We are collecting and generating data on a petabyte scale ($1 \text{ Pb} = 1,000 \text{ Tb} = 1 \text{ M Gb}$).

Data contains valuable information that can drive insights and discoveries.

It can be difficult to access, manage, and generate knowledge and decisions.
Scientific Visualization can help us pair science and design to simplify the complexity, and drive a deeper understanding of the context.
Why Visualization?

“A visualization is worth a thousand numbers”

- Find a story in the data  [Exploration]
- Tell a story to an audience  [Explanation]

Represent large data sets in a comprehensible way
Help the user see relationships in the data
Visualization Systems & Hardware
Multiscreen Systems
Visualization & Interaction Technologies
Web 3.0 and GPU

JS x 100 - Multicore GPU

Big Data Analytics

Rich Interactive Interfaces

Desktop-like Games

Scientific Visualization

Image / Video Processing

Augmented / Immersive Reality

AMD Radeon HD 7990 – 4096 Streaming Processing Units – $899

8.2 TFLOPs compute power (1st 2001, 6th 2003, 17th in 2004)

82 TFLOPs compute power (10th 2007) – (36,864 cores)
Augmented Reality

Future of Social Networking with Augmented Reality

Concept investigation by Matthew Buckland and Phil Langley of 20fourlabs.com
Immersive Reality

VR Headset

- Oculus Rift
- Sony Morpheus
- DuroVis Dive
- Zeiss Cinemizer
- Avegant Glyph
- Hasbro My3D
- Altergaze
Interaction

Hand Gesture

Body Motion
Concepts & Examples
Rich Graphics

WebGL

Asm.js
DYNAMIC DATA
HIGH-RESOLUTION
FLOW VISUALIZATION
Sensor and Simulation
Data Visualization
Experiment Planning
Time Series Visualization

IFC STREAM SENSOR
Chequest Creek || Keosauqua
Station ID: CHQSTCR02
Water Level: 1 ft 11 in
Last Reported: Fri, Jun 13, 2014 3:00 pm UTC

IFC BRIDGE SENSOR
Street Name (City): Keosauqua
River Name: Chequest Creek
Stream Forecast: not available
Bridge Height: 17 ft 7 in
Last Reported: Friday, June 13, 2014 10:00 am
Last Reading: 1 ft 11 in

Water Level (ft)
- 0 ft
- 5 ft
- 10 ft
- 15 ft
- 18 ft

Date
- Fri, Jun 6
- Sat, Jun 7
- Sun, Jun 8
- Mon, Jun 9
- Tue, Jun 10
- Wed, Jun 11

Weather Conditions:
- Partly Cloudy
- Thunderstorm
- Mostly Cloudy
- Chance of Rain
- Partly Cloudy
Disdrometer Visualization

- May 3, 2013
- Rain Rate (mm/h)
- Reflectivity (dBZ)
- Drop Size (mm)
- Number of Drops

10:30 pm to 11:00 pm UTC
Large Scale Geospatial Data Visualization
Rainfall Visualization

2013-06-15

Map of rainfall visualization with color-coded areas indicating different rainfall amounts.
550 hours (2200 steps) of data
Game-based Learning
**What is Gamification?**

Gamification is the use of elements of game play in non-game contexts.

**Gamification** [gay-muh-fi-kay-shuhn] integrating game dynamics into your site, service, community, content or campaign, in order to drive participation.

(see Bunchball)

It provides rewards and engagement for customers.

**Traditional Trainer**

Please turn your mobile phones off.

**Gamified Trainer**

Please turn your mobile phones on.
HOW GAMIFICATION WORKS:

5 COMMON MECHANICS

- **POINTS**
  - Measure a user's achievements in relation to others
  - Can double as currency to exchange for rewards

- **BADGES**
  - Reward achievements visually

- **LEVELS**
  - Encourage users to progress and unlock new rewards

- **LEADERBOARDS**
  - Organise players by rank

- **CHALLENGES**
  - Encourage engagement by offering specific tasks to complete

4 MAIN WAYS TO DRIVE ENGAGEMENT

- **ACCELERATED FEEDBACK CYCLES**
- **CLEAR GOALS AND RULES OF PLAY**
- **A COMPPELLING NARRATIVE**
- **CHALLENGING BUT ACHIEVABLE TASKS**
Games for Research
FOLDABLE CHILDREN’S BOOK

IOWA FLOOD
INFORMATION SYSTEM

The Iowa Flood Information System (IFIS) is a one-stop web platform to access community-based flood conditions, forecasts, visualizations, inundation maps, and flood-related data, information, and applications.

IFIS provides flood inundation maps for major communities in Iowa with flood depth.

Flood Map Controller
Actual Stage: 12 ft 4 in
Date: Sun, May 27, 2000 am

Des Moines River (70%)
Raccoon River (70%)
Two rivers (50%/50%)

EDUCATION
2D FLOOD SIMULATOR GAME

SCORING

Your Best: 12.9 sq mi
Last Score: 12.9 sq mi

You saved 12.9 sq miles of the city from flooding.
Good job!

ANIMATION
GAMIFICATION
FLOOD MAP FLIGHT SIMULATOR

3-DIMENSIONAL
REMOTE INTERACTION

Des Moines, Iowa

Flood Map Flight Simulator Controller

- Connecting to server
- This button starts and stops recording
- View 3D model of the area in real-time
- Accurate position and real-time weather conditions
- Web tracking feature
FLOOD MAP FLIGHT SIMULATOR

IOWA CITY
River: Iowa River
Flood Level: 22 ft

View Maps by
☑️ River Stage
☐ Return Period
☐ Real-time Stage Values
☐ Flight Simulator

Flood Map Controller
Stage: 17 ft
Discharge: 7180 cfs

3-D ENGAGING
REMOTE INTERACTION
Dynamic Objects

Static Objects

Levee/Dam

River System

Virtual Reality

Game Physics
VIRTUAL REALITY
Augmented Projection

Marker

Table

Marker Detection

Augmented Reality
AUGMENTED REALITY
Distorted Projection of Scene

HEADS-UP DISPLAY

IMMERSIVE REALITY

Heads-up Display
IMMERSIVE REALITY
Controls and Interaction

**Gesture Tracking**

**Motion Tracking**

**Remote Interaction**

**MOTION TRACKING**

**GESTURE CONTROLS**
3D HYDROLOGIC SIMULATION SYSTEM

Tablet & Smartphone Controller

- Hold iPad/Poll to position where
- Til device left/right to rotate the scene
- Til device upwards/downwards to zoom in/out the scene
- Connecting to server...
- Status: Scene held slowly
- Accelerometer x: 10.00958384 G
- Accelerometer y: -2.77799173 G
- Accelerometer z: -2.64076786 G

REMOTE INTERACTION
Thank you

Questions

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