

健康数据可视化

周亮

北京大学健康医疗大数据国家研究院



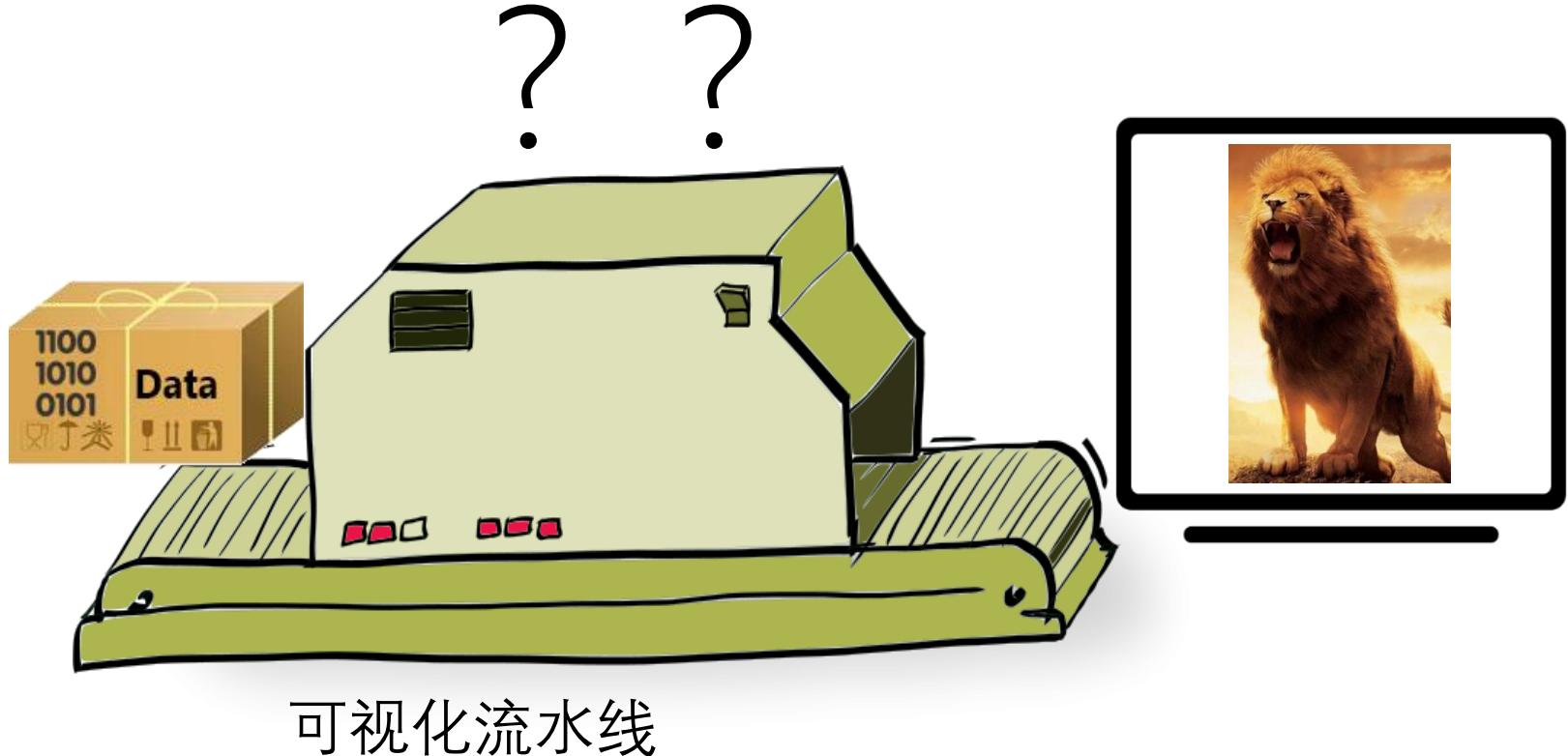
北京大学 健康医疗大数据国家研究院
NATIONAL INSTITUTE OF HEALTH DATA SCIENCE AT PEKING UNIVERSITY

2021-2022 第一学期

3. 可视化实现

如何实现可视化?

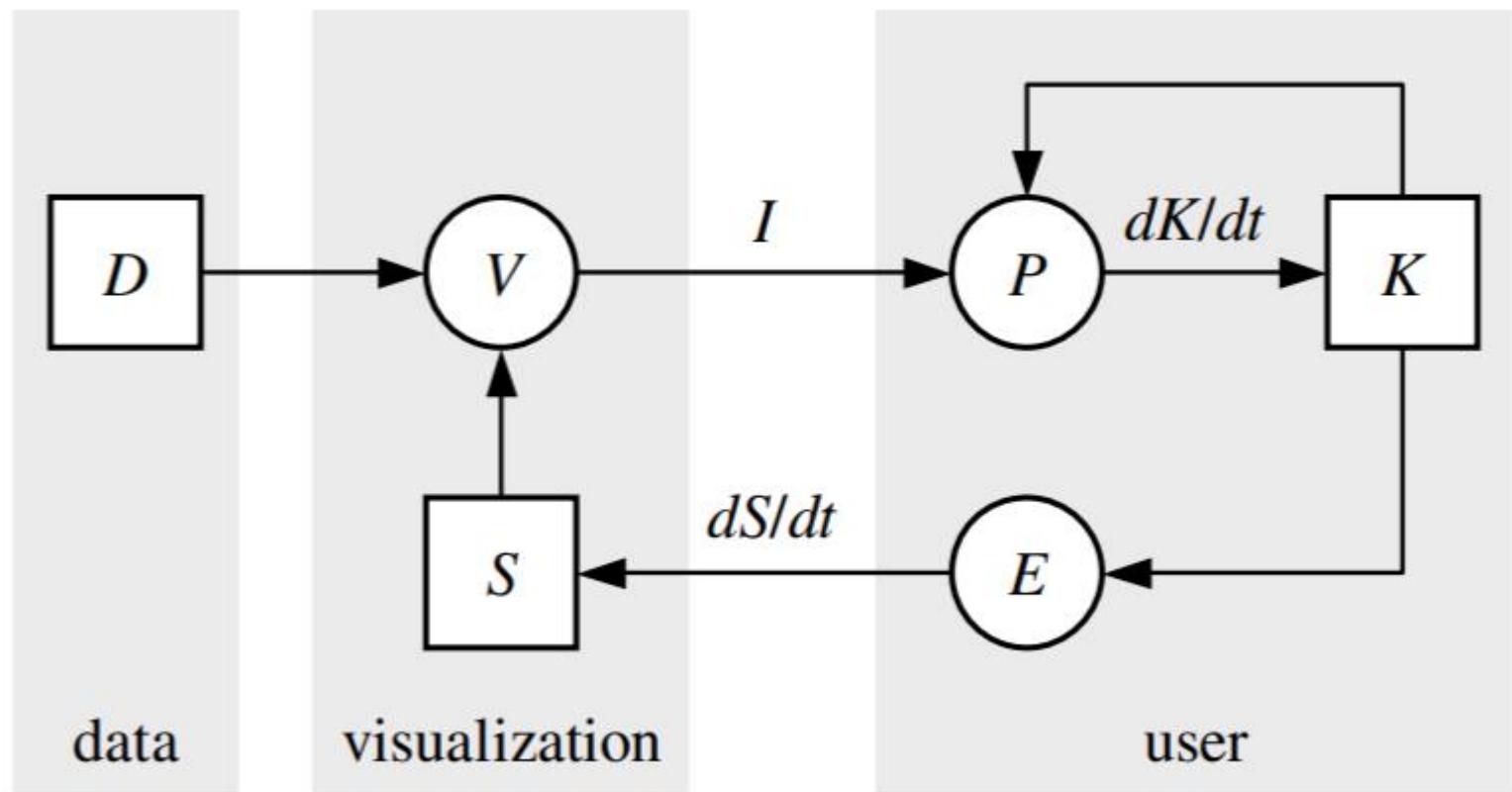
- 需要解决哪些基本问题?



可视化流水线

如何实现可视化?

- 分解可视化流水线各部分可得知可视化方法实现需要的元素
 - 数据预处理
 - 数据变换
 - 图形绘制
 - 用户交互



[Jarke van Wijk. [The Value of Visualization](#). Proceedings of the IEEE Visualization Conference, pp. 79-86, 2005.]

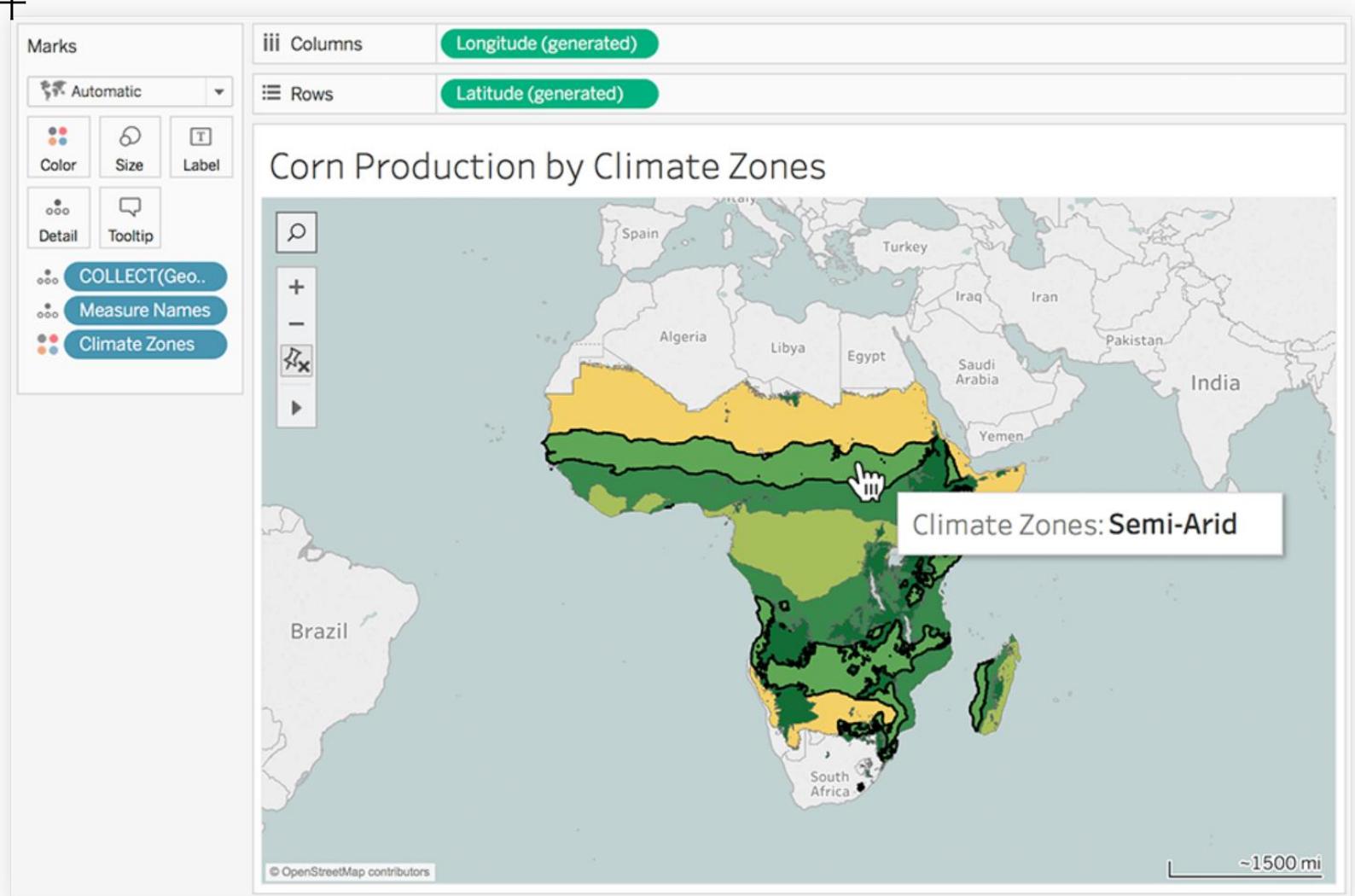
可视化和可视分析工程实现

- 可视化和可视分析工具
 - 科学可视化:
 - ParaView <https://www.paraview.org/>
 - SCI Institute的各种工具
<https://www.sci.utah.edu/sci-software/visualization.html>
 - Inviwo <https://inviwo.org/>
 - Voreen <https://www.uni-muenster.de/Voreen/index.html>
 -
 - 信息可视化, 可视分析:
 - Tableau <https://www.tableau.com/>
 - Power BI <https://powerbi.microsoft.com/>
 -
- 可视化软件库
 - VTK <https://vtk.org/>
 - D3 <https://d3js.org/>
- 编码实现可视化可视分析
 - 编程语言:
 - C++, JavaScript, Python, R.....
 - 技能:
 - 交互界面 (UI) 编程——Qt, Vue.js.....
 - 图形编程——OpenGL, WebGL
 - 图形处理器 (GPU) 编程——Shaders, CUDA



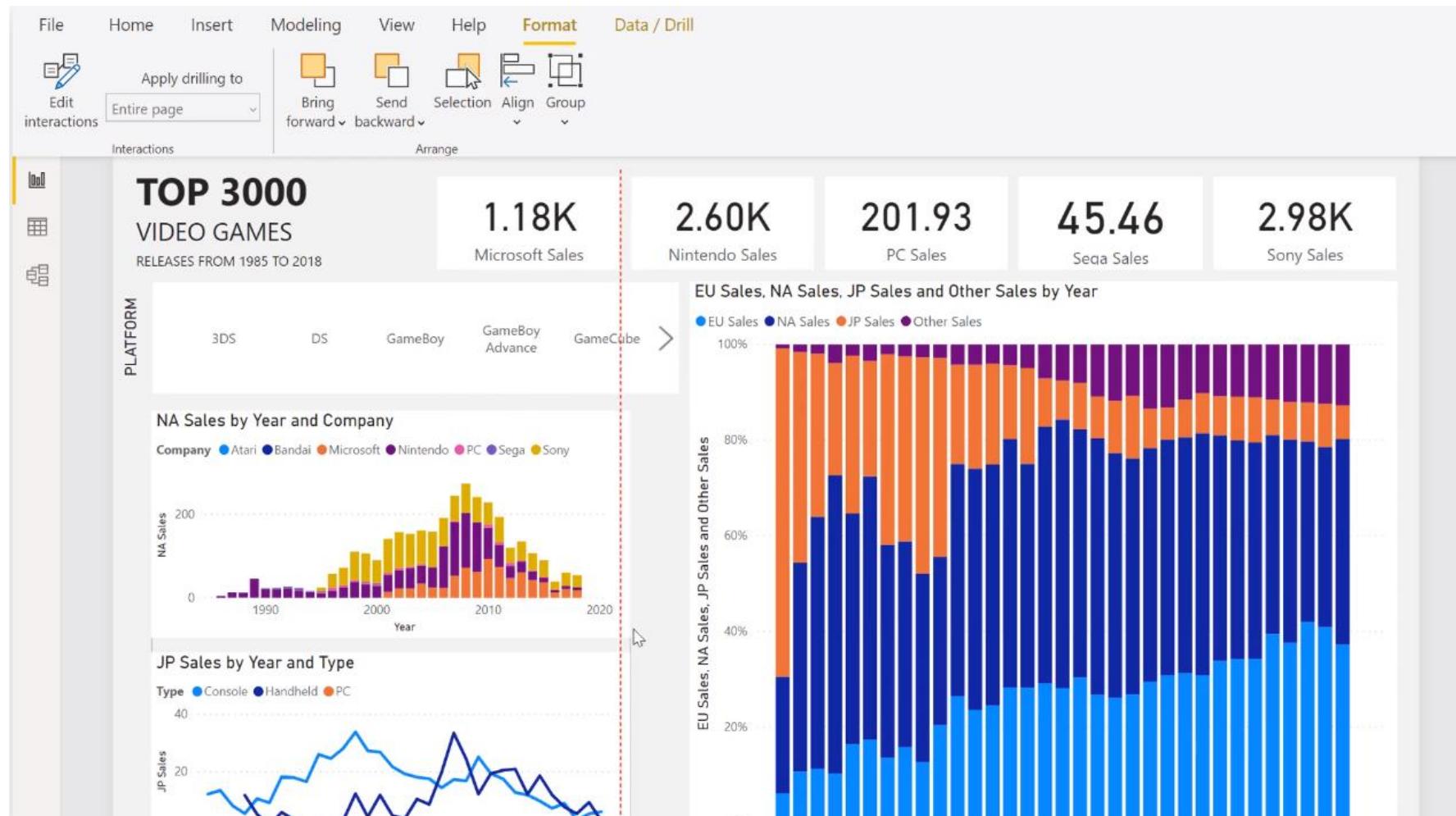
Tableau

- 信息可视化、可视分析
- 商业软件



Power BI

- 信息可视化、可视分析
- 商业软件



<https://powerbi.microsoft.com/>

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VTK——The Visualization Toolkit

- 科学可视化，图像处理
- 开源软件；模块化；Paraview相当于VTK的图形界面

Kitware | Open Source

The screenshot shows the VTK website's 'Overview' section. At the top, there is a navigation bar with links: About, VTK in Action, Flavors, Resources, Services, Careers, Download, and a search icon. Below the navigation bar, the title 'Overview' is displayed. A descriptive paragraph follows, stating: 'The Visualization Toolkit (VTK) is an open-source, freely available software system for 3D computer graphics, modeling, image processing, volume rendering, scientific visualization, and 2D plotting. It supports a wide variety of visualization algorithms and advanced modeling techniques, and it takes advantage of both threaded and distributed memory parallel processing for speed and scalability, respectively.' Another paragraph notes: 'VTK is designed to be platform agnostic. This means that it runs just about anywhere, including on Linux, Windows, and Mac; on the Web; and on mobile devices.' Below this text are two 3D visualizations of a human head. The left image shows a smooth surface with vertical orange stripes, while the right image shows a more complex, jagged surface with a similar color scheme. A caption below the images reads: 'Generating triangle strips from a polygonal data set. On the left, the original laser range data is stripped; on the right, an unstructured mesh (after decimation) is stripped.' Further down the page, there is a paragraph about VTK's quality software process, mentioning CMake, CTest, CDash, and CPack, and its BSD-style license.

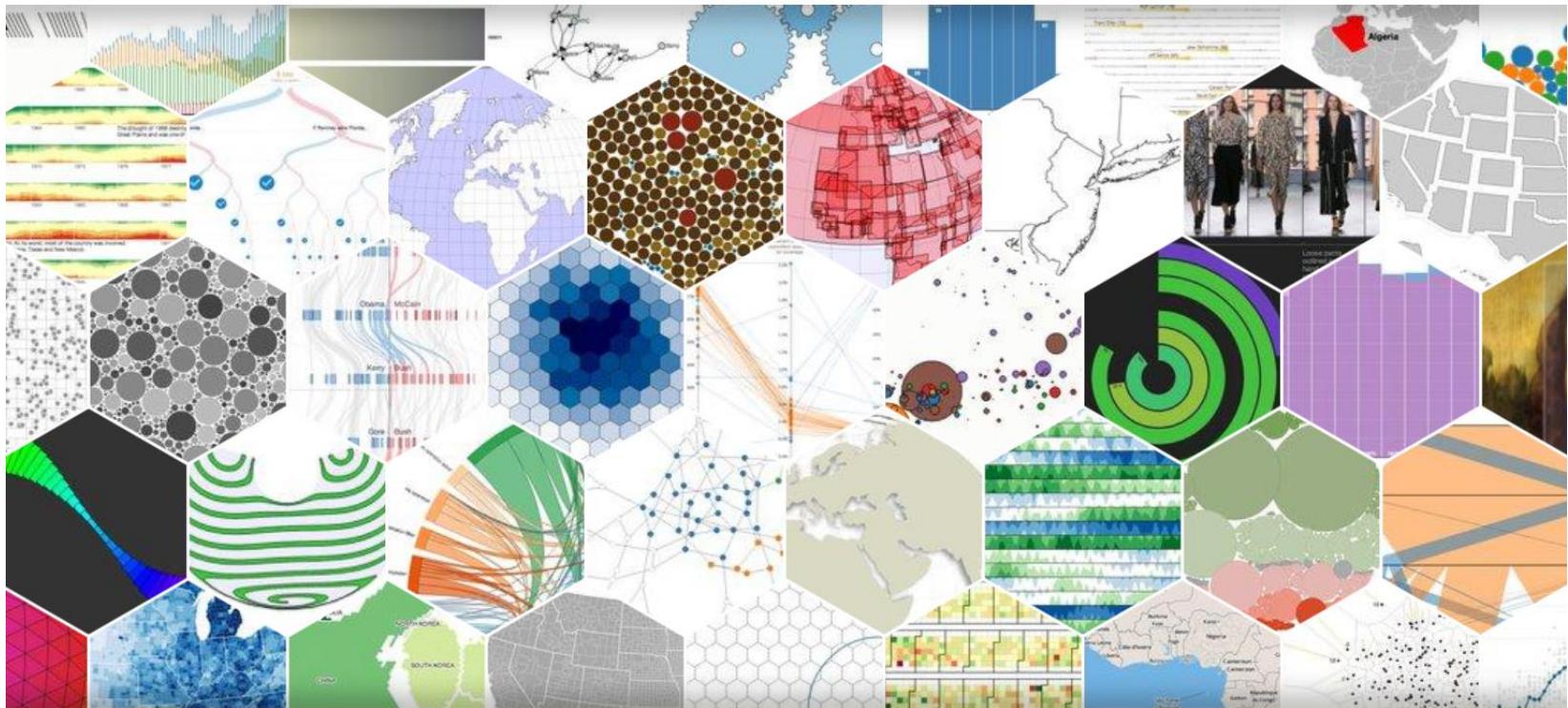
VTK employs Kitware's quality software process, which includes CMake, CTest, CDash, and CPack to build, test, and package the system. Combined with a strong distributed developer community, the result is very high-quality, robust code. The core functionality of VTK is written in C++ to maximize efficiency. This functionality is wrapped into other language bindings to expose it to a wider audience. Interoperability with Python is particularly well-refined.

As open source software, VTK is free to use for any purpose. Technically, VTK has a BSD-style license, which imposes minimal restrictions for both open and closed source applications.

For statistics on VTK, please refer to its [Open Hub page](#).

D3—Data-Driven Documents

- JavaScript库
- 开源（一个.js文件）； 方便操纵网页DOM； 包含大量例子



Like visualization and creative coding? Try interactive JavaScript notebooks in **Observable!**

<https://d3js.org/>

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Qt

- 跨平台图形界面库——适合科学可视化可视分析应用
- 有开源版本；C++；有大量例子

The screenshot shows the official Qt website homepage. At the top, there is a navigation bar with links for Developers, Blog, English, Contact Us, Download, Try, Buy, Design, Develop, Deploy, Product, Why Qt?, Resources, a search icon, and a user icon. Below the navigation bar is a large image of a television screen displaying a green landscape and the text "HDMI1". Overlaid on the bottom left of the TV screen is the text "One framework. One codebase. Any platform." In the background of the TV screen, there are icons for various platforms and services like Netflix, Amazon, Hulu, Vudu, and YouTube. At the bottom of the page, there are three main sections: DESIGN (Create beautiful interfaces), DEVELOP (Code using powerful tools), and DEPLOY (Build for all platforms). Each section has a brief description and a link to learn more.

Developers Blog English Contact Us Download. Try. Buy.

Design Develop Deploy Product Why Qt? Resources

HDMI1

One framework. One codebase. Any platform.

Everything you need for your entire software development life cycle. Qt is the fastest and smartest way to produce industry-leading software that users love.

Browse Qt Tools Browse Qt Features

DESIGN Create beautiful interfaces

DEVELOP Code using powerful tools

DEPLOY Build for all platforms

Designing and prototyping with Qt > Coding and testing with Qt > Deploying and maintaining with Qt >

<https://www.qt.io/>



Vue.js

- JavaScript图形界面库——适合信息可视化可视分析应用
- 开源；有大量例子

The Progressive JavaScript Framework

Special Sponsor: Autocode

Guide: 2.x

Essentials

- Installation
- Introduction
 - What is Vue.js?
 - Getting Started
 - Declarative Rendering
 - Conditionals and Loops
 - Handling User Input
 - Composing with Components
 - Relation to Custom Elements
 - Ready for More?
- The Vue Instance
- Template Syntax
- Computed Properties and Watchers
- Class and Style Bindings
- Conditional Rendering
- List Rendering
- Event Handling
- Form Input Bindings

What is Vue.js?

Vue (pronounced /vju:/, like view) is a progressive framework for building user interfaces. Unlike other monolithic frameworks, Vue is designed from the ground up to be incrementally adoptable. The core library is focused on the view layer only, and is easy to pick up and integrate with other libraries or existing projects. On the other hand, Vue is also perfectly capable of powering sophisticated Single-Page Applications when used in combination with modern tooling and supporting libraries.

If you'd like to learn more about Vue before diving in, we created a video walking through the core principles and a sample project.

If you are an experienced frontend developer and want to know how Vue compares to other libraries/frameworks, check out the Comparison with Other Frameworks.

Watch a free video course on Vue Mastery

Getting Started

Installation

<https://vuejs.org/>

图形编程——OpenGL, WebGL

- 跨平台硬件加速图形接口
- OpenGL: 单机应用; WebGL: 网络应用
- 需熟悉现代图形流水线CPU+GPU; 代码量较大; 要仔细考虑计算效率

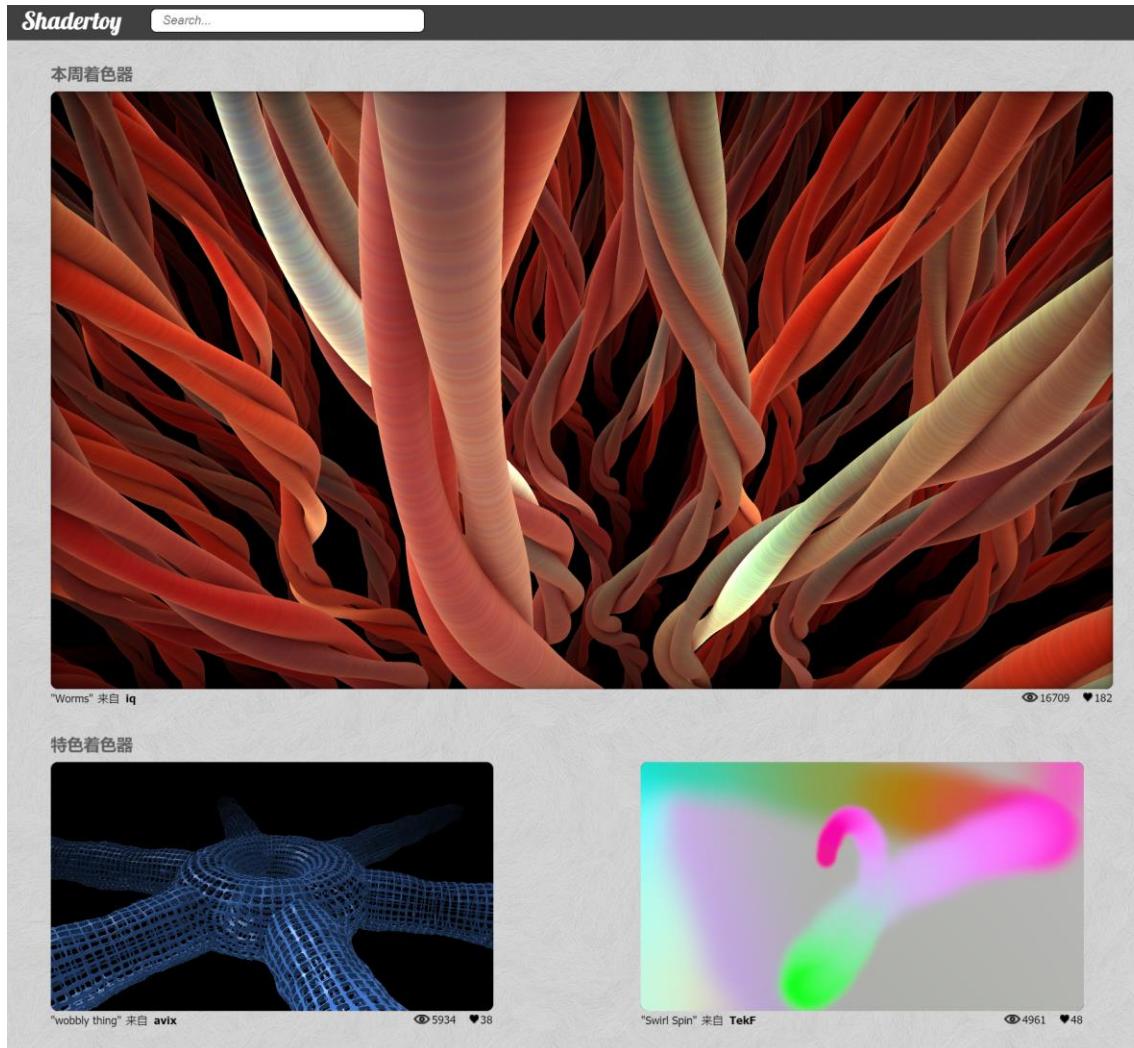
The screenshot shows the OpenGL.org homepage with a dark blue header. The header features the OpenGL logo, a search bar, and a link to "ENHANCED BY Google". Below the header, the text "The Industry's Foundation for High Performance Graphics" and "FROM GAMES TO VIRTUAL REALITY, MOBILE PHONES TO SUPERCOMPUTERS" is displayed. A navigation bar with links to "Documentation", "Coding Resources", "Wiki", "Forums", and "About OpenGL" is visible. The main content area has a light blue background and displays three news articles:

- NVIDIA provides OpenGL-accelerated Remote Desktop for GeForce**
In these days of social distancing, game developers and content creators all over the world are working from home and asking for help using Windows Remote Desktop streaming with the OpenGL tools they use. NVIDIA has created a special tool for GeForce GPUs to accelerate Windows Remote Desktop streaming with [GeForce drivers R440 or later](#). Download and run the [executable](#) (nvidiaopenglrdp.exe) from the DesignWorks website as Administrator on the remote Windows PC where your OpenGL application will run. A dialog will confirm that OpenGL acceleration is enabled for Remote Desktop and if a reboot is required.
April 07, 2020 | [Read article...](#) | [Permalink](#)
- Mesa 20.0 Now Defaults To The New Intel Gallium3D Driver For Faster OpenGL**
After missing their original target of transitioning to Intel Gallium3D by default for Mesa 19.3 as the preferred OpenGL Linux driver on Intel graphics hardware, this milestone has now been reached for Mesa 20.0.
Jan 24, 2020 | [Read article...](#) | [Permalink](#)
- Khronos Group Releases Vulkan 1.2**
The Khronos Group [announces the release of the Vulkan 1.2 specification](#) for GPU acceleration. This release integrates 23 proven extensions into the core Vulkan API, bringing significant developer-requested access to new hardware functionality, improved application performance, and enhanced API usability. Multiple GPU vendors have certified conformant implementations, and significant open source tooling is expected during January 2020. Vulkan continues to evolve by listening to developer needs, shipping new functionality as extensions, and then consolidating extensions that receive positive developer feedback into a unified core API specification. Khronos and the Vulkan community will support Vulkan 1.2 in a wide range of open source compilers, tools, and debuggers by the end of January 2020. Driver release updates will be posted on the [Vulkan Public Release Tracker](#).
Find more information on the Vulkan 1.2 specification and associated tests and tools at: <https://www.vulkan.org/>

On the right side of the page, there are sections for Vulkan, OpenGL ES, and WebGL, each with links to their respective documentation and reference cards.

图形处理器 (GPU) 编程——着色器 (shaders)

- 在GPU上运行的并行程序编程，主要负责绘制
- GLSL (OpenGL着色器) ; WebGL



WebGL着色器编程分享平台
(有大量例子)：
<https://www.shadertoy.com/>



图形处理器 (GPU) 编程——CUDA

- CUDA (Compute Unified Device Architecture): nVidia公司的GPU加速的并行高性能计算平台和接口
- 大规模计算；需深刻理解硬件和并行计算原理；各种科学计算；深度学习

CUDA Toolkit

Develop, Optimize and Deploy GPU-Accelerated Apps

The NVIDIA® CUDA® Toolkit provides a development environment for creating high performance GPU-accelerated applications. With the CUDA Toolkit, you can develop, optimize, and deploy your applications on GPU-accelerated embedded systems, desktop workstations, enterprise data centers, cloud-based platforms and HPC supercomputers. The toolkit includes GPU-accelerated libraries, debugging and optimization tools, a C/C++ compiler, and a runtime library to build and deploy your application on major architectures including x86, Arm and POWER.

Using built-in capabilities for distributing computations across multi-GPU configurations, scientists and researchers can develop applications that scale from single GPU workstations to cloud installations with thousands of GPUs.

[Download Now](#)

CUDA 11 Features



CUDA 11 introduces support for the NVIDIA Ampere architecture, Arm server processors, performance-optimized libraries, and new developer tool capabilities.

Support for the NVIDIA Ampere architecture includes next generation Tensor Cores, mixed precision modes, Multi-Instance GPU (MIG), advanced memory management, and

standard C++/Fortran parallel language constructs.

<https://developer.nvidia.com/cuda-toolkit>

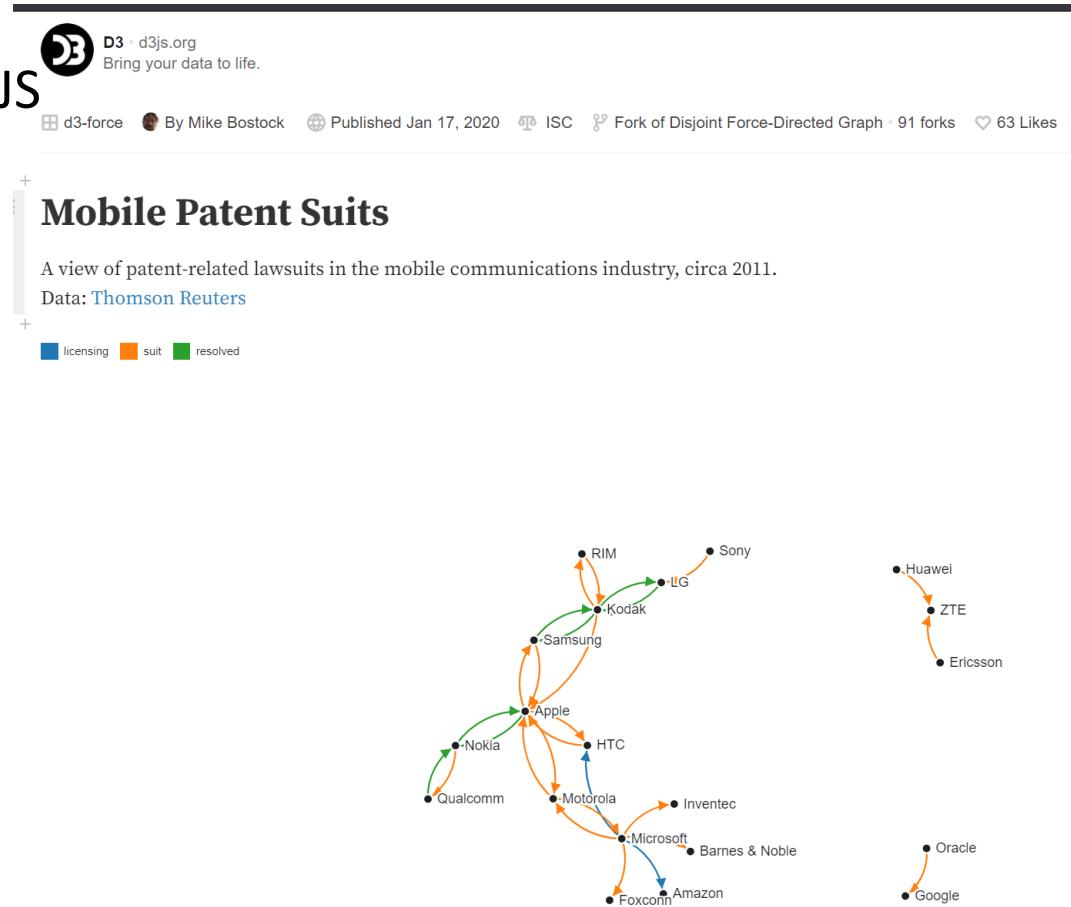
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信息可视化的实现

- 过去：编写桌面应用，例如，Windows上的应用程序
 - 所需语言：
 - C++
 - 所需软件库
 - OpenGL, DirectX, Qt
 - 优点？
 - 缺点？

信息可视化的实现

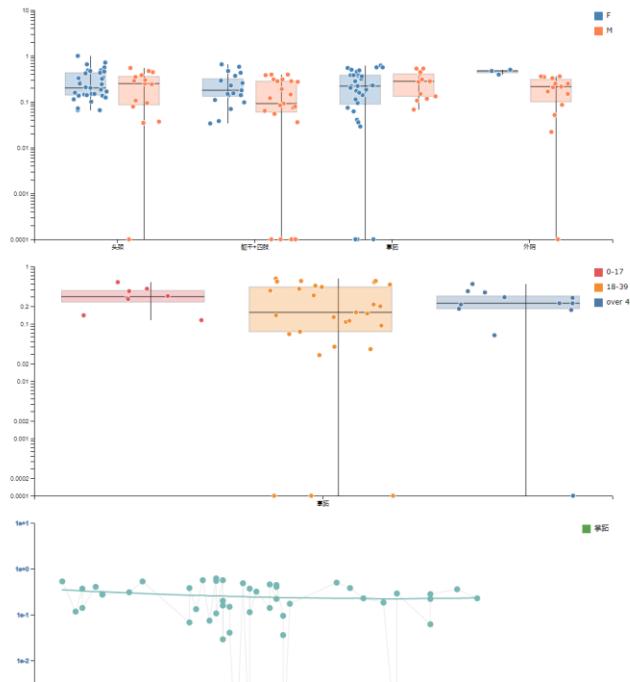
- 现在：编写基于网页的应用（Web应用）
 - 所需语言：
 - JavaScript
 - 所需软件库：
 - D3js, three.js, CanvasJS
 - Vue, React
 - 优点？
 - 缺点？



基于网页的可视化应用开发所需工具

- 运行、调试工具：

- 支持HTML5的各种网络浏览器
- 推荐Firefox
- 如何查看当前网页的源代码？



```
// get g_colorMap.thres
530 //   thres = "[" + id + ", " + g_colorMap.thres[i+1] +
531 //   else
532 //   {
533 //     if(g_isEnglish)
534 //       thres = "[" + id + ", +inf)";
535 //     else
536 //       thres = "[" + id + ", 无穷)";
537 //   }
538 //   return thres;
539 // }
540 // .attr("text-anchor", "left")
541 // .style("alignment-baseline", "middle")
542
543 // Draw parts
544 // Warning: All body parts are transformed to corner
545 // parts. This might went wrong!
546 var parts = [1]; // [1, 2, 3, 4, 5];
547 var nodePartsSilhouette = svg.append("g").attr("class", "silhouette");
548 var allPathData = [];
549 var xscale = width/g_orgBodyImgWidth;
550 var yscale = height/g_orgBodyImgHeight;
551
552 // console.log(g_tmMeanVal[g_selectedRow]);
553 d3.queue()
554   .defer(d3.csv, "./data/imagePaths/male/path/polsol")
555   .defer(d3.csv, "./data/imagePaths/male/path/polsol")
556   .defer(d3.csv, "./data/imagePaths/male/path/polsol")
557   .defer(d3.csv, "./data/imagePaths/male/path/polsol")
558   .defer(d3.csv, "./data/imagePaths/male/path/polsol")
559   .defer(d3.csv, "./data/imagePaths/male/path/polsol")
560   .defer(d3.csv, "./data/imagePaths/male/path/extremi")
561   .defer(d3.csv, "./data/imagePaths/male/path/extremi")
562   .defer(d3.csv, "./data/imagePaths/male/path/extremi")
563   .defer(d3.csv, "./data/imagePaths/male/path/headNeck")
564   .defer(d3.csv, "./data/imagePaths/male/path/Perineum")
565   .defer(d3.csv, "./data/imagePaths/male/path/orso")
566   .defer(d3.csv, "./data/imagePaths/male/path/extremi");
567 await(function(error, data1, data2, data3, data4,
568 {
569   if (error) throw error;
570   var bodyPart1_1 = nodePartsSilhouette
571     .append("path")
572     .attr("id", "pathPolsol")
573     .attr("class", "bodyOutline")
574     .attr("d", function(){
575       var pathStr =
576         for(var i = 0; i < data1.length; i++)
577           if(i > 0)
578             pathStr += "L " + data1[i].x * xscale +
579           else
580             pathStr += data1[i].x * xscale +
581               if(i == data1.length-1)
582                 pathStr += "z";
583     })
584   return pathStr;
585 })
```

基于网页的可视化应用开发所需工具

▪ 程序编码工具

- 各种文本编写工具
- 推荐Visual Studio Code

```
// {
//   if(a[keys[k]])
// }
// });
var classKeys = gExpertMedClass;
// Group by classification
// keys = classKeys;

gStreamGraphKeys = keys;
var stackGen = d3.stack()
  .keys(keys)
  .order(d3.stackOrderNone)
  .offset(d3.stackOffsetSilhouette)
  // .offset(d3.stackOffsetWiggle)
  ;
// .value(function(d) { return d.values; })
var layers = stackGen(data);
gStreamGraphLayers = layers;
// var layers = stack.keys(keys)(dataForStack);

// TODO: need to fix the y range
// x.domain(d3.extent(data, function(d) { return d.date; }));
x.domain(d3.extent(data, function (d) { return d.visit; }));
y.domain([-120, 120]);

var layernode = svg.selectAll(".layer")
  .data(layers)
  .enter();

layernode.append("path")
  .attr("class", "layer")
  .attr("d", d3.area()
    .curve(d3.curveBasis)
    .x(function (d, i) { return x(d.data.visit); })
    .y0(function (d) { return y(d[0]); })
    .y1(function (d) { return y(d[1]); })
  )
  .style("fill", function (d, i) {
    var medClass = -1;
    for (var ii = 0; ii < gMedProperties.length; ii++) {
      if (d.key == gMedProperties[ii].name) {
        // Search the name of medicine classification in the major classification list
        for (var j = 0; j < gExpertMedClass.length; j++) {
          if (gMedProperties[ii].classExp.search(gExpertMedClass[j]) >= 0) {
            medClass = j;
            break;
          }
        }
      }
    }
  });


```

网页编程入门

- HTML语言
- 静态网页
- 网页应用的入口都是html网页
- 试试下边的html语句

```
<!DOCTYPE html>
```

```
<!-- Add a title -->  
<h1>第一个网页</h1>
```

```
<!-- Add a bit of text --> <p>你好</p>
```

```
<!-- Add a link --> <p>这是 <a  
href="http://www.nihds.pku.edu.cn/">北京大学健康医学大数据  
国家研究院的链接</a></p>
```

参考：https://www.d3-graph-gallery.com/intro_d3js.html

网页编程入门

- 如何设定网页中各元素的风格?
- Cascading Style Sheet (CSS)

```
<!DOCTYPE html>
<style> .inBlue { color: blue; } </style>
<!-- Add a title -->
<h1 class="inBlue"第一个网页</h1>

<!-- Add a bit of text --> <p>你好</p>

<!-- Add a link --> <p>这是 <a href="http://www.nihds.pku.edu.cn/">北京大学健康医学  
大数据国家研究院的链接</a></p>
```

参考: https://www.d3-graph-gallery.com/intro_d3js.html

网页编程入门

- 如何在网页中绘制图形?
- 一个方法是使用Scalar Vector Graphic (SVG)

```
<!DOCTYPE html>
<style> .inBlue { color: blue; } </style>
<!-- Add a title -->
<h1 class="inBlue"第一个网页</h1>

<!-- Add a bit of text --> <p>你好</p>

<!-- Add a link --> <p>这是 <a
href="http://www.nihds.pku.edu.cn/">北京大学健康医
学大数据国家研究院的链接</a></p>

<svg> <circle style="fill: #69b3a2" stroke="black"
cx=50 cy=50 r=40></circle> </svg>
```

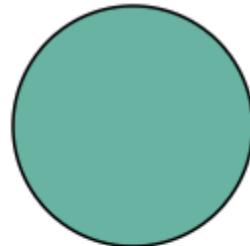
网页编程入门

- 看看效果是否一样？

第一个网页

你好

这是 [北京大学健康医学大数据国家研究院的链接](#)



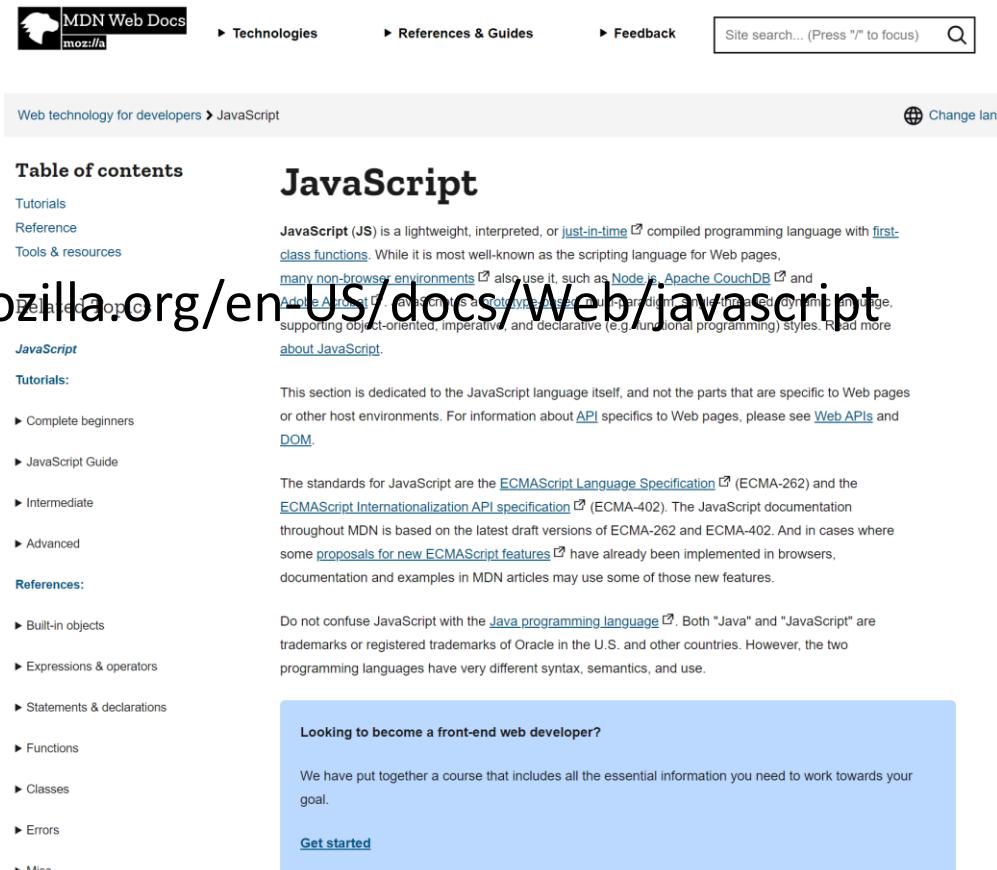
网页编程入门

▪ 试试绘制其他图形

```
<line x1="0" y1="0" x2="10" y2="10" stroke="black"></line>
<rect x="0" y="0" width="10" height="10"></rect>
<circle cx="5" cy="5" r="5"></circle>
<ellipse cx="10" cy="5" rx="10" ry="5"></ellipse>
<polygon points="0,0 10,5 20,0 20,20 10,15 0,20"></polygon>
<polyline points="0,0 10,5 20,0 20,20 10,15 0,20" stroke="black"></polyline>
<path d="M65,10 a50,25 0 1,0 50,25"></path>
```

网页编程入门

- 如何用程序控制，实现动态网页？
- JavaScript编程
- 脚本语言
- 语法类似C, C++
- 教程<https://developer.mozilla.org/en-US/docs/Web/JavaScript>



The screenshot shows the MDN Web Docs website for the JavaScript tutorial. At the top, there's a navigation bar with the MDN logo, 'MDN Web Docs', 'Technologies', 'References & Guides', 'Feedback', and a search bar. Below the header, the URL 'Web technology for developers > JavaScript' is visible, along with a 'Change lang' button. The main content area has a title 'Table of contents' on the left and 'JavaScript' on the right. The 'JavaScript' section includes a brief introduction about its nature as a lightweight, interpreted language, its use in web pages, and its applications in various environments like Node.js and Apache CouchDB. It also mentions its object-oriented, imperative, and declarative nature. A sidebar on the right provides information for front-end web developers, including a 'Get started' button.

Tutorials

Learn how to program in JavaScript with guides and tutorials.

For complete beginners

Head over to our [Learning Area JavaScript topic](#) if you want to learn JavaScript but have no previous

<https://developer.mozilla.org/en-US/docs/Web/JavaScript>

网页编程入门

- 理论上，可以用JavaScript以及HTML5接口制作可视化网页
- 如何与数据建立关联？
- D3js库的基本原理
 - 控制网页的Document Object Model (DOM)

```
<!DOCTYPE html>
<style> .inBlue { color: blue; } </style>
<!-- Add a title -->
<h1 class="inBlue">第一个网页</h1>

<!-- Add a bit of text --> <p>你好</p>

<!-- Add a link --> <p>这是 <a href="http://www.nihds.pku.edu.cn/">北京大学健康医学大数据国家研究院的链接</a></p>

<svg>
<circle class="target" style="fill: #69b3a2" stroke="black" cx=50 cy=50 r=40></circle>
</svg>
<!-- Load d3.js --> <script src="https://d3js.org/d3.v4.js"></script>
<script> d3 .select(".target") // select the elements that have the class 'target'
.style("stroke-width", 8) // change their style: stroke width is not equal to 8 pixels
</script>
```

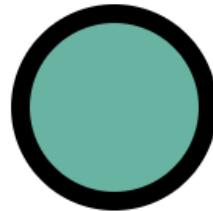
网页编程入门

- 看看效果？

第一个网页

你好

这是 [北京大学健康医学大数据国家研究院的链接](#)



网页编程入门

- 常见问题
- 为什么我修改了网页代码但刷新网页没有变化?
 - 清理浏览器缓存
- 为什么有的网页直接打开.html就可以运行，但我写的网页无法运行?
 - 双击.html后无反映
 - ? ? ? ?
 - 涉及到读取本地文件的操作，由于安全性原因都无法直接运行!
 - 需要http服务器！

如何在本地搭建http服务器？

- 步骤1：安装node.js <https://nodejs.org/en/>



Node.js® is a JavaScript runtime built on Chrome's V8 JavaScript engine.

Download for Windows (x64)

14.17.6 LTS

Recommended For Most Users

16.10.0 Current

Latest Features

[Other Downloads](#) | [Changelog](#) | [API Docs](#)

[Other Downloads](#) | [Changelog](#) | [API Docs](#)

Or have a look at the [Long Term Support \(LTS\) schedule](#)

如何在本地搭建http服务器？

- 步骤2： 使用node js的npm工具按照http-server
- 在命令行中输入：
- **npm install http-server**
- 步骤3： 启动http-server
 - 在命令行环境下
 - 在想要运行网页所在目录下输入：
 - **http-server&**

```
Starting up http-server, serving ./  
Available on:  
    http://172.27.96.1:8080  
    http://192.168.0.101:8080  
    http://127.0.0.1:8080  
Hit CTRL-C to stop the server
```

可视化和可视分析工程实现

- 可视化和可视分析工具
 - 科学可视化:
 - ParaView <https://www.paraview.org/>
 - SCI Institute的各种工具
<https://www.sci.utah.edu/sci-software/visualization.html>
 - Inviwo <https://inviwo.org/>
 - Voreen <https://www.uni-muenster.de/Voreen/index.html>
 -
 - 信息可视化, 可视分析:
 - Tableau <https://www.tableau.com/>
 - Power BI <https://powerbi.microsoft.com/>
 -
- 可视化软件库
 - VTK <https://vtk.org/>
 - D3 <https://d3js.org/>
- 编码实现可视化可视分析
 - 编程语言:
 - C++, JavaScript, Python, R.....
 - 技能:
 - 交互界面 (UI) 编程——Qt, Vue.js.....
 - 图形编程——OpenGL, WebGL
 - 图形处理器 (GPU) 编程——Shaders, CUDA

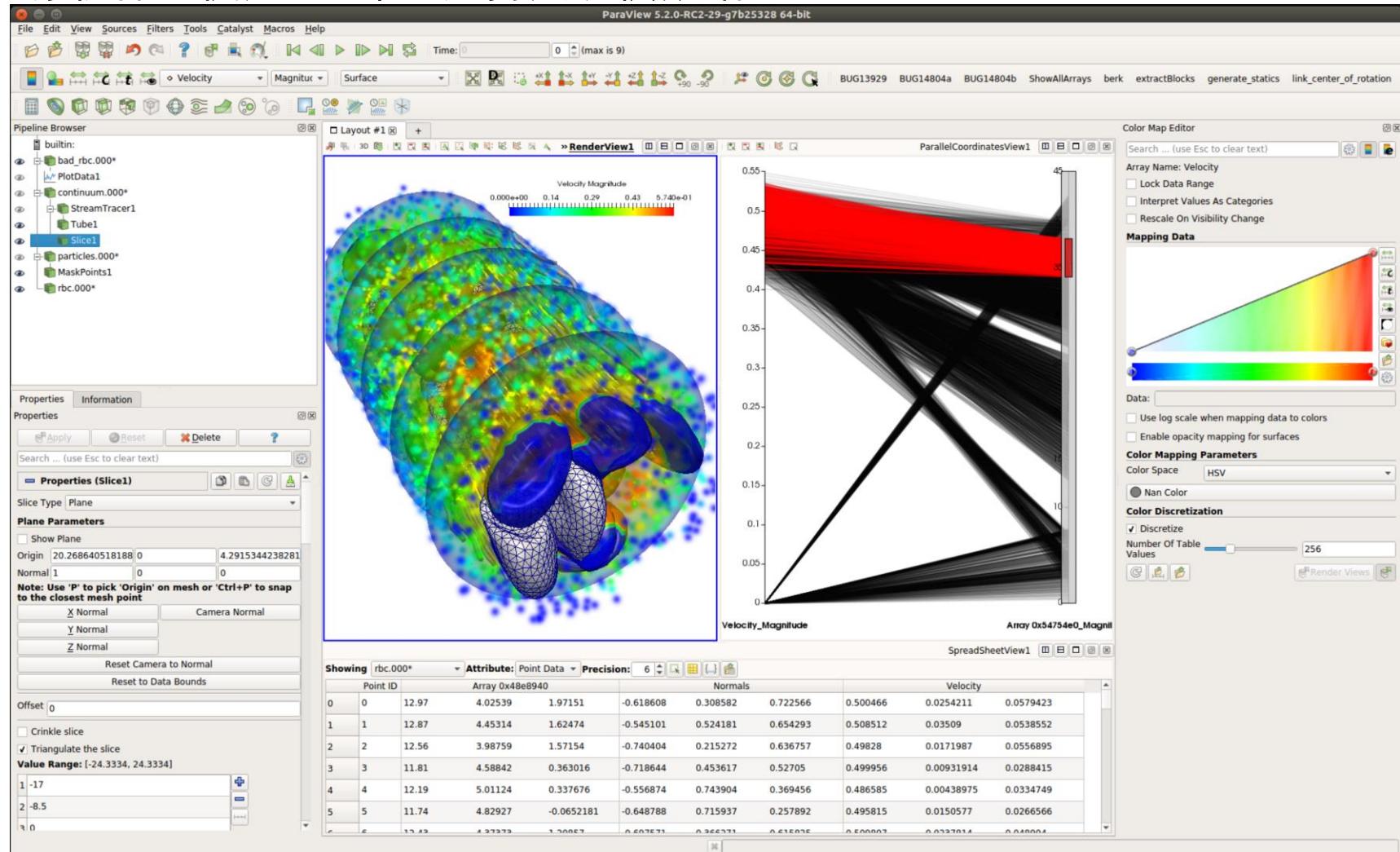


科学可视化的实现

- 过去：编写桌面应用，例如，Windows上的应用程序
 - 所需语言：
 - C++
 - 所需软件库
 - OpenGL, DirectX, Qt
 - 优点？
 - 缺点？
- 现在：基于网页的应用越来越多
- 但是，由于对性能的高要求，大部分应用还是基于桌面应用

Paraview

- 科学可视化、可视分析，数据处理
- 开源软件；使用VTK库；支持大规模数据



SCI Institute的各种工具

- 科学可视化的各种开源工具
- 包括集成式问题解决、图像分析、几何形状建模、模拟、可视化

SCI Home The Institute Research Centers Media Publications Software People Opportunities Internal Search

The Scientific Computing and Imaging Institute

SCI Software

Scientific Software Environments

Software at the SCI Institute is developed in close collaboration with application users to satisfy real needs within their research communities. We use a robust, yet agile software process that is fully open-source to produce software environments that integrate leading-edge algorithms in image processing, scientific visualization, and scientific computing. Software products developed at the SCI Institute can be categorized in the following ways: Problem Solving Environments (Integrated Modeling, Simulation, and Visualization), Image Analysis, Geometric and Shape Modeling, Simulation, and Visualization.

[Problem Solving Environments](#) | [Image Analysis](#) | [Geometric and Shape Modeling](#) | [Simulation](#) | [Visualization](#)

Problem Solving Environments (Integrated Modeling, Simulation, and Visualization)

FEBio

FEBio is a nonlinear finite element solver that is specifically designed for biomechanical applications. It offers modeling scenarios, constitutive models and boundary conditions that are relevant to many research areas in biomechanics. All features can be used together seamlessly, giving the user a powerful tool for solving 3D problems in computational biomechanics. The software is open-source, and pre-compiled executables for Windows, Mac OS X and Linux platforms are available.

[More information and links to downloads](#)

PreView

PreView is a Finite Element (FE) preprocessor that has been designed specifically to set up FE problems for FEBio. It allows the user to specify the boundary conditions and material properties in a user-friendly graphical environment.

[More information and links to downloads](#)

PostView

PostView is a finite element post-processor that is designed to visualize and analyze results from an FE analysis. It can import the FEBio extendible pilot file format (XPLT), as well as several other data formats (e.g. LSDYNA Keyword, LSDYNA binary database, VTK). It also offers a way to add additional data to an already loaded model.

[More information and links to downloads](#)

<https://www.sci.utah.edu/sci-software/visualization.html>

Seg3D

CIBC Seg3D Segmentation

Segmentation Image Processing

Seg3D is a free volume segmentation and processing tool developed by the NIH Center for Integrative Biomedical Computing. It combines a flexible manual segmentation interface with powerful higher-dimensional image processing and segmentation algorithms from the Insight Toolkit.

[Download](#) [Previous Releases](#)

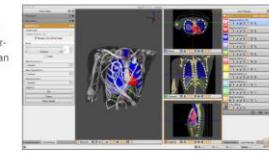
[Overview](#) [User Documentation](#) [Developer Documentation](#) [FAQ](#) [Support](#) [Seg3D Data](#)

Overview

Seg3D is a free volume segmentation and processing tool developed by the NIH Center for Integrative Biomedical Computing at the University of Utah Scientific Computing and Imaging (SCI) Institute. Seg3D combines a flexible manual segmentation interface with powerful higher-dimensional image processing and segmentation algorithms from the Insight Toolkit. Users can explore and label image volumes using volume rendering and orthogonal slice view windows.

Seg3D at a glance:

- Fully 3D interface with multiple volumes managed as layers
- Automatic segmentation integrated with manual contouring
- Volume rendering with 2D transfer function manipulation in real-time



<https://www.sci.utah.edu/software/seg3d.html>



Simple Scalable Interactive

ImageVis3D is a new volume rendering program developed by the NIH/NIGMS Center for Integrative Biomedical Computing. The main design goals are simplicity, scalability, and interactivity.

[Download](#) [Source Code](#)

[Overview](#) [User Documentation](#) [Developer Documentation](#) [Support](#) [Data](#)

Overview

ImageVis3D is a new volume rendering program developed by the NIH/NIGMS Center for Integrative Biomedical Computing (CIBC). The main design goals of ImageVis3D are: simplicity, scalability, and interactivity. Simplicity is achieved with a new user interface that gives an unprecedented level of flexibility. Scalability and interactivity mean that users can interactively explore terabyte-sized data sets on hardware ranging from mobile devices to high-end graphics workstations. Finally, the open source nature as well as the strict component-by-component design allow developers not only to extend ImageVis3D itself but also reuse parts of it, such as the rendering core. This rendering core for instance is planned to replace the volume rendering subsystems in many applications at the SCI Institute and with our collaborators.

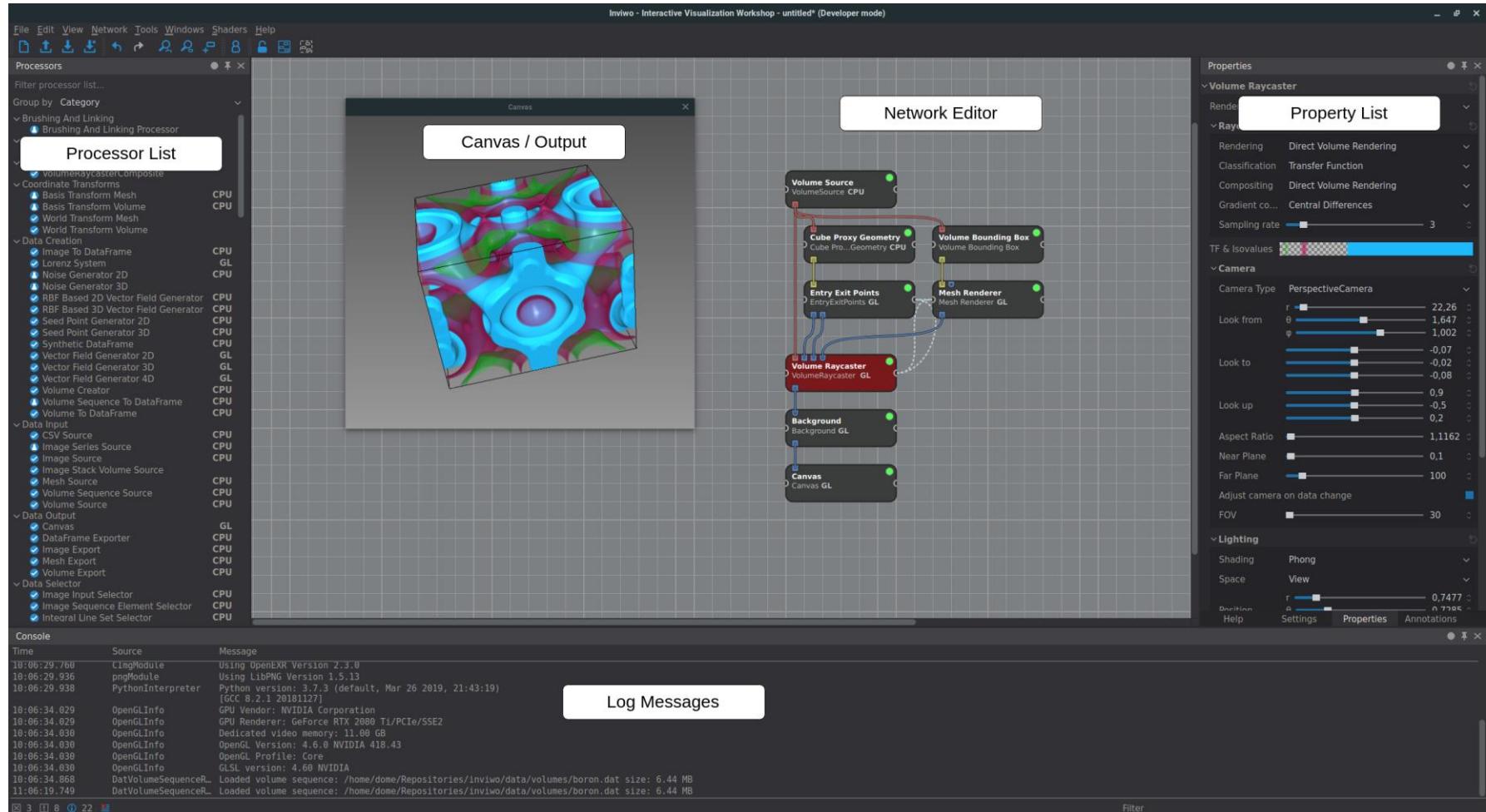


ImageVis3D Mobile for the iPhone and iPad is now available from [Apple iTunes App store](#).

<https://www.sci.utah.edu/software/imagevis3d.html>

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- 科学可视化
- 开源软件；模块化搭建可视化；高质量渲染



<https://inviwo.org>

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Voreen

- 科学可视化
- 开源软件；模块化搭建可视化；高质量渲染

The screenshot shows the official website for Voreen, a volume rendering engine. The header features logos for WWU Münster, DFG Deutsche Forschungsgemeinschaft, and SFB 656 MoBil. A search bar is also present. The main content area includes a large image of a red heart, the Voreen logo, and navigation links for Home, Gallery, Download, Documentation, Team, and Contact. On the left, there's a sidebar with links for System Requirements, Funding and Cooperation, Partners, Licence, and Publications. The central column contains sections for About Voreen (describing it as an open-source framework for visualization and analysis of multi-modal volumetric data sets), News (announcing Voreen 5.1.1 and 5.1.0 releases), and Main Features (listing capabilities like Direct volume rendering, support for various illumination models, and large data visualization). A screenshot of the Voreen software interface showing multiple 3D brain slices is included.

<https://www.uni-muenster.de/Voreen/index.html>

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D3 初步介绍

- 基于网站https://www.d3-graph-gallery.com/intro_d3js.html

← D3.js Graph Gallery

Q CHART TYPES QUICK ALL R PYTHON DATA TO VIZ WHO AM I ABOUT

An introduction to d3.js in 10 basic examples.



D3.js is a [JavaScript library](#) for manipulating documents based on data. It allows to build absolutely any type of [data visualization](#). This document displays 10 interactive examples illustrating the key concepts of d3, leading to a first basic scatterplot. Note that this [online course](#) is a great resource to get you started with d3.js.

D3 初步介绍

- 目标：实现自己的第一个直方图（histogram）

Most basic histogram in d3.js



This post describes how to build a very basic [histogram](#) with d3.js. Only one category is represented, to simplify the code as much as possible. You can see many other examples in the [histogram section](#) of the gallery. Learn more about the theory of histogram in [data-to-viz.com](#). This example works with d3.js v4 and v6

[HISTOGRAM SECTION](#)

[DOWNLOAD CODE](#)

THREE.js创建三维可视化

- <https://threejs.org/docs/index.html#manual/en/introduction/Creating-a-scene>

The screenshot shows the left sidebar of the three.js documentation site with a dark theme. The sidebar includes links for 'three.js', 'docs', 'examples', a search bar, and language selection ('en'). Under the 'Manual' section, the 'Creating a scene' link is highlighted. The main content area has a light background and displays the 'Creating a scene' tutorial. It starts with a brief introduction: 'The goal of this section is to give a brief introduction to three.js. We will start by setting up a scene, with a spinning cube. A working example is provided at the bottom of the page in case you get stuck and need help.' Below this is a section titled 'Before we start' with instructions: 'Before you can use three.js, you need somewhere to display it. Save the following HTML to a file on your computer, along with a copy of `three.js` in the `js/` directory, and open it in your browser.' A code block shows the HTML template:

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <title>My first three.js app</title>
    <style>
      body { margin: 0; }
    </style>
  </head>
  <body>
    <script src="js/three.js"></script>
    <script>
      // Our Javascript will go here.
    </script>
  </body>
</html>
```

At the bottom of the content area, a note says: 'That's all. All the code below goes into the empty <script> tag.'

The footer of the page contains the text 'Creating the scene'.

THREE.js创建三维可视化

- 目标：实现绘制一个立方体

