3d curvilinear skeletonization algorithm

with application to path tracing

a story by

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Venceslas Biri - Michel Couprie

produced by

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cnrs

Once upon a time...

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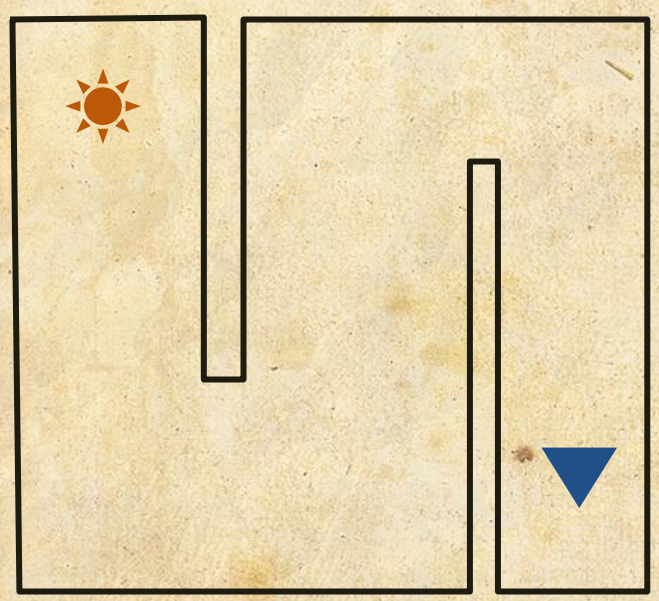

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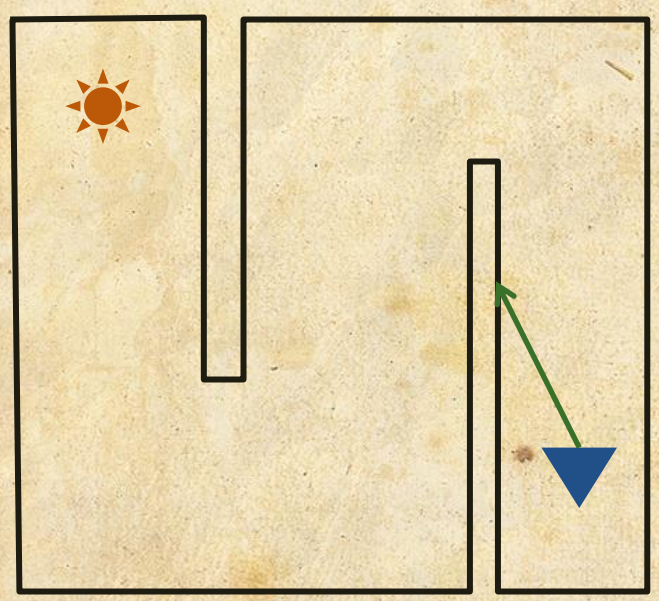

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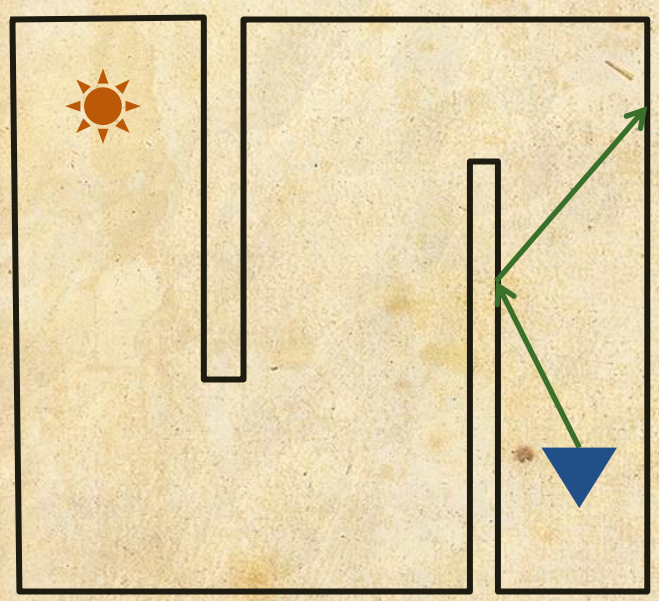

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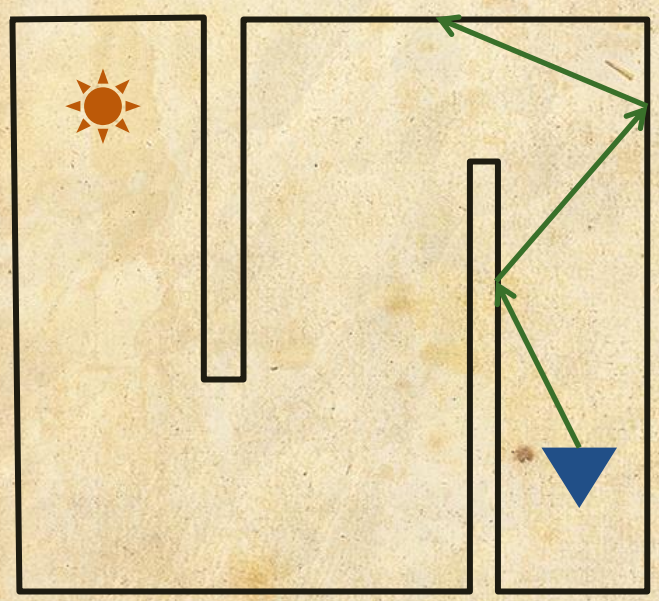

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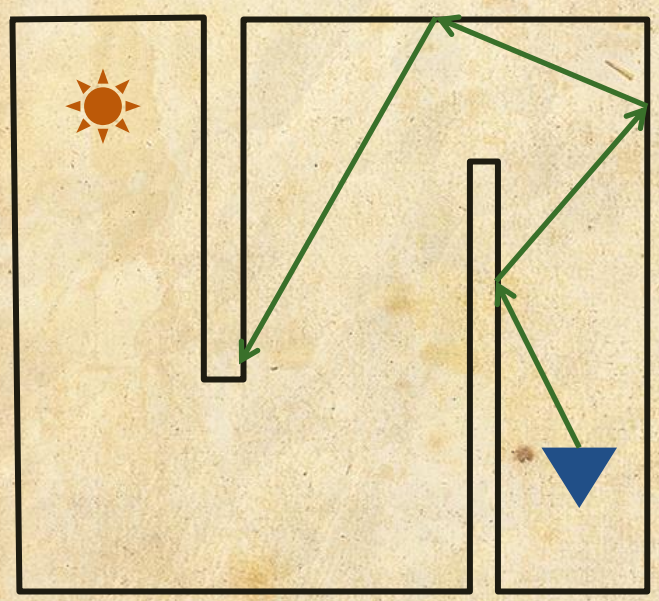

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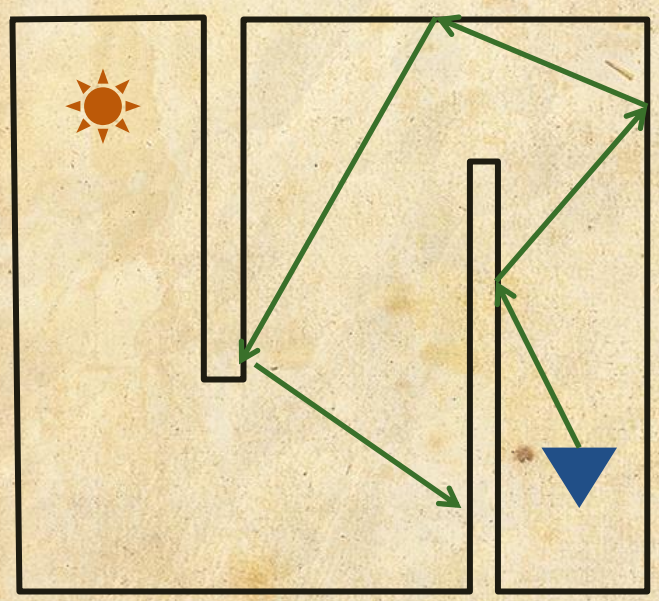

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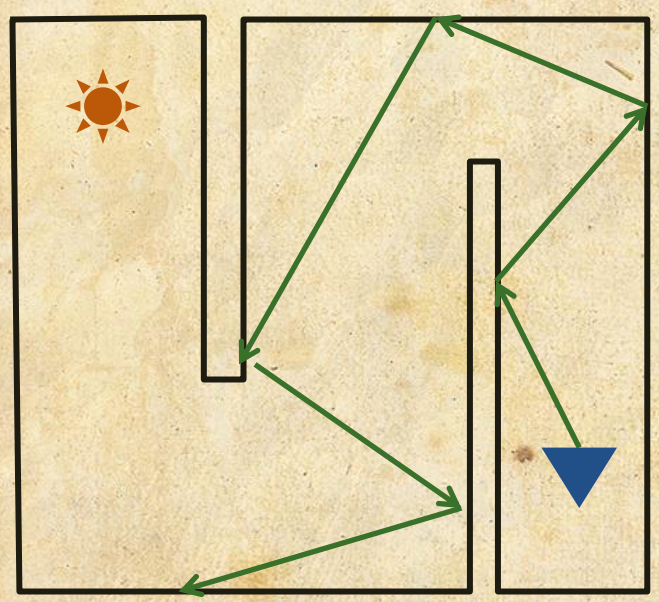

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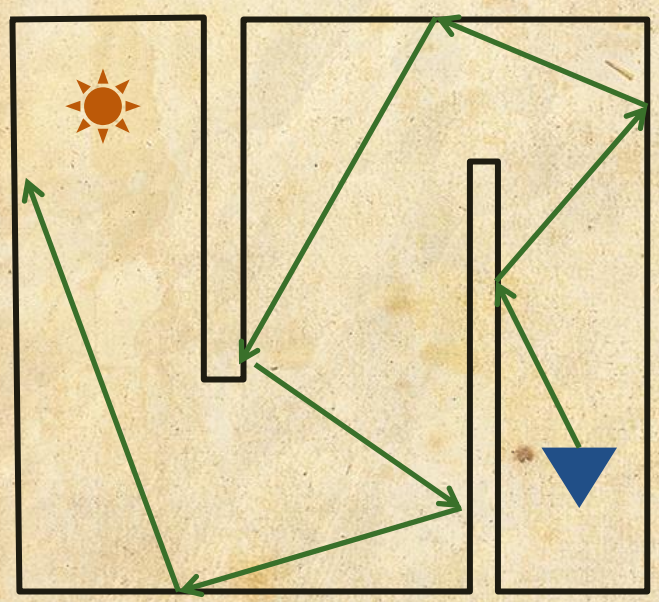

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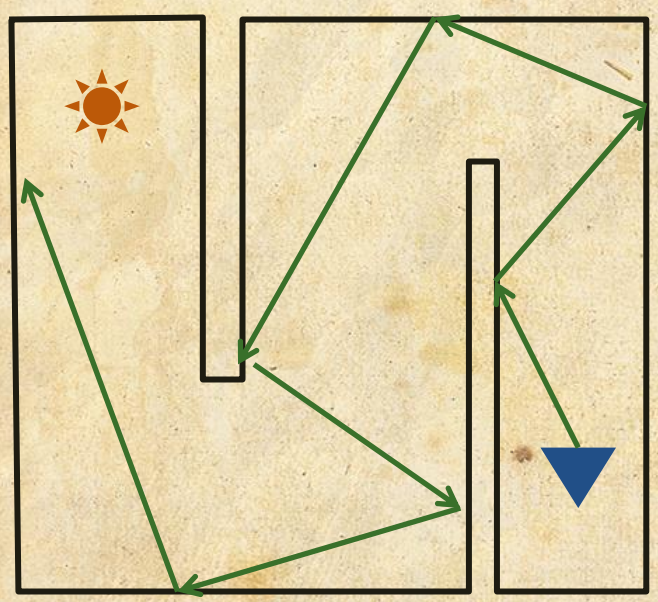

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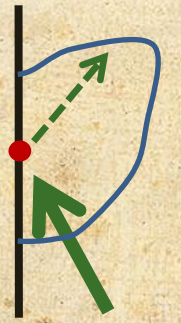

BRDF

The BRDF function of an object tells how light tends to reflect on this object.

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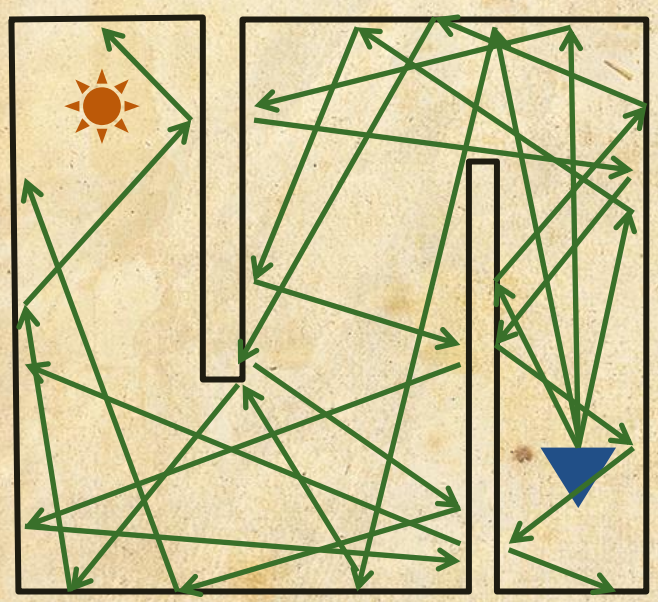
Many rays must be simulated in order to obtain a photorealistic result.



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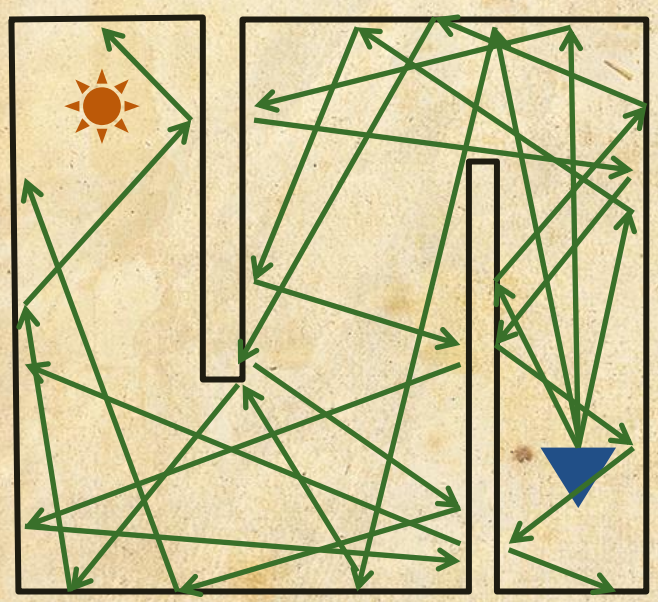

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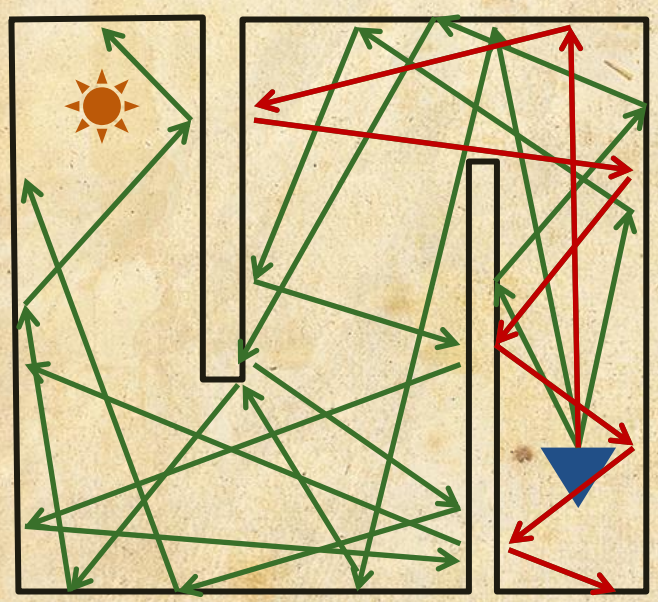

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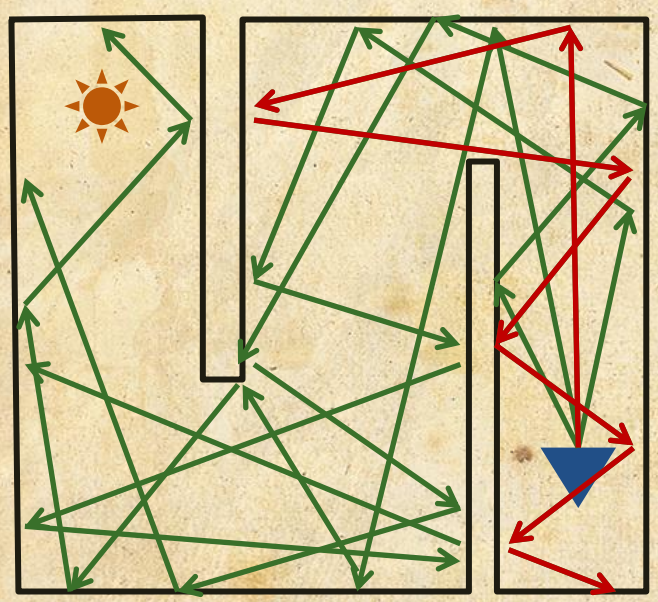


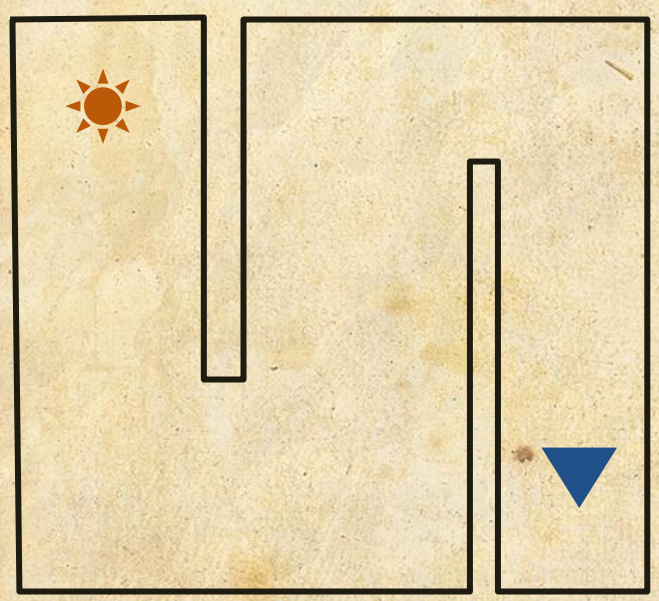
The process is **time–consuming.**

Some rays never reach any bright area of the scene : these rays collect little information on the scene and don't contribute much to the final result.

Reducing the number of these non contributing rays is a way to make the computation faster without changing the output quality.

Path-tracing

Our idea is to use a **skeleton of the voids of the scene** in order to **guide the rays towards the bright areas** of the scene.



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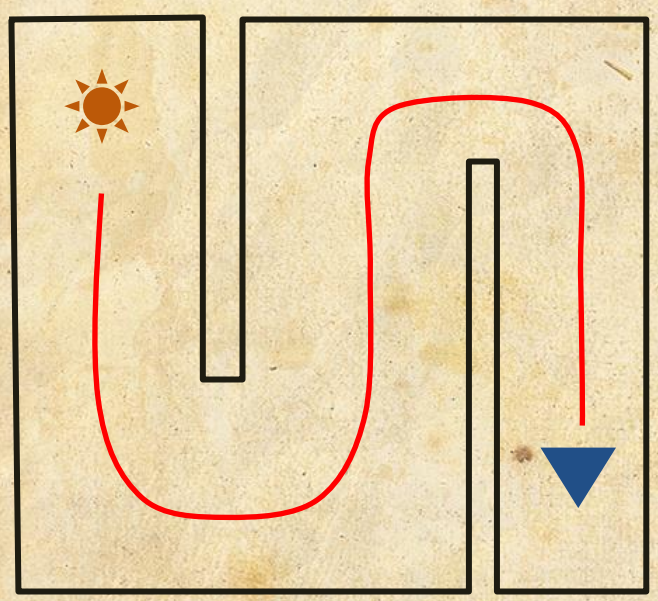

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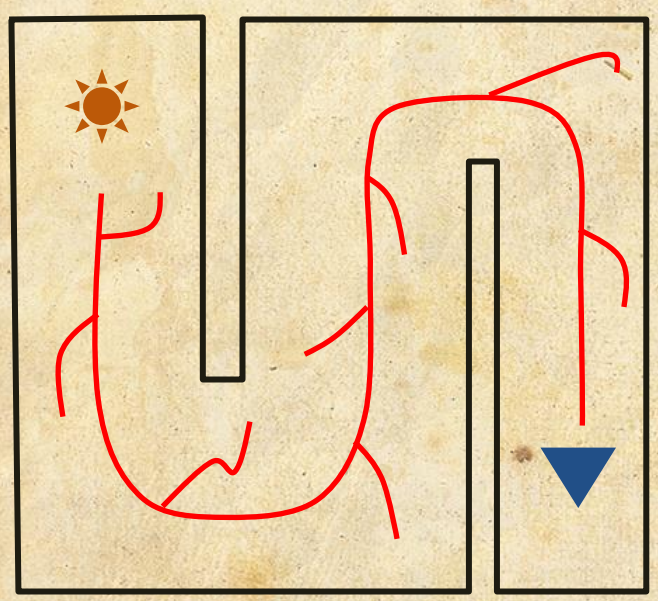

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To be efficient, we need a **skeleton which « looks » like the original object and contain as few spurious branches as possible**.

Curvilinear skeletonization algorithm

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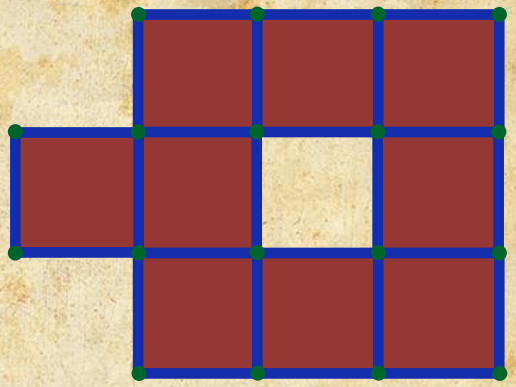

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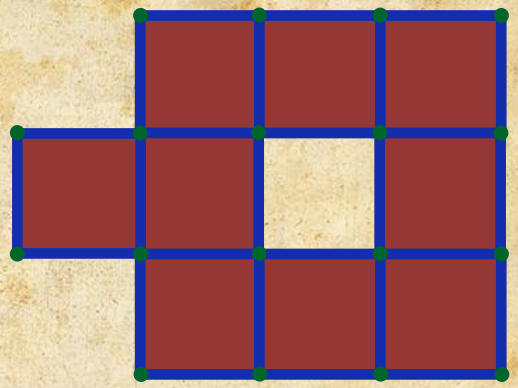

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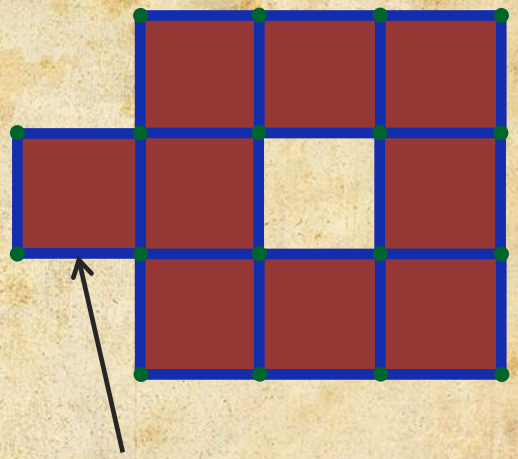

This line touches exactly one square : it is free

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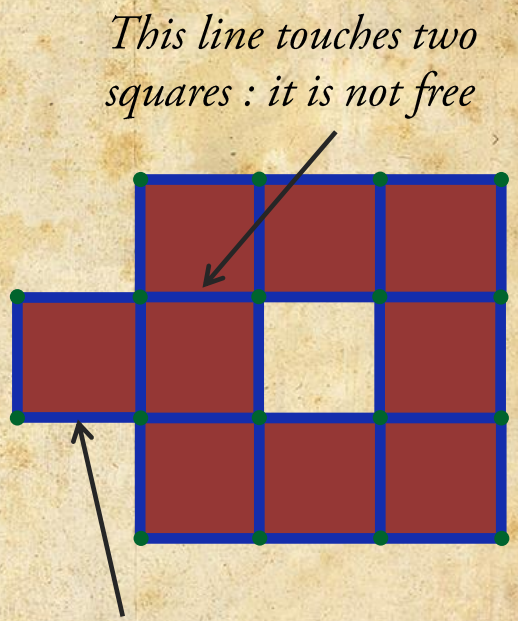

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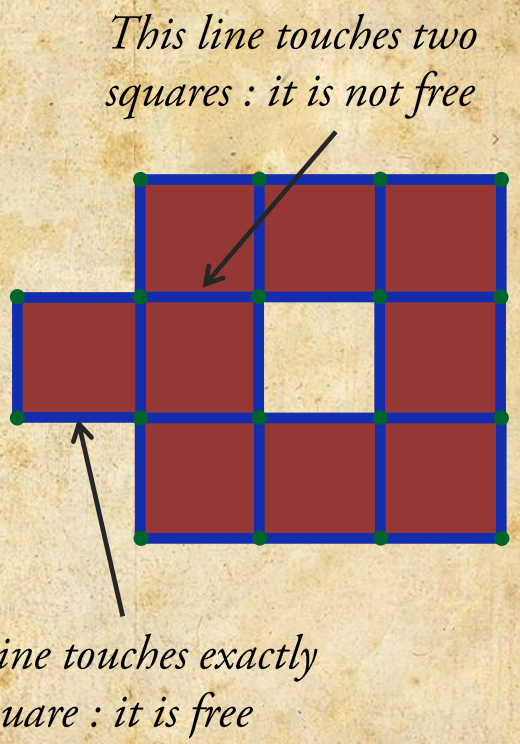

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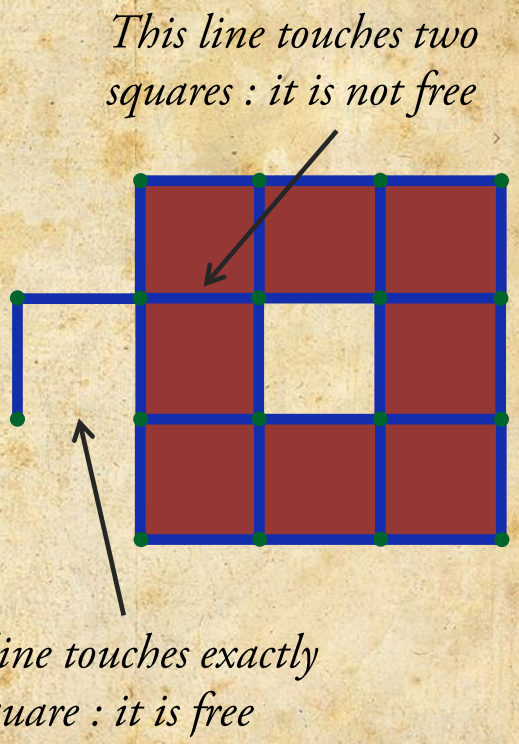

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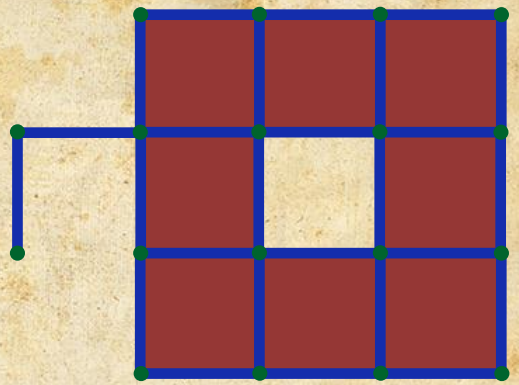

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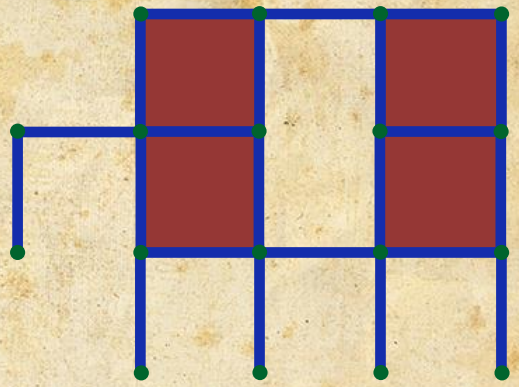

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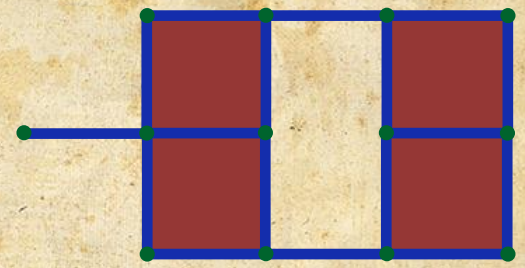

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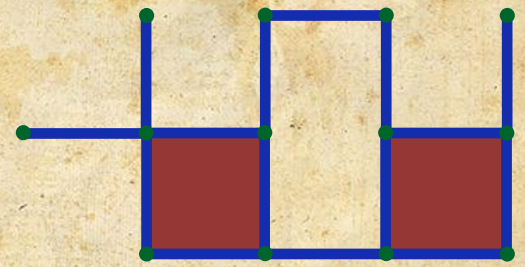

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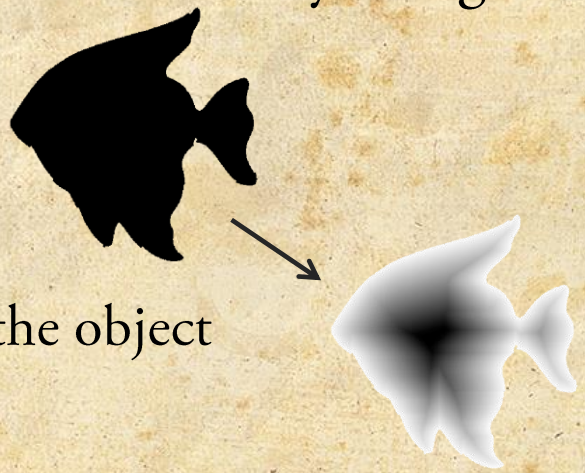

The 6-distance map of the object

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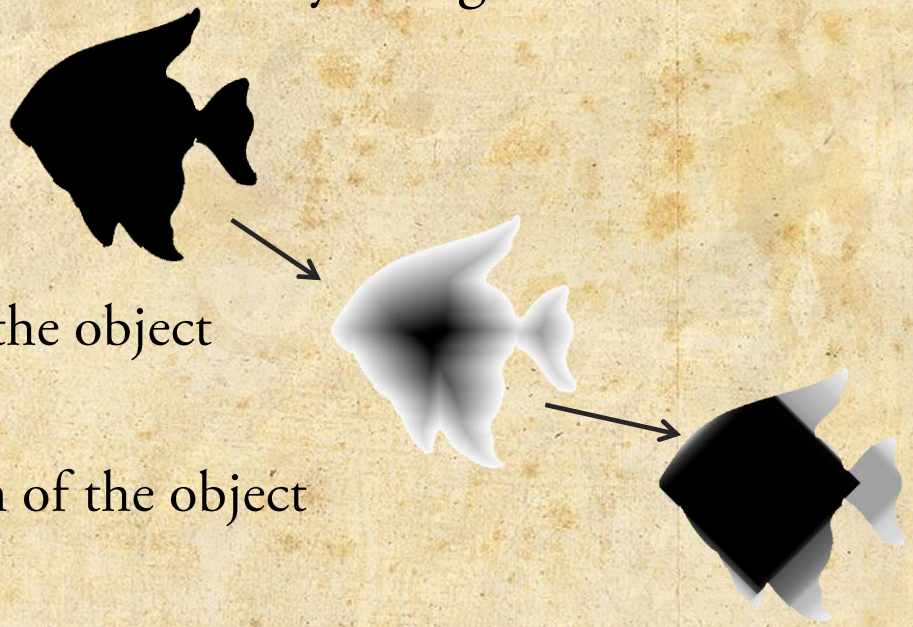

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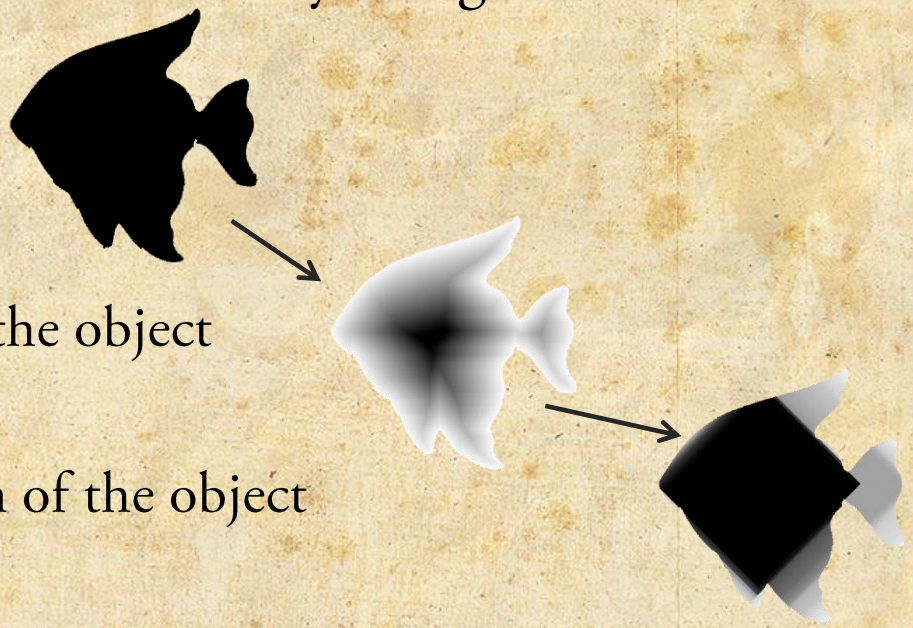

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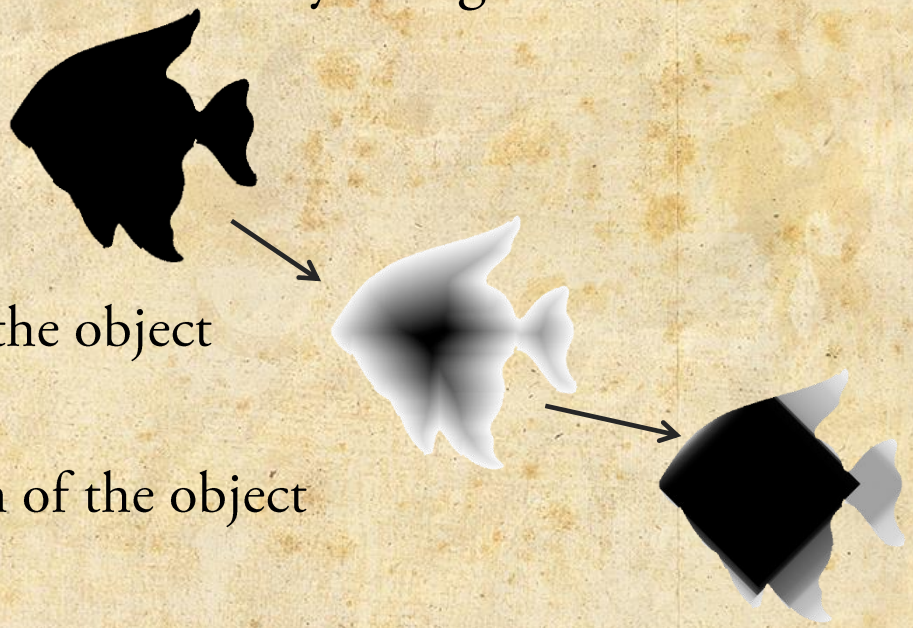

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The algorithm is entirely automatic: it does not need any user input to perform the filtering.

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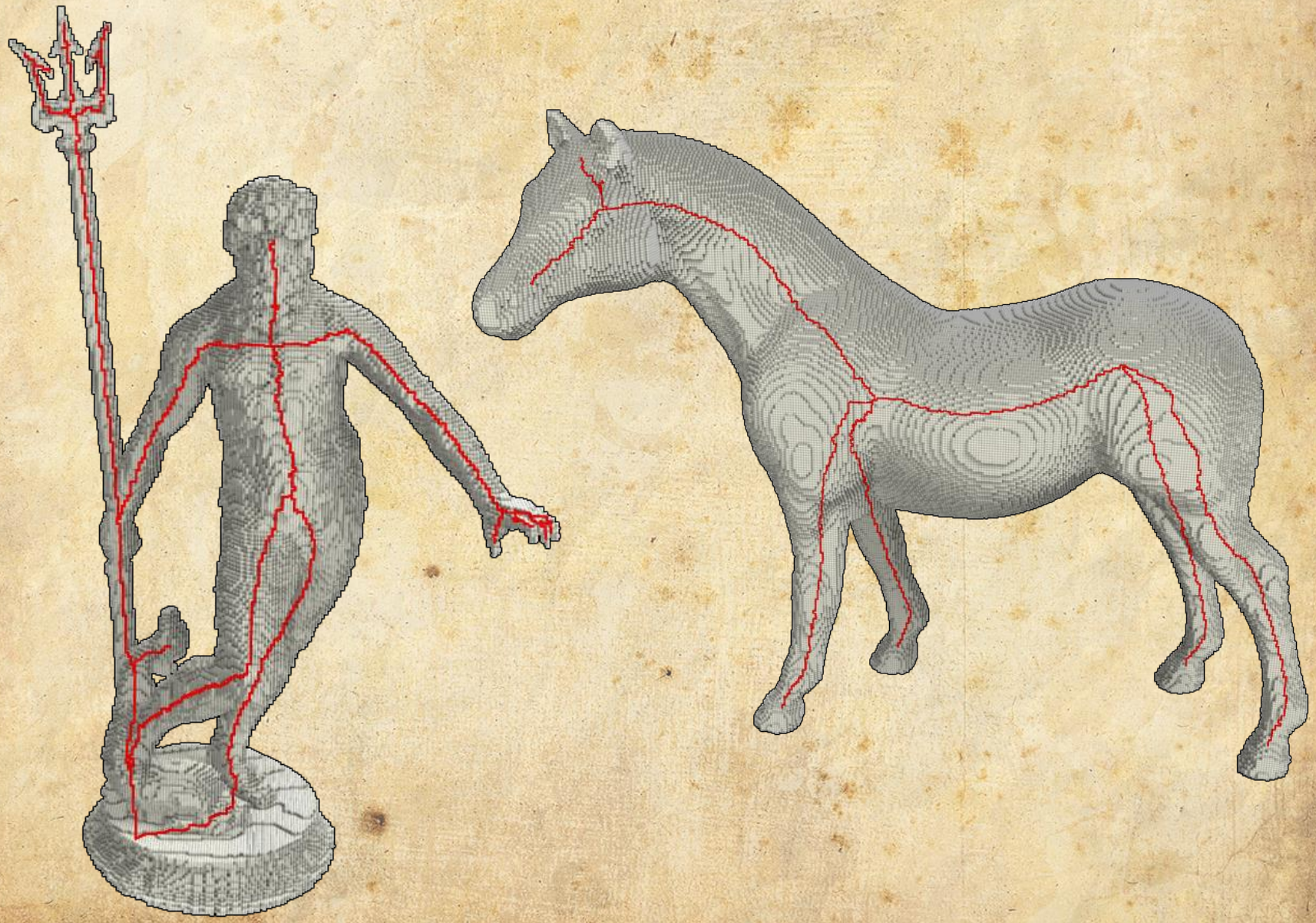

Skeleton path-tracing

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The skeleton node which is closest to a light source and still visible from the hit spot *(help the rays go towards bright areas)*.

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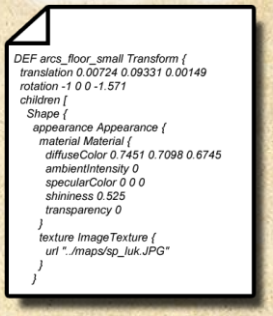
The object's BRDF *(realistic result)*.

The skeleton node which is closest to a light source and still visible from the hit spot *(help the rays go towards bright areas)*.

These two elements must be carefully averaged in order to still obtain photorealistic images and reduce the number of non contributing rays.

Skeleton path-tracing

Workflow



```
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  rotation -1 0 0 -1.571
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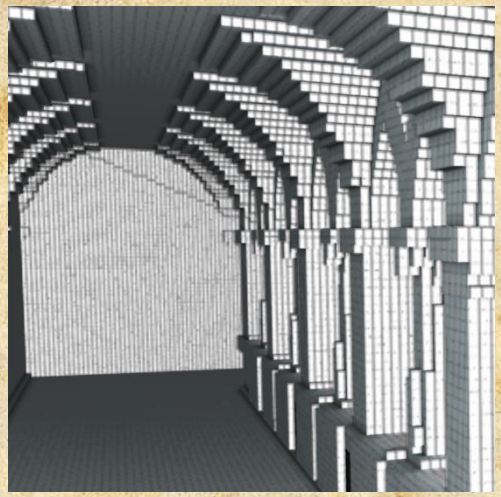

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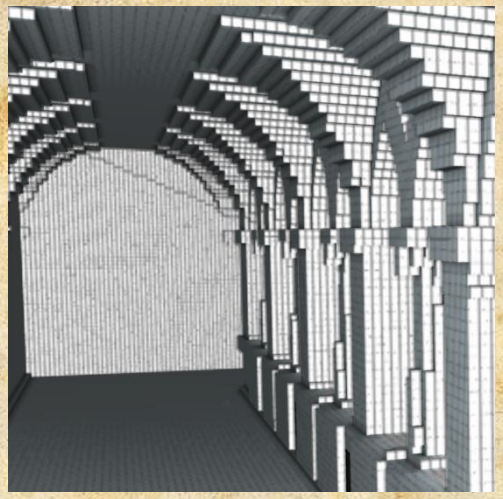
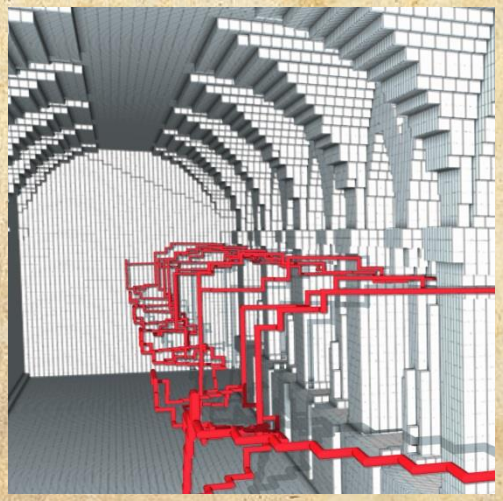


thinning



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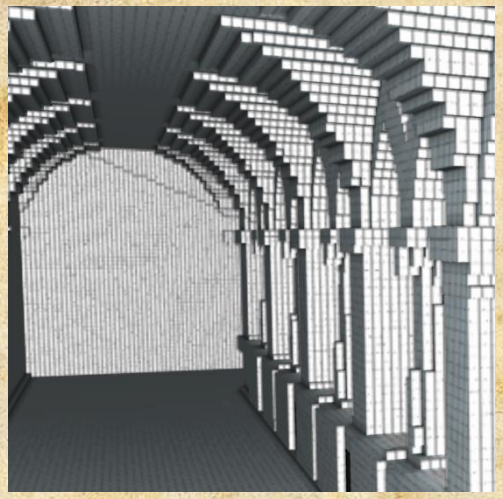
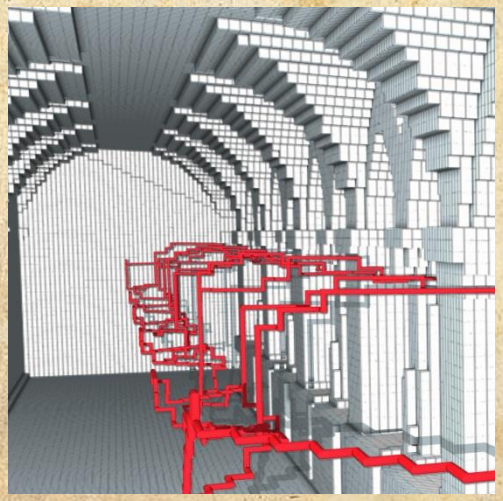


thinning

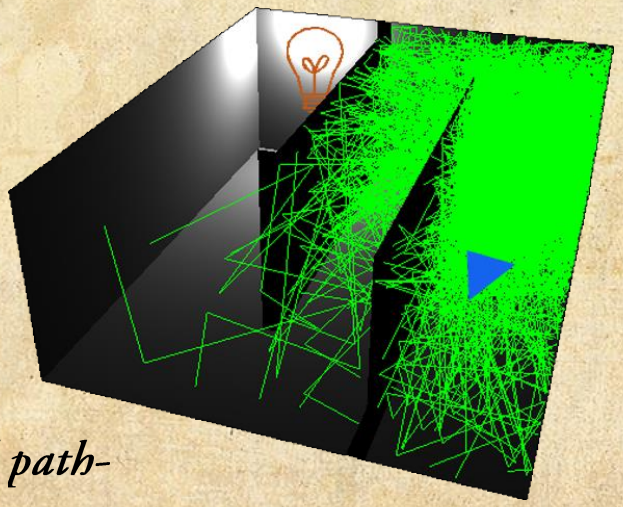


skeleton path-tracing

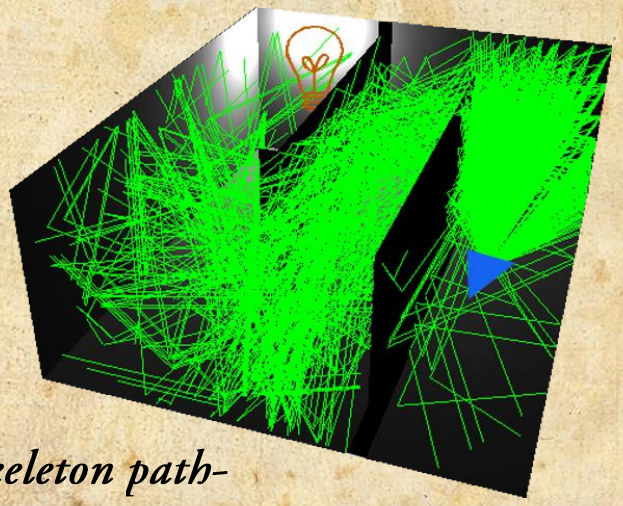
Skeleton path-tracing

Results:

For a same amount of rays sent in the scene, **our method produces more rays reaching bright areas** (useful rays).



classical path-tracing

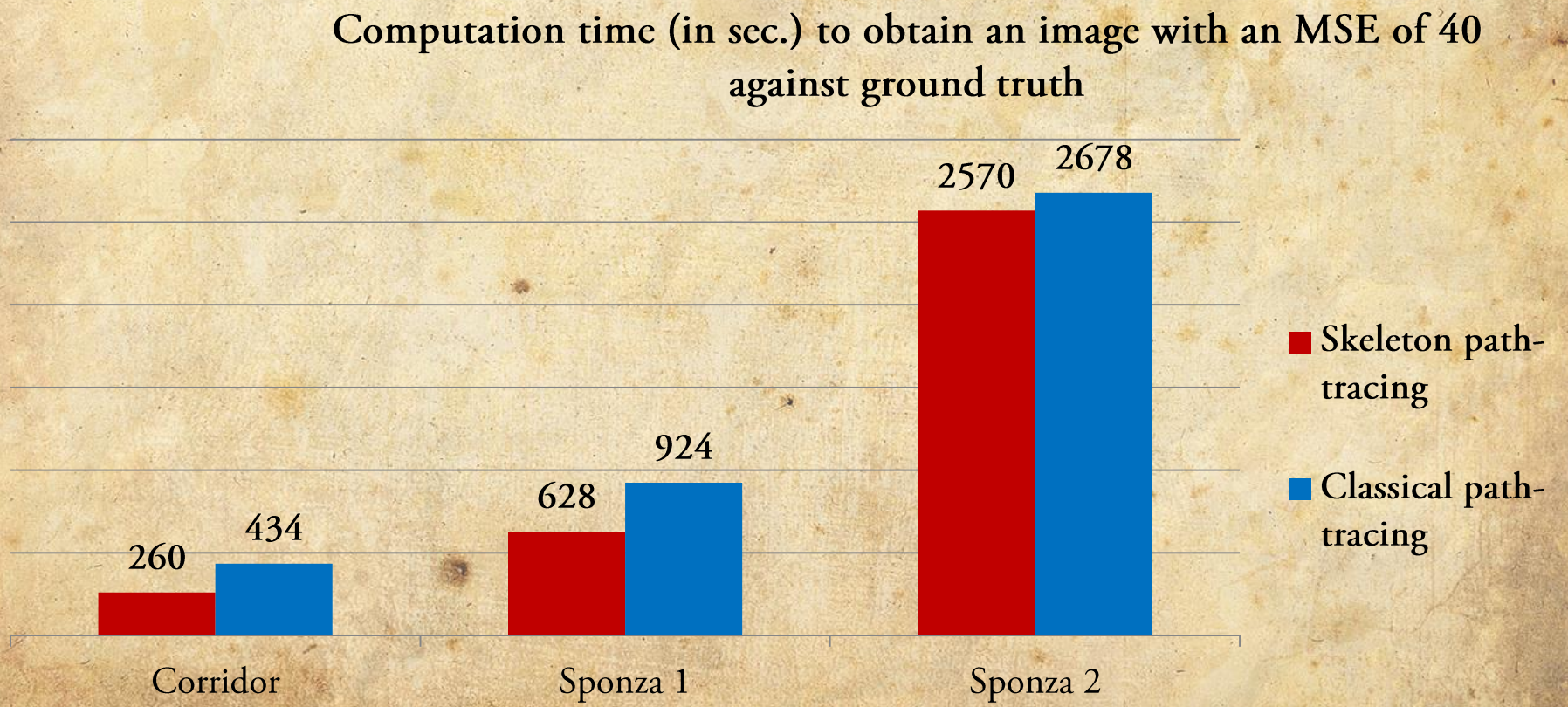


skeleton path-tracing

Skeleton path-tracing

Results:

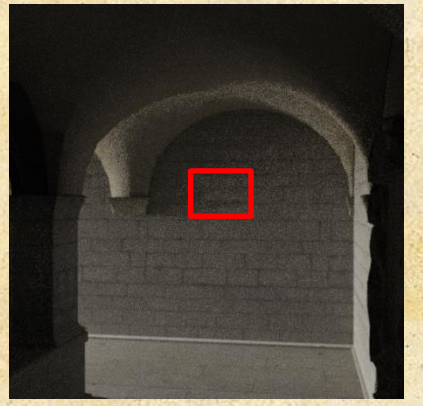
Our method is faster than classical path-tracing to produce same quality images.



Skeleton path-tracing

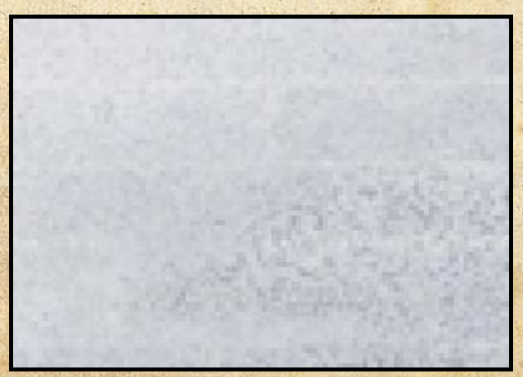
Results:

Our method produces less noisy images.



classical path-tracing

skeleton path-tracing



Thank you for your attention,

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