LamaConductor	18 nodes: add, artistic_ior, clamp, combine2, conductor_bsdf, convert, divide, ifgreater, ifgreatereq, layer, max, multiply, normalize, power, rotate3d, subtract, switch, thin_film_bsdf
UsdPreviewSurface	17 nodes: add, artistic_ior, conductor_bsdf, convert, dielectric_bsdf, divide, generalized_schlick_bsdf, ifgreatereq, layer, mix, multiply, normalmap, oren_nayar_diffuse_bsdf, roughness_anisotropy, subtract, surface, uniform_edf
LamaDielectric	17 nodes: add, anisotropic_vdf, artistic_ior, clamp, combine2, convert, dielectric_bsdf, divide, ifgreatereq, layer, max, multiply, normalize, power, rotate3d, subtract, switch
standard_surface_to_gltf_pbr	7 nodes: divide, dot, dotproduct, ifequal, ifgreater, mix, multiply
standard_surface_to_UsdPreviewSurface	6 nodes: divide, dot, dotproduct, mix, multiply, subtract
gltf_colorimage	5 nodes: combine3, dot, gltf_image, multiply, separate4
gltf_normalmap	5 nodes: divide, image, multiply, normalmap, place2d
gltf_image	4 nodes: divide, image, multiply, place2d
LamaSheen	4 nodes: add, multiply, power, sheen_bsdf
gltf_iridescence_thickness	3 nodes: extract, gltf_image, mix
UsdUVTexture	3 nodes: add, image, multiply
LamaSSS	3 nodes: convert, multiply, subsurface_bsdf
LamaAdd	2 nodes: add, multiply
LamaDiffuse	2 nodes: multiply, oren_nayar_diffuse_bsdf
LamaLayer	2 nodes: layer, multiply
glossiness_anisotropy	2 nodes: invert, roughness_anisotropy
UsdPrimvarReader	1 nodes: geompropvalue
UsdTransform2d	1 nodes: place2d
LamaEmission	1 nodes: uniform_edf
LamaMix	1 nodes: mix
LamaTranslucent	1 nodes: translucent_bsdf

Node Definition	Used by
multiply	17 nodes: LamaAdd, LamaConductor, LamaDielectric, LamaDiffuse, LamaLayer, LamaSSS, LamaSheen, UsdPreviewSurface, UsdUVTexture, gltf_colorimage, gltf_image, gltf_normalmap, gltf_pbr, open_pbr_surface, standard_surface, standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr
divide	10 nodes: LamaConductor, LamaDielectric, UsdPreviewSurface, gltf_image, gltf_normalmap, gltf_pbr, open_pbr_surface, standard_surface, standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr
add	9 nodes: LamaAdd, LamaConductor, LamaDielectric, LamaSheen, UsdPreviewSurface, UsdUVTexture, gltf_pbr, open_pbr_surface, standard_surface
mix	8 nodes: LamaMix, UsdPreviewSurface, gltf_iridescence_thickness, gltf_pbr, open_pbr_surface, standard_surface, standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr
convert	7 nodes: LamaConductor, LamaDielectric, LamaSSS, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
subtract	7 nodes: LamaConductor, LamaDielectric, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface, standard_surface_to_UsdPreviewSurface
layer	7 nodes: LamaConductor, LamaDielectric, LamaLayer, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
roughness_anisotropy	5 nodes: UsdPreviewSurface, glossiness_anisotropy, gltf_pbr, open_pbr_surface, standard_surface
oren_nayar_diffuse_bsdf	5 nodes: LamaDiffuse, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
dielectric_bsdf	5 nodes: LamaDielectric, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
max	5 nodes: LamaConductor, LamaDielectric, gltf_pbr, open_pbr_surface, standard_surface
uniform_edf	5 nodes: LamaEmission, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
power	5 nodes: LamaConductor, LamaDielectric, LamaSheen, open_pbr_surface, standard_surface
thin_film_bsdf	4 nodes: LamaConductor, gltf_pbr, open_pbr_surface, standard_surface
sheen_bsdf	4 nodes: LamaSheen, gltf_pbr, open_pbr_surface, standard_surface
ifgreatereq	4 nodes: LamaConductor, LamaDielectric, UsdPreviewSurface, gltf_pbr
surface	4 nodes: UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
clamp	4 nodes: LamaConductor, LamaDielectric, open_pbr_surface, standard_surface
rotate3d	4 nodes: LamaConductor, LamaDielectric, open_pbr_surface, standard_surface
normalize	4 nodes: LamaConductor, LamaDielectric, open_pbr_surface, standard_surface
ifgreater	4 nodes: LamaConductor, open_pbr_surface, standard_surface, standard_surface_to_gltf_pbr
artistic_ior	4 nodes: LamaConductor, LamaDielectric, UsdPreviewSurface, standard_surface
generalized_schlick_bsdf	3 nodes: UsdPreviewSurface, gltf_pbr, open_pbr_surface
dot	3 nodes: gltf_colorimage, standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr
image	3 nodes: UsdUVTexture, gltf_image, gltf_normalmap
place2d	3 nodes: UsdTransform2d, gltf_image, gltf_normalmap
translucent_bsdf	3 nodes: LamaTranslucent, open_pbr_surface, standard_surface
subsurface_bsdf	3 nodes: LamaSSS, open_pbr_surface, standard_surface
conductor_bsdf	3 nodes: LamaConductor, UsdPreviewSurface, standard_surface
anisotropic_vdf	2 nodes: LamaDielectric, gltf_pbr

Node Definition	Used by
min	2 nodes: gltf_pbr, open_pbr_surface
extract	2 nodes: gltf_iridescence_thickness, gltf_pbr
ifequal	2 nodes: gltf_pbr, standard_surface_to_gltf_pbr
gltf_image	2 nodes: gltf_colorimage, gltf_iridescence_thickness
normalmap	2 nodes: UsdPreviewSurface, gltf_normalmap
generalized_schlick_edf	2 nodes: open_pbr_surface, standard_surface
luminance	2 nodes: open_pbr_surface, standard_surface
switch	2 nodes: LamaConductor, LamaDielectric
combine2	2 nodes: LamaConductor, LamaDielectric
dotproduct	2 nodes: standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr
ln	1 nodes: gltf_pbr
separate4	1 nodes: gltf_colorimage
combine3	1 nodes: gltf_colorimage
sqrt	1 nodes: open_pbr_surface
sign	1 nodes: open_pbr_surface
geompropvalue	1 nodes: UsdPrimvarReader
invert	1 nodes: glossiness_anisotropy

Non-Graph Nodes: 30

absorption_vdf, add, anisotropic_vdf, artistic_ior, blackbody, burley_diffuse_bsdf, conductor_bsdf, conical_edf, dielectric_bsdf, disney_brdf_2012, disney_bsdf_2015, displacement, generalized_schlick_bsdf, generalized_schlick_edf, layer, light, measured_edf, mix, multiply, oren_nayar_diffuse_bsdf, roughness_anisotropy, roughness_dual, sheen_bsdf, subsurface_bsdf, surface, thin_film_bsdf, thin_surface, translucent_bsdf, uniform_edf, volume

Node Usage Results for all Standard Library Nodes

In [ ]:
```
nodes_use, nodes_used_by, nongraph_nodes, unimplemented = getNodeDefUsage(doc)

printNodeDefUsage(nodes_use, nodes_used_by, nongraph_nodes, unimplemented)
```

Node Definition	Uses
open_pbr_surface	28 nodes: add, clamp, convert, dielectric_bsdf, divide, generalized_schlick_bsdf, generalized_schlick_edf, ifgreater, layer, luminance, max, min, mix, multiply, normalize, oren_nayar_diffuse_bsdf, power, rotate3d, roughness_anisotropy, sheen_bsdf, sign, sqrt, subsurface_bsdf, subtract, surface, thin_film_bsdf, translucent_bsdf, uniform_edf
standard_surface	26 nodes: add, artistic_ior, clamp, conductor_bsdf, convert, dielectric_bsdf, divide, generalized_schlick_edf, ifgreater, layer, luminance, max, mix, multiply, normalize, oren_nayar_diffuse_bsdf, power, rotate3d, roughness_anisotropy, sheen_bsdf, subsurface_bsdf, subtract, surface, thin_film_bsdf, translucent_bsdf, uniform_edf
gltf_pbr	22 nodes: add, anisotropic_vdf, convert, dielectric_bsdf, divide, extract, generalized_schlick_bsdf, ifequal, ifgreatereq, layer, ln, max, min, mix, multiply, oren_nayar_diffuse_bsdf, roughness_anisotropy, sheen_bsdf, subtract, surface, thin_film_bsdf, uniform_edf
LamaConductor	18 nodes: add, artistic_ior, clamp, combine2, conductor_bsdf, convert, divide, ifgreater, ifgreatereq, layer, max, multiply, normalize, power, rotate3d, subtract, switch, thin_film_bsdf
UsdPreviewSurface	17 nodes: add, artistic_ior, conductor_bsdf, convert, dielectric_bsdf, divide, generalized_schlick_bsdf, ifgreatereq, layer, mix, multiply, normalmap, oren_nayar_diffuse_bsdf, roughness_anisotropy, subtract, surface, uniform_edf
LamaDielectric	17 nodes: add, anisotropic_vdf, artistic_ior, clamp, combine2, convert, dielectric_bsdf, divide, ifgreatereq, layer, max, multiply, normalize, power, rotate3d, subtract, switch
triplanarprojection	13 nodes: absval, add, clamp, combine2, divide, dotproduct, extract, image, multiply, normalize, power, separate3, switch
unifiednoise2d	12 nodes: add, cellnoise2d, combine3, fractal3d, multiply, noise2d, range, rotate2d, separate2, subtract, switch, worleynoise2d
gooch_shade	11 nodes: add, divide, dotproduct, max, mix, multiply, normal, normalize, power, reflect, viewdirection
tiledcircles	11 nodes: add, circle, combine2, convert, divide, ifequal, ifgreater, max, modulo, multiply, subtract
tiledcloverleafs	11 nodes: add, cloverleaf, combine2, convert, divide, ifequal, ifgreater, max, modulo, multiply, subtract
tiledhexagons	11 nodes: add, combine2, convert, divide, hexagon, ifequal, ifgreater, max, modulo, multiply, subtract
unifiednoise3d	10 nodes: add, cellnoise3d, fractal3d, multiply, noise3d, range, rotate3d, subtract, switch, worleynoise3d
hexagon	10 nodes: absval, clamp, combine2, constant, dotproduct, ifgreater, min, multiply, sqrt, subtract
crosshatch	10 nodes: add, combine2, convert, ifequal, ifgreater, line, max, modulo, multiply, subtract
grid	9 nodes: absval, add, convert, ifequal, ifgreater, min, modulo, multiply, subtract
range	8 nodes: absval, clamp, divide, ifequal, multiply, power, remap, sign
standard_surface_to_gltf_pbr	7 nodes: divide, dot, dotproduct, ifequal, ifgreater, mix, multiply
line	7 nodes: clamp, distance, divide, dotproduct, ifgreater, multiply, subtract
standard_surface_to_UsdPreviewSurface	6 nodes: divide, dot, dotproduct, mix, multiply, subtract
checkerboard	6 nodes: dotproduct, floor, mix, modulo, multiply, subtract
refract	6 nodes: add, dotproduct, ifgreater, multiply, sqrt, subtract

Node Definition	Uses
gltf_colorimage	5 nodes: combine3, dot, gltf_image, multiply, separate4
gltf_normalmap	5 nodes: divide, image, multiply, normalmap, place2d
facingratio	5 nodes: absval, dotproduct, ifequal, invert, multiply
cloverleaf	5 nodes: add, circle, combine2, max, subtract
place2d	5 nodes: add, divide, rotate2d, subtract, switch
hsvadjust	5 nodes: add, convert, hsvtorgb, multiply, rgbtohsv
colorcorrect	5 nodes: colorcorrect, combine3, combine4, separate3, separate4
gltf_image	4 nodes: divide, image, multiply, place2d
LamaSheen	4 nodes: add, multiply, power, sheen_bsdf
tiledimage	4 nodes: divide, image, multiply, subtract
randomfloat	4 nodes: cellnoise2d, combine2, convert, range
circle	4 nodes: dotproduct, ifgreater, multiply, subtract
safepower	4 nodes: absval, multiply, power, sign
gltf_iridescence_thickness	3 nodes: extract, gltf_image, mix
UsdUVTexture	3 nodes: add, image, multiply
LamaSSS	3 nodes: convert, multiply, subsurface_bsdf
g18_rec709_to_lin_rec709	3 nodes: combine4, convert, g18_rec709_to_lin_rec709
g22_rec709_to_lin_rec709	3 nodes: combine4, convert, g22_rec709_to_lin_rec709
rec709_display_to_lin_rec709	3 nodes: combine4, convert, rec709_display_to_lin_rec709
acescg_to_lin_rec709	3 nodes: acescg_to_lin_rec709, combine4, convert
g22_ap1_to_lin_rec709	3 nodes: combine4, convert, g22_ap1_to_lin_rec709
srgb_texture_to_lin_rec709	3 nodes: combine4, convert, srgb_texture_to_lin_rec709
lin_adobergb_to_lin_rec709	3 nodes: combine4, convert, lin_adobergb_to_lin_rec709
adobergb_to_lin_rec709	3 nodes: adobergb_to_lin_rec709, combine4, convert
srgb_displayp3_to_lin_rec709	3 nodes: combine4, convert, srgb_displayp3_to_lin_rec709
lin_displayp3_to_lin_rec709	3 nodes: combine4, convert, lin_displayp3_to_lin_rec709
ramp4	3 nodes: clamp, extract, mix
trianglewave	3 nodes: absval, modulo, subtract
reflect	3 nodes: dotproduct, multiply, subtract
contrast	3 nodes: add, multiply, subtract
overlay	3 nodes: combine4, overlay, separate4
LamaAdd	2 nodes: add, multiply
LamaDiffuse	2 nodes: multiply, oren_nayar_diffuse_bsdf
LamaLayer	2 nodes: layer, multiply
glossiness_anisotropy	2 nodes: invert, roughness_anisotropy
randomcolor	2 nodes: convert, randomcolor

Node Definition	Uses
bump	2 nodes: heighttonormal, normalmap
distance	2 nodes: magnitude, subtract
saturate	2 nodes: luminance, mix
convert	2 nodes: convert, surface_unlit
extract	2 nodes: switch, swizzle
UsdPrimvarReader	1 nodes: geompropvalue
UsdTransform2d	1 nodes: place2d
LamaEmission	1 nodes: uniform_edf
LamaMix	1 nodes: mix
LamaTranslucent	1 nodes: translucent_bsdf
noise2d	1 nodes: noise2d
noise3d	1 nodes: noise3d
fractal3d	1 nodes: fractal3d
smoothstep	1 nodes: smoothstep
separate2	1 nodes: swizzle
separate3	1 nodes: swizzle
separate4	1 nodes: swizzle

Node Definition	Used by
multiply	41 nodes: LamaAdd, LamaConductor, LamaDielectric, LamaDiffuse, LamaLayer, LamaSSS, LamaSheen, UsdPreviewSurface, UsdUVTexture, checkerboard, circle, colorcorrect, contrast, crosshatch, facingratio, gltf_colorimage, gltf_image, gltf_normalmap, gltf_pbr, gooch_shade, grid, hexagon, hsvadjust, line, open_pbr_surface, overlay, randomfloat, range, reflect, refract, safepower, standard_surface, standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr, tiledcircles, tiledcloverleafs, tiledhexagons, tiledimage, triplanarprojection, unifiednoise2d, unifiednoise3d
subtract	28 nodes: LamaConductor, LamaDielectric, UsdPreviewSurface, checkerboard, circle, cloverleaf, colorcorrect, contrast, crosshatch, distance, gltf_pbr, grid, hexagon, line, open_pbr_surface, overlay, place2d, reflect, refract, standard_surface, standard_surface_to_UsdPreviewSurface, tiledcircles, tiledcloverleafs, tiledhexagons, tiledimage, trianglewave, unifiednoise2d, unifiednoise3d
convert	26 nodes: LamaConductor, LamaDielectric, LamaSSS, UsdPreviewSurface, acescg_to_lin_rec709, adobergb_to_lin_rec709, convert, crosshatch, g18_rec709_to_lin_rec709, g22_ap1_to_lin_rec709, g22_rec709_to_lin_rec709, gltf_pbr, grid, hsvadjust, lin_adobergb_to_lin_rec709, lin_displayp3_to_lin_rec709, open_pbr_surface, randomcolor, randomfloat, rec709_display_to_lin_rec709, srgb_displayp3_to_lin_rec709, srgb_texture_to_lin_rec709, standard_surface, tiledcircles, tiledcloverleafs, tiledhexagons
add	26 nodes: LamaAdd, LamaConductor, LamaDielectric, LamaSheen, UsdPreviewSurface, UsdUVTexture, cloverleaf, colorcorrect, contrast, crosshatch, gltf_pbr, gooch_shade, grid, hsvadjust, open_pbr_surface, place2d, randomcolor, refract, srgb_texture_to_lin_rec709, standard_surface, tiledcircles, tiledcloverleafs, tiledhexagons, triplanarprojection, unifiednoise2d, unifiednoise3d
divide	21 nodes: LamaConductor, LamaDielectric, UsdPreviewSurface, adobergb_to_lin_rec709, gltf_image, gltf_normalmap, gltf_pbr, gooch_shade, line, open_pbr_surface, place2d, range, srgb_texture_to_lin_rec709, standard_surface, standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr, tiledcircles, tiledcloverleafs, tiledhexagons, tiledimage, triplanarprojection
max	17 nodes: LamaConductor, LamaDielectric, adobergb_to_lin_rec709, cloverleaf, crosshatch, g18_rec709_to_lin_rec709, g22_ap1_to_lin_rec709, g22_rec709_to_lin_rec709, gltf_pbr, gooch_shade, open_pbr_surface, rec709_display_to_lin_rec709, srgb_texture_to_lin_rec709, standard_surface, tiledcircles, tiledcloverleafs, tiledhexagons
power	16 nodes: LamaConductor, LamaDielectric, LamaSheen, adobergb_to_lin_rec709, colorcorrect, g18_rec709_to_lin_rec709, g22_ap1_to_lin_rec709, g22_rec709_to_lin_rec709, gooch_shade, open_pbr_surface, range, rec709_display_to_lin_rec709, safepower, srgb_texture_to_lin_rec709, standard_surface, triplanarprojection
mix	14 nodes: LamaMix, UsdPreviewSurface, checkerboard, gltf_iridescence_thickness, gltf_pbr, gooch_shade, open_pbr_surface, overlay, ramp4, saturate, srgb_texture_to_lin_rec709, standard_surface, standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr
ifgreater	14 nodes: LamaConductor, circle, crosshatch, grid, hexagon, line, open_pbr_surface, refract, srgb_texture_to_lin_rec709, standard_surface, standard_surface_to_gltf_pbr, tiledcircles, tiledcloverleafs, tiledhexagons
combine4	12 nodes: acescg_to_lin_rec709, adobergb_to_lin_rec709, colorcorrect, g18_rec709_to_lin_rec709, g22_ap1_to_lin_rec709, g22_rec709_to_lin_rec709, lin_adobergb_to_lin_rec709, lin_displayp3_to_lin_rec709, overlay, rec709_display_to_lin_rec709, srgb_displayp3_to_lin_rec709, srgb_texture_to_lin_rec709
dotproduct	11 nodes: checkerboard, circle, facingratio, gooch_shade, hexagon, line, reflect, refract, standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr, triplanarprojection
combine2	10 nodes: LamaConductor, LamaDielectric, cloverleaf, crosshatch, hexagon, randomfloat, tiledcircles, tiledcloverleafs, tiledhexagons, triplanarprojection
ifequal	9 nodes: crosshatch, facingratio, gltf_pbr, grid, range, standard_surface_to_gltf_pbr, tiledcircles, tiledcloverleafs, tiledhexagons
clamp	9 nodes: LamaConductor, LamaDielectric, hexagon, line, open_pbr_surface, ramp4, range,

Node Definition	Used by
	standard_surface, triplanarprojection
layer	7 nodes: LamaConductor, LamaDielectric, LamaLayer, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
switch	7 nodes: LamaConductor, LamaDielectric, extract, place2d, triplanarprojection, unifiednoise2d, unifiednoise3d
absval	7 nodes: facingratio, grid, hexagon, range, safepower, trianglewave, triplanarprojection
modulo	7 nodes: checkerboard, crosshatch, grid, tiledcircles, tiledcloverleafs, tiledhexagons, trianglewave
combine3	6 nodes: colorcorrect, gltf_colorimage, overlay, randomcolor, srgb_texture_to_lin_rec709, unifiednoise2d
normalize	6 nodes: LamaConductor, LamaDielectric, gooch_shade, open_pbr_surface, standard_surface, triplanarprojection
constant	6 nodes: acescg_to_lin_rec709, hexagon, lin_adobergb_to_lin_rec709, lin_displayp3_to_lin_rec709, srgb_displayp3_to_lin_rec709, srgb_texture_to_lin_rec709
roughness_anisotropy	5 nodes: UsdPreviewSurface, glossiness_anisotropy, gltf_pbr, open_pbr_surface, standard_surface
oren_nayar_diffuse_bsdf	5 nodes: LamaDiffuse, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
dielectric_bsdf	5 nodes: LamaDielectric, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
extract	5 nodes: convert, gltf_iridescence_thickness, gltf_pbr, ramp4, triplanarprojection
uniform_edf	5 nodes: LamaEmission, UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
ifgreatereq	5 nodes: LamaConductor, LamaDielectric, UsdPreviewSurface, gltf_pbr, overlay
image	5 nodes: UsdUVTexture, gltf_image, gltf_normalmap, tiledimage, triplanarprojection
rotate3d	5 nodes: LamaConductor, LamaDielectric, open_pbr_surface, standard_surface, unifiednoise3d
range	5 nodes: colorcorrect, randomcolor, randomfloat, unifiednoise2d, unifiednoise3d
min	4 nodes: gltf_pbr, grid, hexagon, open_pbr_surface
thin_film_bsdf	4 nodes: LamaConductor, gltf_pbr, open_pbr_surface, standard_surface
sheen_bsdf	4 nodes: LamaSheen, gltf_pbr, open_pbr_surface, standard_surface
surface	4 nodes: UsdPreviewSurface, gltf_pbr, open_pbr_surface, standard_surface
artistic_ior	4 nodes: LamaConductor, LamaDielectric, UsdPreviewSurface, standard_surface
transformmatrix	4 nodes: acescg_to_lin_rec709, lin_adobergb_to_lin_rec709, lin_displayp3_to_lin_rec709, srgb_displayp3_to_lin_rec709
swizzle	4 nodes: extract, separate2, separate3, separate4
generalized_schlick_bsdf	3 nodes: UsdPreviewSurface, gltf_pbr, open_pbr_surface
separate4	3 nodes: colorcorrect, gltf_colorimage, overlay
dot	3 nodes: gltf_colorimage, standard_surface_to_UsdPreviewSurface, standard_surface_to_gltf_pbr
place2d	3 nodes: UsdTransform2d, gltf_image, gltf_normalmap
normalmap	3 nodes: UsdPreviewSurface, bump, gltf_normalmap
translucent_bsdf	3 nodes: LamaTranslucent, open_pbr_surface, standard_surface
subsurface_bsdf	3 nodes: LamaSSS, open_pbr_surface, standard_surface

Node Definition	Used by
sqrt	3 nodes: hexagon, open_pbr_surface, refract
sign	3 nodes: open_pbr_surface, range, safepower
luminance	3 nodes: open_pbr_surface, saturate, standard_surface
conductor_bsdf	3 nodes: LamaConductor, UsdPreviewSurface, standard_surface
separate3	3 nodes: colorcorrect, overlay, triplanarprojection
fractal3d	3 nodes: fractal3d, unifiednoise2d, unifiednoise3d
anisotropic_vdf	2 nodes: LamaDielectric, gltf_pbr
gltf_image	2 nodes: gltf_colorimage, gltf_iridescence_thickness
generalized_schlick_edf	2 nodes: open_pbr_surface, standard_surface
acescg_to_lin_rec709	2 nodes: acescg_to_lin_rec709, g22_ap1_to_lin_rec709
srgb_texture_to_lin_rec709	2 nodes: srgb_displayp3_to_lin_rec709, srgb_texture_to_lin_rec709
lin_adobergb_to_lin_rec709	2 nodes: adobergb_to_lin_rec709, lin_adobergb_to_lin_rec709
invert	2 nodes: facingratio, glossiness_anisotropy
noise2d	2 nodes: noise2d, unifiednoise2d
noise3d	2 nodes: noise3d, unifiednoise3d
cellnoise2d	2 nodes: randomfloat, unifiednoise2d
rotate2d	2 nodes: place2d, unifiednoise2d
hsvtorgb	2 nodes: hsvadjust, randomcolor
circle	2 nodes: cloverleaf, tiledcircles
ln	1 nodes: gltf_pbr
geompropvalue	1 nodes: UsdPrimvarReader
g18_rec709_to_lin_rec709	1 nodes: g18_rec709_to_lin_rec709
g22_rec709_to_lin_rec709	1 nodes: g22_rec709_to_lin_rec709
rec709_display_to_lin_rec709	1 nodes: rec709_display_to_lin_rec709
g22_ap1_to_lin_rec709	1 nodes: g22_ap1_to_lin_rec709
adobergb_to_lin_rec709	1 nodes: adobergb_to_lin_rec709
srgb_displayp3_to_lin_rec709	1 nodes: srgb_displayp3_to_lin_rec709
lin_displayp3_to_lin_rec709	1 nodes: lin_displayp3_to_lin_rec709
normal	1 nodes: gooch_shade
viewdirection	1 nodes: gooch_shade
reflect	1 nodes: gooch_shade
worleynoise2d	1 nodes: unifiednoise2d
separate2	1 nodes: unifiednoise2d
cellnoise3d	1 nodes: unifiednoise3d
worleynoise3d	1 nodes: unifiednoise3d
ceil	1 nodes: randomcolor

Node Definition	Used by
randomfloat	1 nodes: randomcolor
randomcolor	1 nodes: randomcolor
floor	1 nodes: checkerboard
distance	1 nodes: line
line	1 nodes: crosshatch
cloverleaf	1 nodes: tiledcloverleafs
hexagon	1 nodes: tiledhexagons
heighttonormal	1 nodes: bump
magnitude	1 nodes: distance
smoothstep	1 nodes: smoothstep
remap	1 nodes: range
rgbtohsv	1 nodes: hsvadjust
contrast	1 nodes: colorcorrect
saturate	1 nodes: colorcorrect
hsvadjust	1 nodes: colorcorrect
colorcorrect	1 nodes: colorcorrect
overlay	1 nodes: overlay
surface_unlit	1 nodes: convert

Non-Graph Nodes: 129

absorption_vdf, absval, acos, add, ambientocclusion, anisotropic_vdf, artistic_ior, asin, atan2, bitangent, blackbody, blur, burley_diffuse_bsdf, burn, ceil, cellnoise2d, cellnoise3d, clamp, combine2, combine3, combine4, conductor_bsdf, conical_edf, constant, convert, cos, creatematrix, crossproduct, determinant, dielectric_bsdf, difference, directional_light, disjointover, disney_brdf_2012, disney_bsdf_2015, displacement, divide, dodge, dot, dotproduct, exp, floor, fractal3d, frame, generalized_schlick_bsdf, generalized_schlick_edf, geomcolor, geompropvalue, heighttonormal, hsvtorgb, ifequal, ifgreater, ifgreatereq, image, in, inside, invert, invertmatrix, layer, light, ln, luminance, magnitude, mask, matte, max, measured_edf, min, minus, mix, modulo, multiply, noise2d, noise3d, normal, normalize, normalmap, oren_nayar_diffuse_bsdf, out, outside, over, plus, point_light, position, power, premult, ramplr, ramptb, remap, rgbtohsv, rotate2d, rotate3d, roughness_anisotropy, roughness_dual, round, screen, sheen_bsdf, sign, sin, smoothstep, splitlr, splittb, spot_light, sqrt, subsurface_bsdf, subtract, surface, surface_unlit, surfacematerial, switch, swizzle, tan, tangent, texcoord, thin_film_bsdf, thin_surface, time, transformmatrix, transformnormal, transformpoint, transformvector, translucent_bsdf, transpose, uniform_edf, unpremult, viewdirection, volume, worleynoise2d, worleynoise3d

Unimplemented Nodes 3

arrayappend, curveadjust, volumematerial