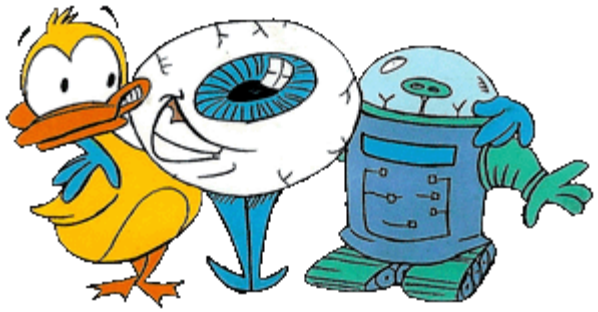
# The aMazing History of Maze
## - It's a Small World After-all



As told by Greg Thompson
gregt@alum.mit.edu
One of a number of "MazeWars" game authors

# It all started about 4000 feet from here

At NASA/Ames Research Center Computation Division
Moffett Field California sponsored by Jim Hart

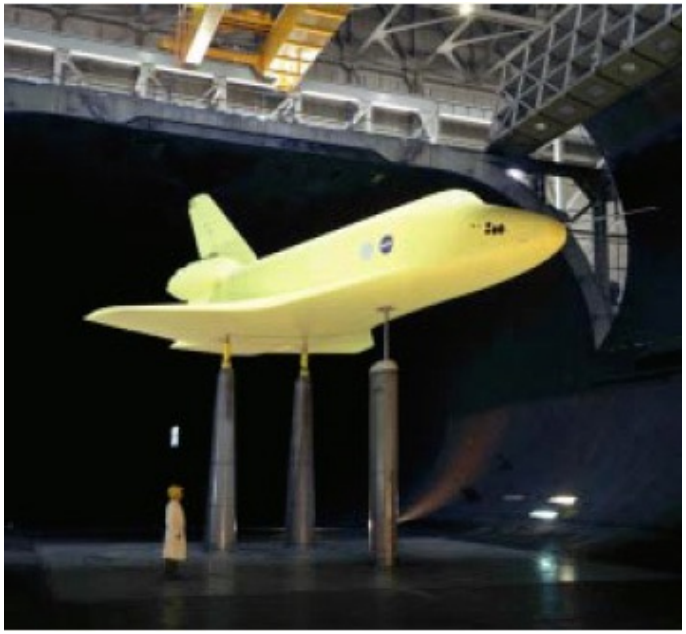
# Under a School Work/Study Program

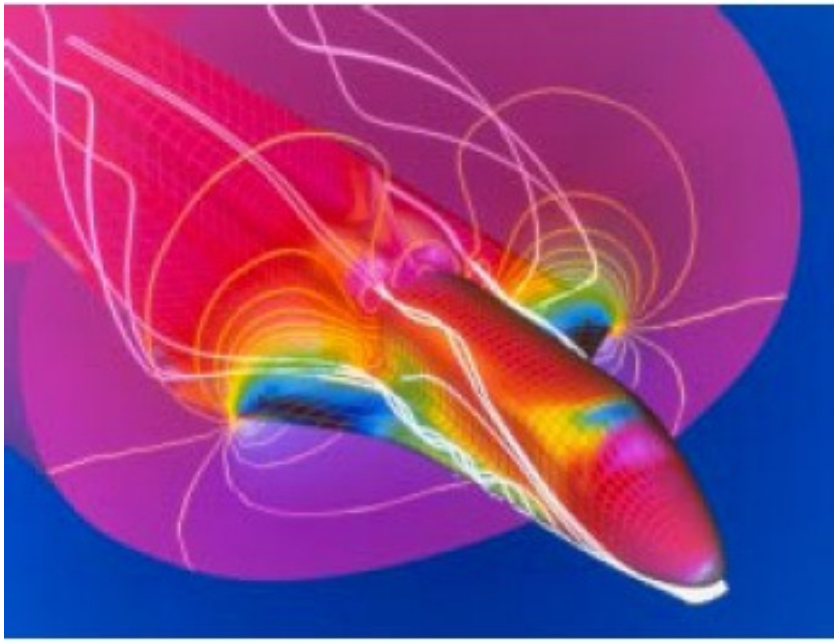

- Steve Colley & Howard Palmer
  - Lynbrook High School?
- Greg Thompson
  - Homestead High School '73
    John McCollum, electronics teacher
    - Steve Jobs '72 and Steve Wozniak '68 came from the same lab, founding Apple in 1976
  - For school credit, later via PMI»Informatics, Digital
- plus Jim Clark and others
  - For example: Jim was a post-graduate at the time

- Went on to co-found SGI in 1981 and Netscape in 1994
- SGI built the building the Computer History Museum is now in
- SGI used in 1st cable VOD trial 1994 in Orlando by Time Warner
- SGI now the major Super Computer supplier to NASA/Ames

# Supporting CFD and Wind Tunnels

- Charter of Jim Hart's group was to provide support to the aerodynamics research at NASA/Ames including:
  - Wind Tunnel Data Acquisition and Analysis
  - Computational Fluid Dynamics (CFD) research
- Our focus was in graphics-based visualization of results





# using Super Computers, Minicomputers,

- IBM 1800 & duplex IBM 360/67 under TSS in 1969
- Illiac IV in 1972 (not reliable/operational until Nov 1975)
- CDC 6600, then a CDC 7600 in 1975, Cray 1S in 1981
- Digital Equipment Corp PDP-11s and VAX/VMS systems

Cray 1S at NASA/Ames

DEC PDP-11s & VAX/VMS supporting 40x80

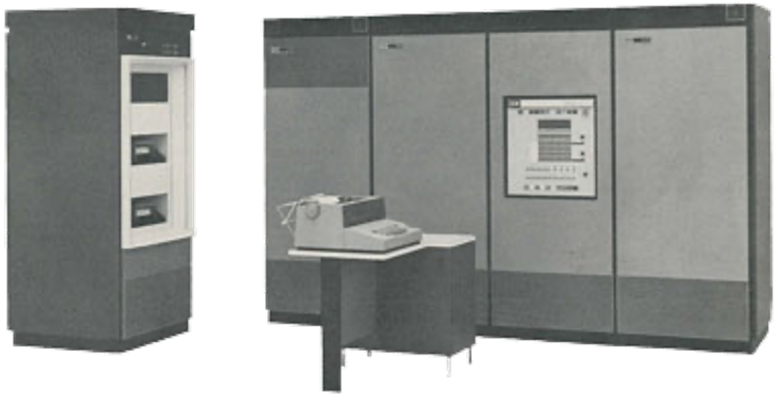
64 processor Illiac IV system

**Unicon Terabit "write-only" laser memory**

**40 packs of 10 Mylar strips**
**< 10 sec to access a strip**
**+ 400 ms to access a track**

# and Graphics Subsystems

- IBM 2250 attached to an IBM 1800
- Dicomed D47 Color Film Recorder
- Evans and Sutherland LDS-2
- Tektronix 4010/4014 terminals
- Imlac PDS-1, PDS-1D, PDS-4s



IBM 1800 (1130 with 360 channels)

Tek 4010 storage display

E&S Line Drawing System

IBM 2250 vector display

# including Imlac PDS-1, PDS-1D, PDS-4

- 16-bit PDP-8 like minicomputer plus a fully programmable vector-based display processor
- Developed infrastructure, WYSIWYG text editing, software emulating other terminals (IBM 2250, Tek) plus games while researching the platform's capabilities

Imlac PDS-1 at NASA/Ames


Imlac PDS-4 at NASA/Ames

# Imlacs were "State-of-the-Art"

- Imlac Corp founded 1968
  - Same year as E&S
- Four models released:
  - PDS-1 in 1970
    $8,300 + options, 4K words
    2us cycle time, 15" screen
  - PDS-1D in 1972
    $9,970, 10% faster (1.8us)
    8K words, better interrupts
  - PDS-1G in 1973
    $8,500, re-designed PDS-1D
  - PDS-4 in 1974
    $17,300, 1us cycle time
    17" screen, 16 inten, 4 pgs
- 600 PDS sold by 1977

# Imlac Hardware Internals

Tom Uban's
PDS-1D

15" Monitor Right

PDS-1D CPU Front

CPU Left

PDS-1D CPU Back

CPU Right

# NASA/Ames Imlac Maze summer 1973

- Started with Steve Colley experimenting with display of 3D images on the Imlac
  - Rotating wire-frame hidden-line-removed 3D cube
  - I worked on an interactive Imlac debugger/interpreter
- Then idea of a 16x16 array of bits defining a maze
  - Absence of bits defines corridors
  - Steve worked out how to display perspective view
- Howard Palmer and Steve developed single player Maze
  - Adding ability to move through the maze
  - Simple game: Try to find exit out of the Maze
- Howard and Greg developed initial multi-player version
  - Two Imlacs connected with serial links
  - Soon the idea of shooting each other was added

# Imlac Maze moves to MIT in 1974

- We headed off to college
  - Steve went to Cal Tech
  - Howard went to Stanford
  - Greg went to MIT in Fall 1973
- I soon got involved at MIT Project MAC
  - Dynamic Modeling System (MIT-DMS)

    4th floor 545 Technology Square
  - Server: a PDP-10 (DEC-1040-KA) running ITS

    With lots of Imlac PDS-1s as terminals at 50Kbps
- Spring Semester (Feb 1974) I brought to MIT-DMS:
  - Imlac programs from NASA/Ames including Maze
  - NASA/Ames DEBUG program became GRADE at MIT
  - Dave Lebling and I decided to bring up Maze as well

PDS-1 at MIT-DMS

# The MIT-DMS Imlac Maze System

- I significantly enhanced the Imlac Maze code
  - Adding full multi-player, local top-down view, cheats
- Dave Lebling wrote the PDP-10/ITS Maze Server which:
  - Downloads Maze game and optional personalized Maze
  - Links up to 8 players or generated robots in a game
  - Included text messaging and top-down game view on E&S
- Players drawn using ITS userid:

| GAT | GAT | GAT | GAT |
|---|---|---|---|
| Looking away | Looking left | Looking right | Looking at you |

J.C.R. Licklider & Al Vezza

J.C.R. Licklider was lab director and Al Vezza was his deputy

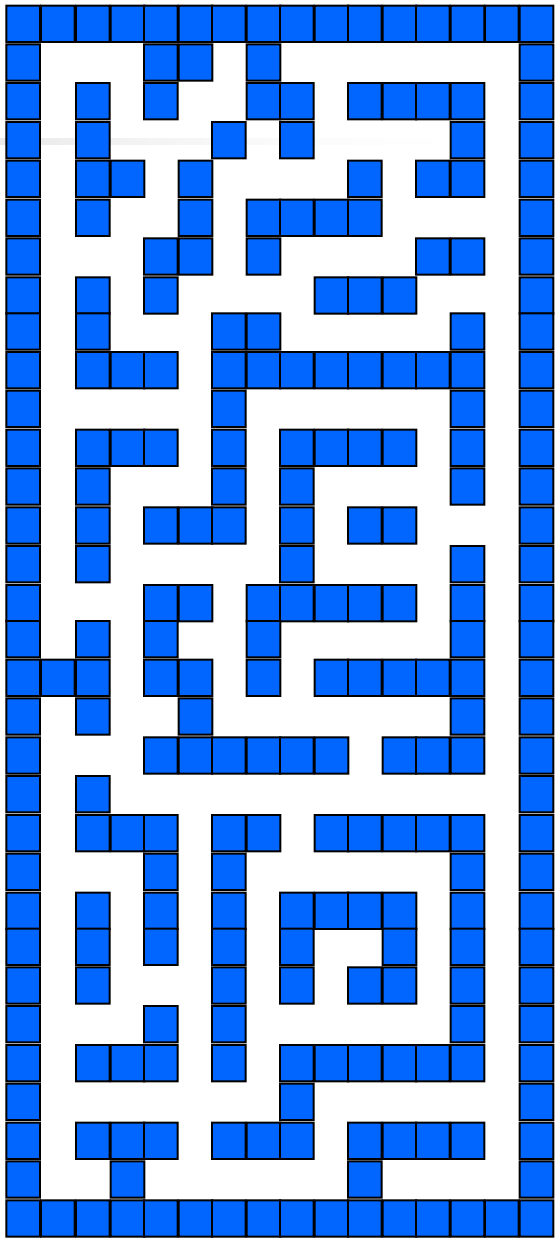
Al tried to limit Maze's use since lab was DARPA funded

But both were observed playing at times as well

# Original Maze (16 x 32)

- Function keyboard keys were:
  - UP ARROW - Move forward 1 square
  - DOWN ARROW - Back up one square
  - LEFT ARROW - Turn 90 degrees left
  - RIGHT ARROW - Turn 90 degrees right
  - FUNCTION 4 - Turn 180 degrees around
  - PAGE XMIT - Peek around corner to the left
  - XMIT - Peek around the corner to the right
  - ESC - Fire in direction of view
  - CTRL-Z - Exit Maze game
  - FORM - Erase message text display buffer
  - TAB - Look at maze from top
  - All other keys - sent to other players as text
- Mice buttons and Keyset keys can also be used
- Cheats to display other player's perspective and to change local definition of maze

Top-down view



# Original MIT Maze Protocol

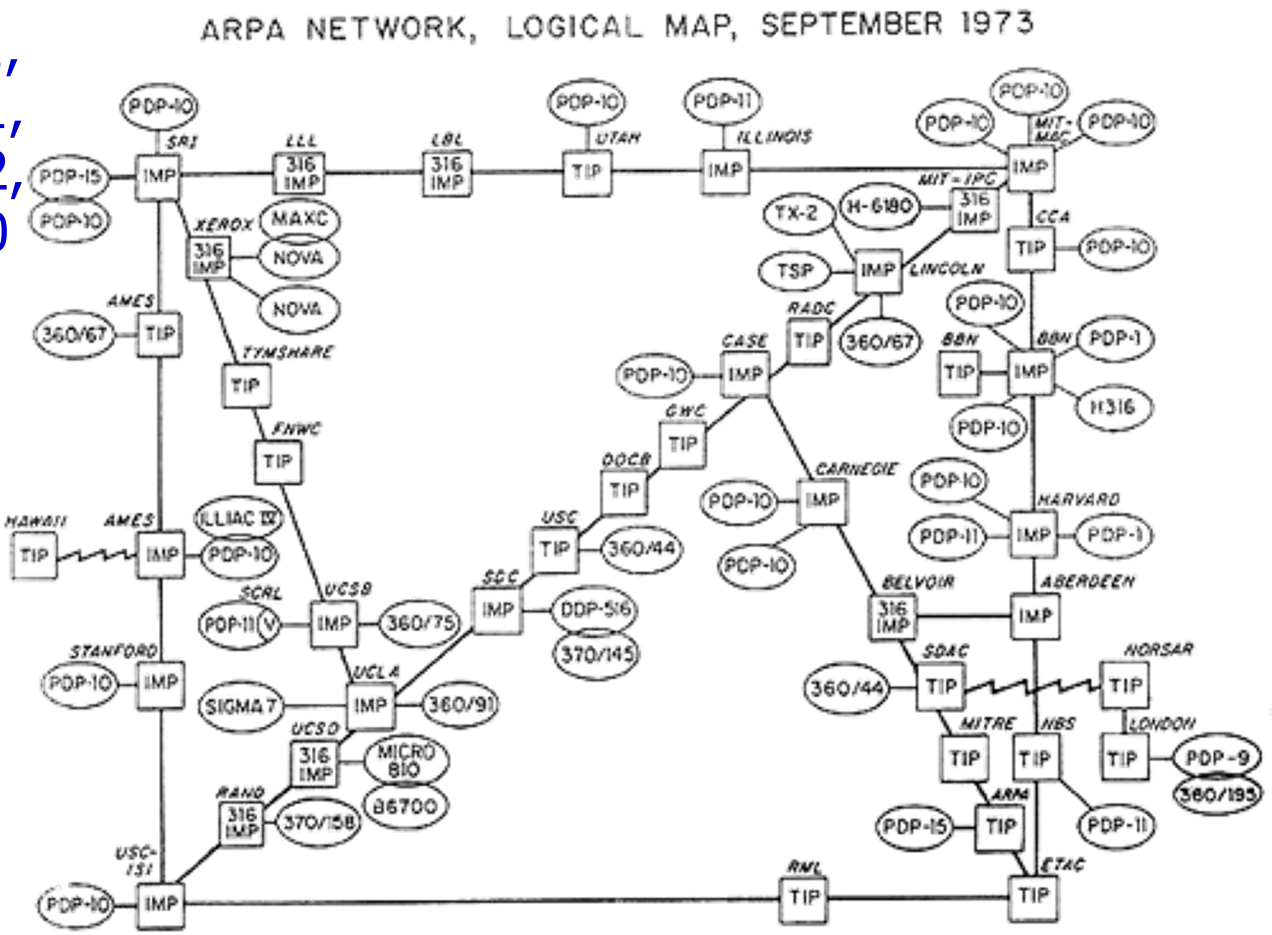
- $001_8$ – Player leaves game
  - <ID of player>
- $002_8$ – Player moved
  - <ID of player>
  - <New direction | 100>
  - <New X location | 100>
  - <New Y location | 100>
- $003_8$ – Player died
  - <ID of shooter>
  - <ID declared dead>
- $004_8$ – Announce new player
  - <ID of new player 1 to 8>
  - <6 chars of ID name>
  - <2 chars number of hits 2x6 bits>
  - <2 chars # of deaths 2x6 bits>
- $014_8$ – Clear text display buffer
- other – Text to display

Another MIT Imlac PDS-1 next to E&S LDS displays

Not all MIT Imlacs were playing Maze

# Imlacs were Popular on the Arpanet

- Imlacs were mentioned in many early RFCs (1971 to 1984):
  86, 101, 126, 164,
  174, 177, 190, 191,
  249, 282, 314, 321,
  372, 373, 398, 472,
  549, 553, 559, 900
- In use at:
  BBN, Case,
  MIT, Mitre,
  NASA/Ames,
  SRI-ARC/NIC,
  Stanford AI,
  UCLA, UCSB,
  Univ. of Illinois,
  and elsewhere



# So Maze Soon Spread to the Arpanet

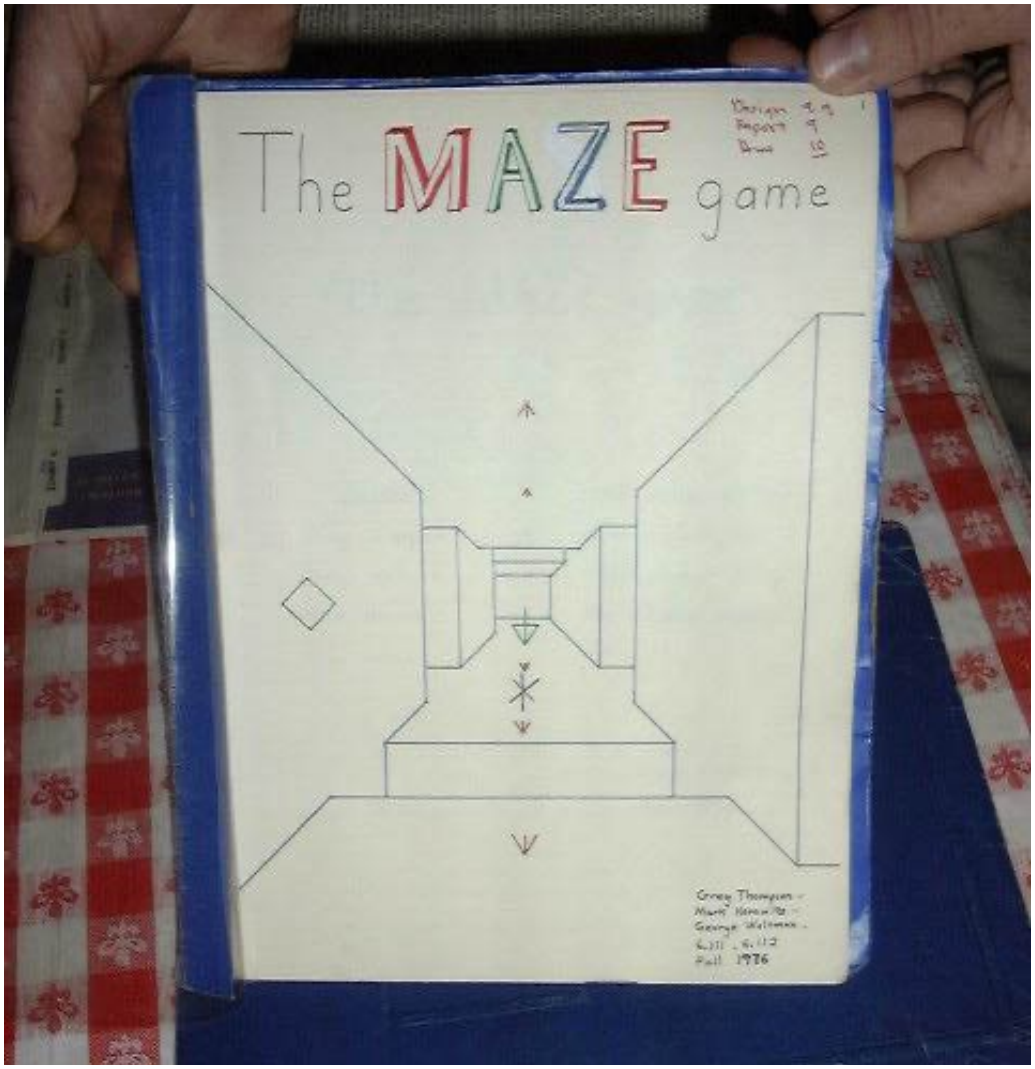
- Before long Maze games spanned across the Arpanet with players at USC and Stanford who also had Imlacs
  - "Legend has it that at one point during that period, MazeWar was banned by DARPA from the Arpanet because half of all the packets in a given month were MazeWar packets flying between Stanford and MIT."
- One problem was original Maze protocol didn't take into account high latency and overhead over the Arpanet
  - Shooting Imlac decided when target player was dead
  - Ken Harrenstien and Charles Frankston fixed the problem using new one byte messages for indicating relative motion

Lower 3 bits of char is ID of originator, upper 4 bits is action:

| | |
|---|---|
| 02x – ID turned right | 15x – ID moved forward 1 step |
| 03x – ID turned left | 16x – ID moved backward 1 step |
| 14x – ID turned around | 17x – (reserved) |

# MIT Hardware Maze Game in 1977

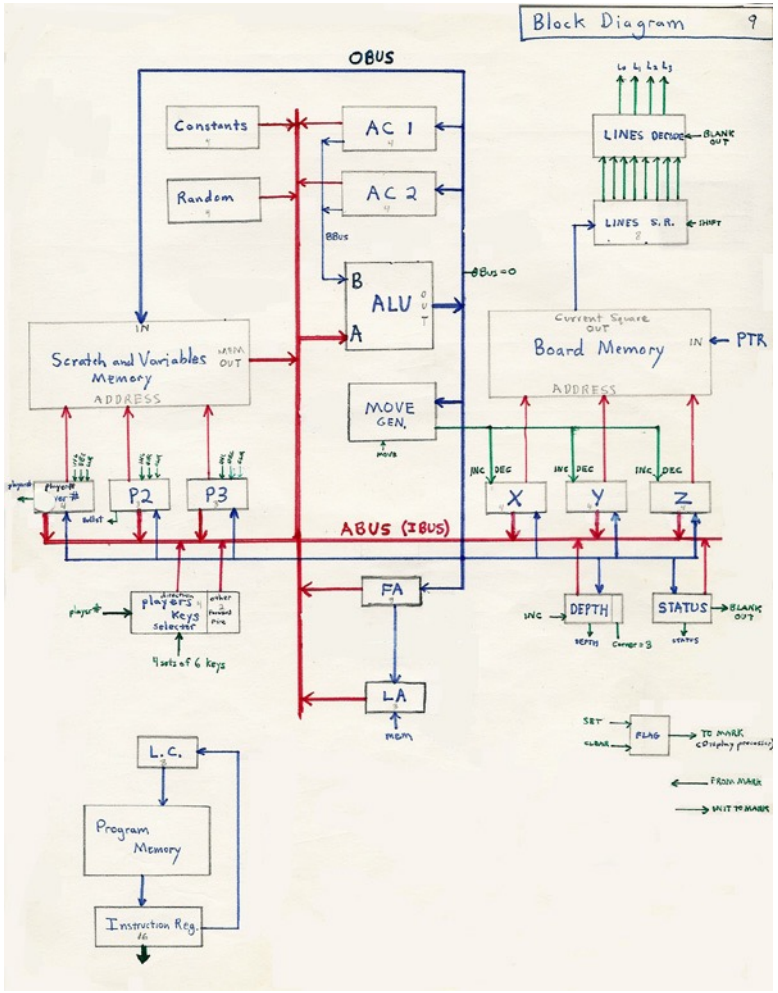
- Fall 1977, three of us from our dorm took EE digital design labs
  - Course 6.111 or 6.112 (advanced)
- We jointly proposed a hardware version of Maze complete with
  - Multiple robots
  - 3D using 4 floors
- We were told it was too ambitious
  - But we didn't let that stop us



# To go where none have gone before

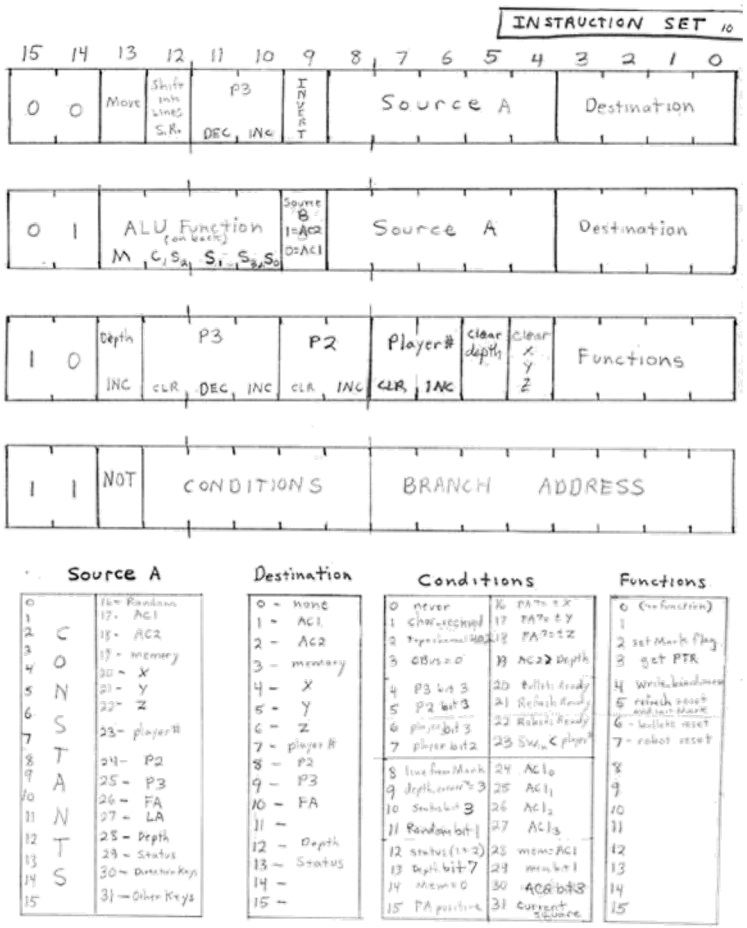
- I designed a custom Maze processor for the game
  - Using 7400 series logic
- George Woltman wrote the software for it
  - In 256 16-bit words using 1702 PROMs
  - 128 bytes RAM to store a 16 x 16 x 4 Maze
  - 128 bytes RAM for state
- Mark Horowitz designed the display processor
  - Human displays used 4 Tektronix Oscilloscopes

Maze Processor Architecture



# A System Designed to Just Run Maze

## Maze Processor Instruction Set




## Start of Maze Software

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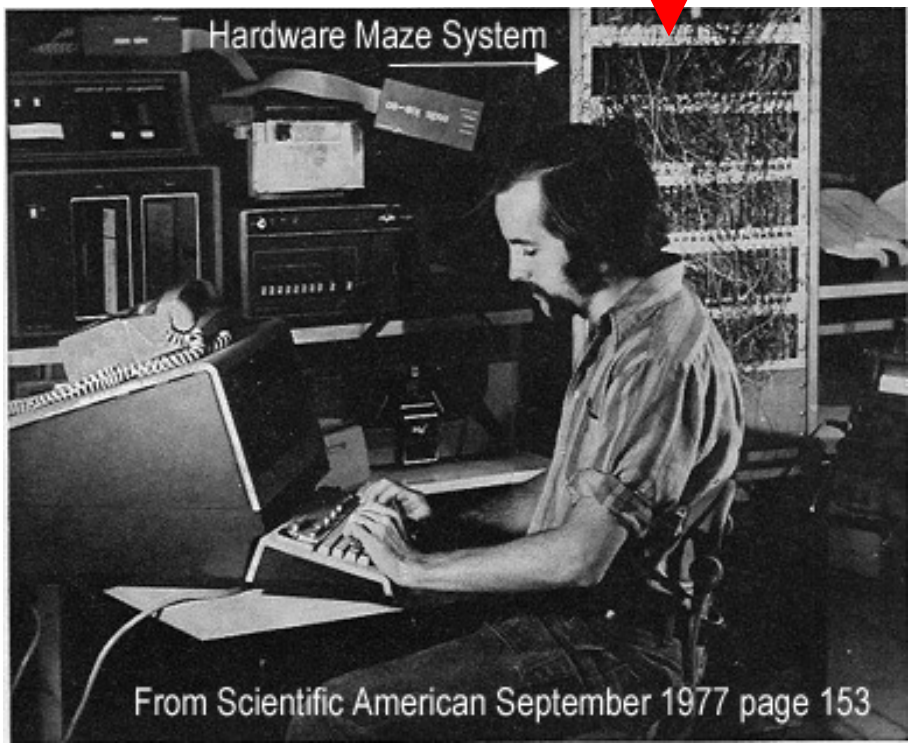
Software Listing
Initialization

| Address | Statement | Microcode | |
|---|---|---|---|
| 00 | clear x,y,z, player #, P2, P3, depth | 92 | B0 |
| 01 | next_char: get_ptr | 80 | 03 |
| 02 | again: if ¬ ptr_ready goto again | E1 | 02 |
| 03 | if tape channel 4 = 0 goto next_char | E2 | 01 |
| 04 | write board memory | 80 | 04 |
| 05 | AC2 ← X | 01 | 42 |
| 06 | X ← AC2 plus 4 | 46 | 44 |
| 07 | if ¬(OBUS = 0) goto next_char | E3 | 01 |
| 08 | AC2 ← Y | 01 | 52 |
| 09 | Y ← AC2 plus 1 | 5D | 25 |
| 0A | if ¬(OBUS = 0) goto next_char | E3 | 01 |
| 0B | AC2 ← Z | 01 | 62 |
| 0C | Z ← AC2 plus 1 | 5D | 26 |
| 0D | if ¬(OBUS = 0) goto next_char | E3 | 01 |
| 0E | new_positions: mem ← 2 | 00 | 23 |
| 0F | inc P2 | 81 | 00 |
| 10 | if ¬(P2 = 0) goto new_positions | E5 | 0E |
| 11 | inc Player #, clear P2 | 82 | 40 |
| 12 | if ¬(Player # = 8) goto new_positions | E6 | 0E |
| | View generation | | |
| 13 | main_loop: if screen refresh=0 goto bullets | F5 | BF |
| 14 | reset screen, init, clear depth, P2, P3, Player # | 92 | A5 |
| 15 | AC2 ← 8 | 00 | 82 |
| 16 | wait_here: if display wait goto wait_here | C8 | 16 |
| 17 | status ← mem, inc P3 | 05 | 3D |
| 18 | X ← mem, inc P3 | 05 | 34 |
| 19 | Y ← mem, inc P3 | 05 | 35 |
| 1A | Z ← mem, inc P3 | 05 | 36 |
| 1B | FA ← mem, inc P3, shift | 15 | 3A |
| 1C | - ← mem, move | 21 | 30 |
| 1D | LA → mem, move, shift | 31 | B3 |
| 1E | LA → -, move, shift | 31 | B0 |
| 1F | FA → -, move, shift | 31 | A0 |
| 20 | LA → -, move, shift | 33 | B0 |

# Its Alive!

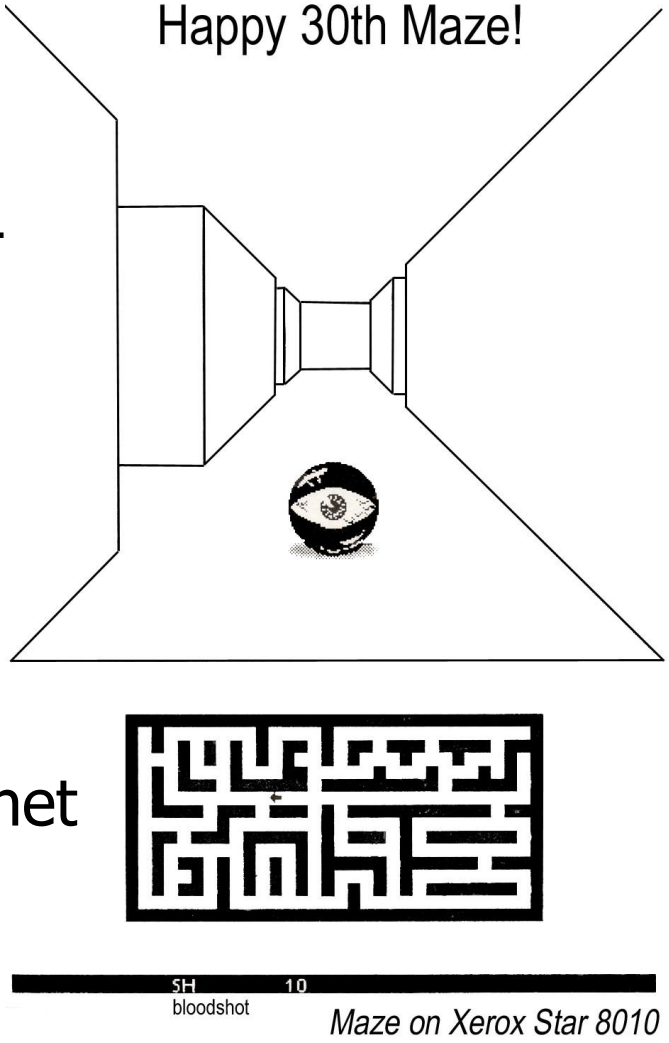
- Project completed weeks early
- Programmer's panel with
  - Address stop, Lights, & Single Step for debugging
- Project required:
  - 4 rails (83 cards) for main processor
  - 2 rails (45 cards) for display processor
- Maze loaded from paper tape reader
- Clock rate controlled how tough robots were

Game left assembled for long time after class ended

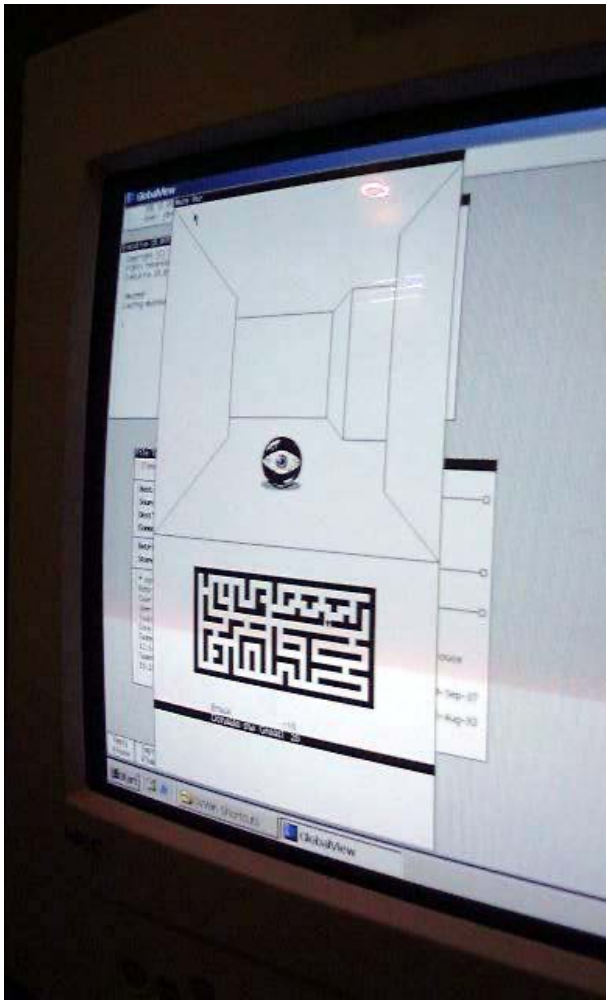


# Xerox Star & Alto MazeWars in 1977

- Developed by Jim Guyton
- Based on MIT Imlac version
- Re-written to support the raster-based displays
- Ran over the 3 Mbps Ethernet

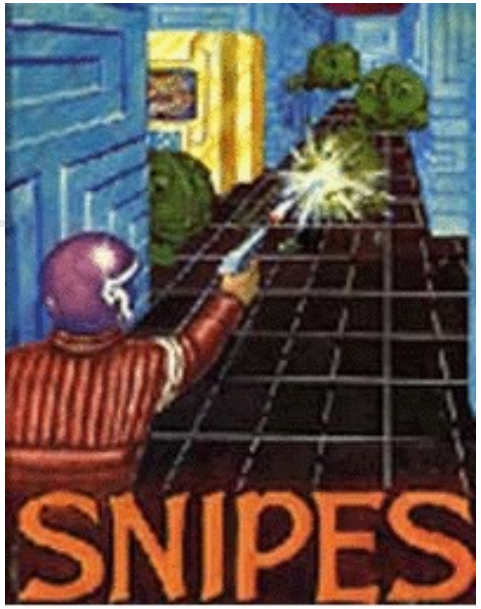



*Maze on Xerox Star 8010*



# Snipes for DOS in 1982

- Developed by Drew Major and Kyle Powell in Provo Utah
- Created to test the new IBM PC and LAN networking and as a demo for SuperSet Software that led to Novell
- Snipes game bundled with Novell Network as NLSNIPES starting in 1990
- Text-based but widely distributed and played

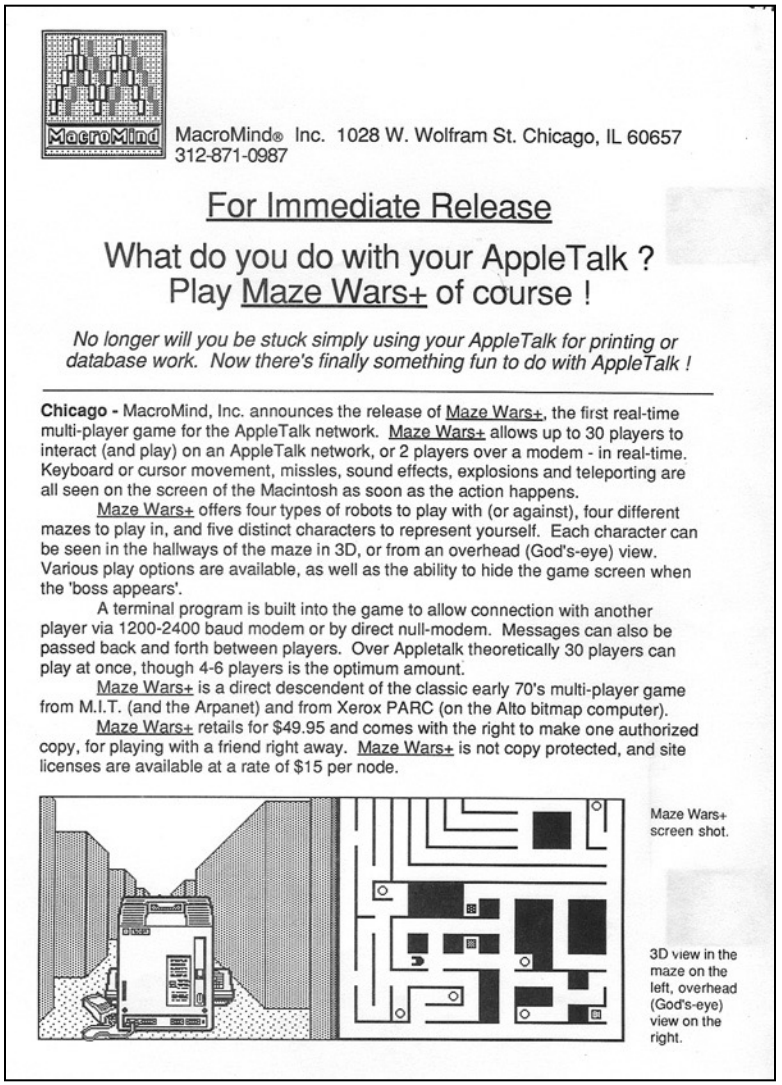



Cover from Game Manual


Sample game screen

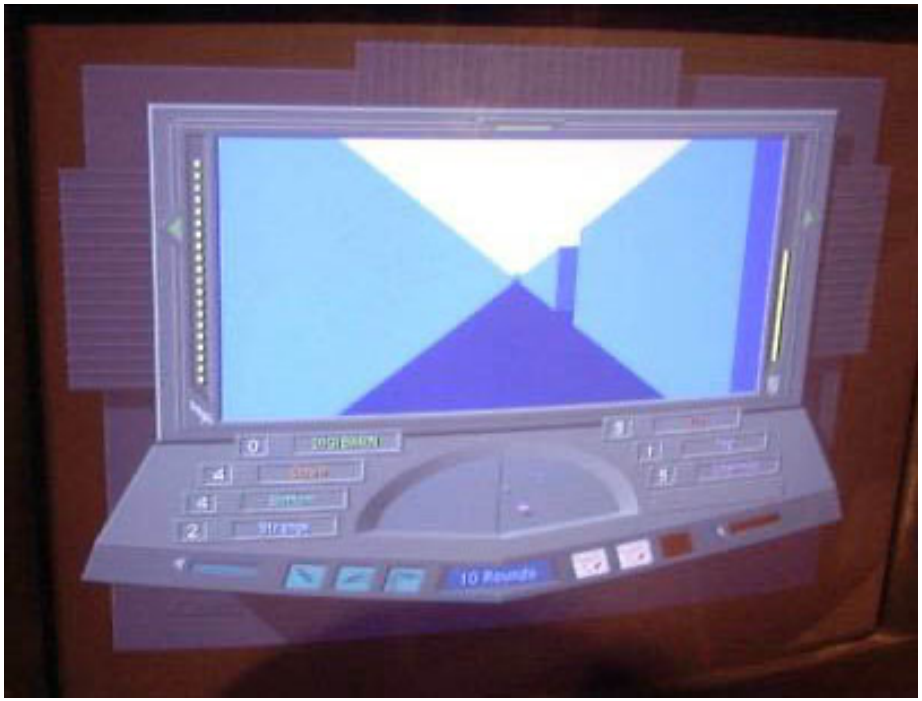
# Maze Wars+ for Macintosh in 1987

- By MacroMind

# Super MazeWars for Macintosh in 1992

- by Callisto out of Natick Massachusetts
- Bundled in with Macintoshes from Apple for a time



SUPER MAZE WARS

***System Requirements***

Super Maze Wars requires:

- 256 colors or grays (color recommended)
- System 6.0.7 or later
- 2 Megabytes (MB) of memory, or 4 MB if you're using System 7 or MultiFinder

***Last-minute News***

You can read about any last-minute changes to Super Maze Wars or this manual by reading the file *Read Me* on the Super Maze Wars disk. Use TeachText or any word processor to read or print the information.

**INSTALLATION**

We recommend that you make a backup copy of the Super Maze Wars disk, and keep the original in a safe place.

To install Super Maze Wars onto your hard disk, drag the Super Maze Wars icon from the Super Maze Wars disk to your startup volume. Super Maze Wars does not need to be installed into the System Folder.

Run Super Maze Wars by double-clicking the Super Maze Wars icon. The first time you run Super Maze Wars, you will be asked to enter your "battle name" and the ten-digit registration number printed on your Super Maze Wars disk. Type them in and click OK. Once you're registered, you will not be asked to type the registration number again. If you have purchased a Net Pack (for 2), each of the two registration numbers on the disk can be used only once.

The Super Maze Wars warranty registration card provides you with a chance to win *FREE SOFTWARE*. Please take a few minutes to fill it out and drop it in a mailbox.

**OVERVIEW**

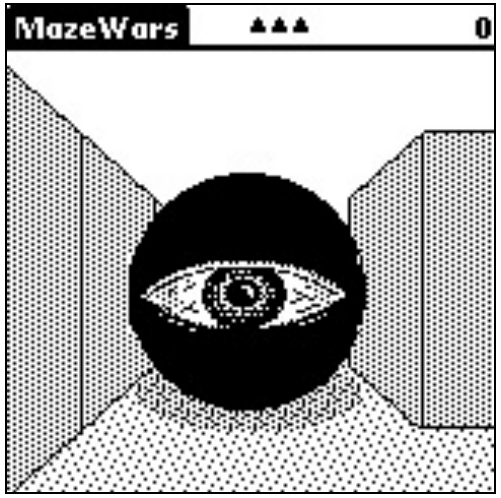
Inside your battle-hardened MazeCruiser™ you roam the mazed hallways of a foreign world, determined to claim victory over up to seven human- and/or robot-controlled opponents.

You must skillfully balance the rewards of loot-filled capsules and shimmering gems against the danger of your lurking enemies' blasts and missiles.

Super Maze Wars offers you six game scenarios, each available as a solo game (with robot opponents) or as a networked game (with human and/or robot opponents). Each game can be played against the clock, or up to a certain number of points or rounds.

# Other Versions

- X MazeWars by Christopher Kent of DEC in 1986
- MIDIMaze for Atari ST by Hybrid Arts in 1987
- Faceball 2000 for the Game Boy by Bullet-Proof Software in 1990
- MazeWars for NeXTSTEP by Mike Kienenberger & others 1994
- MazeWars for PalmOS v2.0 by IndiVideo in 1998

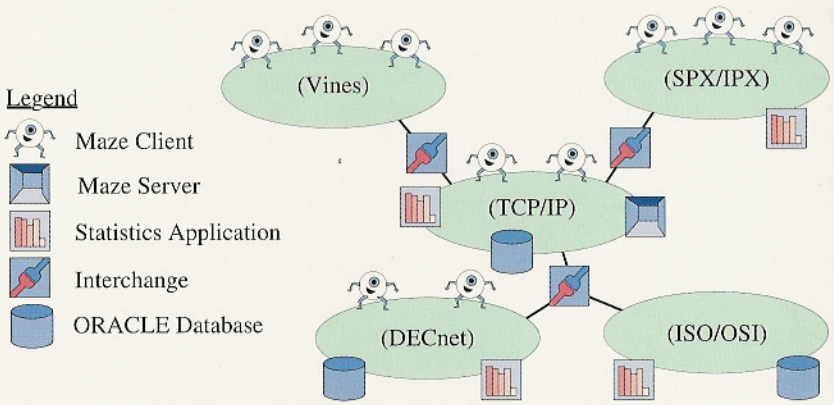


MazeWars for PalmOS

# Oracle Maze for Interop in 1992

- For Interop 92 Jack Haverty and others at Oracle developed a multi-platform Maze game to demo SQL*Net

## Maze at INTEROP™

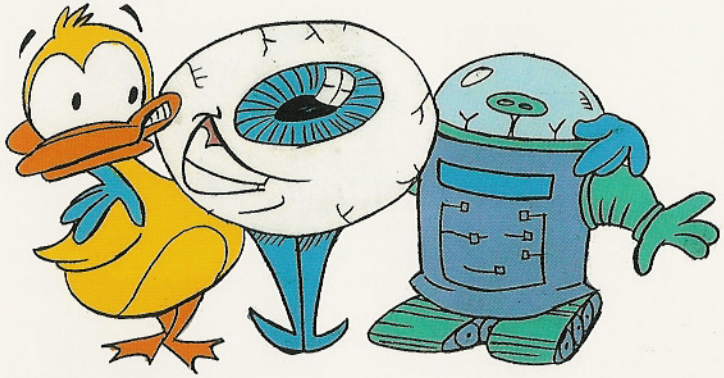



Maze game clients connect, through an Interchange where necessary, to the Maze server to play the game. Game details are logged to one of three Oracle databases and distributed to the other two. Maze statistics are queried from any of the three databases and displayed in the Maze stats application.

Play the game and come to Maze Headquarters for your Maze collectable. Game stations are in many booths on the show floor. High scores each hour and each day win fabulous prizes.

ORACLE® INTEROP 92 FALL

## Maze



A Cooperative Networking Demonstration at INTEROP™

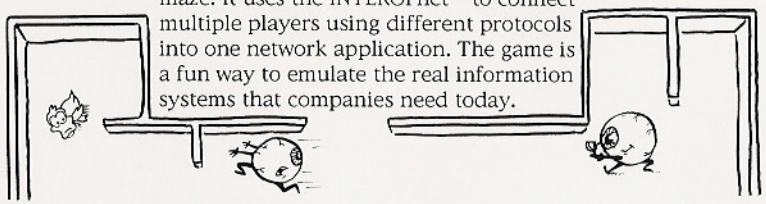
ORACLE

# About the Maze Game

- Jack Haverty worked at MIT-DMS while I was there

*What is Maze?*

Maze is a networked game that stages multiple players as opponents in a 3-D maze. It uses the INTEROPnet™ to connect multiple players using different protocols into one network application. The game is a fun way to emulate the real information systems that companies need today.

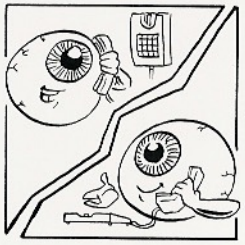


*What does Maze mean to me?*

Have you ever tried to connect your PCs, VAXes, UNIX machines, and mainframes but been unable to because they each run different network protocols? Maze is about overcoming that barrier. We believe Maze is the largest demonstration of real-time, multi-protocol, client/server connectivity ever staged.

*How does it work?*

In Maze, game stations communicate with each other, and ORACLE7 databases from their native environments: (O/S, protocol, windowing software). Any differences in client and server networks are resolved by Oracle's SQL*Net V2 and MultiProtocol Interchange products. Stations communicates *as applications* independent of the protocol they use.



*How did Maze happen?*

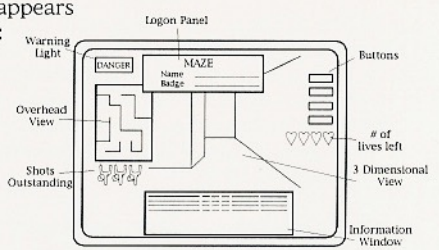
Interop and its participants were looking for ways to increase live network use on the show floor in a meaningful, easily understood way. As one of the worlds largest vendors of networked applications, Oracle Corporation proposed Maze.

*What do I get if I play?*

An eye for an eye as they say. The Oracle booth has a must-have floating eye giveaway for anyone who plays the game. Additional hourly and daily high-score winners will be announced receiving Maze T-shirts and Sharp Wizards respectively.

*What do I need to know to play?*

The screen appears as follows:




Use the two page centerfold on the following page when playing the game.

# Oracle Maze Rules and Hints

- Same rules but better graphics

*What's going on in the game?*

In maze, you are an eye competing against other eyes inside a 3 dimensional maze. Players are identified by different colors representing their network protocols and physical booth locations.

*How do I begin?*

Find a Maze game station and watch the screen to get oriented. To begin playing, Enter your name and Badge ID in the logon window and press "Start".

## Maze Rules


+10 Players in the Maze are eyes. Eyes are the most skillful opponents because they are just like you.


+5 Robots are automated players that wander through the Maze and shoot when they see others. They are slow, and quite predictable.


+2 Also in the Maze are "sitting" ducks. They move, but don't shoot.

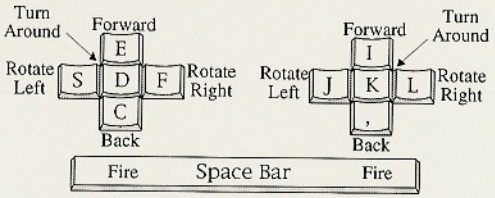

-1 You are armed with magic slingshots. When used, they remain where they are fired for one second before actually firing. This gives potential victims one second to reach safety. When you are fired upon, a danger light flashes warning that a shot will come within one second.



After being shot, you are teleported to another location in the Maze. Be prepared to move quickly, you may land near another player! Each player can be shot up to 4 times before the game is over.

## Valid Keys

Use either the right or left hand key map. On most computers, arrows also work.



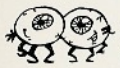

## Maze Hints


*Watch the 3-D screen.* This is where the game is won or lost. The navigation keys only make sense in the 3-D view.


*Keep Moving.* A moving target is harder to shoot. If you do nothing for 1 minute, you are logged off.


*Run.* Holding down the "forward" or "backwards" key allows you to "run" down a corridor.


*Learn about the magic slingshot.* Understanding the slingshot is fundamental to game strategy.


*Sharing Space.* When the screen inverts you are in the same space as another player. Move quickly!

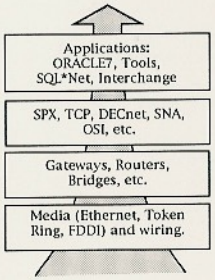

*Don't loiter in long corridors.* These are the deadliest (and most opportunity filled) places in the maze.


*Run at the shooter ...* if you think you can get behind him within one second. The shot will then miss you when it fires.

# Interop 92 Oracle Maze Participants

- Almost over all Networks and Platforms

*What can I learn about Oracle from Maze?*

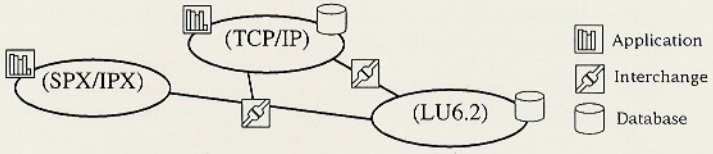



Oracle's business is providing industrial strength, real-world business applications running over your communications infrastructure of routers, bridges, and wiring. In Maze we show:

* Network software that can run on any machine over any protocol, and communicate between unlike protocols for client/server processing.
* A distributed ORACLE7 database logging and querying all data transactions on behalf of the game.
* A portable user interface supporting Windows, Mac, X-Windows, Motif, OpenLook, and DECwindows.

*What do you mean "between unlike networks"?*

Simply put, any client and any server in any networks can communicate. For example, a network of PCs, UNIX workstations, and mainframes using Novell SPX/IPX, TCP/IP, and LU6.2 respecively can freely intercommunicate for client/server applications. The Interchange allows connections to span unlike networks.




*Any final words?*

The most interesting thing about Maze is that it shows many of the vendors at INTEROP™ 92 *actually interoperating*. Maze combines many vendors products into a symphony of integrated network technologies.

*How can I find out more?*

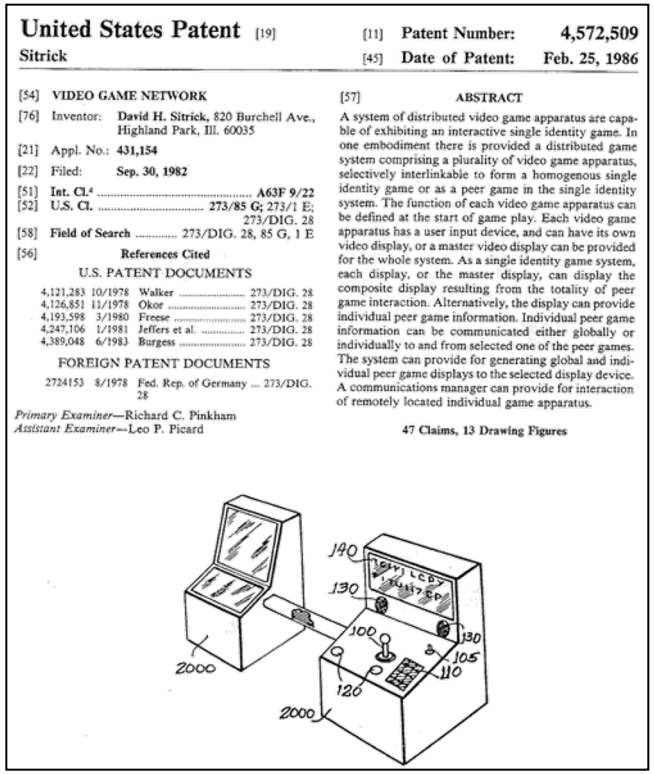
Come to Interop booth #1012 to see Oracle in action, or see one of our hourly presentations. Additionally Maze clients are running in over 50 booths around the show floor. Find a station and try it!

*Who else is participating in Maze at INTEROP?*

| | | |
|---|---|---|
| 3Com Corporation | Coral Network Corporation | Newport Systems |
| AGE Logic, Inc. | Distinct Corporation | NYNEX ALLINK |
| Aggregate Computing | EcoSystems Software Inc | Process Software |
| AMP EOP Group | EICON Technology | PSI |
| Asante Technoligies, Inc | Farallon Computing, Inc. | RAD Data Comm |
| Ascend Communications | Frontier Technologies | RAD Network Devices |
| Auspex Systems, Inc. | Hewlett-Packard Company | Sigma Network Systems |
| BBN Communications | InteCom, Inc. | SysKonnect, Inc. |
| Beame &Whiteside Software | IWI | Telebit Corporation |
| Bridgeway Corporation | LARSE | Tenon Intersystems |
| Brixton Systems | Motorola Codex | TGV, Inc. |
| Canary Communications | NEC America, Inc. | Thursby Software |
| Centrum Communications | Netcor | Vitalink Comm |
| Clearpoint Reasearch | NetFRAME Systems, Inc. | Walker Richer & Quinn |
| Compatible Systems | Netrix | The Wollongong Group |
| Computer Network Tech | N.E.T. | |

# Sitrick vs. Electronic Arts in 2000

- Initiated the un-earthing of Maze history
- Received an e-mail in March 2000 from Charles Frankston at Microsoft
- Attorneys looking to identify networked multi-player games prior-art < 1982
- Case was settled out of court



United States Patent [19]
Sitrick

[11] Patent Number: 4,572,509
[45] Date of Patent: Feb. 25, 1986

[54] VIDEO GAME NETWORK

[76] Inventor: David H. Sitrick, 820 Burchell Ave., Highland Park, Ill. 60035

[21] Appl. No.: 431,154

[22] Filed: Sep. 30, 1982

[51] Int. Cl.[4] ..... A63F 9/22
[52] U.S. Cl. ..... 273/85 G; 273/1 E; 273/DIG. 28
[58] Field of Search ..... 273/DIG. 28, 85 G, 1 E

[56] References Cited

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 4,121,283 | 10/1978 | Walker | 273/DIG. 28 |
| 4,126,851 | 11/1978 | Okor | 273/DIG. 28 |
| 4,193,598 | 3/1980 | Freese | 273/DIG. 28 |
| 4,247,106 | 1/1981 | Jeffers et al. | 273/DIG. 28 |
| 4,389,048 | 6/1983 | Burgess | 273/DIG. 28 |

FOREIGN PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 2724153 | 8/1978 | Fed. Rep. of Germany | 273/DIG. 28 |

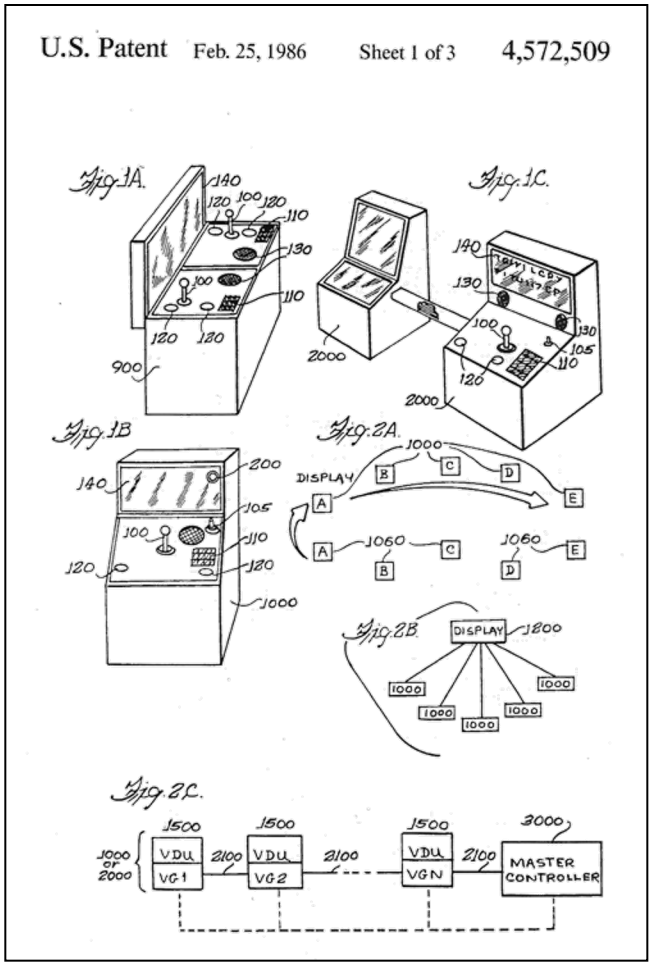
*Primary Examiner*—Richard C. Pinkham
*Assistant Examiner*—Leo P. Picard

[57] ABSTRACT

A system of distributed video game apparatus are capable of exhibiting an interactive single identity game. In one embodiment there is provided a distributed game system comprising a plurality of video game apparatus, selectively interlinkable to form a homogenous single identity game or as a peer game in the single identity system. The function of each video game apparatus can be defined at the start of game play. Each video game apparatus has a user input device, and can have its own video display, or a master video display can be provided for the whole system. As a single identity game system, each display, or the master display, can display the composite display resulting from the totality of peer game interaction. Alternatively, the display can provide individual peer game information. Individual peer game information can be communicated either globally or individually to and from selected one of the peer games. The system can provide for generating global and individual peer game displays to the selected display device. A communications manager can provide for interaction of remotely located individual game apparatus.

47 Claims, 13 Drawing Figures



# MazeWars now a class Assignment

- For example: Stanford University Computer Science 244b: Spring 2004
  - Assignment 1 - Mazewar: A Multiplayer Computer Game

    See http://www.stanford.edu/class/cs244b/mazewar_desc.html

    and http://www.stanford.edu/~priyank9/projects/mazewar.pdf
- or University of Pennsylvania class CSE480
- A hardware MazeWars game can now probably be implemented in a single FPGA chip
  - A pet-project of mine I haven't yet got to
  - Just too busy with Video-on-Demand (VOD)
    - Previously as CTO at nCUBE
    - Now as Chief Video Architect at Cisco Systems BEMRBU

# Where did other people go next?

- Steve Colley went on to found nCUBE in 1983
  - Purchased by Larry Ellison late 1980s
  - Howard and I joined nCUBE in early 1990s
  - nCUBE became a leader in Video-On-Demand

*Stephen Colley, chief executive of NCube*
**"We are trying to be a supercomputer for business."**

NCube co-founder Stephen Colley made Ellison a believer in massively parallel supercomputers. Inside the box: 1,000 microprocessors harnessed together.

# Where did other people go next?

- Dave Lebling went on to form Infocom in 1979 creating Interactive Fiction games like Zork, Enchanter, Suspect, Starcross, Shogun, Spellbreaker Deadline, and others

Dave Lebling

Infocom Team

Professor Mark Horowitz

- Mark Horowitz became Yahoo Founder's Professor and Director of the Computer Systems Lab at Stanford, as well as a co-founder of Rambus Inc. in 1990

# Where did people go next?


George Woltman

- George Woltman became the author of the **G**reat **I**nternet **M**ersenne **P**rime **S**earch (GIMPS) searching for Mersenne Primes ($2^n$-1)

World's Largest Known Primes:

| Rank | Prime# | Digits | Type | Discovered by | When |
|---|---|---|---|---|---|
| 1 | $2^{24036583}$ - 1 | 7235733 | Mersenne | Josh Findley, **George Woltman** | 15/05/2004 |
| 2 | $2^{20996011}$ - 1 | 6320430 | Mersenne | Michael Shafer, **George Woltman** | 17/11/2003 |
| 3 | $2^{13466917}$ - 1 | 4053946 | Mersenne | Michael Cameron, **George Woltman** | 14/11/2001 |
| 4 | $2^{6972593}$ - 1 | 2098960 | Mersenne | Nayan Hajratwala, **George Woltman** | 01/06/1999 |
| 5 | $5359.2^{5054502}+1$ | 1521561 | Proth | Randy Sundquist | 06/12/2003 |
| 6 | $2^{3021377}$ - 1 | 909526 | Mersenne | Roland Clarkson, **George Woltman** | 27/01/1998 |
| 7 | $2^{2976221}$ - 1 | 895932 | Mersenne | Gordon Spence, **George Woltman** | 24/08/1997 |
| 8 | $1372930^{131072}+1$ | 804474 | Gen Fermat | Daniel Heuer | 22/09/2003 |

# So Happy Birthday MazeWars!

## - All ready for the next generation