Keke AI Competition

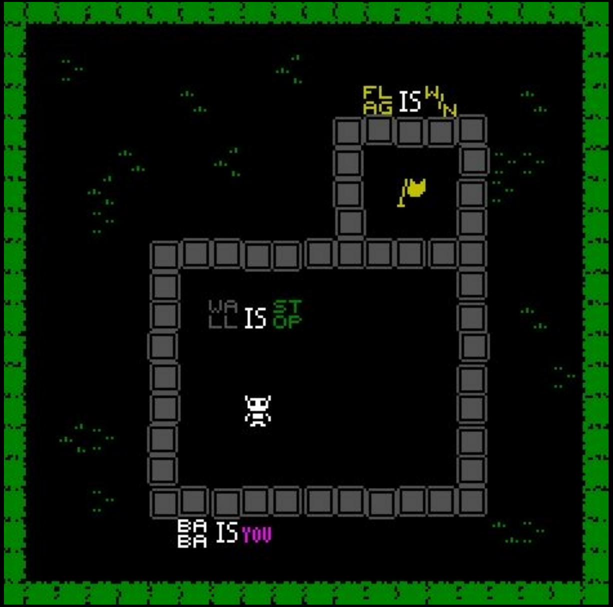
Solving puzzle levels in a dynamically changing mechanic space

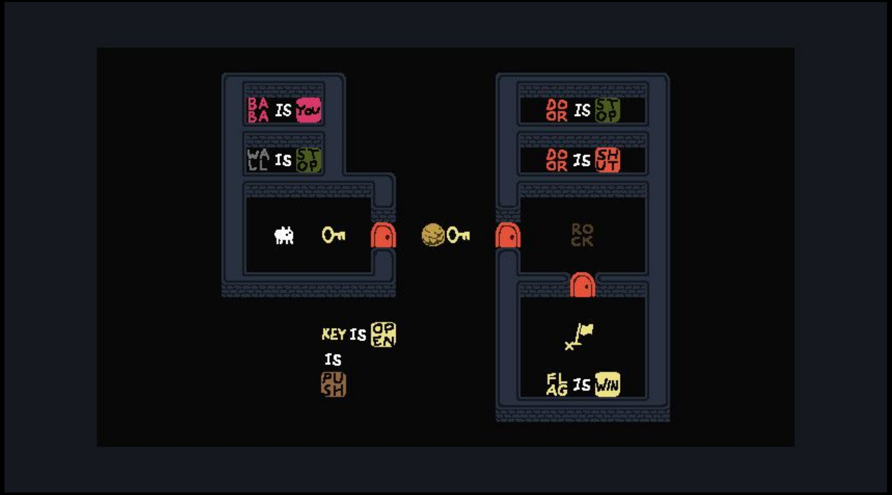
M Charity and Julian Togelius

Dynamic Mechanic Games

- Player-controlled dynamic mechanics that can temporarily or permanently affect the state of the game or player
- Can include:
  - World Physics
  - Time
  - Spatial Dimensions
  - Material Consumption
  - And more…

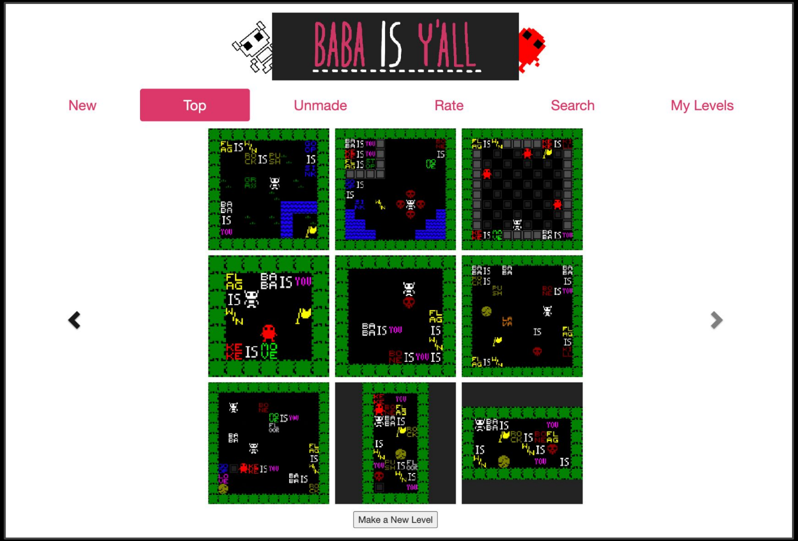
Baba is You

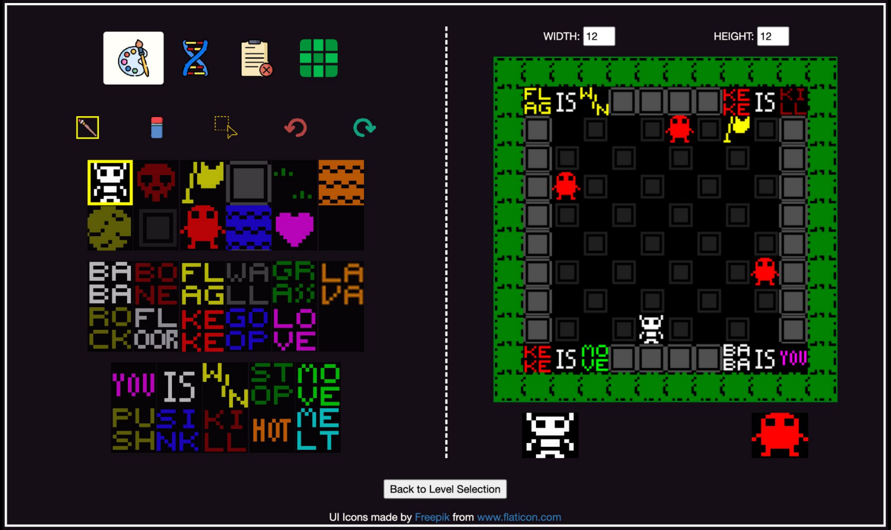




A deterministic, small-scale, dynamic, and simple Sokoban-like puzzle game

Baba is Y'all

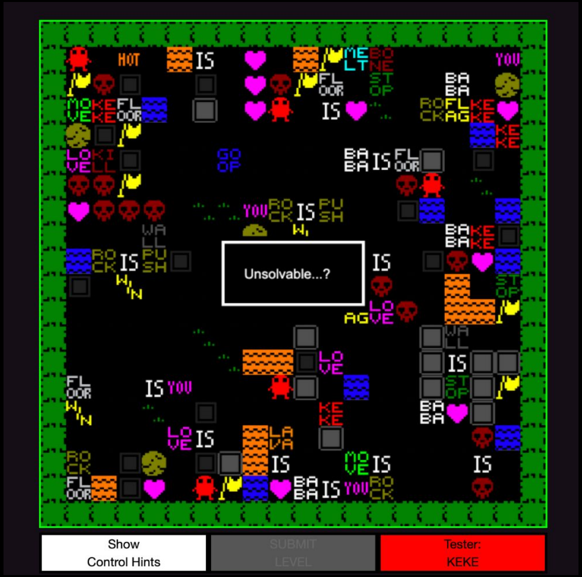




- Mixed-initiative collaborative AI level designer
- Can design levels by hand and/or with the help of a suggestive evolutionary algorithm.
- Levels are evaluated for playability and the mechanic space definition

Main Problem: The solver AI is very dumb

…. 10k iterations later (5-10 min)

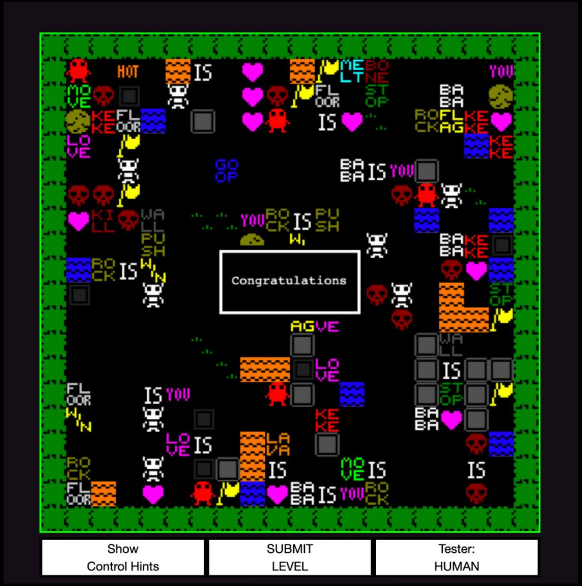


Unsolvable...?

AI SOLVER

VS.

…. 7 steps later (10 seconds)



Congratulations

HUMAN SOLVER

Why?

- Solver defined priorities (i.e. proximity to words/rules and winnables)
- Tree search can get large (especially with more sprites and size of map)
- Little sense of back-tracking (change a rule, go back)
- Browser-based evaluator (dependent on user’s machine)
- Humans are just way smarter

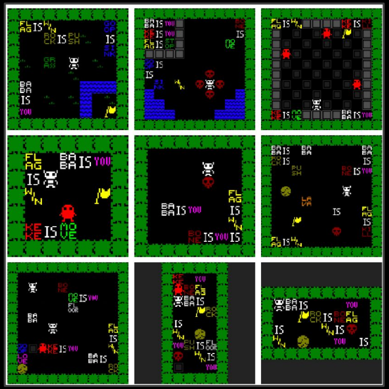
- Mostly: Huge alteration scope of the rulespace and mechanics

Keke AI Competition

KEKE is AI

solver

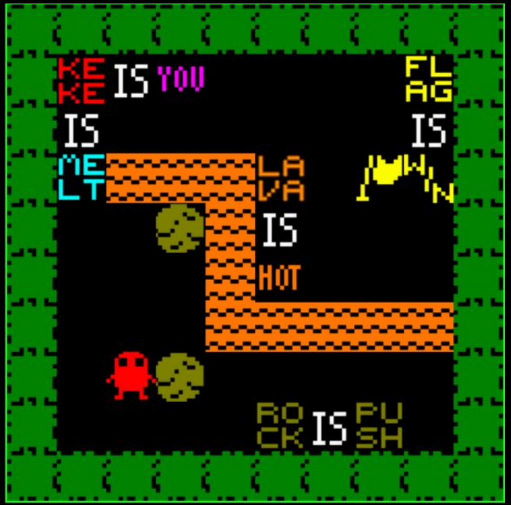
+



BABA is Y'ALL

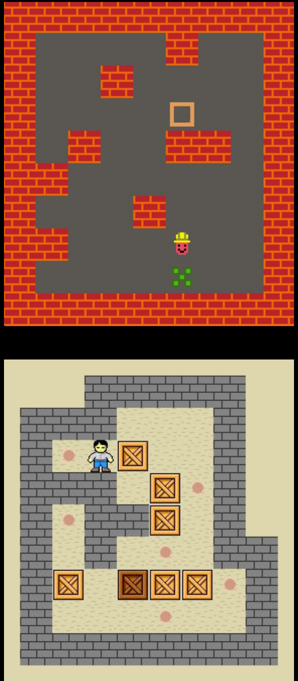
levels

=

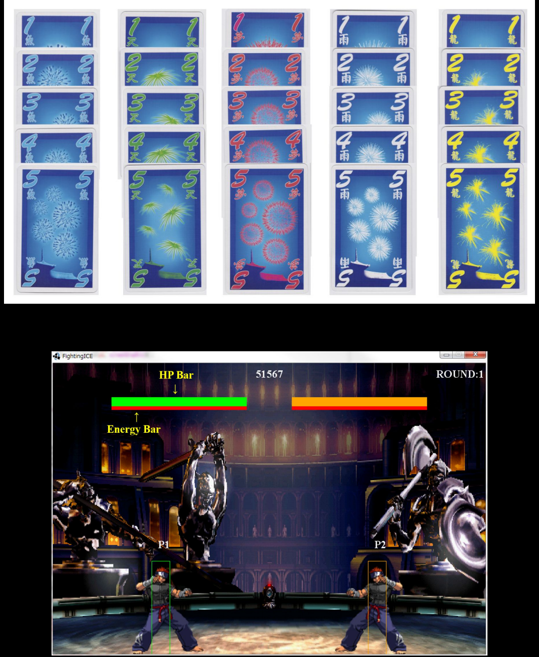


Keke AI Solver Competition

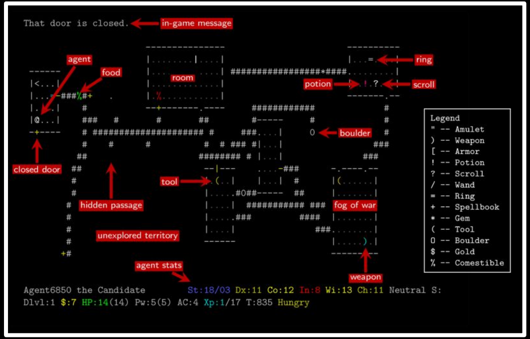
Other Solvers and Competitions



Sokoban Solvers



Adaptive AI Competitions

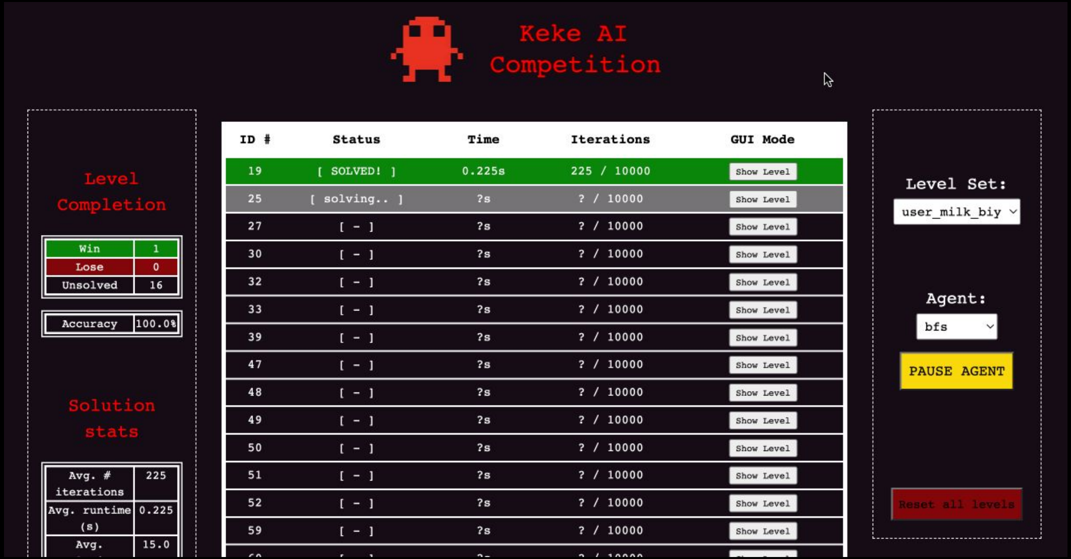


```
That door is closed.

Agent6850 the Candidate          St:18/03 Dx:11 Co:12 In:8 Wi:13 Ch:11 Neutral S:
Dlvl:1 $:7 HP:14(14) Pw:5(5) AC:4 Xp:1/17 T:835 Hungry
```

```
Legend
" -- Amulet
) -- Weapon
[ -- Armor
! -- Potion
? -- Scroll
/ -- Wand
= -- Ring
+ -- Spellbook
* -- Gem
( -- Tool
0 -- Boulder
$ -- Gold
% -- Comestible
```

Grid-World AI Competitions

Offline Interface



Keke AI Competition

Level Completion

Win	1
Lose	0
Unsolved	16

Accuracy	100.0%

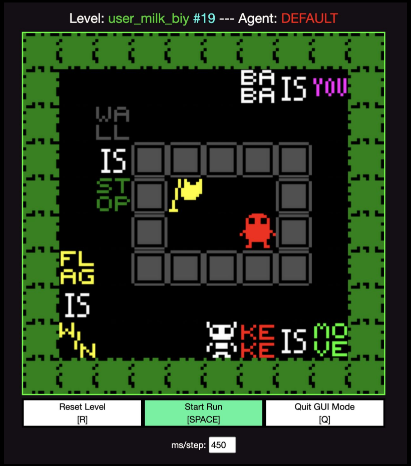
Solution stats

Avg. # iterations	225
Avg. runtime (s)	0.225
Avg.	15.0

ID #	Status	Time	Iterations	GUI Mode
19	[SOLVED!]	0.225s	225 / 10000	Show Level
25	[solving..]	?s	? / 10000	Show Level
27	[-]	?s	? / 10000	Show Level
30	[-]	?s	? / 10000	Show Level
32	[-]	?s	? / 10000	Show Level
33	[-]	?s	? / 10000	Show Level
39	[-]	?s	? / 10000	Show Level
47	[-]	?s	? / 10000	Show Level
48	[-]	?s	? / 10000	Show Level
49	[-]	?s	? / 10000	Show Level
50	[-]	?s	? / 10000	Show Level
51	[-]	?s	? / 10000	Show Level
52	[-]	?s	? / 10000	Show Level
59	[-]	?s	? / 10000	Show Level

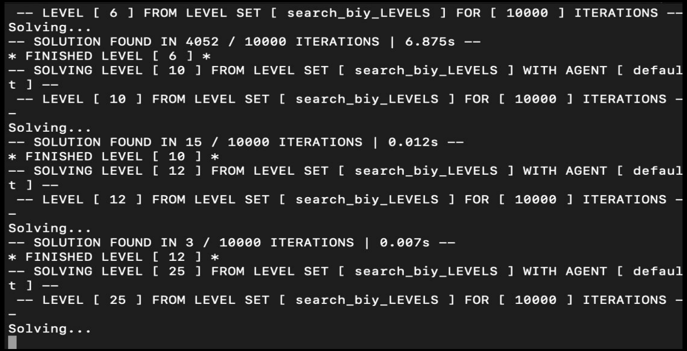
Level Set: user_milk_biy

Agent: bfs



Level: user_milk_biy #19 --- Agent: DEFAULT

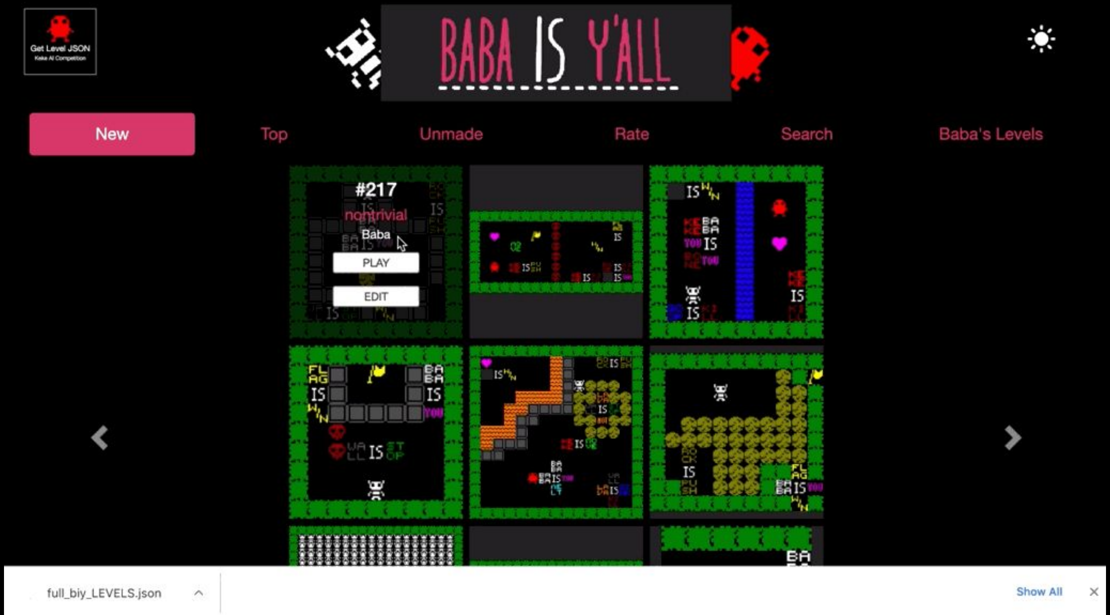
ms/step: 450

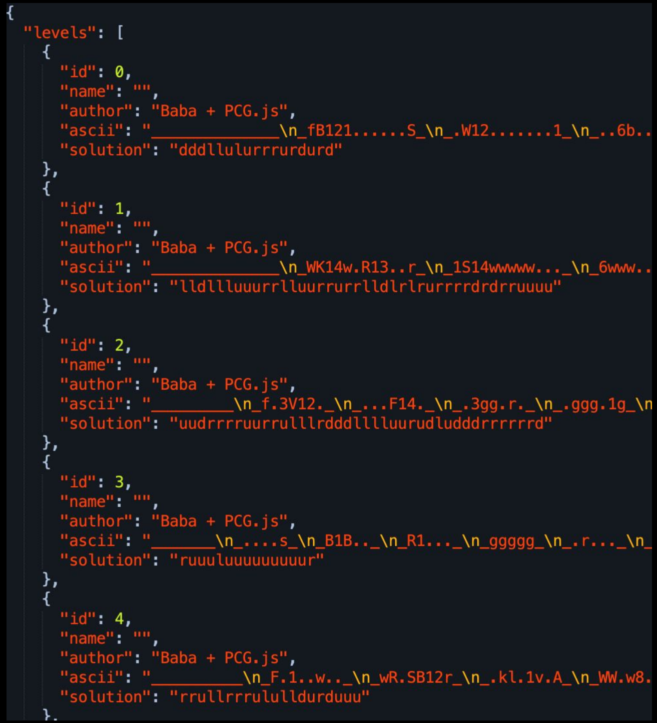


```
 -- LEVEL [ 6 ] FROM LEVEL SET [ search_biy_LEVELS ] FOR [ 10000 ] ITERATIONS --
Solving...
-- SOLUTION FOUND IN 4052 / 10000 ITERATIONS | 6.875s --
* FINISHED LEVEL [ 6 ] *
-- SOLVING LEVEL [ 10 ] FROM LEVEL SET [ search_biy_LEVELS ] WITH AGENT [ defaul
t ] --
 -- LEVEL [ 10 ] FROM LEVEL SET [ search_biy_LEVELS ] FOR [ 10000 ] ITERATIONS -
-
Solving...
-- SOLUTION FOUND IN 15 / 10000 ITERATIONS | 0.012s --
* FINISHED LEVEL [ 10 ] *
-- SOLVING LEVEL [ 12 ] FROM LEVEL SET [ search_biy_LEVELS ] WITH AGENT [ defaul
t ] --
 -- LEVEL [ 12 ] FROM LEVEL SET [ search_biy_LEVELS ] FOR [ 10000 ] ITERATIONS -
-
Solving...
-- SOLUTION FOUND IN 3 / 10000 ITERATIONS | 0.007s --
* FINISHED LEVEL [ 12 ] *
-- SOLVING LEVEL [ 25 ] FROM LEVEL SET [ search_biy_LEVELS ] WITH AGENT [ defaul
t ] --
 -- LEVEL [ 25 ] FROM LEVEL SET [ search_biy_LEVELS ] FOR [ 10000 ] ITERATIONS -
-
Solving...
```

NodeJS browser interface with level GUI to show level solutions and console status output

Training Data

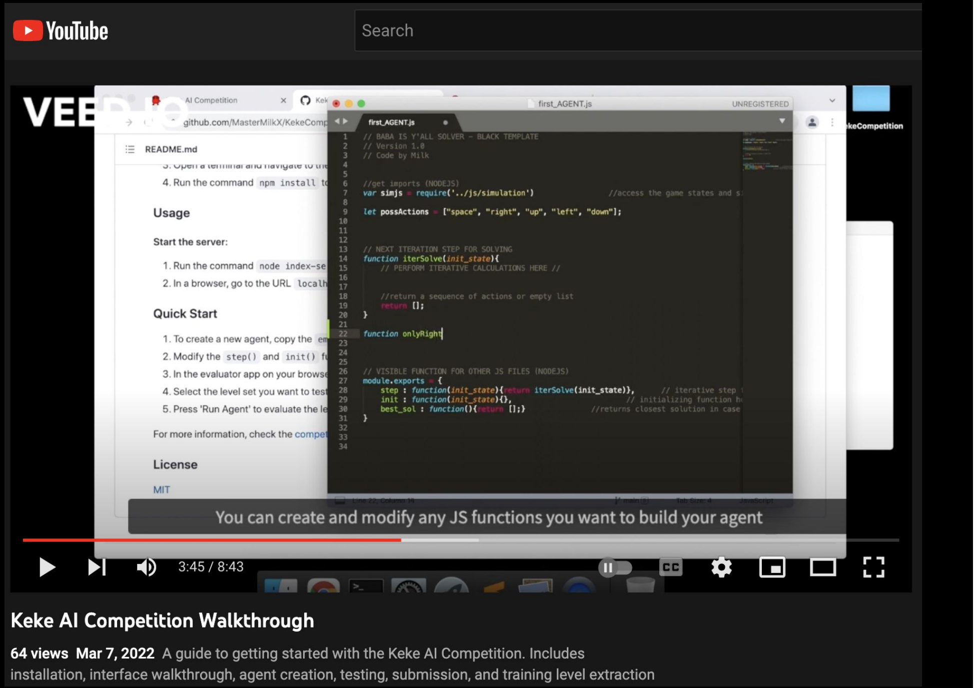




```
{
  "levels": [
    {
      "id": 0,
      "name": "",
      "author": "Baba + PCG.js",
      "ascii": "_______________\n_fB121......S_\n_.W12.......1_\n_..6b..
      "solution": "dddllulurrrurdurd"
    },
    {
      "id": 1,
      "name": "",
      "author": "Baba + PCG.js",
      "ascii": "_______________\n_WK14w.R13..r_\n_1S14wwwww..._\n_6www..
      "solution": "lldllluuurrlluurrurrlldlrlrurrrrdrdrruuuu"
    },
    {
      "id": 2,
      "name": "",
      "author": "Baba + PCG.js",
      "ascii": "__________\n_f.3V12._\n_...F14._\n_.3gg.r._\n_.ggg.1g_\n
      "solution": "uudrrrruurrulllrdddllllluurudludddrrrrrrd"
    },
    {
      "id": 3,
      "name": "",
      "author": "Baba + PCG.js",
      "ascii": "________\n_....s_\n_B1B.._\n_R1..._\n_ggggg_\n_.r..._\n_
      "solution": "ruuuluuuuuuuuur"
    },
    {
      "id": 4,
      "name": "",
      "author": "Baba + PCG.js",
      "ascii": "___________\n_F.1..w.._\n_wR.SB12r_\n_.kl.1v.A_\n_WW.w8.
      "solution": "rrullrrrululldurduuu"
    },
```

Download levels made in the Baba is Y’all website

Tutorial and Wiki



3. Open a terminal and navigate to the
4. Run the command `npm install` to

Usage

Start the server:

1. Run the command `node index-se`
2. In a browser, go to the URL `localh`

Quick Start

1. To create a new agent, copy the `em`
2. Modify the `step()` and `init()` fu
3. In the evaluator app on your browse
4. Select the level set you want to test
5. Press 'Run Agent' to evaluate the le

For more information, check the compet

License

MIT

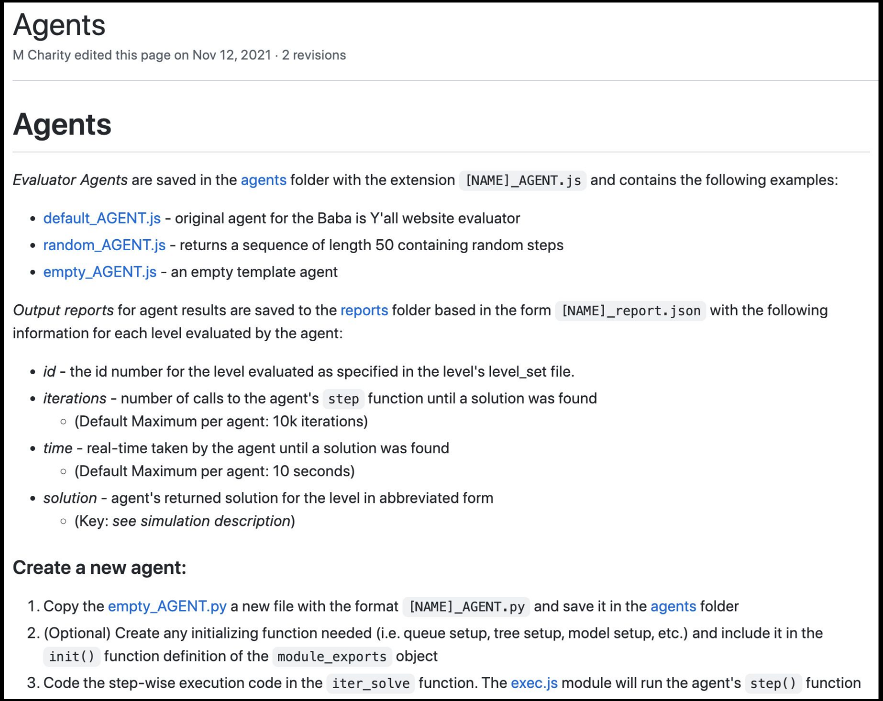
```
// BABA IS Y'ALL SOLVER - BLACK TEMPLATE
// Version 1.0
// Code by Milk


//get imports (NODEJS)
var simjs = require('../js/simulation')                    //access the game states and s

let possActions = ["space", "right", "up", "left", "down"];



// NEXT ITERATION STEP FOR SOLVING
function iterSolve(init_state){
    // PERFORM ITERATIVE CALCULATIONS HERE //


    //return a sequence of actions or empty list
    return [];
}

function onlyRight



// VISIBLE FUNCTION FOR OTHER JS FILES (NODEJS)
module.exports = {
    step : function(init_state){return iterSolve(init_state)},      // iterative step
    init : function(init_state){},                                 // initializing function h
    best_sol : function(){return [];}                            //returns closest solution in case
}
```

You can create and modify any JS functions you want to build your agent

3:45 / 8:43

Keke AI Competition Walkthrough

64 views Mar 7, 2022 A guide to getting started with the Keke AI Competition. Includes installation, interface walkthrough, agent creation, testing, submission, and training level extraction



Agents

M Charity edited this page on Nov 12, 2021 · 2 revisions

Agents

Evaluator Agents are saved in the agents folder with the extension `[NAME]_AGENT.js` and contains the following examples:

- default_AGENT.js - original agent for the Baba is Y'all website evaluator
- random_AGENT.js - returns a sequence of length 50 containing random steps
- empty_AGENT.js - an empty template agent

Output reports for agent results are saved to the reports folder based in the form `[NAME]_report.json` with the following information for each level evaluated by the agent:

- *id* - the id number for the level evaluated as specified in the level's level_set file.
- *iterations* - number of calls to the agent's `step` function until a solution was found
  - (Default Maximum per agent: 10k iterations)
- *time* - real-time taken by the agent until a solution was found
  - (Default Maximum per agent: 10 seconds)
- *solution* - agent's returned solution for the level in abbreviated form
  - (Key: *see simulation description*)

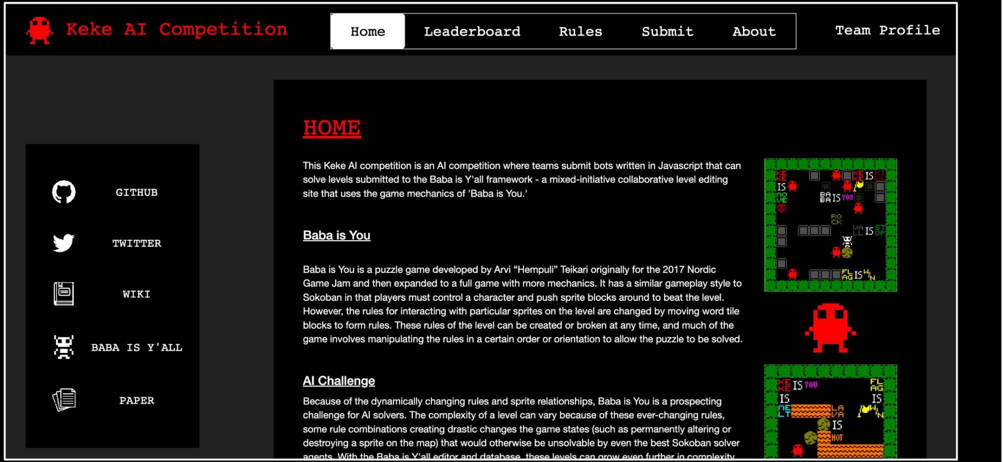
Create a new agent:

1. Copy the empty_AGENT.py a new file with the format `[NAME]_AGENT.py` and save it in the agents folder
2. (Optional) Create any initializing function needed (i.e. queue setup, tree setup, model setup, etc.) and include it in the `init()` function definition of the `module_exports` object
3. Code the step-wise execution code in the `iter_solve` function. The exec.js module will run the agent's `step()` function

YouTube Getting Started tutorial with step by step instructions for installation, testing, and submission

GitHub Wiki with engine documentation and agent descriptions

Submission Website



HOME

This Keke AI competition is an AI competition where teams submit bots written in Javascript that can solve levels submitted to the Baba is Y'all framework - a mixed-initiative collaborative level editing site that uses the game mechanics of 'Baba is You.'

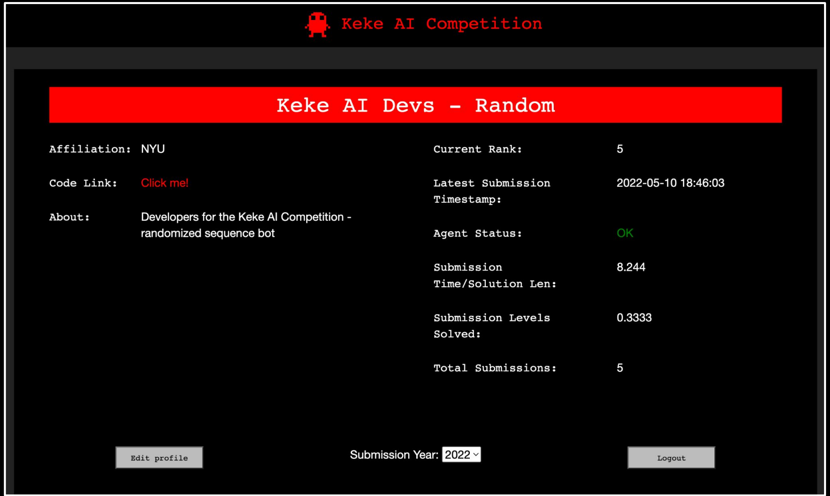
Baba is You

Baba is You is a puzzle game developed by Arvi “Hempuli” Teikari originally for the 2017 Nordic Game Jam and then expanded to a full game with more mechanics. It has a similar gameplay style to Sokoban in that players must control a character and push sprite blocks around to beat the level. However, the rules for interacting with particular sprites on the level are changed by moving word tile blocks to form rules. These rules of the level can be created or broken at any time, and much of the game involves manipulating the rules in a certain order or orientation to allow the puzzle to be solved.

AI Challenge

Because of the dynamically changing rules and sprite relationships, Baba is You is a prospecting challenge for AI solvers. The complexity of a level can vary because of these ever-changing rules, some rule combinations creating drastic changes the game states (such as permanently altering or destroying a sprite on the map) that would otherwise be unsolvable by even the best Sokoban solver agents. With the Baba is Y'all editor and database, these levels can grow even further in complexity

Landing page for the Keke AI Competition Website



Keke AI Devs - Random

Affiliation: NYU

Code Link: Click me!

About: Developers for the Keke AI Competition - randomized sequence bot

Current Rank: 5

Latest Submission Timestamp: 2022-05-10 18:46:03

Agent Status: OK

Submission Time/Solution Len: 8.244

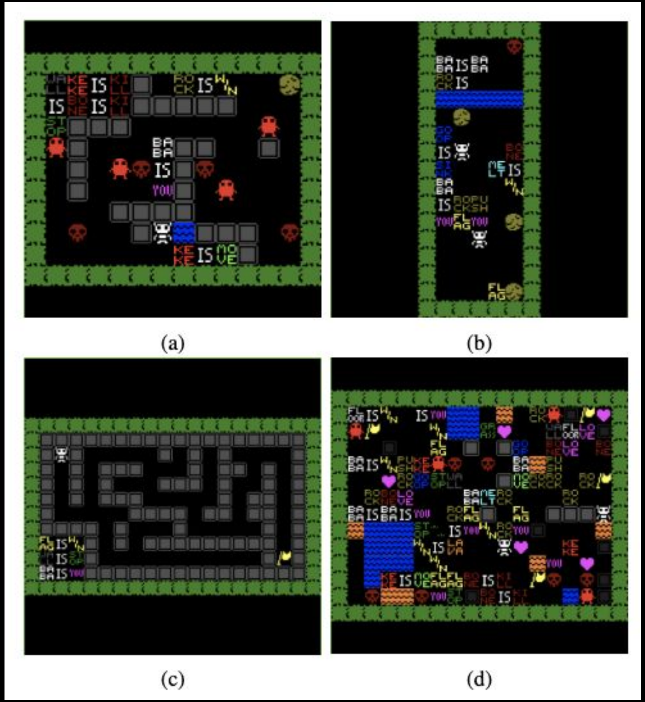
Submission Levels Solved: 0.3333

Total Submissions: 5

Submission Year: 2022

Customizable user profile and submission stats page

Evaluation

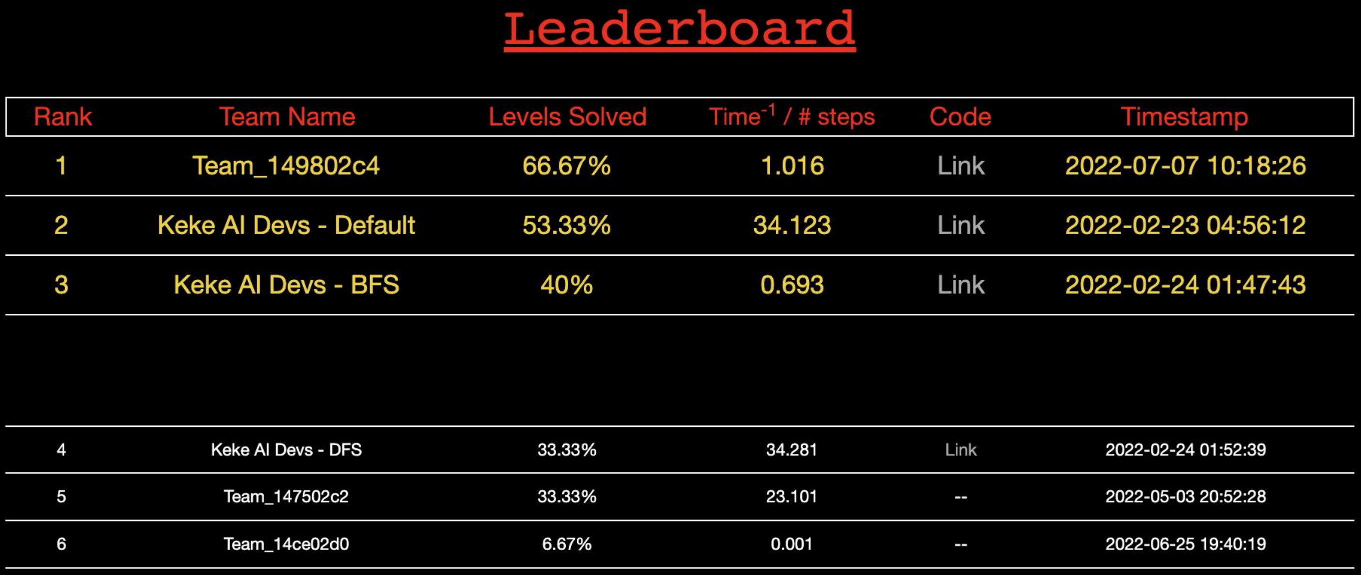


(a) (b) (c) (d)

A) Precision B) Word-push
C) Maze D) Messy sprites

- Use average time^{-1} / # steps to encourage quick and simple solutions
- Automatically validated on the server for code errors and function requirements
- Status and results updated in real-time
- 15 evaluation levels designed to exploit different types of solvers

Results



Leaderboard

Rank	Team Name	Levels Solved	Time^{-1} / # steps	Code	Timestamp
1	Team_149802c4	66.67%	1.016	Link	2022-07-07 10:18:26
2	Keke AI Devs - Default	53.33%	34.123	Link	2022-02-23 04:56:12
3	Keke AI Devs - BFS	40%	0.693	Link	2022-02-24 01:47:43
4	Keke AI Devs - DFS	33.33%	34.281	Link	2022-02-24 01:52:39
5	Team_147502c2	33.33%	23.101	--	2022-05-03 20:52:28
6	Team_14ce02d0	6.67%	0.001	--	2022-06-25 19:40:19

Results as of August 11, 2022

8 teams registered - 3 submissions

Conclusion and Future Improvements

- Much more levels and more diversity of challenges to exploit solvers
- More baseline agents (MCTS, RL agents)
- Incorporate winning agent into Baba is Y’all website
- Added Python support and separate Python track to make it more accessible

Thank You!

Check out the Keke AI Competition at keke-ai-competition.com for leaderboard rankings, source code, and other links!

Keke AI Competition

Submit your bots at keke-ai-competition.com!