

# Final Project Report

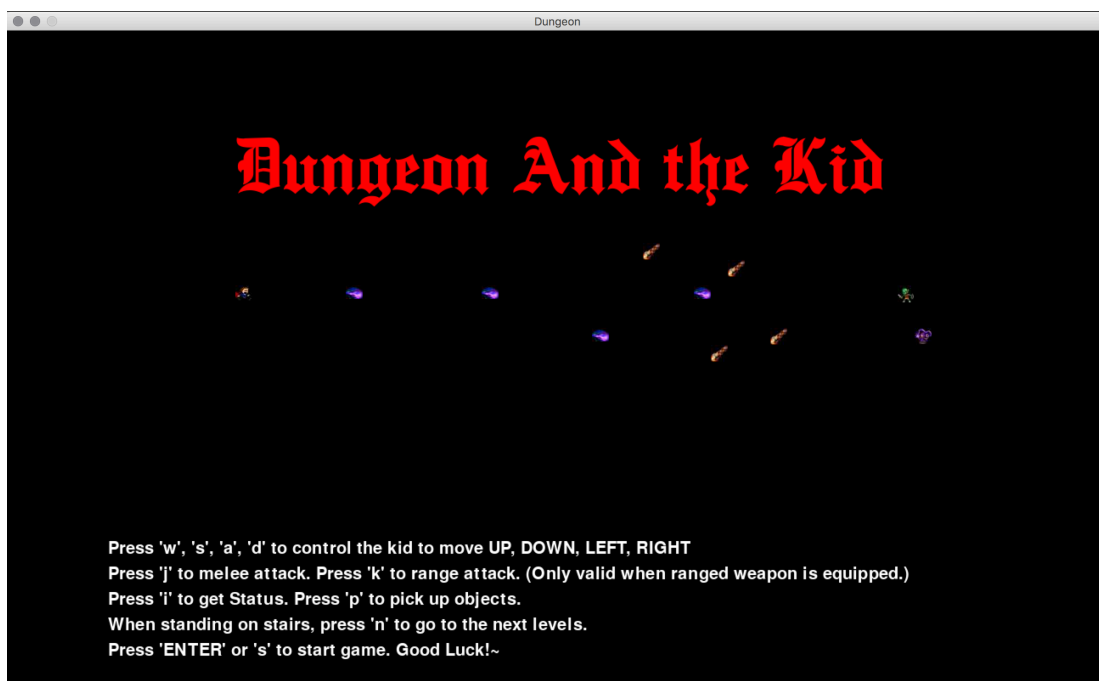
## CS 5150 Game Artificial Intelligence

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## Introduction

Dungeons and Dragons are always attracting game player's interests and attentions. For those who are addicted to western fantasy world, conquer a game in which they can beat various kind of monster, including the gigantic and seemly invincible dragons, and find treasures in the deepest corner of a dungeon, and finally they become a mage who can enchant powerful sorceries, or become a warriors of power strong enough to fight with a dragon. Due to the fact that we are all rookies in game developing, and have just known what game AI is and what game AI can accomplish, we are not sophisticated enough to create a fancy game of dungeons or dragons. However, from what we have learnt so far, and what we will learn in the future, we can definitely create a simple Role-playing dungeon games with elements of mazes, magic, monsters, treasures, and different kinds of game objects for the player to enhance himself.

The Dungeon and the Kid is such a game our team wishes to present. In the game, player is supposed to go through many levels of maze and find the golden treasures located in the deepest level of the dungeon. In each level, the player is supposed to fight with different kinds of monsters to gain experience, weapons, armors or scrolls to make him stronger. There are objects scattered around in the maze, and the player can pick them up and put the objects in his own inventory. With many different elements, the game can show different algorithms we learnt in the class. The following is a screen shot of our start screen.



*Figure 1. The screen shot of the start screen.*

## Environment

The game is a 2-D game. The player can move up, down, left or right in the maze. Basically, each level of maze consists of several rooms and hallways connecting them. The number of rooms, the size and position of each room are generated randomly, and the hallways connecting rooms are also generated randomly by a recursive method. So in each levels of maze, different things will happen. Besides that, each level of maze, except for the last level, have a ladder down to the next level. So once you go to the next level, you can never go back to the previous level. And the unbeaten monsters, unpicked objects are all gone.

The maze is stored as a two-dimensional array, the first dimension represents each row of the maze, and the second dimension represents each column. The array records all of the immovable elements in the game, including walls, ladders and different kind of objects.

```
NULL = 0  
WALL = 1  
ARMORS = 6  
WEAPONS = 7  
POTION = 8  
SCROLLS = 9  
STAIR = 10
```

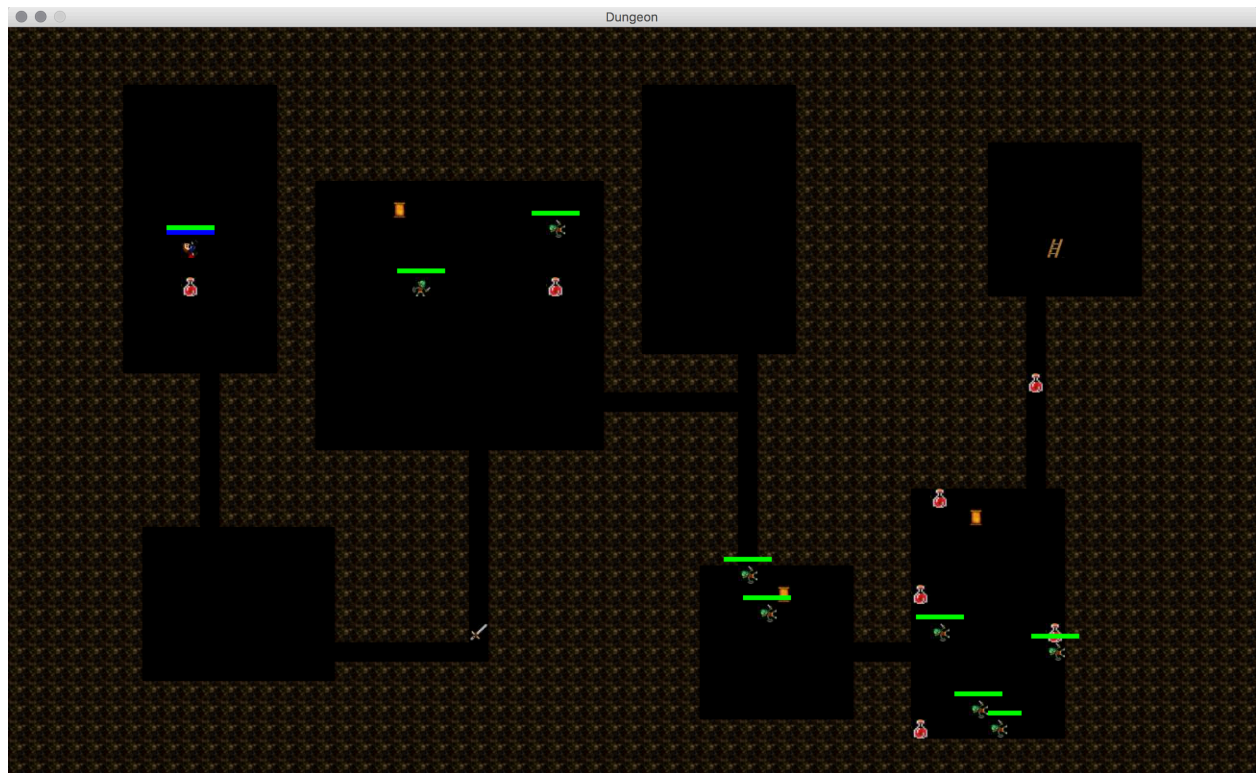
These are the representations of each of the immovable objects in the game. If there is a Scroll in the 15 row and 31 column, then `maze[15][31]` will be 9. The movable elements, including the player, monsters and the sorceries, cannot be represented as numbers in the maze, since once a monster is standing on a object, such representation will overwrite the number representing the object and causing the object to 'disappear'. The representation of movable objects will be introduced in later session.

Basically, each level of the maze is generated in the follow order:

1. Initialize the maze with walls.
2. Generate rooms and hallways in a random manner. Sort the room. Set the place of room and hallways with null (nothing there).
3. Generate a ladder to the next level in the last room.
4. Generate objects in the room.
5. Outside the class, initialize a player, and put the player into the first room of the maze. Set the member variable.
6. Generate monsters at random position. But the monster will not be generated in the first room, where the player is located.

In each level of the maze, random numbers (in a set of range based on the level) of monsters and

different objects are generated in random location. The deeper the dungeon is, the more powerful the monsters are.



*Figure 2: A screen shot of the game environment.*

The monsters and objects are stored in lists as member variable in the maze class.

## **Characters**

The game is consisting of two different “Agent”, the player and different kind of monsters. Each agent has the following four different attributes:

STR: strength, affecting agents’ physical attack damages.

DEF: defense, affecting agents’ ability to reduce damage from physical attacks.

INT: intelligence, affecting agents’ sorcery attack damage and the damage reduction from other’s sorcery attack.

DEX: dexterity, affecting agent’s speed, i.e. the interval between each action. The higher DEX, the shorter time it will take between two actions.

Besides that, each player has its maximum Hit Point (HP) and Mana Point (MP). HP will reduce if the agent is under attack. If HP is 0, the agent will die. MP will reduce if the agent is

enchancing sorceries. If MP is insufficient, the agent is not able to enchant sorceries. Both HP and MP of an agent will recover naturally if it is not involved in a fight. Each agent has an attribute of Levels (LVL). LVL directly influence attributes mentioned before.

### *1. Hero*

Hero is controlled by the player. As mentioned before, hero can have many movements. Moving around in mazes, attacking by different weapons, opening treasure boxes, and ascending or descending to different levels of maze. Hero starts at LVL 1. By beating monsters, equipping armors or weapons, or using different objects, Hero will become stronger. Once Hero kills a monster, Hero will gain experience (EXP). If EXP exceeds the upper limit of current LVL, Hero will level up, and each of the attributes mentioned above will increase, and Hero's HP, MP will immediately set to current maximum level. It is harder for Hero to level up when the player's LVL is higher. Basically, the goal of Hero is to kill monsters (or avoid them) and collect items to become stronger and survives more and more powerful monsters, and finally reaches the deepest level and collects the golden treasure.

### *2. Monsters*

Monsters are the entity where we implements game AI. Monsters are generated randomly in the maze, with the one and only goal: thwart the player from winning the game. They will use path finding or seeking, pursuing to get close to player, and attack. If the monster's HP is low, the monster might flee or evade. Different from Hero, the attributes of monsters are set, based on the LVL of the monsters, when the monsters are spawn. They will never become stronger. Higher LVL monster will provide more EXP for Hero. When monsters were killed by the player, monsters will drop some beneficial items for Hero, with a preset probability. Monsters are not able to ascend or descend levels by stairs in the maze.

The basic algorithms for the implementation of monsters are finite state machines. Each monster has its own state machine, and the state will change based on different situation. The basic algorithm of path finding is A\*, and the movement algorithm is kinetic seek and flee. Although there are some more powerful algorithms that can be applied to our game, such as machine learning, but I think using appropriate algorithm is a right place is very important. After consideration, I think what we choose to have in our game is the most appropriate. It does not take a lot of run-time calculation.

There are two different kinds of monster: Goblin and Dark Witches. Different kinds of monster will have different behaviors.

**Goblin:** Goblins are monsters of low STR, DEF, INT but with high DEX. Besides that, it has a mediocre amount of HP and no MP, since they do not know Sorceries. Therefore, they can only attack the player when they are next to the player. However, they have high speed and a good smelling ability. And the smelling ability is getting stronger for higher LVL Goblins. They can sense the essence of player from a far distance, and use path-finding algorithms to approach player. Besides that, Goblins has the greatest population among monsters, they have abilities to teamwork, they are able to gather a group of Goblins to chase player together. Though a single Goblin is the easiest to kill, a group of Goblins will create a lot of troubles for the player. A Goblin is equipping a short sword. When a Goblin is dead, it has a mediocre probability to drop its potions for Hero to recover.

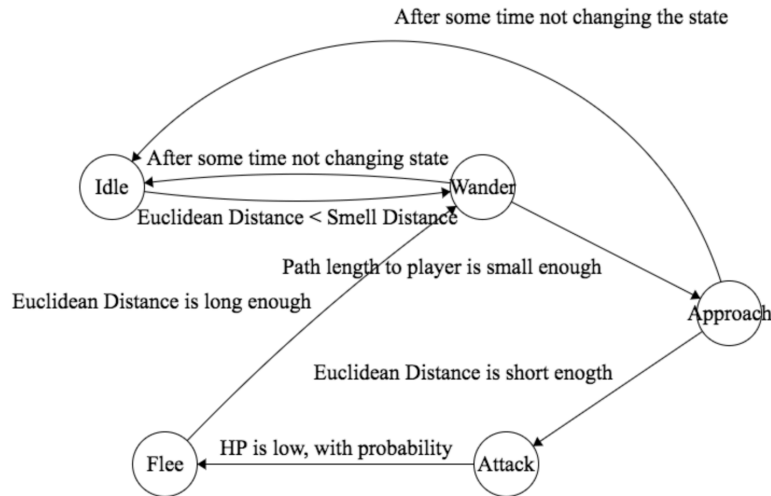
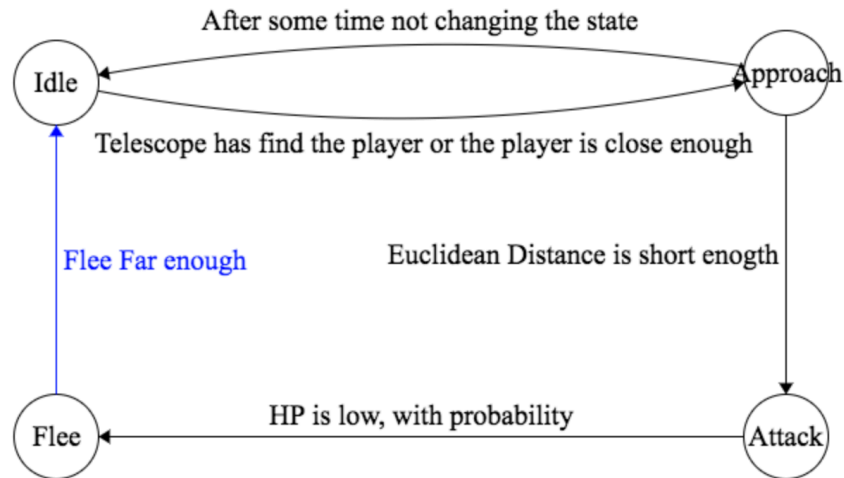


Figure 3: Finite State Machine of Goblins.

**Dark Witch:** Dark Witch is monster of low STR, mediocre DEF, INT, and DEX. Besides that, it has the smallest amount of HP but with sufficient amount of MP for them to enchant sorceries. Dark Witches has a unique skill called Telescope. When they are in idle state, they will use the skill to see a random place in the maze. Dark Witches are famous for their powerful sorceries that will create a lot of troubles for the player. They can attack the player with meteor even when she is behind a wall, and the meteor will make a lot of damage. They can also attack the player with arcane blast when they are in a line with the player. A Dark Witch is good at kiting the player, moving backward to keep a safe distance to the player. She is always equipping Sorcery weapon. When a Snake Women is dead, it has mediocre probabilities to drop its equipment, recovery potions, and scrolls. In our purpose, the Dark Witch has ability to enchant the player and make him sleep. However, due to the time constraint, the feature is not implemented yet.



*Figure 4: State Machine of Dark Witches.*

In our proposal, there are two more kind of characters, the Skull Knight and the Dragon. However, due to the time constraint, the features are not implemented yet.

## Objects

There are many objects, either on Monsters or in the maze, can make player stronger. Basically, there are four kinds of object.

1. Weapons: a weapon is a way for agents to attack each other. Agents with weapons will due far more damage than Agent without. Some weapons are melee, and some for sorceries. Each weapons has durability. It will break if durability reaches 0. Here is a gross list of weapons.

Short sword: increase STR a little, low durability

Long sword: increase STR mediocre, medium durability

Heavy sword: increase STR heavily and DEF a little, decrease DEX a little, high durability. When a character is equipping heavy sword, he cannot equip any shield, since he need both hands to hold the heavy sword.

Wood Staff: increase INT and DEF a little, medium durability

Wind Staff: increase INT and DEX a little, medium durability

Water Staff: increase INT and HP a little, high durability

Fire Staff: increase INT heavily and decrease DEF a little, low durability

Sleep Fang: increase INT a little. Sorceries can make enemy sleep (Not implement yet).

Low durability

Alchemy bomb: Consumable. It will Deal a huge amount of damage in an area after few

seconds. (Not implemented yet)

2. Armors: armor is a way for agents to reduce damages from attacks. Agent without armor takes far more damages than agent without. There are two kinds of armors, shield and armor. Shield can be hold by the character, and the armor is equipped on the character.

Robe: Increase DEF a little, increase INT a little. Low durability

Chainmail: increase DEF mediocre, medium durability

Plate: increase DEF heavily, decrease DEX a little, high durability

Round Shield: increase STR and DEF a little, low durability

Tower Shield: increase STR heavily, increase DEF heavily, Decrease DEX heavily. High durability. A character cannot equip a weapon if he is equipping tower shield, since it need both hand to hold the tower shield.

3. Potions. Consumable. Potions are for player to recovery from injuries or Mana exhaust.

HP potions: recover 40% HP

HP super potions: recover all HP

MP potions: recover 40% MP

MP super potions: recover all MP

Elixir: recover all MP and HP.

4. Scrolls. Consumable. Scrolls are consumed to make Hero gain status, or do some special stuff.

Scrolls of STR: increase STR a little.

Scrolls of DEF: increase DEF a little.

Scrolls of INT: increase INT a little.

Scrolls of DEX: increase DEX a little.

Scrolls of HP: increase HP a little.

Scrolls of MP: increase MP a little.

Scrolls of Teleportation: send player to a random position of current level (Not implemented yet)

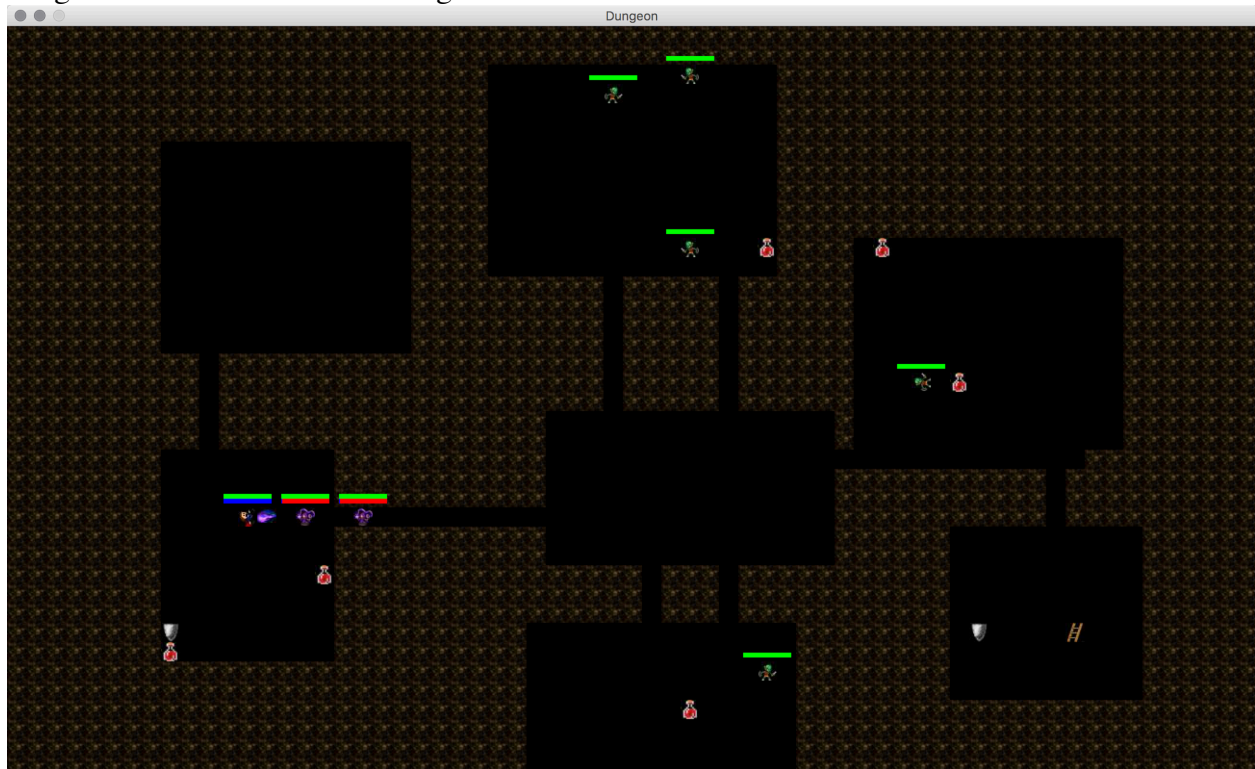
Scrolls of Resurrection: Resurrect player when he die, restore 50% HP, MP. (Not implemented yet)

## **Sorceries**

Sorceries are displayed on the maze once the character has enchanted sorcery attacks. The sorceries will move on the map, and deal damage or disappear. There are two kind of sorceries,



the arcane blast and the meteor. Arcane blast is moving straight. It will disappear after it hit the target, hit the wall or after travelling an amount of distance. The distance is decided by the INT of the enchanter. When it hit the target, it will deal damage. The other kind of sorceries is meteor. The arcane is attacked from above. To make the effects, we decided to generate the meteor from somewhere top-right of the player and move toward to the player in a high speed. The sorceries deal area of effects damages, which means it not only deal damage to the target when it hit the target, but also deal damage to the target when the target is close to where it hit the ground. It deal far more damages than arcane blast.



*Figure 5: The Dark Witches is casting arcane blast to the player.*

## Controls and Tips

### Movement:

- w: move the character up.
- s: move the character down.
- a: move the character left
- d: move the character right

### Attacks:

j: melee attack.(only valid if the monster is next to you in four directions: UP, DOWN, LEFT, RIGHT)

k: range attack (sorceries). (only valid if the character is equipped with sorceries weapons. (Wind Staff, Water Staff, Fire Staff, Wood Staff, Magic Fang)

Accessories:

- i: get Status of the character, and can equip, throw, or use objects. (Instructions is inside.)
- p: pick up objects in the map when the character is just on the objects. The object is appended to the end of the inventory.
- n: when the character is on the stairs(ladder), press n to go to the next level of the dungeon.
- 1: (Warning: The button will make the game boring.) press 1 to cheat. The character will be invincible.

In start screen:

- s or Return: to start playing the game.

In inventory screen:

- z: resume game
- u: throw the last items in inventory to the map.
- w, x, y: unequip the equipment on character. (ARMOR, WEAPON, SHIELD)
- other button: there are letter start from a that numbered the objects in inventory. press correspond button to use or equip different objects.

Tips:

1. Because the game's map, location of monster are all generated in random manner. So there will be situation that a lot of monster is surrounding the player. There is only grantee that the monster will not be born in the start room of each level of maze.
2. The dark witches, that are born in the map after the second level, will use "meteor" to attack character. That means, it can attack player within a certain distance, and the attack will not miss. They can attack the player even when there are walls between then.
3. There are 'DEX' attribute of each character, including player. So the player will respond to the next command after few times once a command is make. So if you want to pick up objects on the map but actually you do not, press p to try again.

## Conclusion

In conclusion, although the implementation of The Dungeon and the Kid is not finished yet, it is currently a playable game. The player will travel in the maze, pick up different object to arm him, and beat monsters to gain experience and level up. The game is growing in its difficulties, for at higher level of the maze, the monster will become more powerful, and different kind of monsters will create troubles for the player. The AI of the game, in this situation, the Goblin and the Dark Witches, can interact with the player and behave differently in different situation. Last but not the least, there are a lot of features that are not finish implementation. Due to the limitation of time, we cannot done that before the end of the semester. However, we will finish the implementation during the Winter break.