

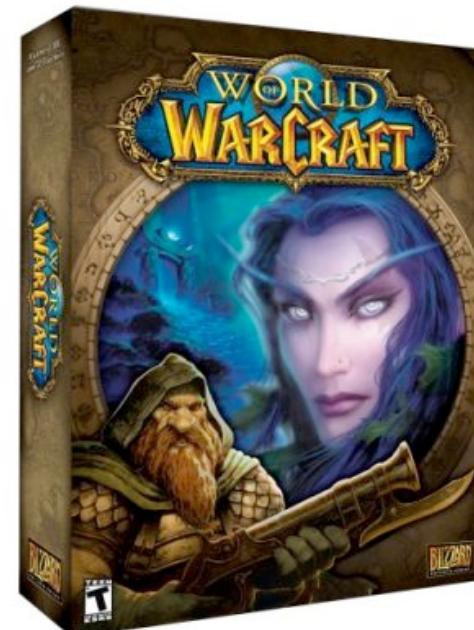
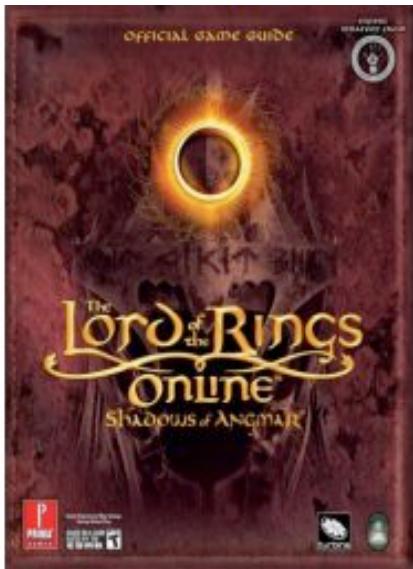
# *NASA's Exploration of Immersive Environments as Learning Tools.*

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University of Maryland Baltimore County

November 6, 2007

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# Immersive Synthetic Environments



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# ISE Statistics

- World of Warcraft: 9 million
- Second Life: 10 million
- Average MMO: 125K-500K
- Club Penguin: 700K

The latest industry estimates are that between 20 and 30 million Americans currently participate in immersive synthetic environments. For comparison 26 million Americans golf.

# Third Spaces

PISE are not just connection points, they are meeting places.

PISE are the new public squares, village centers, malt shops, malls and pubs all rolled into one.

PISE come with a sense of ‘thereness’ that engages the mind like a real place does.



# Learning Theory

- Pierce and James
- Dewey
- Johnson-Laird and Anderson

What makes learning work?

# It starts as real code...

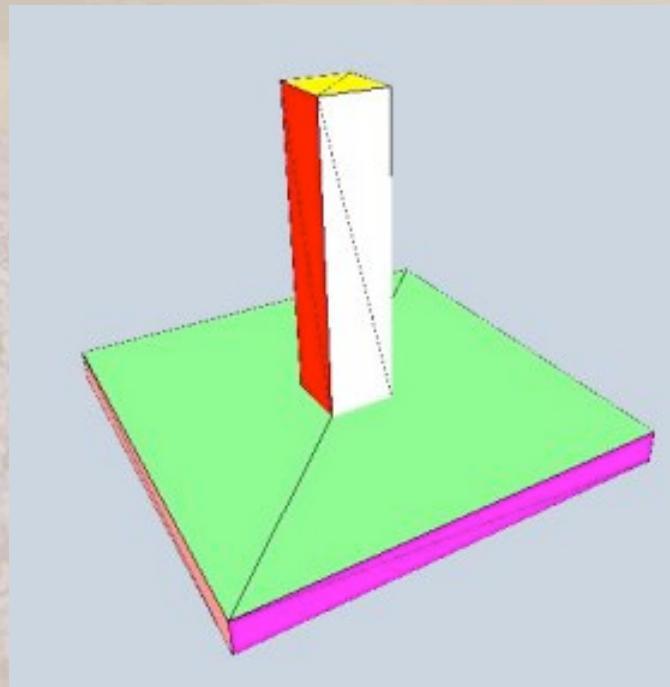
```
// Entity 0
// worldspawn
{
    "classname" "worldspawn"
    "detail_number" "0"
    "min_pixels" "250"
    "geometry_scale" "32.0"
    "light_geometry_scale" "32.0"
    "ambient_color" "0 0 0"
    "emergency_ambient_color" "0 0 0"
    "mapversion" "220"
    // Brush 0
    // sample_group:g[1] -> regular_polys:g[1] -> poly:p[1]
    {
        (-352 -288 0) (368 -288 0) (368 -272 0) concrete [ 1.0 0.0 0.0 -32.0 ] [ 0.0 -1.0 0.0 224.0 ] 0 1.0 -1.0
        (-352 -272 144) (368 -272 144) (368 -288 144) concrete [ 1.0 0.0 0.0 -32.0 ] [ 0.0 1.0 0.0 -224.0 ] 0 1.0 -1.0
        (-352 -288 144) (368 -288 144) (368 -288 0) concrete [ 1.0 0.0 0.0 -32.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
        (-352 -272 0) (368 -272 0) (368 -272 144) concrete [ -1.0 0.0 0.0 32.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
        (-352 -288 0) (-352 -272 0) (-352 -272 144) concrete [ 0.0 -1.0 0.0 -224.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
        (368 -288 144) (368 -272 144) (368 -272 0) concrete [ 0.0 1.0 0.0 224.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
    }
    // Brush 1
    // sample_group:g[1] -> regular_polys:g[1] -> poly:p[2]
    {
        (-352 272 0) (368 272 0) (368 288 0) concrete [ 1.0 0.0 0.0 -32.0 ] [ 0.0 -1.0 0.0 -336.0 ] 0 1.0 -1.0
        (-352 288 144) (368 288 144) (368 272 144) concrete [ 1.0 0.0 0.0 -32.0 ] [ 0.0 1.0 0.0 336.0 ] 0 1.0 -1.0
        (-352 272 144) (368 272 144) (368 272 0) concrete [ 1.0 0.0 0.0 -32.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
        (-352 288 0) (368 288 0) (368 288 144) concrete [ -1.0 0.0 0.0 32.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
        (-352 272 0) (-352 288 0) (-352 288 144) concrete [ 0.0 -1.0 0.0 336.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
        (368 272 144) (368 288 144) (368 288 0) concrete [ 0.0 1.0 0.0 -336.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
    }
}
// Entity 1
// sample_group:g[1] -> portals:g[2] -> portal:b[1]
{
    "classname" "portal"
    "ambient_light" "0"
    // Brush 0
    // sample_group:g[1] -> portals:g[2] -> portal:b[1] -> poly:p[1]
    {
        (-362 -66 -2) (-360 -66 -2) (-360 66 -2) NULL [ 1.0 0.0 0.0 298.0 ] [ 0.0 -1.0 0.0 -8.0 ] 0 1.0 -1.0
        (-362 66 130) (-360 66 130) (-360 -66 130) NULL [ 1.0 0.0 0.0 298.0 ] [ 0.0 1.0 0.0 8.0 ] 0 1.0 -1.0
        (-362 -66 130) (-360 -66 130) (-360 -66 -2) NULL [ 1.0 0.0 0.0 298.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
        (-362 66 -2) (-360 66 -2) (-360 66 130) NULL [ -1.0 0.0 0.0 -298.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
        (-362 -66 -2) (-362 66 -2) (-362 66 130) NULL [ 0.0 -1.0 0.0 8.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
        (-360 -66 130) (-360 66 130) (-360 66 -2) NULL [ 0.0 1.0 0.0 -8.0 ] [ 0.0 0.0 1.0 64.0 ] 0 1.0 -1.0
    }
}
```

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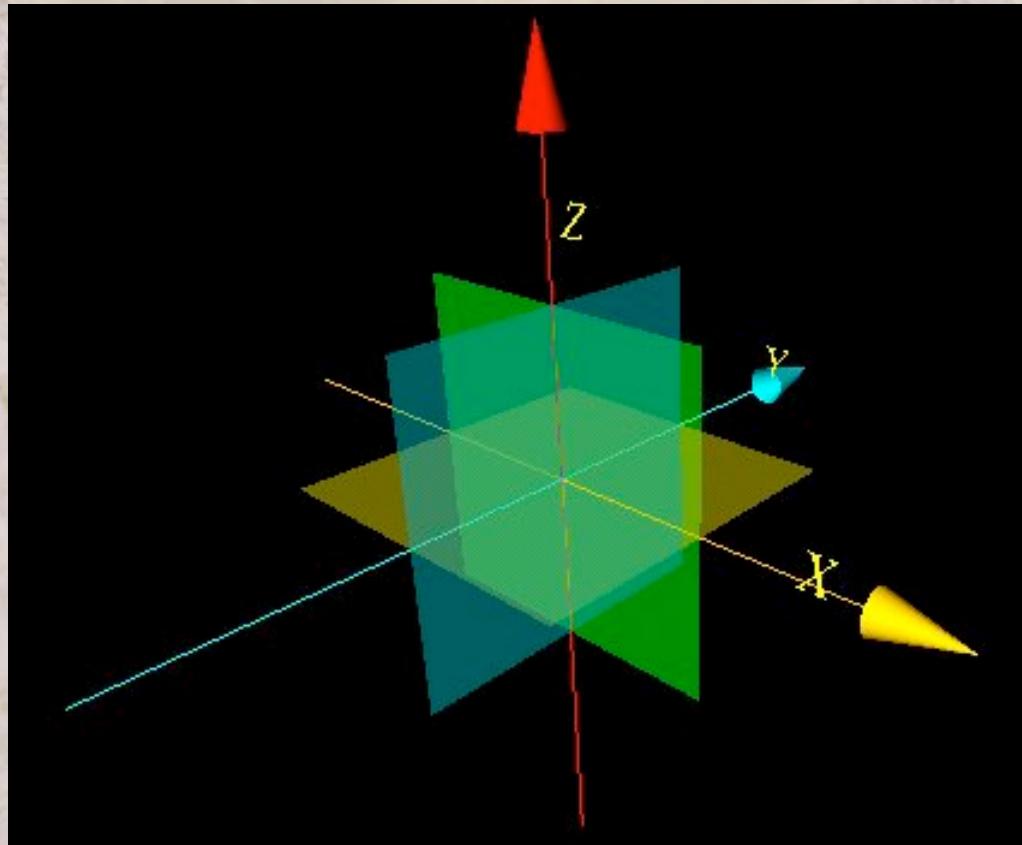
lots of code!

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# The code defines “objects”



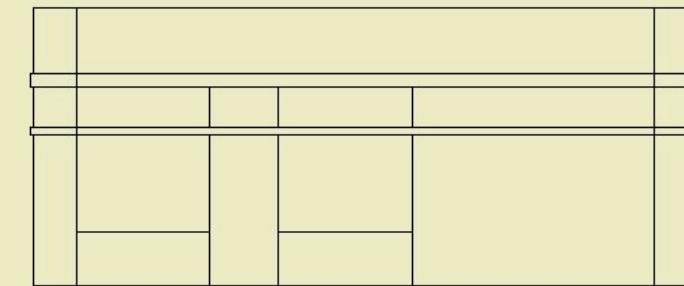
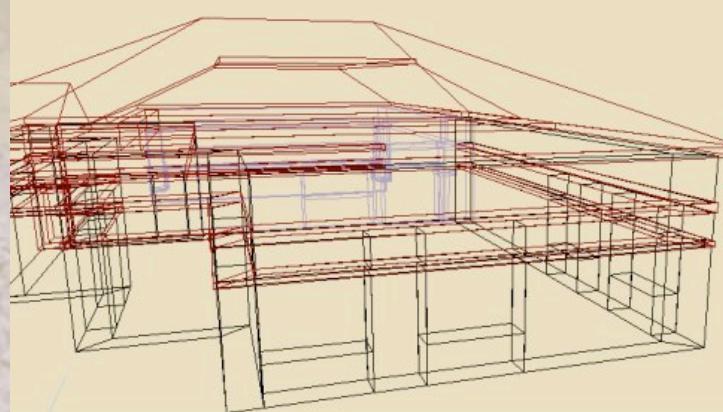
The objects exists in computer space, known as the “grid”.



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# The objects and space combine



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# A “place” is created



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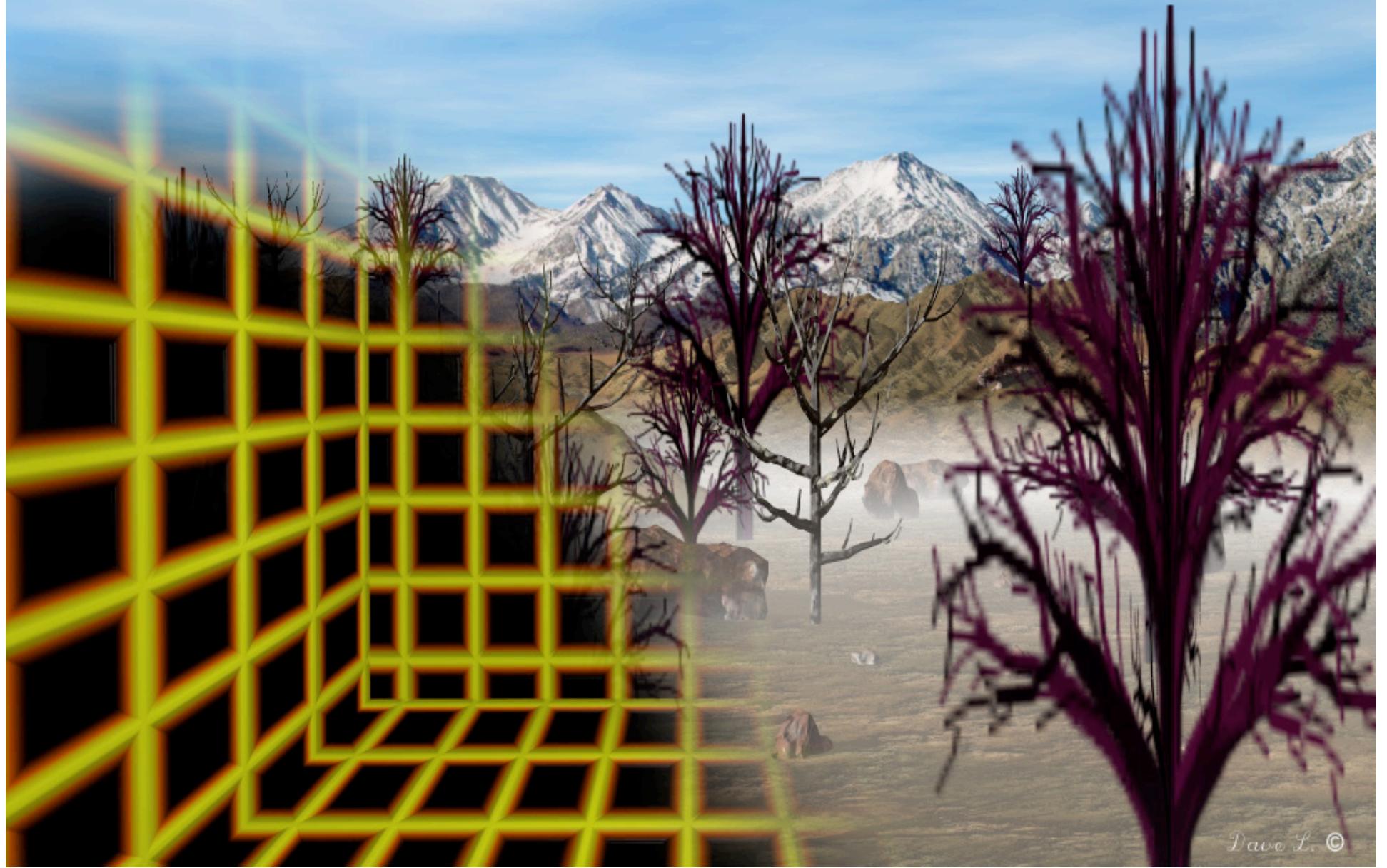
# A “world” is created



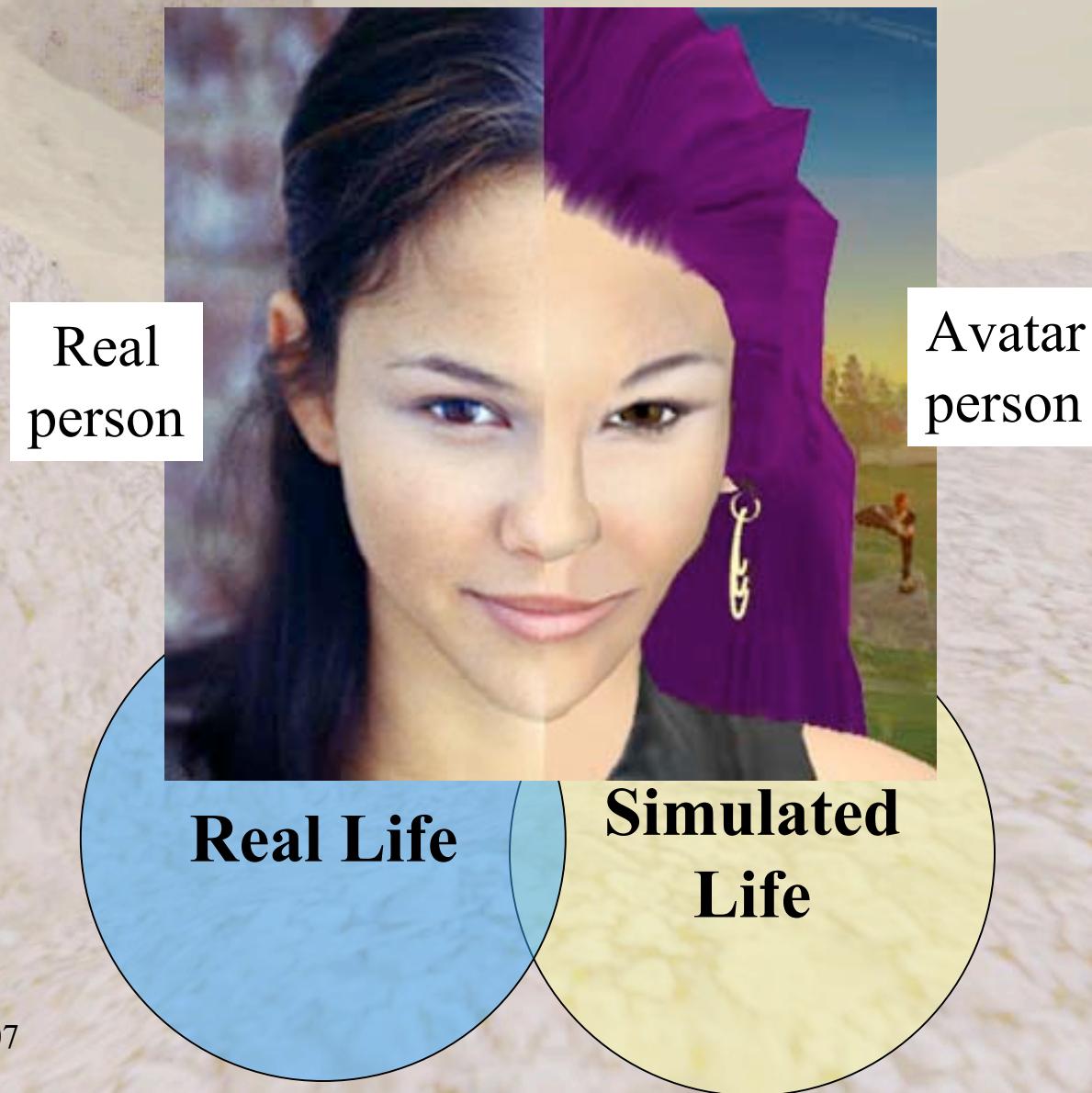
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After awhile, the grid and code becomes obscure,  
and the “world” maintains focus



# Real/Simulated Overlap



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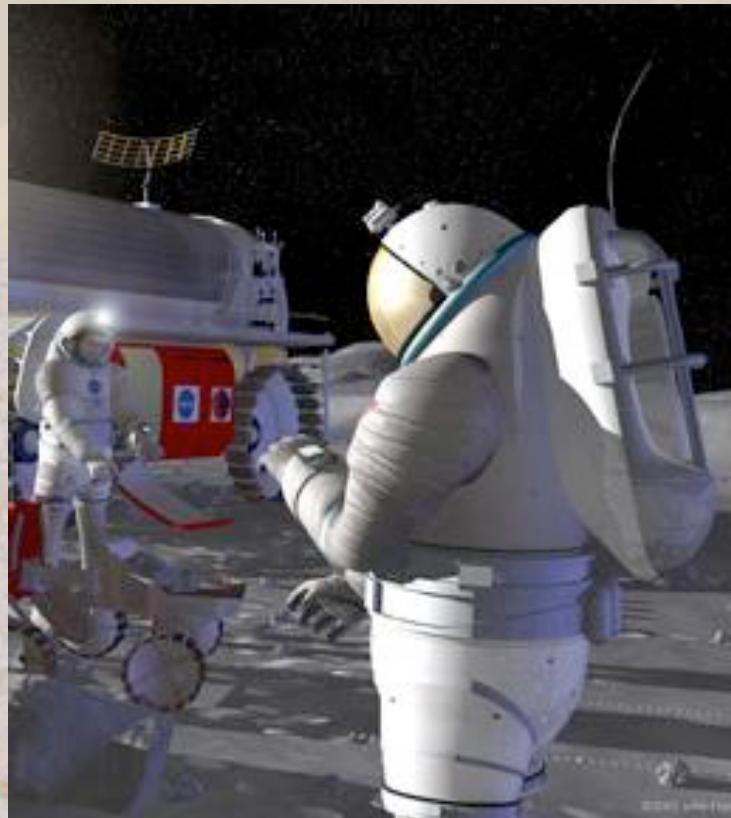
# Learning Practice

- Exposure to new ideas
- Exposure to new experiences
- Exposure to more intricate models

What makes learning work?

# A 21<sup>st</sup> Century Way of Sharing

When NASA returns to the moon in 2020, the people of Earth will be able to share that experience. Not just through the passive medium of television like the last time we went to the moon, but through the virtual experience of a persistent immersive synthetic environment. Kids are starting to use PISE at a very early age already. Nickelodeon and Disney each run their own online worlds. The children who play in those worlds are going to expect more from both their work and play as adult than 2D interactivity. They will expect 3D the same way people today expect cable television and those in the 1970s expected color television.





# Why games?

- Easy repetition
- Fast feedback
- Easy repetition
- Cognitive offloading
- Improved ‘telepathy’
- Built in motivation
- Easy repetition

# Choice of Approach

- Stealth learning (fooling the student)
- Informed learning (fooling the brain)
- Accidental learning (no fooling)

# NASA eEducation Roadmap

## **NASA eEducation Roadmap: Research Challenges in the Design of Persistent Immersive Synthetic Environments for Education & Training**

Prepared for NASA eEducation

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The roadmap establishes a coordinated agenda for the funded research and development work of eEducation. It relies heavily on the application of game technology. eEducation encourages other parties with an interest in educational technology research and development and games as learning media to participate and contribute to this agenda.

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# Roadmap Components

The following technology components are integral to implementing the concepts set forth in the Roadmap. These components will build a firm foundation for an immersive, synthetic 3D Web application for NASA science education:

- the central component is a Massively Multi-player Online Game (MMOG)
- the MMOG acts as a front-end to a larger synthetic environment
- the MMOG contains a developers toolkit to support expansion
- the MMOG uses a powerful physics engine to support accurate science and engineering concepts and challenges
- the components support both formal and informal education

# Approach

The eEducation Roadmap approach blends the development of next generation learning system technologies with focused research on learning.

This approach intelligently applies lessons, techniques, and technologies of computer games and learning pedagogy in real-world science and engineering learning applications.

The focused research and development areas include:

Instructional Design

Stimulating Questions and Answering Questions

Feedback and Assessment

Building Simulations and Synthetic Environments

Integration Tools for Building and Maintaining Learning Environments

# The Concept and Planning Documents

“Harnessing the Power of Video Games for Learning”  
Federation of American Scientists, 2006  
<http://www.fas.org/gamesummit/>

“A Guide to Educational Uses of Games for NASA”  
Learning Technologies Project Office, 2005  
<http://learners.gsfc.nasa.gov/NLT/road.html>

“Learning Federation Science and Technology Roadmaps”  
Federation of American Scientists, 2003

<http://www.fas.org/main/content.jsp?formAction=297&contentId=309>

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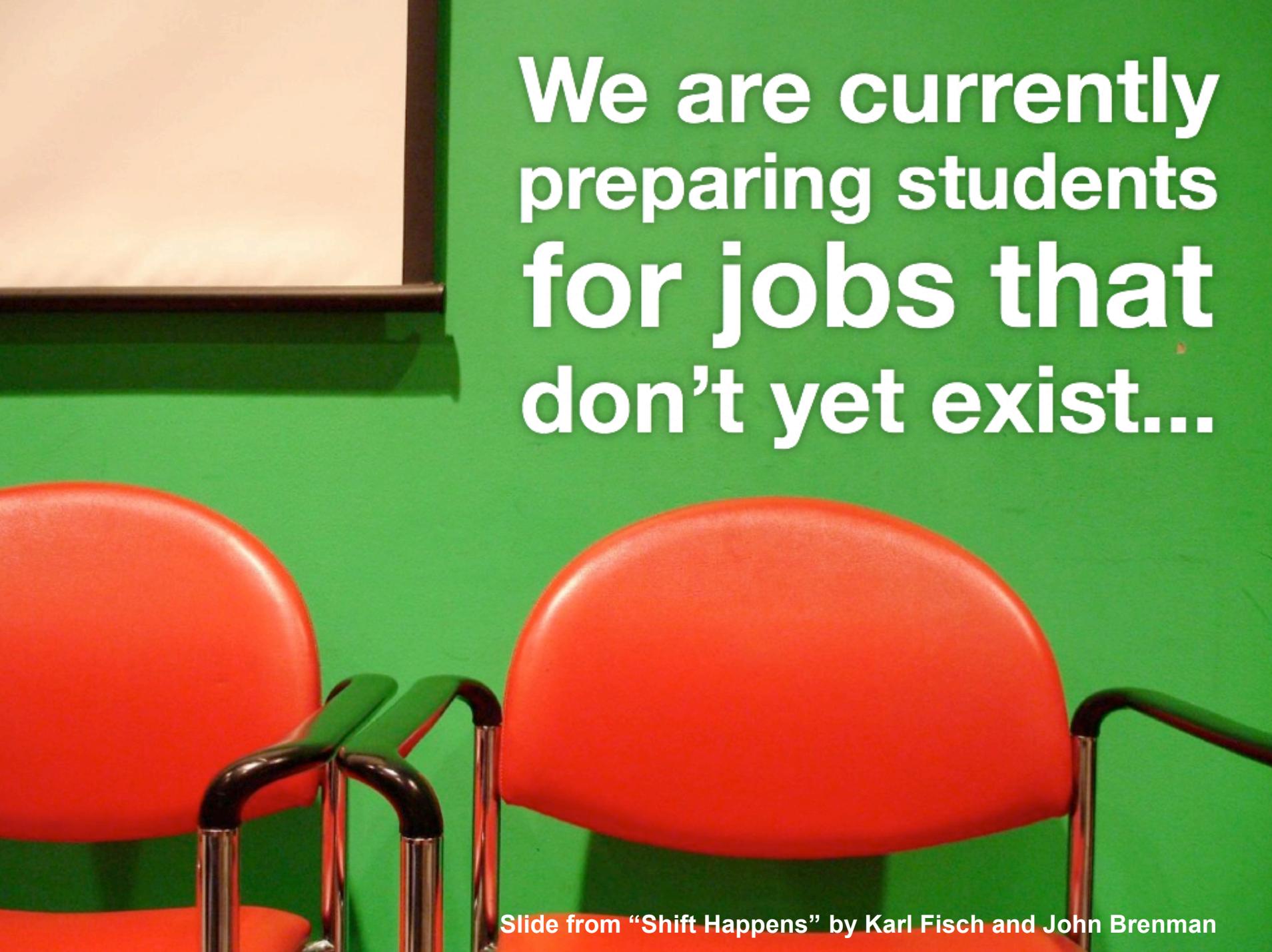
# The Contributing Experts and Reviewers

The following individuals contributed their considerable expertise to the development of the eEducation Roadmap:

**Constance Steinkueler**, U of Wisconsin-Madison; **Eva Baker**, Stanford University; **Chris Dede**, Harvard University; **Jon Farinelli**, Electronic Arts (Mythic); **Jeremy Kemp**, Teaching in Second Life; **John Branson**, University of Washington; **Dava Newman**, MIT; **Clark Aldrich**, SimuLearn; **Cory Ondrejka**, Second Life

The following entities contributed reviewers to assess the eEducation Roadmap:

IBM, NOAA, Microsoft, Library of Congress, Kauffman Foundation, MacArthur Foundation, Department of Commerce, Department of Homeland Security, Bill and Melinda Gates Foundation, Consortium for School Networking, George Lucas Educational Foundation, XPrize Foundation

A photograph showing the backs of several red chairs with black metal frames, arranged in a row. They are positioned in front of a solid green wall. In the top left corner, there is a small white rectangular area, possibly a screen or a piece of paper, which is mostly blank.

**We are currently  
preparing students  
for jobs that  
don't yet exist...**

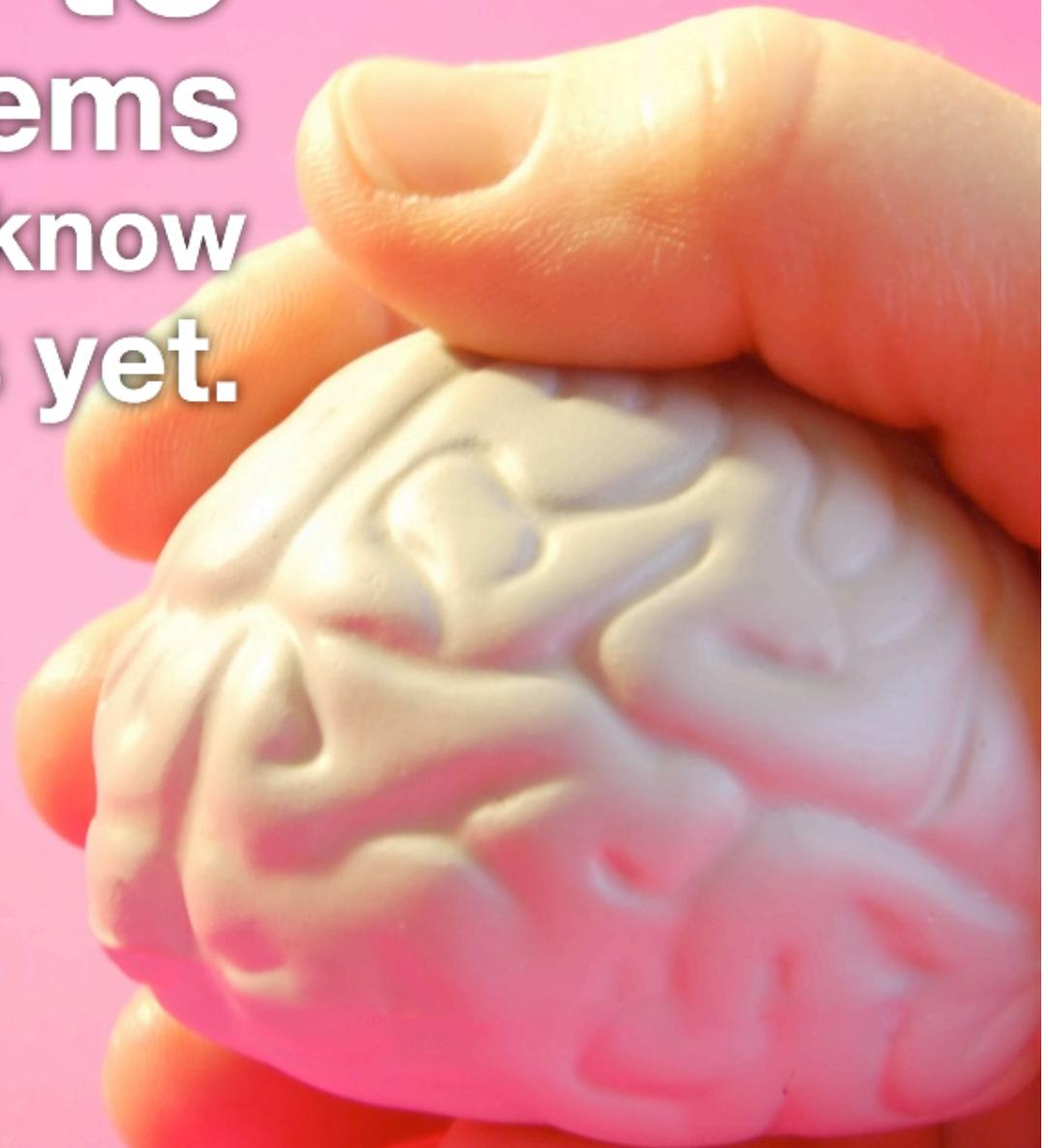
Slide from “Shift Happens” by Karl Fisch and John Brenman

using technologies  
that haven't  
been invented...



Slide from “Shift Happens” by Karl Fisch and John Brenman

in order to  
solve problems  
we don't even know  
are problems yet.

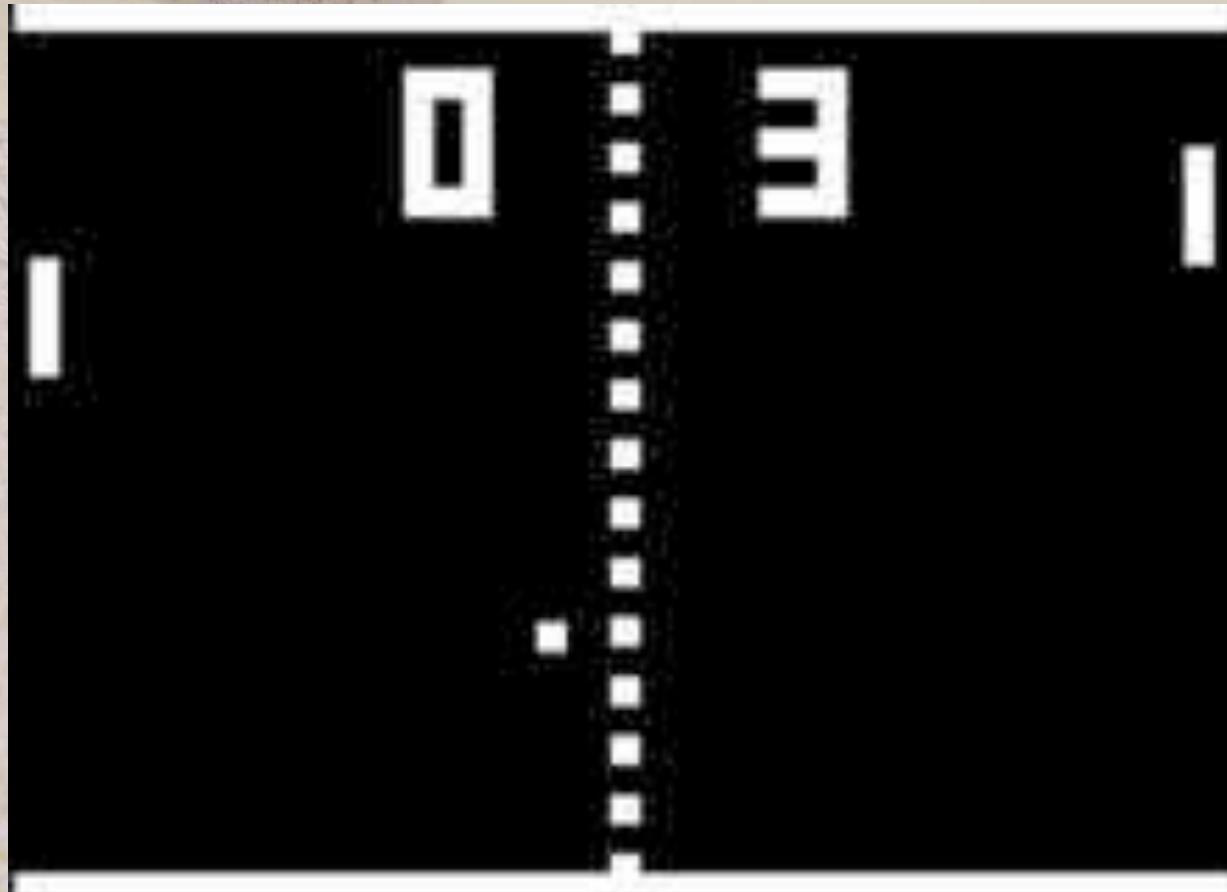


Slide from “Shift Happens” by Karl Fisch and John Brenman

# NASA-based Game Call

- FY2008 Learning Technologies Call.
- Massively Multiplayer Online (MMO) learning game through a Space Act Agreement.
- Developers toolkit for an expanding the MMO.
- A Collaborative Agreement to augment pedagogical design and learning assessment.
- An intramural call for subject matter experts.

Pong, 1972



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# World of Warcraft, 2006



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# NASA Immersive Synthetic Environment Research (NISER) Team

- Research and explore use of virtual worlds technology
- Members at ARC, GSFC, JPL, JSC, KSC, LARC and HQ
- Monthly meetings, inter-center support network



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NASA explores for answers that power ~~our~~ <sup>HIS</sup> future.