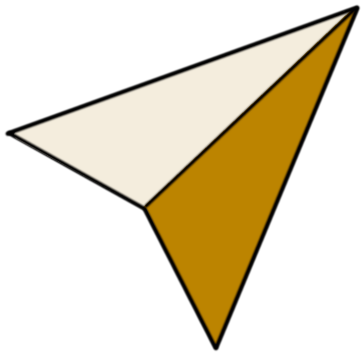


COMP4610/COMP6461

Week 4 - Animation

<Print version>

Labs

[Lab-1]

We have now downloaded **lab-1**, and will mark it this week. Feedback will be provided on the *following* week.

We received more than 90% submissions. Well done. Please let us know if you believe you completed the lab but do not receive a mark.

It is possible that you either...

- forgot to add me as a developer,
- forgot to push your commit,
- changed the name of the rep.

[Lab-2]

Lab 2 is out now. This lab covers

- Splines,
- Graphics2D,
- Hierarchical modeling.

Topics covered in this lab could be useful for **Assignment-1**.

[Assignment-1]

Just a reminder that your 1-page plan is due *this* Friday at 5PM.
If you finish labs early, you can make use of the labs to work on/ask for help with your assignment.

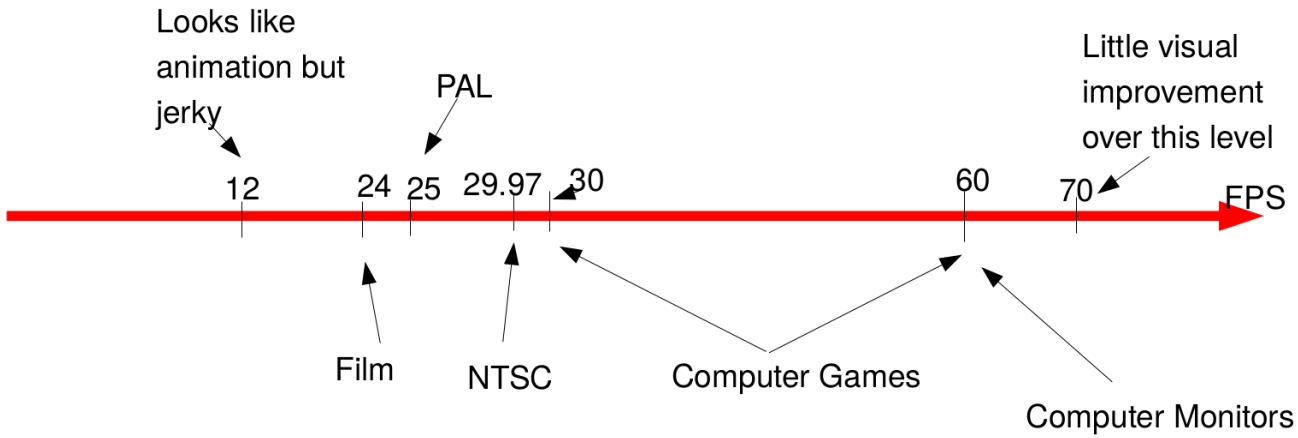
Animation

Computer Animation

- Computer Animation refers to any time sequence changes in the picture displayed.
- Computer Animation can be:
  - *real-time animation* the animation sequence is viewed as it is created.
  - *frame-by-frame animation* frames are created one by one and stored to be played back at a later time.
- The *illusion* of movement is created by rapidly changing frames where each frame renders the scene after a small change in the time domain.
- The **frames-per-second** is an important factor in terms of the visual effect and the computing resources to both generate and display the animation.

FPS

Frame rate is an important factor in terms of the visual effect and the computing resources to both generate and display the animation.



Key Concepts

- Double Buffering: Drawing directly to frame buffer creates flickering and tearing. Double buffering draws to a different buffer and moves this screen image data over in sync with, and ahead of, the raster beam reading from frame buffer. This solves the *flickering* problem.
- Page flipping is a also a form of double buffering where the pointers to the frame buffer and drawing buffer area is switched between each other in sync with the raster beam.
- VSync, or the 'vertical sync' of a display, often refers to the process of making changes to the frame buffer during a period where the screen is not updating. This solves the *tearing* problem.
- Triple Buffering: Uncommonly used. Similar to double buffering, but allows rendering while waiting for the vsync.

Motion blurring

- Animations can often be improved by adding motion blurring.
- Objects are blurred in their direction of travel.
- Blurring is not needed for high framerates due to human persistence of vision. But for low framerates, it can make the animation look much smoother.
- Old solution, draw objects multiple times. Technically correct, but challenging to deal with in 3D. It can also be quite slow.
- New solution, generate motion vectors, and use these to blur the image. This can be done easily with a post-processing filter, so long as motion vectors can be provided by the engine.

Animation Approaches

Fixed movement

```
1  bullet.x += 1;
2  bullet.y += 2;
```

Dynamic timestep

```
1  float elapsed = old_time - current_time;
2  old_time = current_time;
3  bullet.x += 100 * elapsed;
4  bullet.y += 200 * elapsed;
```

Fixed timestep

```
1  elapsed = 1.0/30.0;
2  bullet.x += 100 * elapsed;
3  bullet.y += 200 * elapsed;
```

A Basic Approach to Animation

Design of an a simple animation can be done using the following steps (as listed in Hearn et al. [1]):

- Storyboard Layout
- Object Definitions
- Key-Frame Specifications
- Generation of In-Between Frames

Controlling Animation

Animators use a variety of often overlapping approaches for controlling and directing animation. These include:

- frame by frame explicit control - (record transforms for *every* frame).
- direct motion specification - (e.g. $\theta = 0.1t$)
- key frames / splines
- goal-directed systems - (e.g. walk_to(4,4))
- tracking live action - (e.g. Gollum in Lord of the Rings)
- kinematics (forward, and inverse)
- physics simulations (work in force, not velocity)

Approaches for Animation

- Squash and stretch provides a powerful animation indicator.
- Avoid sudden jerky motion as it is extremely distracting. This is both for the camera position and objects in the scene.
- Stage your action. Select your viewing position carefully (if possible). Provide the most information to the view. Only a single item at any one time should occupy the viewers attention.

Problems with Animation

- **Temporal Aliasing** - jerky movement of objects in the scene, wagon wheels moving backwards! Solutions: increase the temporal resolution; use a weighted average over multiple samples.
- There is a large amount of pixels to calculate and render. Solutions: space-time can be partitioned and rendering calculations can be in this domain.
- Human movement is very complex to model/describe.

References

[1] Donald Hearn. Computer graphics, C version. Pearson Education India, 1997.