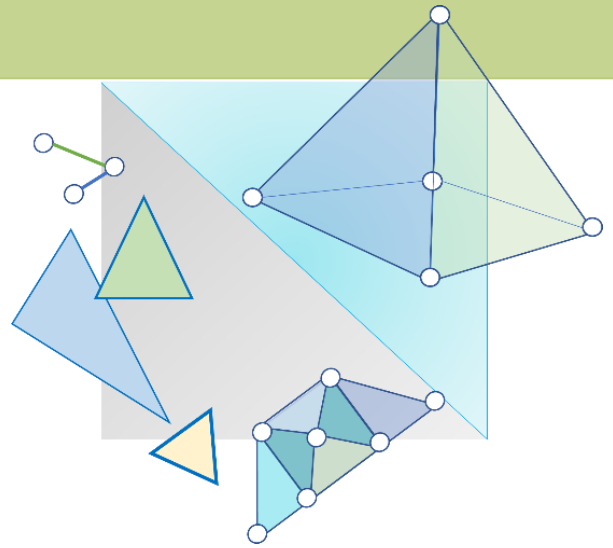
CITS3003 Graphics & Animation

Lecture 23:
Skinning & Rigging



Objectives

- Introduce the basic concepts of
  - Rigging
  - Skinning
- End-term discussion

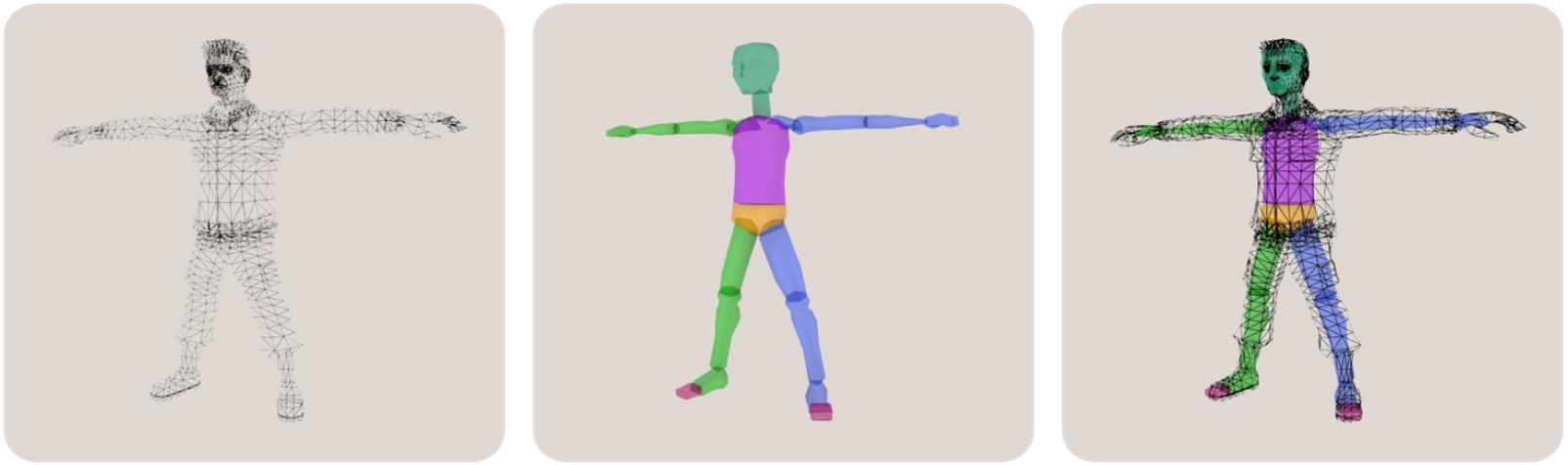
Motivation – Non-rigid Transformations

- Defining complex 3D objects as a hierarchical data structure allows us to define hierarchical transformations.
- Hierarchies of transformations allow parts of complex objects to move relative to each other.
- All vertices in a basic part are transformed the same way
  - Basic parts retain their shape
  - We generally have *rigid transformations*
- This works well for objects like tanks with rigid parts
- But what about human characters and other objects that have parts that rotate and move, but with surfaces that are flexible rather than rigid?

What is Skinning?

- **Skinning** provides a means to animate a model while reducing the "folding" and "creasing" of polygons as the model animates.

- A model is represented in two parts:
  - Skin (this is described by the triangular mesh)
  - Skeleton (the underlying bones of the model)



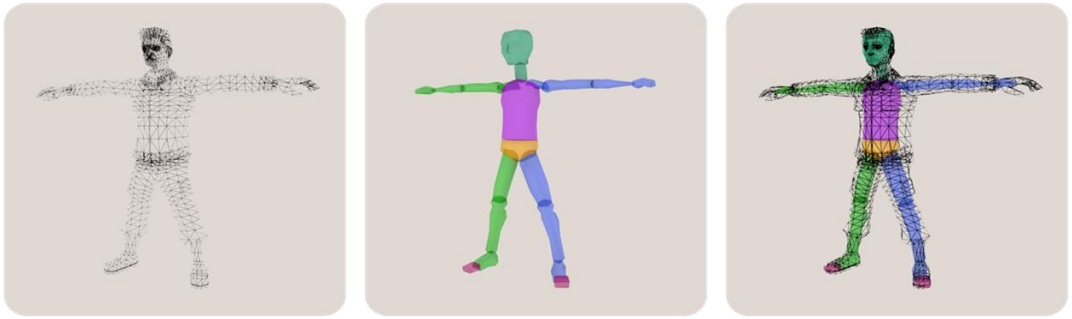
(a) (b) (c)

What is Rigging?

- *Rigging is the process of creating* a geometric skeleton that fits in to a mesh (skin) and defines how an object moves.
- This skeleton can be though of as a set of *bones* that are connected at *joints*.
  - The joint angles (known as **bone transformations**) in a hierarchical character determine the pose.

How is Skinning Implemented?

- Define a bone hierarchy in a model
  - The mesh (triangle) data is defined separately.
  - The bone hierarchy is linked to the model's mesh, so that animating the bone hierarchy animates the mesh's vertices.



(a) (b) (c)

- Note that multiple bones can affect each vertex in the skin mesh.
- So, we can have a weighting value for each bone to determine how much influence it has in proportion to the others
  - This allows smooth transitions around bone joints

Skinning

Coloured triangles are attached to one bone

(different colour means different bone)

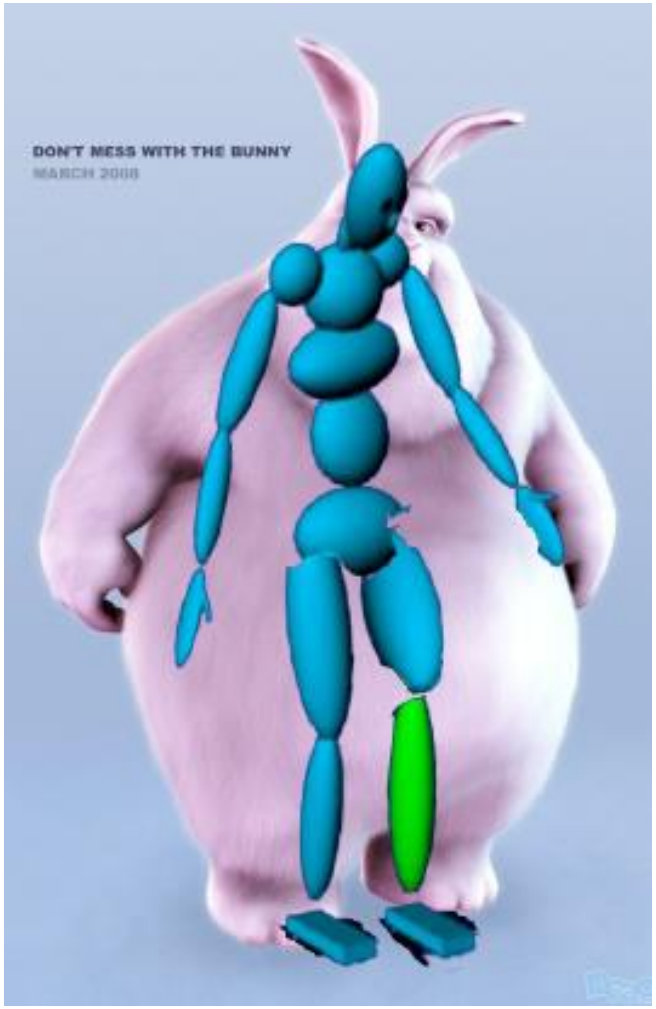
Black triangles are attached to more than one bone

Note that black triangles are near the joints

James & Twigg, Skinning Mesh Animations, 2005, used with permission from ACM, Inc.

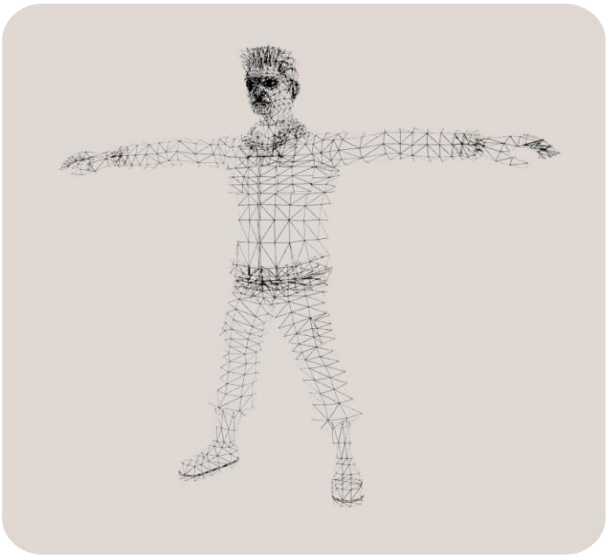
Skinning a Character

- Embed a skeleton into a detailed character mesh
- Animate the “bones” by
  - changing the joint angles in each keyframe, then
  - interpolating the keyframes.
- Bind the skin vertices to bones
  - So, animating skeleton will move the skin with it.

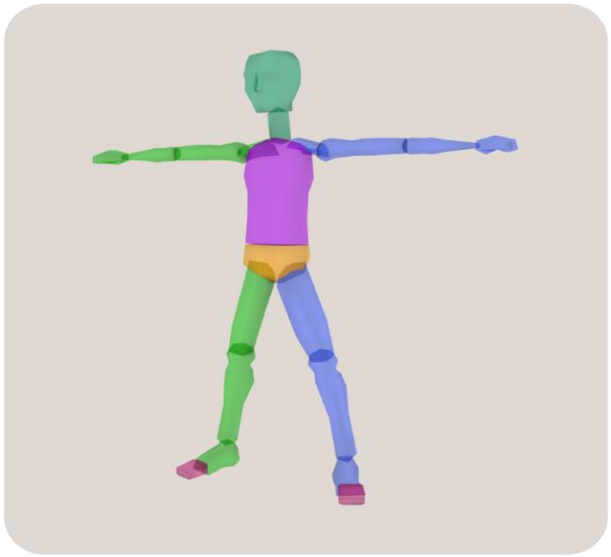


Hierarchical Model

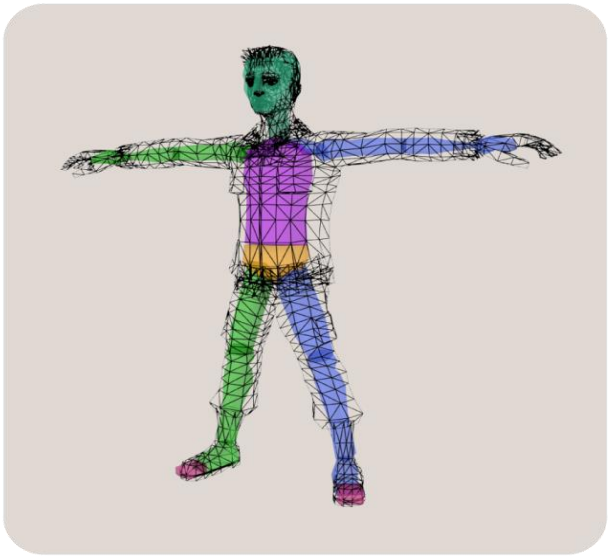
- Bind the skin vertices to bones



(a)



(b)



(c)

End term

INSTRUCTIONS:

Time 2hr

This is an open book invigilated exam. Calculators are allowed.

Total points: 100
Attempt all questions.

The exam has 3 sections:

(1) Short questions – 10 questions worth 40 points — 4~5 mins/question
(2) Long questions – 6 questions worth 44 points — 8~10 mins/question
(3) MCQs & T/F questions – 8 questions worth 16 points — <=1 mins/question

- Questions are asked from the whole content (including before mid-term lectures)
- MCQs- negative marking applies
  - Net score per MCQ can be zero but not negative

Link to previous final exams: http://teaching.csse.uwa.edu.au/units/CITS3003/index.php?fname=lectures

End term

- MCQs- negative marking applies
  - Net score per MCQ can be zero but not negative

Select all the correct statement(s)

a) In a graphics pipeline, objects are processed one at a time, as passed by the application program

b) In parallel projection, all projected rays meet at the center of projection

c) Clipping must be performed before ‘primitive assembly’ in graphics pipeline because it can make ‘primitive assembly’ more efficient by reducing the number of primitives

d) Immediate mode graphics APIs are generally procedural

Thank you

- All students who participated in the unit
- For providing feedback
  - On lectures
  - On midterm

Best of luck for your final Exam