CS380/CS580 Final, version 20120720 NAME_____

Directions: Answer questions as concisely as possible. NO CREDIT if answer is more words than indicated. Bring a pristine, non-marked, stapled copy of this exam to the final (-5% for not doing this).

Total points: 290 (don't write in this table – used for grading)

1	2	3	4	5	6	7	Total

Architecture (17pts)

(1pt) Summarize Smart Objects in <= 6 words: _____.
(hint: use **"agent"** as one of your words)

(2pt) Name 2 benefits of using a complex scripting language (<=3 words each). _____ _____ _____

_____ _____ _____

(2pt) Name 2 problems with using a complex scripting language (<=3 words each). _____ _____ _____

_____ _____ _____

(4pt) Subsumption has layers of code that run: _____. The priority is with the _____layers.

The _____ layers make requests to the _____ layers.

(2pt) Describe 2 key benefits of a subsumption architecture (<=3 words each). _____ _____ _____

_____ _____ _____

(1pt) Name 2 advantages of a limited, focused, scripting system like a trigger system? (<=3 words each) _____ _____ _____

_____ _____ _____

(2pt) What game and person popularized the use of behavior trees? Game: _____ Person: _____.

(1pt) Why is a behavior tree better than a FSM: _____

(2pt) Name two declarative AI architectures (other than planning): _____ _____

State Machines and the State Machine Language (13pts)

(2pt) Name 2 major problems with using a state machine for game AI (<=3 words each). _____ _____ _____

_____ _____ _____

(3pt) Name 3 major benefits of the State Machine Language (SML) approach (<=3 words each): _____ _____ _____

_____ _____ _____

_____ _____ _____

(2pt) In SML, what single mechanism supports event-driven behavior? (one word) _____

(1pt) In SML, what is the key **benefit** of the global message response feature (not what it does)? (<= 3 words): _____ _____ _____

(1pt) Name 1 disadvantage that SML has compared to a traditional scripting language. (<=3 words) _____ _____ _____

(2pt) Delayed messages are either scoped to the substate, state, or state machine. Scoping was introduced into SML to solve what problem? (<=9 words) _____ _____ _____

_____ _____ _____

(2pt) If a delayed message is scoped to the state and the state never changes from the time the message was sent, will the message be delivered to a global message response if it isn't handled in the current state? YES or NO

Planning (7 points)

(2pt) Based on Jeff Orkin's GDC talk, actions are composed of _____ and _____

(1pt) Jeff Orkin used what algorithm to search through possible sequences of actions that would achieve a goal state: _____

(1pt) In planning, what did Jeff Orkin use as his heuristic? _____
(the answer is NOT "Cost Per Action")

(1pt) Jeff Orkin's planning is based on what academic planning system? _____

(2pt) Why is planning a declarative architecture? _____

Agent Awareness (10 points)

(3pt) Conceptually, agents have a _____, _____, _____ cycle that they loop through every frame.

(3pt) What are the three agent vision checks in order from least expensive to most expensive? (least)_____ _____ _____ (most)

(2pt) Agent hearing can most efficiently be modeled with event-driven messages that are sent based on _____ and _____.

(2pt) Agents must avoid flip-flopping decisions. Agents should stick with a decision until _____ or _____.

Agent Coordination and Cooperation (5 points)

What is the cost/time complexity of:
(1pt) Manager coordination with *n* agents: O(_____)
(1pt) Using a blackboard architecture with *n* agents: O(_____)
(1pt) Coordination using decentralized agent communication with *n* agents: O(_____)

(2pt) Describe a blackboard architecture: _____

_____

_____

Movement (20pts)

(2pt) Generally, there are 2 types of movement. _____ and _____ movement.

(2pt) Describe the data structure and content of a flow field: _____

(2pt) In flocking, group behavior emerges from what? _____

(3pt) List the 3 flocking rules (one word each): _____ _____ _____

(3pt) Name 3 other rules/steering behaviors to enhance flocking (randomness is not an answer). (<=2 words each). _____ _____ _____

(2pt) Name the father of flocking (the person who came up with the algorithm): _____

(2pt) What are flocking creatures called? (1 word) _____

(4pt) Formations can be said to have 2-level steering. What are the 2 levels? (<=5 words each)

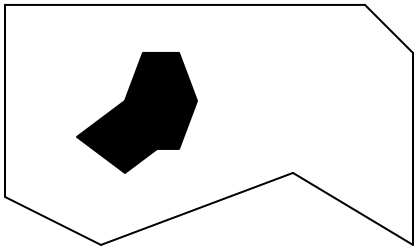
1st level: _____

2nd level: _____

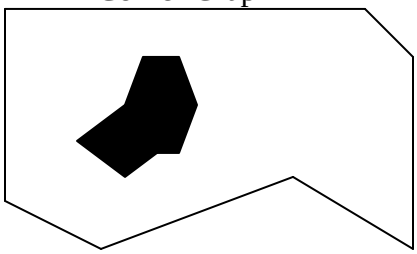
Pathfinding (151pts)

(30pt) Draw the following search space representations (include ***ALL*** details – be careful and **accurate**!):

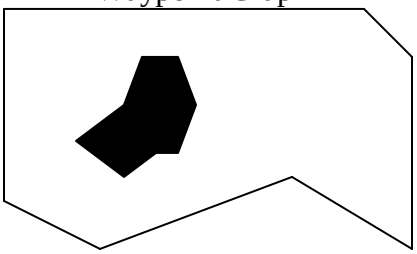
Grid



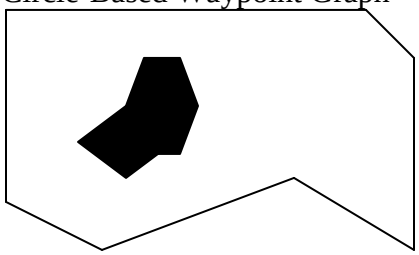
Corner Graph



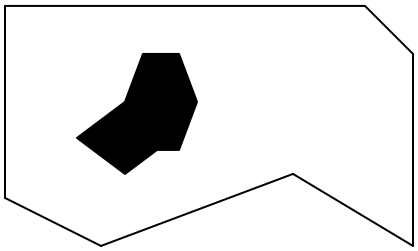
Waypoint Graph



Circle-Based Waypoint Graph



Nav Mesh



(1pt) Which search space typically results in the most nodes? _____

(1pt) Which search space typically results in the fewest nodes? _____

(2pt) Which search space(s) represent the walkable surface area? _____

(2pt) Which search space is best suited to representing the entire walkable surface area? _____

(2pt) Which search space(s) can be used with the Floyd-Warshall algorithm? _____

(2pt) Why is one search **algorithm** (not search space) faster than another? (<=3 words) _____ _____ _____

(2pt) If the heuristic cost in A* is absolutely accurate, what does it exactly represent? (<=6 words, be precise) _____

(2pt) If a heuristic is admissible in A*, then it _____ the true cost.

(2pt) If A* uses an admissible heuristic, then what is guaranteed to be found if it exists? (<=2 words)_____ _____

(2pt) What positive effect does an inadmissible heuristic cost have on the A* search? (<=2 words) _____ _____

(3pt) The cost in a Dijkstra search is the_____ cost from the _____ node to the _____ node.

(3pt) The cost in a Best-First search is the _____ cost from the _____ node to the _____ node.

(2pt) If a search algorithm is complete, then what is _____
guaranteed and under what condition is it guaranteed? (<=5 words)

(1pt) At runtime, how does the Floyd-Warshall generate paths faster than A*? (<=3 words) _____

(1pt) Given that Floyd-Warshall is faster than A*, what is the primary tradeoff to get that speed? (1 word) _____

(1pt) Calculation for octile distance:_____

(8pt) Name 4 search algorithms that are smart? _____

(4pt) Name 2 search algorithms that guarantee an optimal path: _____

(11pt) Given these optimizations or choices, judge whether the benefit is LARGE or SMALL relative to the average search cost.

Pathfinding Optimization or Choice	Circle one or the other
Choice of search space representation	LARGE or SMALL
Check for possible straight-line path before running A*	LARGE or SMALL
Overestimate heuristic	LARGE or SMALL
Check if destination is unreachable using some other method before running A*	LARGE or SMALL
Sort open list using priority queue	LARGE or SMALL
Avoid considering parent node when exploring neighboring nodes	LARGE or SMALL
Avoid putting neighboring node on open list if already on open/closed list with lower cost	LARGE or SMALL
Cache failed start-end pairs	LARGE or SMALL
Hierarchical pathfinding	LARGE or SMALL
A* bidirectional pathfinding	LARGE or SMALL
Avoid allocating memory for nodes during search	LARGE or SMALL

(2pt) Is it better to: (circle answer)

a. Perform a pathfinding search simultaneously for all requests every frame.
b. Perform a pathfinding search on one path request at a time and make the rest wait in a queue.

(10pt) For a grid search space that allows for diagonals, determine if each heuristic is admissible/inadmissible (circle one for each) and rank them from best to worst for most accurate underestimating distance in this context (1 being best and 5 being worst – circle rank # for each):

Euclidean distance:	ADMISSIBLE or INADMISSIBLE	rank	1 2 3 4 5
Octile distance:	ADMISSIBLE or INADMISSIBLE	rank	1 2 3 4 5
Zero distance:	ADMISSIBLE or INADMISSIBLE	rank	1 2 3 4 5
Manhattan distance:	ADMISSIBLE or INADMISSIBLE	rank	1 2 3 4 5
Chebychev distance:	ADMISSIBLE or INADMISSIBLE	rank	1 2 3 4 5

(2pt) Pathfinding in Company of Heroes used (circle all that apply):
a. Grid search space b. Hierarchical pathfinding c. Nav mesh d. Crush map e. Impass map f. A* g. IDA*

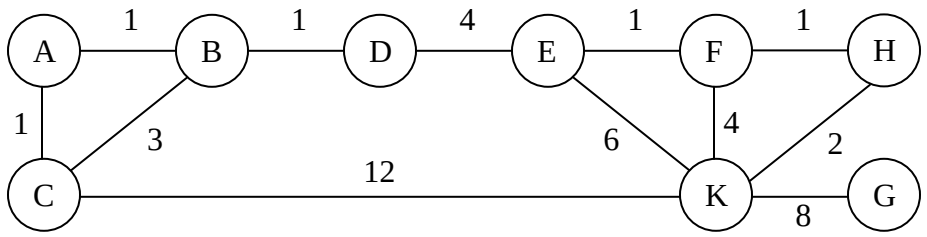
(2pt) What info does a Company of Heroes precise map contain? _____

(2pt) The top level hierarchical map in Company of Heroes most resembled which classic search space representation? _____

(1pt) The pathfinding project used a _____ spline that was smooth in the _____ .

CS380/CS580 Final, version 20120720 NAME_____

(50pt) Given the following search space, start node (A), and goal node (G), calculate on this sheet of paper a path found using A* (recall the A* algorithm from memory). Please show all work using the Open and Closed lists, **crossing out items with a single strikethrough** when deleting a node **off of either list**. Please mark parent pointers and all cost terms. Use the indicated actual cost along each node-to-node connection and use the distance values in the table for the heuristic. **(NOTE: One mistake loses 25 points, two or more loses 50 points – don't make even one mistake – double check all math)**



Euclidean distance to Goal node (G) from any given node (use this table for the heuristic):

A	B	C	D	E	F	G	H	K
5.4	4.4	5.0	3.4	2.4	1.4	0.0	10.0	1.0

Open List:

Node	Parent	g(x)	h(x)	f(x)

Closed List:

Node	Parent	f(x)

Final Waypoint Path from start to goal:

Terrain Analysis (20 points)

(2pt) What quality or property is a good tactical indicator in static terrain analysis? _____

(3pt) Describe an influence map (data structure and algorithm):

_____

(1pt) An influence map is likely to use which equation to determine influence (where d stands for distance)? _____

(1pt) An influence map can help you find:
a. Badly damaged units. b. Chokepoints. c. The front of the battle. d. Ambush spots.

(1pt) An influence map should be calculated:
a. From scratch each frame so that it stays accurate and up-to-date. b. Only when the AI needs to consult it, to avoid extra work.
c. By continuously updating it only when forces move. d. Once every couple frames since forces tend to move slowly.

(2pt) If Agent A has a node visibility array of 0111010, Agent B has a node visibility array of 1001000, and Agent C has a node visibility array of 0001010, then circle all nodes that are safe from these agents:
a. Second node b. Third node c. Fourth node d. Fifth node e. Seventh node

(2pt) If we want to attack Agent A and not be seen by Agents B or C (using the previous arrays), which nodes could we stand on?
a. Second node b. Third node c. Fourth node d. Fifth node e. Seventh node

(1pt) In spatial terrain analysis, a visibility layer will weight grid cells by: (circle one)
a. How many agents are close to a given grid cell. b. How exposed a given grid cell is to all other grid cells.
c. How close a grid cell is to static obstacles. d. How exposed the grid cell is to agent line-of-sight.

(1pt) In spatial terrain analysis, an area search layer will show: (circle one)
a. Potential hiding places for enemies. b. Promising areas to search for enemies.
c. Which grid cells have been recently visited. d. Grid cells that do not contain enemy agents.

(2pt) What are the 2 qualities of a good sniper point? _____ _____

(2pt) Explain the algorithm that the Kynogon (AutoDesk) terrain analysis middleware used to determine good sniper points:

_____

(2pt) Explain the algorithm you used in the terrain analysis project to determine good sniper points:

_____

Learning (32 points)

(1pt) How can you fake learning (without using indirect or direct adaptation)?

_____

(1pt) Circle all that apply to indirect adaptation:
a. Riskier than direct adaptation once shipped. b. Generalizes from training data.
c. Constructs a model of how the game is being played. d. Tunes and adapts parameters that directly control the AI.

(1pt) Why is indirect adaptation preferred over direct adaptation? Circle all that are true:
a. Indirect is more robust and stable. b. Indirect is usually computationally faster.
c. Indirect is easier to fix when behaving badly. d. Indirect results in more novel learning.

(1pt) Which kind of N-Gram would be most appropriate for the sequence 131131832131413_
a. Uni-Gram b. Bi-Gram c. Tri-Gram d. Quad-Gram e. N-Gram would not be appropriate

(8pt) Use this sequence for the following four (4) questions to determine the **probability** of the next move being a **Kick**:
Punch, Punch, Punch, Kick, Punch, Uppercut, Punch, Punch, Kick, Punch, Punch, Kick, Punch, Punch

Uni-Gram:_____, Bi-Gram: _____, Tri-Gram: _____, Quad-Gram: _____

(3pt) Describe the general Player Modeling strategy/algorithm:

_____

(2pt) In player modeling, UsesSmokeGrenades is stored as what data type? _____

(2pt) In player modeling, list all possible values that AttacksOnTwoFronts could have: _____

(3pt) In player modeling, AttacksOnTwoFronts, UsesSmokeGrenades, and CanDoTrickyJumps are examples of _____.

(3pt) What is the abstract strategy/algorithm in Weakness Modification Learning that could be applied to any game?

_____

(1pt) In general, what are neural networks good at? _____

(1pt) Name a problem with using neural networks: _____

(1pt) What are genetic algorithms good at? _____

(1pt) Name a problem with using genetic algorithms: _____

(1pt) Name two learning algorithms used in the game Black & White: _____

(2pt) Explain how n-gram recombination works: _____

Gesture Recognition (5 points) _____

(1pt) With gesture recognition, a new gesture must first be processed to minimize the effect of which aspects? (circle all that apply)
a. Size b. Curvature c. Position d. Weight e. Speed (number of samples)

(2pt) The player made a gesture consisting of [5,18,9,12]. Using the nearest neighbor technique along with root mean square error, which gesture in the database matches best?
a. [1,18,9,16] b. [2,15,5,12] c. [8,15,12,12] d. [10,18,9,14] e. [5,18,9,18]

(2pt) Circle all algorithms that are useful for gesture recognition:
a. Genetic algorithms b. Neural networks c. Nearest neighbor
d. Decision trees e. N-gram f. Weakness modification learning

Randomness (10 points)

(2pt) When rand() is called, it gives back a number in what range: [_____, _____]

(3pt) What was "Rabin's Radical idea on Randomness in Games"? _____

(5pt) Write a **ONE LINE** equation to generate Gaussian randomness in the range [-3,3] with roughly a **NORMAL** distribution (which has a standard deviation of 1). Your solution should make use of the random function RandReal() that returns a uniform random number in the range [0,1]:

_____