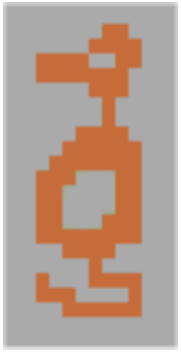
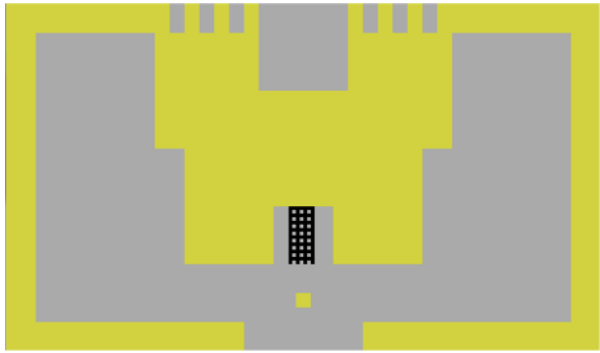
GDC

Design of *Adventure* for the Atari 2600:

The First Action-Adventure Game



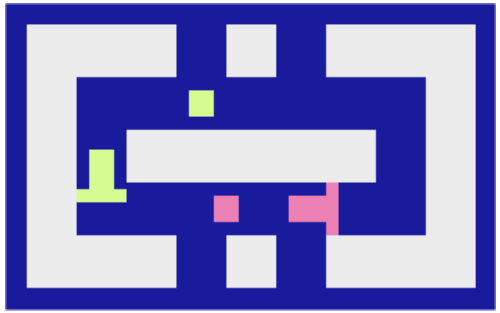


Warren Robinett

Talk Outline

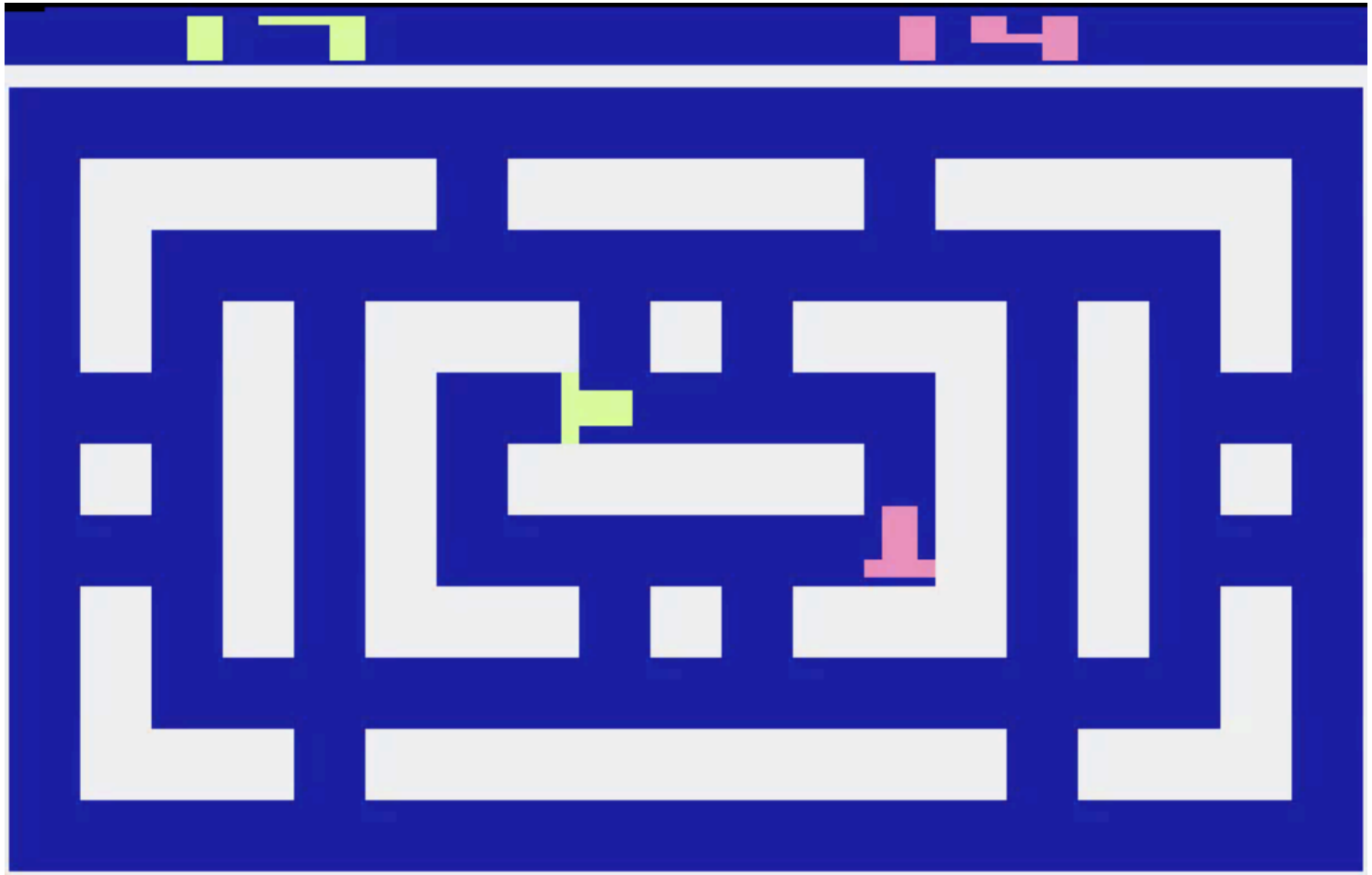
- I. Design of Adventure
  - where the idea came from
- II. Implementation
  - how I fit it into 4K of ROM memory
- III. Atari Internal Politics
  - why I created the Easter Egg

The Setting:
1978 in Sunnyvale, California



- I worked for Atari. I was 26.
- I needed an idea for my next video game.
- I was finishing my first game for the Atari 2600 console.
- Video: Slot Racers

Slot Racers video



The Platform: The Atari 2600 Console

The 2600 was very, very limited.

- tiny ROM memory: 4096 bytes (4K)
- miniscule RAM memory: 128 bytes
- weak 8-bit processor (6502)
- slow 1.2 MHz clock speed
- crude 2D graphics

Game Design in the Stone Age

Each 2600 game was produced by one person.

- You had the idea;
- You wrote the code;
- You created the graphics;
- You created the sound effects;
- You tested it on kids, until you were satisfied.

The Inspiration

- I played the original text adventure game.
  - by Willie Crowther and Don Woods
  - It was 100% text – no graphics at all.

- I decided that this concept could work as a my next video game:
  - rooms, objects, puzzles, monsters...

Crowther and Woods's all-text Adventure: A Brief Taste...

(First, it explained the rules of the game.)

```
Somewhere nearby is Colossal Cave, where others have
found fortunes in treasure and gold, though it is
rumored that some who enter are never seen again.
Magic is said to work in the cave.  I will be your eyes
and hands.  Direct me with commands of 1  or 2 words.
```

(Next, it described your location.)

```
You are standing at the end of a road before a small
brick building.  Around you is a forest.  A small
stream flows out of the building and down a gully.
```

(Then it paused, waiting for you to type a command.)

ENTER BUILDING

You are inside a building, a well house for a large spring. There are some keys on the ground here. There is a shiny brass lamp nearby.

(picking up objects)

TAKE KEYS

OK

TAKE LAMP

OK

(moving through the game-world)

LEAVE BUILDING

You're in front of building.

GO SOUTH

You are in a valley in the forest beside a stream tumbling along a rocky bed.

GO SOUTH

At your feet, all the water splashes into a 2-inch slit in the rock. Downstream the streambed is bare rock.

(first obstacle)

GO SOUTH

You are in a 20-foot depression floored with bare dirt. Set into the dirt is a strong steel grate mounted in concrete. A dry streambed leads into the depression. The grate is locked.

GO DOWN

You can't go through a locked steel grate! You're outside grate.

INVENTORY

```
You are currently holding the following:
Set of keys
Brass lantern
```

UNLOCK GRATE

```
The grate is now unlocked.
```

(use an object to get past obstacle)

GO DOWN

```
You are in a small chamber beneath a 3x3 steel grate to
the surface.  A low crawl over cobbles leads inward to
the west.  The grate is open.
```

GO WEST

You are crawling over cobbles in a low passage. There is a dim light at the east end of the passage. There is a small wicker cage discarded nearby.

GO WEST

It is now pitch dark. If you proceed you will likely fall into a pit. **(second obstacle)**

LIGHT LAMP **(solution to second obstacle)**

You are in a debris room filled with stuff washed in from the surface. A low wide passage with cobbles becomes plugged with mud and debris here, but an awkward canyon leads upward and west. A note on the wall says "MAGIC WORD XYZZY". A three-foot black rod with a rusty star on an end lies nearby.

GO WEST

You are in a splendid chamber thirty feet high. The walls are frozen rivers of orange stone. An awkward canyon and a good passage exit from east and west sides of the chamber. A cheerful little bird is sitting here singing.

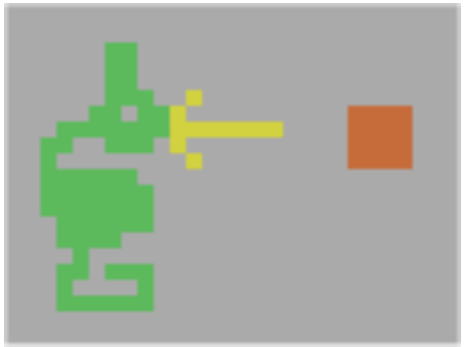
(you should have picked up the rod and the cage.)

I thought I could make a video game for the Atari 2600 containing rooms, objects, obstacles, and monsters ...

just like the text adventure game

Forbidden Fruit

- The text adventure required 100's of K.
- The 2600 had only 4K.
- My boss told me it was impossible: don't work on it.
- But I thought I had a way to do it.
- I worked on it in secret.

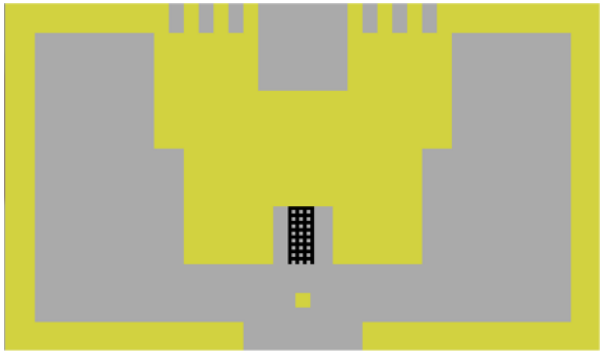


Phases in Adventure's Development

- Proof of feasibility.
- I made a prototype in a month.
- It showed the game-concept was feasible, but wasn't much of a game.
- Making a game that was fun.
- I had to come up with some objects and creatures that were interesting, and worked together.
- It all had to fit into the tiny memory.

Adapting the text game to be a video game.

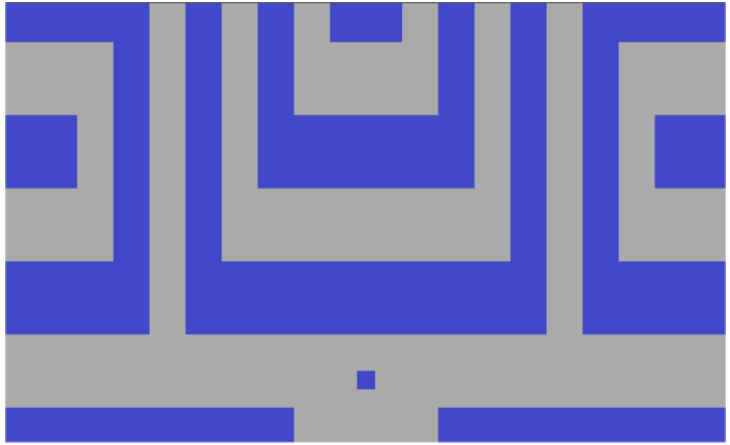
How do you represent an adventure game "room" graphically?
Use the entire screen to depict a map-like overhead view of the current room.



How do you represent movable objects graphically?
Use hardware sprites to show them as little icons.

How do you represent your "self" and where you are in the game world?
Use another little icon as your avatar.

Adapting… (2)



How do you move within a room?

Use the joystick to move your avatar.

How do you move from room to room?

Drive yourself off the edge of the screen into an "adjacent" room. This meant every room had four adjacent rooms.

How do you constrain where you can go?

Interpret the graphics depicting each room as walls and passages. Walls constrain where you can go.

Adapting… (3)

How do you show the “inventory” of objects you have picked up?

You don’t: the player can only carry one object at a time. Show the object beside you as you carry it.

How do you pick up an object?

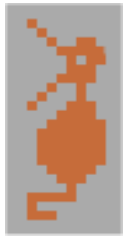
Drive yourself into it. Touching it picks it up.

How do you drop an object?

Use the joystick button.

(The Atari joystick had only one button.)

Adapting… (4)

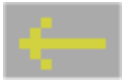


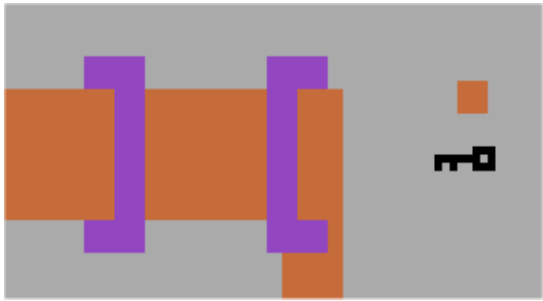
What kind of obstacles can be created?

Maze walls, locked doors, dragons that eat you.

How do you get past these obstacles?

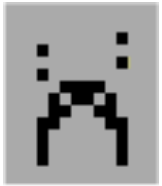
Create tool-objects: a bridge to cross walls, keys to open doors, a sword to kill dragons.





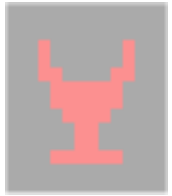
How do you make autonomous creatures?

Associate a subroutine executed each frame with a graphical object. Control their motions (towards or away from other objects in the game) by giving them "desires" and "fears".



Adapting… (5)

What's the goal of the game?
It's a quest. You must find and retrieve the Holy Grail.



How do you fit all this into 4096 bytes of ROM and 128 bytes of RAM?
A good data structure, and efficient coding.

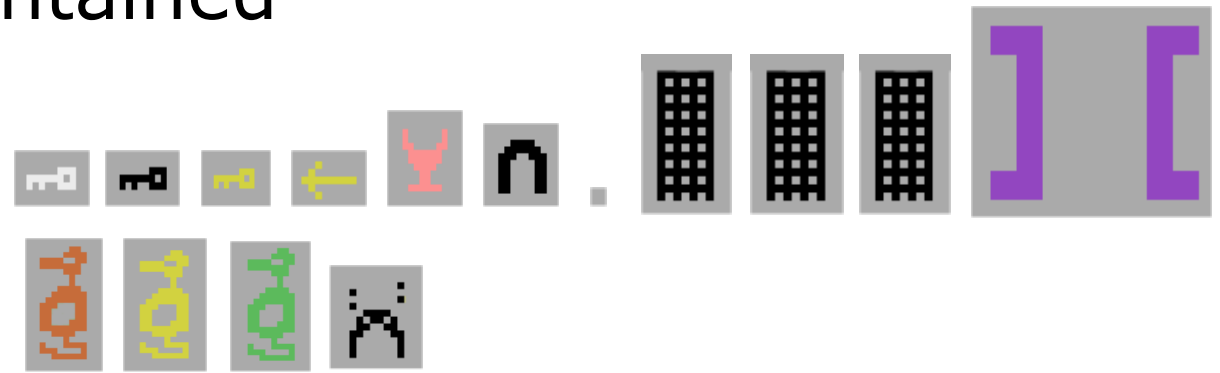
Adapting… (6)

How do you get public credit for your cool game when Atari's policy is anonymity of the game designers?

Create a secret room that's really hard to get to, and hide your signature in it. Don't tell anyone until they've manufactured a few hundred thousand cartridges and shipped them all over the world. (This was the first Easter Egg.)

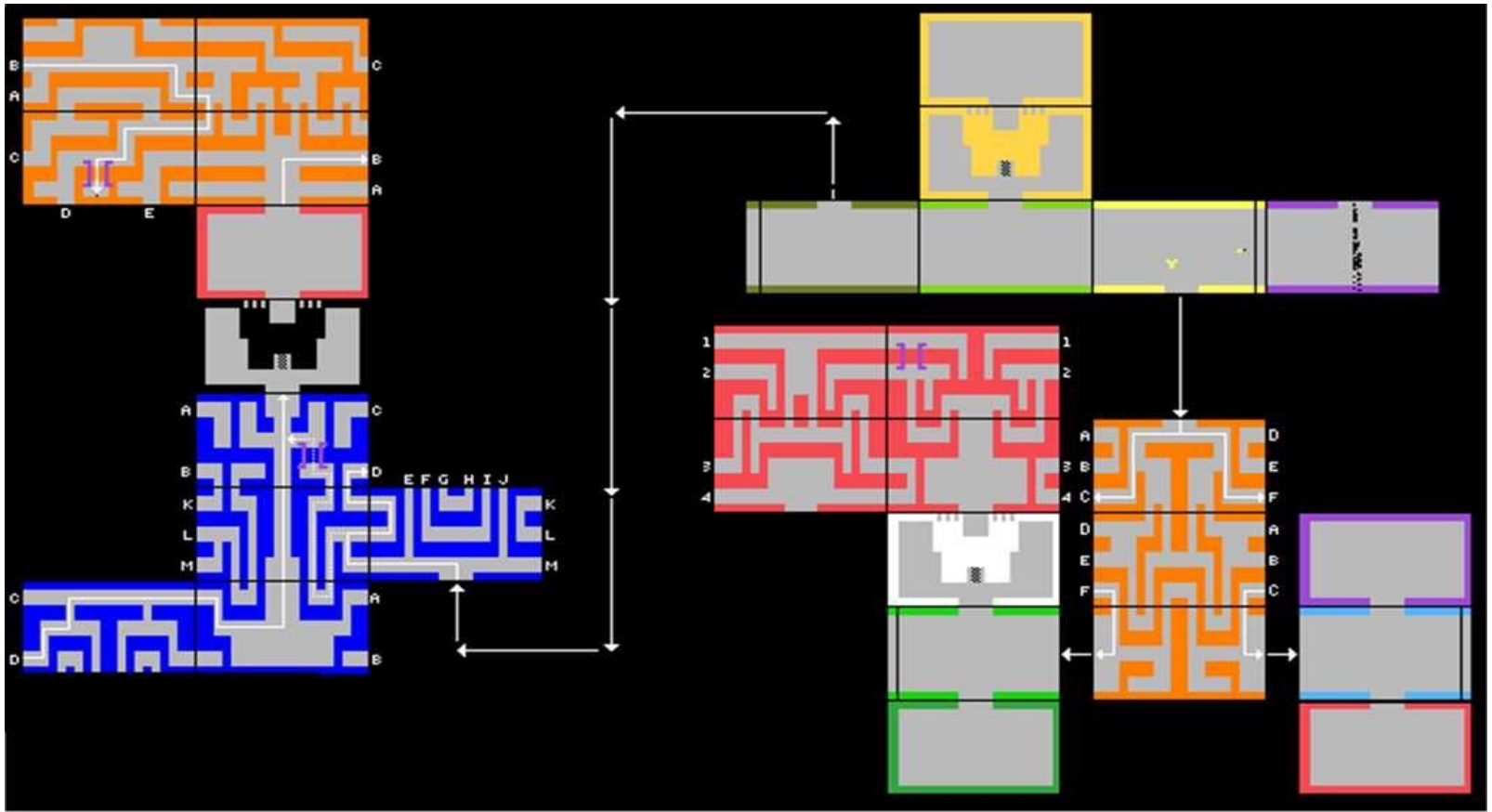
My Idea Worked!

- The game contained
- 30 rooms,
- 14 objects, and
- 4 creatures.

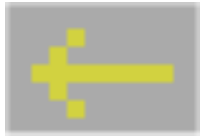


- It fit into 4K of ROM and 128 bytes of RAM.

Adventure's Game World (30 Rooms)

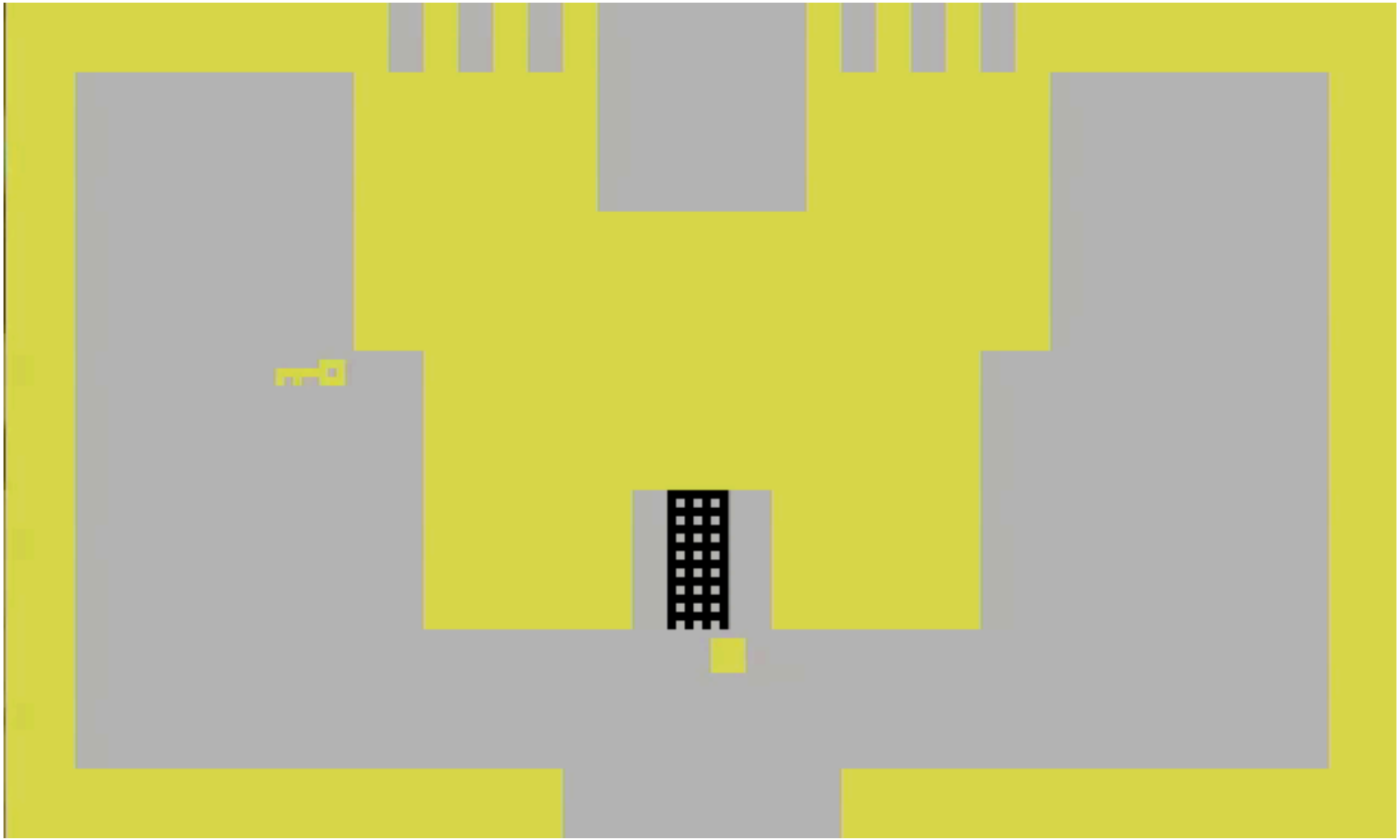


Show Video: Adventure.



- Video: Adventure for the Atari 2600

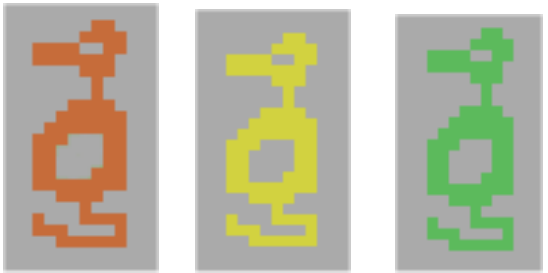
  Adventure Run-through video



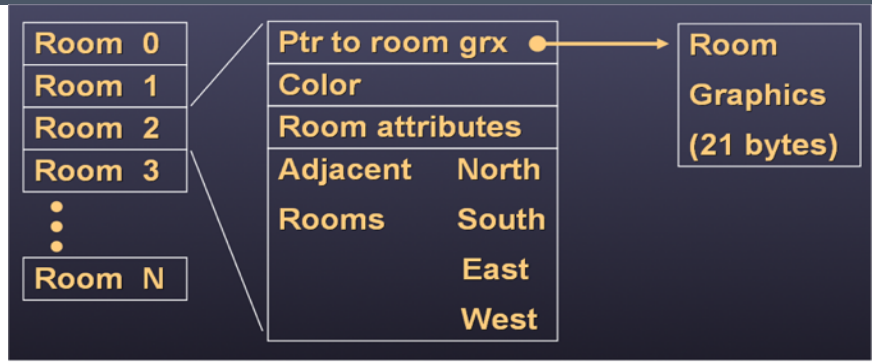
Part II: Implementation

How I Fit Adventure into 4K

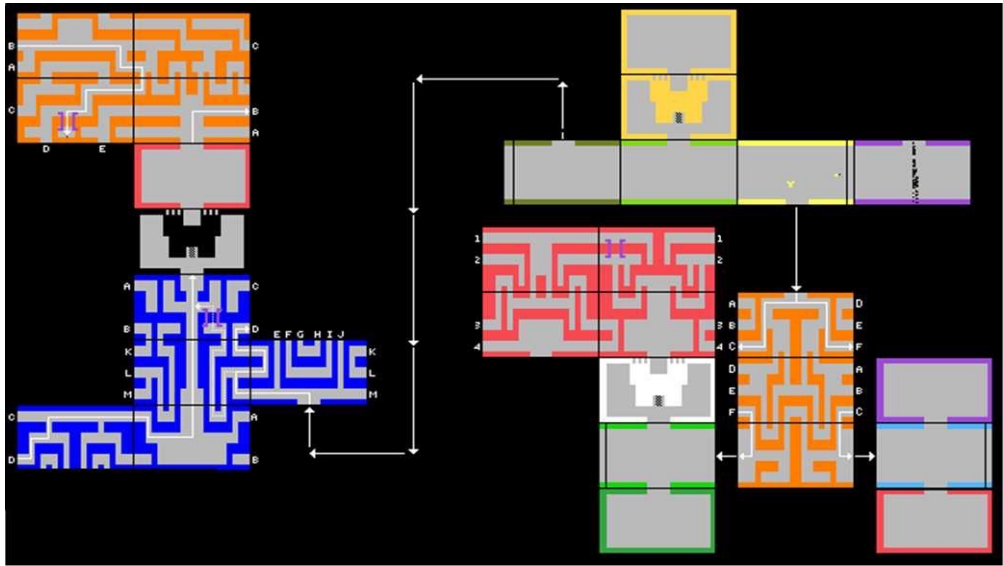
- A good data structure
  - Room-List
  - Object-List
  - Chase-Flee-List
- Efficient coding



The Room-List

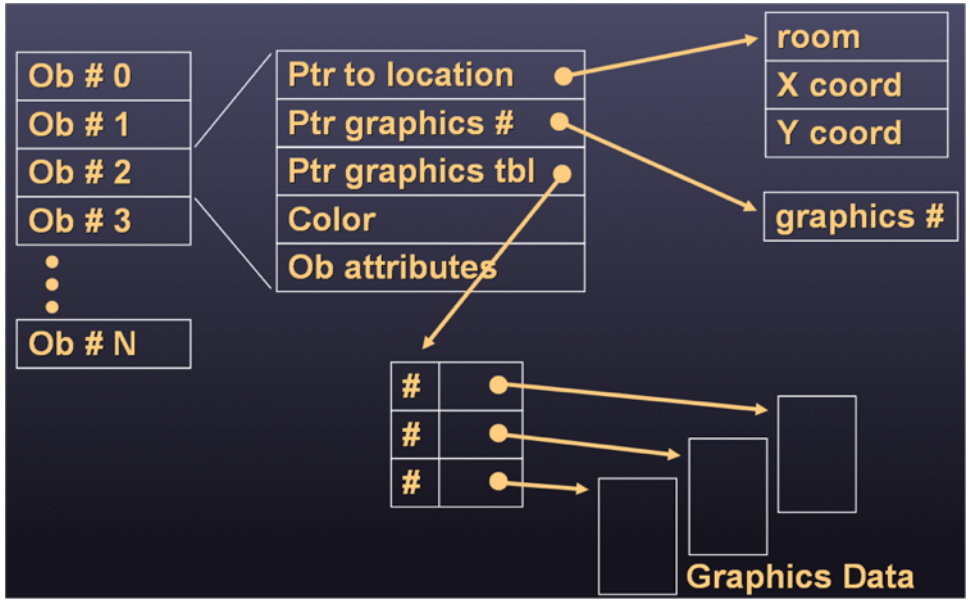


- Defined the game world (30 rooms)
  - topology, room graphics, wall colors
- Each room used:
  - 21 bytes graphics data
  - 9 bytes for links, wall color, attributes

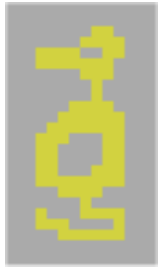


The Object-List

- Defined the 18 objects in the game.
  - location (room,x,y)
  - state
  - graphics
- Memory conservation
  - variable-length data structures
  - RAM vs. ROM usage



Chase-Flee Lists



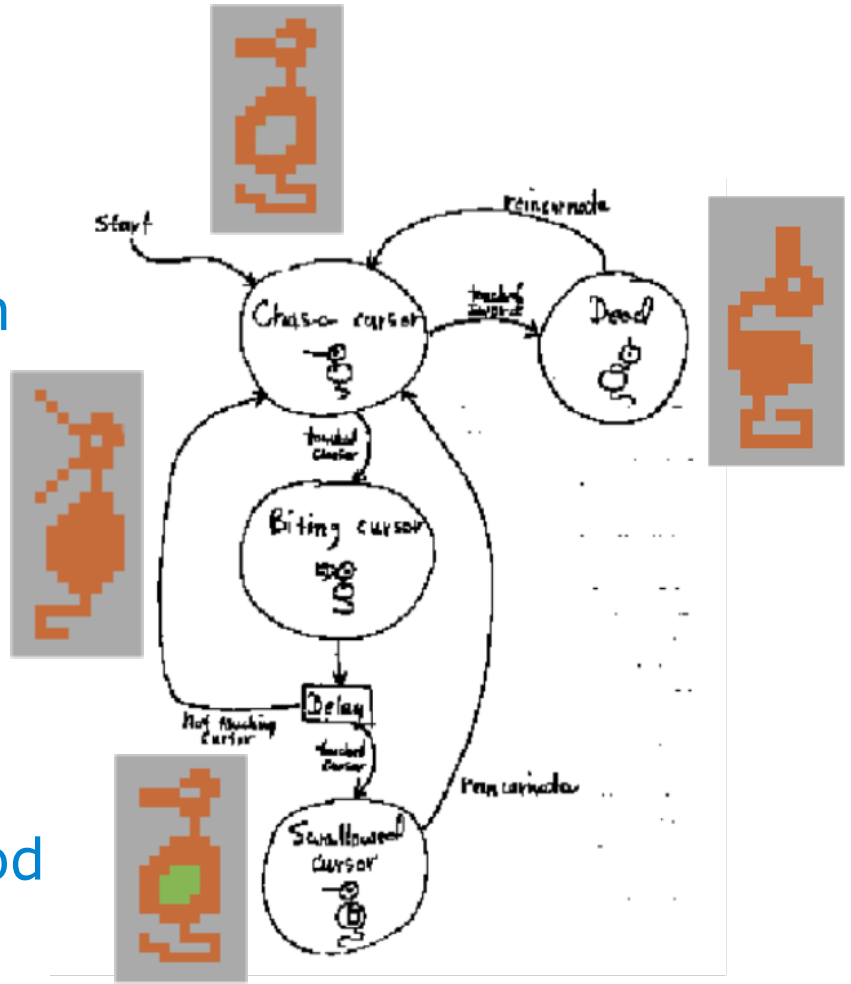
- Behaviorism
- prioritized list of objects
- whether to chase or flee from each object
  - "desires" and "fears"
- go down the list: respond to first object in same room.
- a creature could "change its mind" when a new object entered the room.

Stimulus	Response
Sword	flee
Yellow Key	flee
Man	chase
Chalice	chase

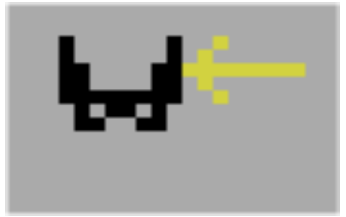
Yellow Dragon's Chase-Flee List

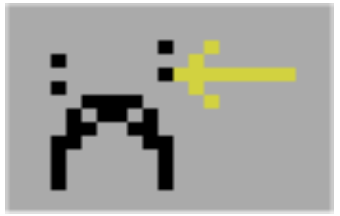
Dragon's State-Machine

- State diagram
  - shows transitions between states
  - and what events trigger transitions
- Dragon states
  - Chasing, Biting, Dead, Swallowed-Man
  - graphics tied to state: good animation



The Bat: A Chaos Factor





- Added to keep the game from being too predictable.
  - the Bat moved objects around
  - used a Chase-Flee list (but only chased)
  - off-screen events (Bat moving things)
  - the Bat ignored the Man (avatar)
    - but could steal the Man's held ob
    - (take your sword; leave you a dragon)

Game-State

3 bytes	dot	(room,x,y)
5 bytes	redDragon	(room,x,y,dir,state)
5 bytes	greenDragon	(room,x,y,dir,state)
5 bytes	yellowDragon	(room,x,y,dir,state)
3 bytes	magnet	(room,x,y)
3 bytes	sword	(room,x,y)
3 bytes	chalice	(room,x,y)
3 bytes	bridge	(room,x,y)
3 bytes	yellowKey	(room,x,y)
3 bytes	blackKey	(room,x,y)
3 bytes	whiteKey	(room,x,y)
3 bytes	gateState[3]	state, state, state
7 bytes	bat	(room,x,y,dir,state,timer,batHeldOb)

Total: 49 bytes RAM

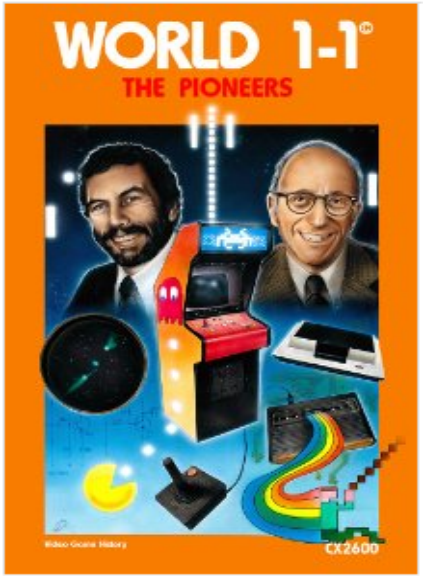
More Info on Adventure

- My E-book: *The Annotated Adventure*
  - warrenrobinett.com/adventure
- Discusses the implementation of *Adventure* in detail.

More Info on Adventure (2)

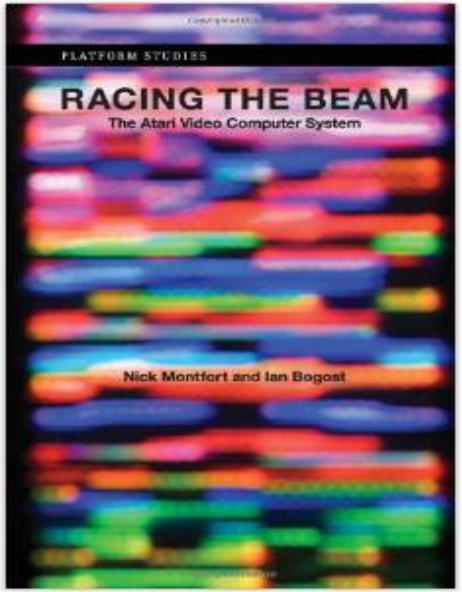
- World 1-1 (Documentary)

https://worldoneonemovie.vhx.tv/buy/world-1-1-the-pioneers



- Racing the Beam

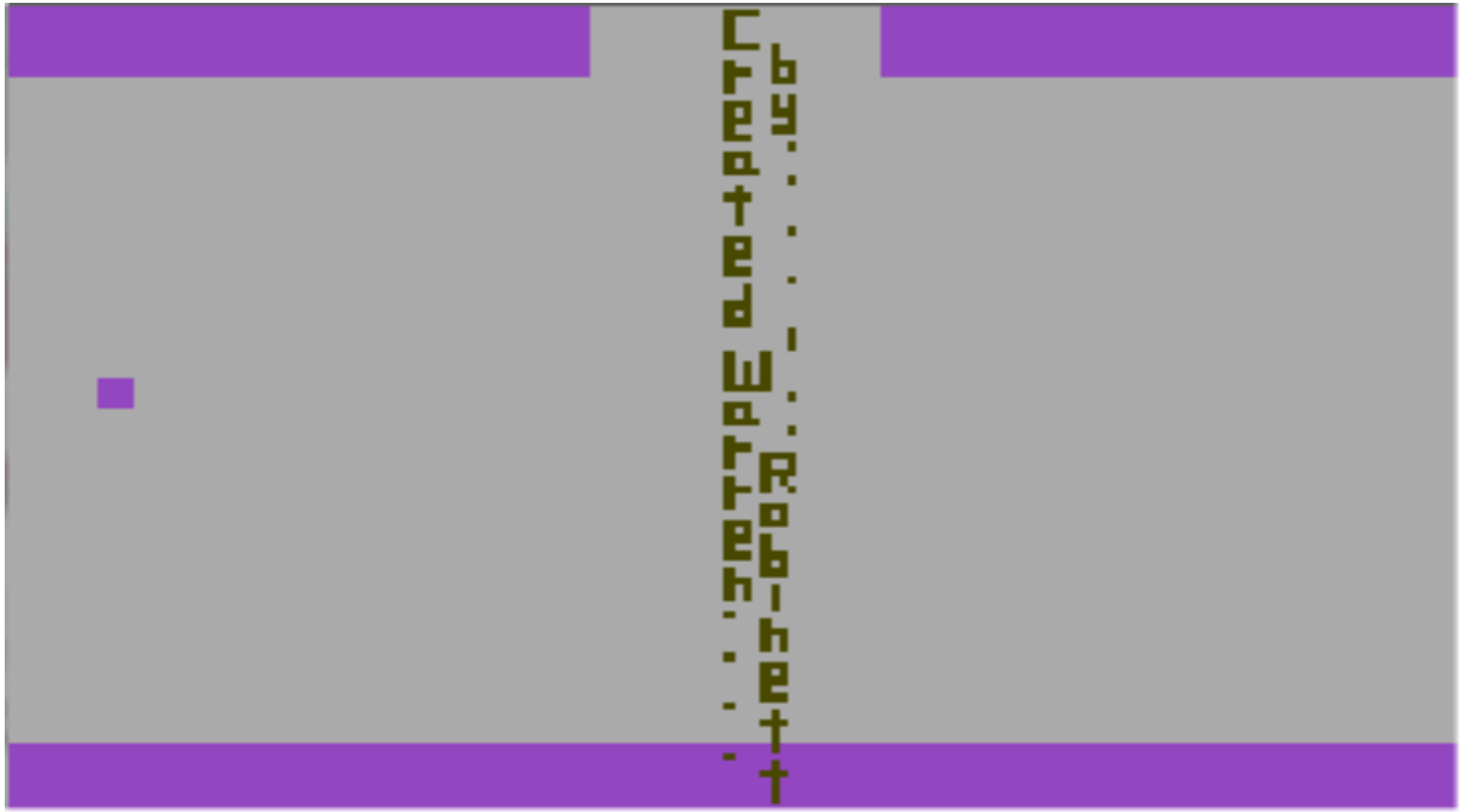
http://mitpress.mit.edu/books/racing-beam



Part III. Political Issues at Atari

- My boss told me not to work on it.
- but I made a prototype that showed it was possible.
- Atari Marketing told me to turn it into a game about Superman.
- but I got somebody else to do that.
- Atari game designers did not get their names on the box.
- but I found a way to put my name on the screen.

Secret Room and Signature



Summary: Atari 2600 Adventure

First action-adventure video game.

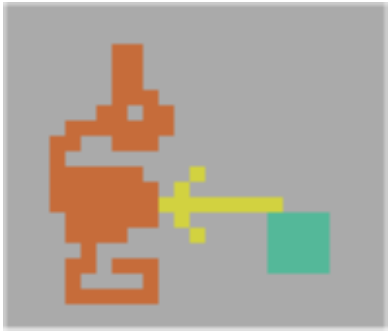
Sold 1 million units @ $25 each.

I got paid a salary (22K/year); no royalty.

Established the genre; widely imitated.

e.g., Legend of Zelda

The End



Questions?