X4

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X4 - The Game

The classic game of Connect Four or Four-in-a-Row.

- ☒ Game board is 7x6
- ☒ Two player game, each get a color
- ☒ Players alternate until four tokens of the same color make a line
- ☒ Stalemates are possible

X4 - The Essentials

What was needed to build the project?

- ☒ PyCharm IDE
- ☒ Python 3.2.5
- ☒ pygame
- ☒ Google

X4 - My Project

At the beginning of the project I had big dreams and ideas for the game.

I wanted everything in the project, a perfect good looking game, with unbeatable AI, full scale networking with encryption, a chat system, and other bonus features.

I put everything that I could think of on my proposal and didn't think about actually getting it all done.

Approved. Okay, set, go.

At the end of the project I am proud of what I have learned and accomplished.

A mistake I will not make again, plan and design.
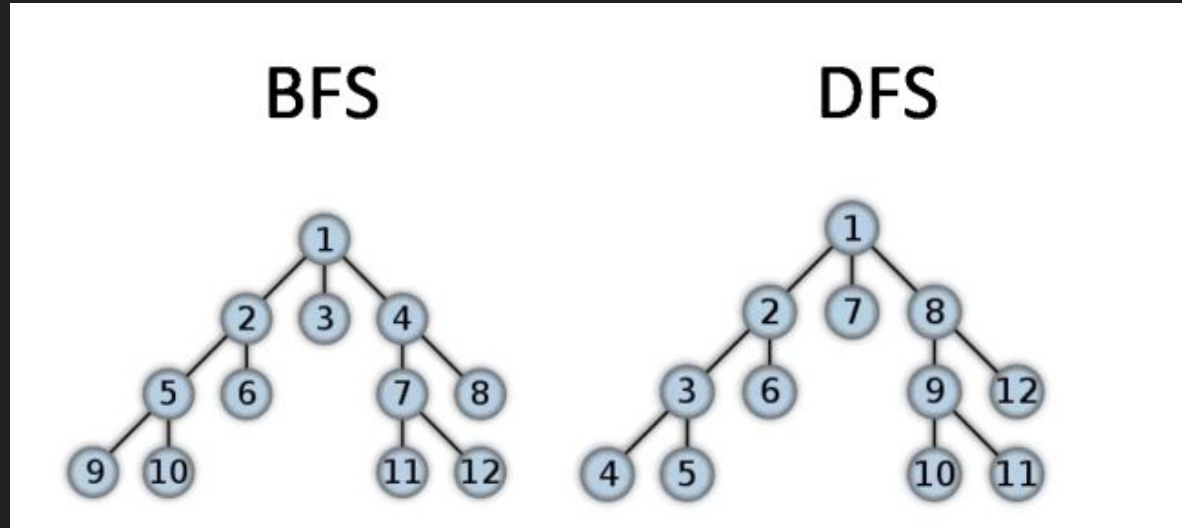
Parts were cut.

New stuff was added.

Final game is a more finished and focused product.

Wow, didn't expect the difficulty.

X4 - Artificial Intelligence

In my project the main focus was on AI.

☒ Depth-First Search
☒ Breadth-First Search
☒ A*
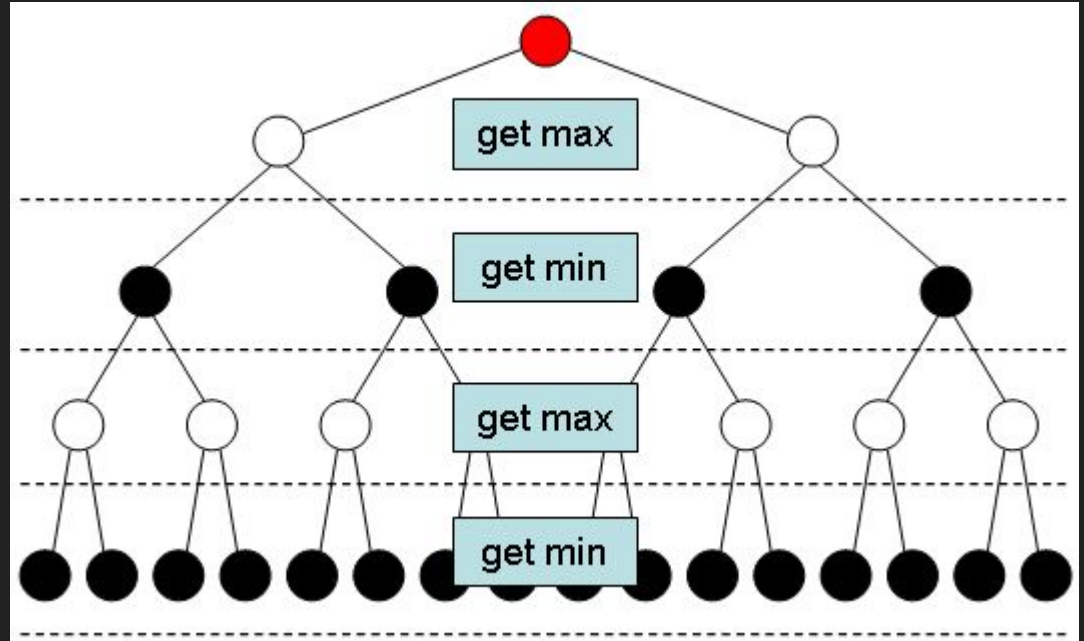☒ Unbeatable

Minimax (Min-Max)

Simply the best algorithm to implement my AI.

Minimax is a way to calculate the value of your moves and your opponent's moves.

A value is set to each move variation.

The best value is the move the AI picks.

Both my Depth-First and Depth-First search are used in collaboration with Minimax.

A* (A-Star)

- ☒ This algorithm is incredible.
- ☒ Amazing at pathfinding.
- ☒ A* is given a start and end point.
- ☒ Nodes spread toward goal.
- ☒ Interruptions and failures of nodes cause it to step back and try again.
- ☒ My research about A* helped me learn about Heuristics.
- ☒ After working on A*, I learned a lot.

X4 - Problems

After getting a working AI, realizations.

☒ Depth is slow, exponential.
- ❏ 1 move, unoticable delay
- ❏ 2 moves, less than a second
- ❏ 3 moves, 15+ seconds

☒ Breadth is dumb.
- ❏ OOOO! Look, a possible win!!

☒ A* won't work.
- ❏ Where is the end?

WHY?

This annoying thing called deepcopy()

b = a[:]	0.039ms
b = list(a)	0.085ms
b = copy(a)	0.187ms
b = deepcopy(a)	10.592ms

Unbeatable AI

Why? Just, Why??

- ☒ Research
- ☒ 4.53 Trillion, Board Combinations
- ☒ Sadness
- ☒ Pivot
- ☒ Strategy
  - ❏ Looking Ahead
  - ❏ Cheating?
  - ❏ Taking Advantage
  - ❏ Conclusion

X4 has opened my eyes.

Thank You

Minimax Graph: http://mnemstudio.org/ai/game/images/minimax_move_tree1.gif

A* Pictures: https://en.wikipedia.org/wiki/A*_search_algorithm

Deepcopy Times: https://news.ycombinator.com/item?id=3201033

Pygame: http://pygame.org/hifi.html
PyCharm: https://www.jetbrains.com/pycharm/
Tornado: http://www.tornadoweb.org/en/stable/

☒ **Base Program**
- ○ New Language to Learn — 2
- ○ Another New Language — 2
- ○ Adequate UI — 3
- ○ Aesthetically Pleasing GUI — 3

☒ **Artificial Intelligence**
- ○ Depth-First Search — 1
  - ■ Changeable Difficulty — 1
  - ■ Recursive — 1
- ○ Breadth-First Search — 1
  - ■ Changeable Difficulty — 1
  - ■ Recursive — 1
- ○ Unbeatable AI — 4

☒ **Networking**
- ○ Server AI vs Client Play — 2
- ○ Client vs Client Play — 2
- ○ Play on Network — 3
- ○ Encryption Added — 3

☒ **Extra Features**
- ○ Leaderboard — 1
- ○ Sounds — 2
- ○ Multiple Games at Once (Threading) — 3
- ○ Client and Server Different Languages — 3
- ○ Chat System — 5
- ○ User Accounts with Passwords — 3

SUBTOTAL - 21/47

☒ **Base Program**
- ○ Connect Four Animated Game — 2

☒ **Artificial Intelligence**
- ○ AI vs AI — 1
- ○ Minimax — 2
- ○ A* Work and Research — 1
- ○ Unbeatable Worth More — 2
- ○ Pruning — 1

☒ **Other**
- ○ Options Menu — 1
- ○ Leaderboard Worth More — 1
- ○ Unexpected Intensive Research — 2
- ○ Difficulty of Project (Randy's Email) — 2
- ○ pygame Module (Whole week to get working) — 1

SUBTOTAL - 16

Rubric: 21
Extras: 16

Final Points: 37

Rubric Grading Scale: A = 40+   B = 32+   C = 28+