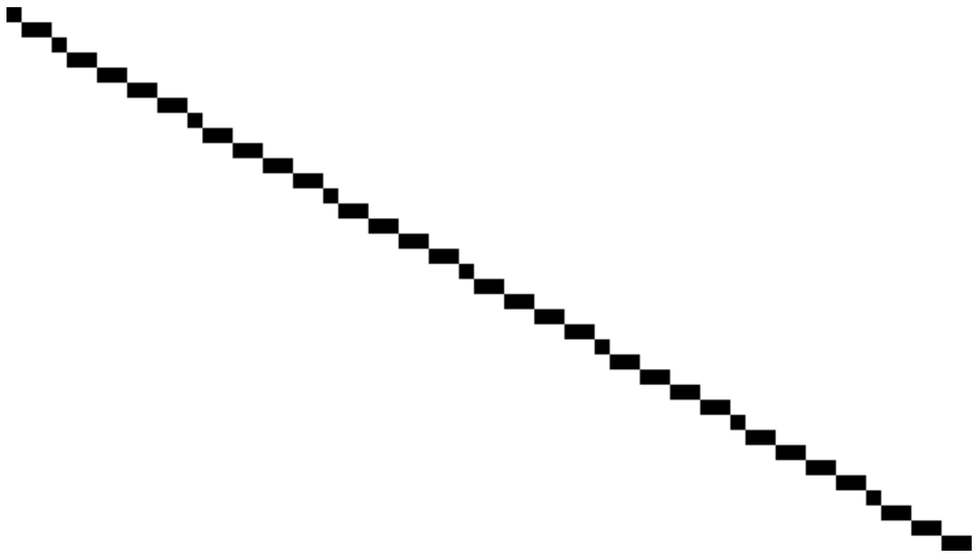
Lecture 14

Anti-aliasing
Ray-tracing
Radiosity

Anti-aliasing



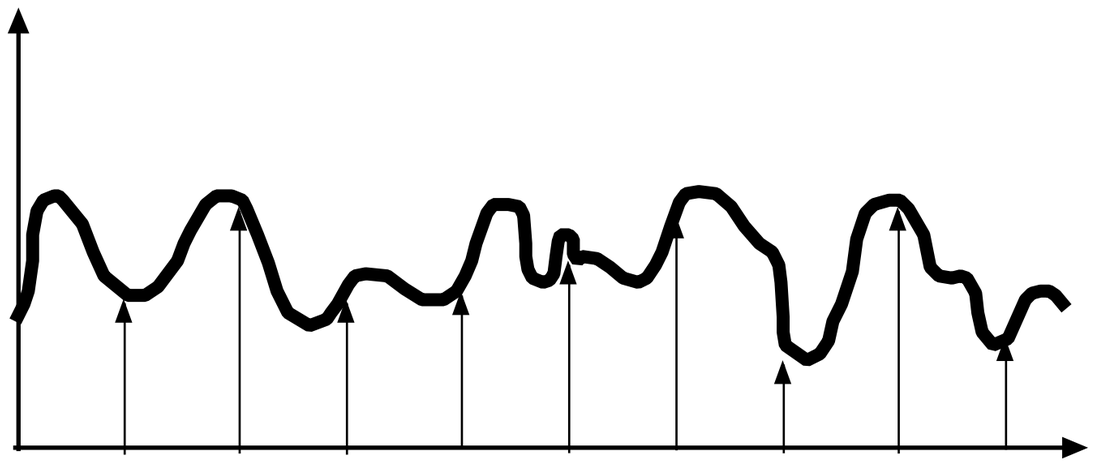
Frequency space

Any signal can be decomposed into sinus waves

The amplitudes of all sinus waves form a new space - frequency space

This space exists in any dimension. An image is a 2D signal and has a 2D frequency space.

Sampling



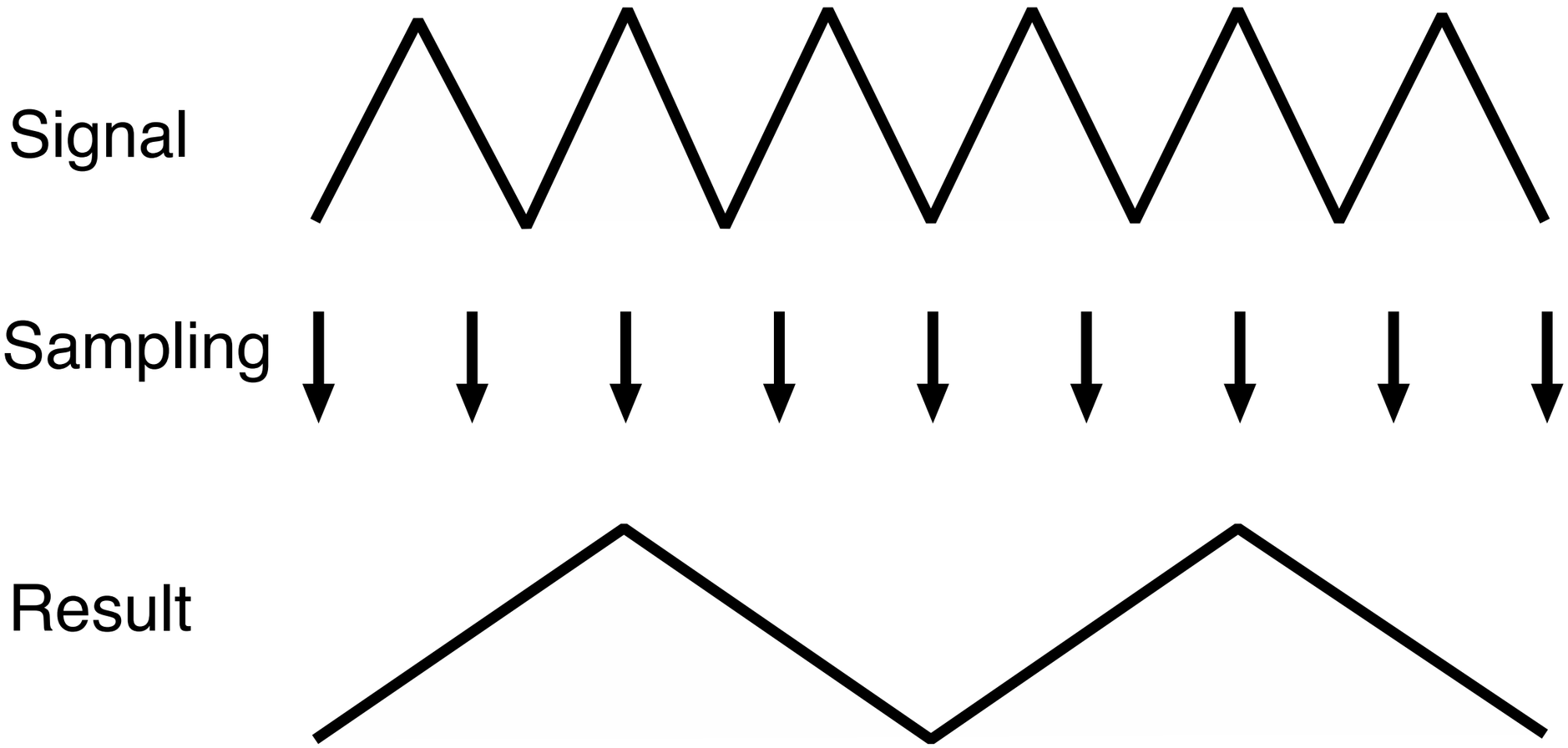
A digital image is a sampled version of an underlying analog 2D signal.

Sampling

When presenting the digital signal, it is reconstructed to an analog signal.

A signal can be decomposed into different frequency bands.

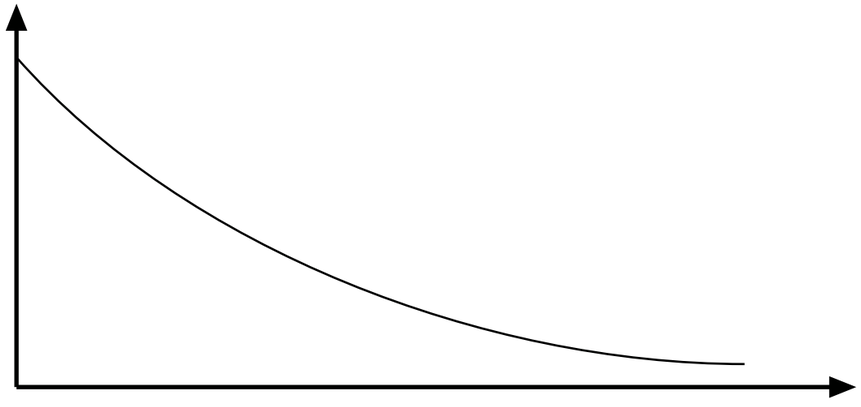
What parts of the original signal that are accurately reconstructed depend on the frequencies.

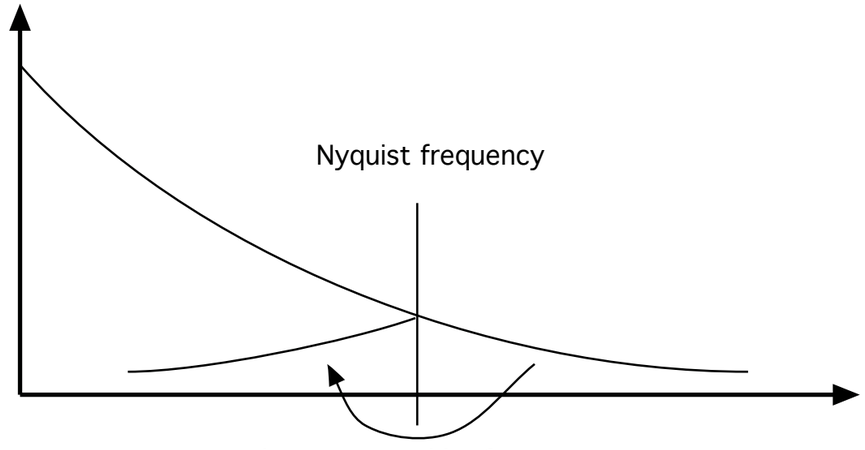

Signal
Sampling
Result

Think in frequency space!

Which frequencies are preserved and which cause problems?

Amplitudes usually lower for higher frequencies!

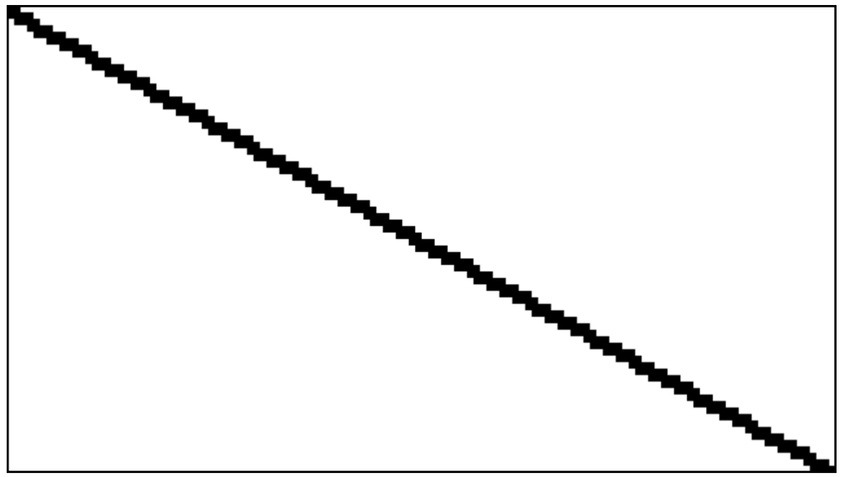




Anti-aliasing methods

- **Linear post-filtering. Bad.**
- **Super-sampling: Split pixels in sub-pixels. Check how many sub-pixels that hit one pixel.**
- **Area sampling: Calculate covered areas of each pixel.**
- **Non-linear post-filtering.**

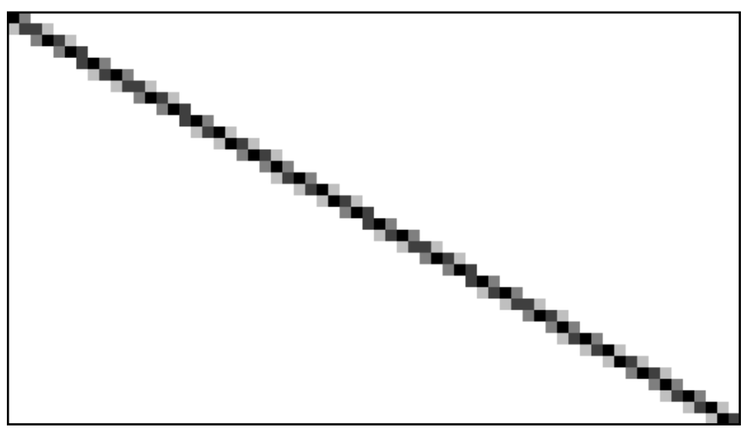
Supersampling



Draw in a high-res image buffer

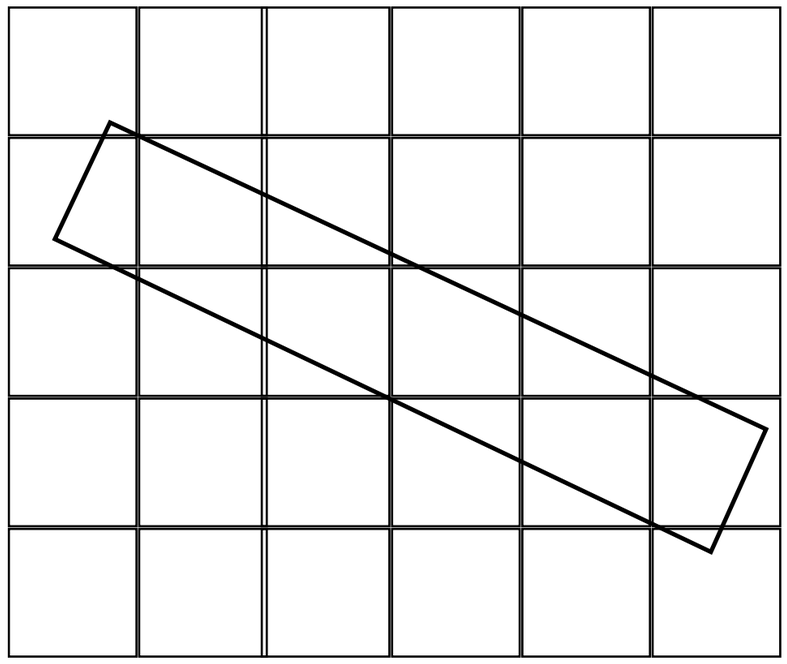
Simple but slow and memory-demanding

Sample down to destination buffer



Area sampling

Determine how much of each pixel that is covered by the shape



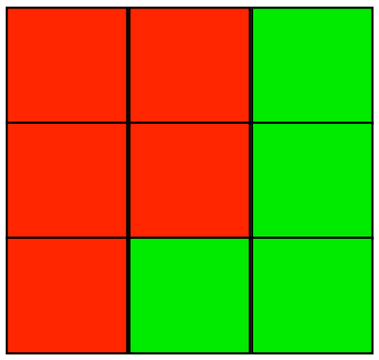
Multisampling

Variant of supersampling

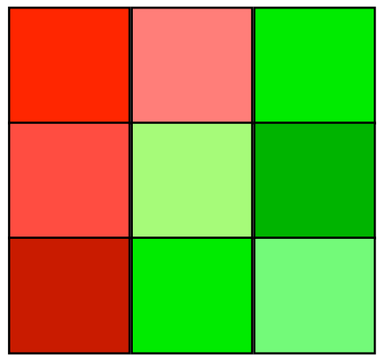
More efficient

Slightly lower precision

Multisampling



Multisampling: Only one execution of fragment shader for all samples from the same geometry



Supersampling: One execution of fragment shader for each sample

Multisampling

Less fragment processing

Fewer texture accesses

Same number of memory writes and same post-processing

FXAA = Fast approXimative AA

Post-processing

No higher resolution image

Non-linear filter

Don’t filter patterns

Several recent methods of this kind

Anti-aliasing in OpenGL

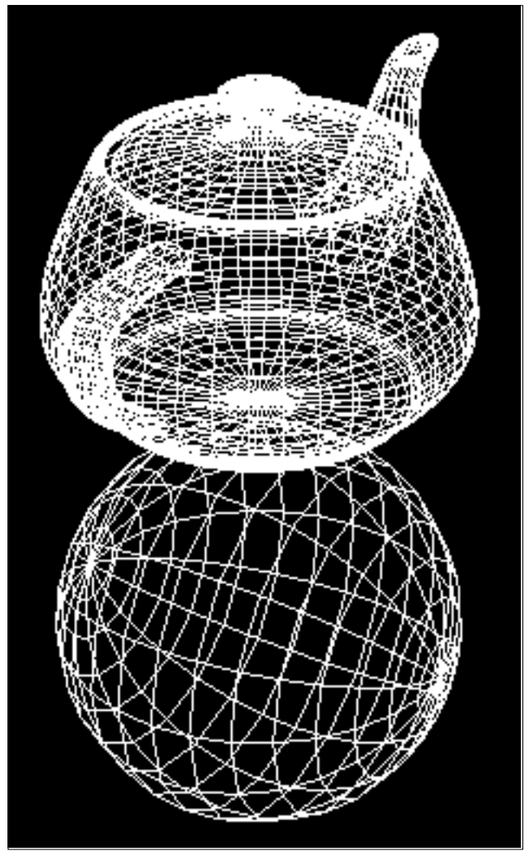
GL_POLYGON_SMOOTH - Old built-in, avoid

Accumulation buffer tricks: Obsolete, avoid

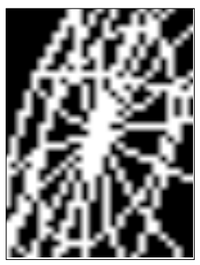
glEnable(GL_MULTISAMPLE); Preferred!

Can also be done by shaders. Usually unnecessary.

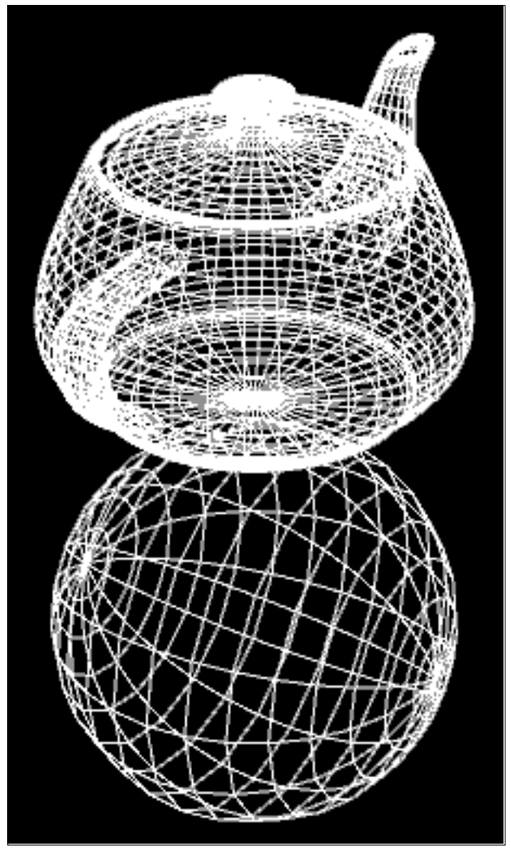
FSAA example



No AA



AA



Anti-aliasing

We will return to anti-aliasing in the ray-tracing part (with even more elaborate supersamling)