WILDFIRE WALLY: A VOLUNTEER COMPUTING GAME

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ABSTRACT

The popularity of online casual gaming can be exploited as a tool for distributed computing. To demonstrate this, we present *Wildfire Wally*, an online casual game which solves the maximum clique problem. As players struggle to contain a voracious forest fire by creating fire lines and dousing flames, their actions are used to make algorithmic decisions.

Wildfire Wally is a prototype of a concept that can have a significant impact on volunteer computing efforts. We believe that complex problems can be presented through online casual games—combining the efficiency of distributed algorithms with the accessibility of engaging game play. By integrating distributed algorithms into games, we believe we can overcome many of the obstacles currently facing volunteer computing.

Wildfire Wally serves as an example of how games can be used to accomplish work, allowing people from across the globe to simultaneously work on the same problem

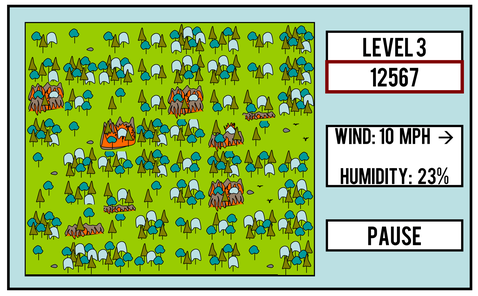
MOTIVATION

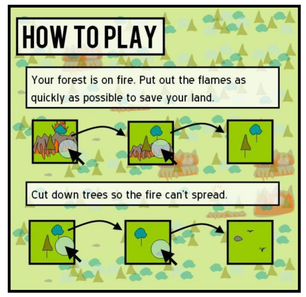
While volunteer computing has proven to be useful to the research community, it has fallen far short of its full potential. There have been at least four distinct barriers to participation in volunteer computing: *lack of awareness, lack of broad appeal, a limited demographic*, and *lack of technical savvy*.

We believe that casual online gaming is capable of breaking all of these barriers. Games as a medium immediately overcomes barriers of awareness and broad appeal. Casual gaming websites such as AddictingGames, MiniClip, and Yahoo! Games have experienced remarkable success as of late. Also, casual games appeal to a more balanced demographic and can even be specifically catered to different people groups. Finally, since online casual games are by definition, simple and not overly complex, the final barrier of technical savvy is broken.

WILDFIRE WALLY

Wildfire Wally is a prototype of a volunteer computing game. Players play as Wally, a red-bearded wilderness personality, who is trying to protect his forest from a raging fire. Wally contains the flames by either dousing blazing trees with water, or by creating fire-lines that isolate a burning area of the forest. As players progress from level to level, wind gusts and dropping humidity make containing the fire increasingly difficult. If a certain number of trees are not conserved, the player loses.





GAME DESIGN FEATURES

ONE BUTTON CONTROL

The entire game can be played using nothing but mouse clicks. This provides simplicity and caters to all levels of computer users.

GENDER/AGE INCLUSIVE

Fighting a forest fire does not exclude any major demographic. The combination of strategy in building fire lines and skill in quickly extinguishing fires caters to all age groups.

RAPID GAMEPLAY

The constant clicking corresponds to constant progress in the search tree.

DISPLAY OF PROGRESS

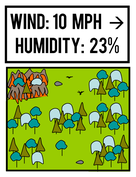
Updating scores makes the player's actions feel meaningful both in the game and towards the problem. We can use these scores in creative ways that may encourage competition among players and result in a stronger attachment to the game.

EASILY EXTENDABLE

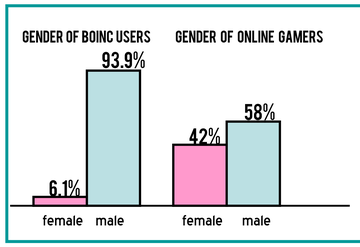
Different dimensions of gameplay can easily be added to the game:

- Random rainstorms that douse fires
- Players need to protect houses to win
- Campers could spark fires mid-level
- Geological barriers like rocks or rivers could effect fire spread

REPLAYABILITY



Play is never repeated from game to game. Each level, players are given a randomly configured forest with a random lightning strike. Also, variables such as humidity and wind can drastically alter gameplay. This keeps players engaged in both the game and the problem.



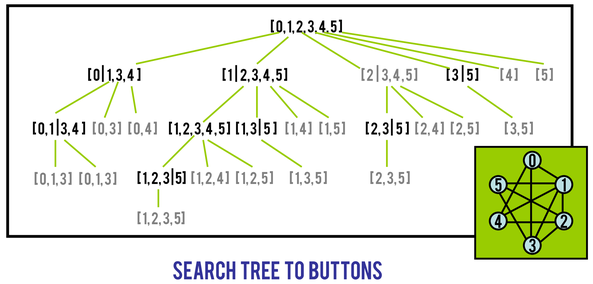
WHY USE GAMES?

- At most, **0.3%** of online computers participate in volunteer computing [1] [2]
- An estimated **100 million people** in the US will play a computer game this year [3]
- The core and casual downloadable games sector **grew over 100%** from 2003-2004 [3]
- **69%** of American heads of households play computer or video games [4]

EVOLUTION OF THE PROBLEM

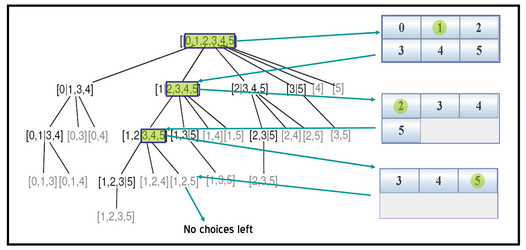
SEARCH TREE OF A GRAPH

One way to consider the cliques of a graph is in a search tree, as below. The volunteer computing algorithm we use to solve the maximum clique problem exhaustively traverses this tree to find the largest clique. At each node, the algorithm either chooses which child to explore next or, if the node has no children, backtracks to the node's parent.



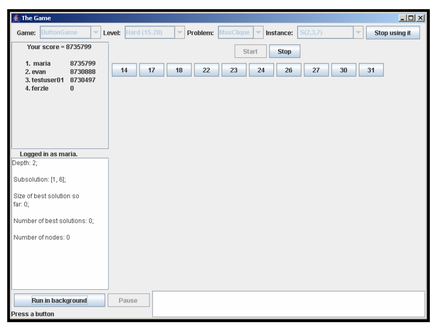
SEARCH TREE TO BUTTONS

There is only one decision-making step in the process of solving a node: choosing which of the node's children to explore next. We can give the player control over this step by representing each child of the node as a button.



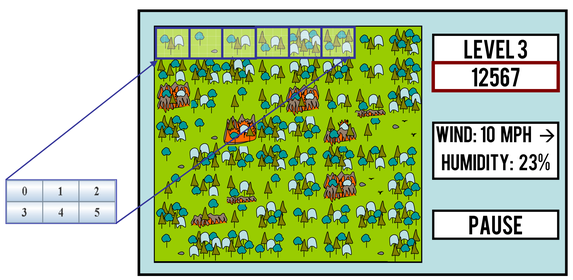
BUTTON GAME REPRESENTATION

The button game simply presents the above representation to the player. Every time there are children to choose from, they are displayed as buttons. Which button the player presses determines which child will be explored next.



WILDFIRE WALLY REPRESENTATION

While playing *Wildfire Wally*, the player's clicks are also mapped to choices in the search-tree. Instead of having one button represent each choice, a simple rule maps each square on the game world's grid to a choice. This mapping is entirely independent of the display or status of the forest, allowing us to use the player's actions to work on the problem without disrupting the flow of the game.

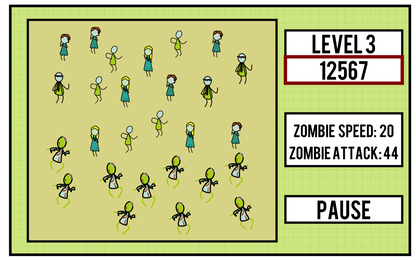


ADAPTABILITY

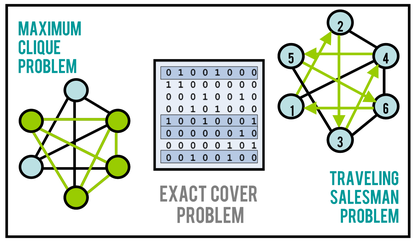
MANY GAMES FOR ONE PROBLEM

The only communication between the game and the problem solving portion of the application is a list of choices and decisions. This allows our implementation to plug in different games by substituting only one java class.

As long as a player makes decisions in a game, his or her gameplay will work seamlessly with our search tree solving algorithm. Hosting a variety of games gives us the opportunity to appeal to players of particular gaming genres.



[A mock-up zombie game that could easily be implemented with our application]



[Several problems that could be solved using our game]

MANY PROBLEMS FOR ONE GAME

The implementation behind *Wildfire Wally* and the Button Game can solve any problem mapped to a search tree. Once again, only one java class needs to be substituted – one that is tailored to the specific problem (in our case, the maximum clique problem).

However many games and problems we implement, each game will be able to solve each problem.

FUTURE POSSIBILITIES

Screenshot from *www.espgame.org*. © 2005 Carnegie Mellon University, all rights reserved. Patent Pending.

HUMAN INSIGHT

While players' decisions have meaning within the context of *Wildfire Wally*, their gameplay cannot solve the maximum clique in an intelligent manner. Future progress can be made in constructing games that generate visual representations of problems – allowing players to have a more direct interaction with them. While Luis von Ahn's human computing work at Carnegie Mellon (left [5]) has focused on problems that computers cannot do well, we similarly believe we can model algorithmic problems, allowing people to use their ingenuity to improve the algorithm.

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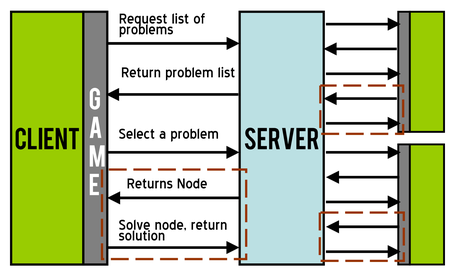
MASSIVELY MULTIPLAYER ONLINE GAMING

While our focus has primarily been confined to casual online gaming, the persistent worlds of MMOGs provide a wonderful opportunity for volunteer computer games, particularly in the realm of human insight. Many MMOGs already consist of large social constructs that work together to accomplish difficult tasks. Since MMOGs typically allow for emergent gameplay, the world would allow users to interact with the algorithm in unexpected ways. Our hope is that emergent behavior can lead to an improvement in the algorithm. Finally, the complex worlds of MMOGs provide an ideal environment for game designers to try and represent problems in new and innovative ways.

CLIENT-SERVER MODEL



This diagram demonstrates the client-server communication during a game of *Wildfire Wally*. All of the game information is contained on the client, while the server accepts and passes information about the problem. The area boxed in by a dotted line is typically repeated many times during gameplay. The more times this is repeated, the more progress is made in the maximum clique problem.

REFERENCES

[1] Anderson, David P.; McLeod VII, John; "Local Scheduling for Volunteer Computing," *Parallel and Distributed Processing Symposium*, 2007. *IPDPS 2007. IEEE International*, pages 1-8.

[2] Anderson, David P. "Public Computing: Reconnecting People to Science," in *Proceedings of the Conference on Shared Knowledge and the Web*, November 2003.

[3] IGDA casual games SIG. *2006 Casual Games White Paper*. 2006.

[4] Entertainment Software Association. *2006 Sales, Demographic, and Usage Data. Essential Facts About the Computer and Video Game Industry*. 2006

[5] The ESP Game. *http://www.espgame.org/*

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