

Get the Gold (or, Pathfinding for Alcoholics)

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ICS 461

Introduction

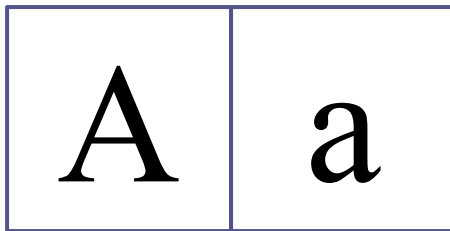
- Start with AIMA code
 - Original Wumpus World
 - Hero
 - Must retrieve gold
 - Single arrow
 - Navigate using percepts
 - Determine what is in adjacent cells
 - Obstacles
 - Pits
 - Wumpus
 - Stationary

Our Additions

- Multi-agent environment
 - A, B, and C agents
 - Competition between agents
 - “Cooperation” between A and C
- Additional features
 - Different agents behave differently
 - Different attacks
 - Different “thought” processes
 - Alcohol

Our Cast

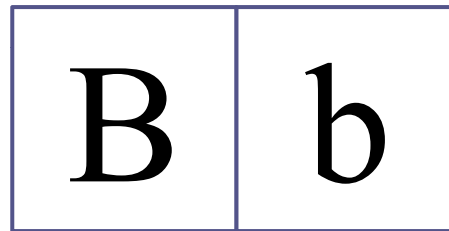
Agent A



Alive

Dead

Agent B



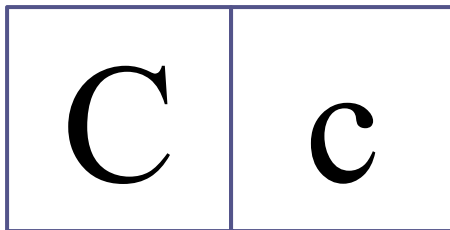
Alive

Dead

Pit



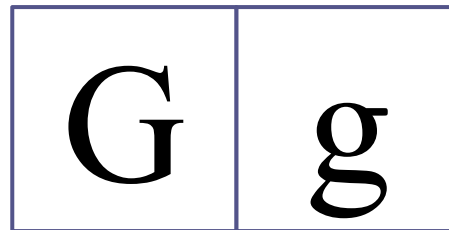
Agent C



Alive

Dead

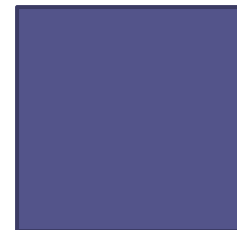
Agent G



Carried

On Ground

Wall



Agent C—The Selfish Elf

- Attacks with bow and arrow
 - Long-range attack
 - Carries a limited number of arrows
 - Stored as a variable
- Advantages
 - Can attack without being near danger
- Disadvantages
 - Has to face target
 - Is not a dwarf

Agent C—Attacks

- Orthogonal line of sight

		B		B
B		C		B
	B			

Agent A—Mortal Man, Doomed to Die

- Attacks with sword
 - Can attack multiple tiles at once
 - Therefore, can kill multiple agents simultaneously
- Advantages
 - Most efficient at defeating other agents
- Disadvantages
 - Vulnerable to attacks from behind
 - Is not a dwarf

Agent A—Attacks

- Thrust

	B	
	A	
		B

- Swing

	B	
B	A	B
		B

Agent B—Drunken Dwarves

- Attack with beards
 - Must be in same tile as target
- Advantages
 - Multiple B agents
 - “Respawning”
 - Too drunk to realize that they should be dead by now
- Disadvantages
 - Difficulty in making intelligent decisions

Agent B—Attacks

- Same tile

	C	B
B		
A		

	Bc	
aB		

“Agent” G—Gold

- A, B and C want to get the gold
 - Gold is shiny
- If A or C get the gold, they win
- B starts out with gold
 - The B agent carrying the gold is labeled “G”

All Agents

- Move in orthogonal directions
- Have a facing direction
 - Allows for walking, shooting, etc. “forward,”
- Can see (at least) one square in orthogonal directions
 - Differentiate between agents, obstacles
- Can pick up gold
- Will almost certainly die horribly

Termination Conditions

- If A or C is alive and is carrying the gold
 - A or C wins
- If A and C are both dead
 - B wins
- If maximum number of turns is reached
 - Draw
 - Though one can say that B wins if B still has gold

Performance Measure

- Start with 0 points
- Each simulation step = -1 points
- Gold = 1000 points
 - Losing the gold deducts these points
- Death = -10000 points
 - Respawnng gives back these points
- To win (get a positive score)
 - Must carry gold
 - Must be alive

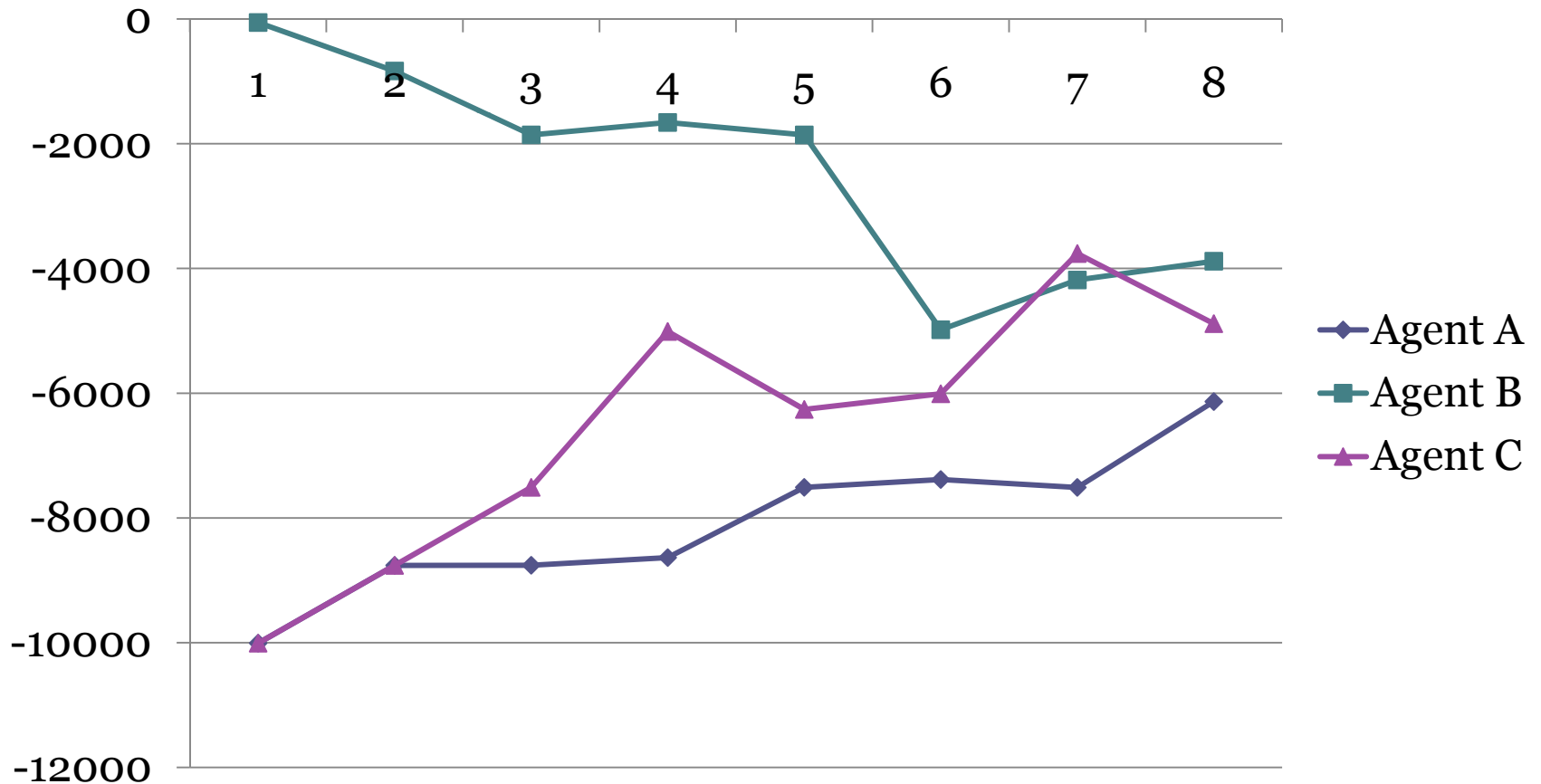
Testing Variables

- Respawn rate for B
- Amount of alcohol for B
- Arrows for C
- Room size and layout
- Operation precedence
- Simulation mechanics

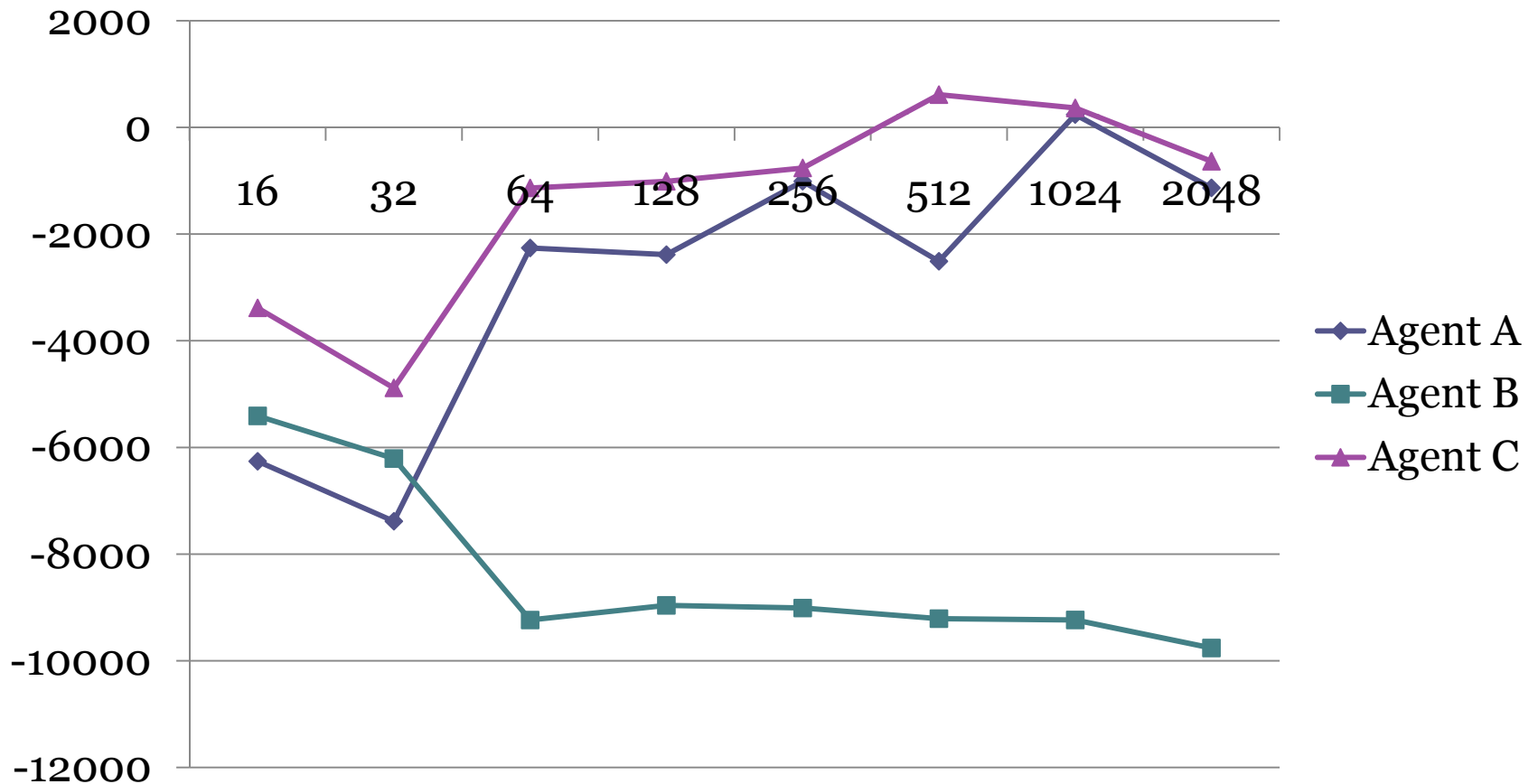
Results—Respawn Rate for B

- B wins as respawn rate approaches $1/1$
- B loses as respawn rate approaches $1/\infty$
- Primary Advantages
 - Difficult for A or C to completely eliminate B
 - B can respawn on a tile that A or C is on

Results—Respawn Rate (1/1-1/8)



Results—Respawn Rate (1/16-1/2048)



B Respawning

- Turn n

	A	bg
C	B	B

- Turn n+1

		ABg
Cb		B

Results—Alcohol for B

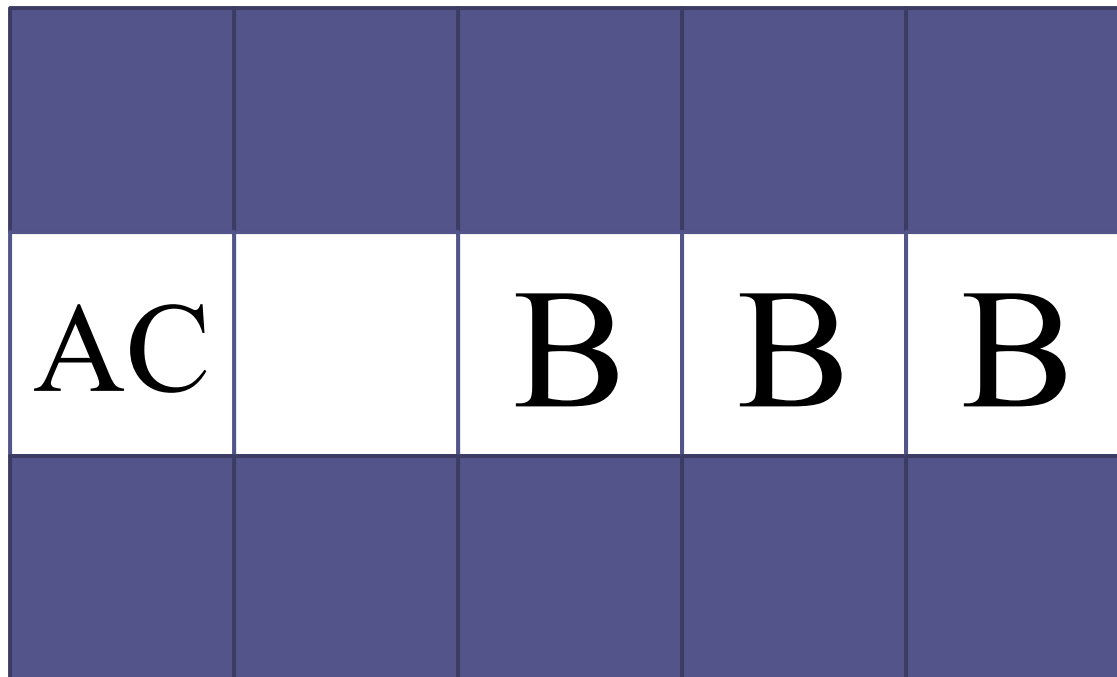
- B places priority on drinking alcohol
 - Even if A or C is immediately adjacent
- Gives other agents time to attack
- When B has more alcohol, A and C win
- When B has no alcohol, B wins
 - Though B would not like this case

Results—Arrows for C

- One arrow can be fired per turn
 - No need for more arrows than the turn limit
- If respawn rate for B is high
 - Arrows are quickly used up
- If C runs out of arrows
 - C is not good at evading B
- Arrows kill any agent that it hits
 - Often kills A instead

Unfriendly Fire

- In long corridor, C has no choice
- A approaches to kill B and moves into line of fire



Results—Room Size

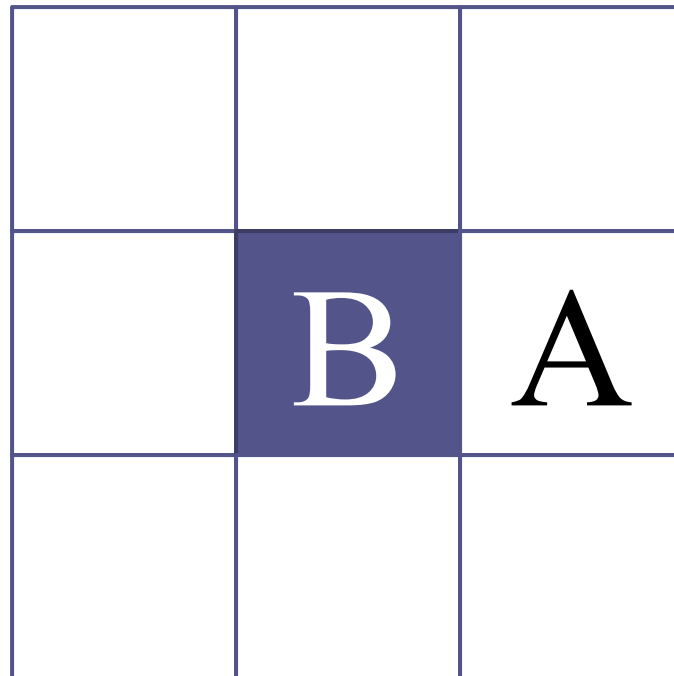
- 3x3
 - Walls on outer edges
 - A, B, C compressed into a single cell
 - A, C have no way to attack
 - Only B can attack in the same cell
 - Therefore, B wins almost instantly
- Larger rooms
 - B still has an advantage
 - More space == more ways to attack from sides or rear

Results—Obstacles

- If less than 25% obstructed, minimal effect on results
- If 50%+ obstructed
 - Movement difficult
 - If wall and agent on same tile
 - Other agents only perceive the wall
- Bottlenecks
 - A does not defend as well as expected
- Pits
 - Undocumented features

Breaking Physics

- B in same tile as wall
- Due to random initial placement



The Sort of Average Wall

- A and C can never attack B
- B can never reach A or C

B	B	B	B	B
	A		C	

Bottlenecks

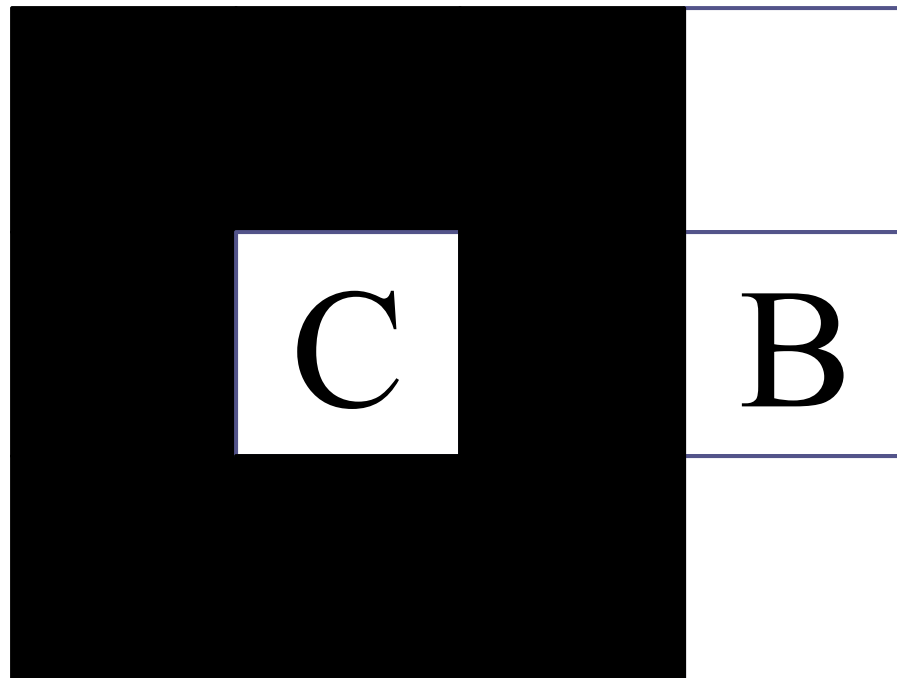
- A cannot adequately defend

	A	BB

	AB	b

Pits

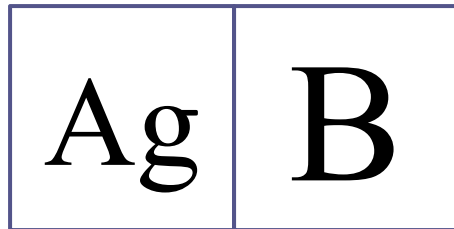
- C does not “see” over pit
- Pit treated as an obstacle



Results—Operation Precedence

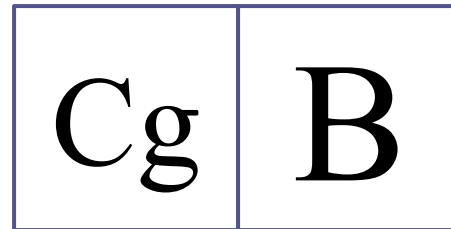
- Case 1

- A with B in swing path
- Gold in same cell as A



- Case 2

- C with B directly in front
- Gold in same cell as C



- In both cases

- Action of A/C is irrelevant
- If B moves, it is to attack
- If B does not move, A/C wins

Results—Simulation Mechanics

- Mechanics favor B
- update-fn executes before agent actions
 - Which includes check if B is in same cell as A or C
- A and C can only kill one agent per cell per turn
- However, B can kill A and C if on same cell
- “Zombie” effect
 - Actions executed without accounting for actions of other agents
 - Therefore agents move for one turn after death

Conclusions

- B has a clear advantage
 - Numbers
 - Respawnning
 - Reduces effect of arrows that C carries
 - Limited percepts for A and C
 - A must be next to B in order to attack
- A and C only consistently win when
 - Respawnning is limited
 - B has lots of alcohol