

Компьютерная графика

Лекция 1: Введение в курс

2021

Что такое компьютерная графика?

Что такое компьютерная графика?

- ▶ Кинематограф



The Matrix Revolutions (2003)





Avatar (2009)





The Avengers (2012)



Что такое компьютерная графика?

- ▶ Кинематограф
- ▶ Компьютерные игры

SCORE<1> HI-SCORE SCORE<2>

0990 0000



3 

CREDIT 00

Space Invaders (1978)





Doom (1993)





Grand Theft Auto: Vice City (2002)





Civilization V (2010)





The Witcher 3: Wild Hunt (2015)





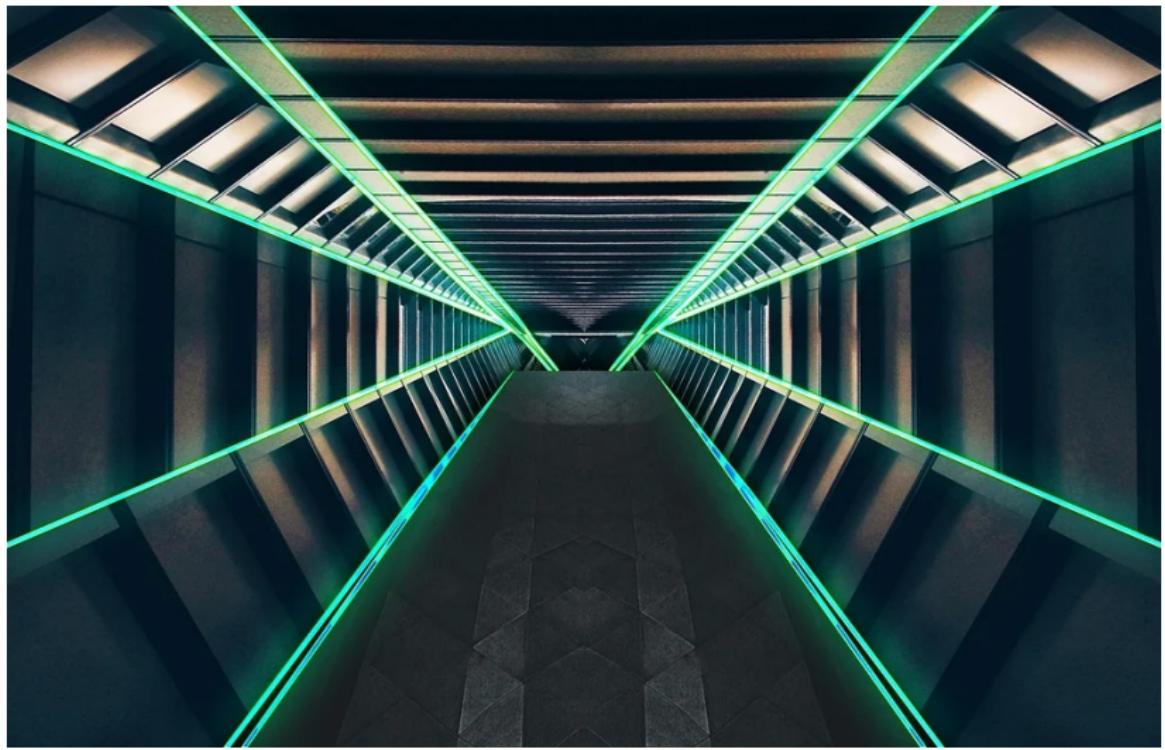
Cyberpunk 2077 (2020)



Что такое компьютерная графика?

- ▶ Кинематограф
- ▶ Компьютерные игры
- ▶ Рисунки, concept art







Что такое компьютерная графика?

- ▶ Кинематограф
- ▶ Компьютерные игры
- ▶ Рисунки, concept art
- ▶ Графический интерфейс



Mac OS Catalina



A

System accent color: #0078D4

Buttons

Enabled button

Disabled button

Toggle button

Checkbox Unchecked Checked Third state Disabled**Radio button** Unchecked Checked Disabled**Calendar Date Picker**

Label title

mm/dd/yyyy

Combo box

Label title

Placeholder text

Hover

mm/dd/yyyy

Hover

Placeholder text

Disabled

mm/dd/yyyy

Disabled

Placeholder text

February 2018

Sun	Mon	Tue	Wed	Thu	Fri	Sat
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	1	2	3	4	5	6
7	8	9	10	11	12	13

Microsoft

Windows

Office

Microsoft

Windows

Office

Textbox

Label title

Placeholder text

Hover

Placeholder text

Disabled

Placeholder text

Typing

This is text.

Password

Toggle switch Off Disabled Off On Disabled On

Windows 10

A
System accent color: #0078D4

Buttons	Calendar Date Picker	Combo box	Textbox																																																	
Enabled button	Label title <input type="text" value="mm/dd/yyyy"/>	Label title <input type="text" value="Placeholder text"/>	Label title <input type="text" value="Placeholder text"/>																																																	
Disabled button	Hover <input type="text" value="mm/dd/yyyy"/>	Hover <input type="text" value="Placeholder text"/>	Hover <input type="text" value="Placeholder text"/>																																																	
Toggle button	Disabled <input type="text" value="mm/dd/yyyy"/>	Disabled <input type="text" value="Placeholder text"/>	Disabled <input type="text" value="Placeholder text"/>																																																	
Checkbox	Disabled <input type="checkbox"/> Unchecked <input checked="" type="checkbox"/> Checked <input type="checkbox"/> Third state <input checked="" type="checkbox"/> Disabled	February 2018 <table border="1"><thead><tr><th>Sun</th><th>Mon</th><th>Tue</th><th>Wed</th><th>Thu</th><th>Fri</th><th>Sat</th></tr></thead><tbody><tr><td>31</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td></tr><tr><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr><tr><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td></tr><tr><td>28</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td></tr></tbody></table>	Sun	Mon	Tue	Wed	Thu	Fri	Sat	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	1	2	3	4	5	6	7	8	9	10	11	12	13	Typing <input type="text" value="This is text."/> Password <input type="password" value="*****"/>
Sun	Mon	Tue	Wed	Thu	Fri	Sat																																														
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Radio button	Unchecked <input type="radio"/> Checked <input checked="" type="radio"/> Disabled <input type="radio"/>	Microsoft Windows Office	Toggle switch Off On Disabled Off Disabled On																																																	

Brandenburg

Gold: 67 Food: 13,023 Silver: 0 Oil: 0 Coal: 0 Wood: 7 Population: 100

SMAALAND WEST

Paused

Diplomas

- Free Christian von Anhalt ...
- Free Clemens von Quern ...

Merchants

- Saxony 0.43 → to Lübeck
- Rheinland 0.37 → to Lübeck

Armies

- 8,000 Kurfürstliche Garde

Niederlausitz Cottbus

Neumark North Germany

Demographics

Tax	0.26
Production	0.10
Total	0.36

Unrest: 0.0 Autonomy: 5.0%

Cores & Claims

Bohemia +22

Culture

Saxon

Religion

Catholic

Diplomacy

Military

Manpower: 261 Supply Limit: 13 Sailors: 0

0% Garrison: 0 No Objective

Trade

Trade Power: 1.6 Trade Value: 1.23 Goods Produced: 0.61

Buildings

10

Estates

No Estate

Province Values

0.00 0.66

EN 9:30 PM 28-May-16

Europa Universalis 4

The screenshot shows the Brandenburg interface in Europa Universalis 4. The top bar displays resources: Gold (67), Food (13,023), Silver (0), Coal (0), Oil (0), Wood (7), and Population (100). It also shows diplomatic relations with Poland (0/2), France (0/0), and Russia (2/2, 1/1). The date is 1444.

Brandenburg (Red Dragon)

Diplomatic Relations:

- Free Christian von Anhalt ...
- Free Clemens von Quern ...

Merchants:

- Saxony 0.43 → to Lübeck
- Rheinland 0.37 → to Lübeck

Armies: 8,000 Kurfürstliche Garde

Demographics:

- Tax 0.26
- Production 0.10
- Total 0.36
- Unrest 0.0
- Autonomy 5.0%

Cores & Claims: Bohemia (+22)

Culture: Saxon

Religion: Catholic

Diplomacy:

Military:

- Mapower 261
- Supply Limit 13
- Sailors 0 (11%)
- Garrison: 0
- No Objective

Trade:

- Trade Power 1.6
- Trade Value 1.23
- Goods Produced 0.61

Buildings: 10

Estates: No Estate

Province Values:

- Food 2 (0.00)
- Wood 0.00 (0.66)

Bottom status bar: EN, 9:30 PM, 28-May-16, system icons.

Example: Custom rendering

Clear **Undo**
Left-click and drag to add
Right-click to undo

Memory Editor

```

E028E4: 00 00 F0 44 00 40 7E 44 ...D.@@D
E028EC: 06 33 88 3C 00 00 A0 40 ...<...@D
E028F4: 18 BADE 00 08 BA DE 00 .....@D
E028FC: 9A 99 99 3E 00 00 C0 40 ...>...@D
E02984: 00 00 C0 40 02 01 00 00 ...@...D
E0298C: 07 01 00 00 06 01 00 00 .....D
E02914: 09 01 00 00 08 01 00 00 .....D
E0291C: 0A 01 00 00 08 01 00 00 .....D
E02924: 0C 01 00 00 0D 01 00 00 .....D
E0292C: 05 01 00 00 03 01 00 00 .....D
E02934: 01 01 00 00 00 01 00 00 .....D
E0293C: 41 00 00 00 43 00 00 00 A..C..
E02944: 56 00 00 00 58 00 00 00 MixX_Console
E0294C: 59 00 00 00 5A 00 00 00 Y...Z...
E02954: 00 00 00 3E CD CC 4C 3D !>>>= implements a console with basic coloring,
E0295C: 00 00 00 00 A4 28 E0 00 !>>>= and history. A more elaborate implementation may
want to store entries along with extra data such as timestamp,
                                         entry etc.

```

8 rows Range E028E4..E03C93 Iter: 13

use functions such as IsItemHovered() on

AAA
BBB
CCC
EEE
LEVERAGE

BBB
CCC
EEE
BUZZWORD

ACTION
REACTION

▶ Text Baseline Alignment
▶ Scrolling

Example: Layout

File

MyObject 0	MyObject: 0
MyObject 1	
MyObject 2	
MyObject 3	
MyObject 4	
MyObject 5	
MyObject 6	
MyObject 7	
MyObject 8	
MyObject 9	
MyObject 10	
MyObject 11	
MyObject 12	
MyObject 13	

Revert **Save**

Enter 'HELP' for help, press TAB to use text completion.

Add Dummy Text **Add Dummy Error** **Clear**

Filter ("incl,-exc1") ("error")

```

0 some text
some more text
display very important message here!
[error] something went wrong
Possible matches:
- HELP
- HISTORY
# HELP
Commands:
- HELP
- HISTORY
- CLEAR
- CLASSIFY
# hello, imgui world!
Unknown command: 'hello, imgui world!'

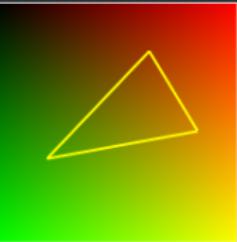
```

hello, imgui world! **Input**

Dear ImGui

▼ Example: Custom rendering

Clear Undo
Left-click and drag to add
Right-click to undo



E028E4: 00 00 F0 44 00 40 7E 44 ...D.@@D
E028EC: 06 33 88 3C 00 00 A0 40 ...<...@
E028F4: 18 BADE 00 08 BA DE 00@...
E028FC: 9A 99 99 3E 00 00 C0 40@...
E02984: 00 00 C0 40 02 01 00 00@...
E0298C: 07 01 00 00 06 01 00 00@...
E02914: 09 01 00 00 08 01 00 00@...
E0291C: 0A 01 00 00 08 01 00 00@...
E02924: 0C 01 00 00 0D 01 00 00@...
E0292C: 05 01 00 00 03 01 00 00@...
E02934: 01 01 00 00 00 01 00 00@...
E0293C: 41 00 00 00 43 00 00 00 A..C..
E02944: 56 00 00 00 58 00 00 00 MailX_Console
E0294C: 59 00 00 00 5A 00 00 00 Y...Z..
E02954: 00 00 88 3E CD CC 4C 3D #>@!<@!& implements a console with basic coloring,
E0295C: 00 00 00 00 A4 28 E0 @!<@!& history. A more elaborate implementation may
want to store entries along with extra data such as timestamp,
8 rows Range E028E4..E03C93 Iter: etc.

▼ Example: Layout

File

MyObject 0
MyObject 1
MyObject 2
MyObject 3
MyObject 4
MyObject 5
MyObject 6
MyObject 7
MyObject 8
MyObject 9
MyObject 10
MyObject 11
MyObject 12
MuObject 13

Revert Save

MyObject: 0
Lorem ipsum dolor sit amet,
consectetur adipiscing elit,
sed do eiusmod tempor
incididunt ut labore et dolore
magna aliqua.

Enter 'HELP' for help, press TAB to use text completion.
Add Dummy Text Add Dummy Error Clear
Filter ("incl,-exc1") ("error")

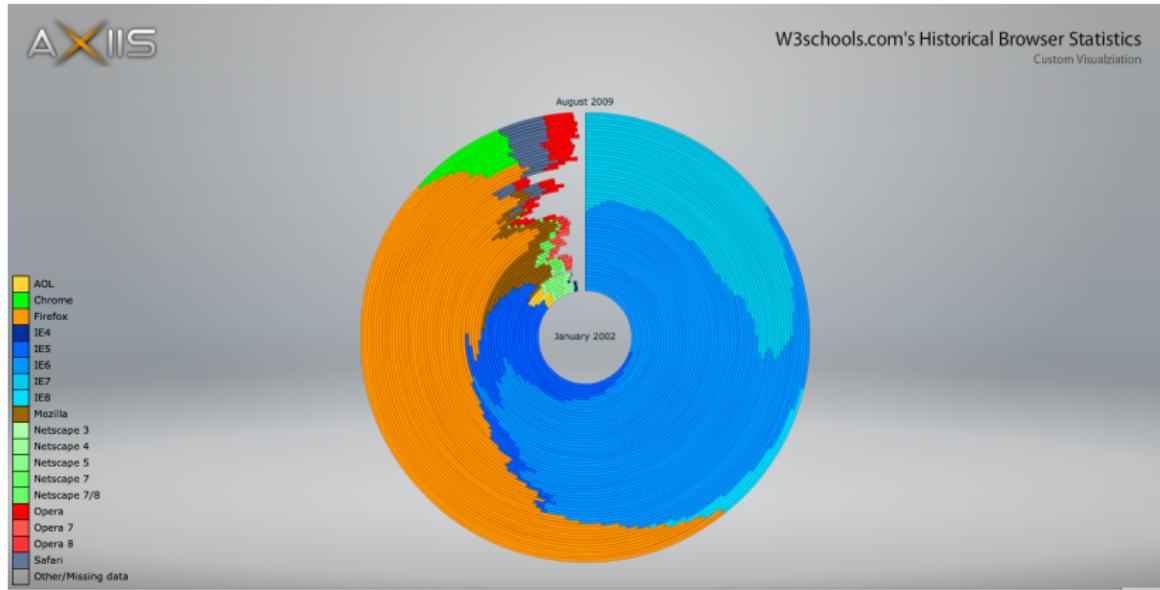
0 some text
some more text
display very important message here!
[error] something went wrong
Possible matches:
- HELP
- HISTORY
HELP
Commands:
- HELP
- HISTORY
- CLEAR
- CLASSIFY
hello, imgui world!
Unknown command: 'hello, imgui world!'

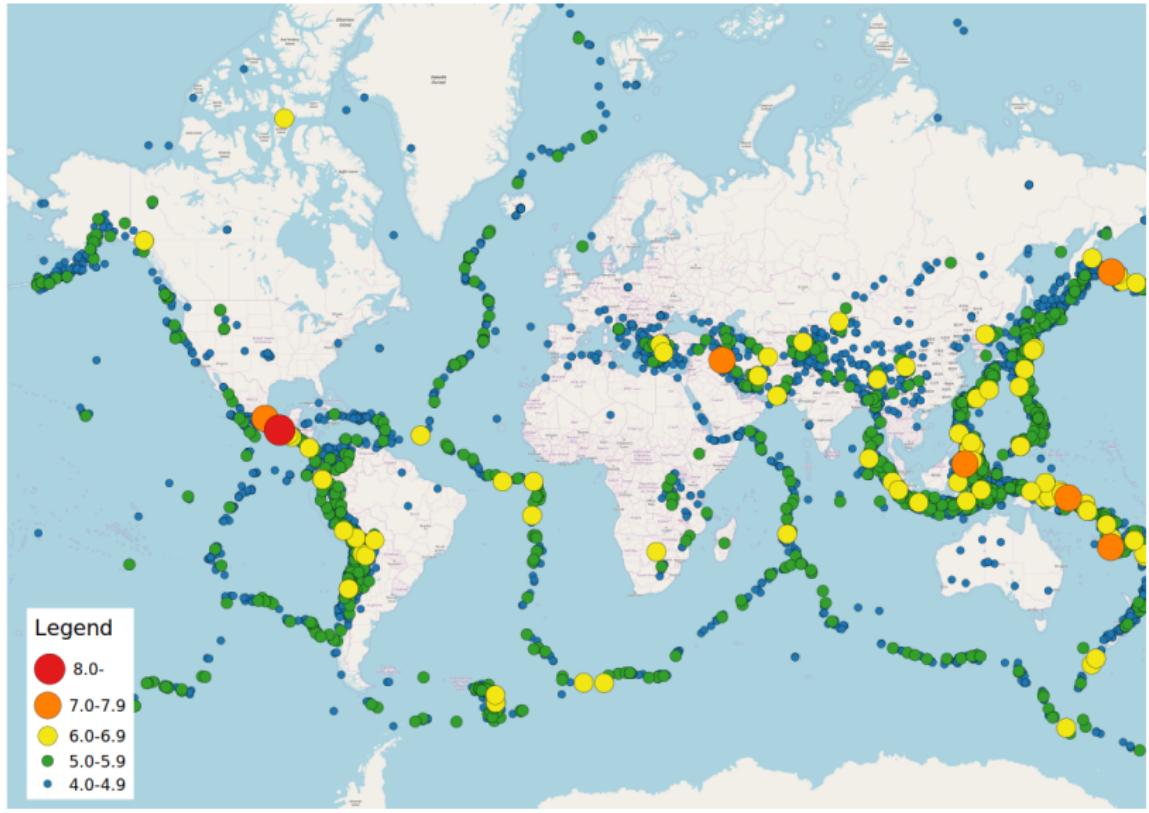
hello, imgui world! Input

Что такое компьютерная графика?

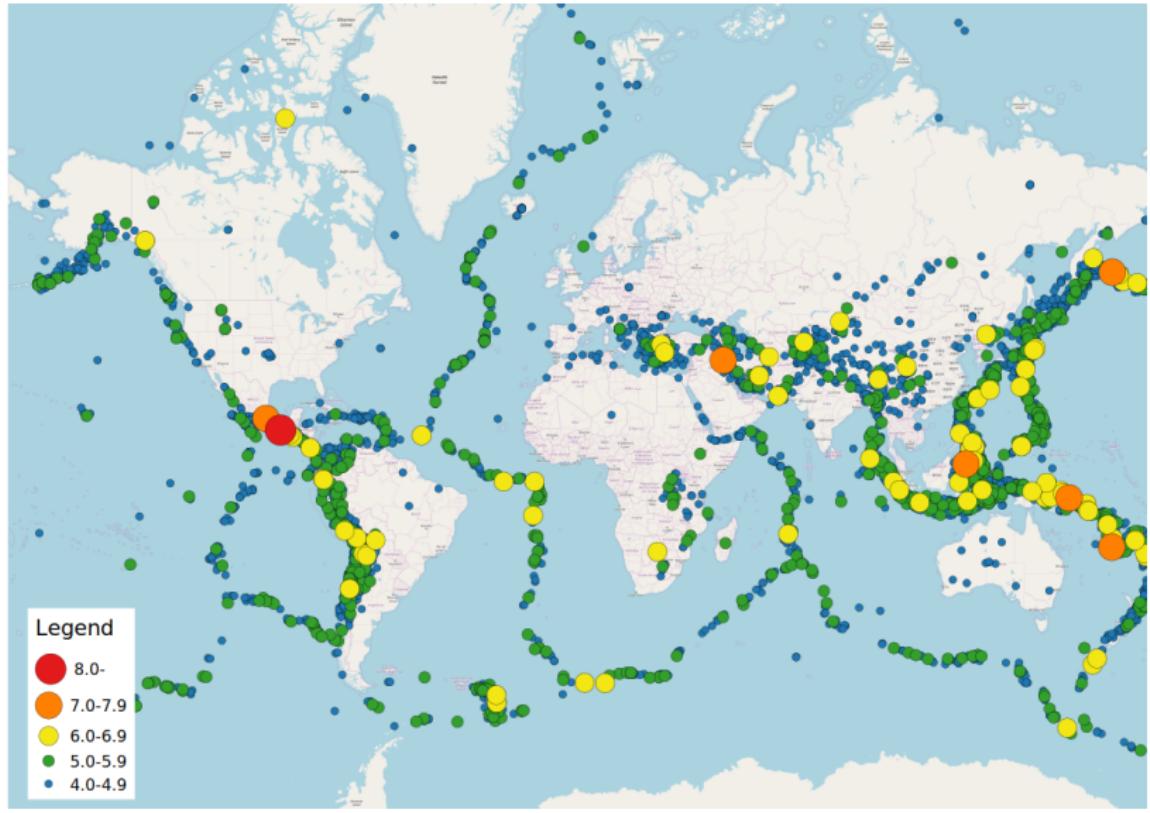
- ▶ Кинематограф
- ▶ Компьютерные игры
- ▶ Рисунки, concept art
- ▶ Графический интерфейс
- ▶ Визуализация данных

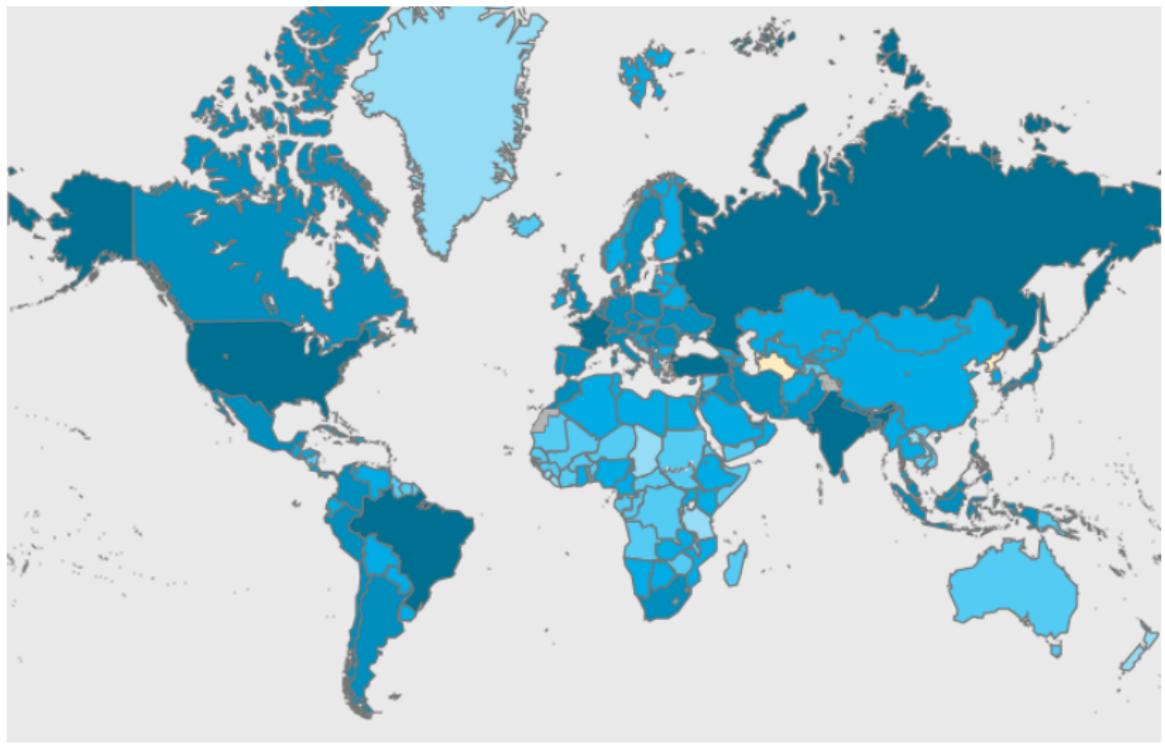
Популярность браузеров в 2002-2009



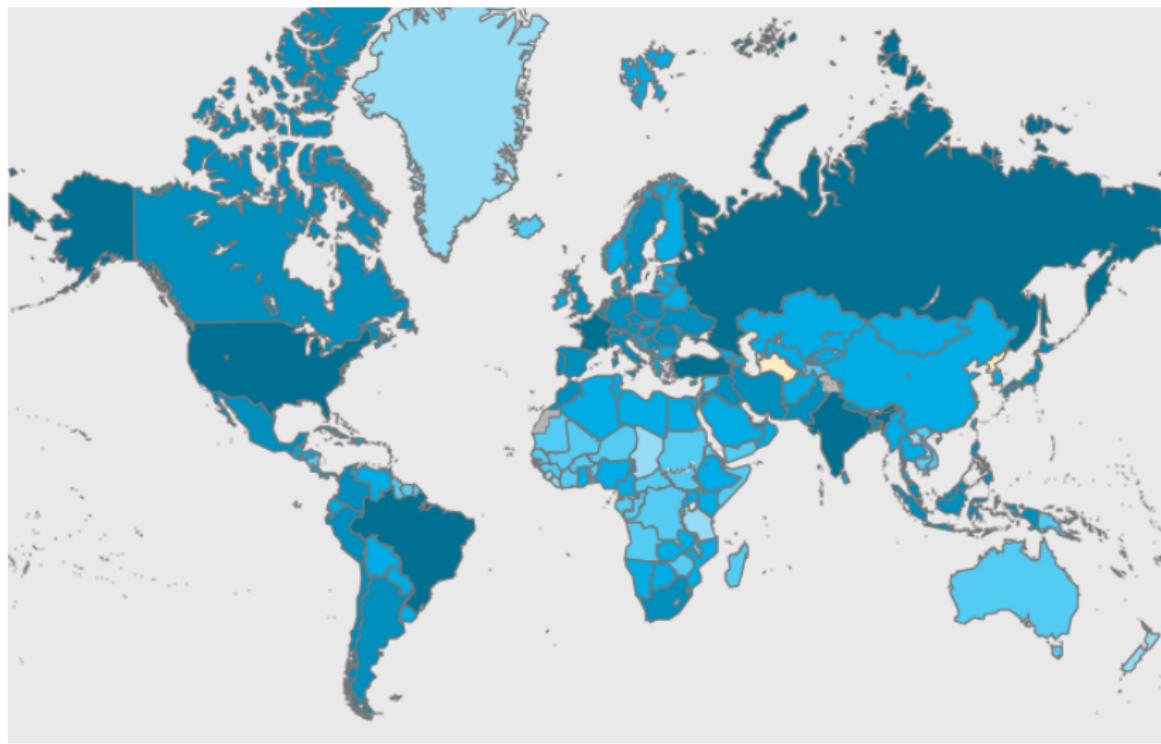


Карта землетресений





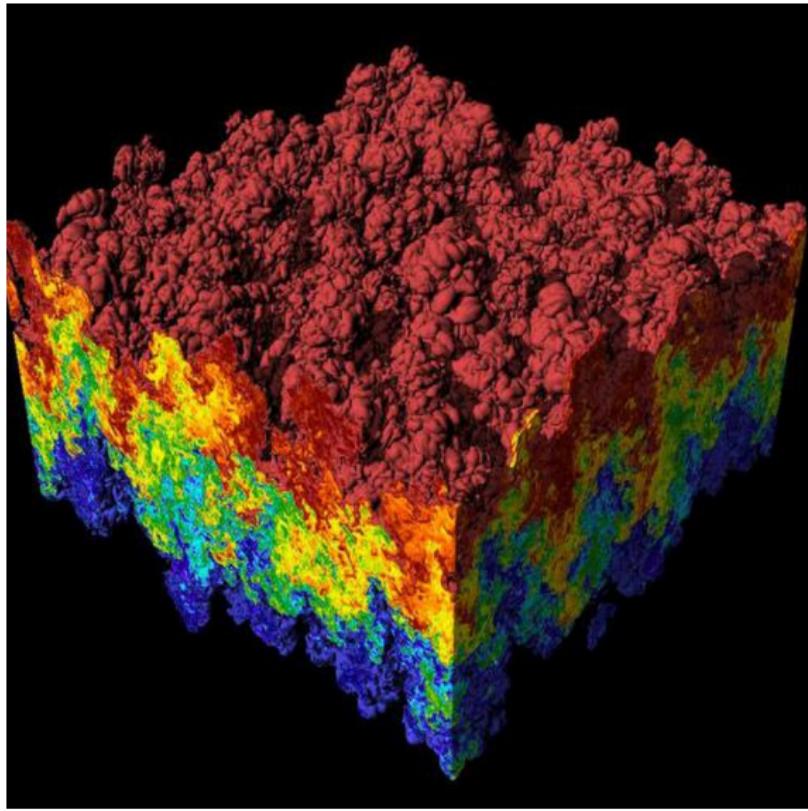
Количество случаев заражения COVID-19



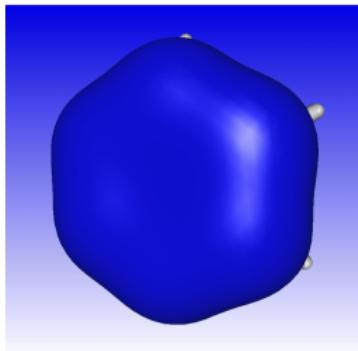
Что такое компьютерная графика?

- ▶ Кинематограф
- ▶ Компьютерные игры
- ▶ Рисунки, concept art
- ▶ Графический интерфейс
- ▶ Визуализация данных
- ▶ Научная визуализация

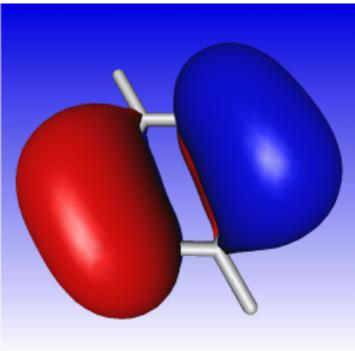
Неустойчивость Рэлея — Тейлора



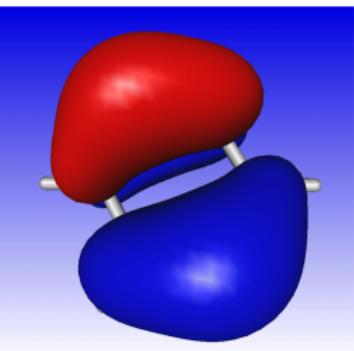
Молекулярные орбитали бензола



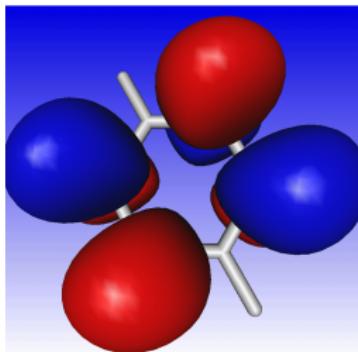
16



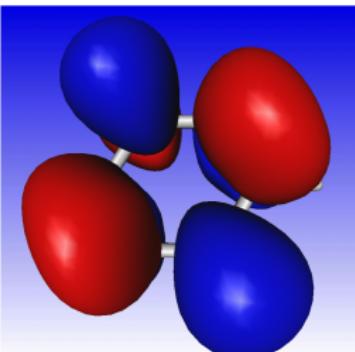
20



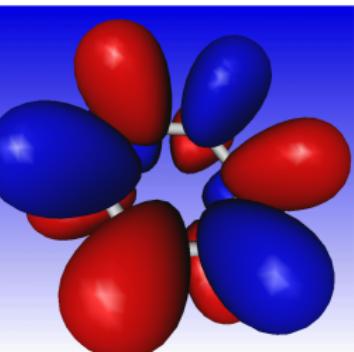
21



22

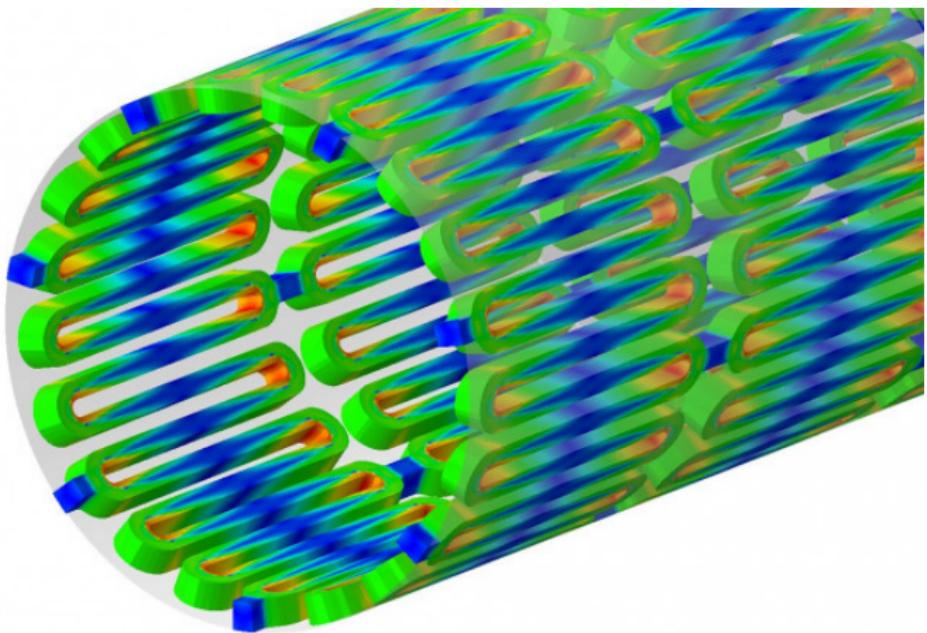


23



30

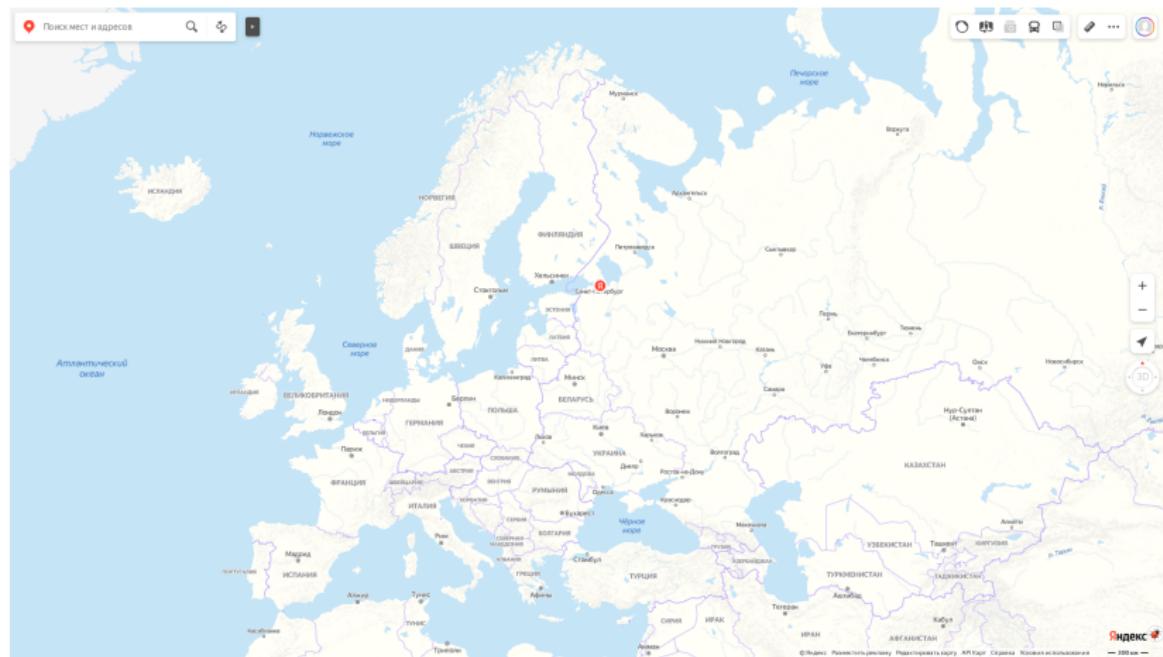
Симуляция напряжений в стенке методом конечных элементов



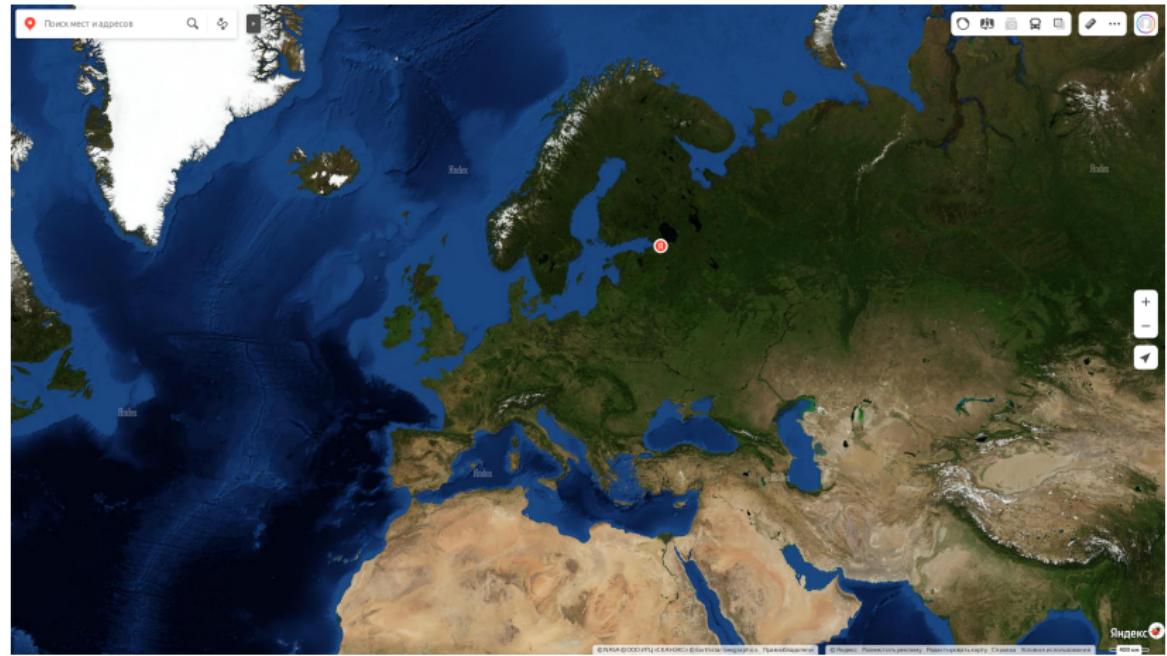
Что такое компьютерная графика?

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- ▶ Графический интерфейс
- ▶ Визуализация данных
- ▶ Научная визуализация
- ▶ Карты

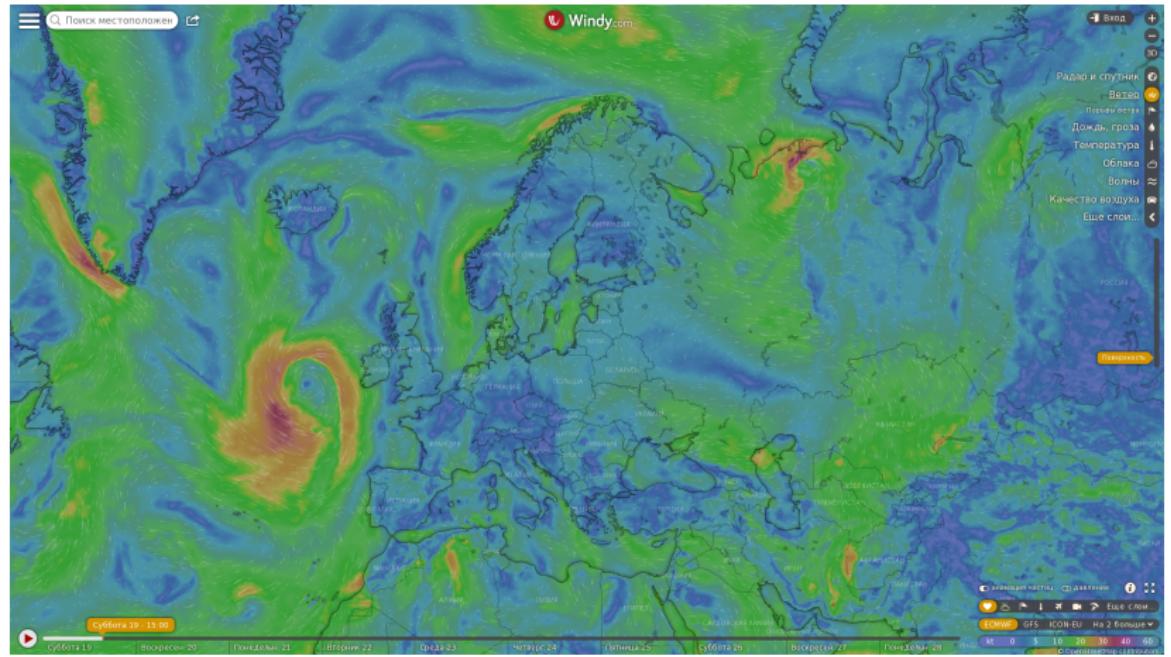
Схематическая карта



Спутниковая карта



Карта погоды



Что такое компьютерная графика?

- ▶ Кинематограф
- ▶ Компьютерные игры
- ▶ Рисунки, concept art
- ▶ Графический интерфейс
- ▶ Визуализация данных
- ▶ Научная визуализация
- ▶ Карты
- ▶ И т.д.

Грубая и неточная классификация

Грубая и неточная классификация

- ▶ 2D / 3D

Грубая и неточная классификация

- ▶ 2D / 2.5D / 3D

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- ▶ 2D / 2.5D / 3D
- ▶ Векторная / растровая

Грубая и неточная классификация

- ▶ 2D / 2.5D / 3D
- ▶ Векторная / растровая
- ▶ Realtime / offline

Грубая и неточная классификация

- ▶ 2D / 2.5D / 3D
- ▶ Векторная / растровая
- ▶ Realtime / near real-time / offline

Грубая и неточная классификация

- ▶ 2D / 2.5D / 3D
- ▶ Векторная / растровая
- ▶ Realtime / near real-time / offline
- ▶ Фотореалистичная / стилизованная

Грубая и неточная классификация

- ▶ 2D / 2.5D / 3D
- ▶ Векторная / растровая
- ▶ Realtime / near real-time / offline
- ▶ Фотореалистичная / стилизованная
- ▶ CPU / GPU

Чем мы будем заниматься?

- ▶ 2D / 2.5D / 3D
- ▶ Векторная / растровая
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