School of Engineering and Information Sciences

MIDDLESEX UNIVERSITY

EXAMINATION PAPER

2011/2012 August

MODULE TITLE Advanced Topics in Games Development

MODULE NUMBER CMT 3325

MODULE LEADER'S NAME Chris Huyck

Time allowed: 3 hours

Total number of questions: 4 questions

Instructions to candidates: Answer all questions. Each question carries 25 marks.

Materials provided: The book Programming Game AI by Example (by Buckland) is allowed, along with one A4 page marked as notes on the top. Please submit that page with the exam (it will not be marked).

Equipment permitted: none

Total number of pages: 3

No books, papers or electronic device is to be brought into the examination room other than any specified above.

Candidates are warned that illegible scripts will not be marked

1. AI and State Spaces

(a) One widely described problem domain is the box world. In this world, there are several boxes; boxes can sit on top of each other or the ground. The ground can hold all the boxes so boxes do not have to be on top of each other. There is one operator, move-box. So, if box A was on top of box B, and box C was clear, I could move-box A to ground, or move-box A to C. (You can only move a box that is on top. So, in the start state in (b), you couldn't move C without moving A and B first.) If there are 3 boxes, how big is the state space?

(6 marks)

Marking scheme:
3 points for reasonable answer
3 points for a correct answer
Sample answer:
1 state with all 3 on the ground.
6 states with one on top of another (AB,AC, BA,BC,CA,CB)
6 states with all in a column (ABC, ACB,BAC,BCA,CAB,CBA)
13 states.

(b)

A	B
B	A
C	C
Start	Goal

Above, A, B and C represent boxes. On the left is the start state, where A is on B, which is on C. On the right is the goal state with B, on A, on C. Apply the move-box operator (several times) showing the transition in states from start to goal.

(5 marks)

Marking scheme:
2 points one move-box
3 points full answer
Sample answer:

Move-box A to ground	**B**		
	C	**A**	
Move-box B to ground	**C**	**A**	**B**
Move-box A to C	**A**		
	C	**B**	
Move-box B to A	**B**		
	A		
	C		

(c) Describe an algorithm that would take you from any Start state to any Goal state.

(6 marks)

Marking scheme:
2 points An algorithm described.
2 points A correct algorithm described.
2 points A correct algorithm described well.
Sample answer:

Many exhaustive algorithms would work including breadth first and depth first (that checked for cycles). The simplest algorithm is probably to merely randomly choose a legitimate operator, and if you've not got to the goal state, repeat. This random search will work, and as the state space is so small, it probably won't take very long (under 100 moves).

(d) Hill climbing is a greedy algorithm. In this case, it will choose the move that takes you closer to the goal state. Show how it works starting from the start state in part (b). Are there any problems?

(8 marks)

Marking scheme:
2 points for noting how to choose the appropriate operator.
2 points for a complete solution (including a dead end)
2 points for noting the conflicts (initially and with all on the ground)
2 points for noting the possible dead end.

Sample answer:

There's only one option so pick it. (It's possible that you might not be able to improve things, so you'd just stop.)

Move-box A to ground B
C A
Move-box B to ground C A B (again no improvement)
Choose either
Move-box A to C A
C B

Or Move-box A to B A
C B

Both improve things. However, only the first takes you to the final state.

Depending on how you interpret it, there could be a problem stuck with C empty.

2. Physics

(a) If two people are sitting (with their feet off the ground) in chairs that roll, and one pushes the other, what will happen? Paraphrase (or quote) Newton's law that gives you the answer.

(8 marks)

Marking scheme:
3 points for they'll move away from each other.
2 points for a reasonable paraphrase
3 points for a solid paraphrase (or exact quote).

Sample answer:

Both chairs will move away from each other and the initial point. This is based on Newton's third law, "To every action there is always an equal and opposed reaction."

(b) The people and the chairs are in interstellar space. After the push, using well positioned thrusters, the two people in the chairs come to rest 10 meters apart. One person and chair weighs 100 kilograms, and the other 200 kilograms. How

much gravitational force does the larger exert on the smaller? (Please show work.)

(9 marks)

Marking scheme:
4 points equation
2 points G
3 points correct
Sample answer:
$F=Gm_1m_2/r^2$
G = 6.656e-11
F = 6.656e-11*100,000*200,000/10*10 =
6.656e-11*100,000*2000 =
6.656e-11*2e+8 = 13.312e-3 = .013312

(c) Part b assumed the movement of the chairs could be described quite simply. If the chairs are sitting in a room on earth, what other forces might be considered for a video game involving chair pushing? What might be involved in an interesting game involving chairs?

(8 marks)

Marking scheme:
2 points gravity between the objects is largely irrelevant.
2 earth's gravity
2 friction
2 other points.
Sample answer:
The two obvious forces are the gravity of the earth and friction of the wheels against the surface. The gravity between the two objects is more or less irrelevant and can be ignored in a game. Wind is probably more of a factor. I think a game that involved pushing chairs around would require some force to actually move the chairs (like a fire extinguisher or a person pushing the chair). An interesting game might involve wheel-chairs.

3. Software
(a) A number of games and game engines (including Crystal Space) provide scripting languages to develop aspects of games. What are the advantages and disadvantages of scripting?

(10 marks)

Marking scheme:
2 points don't need to be a programmer to script.
2 points provides flexibility and customisability
2 points cost of supporting two languages.
2 points cost of testing
2 points conclusion

Sample answer:
Scripting can be relatively simple, and so users can do it. This means that the game can be developed by the users; it can be customised, and they can extend it. This can support a user community, and improve playability. However, scripting comes with a cost. The software has to

support two types of game development, script and the original language. A similar cost comes from testing, because now testing has to be of any possible script. Overall, lots of games provide scripting, so for developing a game community, the advantages often out-weigh the disadvantages.

(b) Being a student in CMT 3325, you can write in source code (e.g. C++). When would you write in a scripting language for a game?

(6 marks)

Marking scheme:
3 points when needed
3 points for just a start
(points for other answers that are reasonable).

Sample answer:
I'd write script when I needed to. Many games that provide scripts, don't provide the ability to write in the source. I'd also write in scripts when I just wanted to get something going. It can be pretty quick to get a script running particularly if examples are provided.

(c) Primary developers allow users access to the system via a scripting language. What would be a good mechanism to assure that the scripts do not cause a fatal crash in the game?

(9 marks)

Marking scheme:
3 points Automated test suites.
3 points User feedback.
3 points other answers

Sample answer:
Testing is difficult so I'd devote a significant effort to developing scripts and associated automated testing suites. I'd also get some beta developers to develop some scripts. Assuming there are going to be multiple releases (of games using the scripts), I'd set up a bug database that users could access. They could then put in the bugs they found. This might merely be a misunderstanding, but the bugs that were found could be fixed via patches, and they could then be added to the test suite. It's also possible to protect the system from bugs by reducing the power of the scripting language; of course this involves a trade off between power and safety.

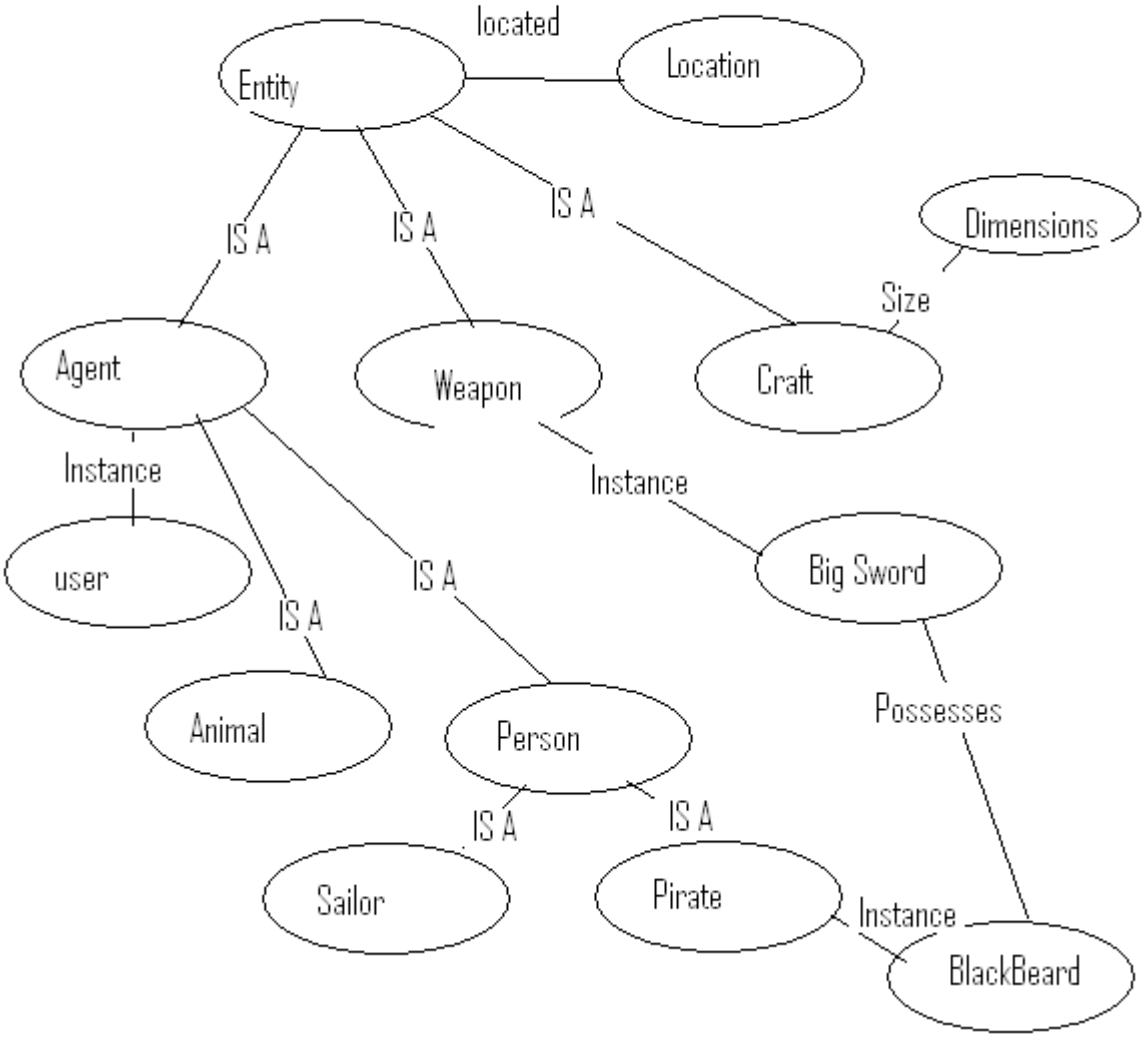
4. AI

(a) You are charged with developing AI agents for a "Pirates of the Caribbean" game. As you'd like the agents to know about the environment, you draft a semantic net of the important concepts in the game. Show your net. Include at least ten concepts and five relations including the most important.

(10 marks)

Marking scheme:

2 points 10 concepts
2 points isa relation
2 points instance relation
2 points 3 other reasonable relations
2 points 3 good net
Sample answer:

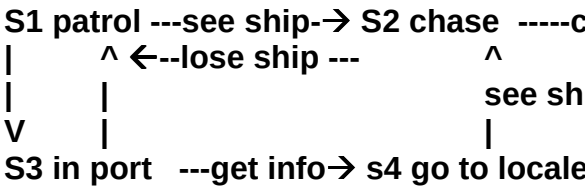


See picture

(b) Show a finite state automata for a Naval Captain searching the seas looking for pirates.

(8 marks)

Marking scheme:
2 points states
2 points transitions
2 points reasonable fsa
2 points good fsa
Sample answer:



(c) In this game, the user will frequently fight Black Beard, a rival pirate. How could the agent that you are developing to play Black Beard learn from the fights, so that he becomes more difficult to beat in later battles?

(7 marks)

Marking scheme:
3 points record user behaviour
2 points a learning algorithm including stats
2 points something clever like choosing actions to explore user behaviour.

Sample answer:

Assuming that battle goes by a series of user choices, agent choices, and states of the individual and area, the agent could record those, and see what the user chooses to do in each state. This could use probability or some kind of standard learning algorithm (like MLPs with backprop). The state space will probably be quite large, and chains of actions may be important. A good ploy would be to guess what the user will do in response to an action, and then test that response by doing the action.