UNIVERSITY OF LIMERICK
OLLSCOIL LUIMNIGH

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING

MODULE CODE:	**CE4041**
MODULE TITLE:	**Artificial Intelligence**
SEMESTER:	**Sample Paper**
DURATION OF EXAM:	**1.5 Hours**
LECTURER:	**Dr. C. Flanagan**

INSTRUCTIONS TO CANDIDATES:

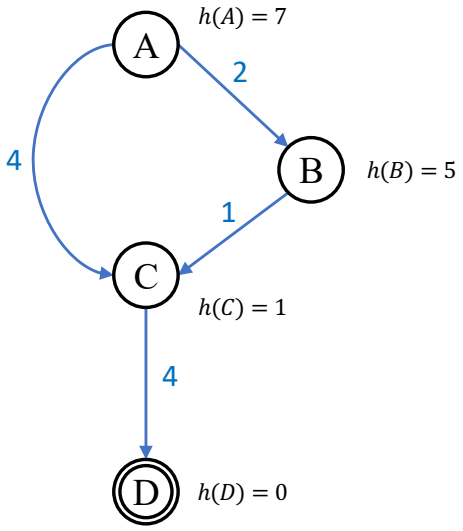
Answer all questions. All questions carry equal marks.
This exam represents 60% of the total module assessment.

Q1. Write Keras/Tensorflow code to create a convolutional network with a $3 \times 3 \times 10$ convolutional layer with unit stride, followed by a maxpooling layer with a 2×2 sampling window (and stride $= 2$), a flattening layer, a 52-neuron hidden layer and a 10-unit output layer. The output layer uses "softmax" activation, otherwise "ReLU" activation is used where appropriate.

Q2. A loss function is defined as $E(w_1, w_2) = w_1^2 + 3w_2^2$. With $\eta = 0.1$, $\alpha = 0.6$, and assuming that the parameter vector $\vec{w} = (w_1, w_2)$ is initialised as $\vec{w}_1 = (3.0, 1.0)$, what is the value of this vector at the start of the third training iteration (i.e., $\vec{w}_3$) if classical momentum is employed?

Q3. Find the appropriate weight and bias for a single-input support vector machine implementing the input-output mapping $1 \rightarrow -1$, $2 \rightarrow +1$. What is the equation of the decision boundary?

Q4. Consider this search graph. Show that A^* tree search succeeds for this problem, but that A^* graph search does not.



Q5. Convert the formula $(b11 \Leftrightarrow (p12 \vee p21)) \wedge \neg b11$ to conjunctive normal form. Show all steps.

Q6. Given a set of conjunctive normal form clauses $\{\{\neg a, b\}, \{\neg b, c\}, \{a\}, \{\neg d\}\}$, is the formula $(c \wedge d)$ entailed by it? Justify your answer using resolution refutation.