

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

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West of House                               Score: 0           Moves: 2

ZORK I: The Great Underground Empire
Copyright (c) 1981, 1982, 1983 Infocom, Inc. All rights reserved.
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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

$(700^4 = 240 \text{ billions})$

Commonsense Reasoning

Open the chest?

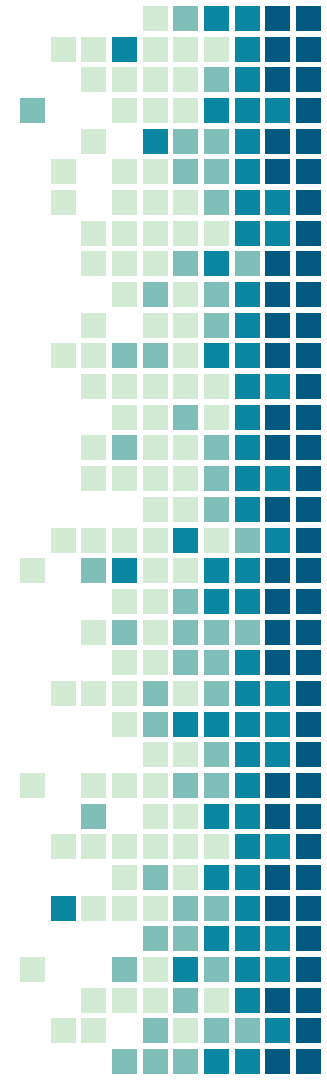
or

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 system

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
.	.	.
.	.	.

Handicaps:

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

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:  $Y \leftarrow \emptyset$  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  $Y$ 
```

Algorithms

DRRN:

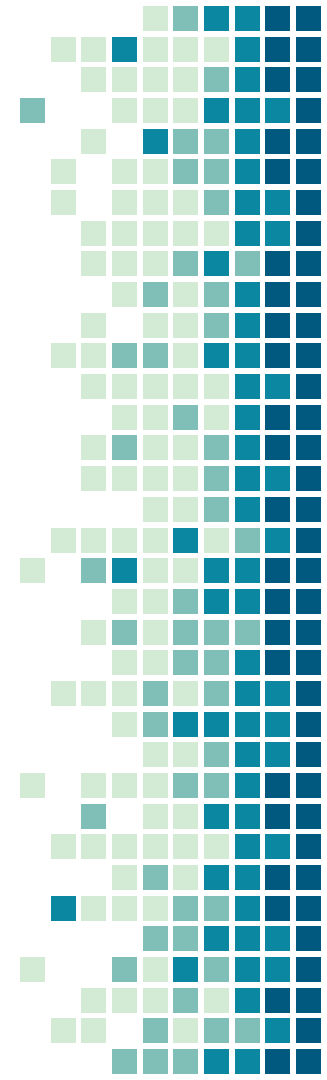
- Choice-based
- Single-game
- Based valid actions
- Update sampling minibatch
- Uses Jericho's handicaps

TDQN:

- Parser-based
- Single-game
- Template 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 32 games

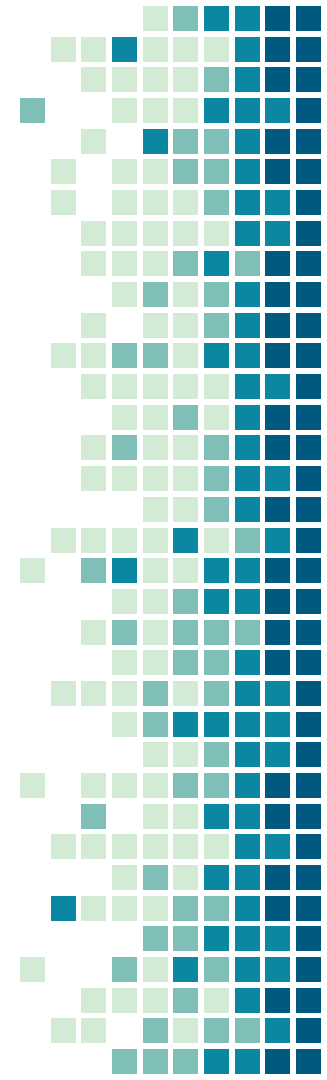
Game	$ \mathcal{T} $	$ \mathcal{V} $	RAND	NAIL	TDQN	DRRN	MaxScore
905	82	296	0	0	0	0	1
acorncourt	151	343	0	0	1.6	10	30
advent [†]	189	786	36	36	36	36	350
adventureland	156	398	0	0	0	20.6	100
afflicted	146	762	0	0	1.3	2.6	75
anchor	260	2257	0	0	0	0	100
awaken	159	505	0	0	0	0	50
balances	156	452	0	10	4.8	10	51
deephomes	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

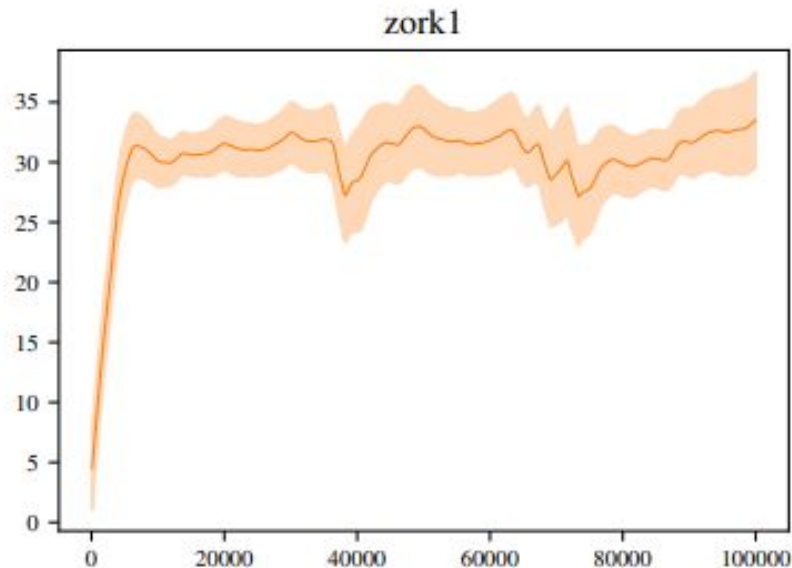
Tree difficulty tiers:

- 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?

