

# Interactive Fiction and Text Generation

Chris Callison-Burch

TAs: Andrew Zhu, Anson Runsheng Huang,  
Kyle Jaewoo Song

<http://interactive-fiction-class.org>

# Chris Callison-Burch he/him

Associate Professor in CIS

## Research Interests

- Artificial Intelligence
- Natural Language Processing

## Fun facts:

- I collaborated with folks at Google to train an AI system to do Dungeons & Dragons style roleplaying
- I back tons of Indie RPG projects on Kickstarter during [ZineQuest](#)



# Andrew Zhu he/they

PhD Student

Research Interests:

- NLP & tabletop gaming
- NLP + PL + software engineering
- Long context evaluation for large language models ... and other cool LLM stuff!
- Check out my [Kani system](#)

Fun Fact:

- Before coming to Penn, I worked at D&D Beyond (now part of Wizards of the Coast)



# Jaewoo (Kyle) Song he/him

Master's Student

Research Interests:

- Evaluation of open-ended generation tasks.
- Efficient usage of language models.
- Open-domain text generation.

Fun Facts:

- I love singing and sometimes sing alone while coding.
- I'm working on a Kani implementation of Labyrinth



# Anson Huang he/him

Master's Student

Research Interests:

- Analyzing the danger of using generative AI for Fake News
- Branching narrative project creating “What If…” stories from Marvel movie plots.

Fun Facts:

- I am working with the former co-instructor for this class
- I love cats



# Today's Class



Interactive Fiction



In-Class Activity



Automated Story  
Generation



Course Overview

# Learning Objectives

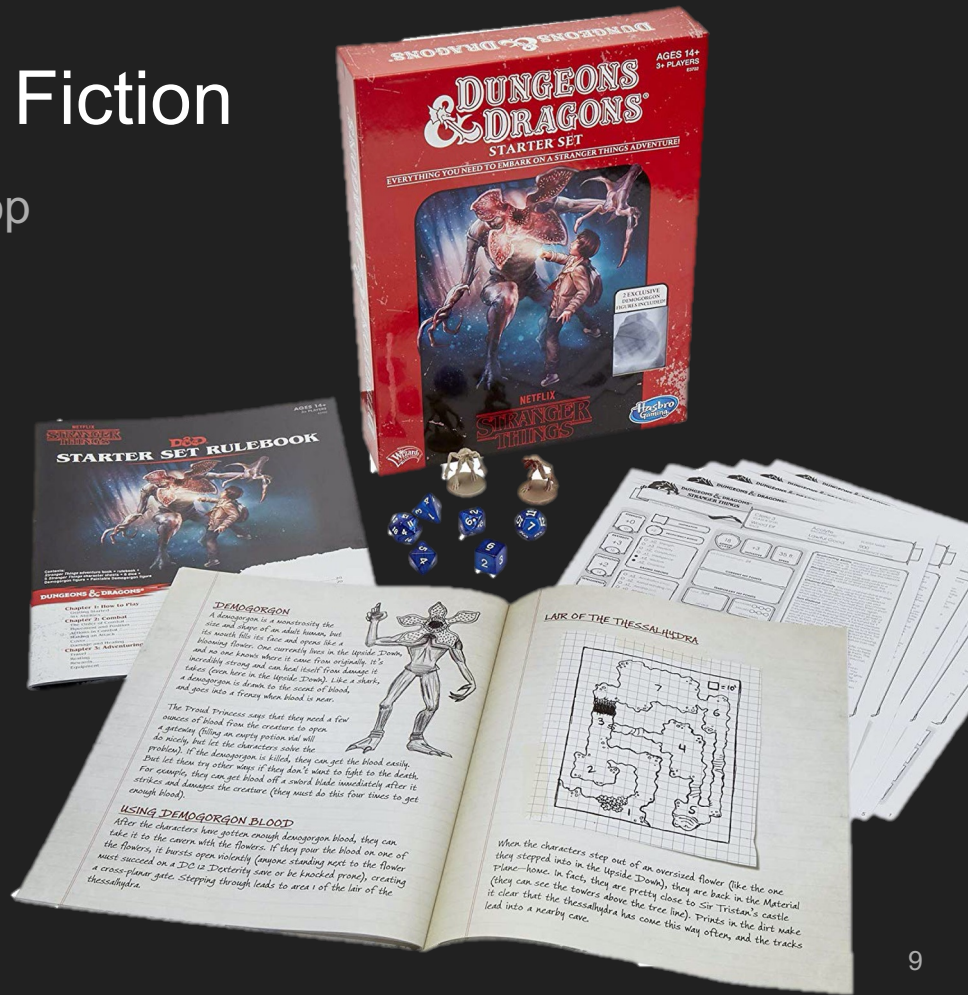
- Identify key characteristics of interactive fiction
- Develop an understanding of what it takes to make a simple IF game
- Get a brief glimpse into what automated story generation is

# Choose-Your-Own Adventures & TRPGs



# Paper & Pencil Interactive Fiction

Dungeons & Dragons is a fantasy tabletop role playing game first published in 1974.



# Dungeons and Dragons (D&D)

- An **open world** game in which the players assume the roles of **characters in a story** and can have them attempt any action they want.
- The game is controlled by a dungeon master, who uses tables, dice, and personal judgment to decide on the effect of a character's efforts.
- The players say what their characters do within the world of the campaign (over many play sessions).

# Old-School Interactive Fiction

Full Action  
Space

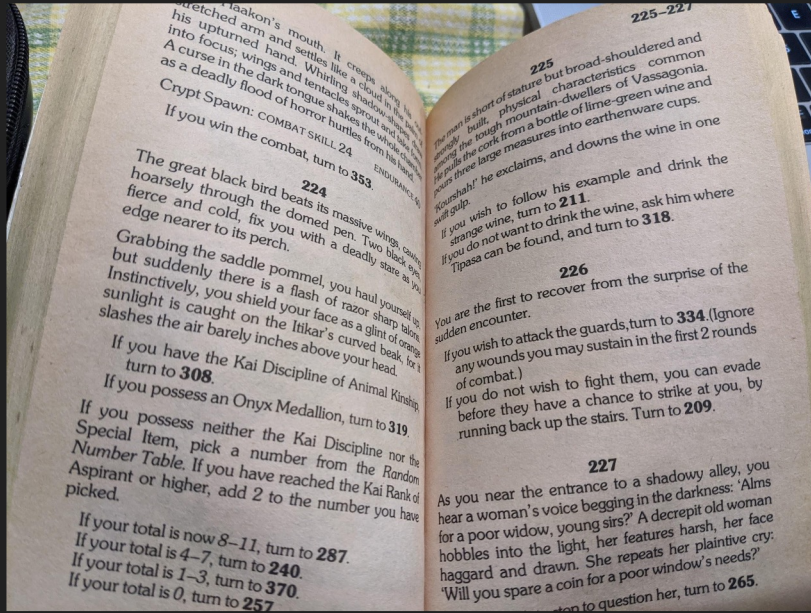
Limited  
Action  
Space

Tabletop  
Roleplaying  
Games

Choose-Your-Own  
Adventures

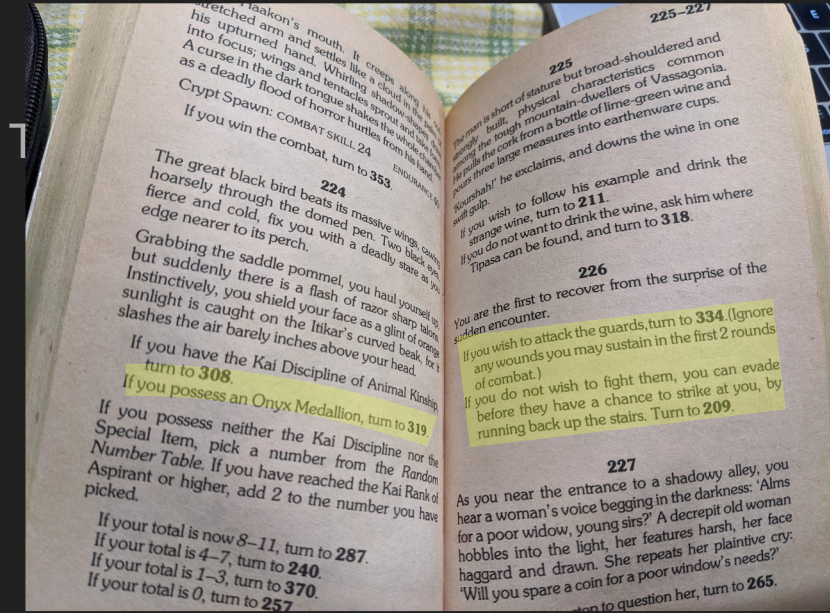
# Paper Interactive Fiction

In the late 1970s, “Choose your own adventure” books grew in popularity.



# Paper Interactive Fiction

In the late 1970s, “Choose your own adventure” books grew in popularity.



CHOOSE YOUR OWN ADVENTURE™ #5

YOU'RE THE STAR OF THE STORY!  
CHOOSE FROM 36 POSSIBLE ENDINGS

# THE MYSTERY OF CHIMNEY ROCK

BY EDWARD PACKARD



ILLUSTRATED BY PAUL GRANGER

Special Book Fair Edition

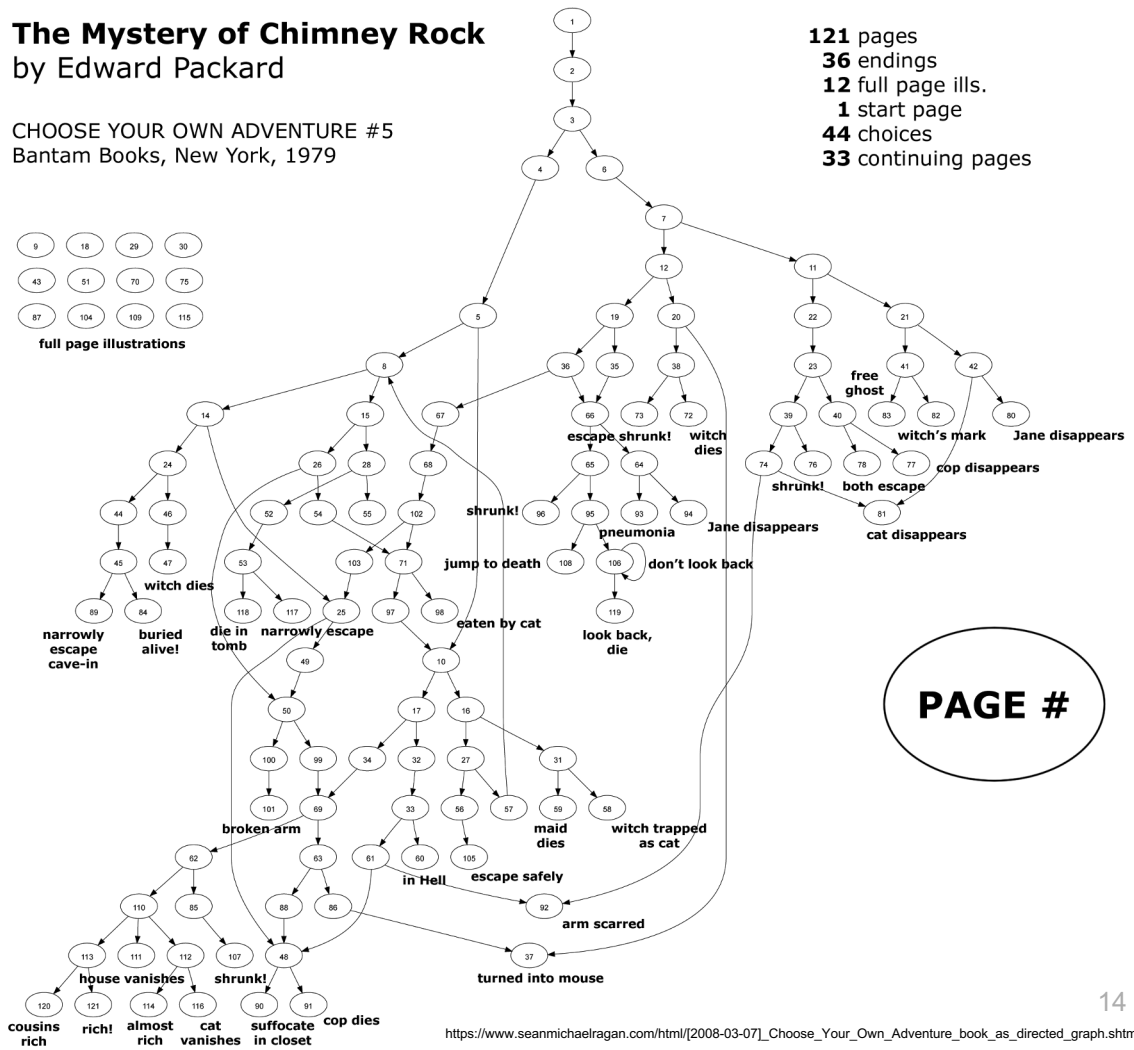
## The Mystery of Chimney Rock

by Edward Packard

CHOOSE YOUR OWN ADVENTURE #5  
Bantam Books, New York, 1979

- 9
- 18
- 29
- 30
- 43
- 61
- 70
- 75
- 87
- 104
- 109
- 115

full page illustrations



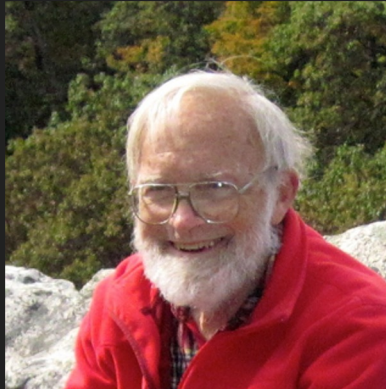
- 121 pages
- 36 endings
- 12 full page ill.
- 1 start page
- 44 choices
- 33 continuing pages

PAGE #

# The Birth of Interactive Fiction Computer Games

## Colossal Cave Adventure

Made in 1975 by Will Crowther



[https://en.wikipedia.org/wiki/Colossal\\_Cave\\_Adventure#/media/File:Will\\_Crowther\\_Fall\\_2012.jpg](https://en.wikipedia.org/wiki/Colossal_Cave_Adventure#/media/File:Will_Crowther_Fall_2012.jpg)

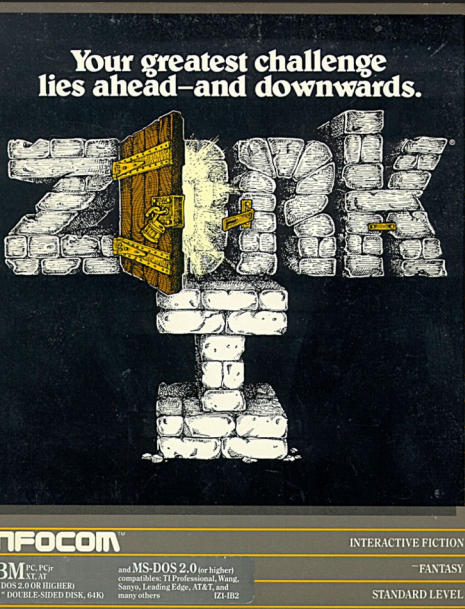


[https://upload.wikimedia.org/wikipedia/commons/d/d8/Colossal\\_Cave\\_Adventure\\_on\\_VT100\\_terminal.jpg](https://upload.wikimedia.org/wikipedia/commons/d/d8/Colossal_Cave_Adventure_on_VT100_terminal.jpg)

# It became a thing

Interactive Fiction/Text Adventure Games were the best-selling computer games of the 1980s. A company called Infocom created the most popular titles.

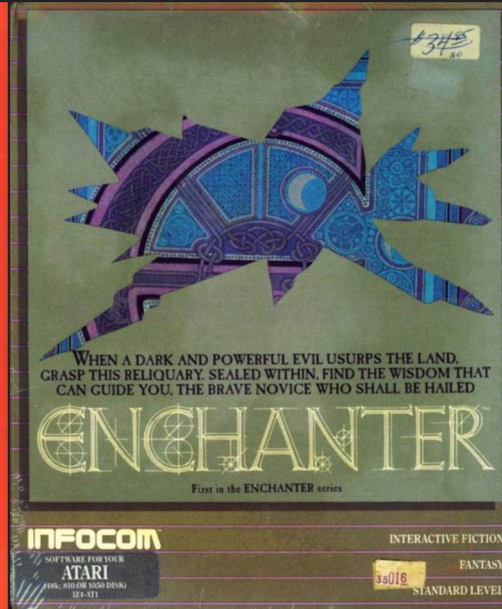
1979



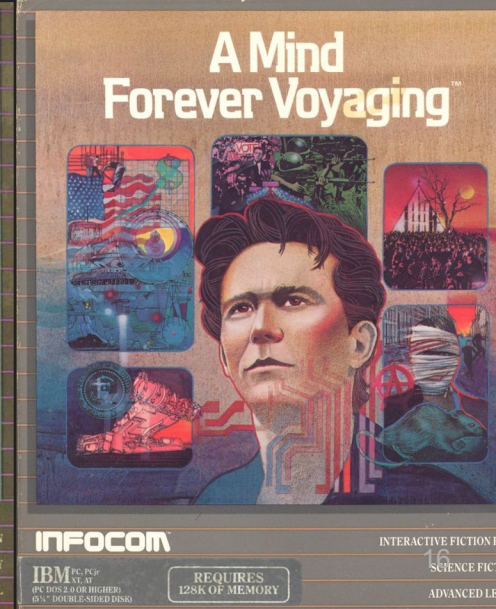
1983



1983



1985





ZORK I: The Great Underground Empire

Copyright (c) 1981, 1982, 1983 Infocom, Inc. All rights reserved.

ZORK is a registered trademark of Infocom, Inc.

Revision 88 / Serial number 840726

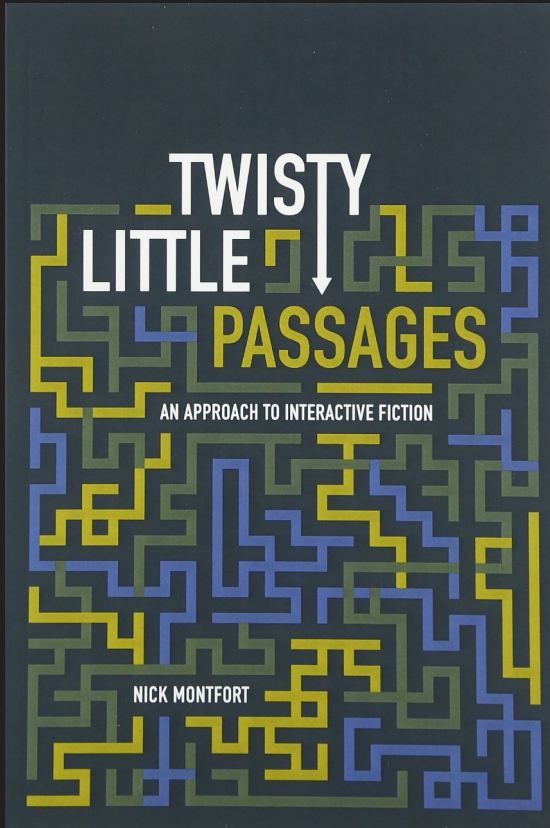
West of House

You are standing in an open field west of a white house, with a boarded front door.

There is a small mailbox here.

>

# Components of Interactive Fiction Games



- The **parser**, which is the component that analyzes natural language input in an interactive fiction work.
- The **world model**, which is setting of an interactive fiction work.

# The Parser

```
West of House                               Score: 0           Moves: 6
West of House
You are standing in an open field west of a white house, with a boarded front
door.
There is a small mailbox here.

>get mailbox
It is securely anchored.

>get key
You can't see any key here!

>push mailbox
Pushing the small mailbox isn't notably helpful.

>pull mailbox
You can't move the small mailbox.

>kick mailbox
Kicking the small mailbox doesn't seem to work.

>Smell mailbox
It smells like a small mailbox.

>Leave the field
I don't know the word "field".

>where am i
I don't know the word "am".

>what am I supposed to do
I don't know the word "am".
```

# Commands

Players input simple sentences such as “get key” or “go east”, which are interpreted by a text parser. Parsers may vary in sophistication; the first text adventure parsers could only handle two-word sentences in the form of **verb-noun** pairs.

# Action Words

Farmer and Mrs. Pig certainly have a lot of children. And they are all doing something.



eating

drinking

standing

sitting

lying down

holding and smelling



pushing

riding

pulling

talking

listening

kneeling



laughing

smiling

frowning

crying

walking

running

jumping



shouting

whispering

giggling

tripping

hiding



reading

writing

drawing

watching



falling

giving

taking

digging

building



pointing

looking

sewing

blowing

singing and dancing



kicking

kissing

hugging

wrestling



Lowly is wriggling.

And what is Mr. Frumble doing?  
Why, Mr. Frumble is still chasing his hat!  
I wonder if he will ever catch it.

You just started up a game and now you're staring at *text* and a *blinking cursor* and you *don't know what to do!* (> |)

Don't panic kids—

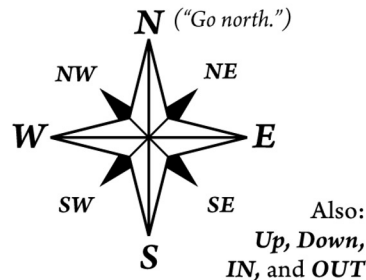
Crazy Uncle Zarf is here to help you get started...

These commands are very common:

EXAMINE it	PUSH it
TAKE it	PULL it
DROP it	TURN it
OPEN it	FEEL it
PUT it IN something	
PUT it ON something	

When in doubt, examine more.

Does the game intro suggest ABOUT, INFO, HELP? Try them first!



You are standing in an open field west of a white house, with a boarded front door. There is a small mailbox\* here.

\*Try opening!

You can try all sorts of commands on the things you see.

Try the commands that make sense!

Doors are for opening; buttons are for pushing; pie is for eating. (Mmm, pie.)



If you meet a person, these should work:

TALK TO name  
ASK name ABOUT something  
TELL name ABOUT something  
GIVE something TO name  
SHOW something TO name

Each game has slightly different commands, but they all look pretty much like these.

You could also try:

EAT it	CLIMB it
DRINK it	WAVE it
FILL it	WEAR it
SMELL it	TAKE it OFF
LISTEN TO it	TURN it ON
BREAK it	DIG IN it
BURN it	ENTER it
LOOK UNDER it	SEARCH it
UNLOCK it WITH something	

Or even:

LISTEN	JUMP
SLEEP	PRAY
WAKE UP	CURSE
UNDO†	SING

†Take back one move — handy!

“What if I only want to type one or two letters?”



N/E/S/W/NE/SE/NW/SW: GO in the indicated compass direction.

L: LOOK around to see what is nearby.

X: EXAMINE a thing in more detail.

I: take INVENTORY of what you possess.

Z: WAIT a turn without doing anything.

G: do the same thing AGAIN



A service of the People's Republic of Interactive Fiction:

<http://pr-if.org>

# Vocabulary

- The original Zork I (1980) had a 600-word vocabulary.
- Trinity (1986) could understand stand 2,120 different words.

# Early Parsers



*Adventure's* verb-noun parser was extremely primitive but removed **ambiguity**.



Ambiguity means that there are multiple interpretations of a sentence, which denote distinct meanings.



## Lexical Ambiguity

The presence of two or more possible meanings within a single word.



"I saw her duck."

## Syntactic Ambiguity

The presence of two or more possible meanings within a single sentence or sequence of words.



"The chicken is ready to eat."

# Basic Linguistics

**Stop words:** Function words like “the” could be stripped from user input, so that “GET THE LAMP” was sent to the parser as “GET LAMP”.

**Prepositions:** “LOOK AT” and “LOOK UNDER” were only considered different by the parser if they were implemented as separate verbs and mapped onto different actions.

**Direct and indirect objects:** Some parsers recognized direct and indirect objects like GIVE [THE BOOK] TO [CHRIS].

“open the red box with the green key then go north”.

Later parsers, such as those built on ZIL (Zork Implementation Language), could understand complete sentences. They could handle more complex inputs.

# Z-machine

Infocom developed a virtual machine to deploy standardized “story files” on many platforms.

The Infocom parser was the best of its era.

It accepted complex, complete sentence commands when its competitors’ parsers were restricted to simple two-word verb-noun combinations.

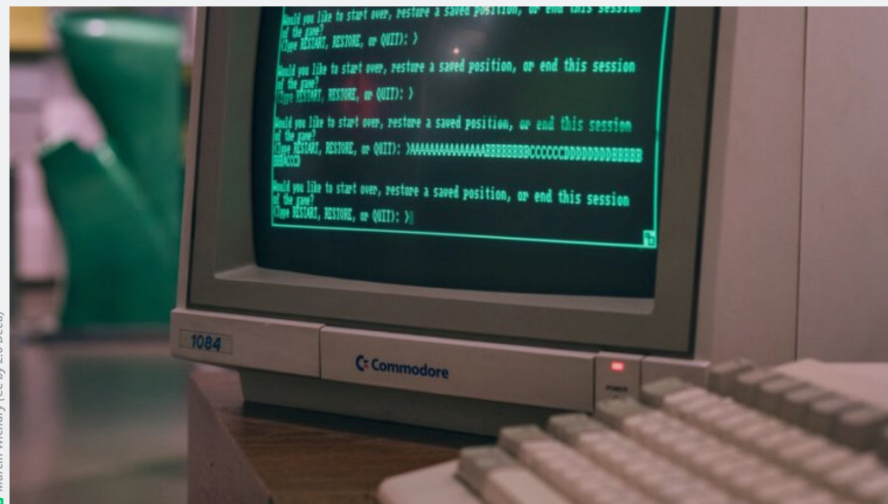
Its parser was actively upgraded, and later games would ‘understand’ multiple sentence input: ‘pick up the gem and put it in my bag. take the newspaper clipping out of my bag then burn it with the book of matches’.

AN ANCIENT INSCRIPTION, PROBABLY A PRAYER IN A FORGOTTEN LANGUAGE —

## Infocom’s ingenious code-porting tools for *Zork* and other games have been found

The Z-machine allowed porting from mainframes to TRS-80, Apple II, and others.

KEVIN PURDY - 11/21/2023, 2:21 PM



B Martin Wichary (CC BY 2.0 Deed)

The source code for many of Infocom’s foundational text-parsing adventure games, including *Zork*, has [been available since 2019](#). But that code doesn’t do anything for modern computers, nor even computers of the era, when it comes to actually running the games.

Most of Infocom’s games were written in “Zork Implementation Language,” which was native to no particular platform or processor, but ready to be interpreted on all kinds of systems by versions of [its Z-Machine](#). The Z-Machine could be considered the first real game development engine, so long as nobody fact-checks that statement too hard. Lots of work has been done in open source realms to create modern, and improved, [versions of these interpreters](#) for pretty much every device imaginable.

# Why were parsers so bad?



**Limited computational resources.** Computers had  $\leq 128$  KB of memory



**Language is difficult.** There are many things that make human languages genuinely challenging for a computer to process.



**Keyword-based commands.** Only exact matches worked properly. No synonyms, no paraphrases.

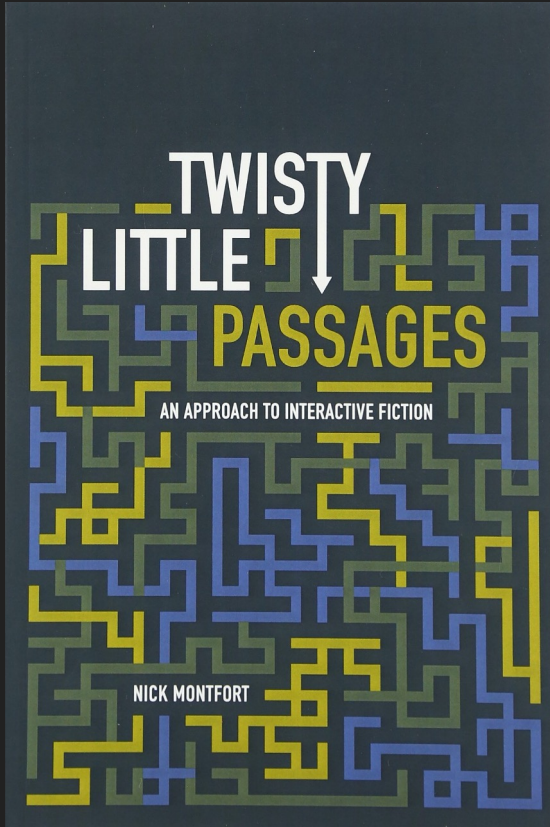


**Everything was manual.** Game developers had to anticipate all possible commands, and manually code the responses.



**No machine learning.** This was prior to the advent of machine-learning-based natural language processing

# Components of Interactive Fiction Games



- The **parser**, which is the component that analyzes natural language input in an interactive fiction work.
- The **world model**, which is setting of an interactive fiction work.

# World Model



It represents the physical environment, and things like

- Settings or locations
- Physical objects in each setting
- The player's character
- Non-player characters

It also represents and simulates the physical laws of the environment.

# Locations

You are at a complex junction. A low hands and knees passage from the north joins a higher crawl from the east to make a walking passage going west. There is also a large room above. The air is damp here.

*A location in Colossal Cave Adventure*



# Navigation in a Text-based World

Cardinal Directions: Go North/South/East/West/  
Northwest/Northeast/Southwest/Southeast

Also: Go Up, Down, In and Out

One letter commands were also supported:

N/E/S/W/NE/SE/NW/SW

Look/L: look around to see what is nearby

Not every direction is possible in every location.



# Colossal Cave Adventure

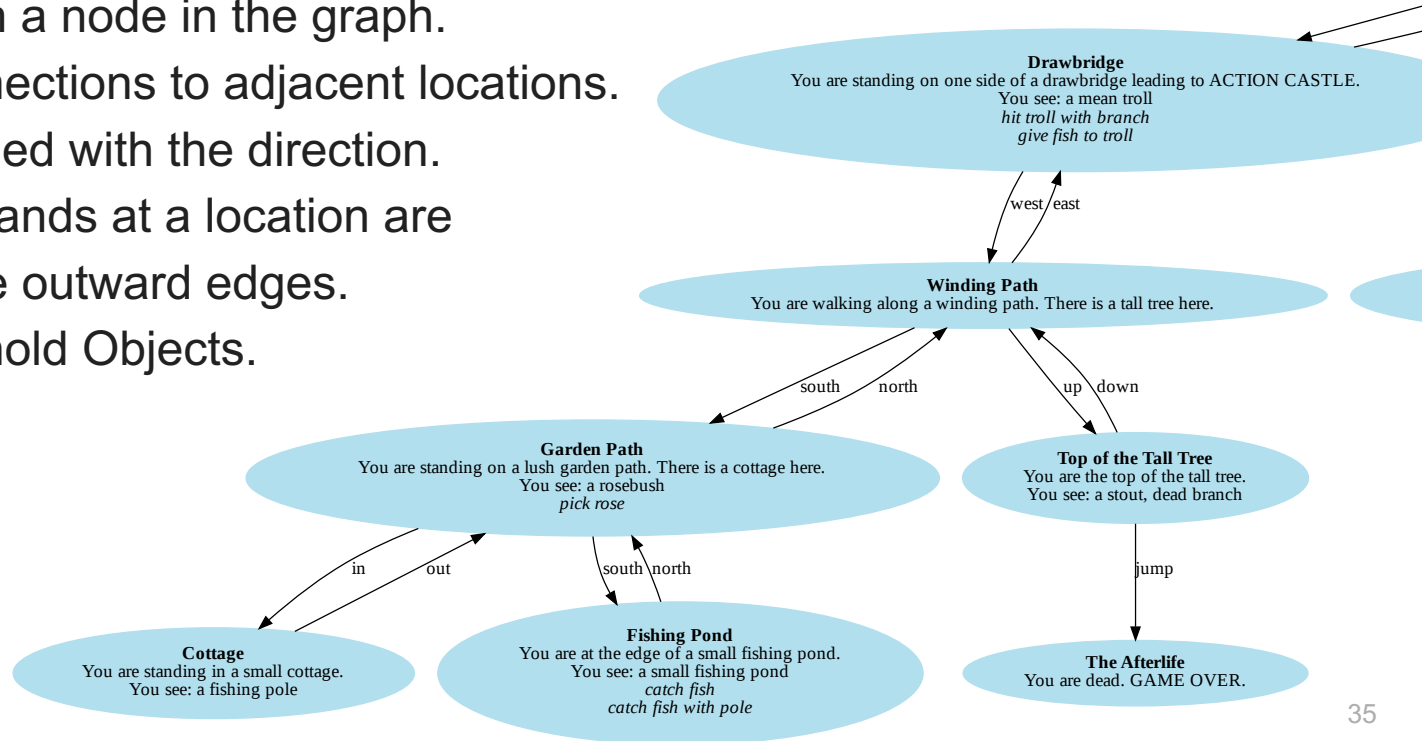
You are standing at the end of a road before a small brick building. Around you is a forest. A small stream flows out of the building and down a gully.

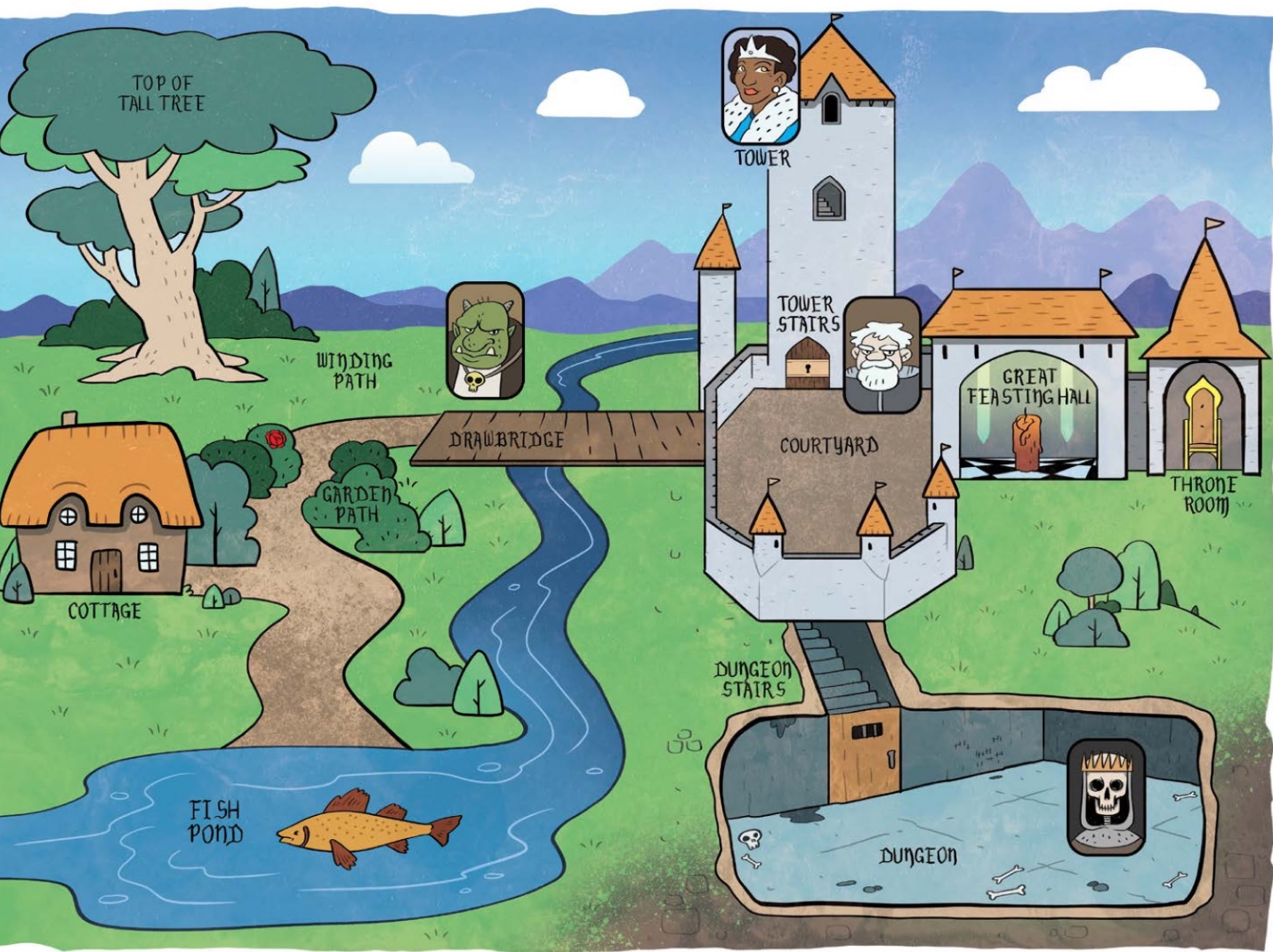
> go south

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

# As a Data Structure

- You can implement an IF game as a directed graph.
- Each location is a node in the graph.
- Edges are connections to adjacent locations.
- Edges are labeled with the direction.
- Possible commands at a location are the labels of the outward edges.
- Locations can hold Objects.



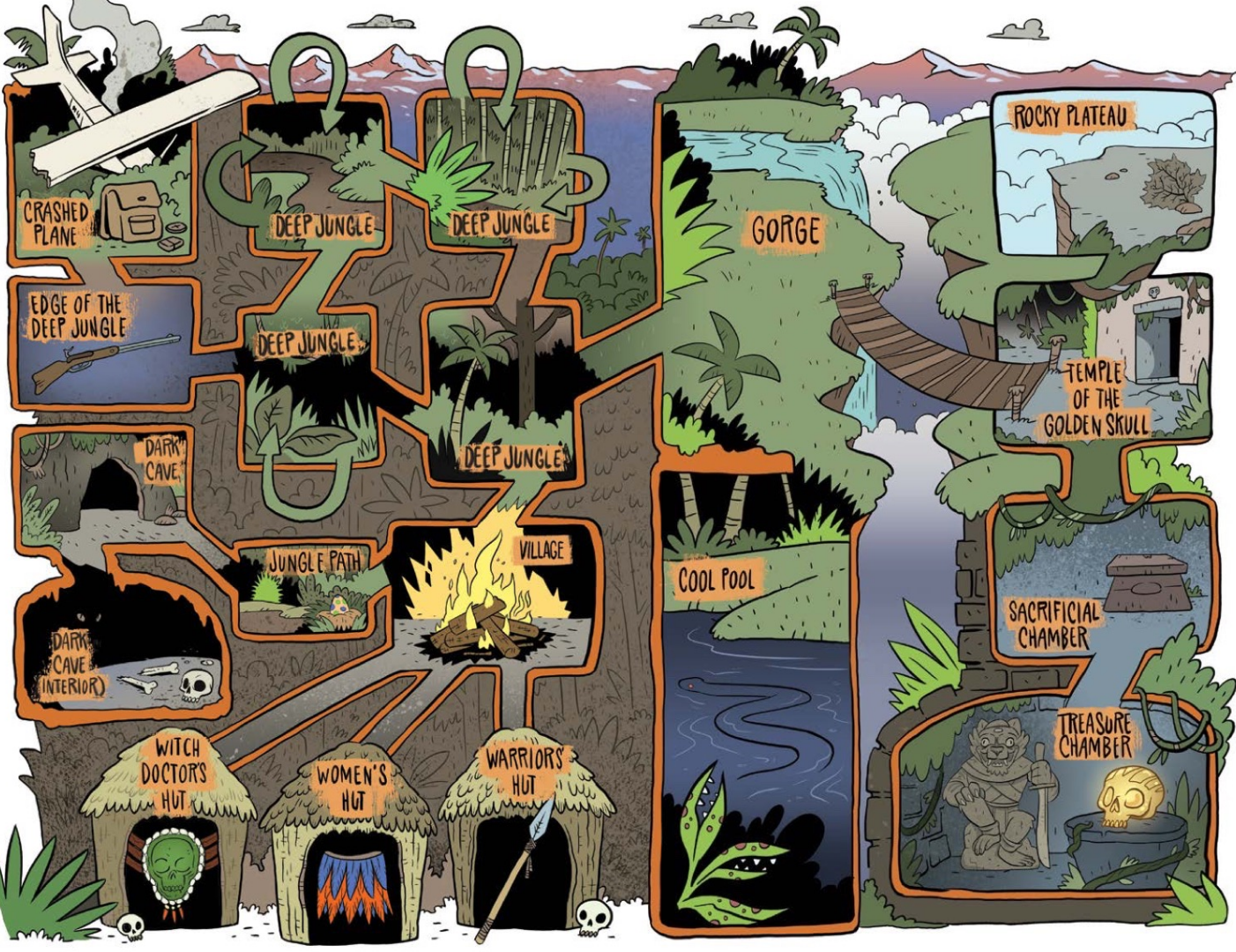


Your greatest challenge lies ahead—and downward.

# ACTION CASTLE

The original Parody game! Explore the lands of Action Castle, brave the dangers and claim the throne!

FANTASY BEGINNER EVERYONE (10+)



## DEEP JUNGLE

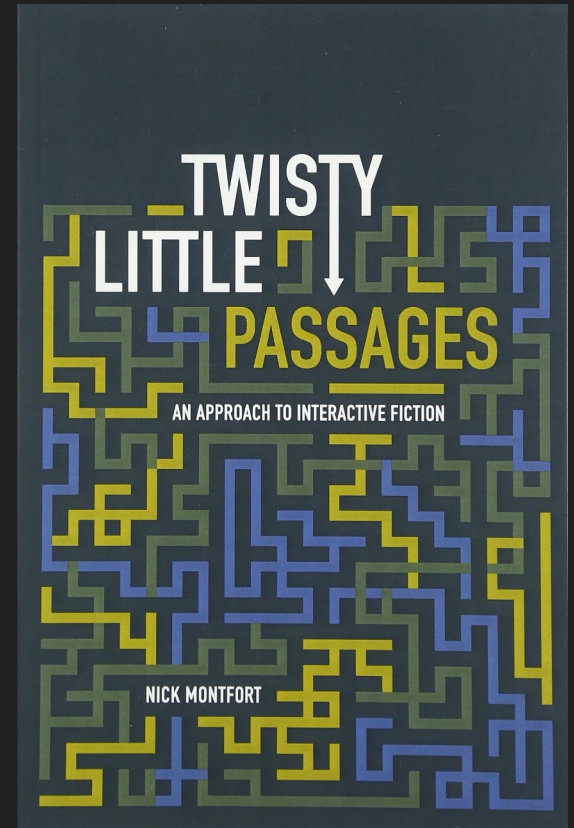
You are lost in the deep jungle.

- > Each location within the Deep Jungle has four exits: NORTH, SOUTH, EAST and WEST. Some of these—marked with U-turn arrows—lead back to the previously entered area.
- > If the player examines the compass while lost in the Deep Jungle, the actual exits are revealed and the U-turns are ignored.

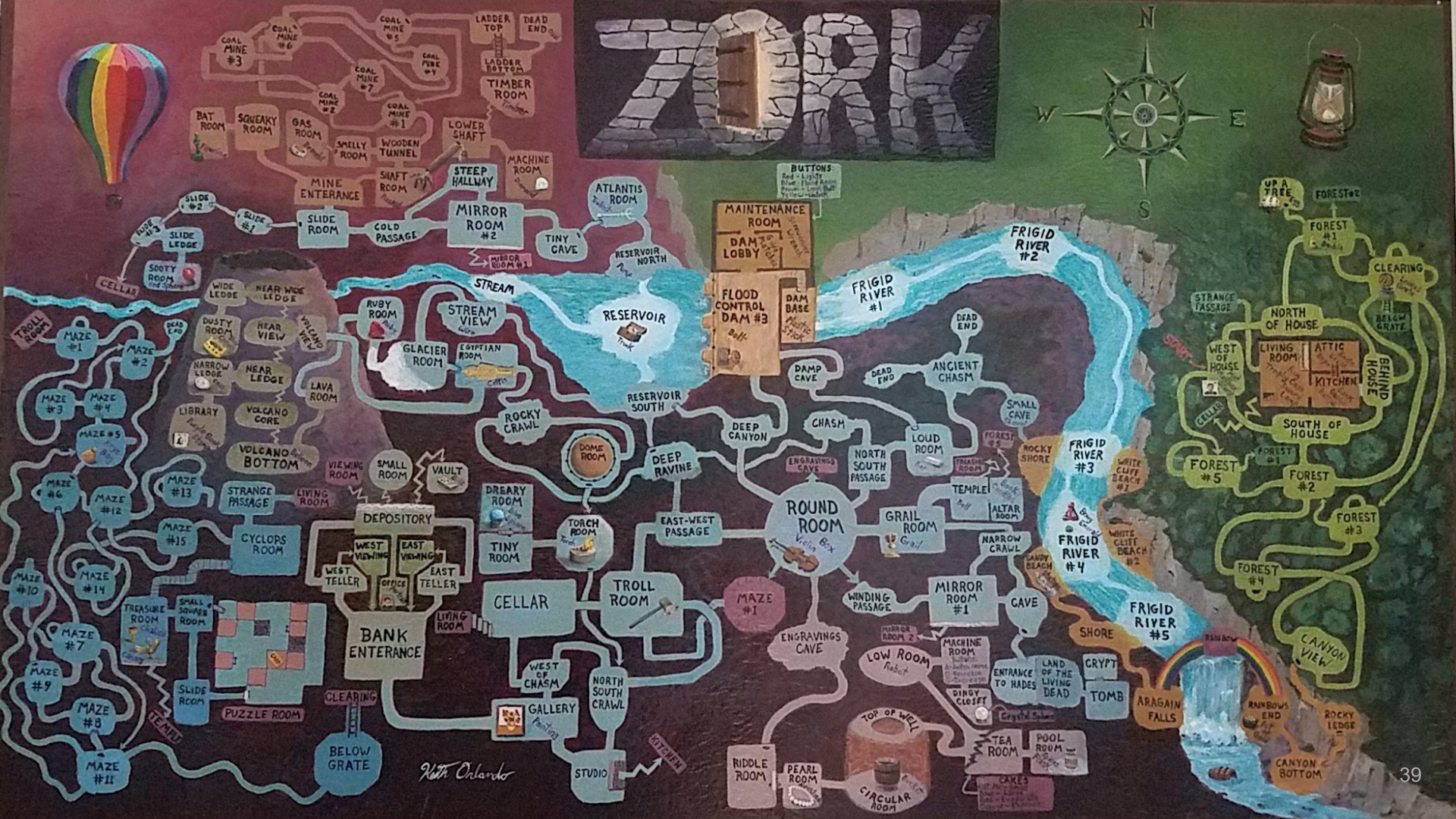
# Maps and Mazes

There was a maze in Adventure that was essentially impossible to get through without making a map. The pirate's maze offered rooms that were all uniformly described as “a maze of **twisty little passages**, all alike.”

To figure out which room was which, the player character had to drop objects to mark the different rooms. The rooms, once all alike, could then be differentiated based on their contents, and mapping ping of the usual sort was possible.



# ZORK



With Orlando

# Objects

In Adventure, instead of a realistic simulation of caving, the author placed five treasures within as an incentive to explore the cave.

The player had to figure out how to get past a snake to move deeper into the cave. The player is attacked by dwarves and their treasure is stolen by a pirate.



# Examine Lamp

Items represent things in the game world. Usually, they are mentioned in the description of a location like:

```
You are on the dungeon stairs. From above, you can  
make out some of the king's guards talking about  
current events. Someone's left an old lamp here.
```

```
Players can inspect them with the "EXAMINE"  
command.
```

```
> EXAMINE LAMP
```

```
This old lamp seems like it's seen some use. It  
ran out of oil ages ago.
```

# Get Lamp

Players can pick up objects in the world, and they are added to the player's inventory with the "GET" command. The inventory is the set of things that the player has collected along the way.

Oftentimes, they are used to solve puzzles. For instance, you must have a lamp in your inventory in order to explore a dark cave.

To list all items that you have, you can issue the "INVENTORY" command (or just the letter "I").

# Light lamp

Objects often have special commands associated with them. For instance, to solve the darkness puzzle you must say “LIGHT LAMP”.

Some special commands require more than one object in your inventory.

On the table is an elongated brown sack, smelling of hot peppers.

A clear glass bottle is here.

The glass bottle contains:

A quantity of water.

>w

You are in the living room. There is a door to the east. To the west is a wooden door with strange gothic lettering, which appears to be nailed shut.

In the center of the room is a large oriental rug.

There is a trophy case here.

On hooks above the mantelpiece hangs an elvish sword of great antiquity.

A battery-powered brass lantern is on the trophy case.

There is an issue of US NEWS & DUNGEON REPORT dated 28-JUL-80 here.

>get sword

Taken.

>break egg with sword

You rather indelicate handling of the egg has caused it some damage.

The egg is now open.

There is a golden clockwork canary nestled in the egg. It seems to have recently had a bad experience. The mountings for its jewel-like eyes are empty, and its silver beak is crumpled. Through a cracked crystal window below its left wing you can see the remains of intricate machinery. It is not clear what result winding it would have, as the mainspring appears sprung.



# Object properties

Containment: Objects may have contents (the bottle can have wine in it)

Weight: Objects have weight (some objects might be too heavy to lift)

Position: An object may be in, on, or under another object

# People are objects too

In Zork, a handful of living opponents thwart the adventurer: **the troll**, who stays put in a single room and serves as an obstacle; **the vampire bat**, who can carry off the adventurer; **the cyclops**, who can dine on the adventurer; and **the thief**, who wanders around the underground areas stealing items from the adventurer.

These people/opponents can be implemented as objects too. People objects often have a special command for dialogue via “TALK TO”.

# In-class Activity: Play a Game

<https://grizel.itch.io/>

Record your game by typing  
“TSTART” at the beginning.

Type “TSTOP” to download your  
game.



And answer these question:

1. What commands did you try that didn't work?
2. How does this experience differ from reading a non-interactive story?



The screenshot shows a top-down view of a bedroom. On the left is a wooden dresser with a bulletin board. In the center is a bed with a red and white striped blanket. On the right is a bedside table with a lamp and a black cat. To the right of the bedroom is a map of the house with a red arrow pointing to the 'bed room'. The map labels include 'bath room', 'bed room', 'kitchen', 'living room', and 'outside'. The map also shows cardinal directions: N (North), S (South), E (East), and W (West).

You are in your bedroom.  
You see: envelope, dresser, bedside table, cat.  
Exits: South, West.  
>TSTART  
OK



# Puzzles

In most interactive fiction, puzzles (sorts of challenges or obstacles) are part of the world the player character moves through. In order to complete the IF work, the interactor must figure out how to meet these challenges.

# Puzzle Solutions

The solutions may be arrived at through the player character's senses or by having the player character manipulate things in the surroundings and then observe the results to determine the workings of the world.

Most interactive fiction does not have great replay value. You cannot simply "replay" a riddle if you know its answer.

However, once you learn to play a board game, the knowledge gained from playing it once game doesn't ruin the experience of playing it again.

# Zork's diamond machine

In the coal mine, the player character finds a machine with a tiny slot in the top of it. What this machine does, and how to turn it on, is unclear.

The solution is to put some coal into the machine, and then turn on the machine using the screwdriver. This results in the coal being compressed with great force producing a diamond.

The player can act as scientist and put anything inside, then observe the results.

# Guess the Verb

A few puzzles require the player “guess the verb” and perform an action that would not be obvious from the commands available. The game's parser does not understand unless the player uses a particular way to phrase the command (sometimes non-obvious).

For example, if there is a crate to be opened with a crowbar and the only way to open it is to "**pry crate with crowbar**", other actions like "**open crate with crowbar**" give a misleading response. Usually this is a deficiency in the parser.

Some games like *Ad Verbum* by Nick Montfort intentionally include guess-the-verb puzzles to good effect in contexts where the puzzles are explicitly about language.

# Writing Style

Interactive fiction features two distinct modes of writing: the player input and the game output.

Player input is expected to be in simple **command form** (in linguistics, these are called **imperative sentences**).

> look in tea chest

“That was the first place you tried, hours and hours ago now, and there’s nothing there but that boring old book. You pick it up anyway, bored as you are.” –Graham Nelson *Curses* (1993)

**Second-Person** - The responses from the game are usually written using second-person pronouns like “you.” They also tend to be in present tense.

"I could not unlove him now, merely because I found that he had ceased to notice me."  
– Charlotte Brontë's *Jane Eyre* (1847)

**First-person** – A first-person narrative is a mode of storytelling in which a narrator relays events from their own point of view using the first-person pronouns "I" or "we". The narrator is the protagonist, or retelling events that they witnessed.

"There was a table and the March Hare and the Hatter were having tea at it: a Dormouse was sitting between them, and the other two were using it as a cushion..."  
– *Alice's Adventures in Wonderland* (1865)

**Third-Person** – All characters are referred to with third person pronouns like he, she, or. This makes it clear that the narrator is an uninvolved entity who conveys the story but is not a character in it.



# IF Summary

1. What's the difference between TTRPGs like D&D and Choose-Your-Own-Adventure games?
2. Why were IF commands so simple?
3. What makes IF games hard to win?

# Stories

What kind of stories are possible in interactive fiction? Can they be high-brow literature?

# Lance Micklus

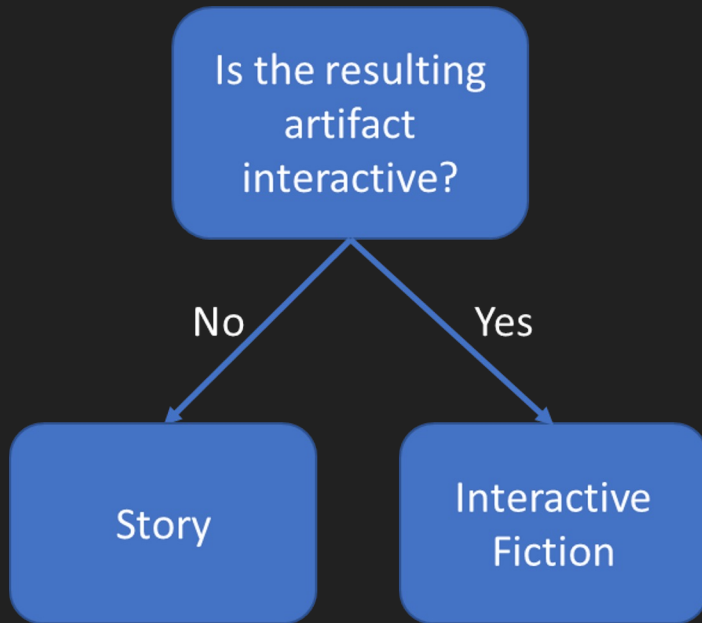
Lance Micklus, Inc.

You had to appeal to their sense of  
overcoming the odds and figuring things out.

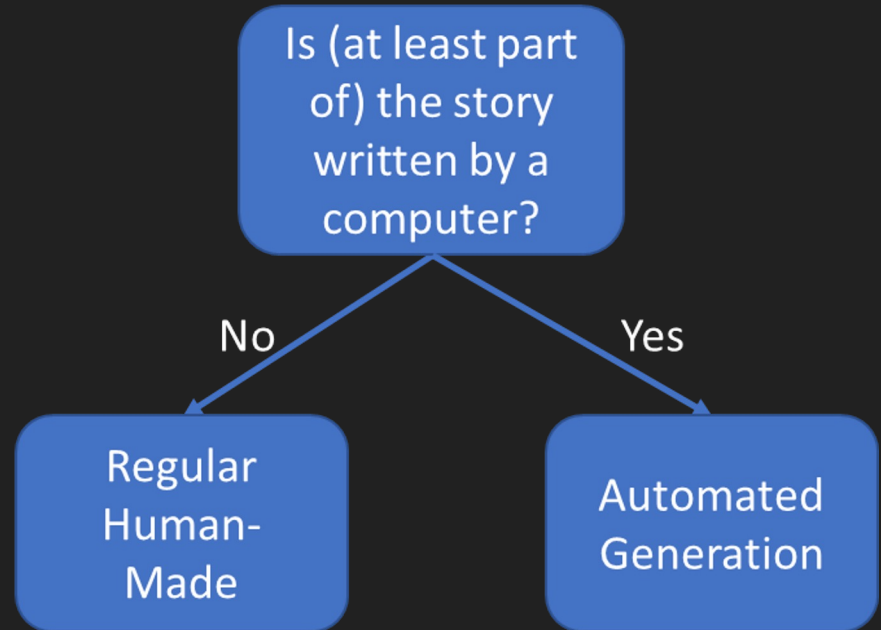
# Automated Story Generation

# Interactive Fiction vs Automated Story Generation

What is it?



How was it made?



# Early Systems

## **TALE-SPIN (1977):**

One day,  
JOE WAS THIRSTY.  
JOE WANTED NOT TO BE  
THIRSTY.  
JOE WANTED TO BE NEAR THE  
WATER.

## **UNIVERSE (1984):**

>> LIZ tells NEIL she doesn't love  
him  
working on goal – (WORRY-ABOUT  
NEIL) – using plan BE-CONCERNED  
Possible candidates – MARLENA  
JULIE DOUG ROMAN DON CHRIS  
KAYLA  
Using Marlena for WORRIER  
>> MARLENA is worried about NEIL

# Common Automated Story Generation Methods

Using a large language model to generate the next word based on their probabilities. Thus, creating stories one word at a time.

More in the next module which will focus on Large Language Models!

Using “plot graphs” to decide which path to take (like the computer is playing a Choose-Your-Own adventure game!)

Later in the course, we'll look at AI Scripts and Story Structure!

Using classical AI planning to set up a story which must have different components in place as prerequisites before each action can be taken.

# Supplemental Materials

- Get LAMP (documentary): <https://www.youtube.com/watch?v=LRhbcDzbGSU>
- Adventuron Classroom: <https://adventuron.io/classroom/>
  - Tutorial: <https://adventuron.blogspot.com/2019/07/video-tutorial-beginners-guide-to.html>
- Action Castle (Jared Sorensen):  
<https://www.youtube.com/watch?v=Sehaj4mw38s>
- An Introduction to AI Story Generation (Mark Riedl): <https://mark-riedl.medium.com/an-introduction-to-ai-story-generation-7f99a450f615>
- How to Make a Text-Based Adventure: Commands and Parser:  
[https://h2g2.com/edited\\_entry/A20600641](https://h2g2.com/edited_entry/A20600641)
- Play some IF games on Itch.io: <https://itch.io/games/tag-interactive-fiction/tag-text-based>



# Course Overview

# Course-Long Learning Objectives

- Understanding the challenges of creating text-based games and automatically generating stories.
- Implement and appraise the value of different technologies (Neural Language Models, Dialogue Systems, Scripts, Planning, and Commonsense Reasoning) in story generation/interactive fiction playing.
- Argue for the appropriate components of a working story generation system or interactive fiction–playing system.
- Create your own story generation system or interactive fiction–playing system.

# Upcoming Topics

- Building a text adventure game (Module 1)
- Large Language Models for generating descriptions of objects and locations and for parsing user commands (Module 2)
- Planning toward a goal for IF playing and story generation (Module 3)
- Character modeling and dialog (Module 4)
- AI Filmmaking with ChatGPT, Midjourney, ElevenLabs, and other tools (Module 5)



# Grading

- ~6 homework assignments = total of 55% of final grade
  - Can be completed in groups  $\leq 4$
  - Make sure to submit it as a group to Gradescope, and don't leave anyone off!
  - Larger groups will do additional work
- One final project = 30%
  - Can be completed in groups  $\leq 5$
- Participation + Paper presentations = 15%

# Group Paper Presentations

- Prepare multiple 10-15 minute group presentations on papers from the reading list.
- Your presentation should summarize the work and discuss the ways it's applicable to either interactive fiction or automated story generation.
- We'll follow a [role-playing paper-reading seminar format](#) where each person in your group will play a different role (e.g. Scientific Peer Reviewer, Archaeologist, Academic Researcher, Industry Practitioner, Hacker, etc)
- Grading:
  - **50%: Send us your slides by Monday at 3 PM the week of your presentation**
  - 50%: presentation to the class

# Links

- Ed Discussion (<https://edstem.org/us/courses/50468/>) – preferred method of contact
- Course website (<https://interactive-fiction-class.org>) – where all homework assignments will be located
- Canvas (<https://canvas.upenn.edu/courses/1770477>) – mainly used for calendar of due dates



Due Tuesday January 23 before class starts



# Homework 1

Implement a text adventure game in Python.

Due 1/30/24 before class starts

# Homework 2

Learn how to work with large language models for interactive fiction.

Due 2/6/24

