



CS 112 - Hierarchical Model Representation

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Slide 1



Animations

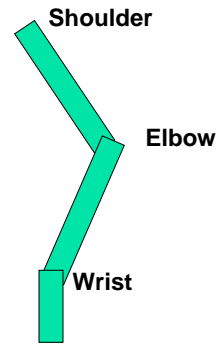
- Need efficient representation of
 - Model geometry
 - Motion
 - Interactive rendering

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Inherent relationship of parts

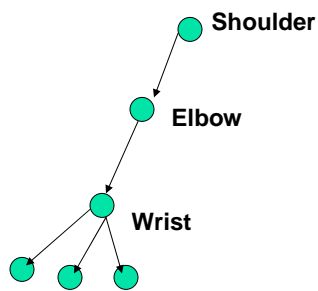
- Arm – Simple model
- Shoulder moves all the three parts
- Elbow moves everything below it
- Inherent hierarchical relationship



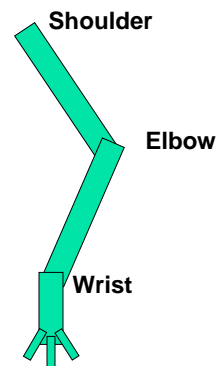
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Inherent relationship of parts



Directed Acyclic Tree



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Dependency

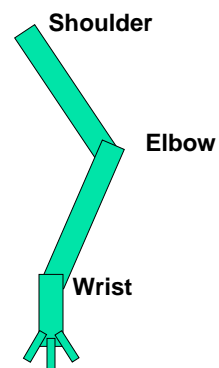
- Any transformation applied to the parent will be undergone by the children
 - Children must be placed appropriately with respect to the parent
- Children may have their own independent movement
 - Not transmitted to the parent

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Representing Transformations

- Transformation with respect to the parent
- Transformation to place it appropriately with respect to the parent



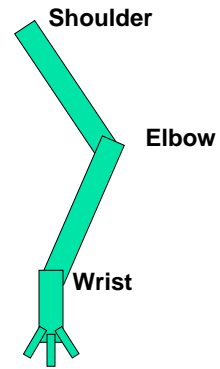
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Representing Transformations

- Transformation with respect to the parent
- Transformation to place it appropriately with respect to the parent



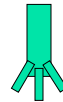
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Representing Transformations

- Assume each part is defined with origin at center



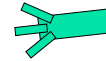
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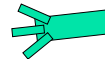
Representing Transformations

- Assume each part is defined with origin at center
- R_w



Representing Transformations

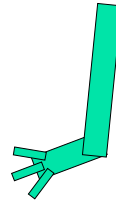
- Assume each part is defined with origin at center
- R_w
- T_{we}





Representing Transformations

- Assume each part is defined with origin at center
- R_w – Wrist
- T_{we} – Wrist
- R_E – Elbow and Wrist



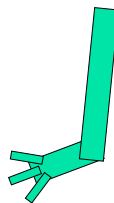
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Representing Transformations

- Assume each part is defined with origin at center
- R_w – Wrist
- T_{we} – Wrist
- R_e – Elbow and Wrist
- T_{es} – Elbow and Wrist

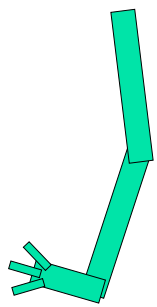


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Representing Transformations

- Assume each part is defined with origin at center
- R_w – Wrist
- T_{we} - Wrist
- R_e – Elbow and Wrist
- T_{es} – Elbow and Wrist
- R_s – Shoulder, elbow and wrist



Representing Transformations

- Assume each part is defined with origin at center
- R_w – Wrist
- T_{we} - Wrist
- R_e – Elbow and Wrist
- T_{es} – Elbow and Wrist
- R_s – Shoulder, elbow and wrist

Wrist: $R_s T_{es} R_e T_{we} R_w$

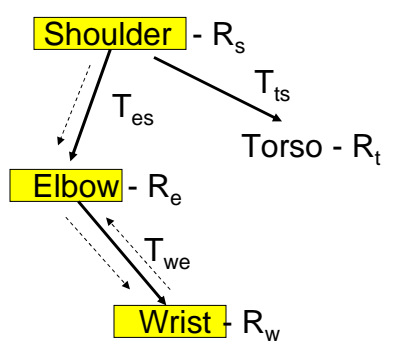
Elbow: $R_s T_{es} R_e$

Shoulder: R_s

Data Structure

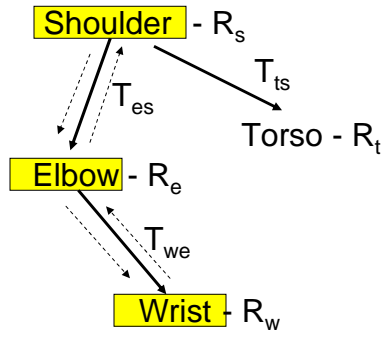
- Depth first traversal of the tree
- Push matrix when entering a node
- Pop matrix when leaving a node
- Render the node as you encounter it
- Example

Data Structure



| |
|-----------------------------|
| $R_s T_{es} R_e T_{we} R_w$ |
| $R_s T_{es} R_e$ |
| R_s |

Data Structure

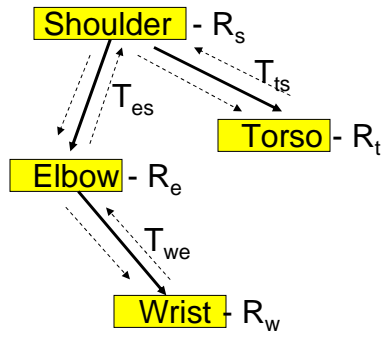


| |
|------------------|
| $R_s T_{es} R_e$ |
| R_s |

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Data Structure

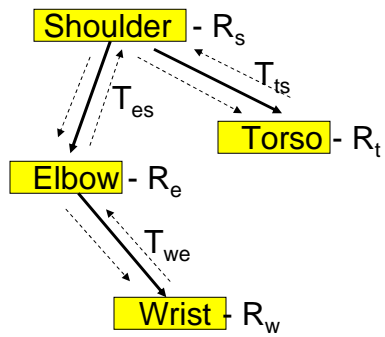


| |
|------------------|
| $R_s T_{ts} R_t$ |
| R_s |

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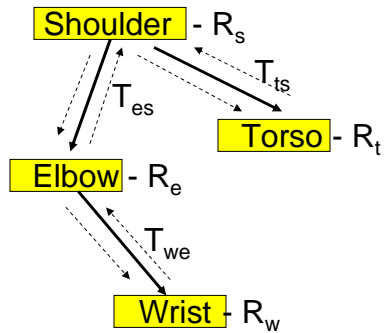
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Data Structure



R_s

Data Structure





Representing Motion

- Keyframes
 - Generate the transformations for key postures
 - Done manually
 - Interpolate everything in between
 - Done automatically