Maya

Programming Interface
Overview
Programming Interfaces

• MEL – Maya Embedded Language
  – Scripting language
  – Interpreted
  – Fast prototyping, slow execution

• C++
  – Powerful, fast
  – Class libraries
Maya Architecture

Graphical User Interface

MEL Command Engine

Dependency Graph
**Dependency Graph (DG)**

- **Data flow model**
  - Data manipulated by series of operations
  - Pipeline
  - Push–pull model
- **DG – heart of Maya**
  - Data and operations represented as nodes
  - Network of nodes to perform task
  - Add functionality by defining new node
The Scene

- Entire 3D graphics state – the DG
  - Models
  - Animations
  - Textures
  - Lights
  - cameras
- Programming interfaces hide much of DG complexity
Example DG

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

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Data Flow

- **Nodes**
- **Attributes** - properties of a node
- **Input/output**
- **Compute function**
NODE

node
input
output
Compute()
Node attributes

- node:
  - size (float)

- pointA (compound):
  - x (float)
  - y (float)
  - z (float)
Node

points (array)

[0] point compound
  x (float)
  y (float)
  z (float)

[1] point compound
  x (float)
  y (float)
  z (float)

[...] point compound
Compute Function

- Output = compute(input0, ..., inputN)
- Input and output attributes are LOCAL
- Black box
- Interface: input and output attributes
Dependent Attributes

- Volume = compute(sphereSize)
- attributeAffects(sphereSize, volume)
Time

- Example of node that only holds data
- Current time in time node named time1
- Moving frame slider or click on Play sets time
Connecting Nodes

• Connect nodes by connecting node attributes
• Attribute can only connect to attribute of same type
• Maya handles flow of data; node not ‘aware’ of connections
• Connections: one-to-many mappings
• When connections broken, node retains value
DAG nodes

- Directed Acyclic Graph
- DAG nodes form Shape-Transform hierarchy
- DAG nodes are in DG – they are DG nodes
  - Some DAG nodes connect to non-DAG DG nodes
  - Some DAG nodes may not be connected to any non-DAG nodes
- Maya shows either DAG hierarchy or connected DG nodes, not both simultaneously
DAG and DG nodes

- time
- animCurve
- transform
- shape

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Shape Nodes

- Meshes
- NURBS curves and surfaces
- Springs
- Camera
- Lights
- Particles
- Etc.
Transform Nodes

- Shape node can’t exist without a transform node
- Shape node holds the data
- Transform node transforms from objects space to world space
Dependent Attributes

- attributeAffects( width, areaOfTop)
- attributeAffects( depth, areaOfTop)
- attributeAffects( areaOfTop, volume)
- attributeAffects( height, volume)

boxMetrics

<table>
<thead>
<tr>
<th>width (float)</th>
</tr>
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<tbody>
<tr>
<td>height (float)</td>
</tr>
<tr>
<td>depth (float)</td>
</tr>
<tr>
<td>areaOfTop (float)</td>
</tr>
<tr>
<td>volume (float)</td>
</tr>
</tbody>
</table>
Transform Hierarchy

- Head
- Torso
  - right arm
  - right leg
  - left leg
  - left arm