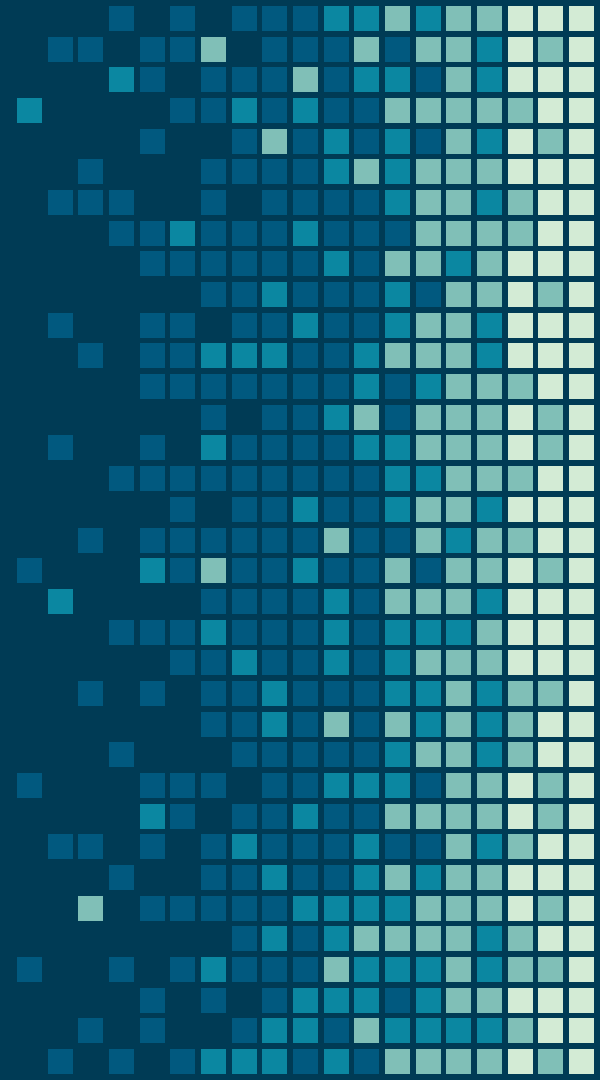# INTERACTIVE FICTION GAMES: A Colossal Adventure

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" ¿WHAT ARE INTERACTIVE FICTION (IF) GAMES?

Fully text-based simulation environments where a player issues text commands to effect change in the environment and progress through the story

```
West of House                                    Score: 0        Moves: 2

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.

>open mailbox
Opening the small mailbox reveals a leaflet.

>read leaflet
(Taken)
"WELCOME TO ZORK!

ZORK is a game of adventure, danger, and low cunning. In it you will explore
some of the most amazing territory ever seen by mortals. No computer should be
without one!"

>_
```

GOAL: test the efficiency of autonomous Reinforcement Learning agents playing IF games.

CHALLENGES:

Combinatorial Action Space

Decision making

+

Natural Language Processing

$(700^4 = 240$ billions$)$

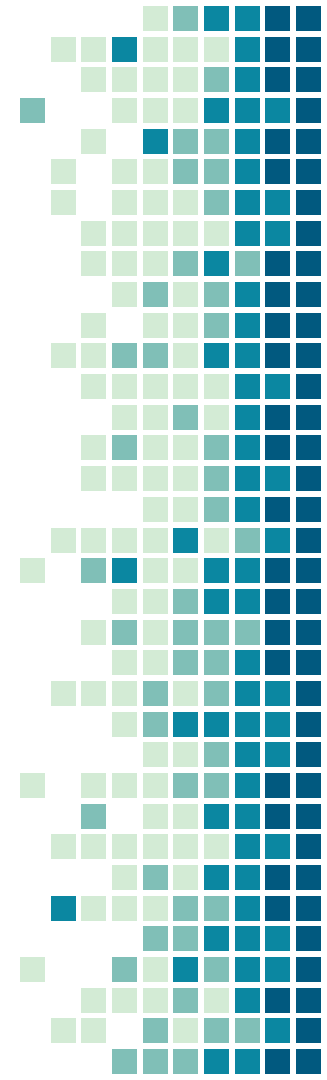**Commonsense Reasoning**

Open the chest?

or

Eat the chest?

Knowledge Representation

Travel through the world

Keeping track of objects

Jericho

- Open source

- Infocom games

- More accessible for existing agents

- Point-based scoring sistem

Templates	Objects
	sword	sword
	jewels	jewels
turn on__	machine	machine
open__	case	case
take__	gothic	gothic
push__	all	all
take_____from_____	troll	troll
east	lantern	lantern
.	grue	grue
.	door	door
	.	.
	.	.

Algorithm 1 Procedure for Identifying Valid Actions

1: $\mathcal{E} \leftarrow$ Jericho environment
2: $\mathcal{T} \leftarrow$ Set of action templates
3: $o \leftarrow$ Textual observation
4: $\mathcal{P} \leftarrow \{p_1 \dots p_n\}$ Interactive objects identified with noun-phrase extraction or world object tree.
5: $Y \leftarrow \varnothing$ List of valid actions
6: $s \leftarrow \mathcal{E}.save()$ – Save current game state
7: **for** template $u \in \mathcal{T}$ **do**
8:     **for** all combinations $p_1, p_2 \in \mathcal{P}$ **do**
9:         Action $a \leftarrow u \Leftarrow p_1, p_2$
10:         **if** $\mathcal{E}.world\_changed(\mathcal{E}.step(a))$ **then**
11:             $Y \leftarrow Y \cup a$
12:             $\mathcal{E}.load(s)$ – Restore saved game state
4 **return** Y

Handicaps:

1. Fixed random seed
2. Load, Save
3. Game templates and vocabulary
4. World object tree representation
5. World change detection
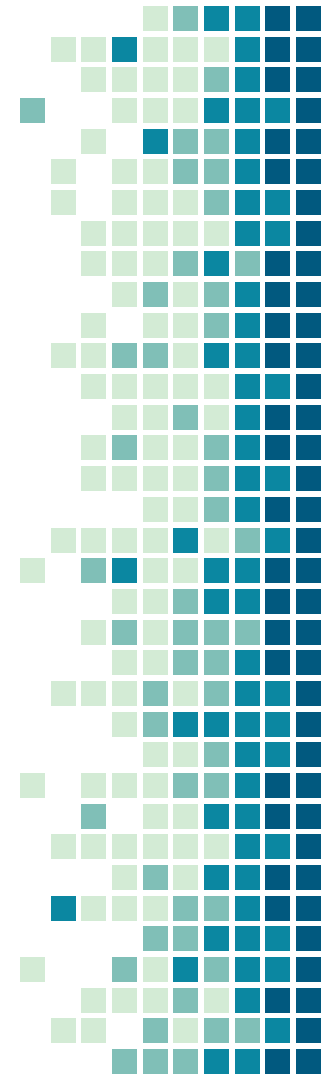
Algorithms

DRRN:

- Choice-based

- Single-game

- Based valid actions

- Update sampling minibatch

- Uses Jericho's handicaps

TDQN:

- Parser-based

- Single-game

- Templete based

- Supervised binary cross entropy loss

- Uses Jericho's handicaps

NAIL:

- Parser-based

- General-game

- Manually heuristic

- Web-based to decide

- No handicaps

Experiments

Agents were **evaluated** across a set of <u>32 games</u>

Game	$|\mathcal{T}|$	$|\mathcal{V}|$	RAND	NAIL	TDQN	DRRN	MaxScore
905	82	296	0	0	0	0	1
acorncourt	151	343	0	0	1.6	**10**	30
advent[†]	189	786	36	36	36	36	350
adventureland	156	398	0	0	0	**20.6**	100
afflicted	146	762	0	0	1.3	**2.6**	75
anchor	260	2257	0	0	0	0	100
awaken	159	505	0	0	0	0	50
balances	156	452	0	**10**	4.8	**10**	51
deephome	173	760	1	**13.3**	1	1	300
detective	197	344	113.7	136.9	169	**197.8**	360

Results

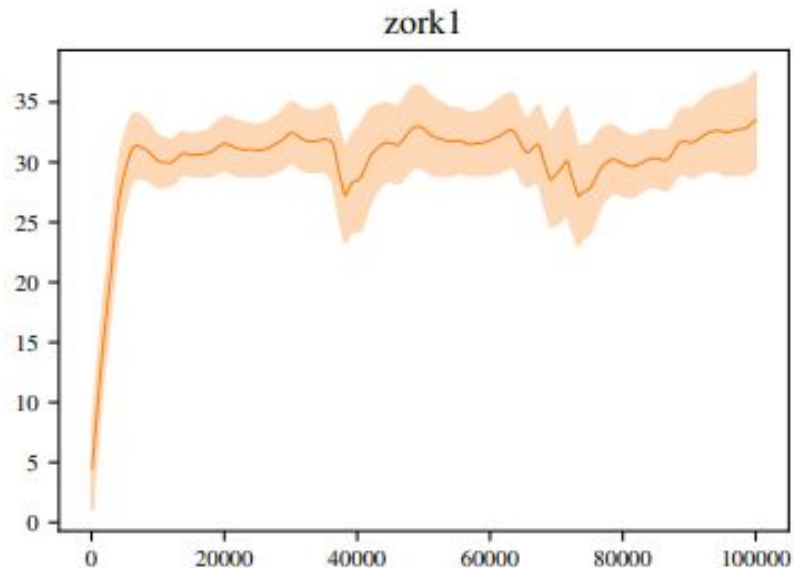| Agent	RAND	NAIL	TDQN	DRRN
Completion rate (%)	1.8	4.9	6.1	10.7

Tree difficulty tiers:
- Possible games
- Difficult games
- Extreme games
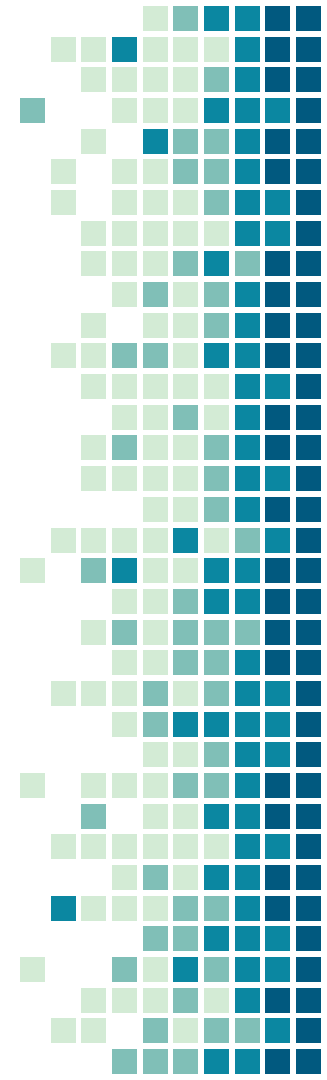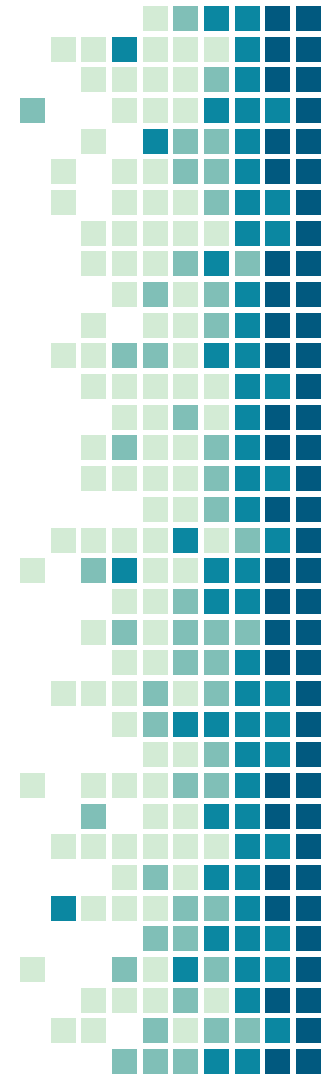
Example with Zork1

-   5 runs of each algorithm

Agents result for Zork 1

Game	|T|	|V|	RAND	NAIL	TDQN	DRRN	Max Score
Zork 1	237	697	0	10.3	9.9	32.6	350

Conclusions

- The fact that DRRN, the choice-based agent, outperformed TQDN, shows the **difficulty of language generation**.
- DRRN and TDQN were trained and evaluated on individual games, still far from a truly **general-purpose agent**
- TDQN algorithm computes independent Q-values for words and templates, **conditional generation** is an improvement yet to be explored.

QUESTIONS?