



**200
150 Students Can't Be Wrong!**
GamesCrafters, a Computational Game Theory Undergraduate
Research and Development Group at UC Berkeley

2007-11-13 @ 12:00-13:00 EST in Theatre 3 ICT, 111 Barry St, Carlton, Australia

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Student Groups

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<p>Problems</p> <ul style="list-style-type: none"> • Nothing to offer to your A+ students after course • Faculty-student interaction limited • Students don't know how to bootstrap into research projects • Few opportunities for students to shine • Research, development, art itches not scratched! 	<p>Solution!</p> <ul style="list-style-type: none"> • Offer student groups that fit your interest • Students can register as "group meeting" or "research project" • Meet in the evenings so scheduling easy • Students can register over and over, choosing bigger projects • 3 groups founded in '01
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What is "Game Theory"?


www.cs.berkeley.edu/~ddgarcia/eyawikagibwata

<p>Combinatorial</p> <ul style="list-style-type: none"> • Sprague and Grundy's 1939 <i>Mathematics and Games</i> • Board games • Nim, Domineering, dots and boxes • Film: <i>Last Year in Marienbad</i> • Complete info, alternating moves • Goal: Last move 	<p>Computational</p> <ul style="list-style-type: none"> • R. C. Bell's 1988 <i>Board and Table Games from many Civilizations</i> • Board games • Tic-Tac-Toe, Chess, Connect 4, Othello • Film: <i>Searching for Bobby Fischer</i> • Complete info, alternating moves • Goal: Varies 	<p>Economic</p> <ul style="list-style-type: none"> • von Neumann and Morgenstern's 1944 <i>Theory of Games and Economic Behavior</i> • Matrix games • Prisoner's dilemma, auctions • Film: <i>A Beautiful Mind</i> (about John Nash) • Incomplete info, simultaneous moves • Goal: Maximize payoff
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What board games do you mean?

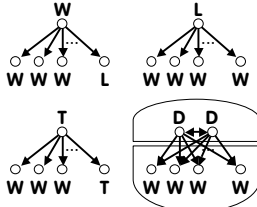
- No chance, such as dice or shuffled cards
- Both players have complete information
 - No hidden information, as in Stratego & Magic
- Two players (Left & Right) usually alternate moves
 - Repeat & skip moves ok
 - Simultaneous moves not ok
- The game can end in a pattern, capture, by the absence of moves, or ...



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Basic Definitions

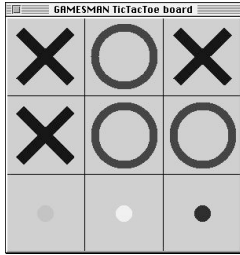
- Games are graphs
 - Position are nodes
 - Moves are edges
- We strongly solve game by visiting every position
 - "Playing" every game ever
- Each position is (for player whose turn it is)
 - Winning (∃ losing child)
 - Losing (All children winning)
 - Tying (∃ losing child, but ∃ tying child)
 - Drawing (can't force a win or be forced to lose)



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Example: Tic-Tac-Toe

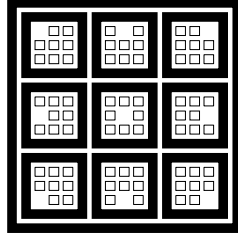
- Rules (on your turn):
 - Place your X or O in an empty slot on 3x3 board
- Goal
 - If you make 3-in-a-row first in any row / column / diag, win
 - Else if board is full with no 3-in-row, tie
- Misère is tricky
 - 3-in-row LOSES
 - Pair up and play now, then swap who goes 1st



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Tic-Tac-Toe Answer Visualized!

- Recursive Values
Visualization Image
- Misère Tic-tac-toe
 - Outer rim is position
 - Inner levels moves
 - Legend
 - Lose
 - Tie
 - Win



Misère Tic-Tac-Toe 2-ply Answer

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Computational Game Theory

- Large games
 - Can theorize strategies, build AI systems to play
 - Can study endgames, smaller version of orig
 - Examples: Quick Chess, 9x9 Go, 6x6 Checkers, etc.
 - Can put 18 years into a game [Schaeffer, Checkers]
- Small-to-medium games
 - Can have computer **strongly** solve and...
 - Play against it and teach us strategy
 - Allow us to test our theories on the database, analysis
 - Analyze human-human game and tell us where we erred!
 - Big goal: *Hunt Big Game* – those not solved yet
 - I wrote GAMESMAN in 1988 (almost 20 yrs ago!), the basis of my GamesCrafters research group

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GamesCrafters

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- Undergraduate Computational Game Theory Research Group
- 140 students since 2001
 - We now average 40/semester!
 - They work in teams of 2+
- Most return, take more senior roles (sub-group team leads)
 - Maximization (bottom-up solve)
 - Oh, DeepaBlue (parallelization)
 - GUI (graphical interface work)
 - Retro (GUI refactoring)
 - Architecture (core)
 - New/ice Games (add / refactor)
 - Documentation (games & code)



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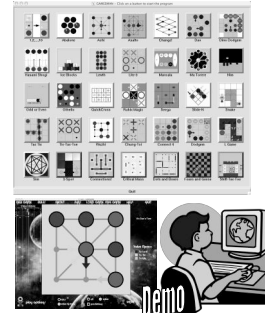
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Lines of Code:
8K Java
80K Tcl/Tk
155K C

GamesCrafters

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- Projects span CS areas
 - AI: Writing "intelligent" players
 - DB: How do we store results?
 - HCI: Implementing interfaces
 - Graphics: Values visualizations
 - SE: Lots of SE juice here, it's big!
 - Defining & implementing APIs
 - Managing open source SW
 - OS: We have our own VM
 - Also eHarmony & net DB
 - PL: We're defining languages to describe games and GUIs
 - THY: Lots of combinatorics here: position & move hash functions
- Perennial Open Day favorite!
- "Research and Development can be fun?!"



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Alumni Feedback

- Student feedback (2006 Student report)
 - Problem: "Undergrads find it hard to participate in research"
 - Solution: "Create more activities like [Dan's groups]"
- "I learned more about real software engineering in GamesCrafters than in my CS classes combined"
- "It pulled together all of the theoretical concepts from the various CS classes in providing my first practical application of my degree. Everything I learned in class was also present in GamesCrafters."
- "The experience prepared me for a career in software development in ways that my CS classes never could."
- "GamesCrafters was the defining institution of my undergraduate career at Cal."

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Conclusion

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- GamesCrafters
 - 200 Alumni
 - 65 Games
 - Almost 250K LoC
 - GAMESMAN open source, download!
- Meta take-away
 - Think of itches you need scratching; form an undergrad group!
 - Ruby on Rails
 - ACM Prog. Contest
 - ... you fill in the blank!



2007Sp GamesCrafters

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