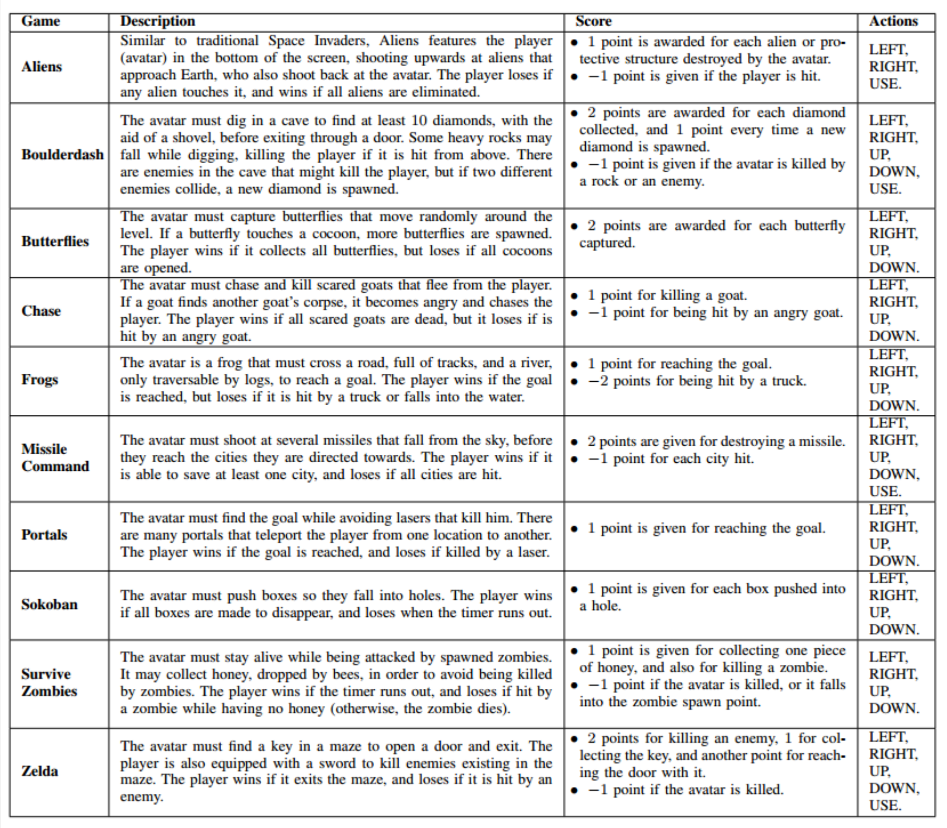
INI Generalized Video Game AI

26 Feb 2015

GVGAI Competition

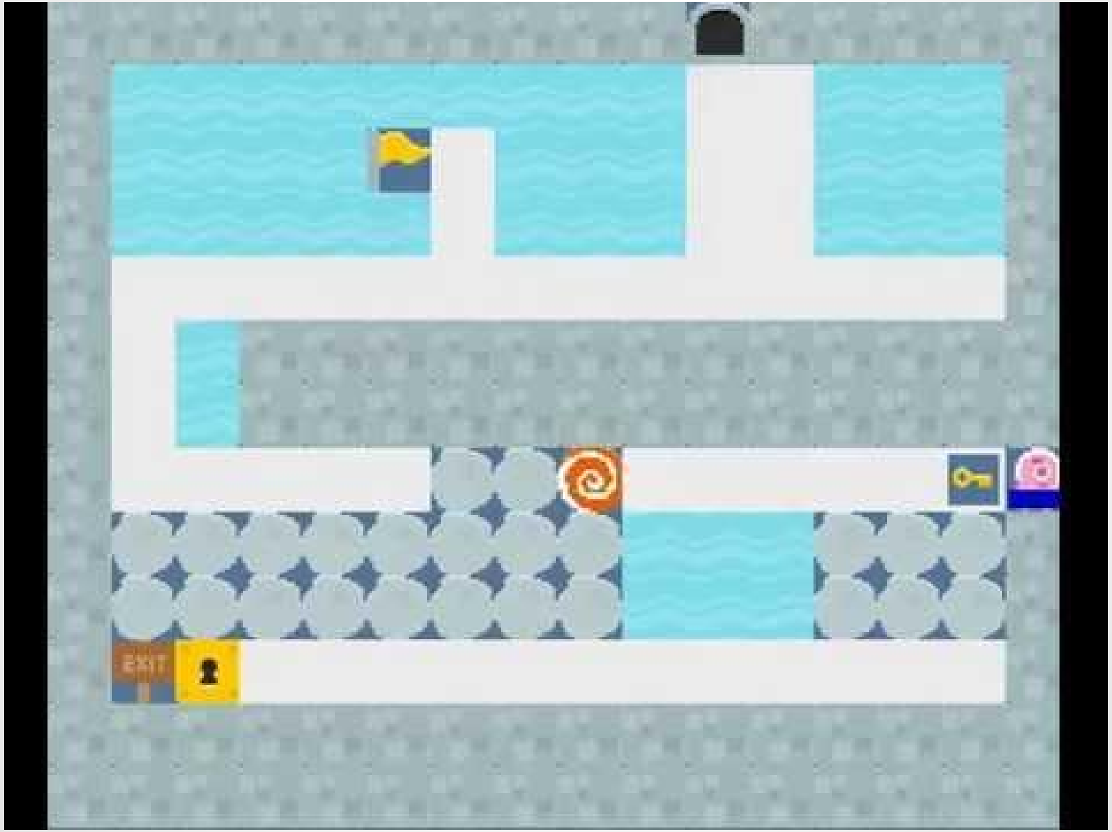
- Code an agent in Java
  - Must respond in realtime (40 ms)
  - Can query the environment, score, and live/dead status
  - Can make use of a forward model that describes the game *if* a specific action is taken
  - Three sets of 10 games for training
  - Secret validation set (10 games) used for public rankings
  - Secret test set (10 games) for final competition results
  - Emphasis on puzzle games this year

Games From the 2013 Competition

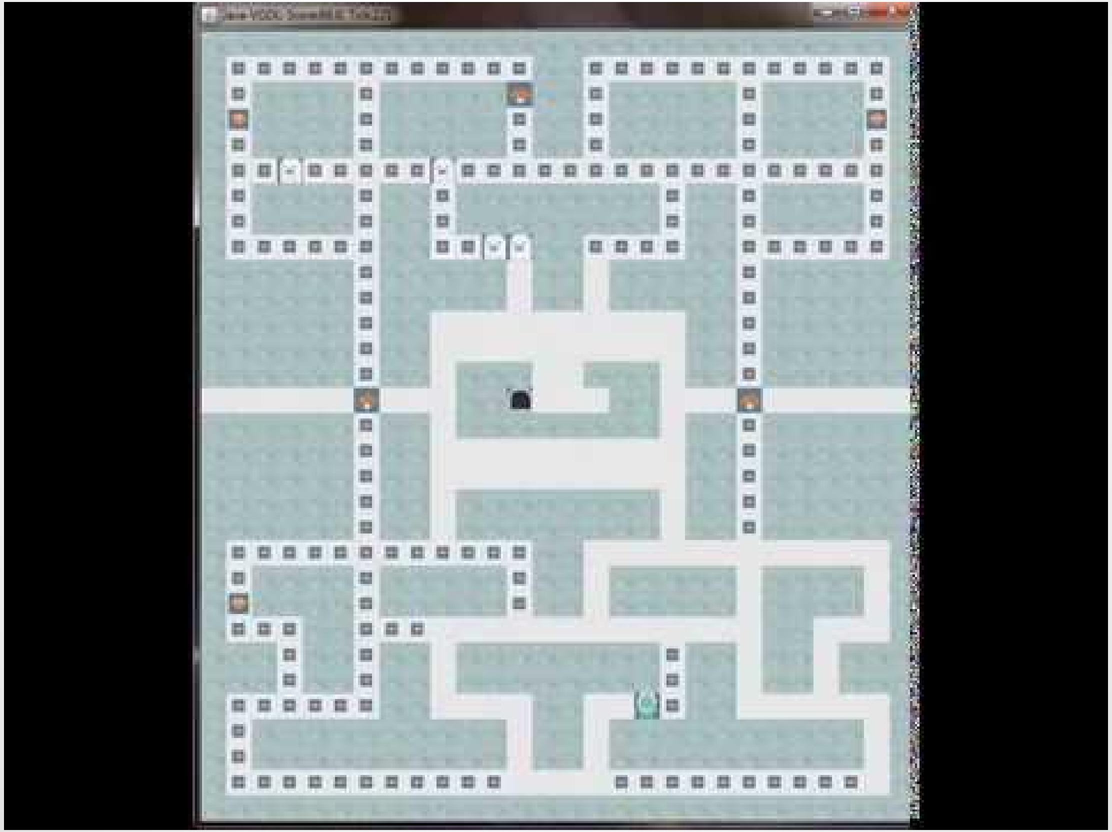


Game	Description	Score	Actions
Aliens	Similar to traditional Space Invaders, Aliens features the player (avatar) in the bottom of the screen, shooting upwards at aliens that approach Earth, who also shoot back at the avatar. The player loses if any alien touches it, and wins if all aliens are eliminated.	• 1 point is awarded for each alien or protective structure destroyed by the avatar. • −1 point is given if the player is hit.	LEFT, RIGHT, USE.
Boulderdash	The avatar must dig in a cave to find at least 10 diamonds, with the aid of a shovel, before exiting through a door. Some heavy rocks may fall while digging, killing the player if it is hit from above. There are enemies in the cave that might kill the player, but if two different enemies collide, a new diamond is spawned.	• 2 points are awarded for each diamond collected, and 1 point every time a new diamond is spawned. • −1 point is given if the avatar is killed by a rock or an enemy.	LEFT, RIGHT, UP, DOWN, USE.
Butterflies	The avatar must capture butterflies that move randomly around the level. If a butterfly touches a cocoon, more butterflies are spawned. The player wins if it collects all butterflies, but loses if all cocoons are opened.	• 2 points are awarded for each butterfly captured.	LEFT, RIGHT, UP, DOWN.
Chase	The avatar must chase and kill scared goats that flee from the player. If a goat finds another goat's corpse, it becomes angry and chases the player. The player wins if all scared goats are dead, but it loses if is hit by an angry goat.	• 1 point for killing a goat. • −1 point for being hit by an angry goat.	LEFT, RIGHT, UP, DOWN.
Frogs	The avatar is a frog that must cross a road, full of tracks, and a river, only traversable by logs, to reach a goal. The player wins if the goal is reached, but loses if it is hit by a truck or falls into the water.	• 1 point for reaching the goal. • −2 points for being hit by a truck.	LEFT, RIGHT, UP, DOWN.
Missile Command	The avatar must shoot at several missiles that fall from the sky, before they reach the cities they are directed towards. The player wins if it is able to save at least one city, and loses if all cities are hit.	• 2 points are given for destroying a missile. • −1 point for each city hit.	LEFT, RIGHT, UP, DOWN, USE.
Portals	The avatar must find the goal while avoiding lasers that kill him. There are many portals that teleport the player from one location to another. The player wins if the goal is reached, and loses if killed by a laser.	• 1 point is given for reaching the goal.	LEFT, RIGHT, UP, DOWN.
Sokoban	The avatar must push boxes so they fall into holes. The player wins if all boxes are made to disappear, and loses when the timer runs out.	• 1 point is given for each box pushed into a hole.	LEFT, RIGHT, UP, DOWN.
Survive Zombies	The avatar must stay alive while being attacked by spawned zombies. It may collect honey, dropped by bees, in order to avoid being killed by zombies. The player wins if the timer runs out, and loses if hit by a zombie while having no honey (otherwise, the zombie dies).	• 1 point is given for collecting one piece of honey, and also for killing a zombie. • −1 point if the avatar is killed, or it falls into the zombie spawn point.	LEFT, RIGHT, UP, DOWN.
Zelda	The avatar must find a key in a maze to open a door and exit. The player is also equipped with a sword to kill enemies existing in the maze. The player wins if it exits the maze, and loses if it is hit by an enemy.	• 2 points for killing an enemy, 1 for collecting the key, and another point for reaching the door with it. • −1 point if the avatar is killed.	LEFT, RIGHT, UP, DOWN, USE.

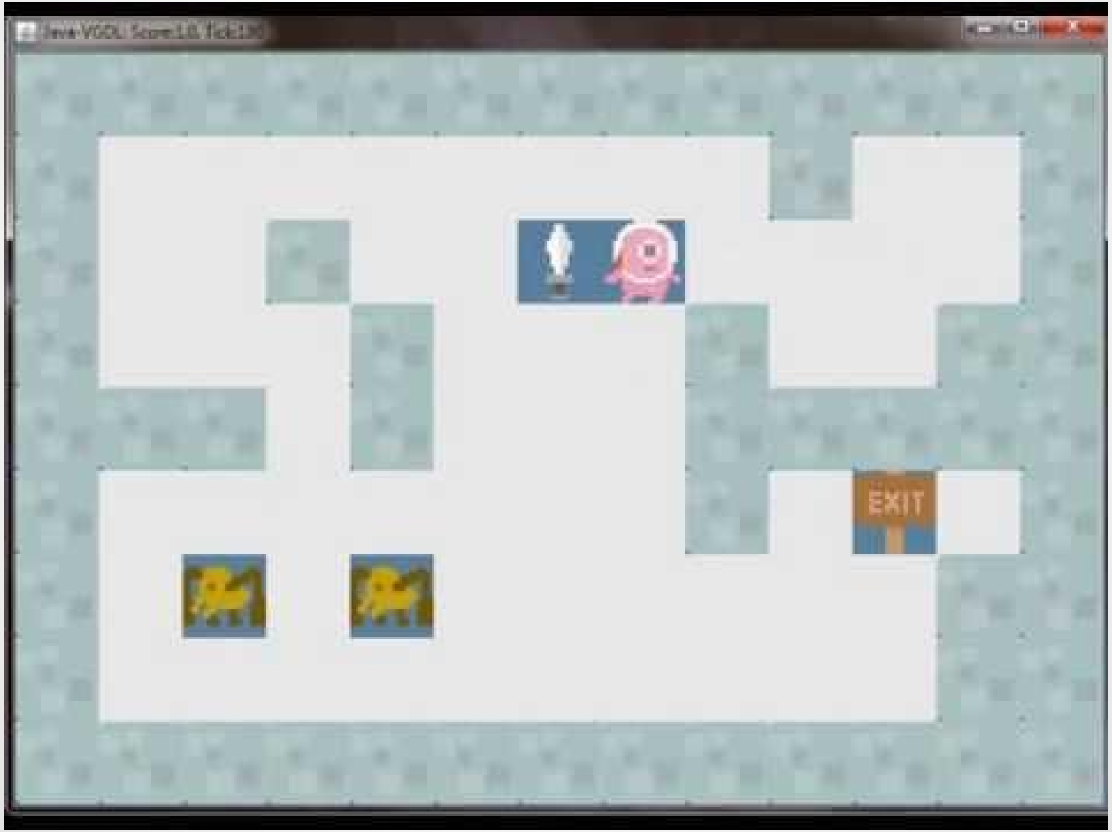
RealPortals



Pacman



Zelda



VGDL - Sokoban

```
BasicGame
    SpriteSet
        hole   > Immovable color=DARKBLUE img=hole
        avatar > MovingAvatar #cooldown=4
        box    > Passive img=box
    LevelMapping
        0 > hole
        1 > box
    InteractionSet
        avatar wall > stepBack
        box avatar  > bounceForward
        box wall    > undoAll
        box box     > undoAll
        box hole    > killSprite scoreChange=1
    TerminationSet
        SpriteCounter stype=box    limit=0 win=True
```

Sample Controller

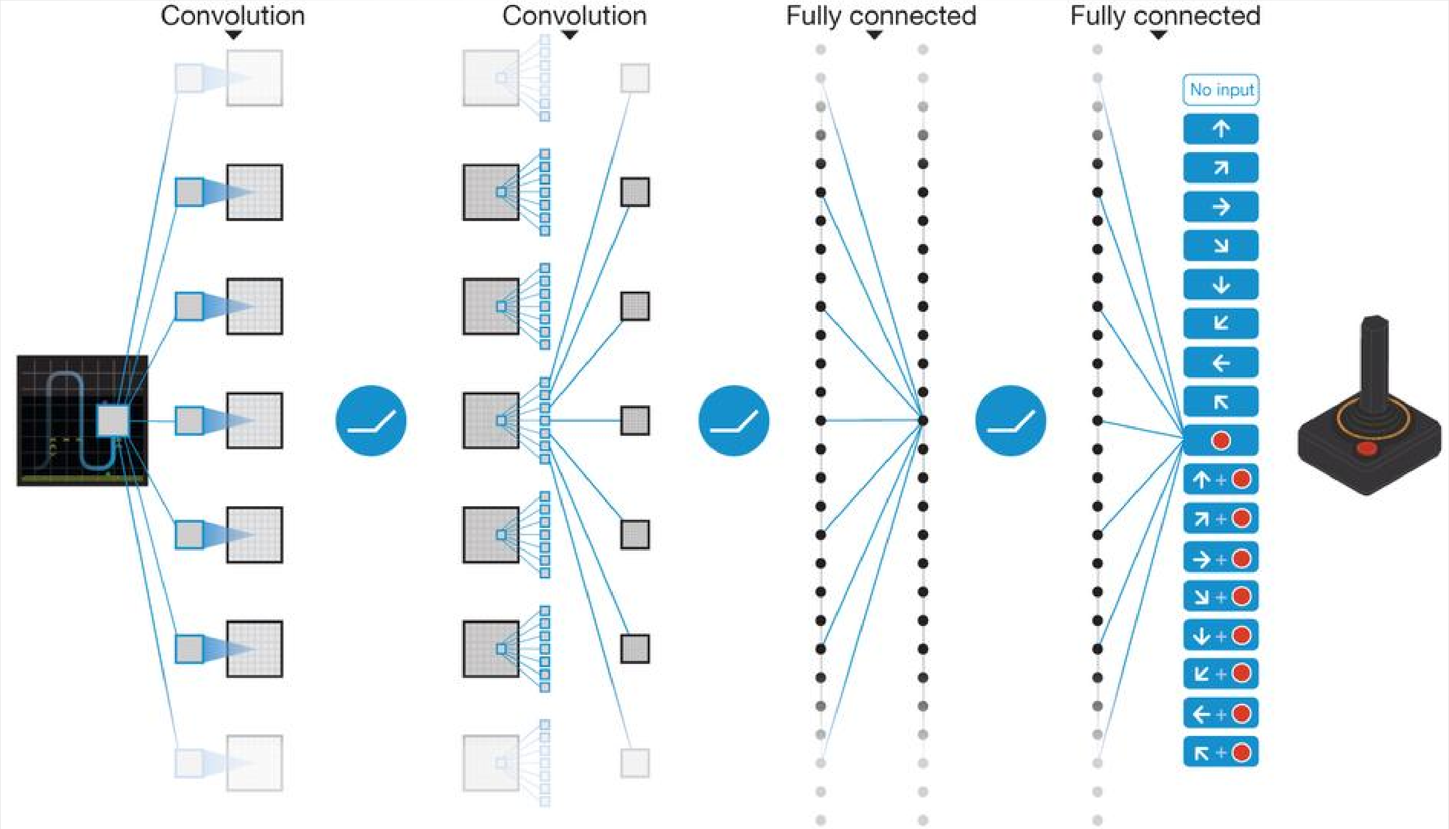
```
package random; //The package name is the same as the username in the web.

public class Agent extends AbstractPlayer {
    protected Random randomGenerator;
    //Constructor. It must return in 1 second maximum.
    public Agent(StateObservation so, ElapsedCpuTimer elapsedTimer)
    {
        randomGenerator = new Random();
    }
    //Act function. Called every game step, it must return an action in 40 ms maximum.
    public Types.ACTIONS act(StateObservation stateObs, ElapsedCpuTimer elapsedTimer) {
        //Get the available actions in this game.
        ArrayList<Types.ACTIONS> actions = stateObs.getAvailableActions();
        //Determine an index randomly and get the action to return.
        int index = randomGenerator.nextInt(actions.size());
        Types.ACTIONS action = actions.get(index);
        //Return the action.
        return action;
    }
}
```

Demo

How this is going to work

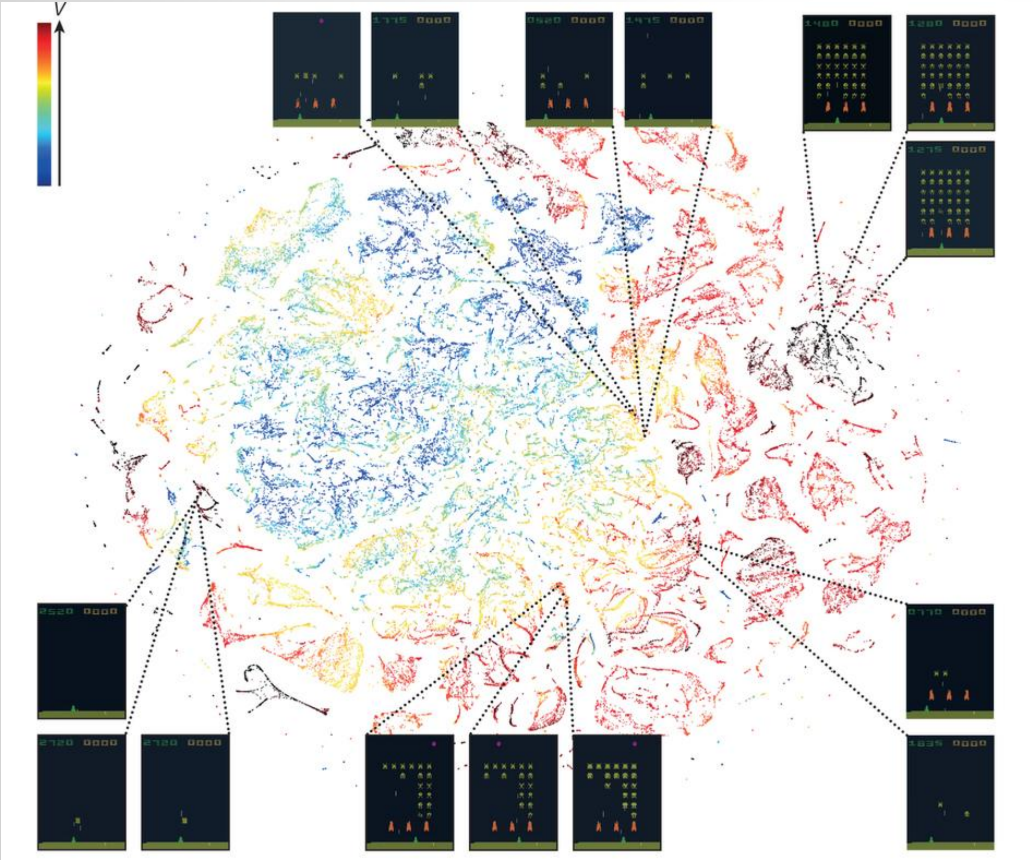
- Meet every 2 weeks, two parts:
  - Discuss competition progress
  - Learn a new topic
- You must write code (but can learn!)
- We will have a listserv
- Sign up for a focus team, for example:
  - TeamHuman - mimic human players, learn strategies humans employ and typical game archetypes
  - TeamLearning - use learning as much as possible to design an agent that learns by itself
  - TeamPlanning - learn and prototype really effective planning algorithms

Academically...



V Mnih et al. Nature 518, 529-533 (2015) doi:10.1038/nature14236

Academically...



V Mnih et al. Nature 518, 529-533 (2015) doi:10.1038/nature14236

Looking ahead

- 3/12: Introduction to Reinforcement Learning
- 3/26: Overview of Traditional Strategies for Planning (Monte-Carlo Tree Search, Evolutionary Algorithms, POMDP)
- 4/9: DeepMind GVGAI
- 4/23: To be determined!

Tasks

- Codebase Manager
  - Send out email about install and setup
  - Manage commits and contributions
- Main Optimizer
  - Take the best submissions, look for small tweaks, do official submissions
- Speakers:
  - Intro to Reinforcement Learning
  - Intro to Planning Algorithms

Next Week

- Introduction to Reinforcement Learning
- Join the email list
- Install and setup GVGAI on your computer