



# Interactive Fiction and Text Generation

Daphne Ippolito  
Chris Callison-Burch

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

# Daphne Ippolito

5<sup>th</sup> year PhD student in NLP

## Research Interests

- Better coherence for story generation
- Understanding the properties and limitations of generated text
- Music generation
- Decoding strategies for language models



# Chris Callison-Burch

Professor in CIS

## Research Interests

- Machine translation
- Natural language understanding
- Paraphrases

## Fun fact:

- I have an army of 200+ R2D2s in my office



# Today's Class



TEXT  
ADVENTURE  
GAMES



IN-CLASS  
ACTIVITY



COURSE  
OVERVIEW

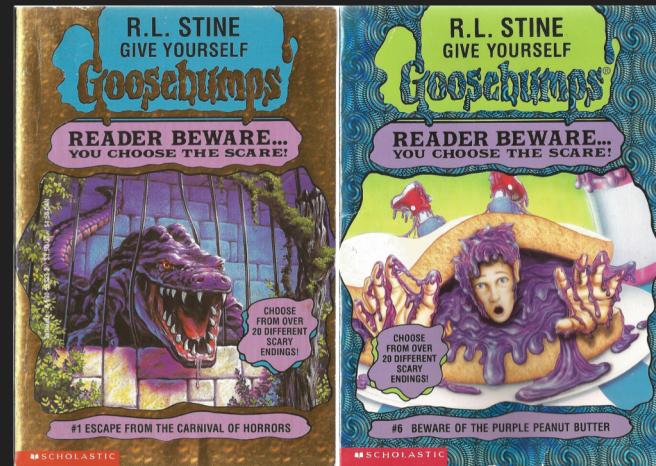
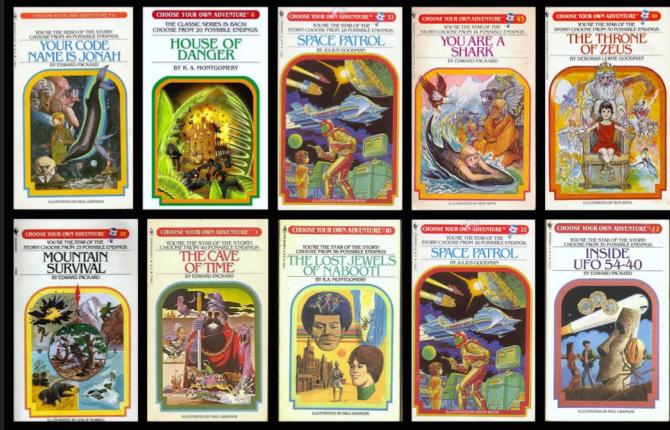
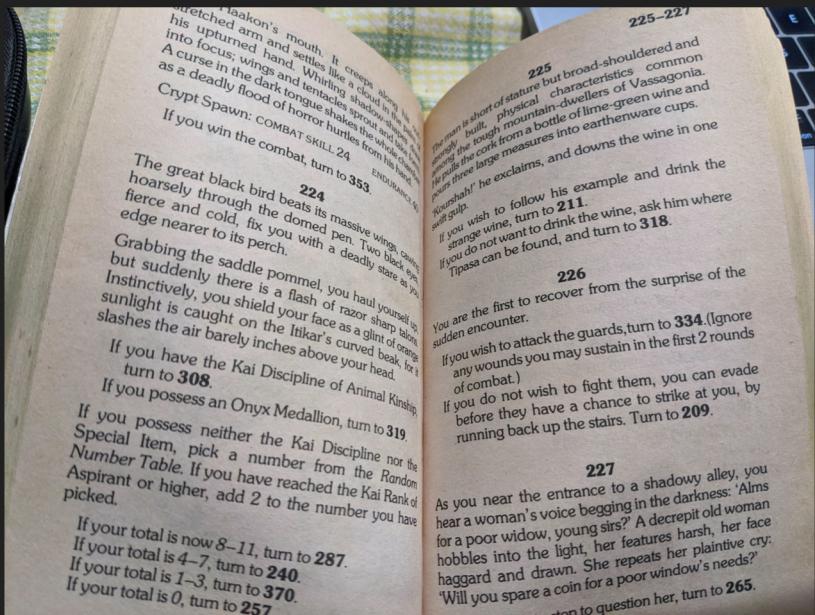


NLP  
INTRODUCTION

# Text Adventure Games

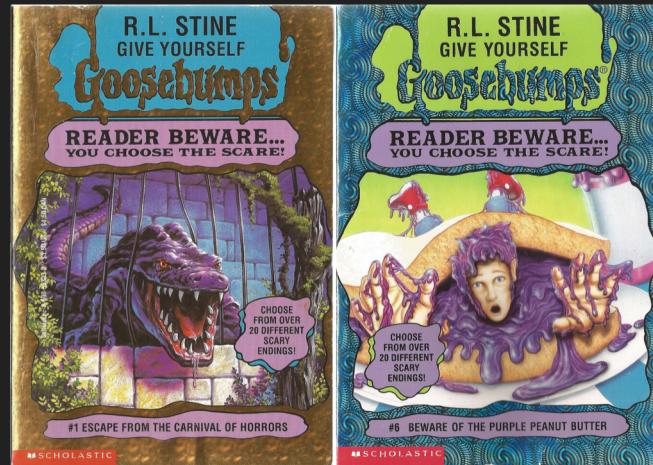
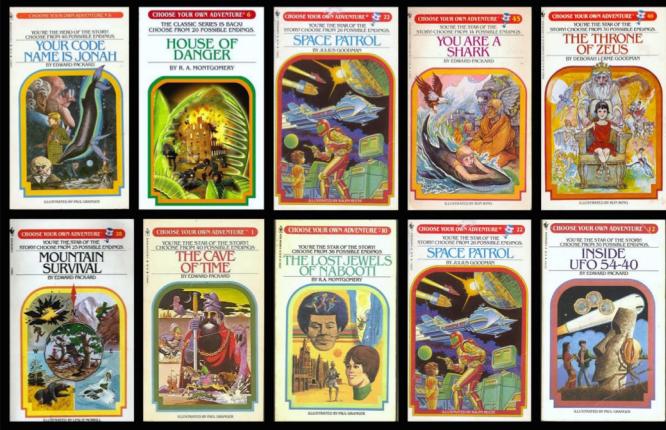
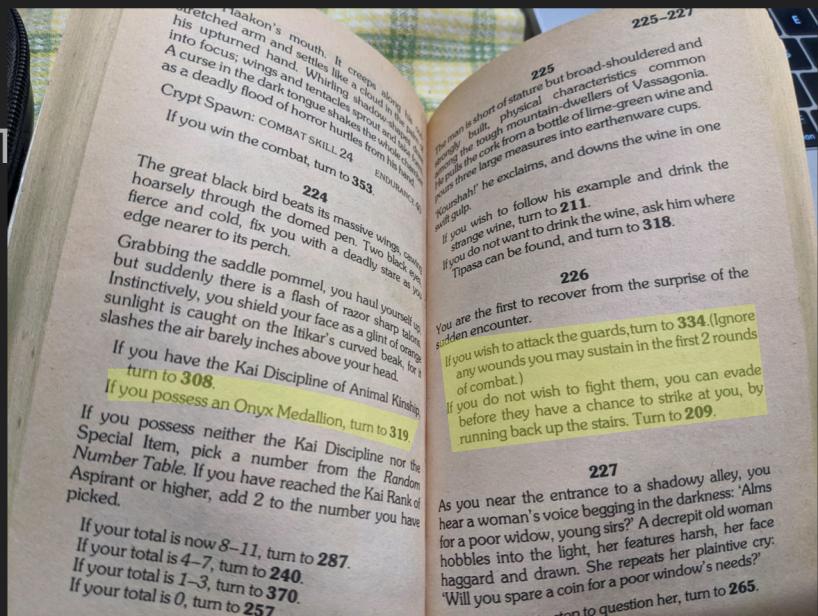
# Paper Interactive Fiction

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



# Paper Interactive Fiction

In the 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

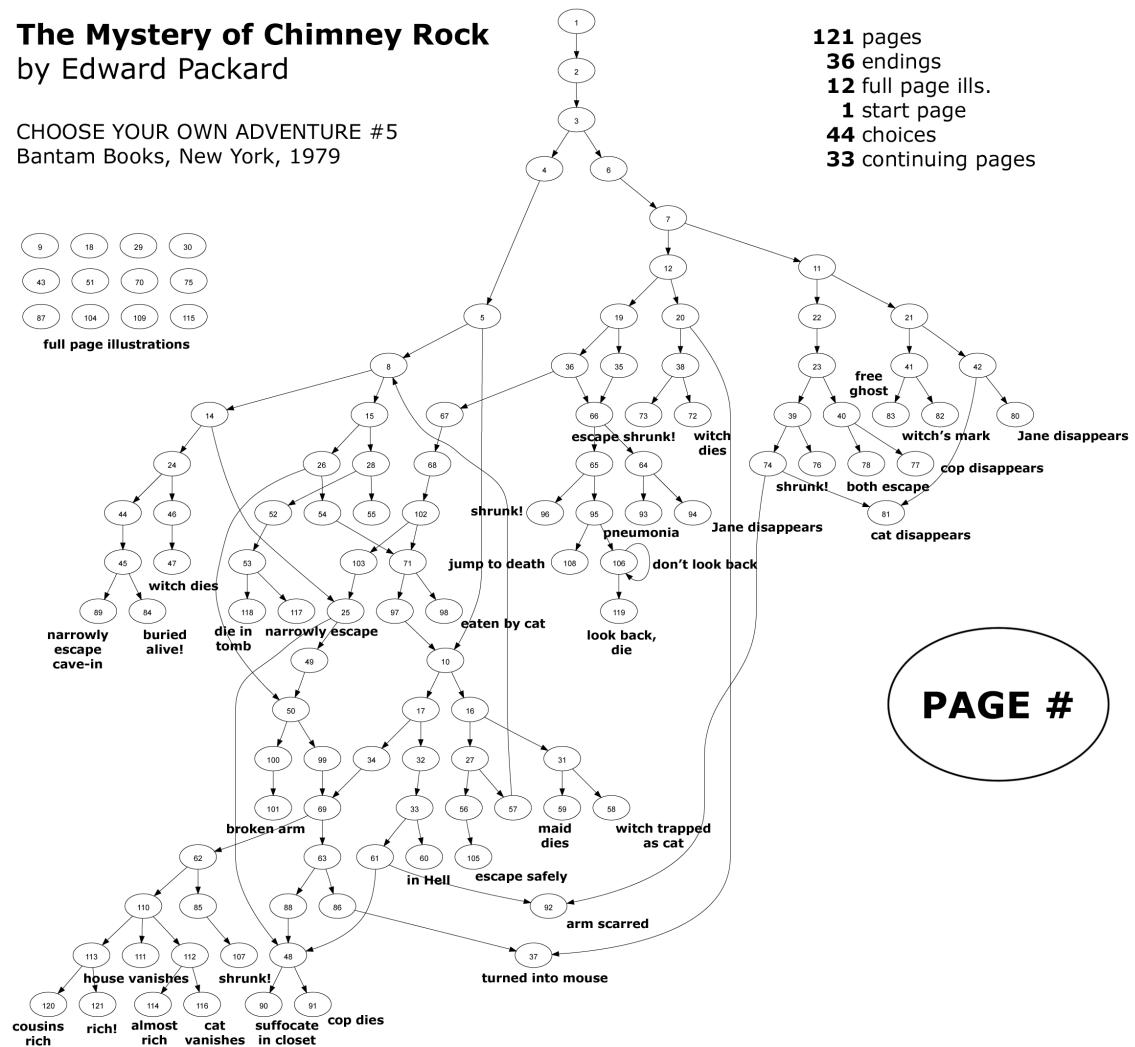
## The Mystery of Chimney Rock

by Edward Packard

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



full page illustrations

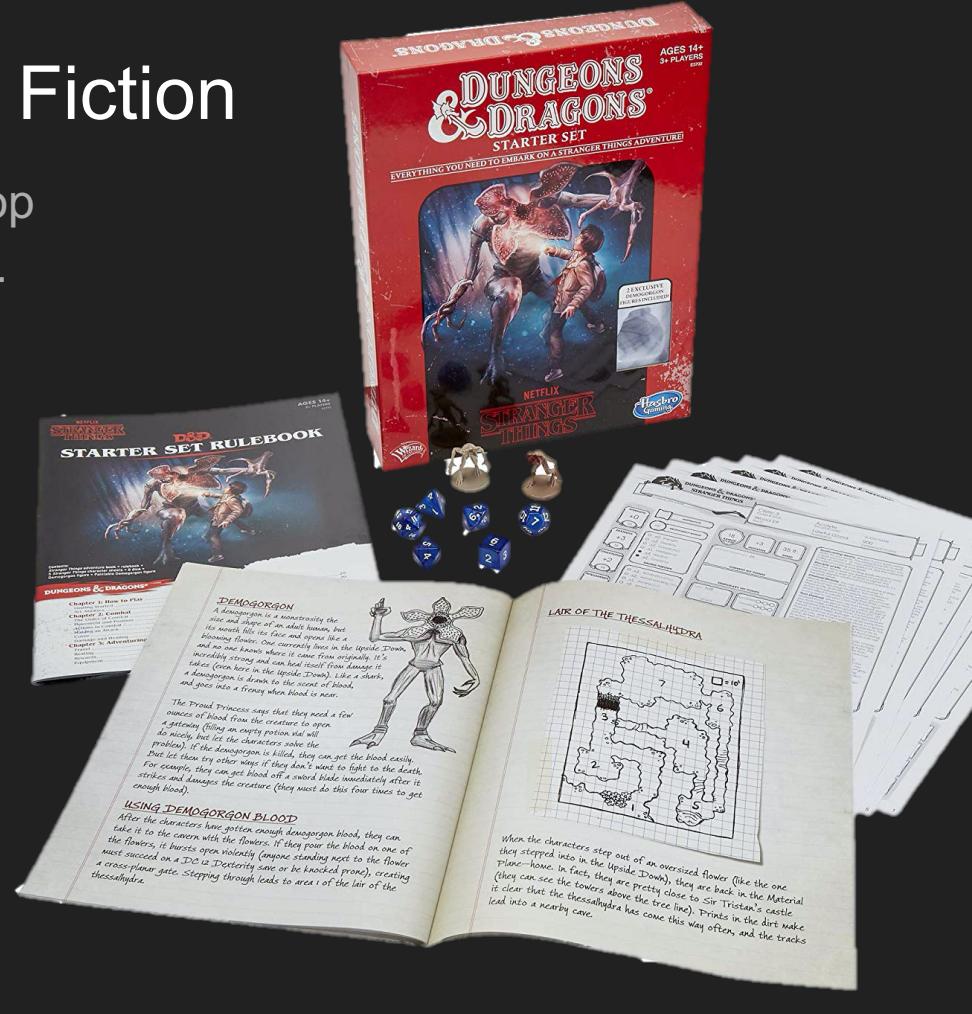


**121** pages  
**36** endings  
**12** full page ill.  
**1** start page  
**44** choices  
**33** continuing pages

PAGE #

# Paper & Pencil Interactive Fiction

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



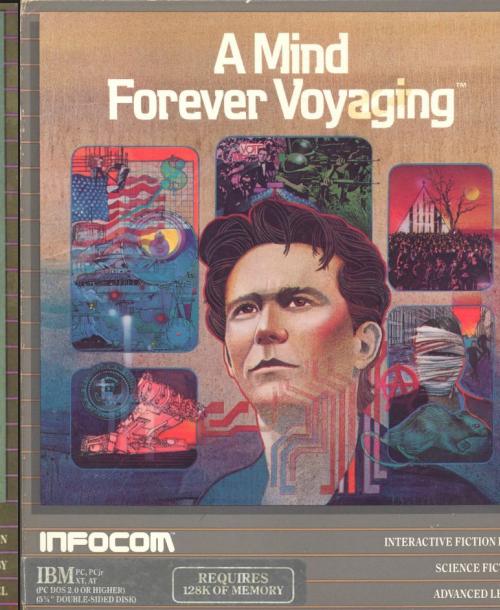
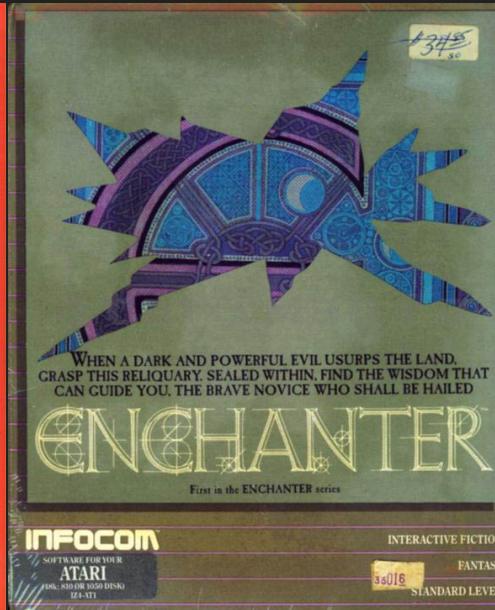
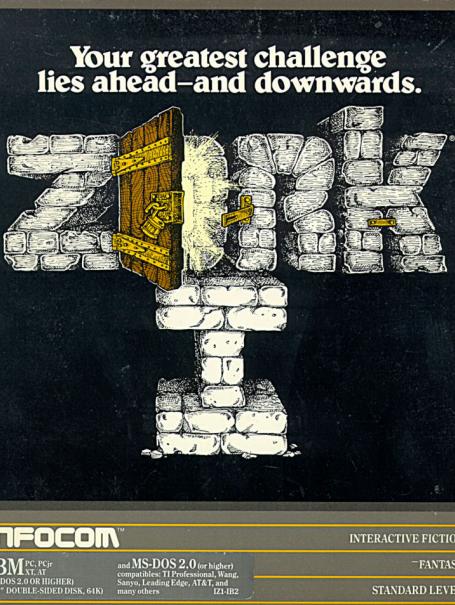
# DUNGEONS AND DRAGON

D&D is an open-ended 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. Dice are rolled to help determine the outcome of combat and other encounters. Over the course of many adventures, the members of a party advance in level and become more powerful-and the dungeon master devises new challenges for them.

# Computer Games Before Graphics

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



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.

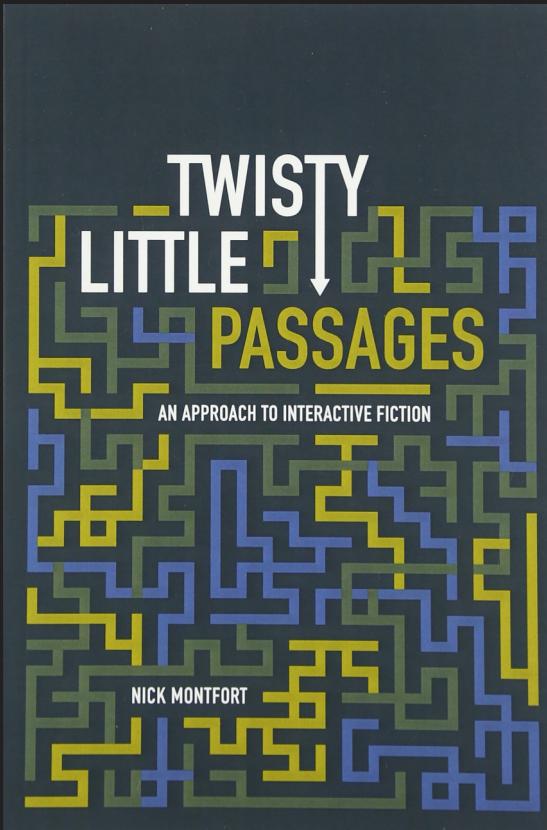
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# Lance Micklus

Lance Micklus, Inc.

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

# 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.

# Natural Language Understanding

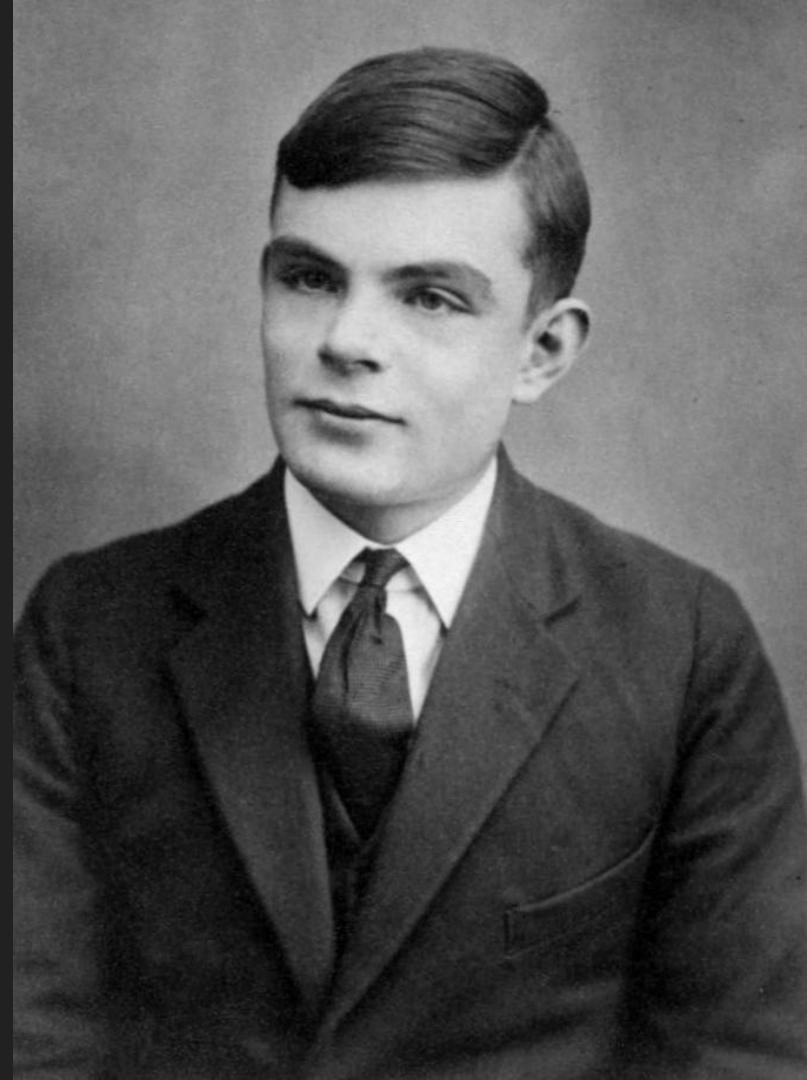
Will it rain tomorrow? Set an alarm for 6:30a.m. Play music from They Might Be Giants. How many pints are in a gallon? Add blueberries to my shopping list. When did California become a state? When is the Winter solstice? What is the weather like in Hawaii this weekend? Turn off the lights. Open the pod bay doors.



# Turing Test

The idea of computer conversation was developed along with the general-purpose purpose digital compute. Turing presented it in his 1950 paper “Computing Machinery and Intelligence”. Which introduced the Turing Test. The question “Can machines think?” could then be replaced by one that was easier to answer: “Are there imaginable digital computers which would do well in the imitation game?”

Turing highlighted lighted the importance of conversational ability to our perception of intelligence, at a time when computers almost exclusively processed numbers rather than language.



# Turing Test

A human evaluator would judge text-based conversations between a human and a machine designed to generate human-like responses. If the evaluator cannot reliably tell the machine from the human, the machine is said to have passed the test. The test results do not depend on the ability to give correct answers to questions, only how closely one's answers resemble those a human would give.



# Early Natural Language Understanding

Welcome to

```
EEEEEE LL      IIII  ZZZZZZ  AAAAAA  
EE      LL      II      ZZ  AA  AA  
EEEEEE LL      II      ZZZ  AAAAAAAA  
EE      LL      II      ZZ  AA  AA  
EEEEEE LLLLLL IIII  ZZZZZZ  AA  AA
```

Eliza is a mock Rogerian psychotherapist.

The original program was described by Joseph Weizenbaum in 1966.

This implementation by Norbert Landsteiner 2005.

ELIZA: Is something troubling you ?

YOU: Men are all alike.

ELIZA: What is the connection, do you suppose ?

YOU: They're always bugging us about something or other.

ELIZA: Can you think of a specific example ?

YOU: Well, my boyfriend made me come here.

ELIZA: Is it important to you that your boyfriend made you come here ?

YOU: He says I'm depressed much of the time.

ELIZA: I am sorry to hear that you are depressed.

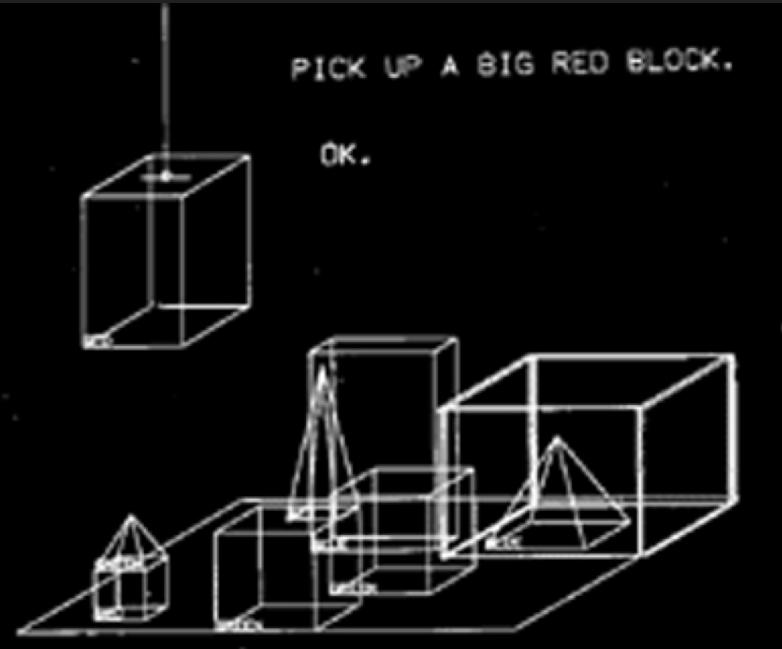
YOU: It's true. I am unhappy.

ELIZA: Can you explain what made you unhappy ?

YOU: ■

PICK UP A BIG RED BLOCK.

OK.



# ELIZA

ELIZA is a language analysis program that can run scripts to have different sorts of conversations; the most famous script was DOCTOR, which was “designed to permit it to play (or parody) the role of a Rogerian psychotherapist engaged in an interview with a patient”.

ELIZA was the first computer conversationalist, the first chatbot. ELIZA searched for keywords in input. If some were found, the program would transform the input according to a rule and print out the transformed sentence. If none were found, it would provide a default (usually noncommittal) output like “What makes you say that?”

# SHRDLU

Terry Winograd's SHRDLU had a dialog with the user via teletype and displayed an image of a tabletop with blocks on it. It could respond to natural language commands in real time. It would move the simulated blocks around if asked to; it could also answer questions about them.

SHRDLU used its knowledge of the simulated world to help it parse input. It represented its knowledge as procedures. SHRDLU had several different components. There was a module for generating replies to the user,, and one for simulating the blocks world.

# Simulated World

What's the difference between a conversational agent and a work of interactive fiction? **The simulated world.**

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* by Will Crowther (1975)

# 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.

# 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

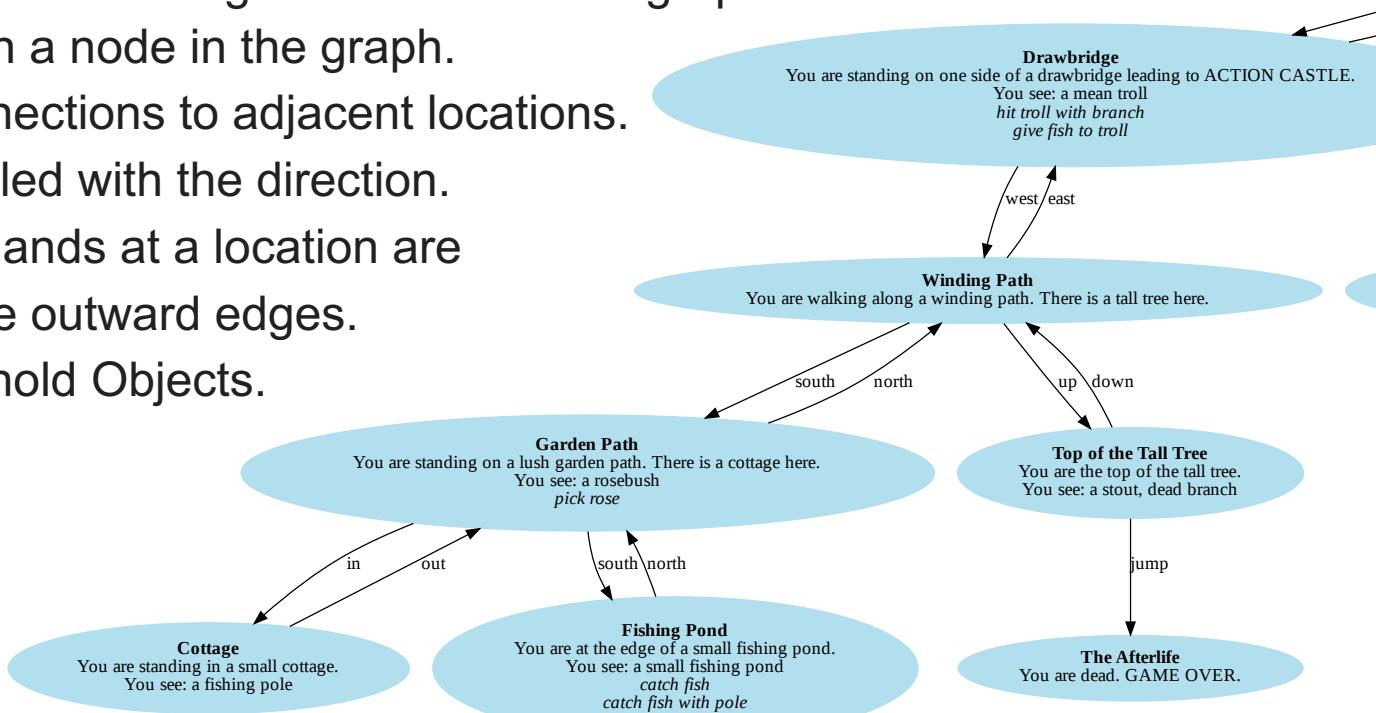
Look/L: look around to see what is nearby

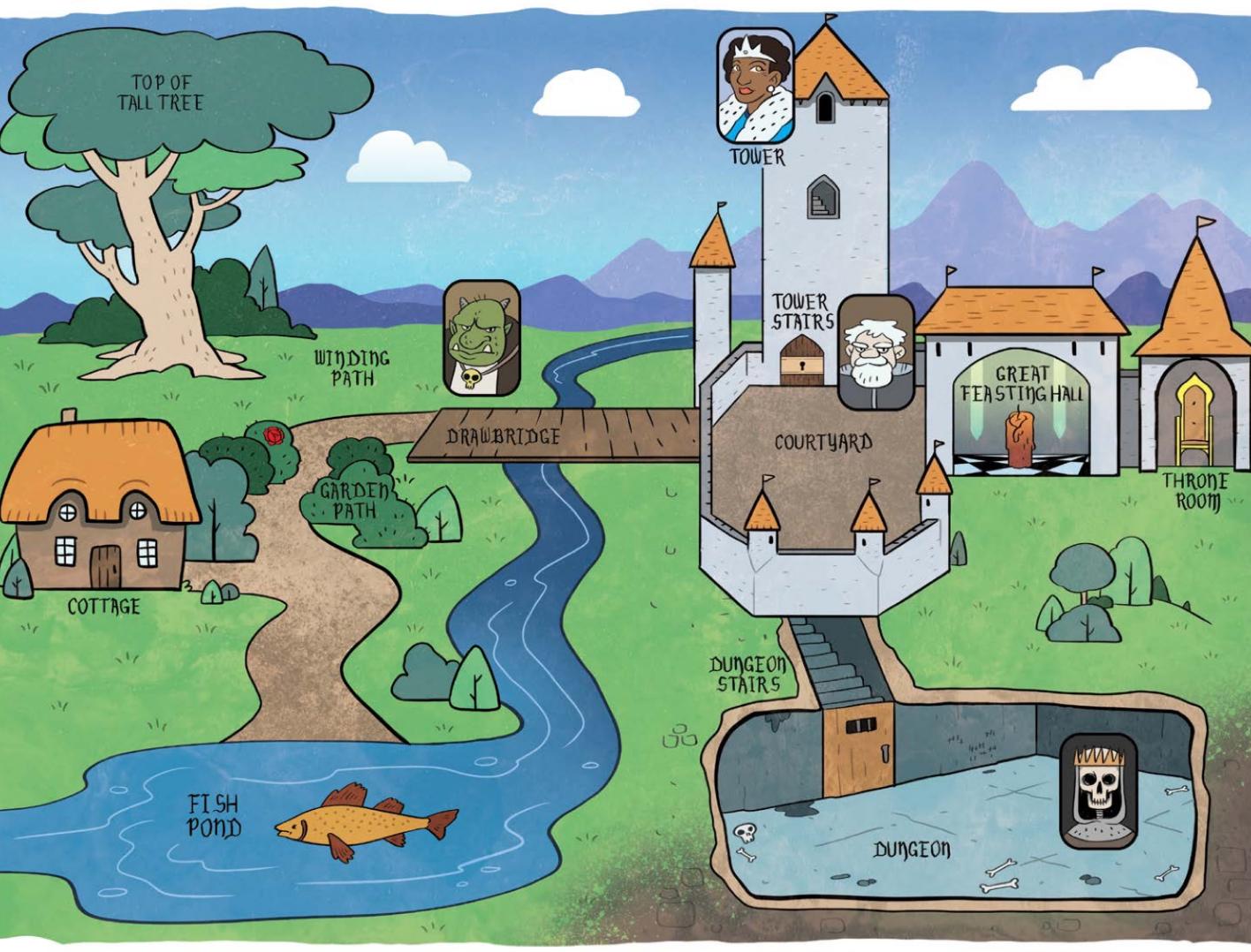
Not every direction is possible in every location.



# As a Data Structure

- You can implement an IF game as a directed graph.
- Each location in 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.





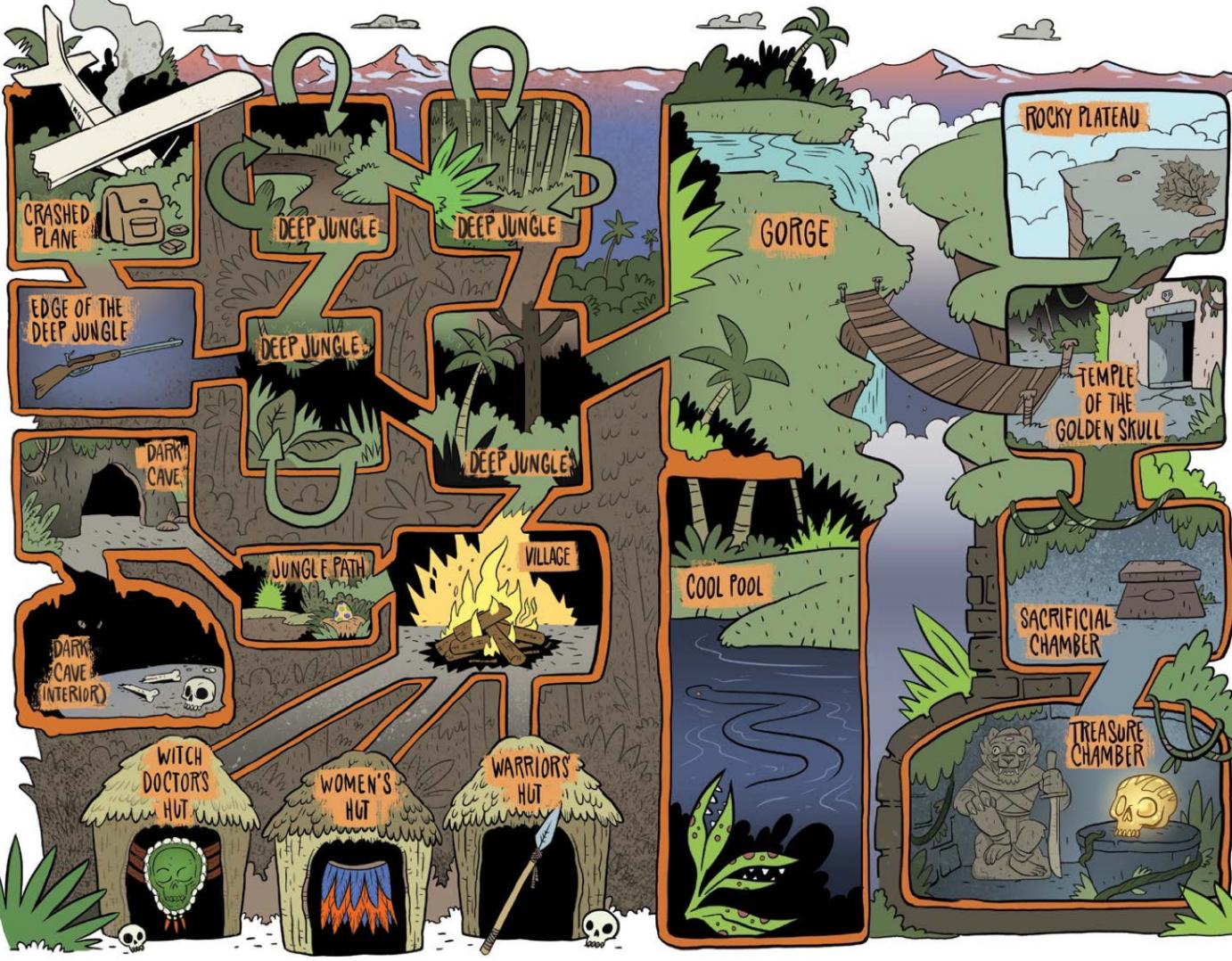
Your greatest challenge lies ahead—and downward.

# ACTION CASTLE

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

FANTASY  
BEGINNER

CONTENT RATED BY PARENTS  
EVERYONE (10+)



## DEEP JUNGLE

You are lost in the deep jungle.

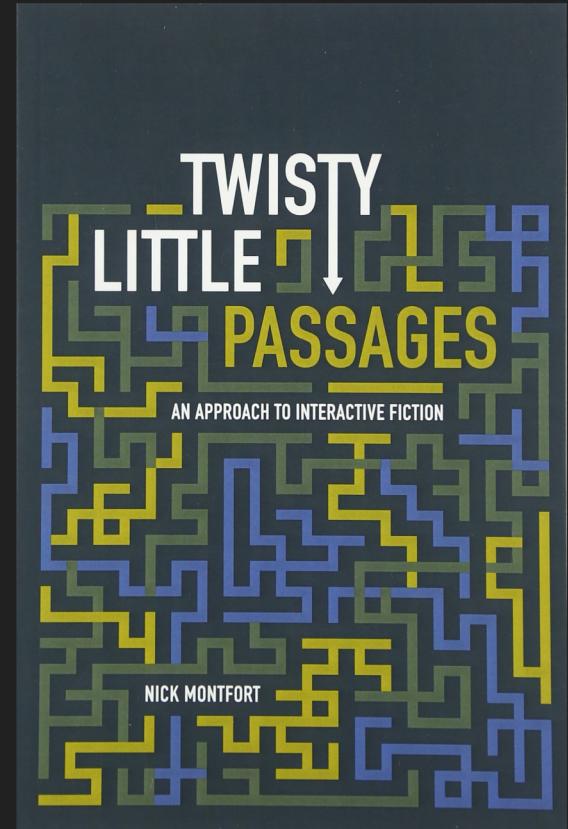
> Each location within the Deep Jungle has four exits: NORTH, SOUTH, EAST and WEST. Some of these—marked with U-turn arrows—lead back to the previously entered area.

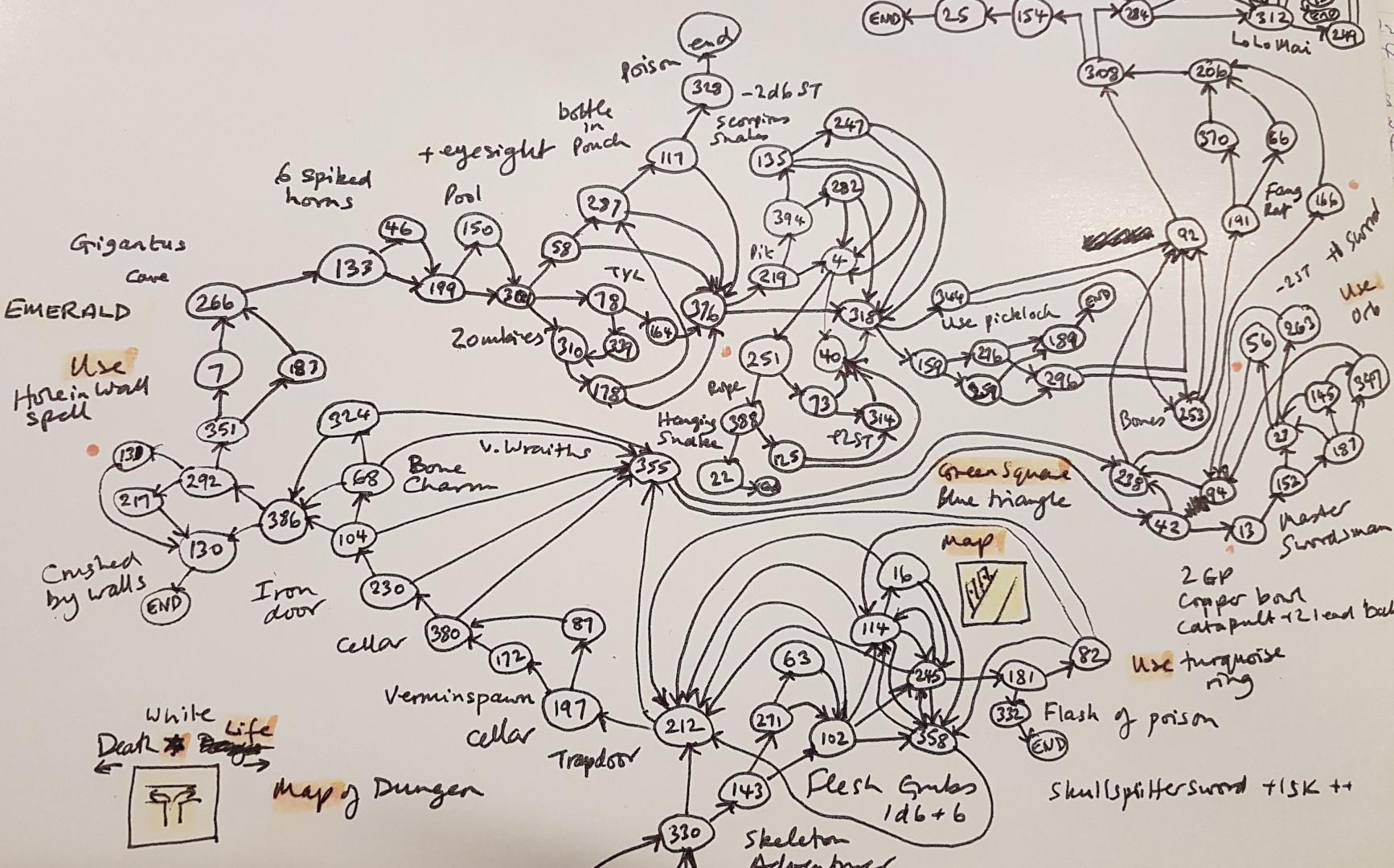
> If the player examines the compass while lost in the Deep Jungle, the actual exits are revealed and the U-turns are ignored.

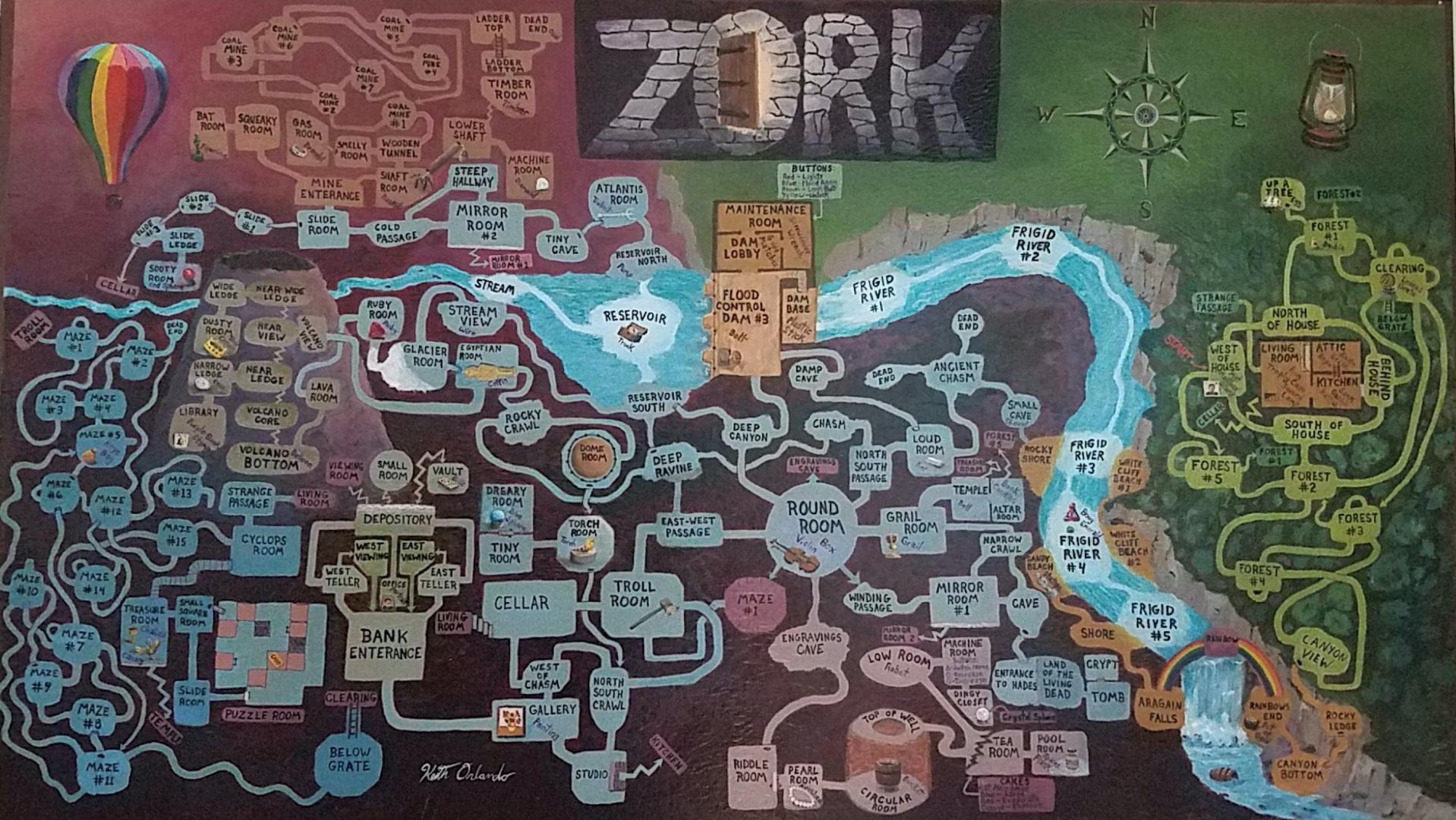
# Maps and Mazes

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.







# 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, in order to solve the darkness puzzle you must say “LIGHT LAMP”.

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

BREAK EGG

BREAK EGG WITH SWORD

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”.

# Vehicles and Robots

Zork included vehicles including a hot air balloon and a boat. They were implemented as if they were mobile rooms.

It also had a robot that the player had to command in order to get through one section of the game.

# 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.



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...

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

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.)



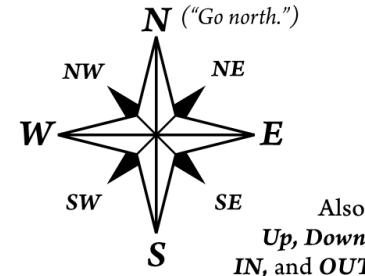
If you meet a person, these should work:

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.

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! }



“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>

*+Take back one move — handy!*

# Lance Micklus

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

# 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

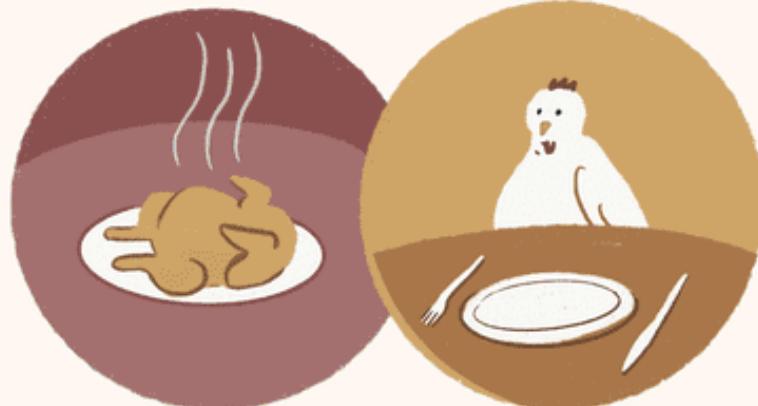
The presence of two or more possible meanings within a single word.



"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."

# I saw the girl with the telescope.



I saw the girl with the telescope.



# Vocabulary

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

# 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 [DAPHNE].

“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’.

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# 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

# 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.

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# 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.

# Stories

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

And it was clear to me from my small experience of Adventure,  
the description of Zork, the stuff I saw  
on these monochrome monitors



Robert Pinsky  
Poet Laureate of the  
United States, 1997-2000

# In-class Activity: Play Bronze

Play in groups of 2-3.

Draw a map as you go (you can use the whiteboards).

Answer the questions.

# Artificial Intelligence

How can artificial intelligence help us design better interactive fiction?

Can text adventure games help us create better AI?

From: goetz@acsu.buffalo.edu (Phil Goetz)  
Subject: Re: Adventure generators (skippable)  
Newsgroups: rec.arts.int-fiction  
**Date: 29 Oct 92 04:40:05 GMT**  
Sender: nntp@acsu.buffalo.edu  
Organization: State University of New York at Buffalo/Comp Sci

morpheus@sage.cc.purdue.edu (Morpheus Nosferatu) writes:

>Has anyone ever worked on, or even heard of, an adventure generator?

>

>I'm not talking about an adventure design language like TADS or Alan,  
>but rather a stand-alone adventure generator that produces complete  
>adventures, where the user need only give a minimal degree of input,  
>such as the level of complexity, type of adventure (mystery, treasure  
>hunt, etc.), size of adventure, and so forth?

>...

>But as anyone ever heard of someone trying to come up with a generator  
>which would produce infocom-style text adventures? I can just imagine  
>what kind of limitations it would have, but I'm curious to know if  
>anyone has tried this, and if so what degree of success they've had.

No. ... The generator you speak of is not written, not being written, and not anywhere on the horizon. In 50 years, maybe. In 20, definitely not. The problem of writing interesting stories, which adhere to someone's definition of a plot (with goal explanations, conflict, resolution, complication, climax, etc., all occurring at appropriate intervals) is very hard, and I don't expect a solution soon. But the problem of writing clever puzzles involves much greater creativity, and I have seen NO evidence that ANYBODY has a clue in these creativity issues; the most you will find in the field are a few vague theories of creativity.

This problem is what Stuart Shapiro calls "AI-complete": Solving it would be equivalent to solving all the other problems of AI.

Phil  
goetz@cs.buffalo.edu

# Text World

In 2018, Microsoft released a system that automatically generates text adventure games. These games can be played by human gamers, but they are really intended to be a testbed for automatic agents.



For more information go to  
[aka.ms/textworld](http://aka.ms/textworld)

# AI Dungeon

The project finetuned a large generative language model on thousands of lines of text adventure games. You will play with this later in class.

You are Donald, a noble living in the kingdom of Larion. You have a pouch of gold and a small dagger. You are awakened by one of your servants who tells you that your keep is under attack. You look out the window and see a large army marching towards your door. "Run!" you shout, "I'll fight them off." The next day, you wake up to find yourself alone on the battlefield. Your soldiers have been killed or turned into mindless beasts. The enemy has won!

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> ***Run for president.***

You turn around and begin running towards the palace. It's time to make a change, but how?

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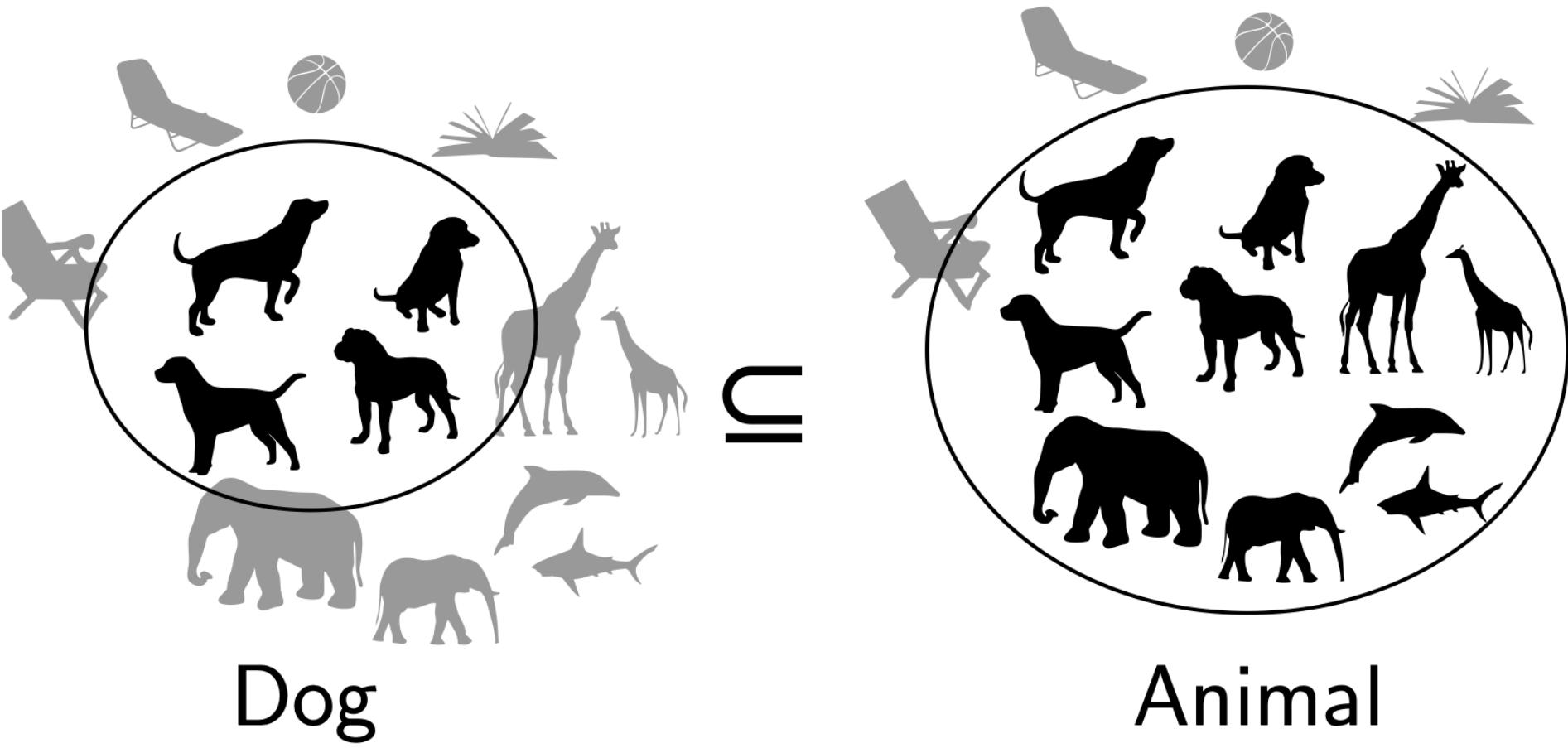
> ***Choose campaign slogan.***

"We're gonna be great again!" You raise your fist and yell as loud as you can. You hear a few cheers from the crowd. This seems to cheer you up, so you continue shouting it louder until everyone is cheering along with you.

# Natural Language Processing

# Lexical Knowledge Bases

NLP researchers have built structure knowledge bases and ontologies that encode a lot of important information about the meaning of words.



# Entailment in formal semantics

All animals have an ulnar artery

⇒

All dogs have an ulnar artery

- + Mathematically well-understood
- + Powerful machinery for handling logical operations

# WordNet Search - 3.1

- [WordNet home page](#) - [Glossary](#) - [Help](#)

Word to search for:

Display Options:

Key: "S:" = Show Synset (semantic) relations, "W:" = Show Word (lexical) relations

Display options for sense: (gloss) "an example sentence"

## Noun

- S: (n) **dog**, [domestic dog](#), [Canis familiaris](#) (a member of the genus Canis (probably descended from the common wolf) that has been domesticated by man since prehistoric times; occurs in many breeds) "*the dog barked all night*"
- S: (n) **frump**, **dog** (a dull unattractive unpleasant girl or woman) "*she got a reputation as a frump*"; "*she's a real dog*"
- S: (n) **dog** (informal term for a man) "*you lucky dog*"
- S: (n) **cad**, [bounder](#), [blackguard](#), **dog**, [hound](#), [heel](#) (someone who is morally reprehensible) "*you dirty dog*"
- S: (n) **frank**, [frankfurter](#), [hotdog](#), [hot dog](#), **dog**, [wiener](#), [wienerwurst](#), [weenie](#) (a smooth-textured sausage of minced beef or pork usually smoked; often served on a bread roll)
- S: (n) **pawl**, [detent](#), [click](#), **dog** (a hinged catch that fits into a notch of a ratchet to move a wheel forward or prevent it from moving backward)
- S: (n) **andiron**, [firedog](#), **dog**, [dog-iron](#) (metal supports for logs in a fireplace) "*the andirons were too hot to touch*"

## Verb

- S: (v) [chase](#), [chase after](#), [trail](#), [tail](#), [tag](#), [give chase](#), **dog**, [go after](#), [track](#) (go after with the intent to catch) "*The policeman chased the mugger down the alley*"; "*the dog chased the rabbit*"

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  - [part meronym](#)
  - [member holonym](#)
  - [direct hypernym](#) / [inherited hypernym](#) / [sister term](#)
    - S: (n) [canine](#), [canid](#) (any of various fissiped mammals with nonretractile claws and typically long muzzles)
    - S: (n) [domestic animal](#), [domesticated animal](#) (any of various animals that have been tamed and made fit for a human environment)
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    - S: (n) [carnivore](#) (a terrestrial or aquatic flesh-eating mammal) "*terrestrial carnivores have four or five clawed digits on each limb*"
      - S: (n) [placental](#), [placental mammal](#), [eutherian](#), [eutherian mammal](#) (mammals having a placenta; all mammals except monotremes and marsupials)
      - S: (n) [mammal](#), [mammalian](#) (any warm-blooded vertebrate having the skin more or less covered with hair; young are born alive except for the small subclass of monotremes and nourished with milk)
      - S: (n) [vertebrate](#), [craniate](#) (animals having a bony or cartilaginous skeleton with a segmented spinal column and a large brain enclosed in a skull or cranium)
      - S: (n) [chordate](#) (any animal of the phylum Chordata having a notochord or spinal column)
      - S: (n) [animal](#), [animate being](#), [beast](#), [brute](#), [creature](#), [fauna](#) (a living

# Word Embeddings

Vector space semantics provide a way of learning which words are similar to each other, based on what words they co-occur with.

# Distributional Hypothesis

If we consider **optometrist** and **eye-doctor** we find that, as our corpus of utterances grows, these two occur in almost the same environments. In contrast, there are many sentence environments in which **optometrist** occurs but **lawyer** does not...

It is a question of the relative frequency of such environments, and of what we will obtain if we ask an informant to substitute any word he wishes for **oculist** (not asking what words have the same meaning).

These and similar tests all measure the probability of particular environments occurring with particular elements...  
If A and B have almost identical environments we say that they are synonyms.

–Zellig Harris (1954)



# Intuition of distributional word similarity

- Nida (1975) example:

A bottle of **tesgüino** is on the table

Everybody likes **tesgüino**

**Tesgüino** makes you drunk

We make **tesgüino** out of corn.

- From context, you can guess what **tesgüino** means.

# Term-Document Matrix

	D1	D2	D3	D4	D5
abandon					
abdicate					
abhor					
academic					
...					
zygodactyl					
zymurgy					

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	D1	D2	D3	D4	D5
abandon					
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...					
zygodactyl					
zymurgy					

Each column vector represents a Document

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	D1	D2	D3	D4	D5
abandon					
abdicate					
abhor					
academic					
...					
zygodactyl					
zymurgy					

Each row vector  
represents a Term



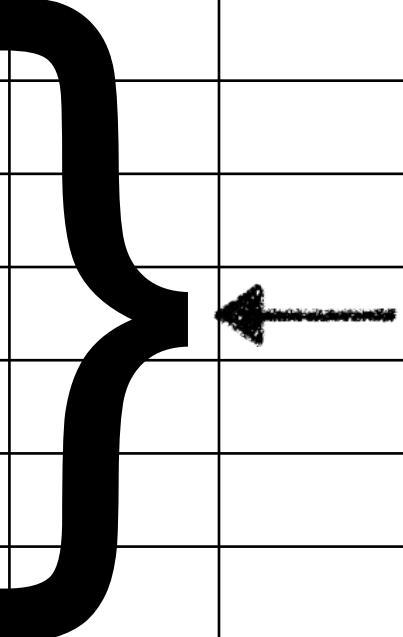
# Term-Document Matrix

	D1	D2	D3	D4	D5
abandon					
abdicate		3			
abhor					
academic					
...					
zygodactyl					
zymurgy					

The value in a cell is  
based on how often that term  
occurred in that document

# Term-Document Matrix

	D1	D2	D3	D4	D5
abandon					
abdicate					
abhor					
academic					
...					
zygodactyl					
zymurgy					





The length of the document vectors  
is the size of the vocabulary

# Term-Document Matrix

	D1	D2	D3	D4	D5
abandon		0			
abdicate		3			
abhor		0			
academic		0			
...		...			
zygodactyl		0			
zymurgy		0			

Document vectors  
can be sparse  
(most values are 0)

# Term-Document Matrix

	D1	D2	D3	D4	D5
abandon					
abdicate					
abhor					
academic					
...					
zygodactyl					
zymurgy					

We can measure how similar two documents are by comparing their column vectors

# Co-reference Resolution

Things can be referred to in many ways, including via pronouns like *she, he, it, they, them, those, that*. Humans can easily figure out what *they* refer to. Computers can't.

# Co-reference resolution

0 Samantha was deciding whether to take 1 a class . 0 She decided to take 1 it .

You see 0 a rosebush with a single blossom on 0 it . Take 0 it . You have taken the rosebush

# Text Classifiers

Given a collection of texts that each have a label associated with them, a classifier can be trained to predict the label given the text.

# Text Classification



ASSIGNING  
SUBJECT  
CATEGORIES,  
TOPICS, OR  
GENRES



SPAM DETECTION



AUTHORSHIP  
IDENTIFICATION



AGE/GENDER  
IDENTIFICATION



LANGUAGE  
IDENTIFICATION



SENTIMENT  
ANALYSIS



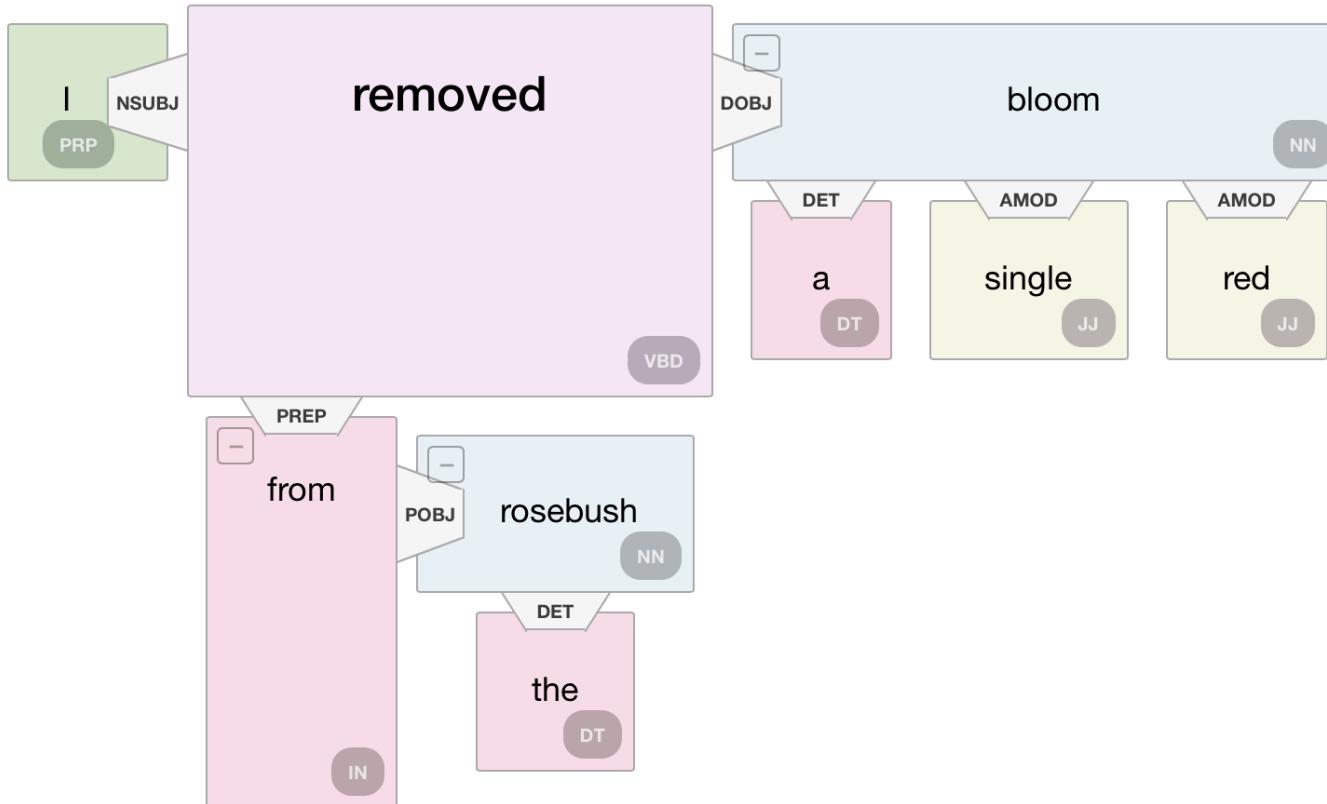
DOES THIS  
SOUND LIKE  
SHAKESPEARE?

# Dependency Parsing

We are often interested in syntactic questions like “What is the subject of this verb? What is the object?” Dependency parsing helps us to answer these.

I removed a single red bloom from the rosebush

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# Language Models

Language models are text generation systems. They take an input sequence of text, and try to predict the most likely next word, or word sequence.

# GPT-2

Open AI trained a large-scale unsupervised language model called GPT-2 which generates coherent paragraphs of text. These large-scale language models generate surprisingly coherent text. They have allowed NLP researchers to make advances to many NLP research problems like automatic question answering, machine translation, and commonsense reasoning.

**Human written prompt:** *In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.*

**GPT-2 completion:** The scientist named the population, after their distinctive horn, Ovid's Unicorn. These four-horned, silver-white unicorns were previously unknown to science.

Now, after almost two centuries, the mystery of what sparked this odd phenomenon is finally solved.

Dr. Jorge Pérez, an evolutionary biologist from the University of La Paz, and several companions, were exploring the Andes Mountains when they found a small valley, with no other animals or humans. Pérez noticed that the valley had what appeared to be a natural fountain, surrounded by two peaks of rock and silver snow.

Pérez and the others then ventured further into the valley. “By the time we reached the top of one peak, the water looked blue, with some crystals on top,” said Pérez.

# In-class Activity: Play AI-Dungeon

Play in groups of 2-3.

If you find weird responses, copy-and-paste them somewhere to share.

Start thinking of answers to the questions we asked.

# Course Overview

# Topics to be covered

- Building a text adventure game
- Reinforcement Learning for solving text-adventure games
- Common-sense reasoning for interactive fiction
- World representations
- Automatic extraction of narrative structure from text
- Text Generation for stories and open-ended dialog
- Controllable text generation

# Topics to be covered (continued)

- Human-computer interaction principles for collaborative storytelling
- Bias in generative language models
- Connections to computer vision, speech, and other multimodal areas
- History of storytelling and artificial intelligence

## Grading

- Five homeworks worth a total of 50%
  - Can be completed in groups  $\leq 2$
- One final project worth 40%
  - Can be completed in groups  $\leq 4$
- Class participation worth 10%

## How to contact us

- Slack channel (for discussing homeworks, project, anything related broadly to the class)
- Mailing list for announcements about homeworks and lectures.
- Email us with specific questions ([ccb@seas.upenn.edu](mailto:ccb@seas.upenn.edu), [daphnei@sea.upenn.edu](mailto:daphnei@sea.upenn.edu))

Daphne will have office hours after class at 4:30 PM.

# Student Presentations

- Prepare a 10-15 minute presentation on a paper from the reading list.
- Your presentation should summarize the work and discuss the ways it's applicable to either interactive fiction or automatic story generation.
- Grading:
  - 50%: **Send us your slides by Monday at 3 PM the week of**
  - 50%: presentation to the class

# Presentation Signups

<https://bit.ly/36I1nAs>

Fill out this form by the end of today.



# Homework 1

Implement a simple text adventure game in Python.

Due 01/23/20 at **before class**

# Homework 2

Improve your text adventure game using NLP!

Due 01/30/20

# Homework 1: Build a Text-Adventure Game

## Instructions

In this homework assignment, you will write your own classic text adventure game. This homework can be completed in groups of up to 2 people. You will implement two text adventure games. One will be a re-implementation of the **Action Castle** game, and one will be a game that you design yourself. The game that you design can be on any topic, or can tell any story of your choice. We will play the games that you design during class, and part of your grade will be awarded based on how creative/exciting your classmates think your game is.

## Starter code

We have provided starter code for a basic text adventure game. You are free modify it however you want, and bring in any dependencies you feel will be useful.

### Task 1: Implement Action Castle

Action Castle is a game by Jared A. Sorensen. It is included in his book [Parsley](#), which is a collection of games inspired by the text-adventures of the 1980s. Parsley is a party game where you take on the role of the parser, and the players shout out commands like GO NORTH, LIGHT LAMP or GET SWORD. You obtusely follow player's commands, simulating a computer's limited vocabulary. The effect is suprisingly hilarious and fun.

We got Jared's permission to distribute the Action Castle module in class, and you can also [buy the Parsley book for \\$20](#) if you'd like to support an awesome indie game developer.

You should modify the provided code to:

1. Create the 13 locations from Action Castle (Cottage, Garden Path, Fishing Pond, Winding Path, Top of the Tall Tree, Drawbridge, Courtyard, Tower Stairs, Tower, Dungeon Stairs, Dungeon, Great Feasting Hall, Throne Room).
2. Create the items for the game (fishing poll, rosebush, club, fish, the troll etc.).
3. Update the code so that it can handle the actions/commands/preconditions that are described by the Action Castle module.

<http://interactive-fiction-class.org/homeworks/text-adventure-game/text-adventure-game.html>

**Need a hint on how to get started?** I was able to re-implement the whole of the Action Castle game\* using the starter code by modifying the `build_game` function, the `check_preconditions` function, and by adding a few new methods to the [Special functions section](#). None of the other starter code needed to be modified. It took me about 5 hours total to implement the game.

\*Except for this part: *The ghost will reach out for the player to stop his heart if the player lingers here.* I skipped that part of the game.

# In-class Activity: Play AI Dungeon

Play in groups of 2-3.  
Answer the questions.