

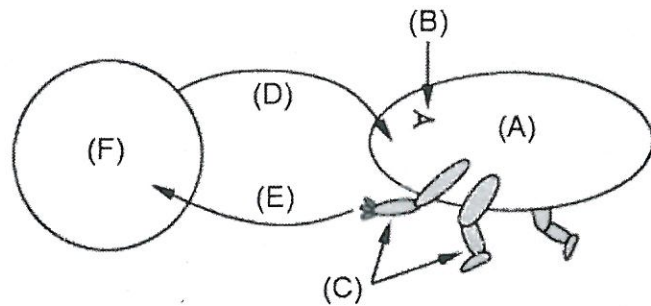
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請將答案寫入本「題目紙」, 考畢交回。

一、(2分) What is the difference between strong AI and weak AI?

strong AI 認為有可能製造出能夠真正地推理及解決問題的智能機器  
weak AI 則認為不可能

二、(3分) The following diagram shows the structure of an agent. What does each of the lettered items A, B, C, D, E, F represent?



(A) agent (B) sensor (C) actuators (D) percept (E) action (F) environment

三、(1分) 選擇題: AlphaGo was the first program to beat a world Go champion. Who did AlphaGo beat in 2016? (a)

- (a) Lee Sedol (b) Aja Huang (c) Ke Jie (d) Garry Kasparov

四、(2分) What is the difference between systems that think like humans and systems that act like humans?

systems think like human 系統的思維會和人類相似

systems act like human 系統的動作會和人類相似

五、(2分) 書上有提到比 "Turing test" 更進一步的 "total Turing test"。請你說明 "total Turing test" 進一步的要求為何? (提示: Turing's test avoided direct physical interaction between the interrogator and the computer.)

total Turing test 還要測試受試者感知及移動物體的能力

六、(1分) Which event is considered the "birth" of Artificial Intelligence? (b) (單選題)

- (a) The formulation of the Turing test by Alan Turing in 1950.  
(b) A workshop in the summer of 1956 at Dartmouth.  
(c) The development of the Lisp programming language in 1958.  
(d) The victory of the Deep Blue computer system over the chess world champion in 1997.

七、(1分) Control theory is? (c) (單選題)

- (a) a theory how to control humans.  
(b) a theory how to control companies.  
(c) a research area about automatic control of artifacts.  
(d) a part of economy about running (controlling) companies effectively.

八、(5分) Which of the following tasks can be done by computers at present? 請填「是」或「非」即可。

- (a) Play the game of bridge at a human expert level. 是  
(b) Talk fluently and successfully with a normal person for an hour. 非  
(c) Unload(卸載) a dishwasher and put everything away. 是  
(d) Perform a simple surgical operation(外科手術) under the command of a doctor. 是  
(e) Write a funny story. 非

九、(15分) 是非題, 請填「是」或「非」即可。

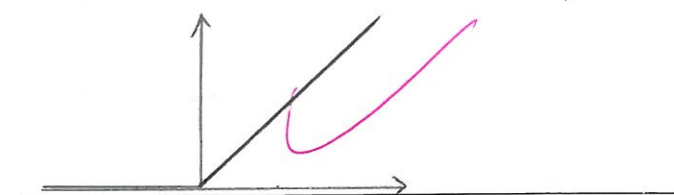
- (a) The Turing test was proposed by Alan Turing as a means of determining whether an artificially intelligent machine has been constructed. 是  
(b) A perfectly playing poker-playing agent never loses. 非  
(c) Every agent is rational in an unobservable environment. 非  
(d) At the present time, AlphaGo program may play a bad move in some board. 是  
(e) An agent that senses only partial information about the state cannot be perfectly rational. 是  
(f) If you increase the number of hidden layers in a neural network, the classification error of test data always decreases. 非  
(g) A search algorithm is complete if it always finds a solution. 是  
(h) Depth-first search always expands at least as many nodes as A\* search with an admissible heuristic. 非  
(i)  $h(n) = 1$  is an admissible heuristic for the 8-puzzle problem. 非  
(j) Breadth first Search is complete even if zero step-costs are allowed. 是  
(k) The greedy best-first search algorithm is optimal. 非  
(l) If  $h_1(n)$  is an admissible heuristic and  $h_2(n)$  is also an admissible heuristic, then  $\max(h_1(n), h_2(n))$  must be admissible. 是  
(m) Depth-first iterative deepening always returns the same solution as breadth-first search if the branching factor  $b$  is finite and the successor ordering is fixed. 是  
(n) A\* search with an admissible heuristic may find a better solution than uniform-cost search. 是  
(o) The uniform-cost search can find the optimal goal if all the step costs are  $> 1$ . 非

十、(17分) 右圖是一個類神經網路 neuron 的示意圖。

(a) 請問這個  $f$  一般稱呼為何(請用英文回答)?

activation function

(b) ReLU 是常用的  $f$ , 請繪出 ReLU 函數的形狀。



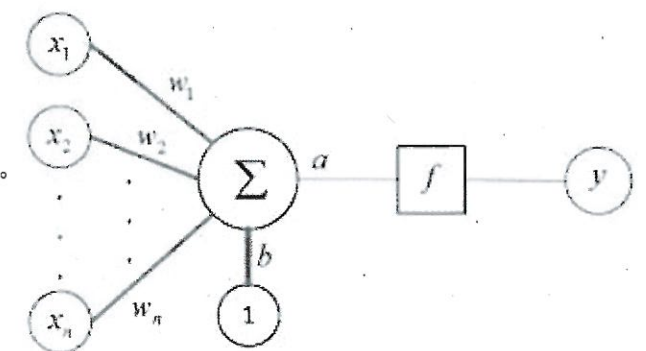
(c) 請寫出  $y$  的計算公式。

$$f(x_1 w_1 + x_2 w_2 + \dots + x_n w_n + b)$$

(d) 請問圖中  $b$  的下邊輸入固定的 1, 其目的為何?

作為 bias 使用

(e) 如果少了圖中的  $b$  以及其下邊輸入固定的 1, 則這個 neuron 會有甚麼缺點?





可能為 0

(f) 何謂 learning rate?

控制權重更新速度的值

(g) 何謂 mean square error?

觀測值與實際值的差的平方的平均值

(h) 何謂 overfitting?

訓練出的 model 過度符合 training data set, 導致其無法良好的預測未來的 data

(i) What does "deep" learning mean?

用多層的類神經網路訓練讓機器學習 deep 代表神經網路的深

(j) What is the objective of backpropagation algorithm?

更改模型的權重

(k) Consider the boolean function  $x_1 \rightarrow x_2$ , and note that it is the same as  $\neg x_1 \vee x_2$ . Can a single neuron with two inputs  $x_1$  and  $x_2$  output 1 iff  $x_1 \rightarrow x_2$ ?

If yes, please give weights:  $w_1 =$  \_\_\_\_\_  $w_2 =$  \_\_\_\_\_  $b =$  \_\_\_\_\_

If not, why not?

因為  $x_1 \rightarrow x_2$  有四種情況, 單個 neuron 無法解決

(l) Consider the boolean XOR function  $x_1 \oplus x_2$ , and note that it is the same as  $(\neg x_1)x_2 \vee (\neg x_2)x_1$ . Can a single neuron with two inputs  $x_1$  and  $x_2$  output 1 iff  $x_1 \oplus x_2$ ?

If yes, please give weights:  $w_1 =$  \_\_\_\_\_  $w_2 =$  \_\_\_\_\_  $b =$  \_\_\_\_\_

If not, why not?

因為  $x_1 \oplus x_2$  有四種情況, 單個 neuron 無法解決

(m) Can a single neuron capture inequalities: given two **real-valued** inputs  $x_1$  and  $x_2$ , can the neuron output 1 if  $x_1 > x_2$  and 0 otherwise?

If yes, please give weights:  $w_1 =$  1  $w_2 =$  -1  $b =$  0

If not, why not?

(n) 以下是一個初學者先照我們的講義寫 python 程式, 來計算(m)小題中某組輸入其對應的輸出及誤差。假設在第 2 行隨機給定  $x$  及  $w$  的一些初始值。但他在第 3 行及第 4 行還沒改正確,

程式是亂七八糟的。請你修正這個程式的第 3 行及第 4 行並將寫出來。

```
from numpy import *
x1=0.7; x2=-0.2; w1=-0.2; w2=0.1; b=0.9;
target=1; x=w1*x1+w2*x2+w3*x3; y=1/(1+exp(-x)); E=0.5*(target-y)**2
print("w1=",w1,"w2=",w2,"w3=",w3,"b=",b,"nx=",x,"y=",y,"E=",E)
```

```
target=1; x=w1*x1+w2*x2+b; y=1/(1+exp(-x)); E=0.5*(target-y)**2
print("w1=",w1,"w2=",w2,"b=",b,"nx=",x,"y=",y,"E=",E)
```

(o) 請問(n)小題第 1 行的 numpy 它的用途為何?

用來做矩陣運算的 module

(p) 上面(n)小題第 3 行的  $y=1/(1+\exp(-x))$ , 它是一種 activation function, 請寫出它的英文名稱。

sigmoid

(q) 上面(n)小題第 3 行的  $E=0.5*(target-y)**2$ , 它是一種 error function, 請寫出它的英文名稱。

mean square error

十一、(3 分)請說明 episodic task environments 和 sequential task environments 最主要的差異為何。

episodic task environment: agent 的 experience 被分為多個 episode. 當前的 episode 不 depend on 上個 action

sequential task environment: 當前的動作會影響未來

十二、(3 分)下表中, 最下方中有六個空格, 請填空。

| Task Environment   | Observable | Agents | Deterministic | Episodic   | Static  | Discrete   |
|--------------------|------------|--------|---------------|------------|---------|------------|
| Crossword puzzle   | Fully      | Single | Deterministic | Sequential | Static  | Discrete   |
| Chess with a clock | Fully      | Multi  | Deterministic | Sequential | Semi    | Discrete   |
| Poker              | Partially  | Multi  | Stochastic    | Sequential | Static  | Discrete   |
| Backgammon         | Fully      | Multi  | Stochastic    | Sequential | Static  | Discrete   |
| Taxi driving       | Partially  | Multi  | Stochastic    | Sequential | Dynamic | Continuous |

十三、(6 分) Consider the agent AlphaGo, which recently beat a human expert at the game Go. Recall that in the game of Go, two players take turns placing stones on a 19x19 board. The objective is to capture territory and/or the other player's stones by surrounding them. This question refers to a setting in which AlphaGo plays a single game with a human without considering the thinking time. For each part below, choose which best describes this environment for AlphaGo:

- a. Fully observable or Partially observable: Fully observable  
b. Deterministic or Stochastic: Deterministic  
c. Episodic or Sequential: Sequential  
d. Static or Dynamic: Static  
e. Discrete or Continuous: Discrete  
f. Single agent or Multi-agent: Multi-agent



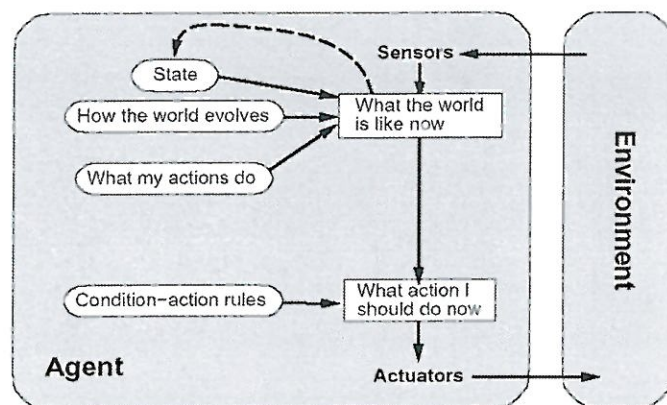
-8. 費 1112 408470153 紀軒宇

十四、(4分) Rational agents are often specified by a PEAS description. What do each of the letters in "PEAS" stand for? (請用英文作答)

P: performance E: environment A: actuators S: sensor

十五、(2分) 請問右圖是哪一種 agent 的示意圖? (C) (單選題)

- (a) Table-driven-agent
- (b) Simple reflex agent
- (c) Model-based reflex agent
- (d) Goal-based agent
- (e) Utility-based agent
- (f) Learning agent



十六、(2分) 單選題: AlphaGo可視為一個agent, 請問它是屬於以下哪一種agent? (f)

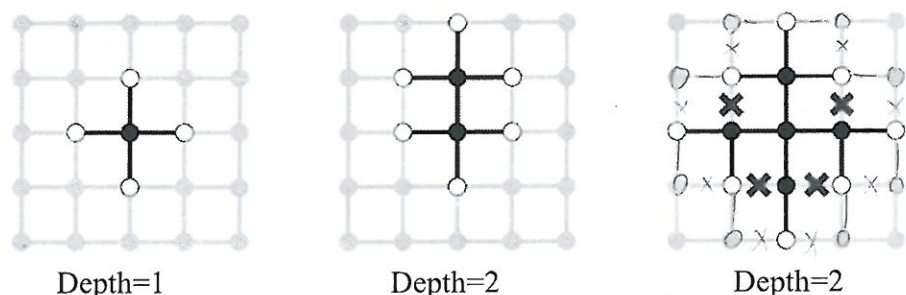
(a) Table-driven agent (b) Simple reflex agent (c) Model-based reflex agent (d) Goal-based agent  
(e) Utility-based agent (f) Learning agent

十七、(2分) 請說明Goal-based agent和Utility-based agent最主要的差異。

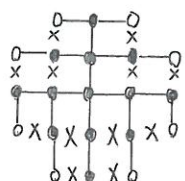
Goal-based agent 會衡量該action是否會達到 goal

Utility-based agent 會衡量該action可以帶來多少 happiness

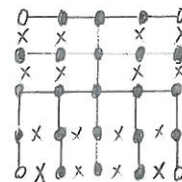
十八、(7分) 考慮以下 5\*5 的 2D grid。其中起點是中間的(3, 3)位置, 而 goal state 為右上角位置(1, 5)。此題我們均使用 graph version, 也就是已拜訪過的位置不會重覆走入。首先使用 breadth-first search。而節點及每個節點的相鄰的邊的拜訪次序均為 row-major ordering, 也就是往上、往左、往右、往下排序。如下所示為前幾個回合的示意圖。打x表示不走那個邊。



- (a) 請問圖中黑色的節點集合可稱為甚麼(請用英文作答)? close set
- (b) 請問圖中白色的節點集合可稱為甚麼(請用英文作答)? open set
- (c) 請問圖中灰色的節點集合可稱為甚麼(請用英文作答)? unvisited set
- (d) 請問branching factor b值是多少? 4
- (e) 請繪出Depth=3的圖。(白色、黑色節點及粗黑邊、x都要標示出來)



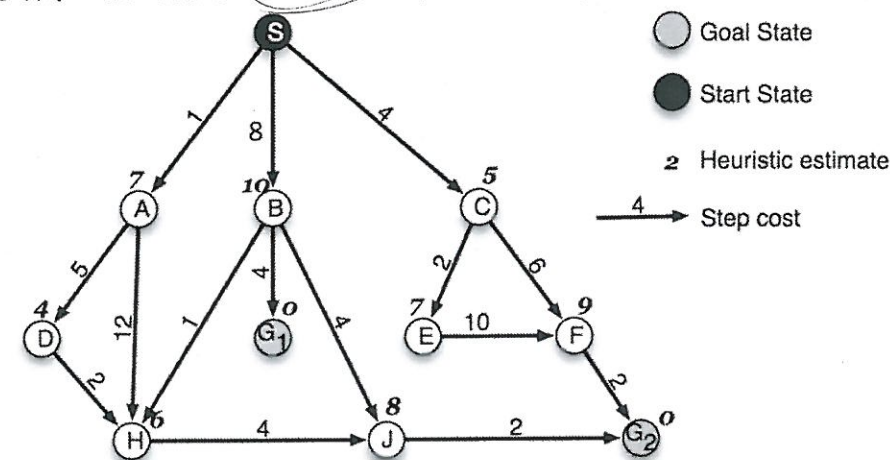
(f) 請繪出Depth=4的圖。(白色、黑色節點及粗黑邊、x都要標示出來)



(g) breadth-first search最後找到的solution path如何走?

向上, 向上, 向右, 向右.

十九、(12分) 給定下圖, 共有 11 個節點。起點是 S, 終點為 G<sub>1</sub> 或 G<sub>2</sub>。每個節點的 successors 用 directed edges(有向邊)表示, 其中 edges 旁邊的數字為其 cost。而每個節點旁邊的數字為其 heuristic function 值(估的不是理想), 也就是給一個其到終點(G<sub>1</sub> 或 G<sub>2</sub>)的估算距離。我們想利用後面所列各種 search algorithms 展開此圖找 S 到 G<sub>1</sub> 或 G<sub>2</sub> 的一條路徑之解答(結果不一定會是最短的路徑)。在展開時, 如果某節點有多個 successors 可同時選擇時, 則其子節點由左往右為其優先順序。假設使用 tree search 版本, 也就是會重覆走入或展開曾走過的節點。



(甲) 假設使用 breadth-first search。請依序列出會拜訪的節點的順序。最後找到的路徑長度為何?

S, A, B, C, D, H, H, G<sub>1</sub>

路徑長度 12

(乙) 假設使用 depth-first search。請依序列出會拜訪的節點的順序。最後找到的路徑長度為何?

S, A, D, H, H, B, H, G<sub>1</sub>

路徑長度 12

(丙) 假設使用 iterative deepening search。請依序列出會拜訪的節點的順序。最後找到的路徑長度為何?

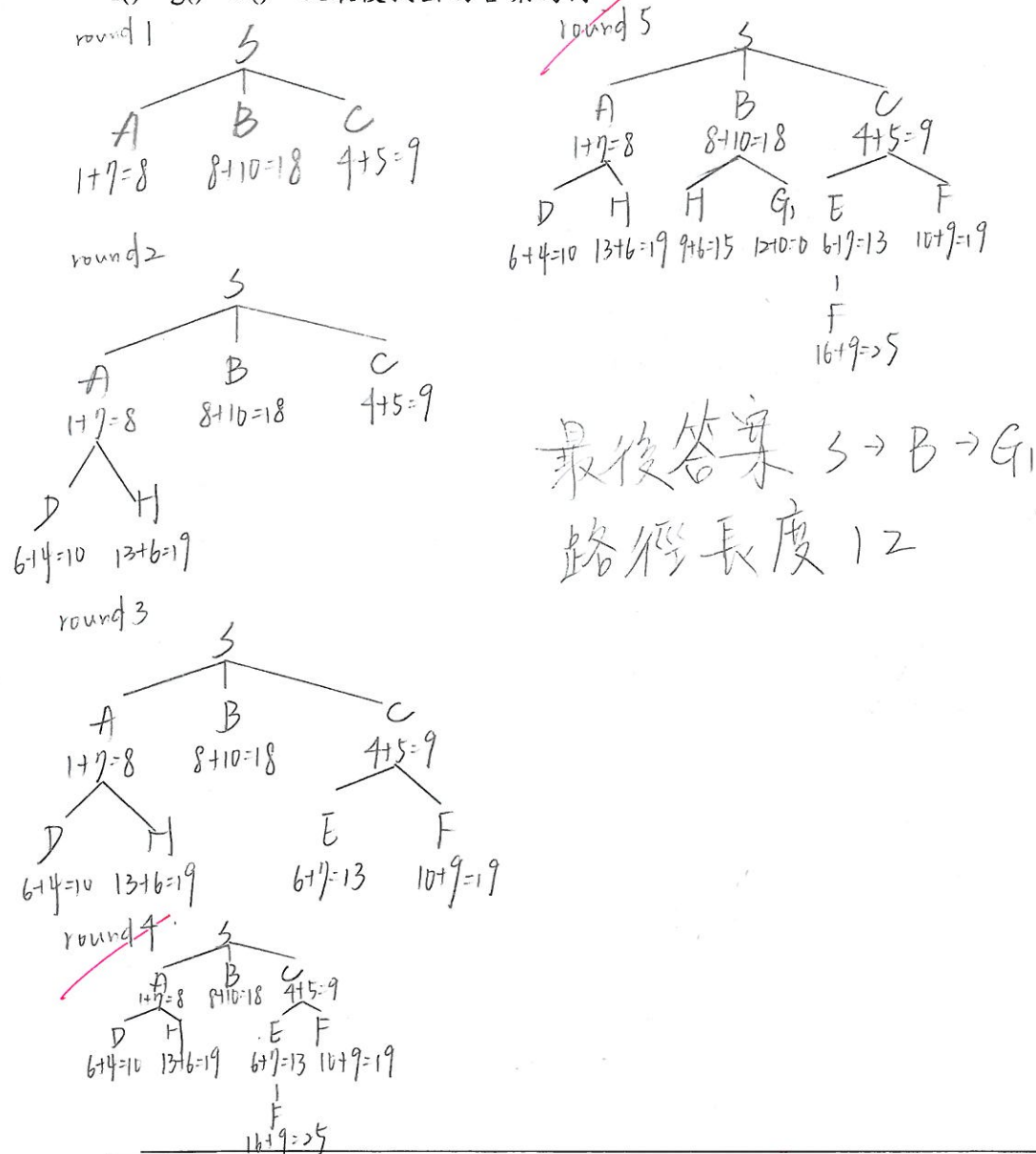
limit=1 SABC

limit=2 SADH BHG<sub>1</sub>

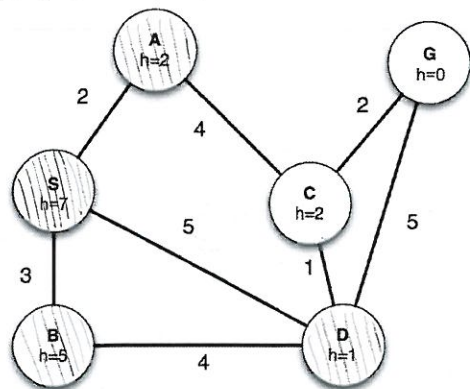
路徑長度 12



廿一、(8分)接上一題相同的條件，請利用 A\* search 展開上一題的圖找 S 到 G<sub>1</sub> 或 G<sub>2</sub> 的路徑之解。請依節點產生的次序逐步用繪圖的方式表示每一回合的 search tree，並顯示所產生的節點的 f()、g()、h()、及最後找出的答案為何。



廿一、(8分)給定下圖，共有 6 個節點，每個節點的 heuristic function 值以 h=? 表示。每個節點的 successors 用 undirected edges(無向邊)表示，其中數字為其 cost。我們想利用 A\* search using the heuristic function h 展開此圖，以找出從 S 到 G 的最短路徑之解。我們已將前兩個步驟的結果顯示在下面右方。其中 Open list，由左往右為其優先順序。假設使用 graph search 版本，也就是重覆的節點不會重覆走進去或展開。



| step | Node expanded | g  | h | f  | parent | Open list |
|------|---------------|----|---|----|--------|-----------|
| 1    | S             | 0  | 7 | 7  |        |           |
| 2    | A             | 2  | 2 | 4  | S      | A         |
|      | B             | 3  | 5 | 8  | S      | AB        |
|      | D             | 5  | 1 | 6  | S      | ADB       |
| 3    | C             | 6  | 2 | 8  | A      | DBC       |
| 4    | G             | 10 | 0 | 10 | D      | BCG       |
| 5    |               |    |   |    | B      | CG        |
| 6    |               |    |   |    | C      | G         |
| 7    |               |    |   |    | G      |           |

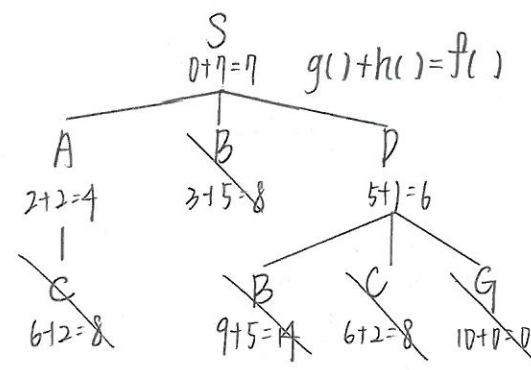
(甲)請將接下來的 step 3、step 4、...等結果接填續入表格下方，一直到找到答案為止。(6分)

(乙)請問此例子最後找到的 solution 為何?(2分)

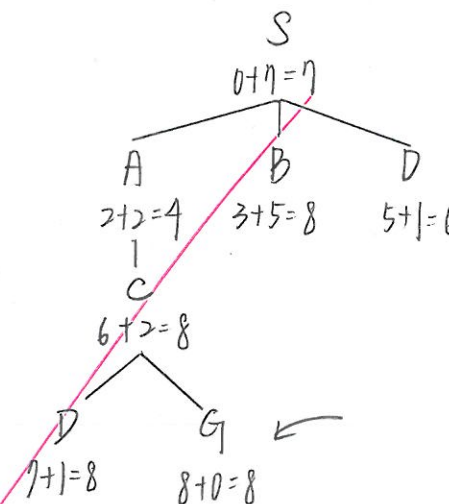
S → D → G

廿二、(8分)請利用 IDA\* search 展開第廿一題的圖，以找出從 S 到 G 的最短路徑之解。請依節點產生的次序逐步用繪圖的方式表示每一回合的 search tree，並顯示所產生的節點的 f()、g()、h()、及 f-limit scores。

round 1  
f-limit = 7  
next limit = 8



round 2  
f-limit = 8  
next limit =



最短路徑 S → A → C → G