A. Question Answering

1. (5%) What is Turing test? Please remember to write down the most important characteristic of it.

✓

Let a human agent have a conversation session with the AI agent through a computer terminal. The human agent was not told about whether the other peer is a human or computer.
After the session, if the human agent cannot tell that the other peer is an AI-agent, then this AI-agent is said to have passed the Turing test

2. (4%) Understanding general images is usually done in 2 steps. What are these 2 steps? Describe them briefly.

2

1 Region finding.

2 Extract the geometric characteristics

3. (5%) Why is the halting problem important? Try to write down as much as you can.

✓

It is the most significant example of the existance of non-computable functions, and hence the capability of deterministic algorithmic process is limited.

4. (4%) Please briefly describe the processes of traditional development phase, i.e., the waterfall model, for software engineering.

3

Design → Implement → Test

5. (5%) What are the functionalities of scheduler and dispatcher?

3

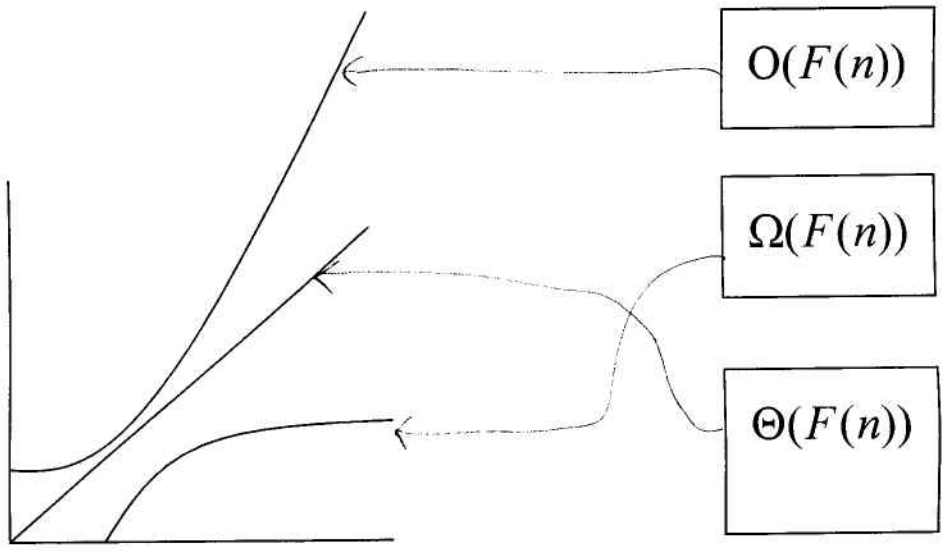
Scheduler : Coordinate the use of CPU time, so that the program can block others from using it. Also perform the context exchang process when switching from one task to another.

Dispatcher : Find the next process to run.

6. (3%) The browser tries to contact the FTP server at the machine named stargazer.universe.org to retrieve a document "dolphin.doc" in the location "E:\national_park\animals\mamal". The root directory in the server is "E:\national_park\animals". Please write down the corresponding URL that the browser needs in order to access this document.

ftp://stargazer.universe.org/mamal/dolphin.doc

7. (3%) The following figure shows the relationship of 3 formulas. ~~If a problem can be solved in $\Theta(F(n))$, please~~ Connect $O(F(n))$, $\Theta(F(n))$ and $\Omega(F(n))$ to their corresponding lines.



B. Answer the following questions regarding to robots (10%)

1. What are the 4 levels of intelligence in behavior?

perception, reflexive response, decision making, reasoning

2. Identify the level of intelligence of the following robots.

(1) 吃喝拉撒睡不再是人的專利，現在連機器人也會，高雄市立美術館展覽一台來自比利時的機器人，不但會吃東西還會排泄，來自比利時的機器人有嘴巴、胃還有大腸，人體器官一應俱全。樹德視傳系主任郭邑芬指出，上面有很多 PH 值，都是已經設定的，包含體溫設定也是跟人體一樣，在 37 度。有趣的是，仿造人體構造的機器人，只要餵它吃東西，經過 12 個小時消化，就會開始排泄。

+5

Second level

(2) 日本方面推出高科技產品家用安全機器人，體型嬌小像隻裝飾品的機器人，裡面裝了一個數位攝影機、紅外線探測器和自動撥號影像式的電話，如果有任何侵入者，機器人可以立即通知屋主，同時將拍攝到的異常畫面，用手機傳給屋主。

Second level.

Both performs only the preprogrammed response

3. Assume we send a robot to some family as a servant to test its functionality. What is the software testing strategy we apply here?

Beta release.

8 C. (9%) Answer the following questions regarding to production systems.

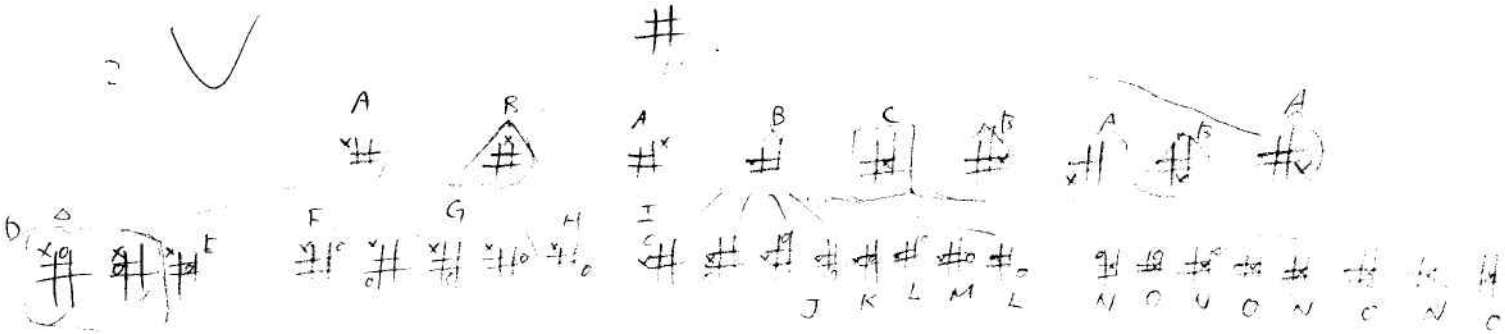
1. What are the components of production systems?
2. In Tic-tac-toe(井字遊戲), give a search tree with 4 levels using breadth-first search

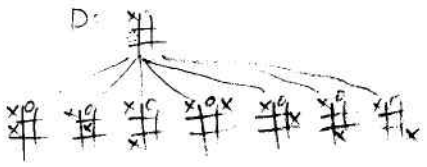
1.

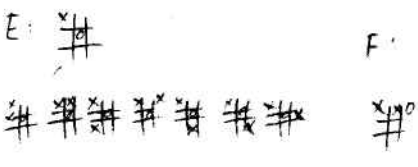
A : A decision maker that decides the next step

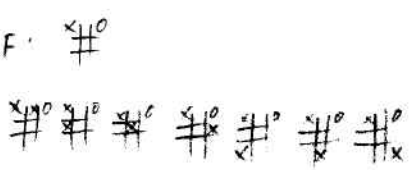
B : A transition function to move between states

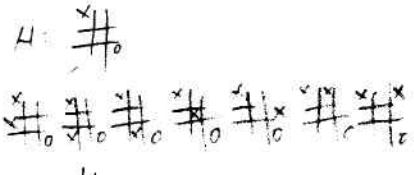
C : A goal function. (A Goal)

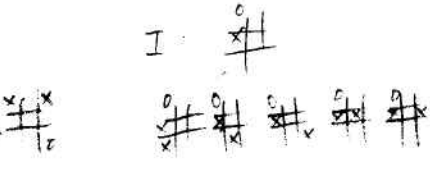


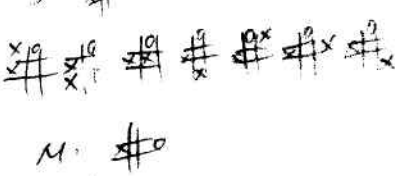


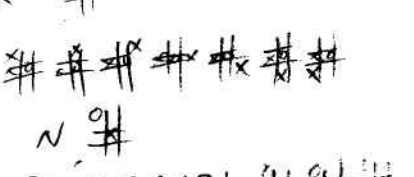


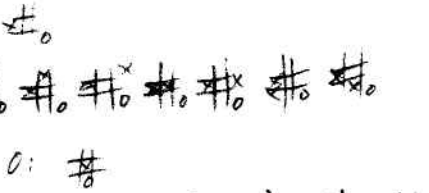


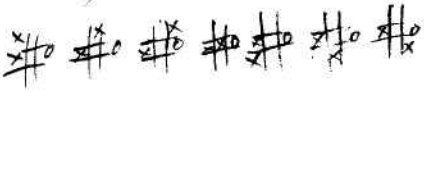












D. (7%) Now we have a bare bones language with following statements.

- clear name;
- incr name;
- decr name;
- while name not 0 do; … end;

Please use this bare bones language to write a program to compute the value of x+y.

```
clear t1;
clear t1;
clear sum;
while x not 0 do;
    incr t1;
    decr x;
end;
while y not 0 do;
    incr t2;
    decr y;
end;
while t1 not 0 do;
    incr sum;
    incr x;
    decr t1;
end;
while t2 not 0 do;
    incr sum
    incr y;
    decr t2;
end;
```

E. (6%) Answer the following questions regarding to Genetic Algorithms.

1. Where is Genetic Algorithms inspired from? What is the main concept of GA?
2. Assume we have an encoding system for girls. For example, 001010011100101 represent a girl. Each bit is either 0 or 1. The first 3 bits represent the beauty of a girl. The 4th to 6th bits represent the wisdom of a girl. The 7th to 9th bits represent the kindness of a girl. The 10th to 12th bits represent the vitality of a girl. The last 3 bits represent the strength of a girl. The fitness value is the sum of the values of these 5 parts. For instance, the fitness value of 001010011100101 is 001+010+011+100+101=1+2+3+4+5=15. Suppose we have 2 girls: 0100100010010010 and 101101101101001, and we do the cross-over between the 8th and 9th bits to produce the candidates of the next generations. Which one of these 4 girls is the best and what is the fitness value of her?

+6

2.

Evolution.

Combining good part of solutions will make a better solution

2.

I : 010 010 010 010 010 → 10

II : 101 101 101 101 001 → 21 ☆

III : 101 101 100 010 010 → 18

IV : 010 010 011 101 001 → 13

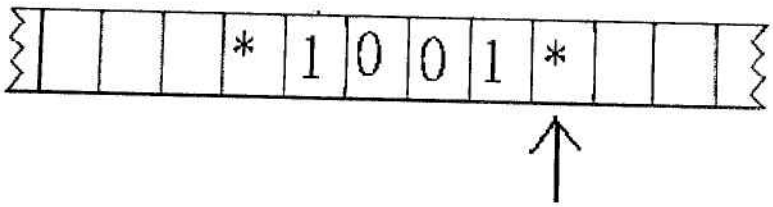
$\frac{18+13}{2} = \frac{31}{2} = 15.5$

Unfortunately, children do not excel.

The average fitness also remain unchanged.

F. (10%) Answer the following questions regarding to Turing machines.

1. The following is a Turing machine. Write a program to change the 1001 on it to 0111. And your pointer must stop at the left * symbol when your program halts. Your program should start from the cell indicated by the arrow.



2. Assume we need to use the "von Neumann" architecture to simulate Turing machines. Describe your simulation approach.

1. Initial state: START

state	value	new value	move	new state
START	*	*	LEFT	A1
A1	1	1	LEFT	A2
A2	0	1	LEFT	A3
A3	0	1	LEFT	A4
A4	1	0	LEFT	HALT
HALT	*	*	no move	halt.

~~+0~~ +5 X.

2.

Operation: value → new_value

Provide: the 'value'

Output the new_value

Incrementation of program counter: 'move'

Fetch: 'new_state'

G. (10%) Answer the following questions regarding to RSA

You have the following number: n=133, e=5, d=8.

1. Encrypt the message 110011.
2. Compress your answer of questions 1. using LZ77 encoding. (Note: the original string can not be more than 3 digits.)

1. $110011 = 51 = m$

$c = m^e \pmod n = 51^5 \pmod{133}$

$= (51^2 \bmod 133)^2 \cdot 51 \pmod{133}$

$= (74^2 \pmod{133}) \cdot 51 \pmod{133}$

$= 23 \cdot 51 \pmod{133}$

$= 109 = 1101101$

+10

2.

110 (3, 3, 1)

H. (10%) In order to maintain the database integrity, the DBMS use the locking approach to prevent others from accessing data being used by a transaction. Two different locks, shared lock and exclusive lock, are employed.

1. Will the deadlock problem happen? Why or why not? Briefly explain it (you can use examples to illustrate).
2. How to resolve the deadlock problem if it occurs?

1. No. see the solution below.

2. All transactions are required to lock everything they need exclusively before anything could be done.

If this is not possible (ex: some other transaction is on its way), then we should give up and unset everything locked so far by us.

Then we wait for a certain (or random) amount before retry.

If the operation still cannot be done after a few retries, we give up completely, telling the user that the transaction was aborted.

I. Suppose a hash storage system is constructed with several buckets, using the hash function: $h(x) = x \ (mod\ a)$. For each of the following key values (a) ~ (l) written in hexadecimal representation, please transfer them into equivalent base ten values, and complete the following process:

1. (2%) Choose a proper value a from 18, 11 and 6 that may waste the least space, and cause the least collision problem.
2. (7%) Locate the corresponding bucket for the numbers using the hash function you chose in (1).

The numbers that are to be inserted into the system are:

(a) 11^{17} (b) $1B^{27}$ (c) 15^{21} (d) $2A^{42}$ (e) $4F^{79}$ (f) 54^{84}
(g) $3A^{58}$ (h) $3F^{63}$ (i) 30^{48} (j) 36^{54} (k) 53^{83} (l) 21^{33}

+9

1.

a = 18

(a) → 17 (f) → 11 (k) → 10
(b) → 9 (g) → 4 (l) → 15
(c) → 2 (h) → 9
(d) → 8 (i) → 10
(e) → 7 (j) → 0

Collisions : 1

Wasted : 1, 2, 5, 6, 12, 13, 14, 16, → 8 slots

a = 11

(a) → 6 (f) → 7 (k) → 6
(b) → 5 (g) → 3 (l) → 0
(c) → 10 (h) → 8
(d) → 9 (i) → 4
(e) → 2 (j) → 10

Collisions : 1

Wasted : 1, 0, 1 slots

a = 6

(a) → 5 (f) → 0 (k) → 5
(b) → 3 (g) → 4 (l) → 3
(c) → 3 (h) → 3
(d) → 0 (i) → 0
(e) → 1 (j) → 0

Collisions : 7

Wasted : 2 → 1 slots.

The best choice is a = 11

2.

See above

J. Look at the following two recursive algorithms. What are the purposes of these two algorithms? Elaborate the details as much as you can.

10

1. (10%)

(1) x and y are arrays.

(2) Initially set i=j=0.

```
Unknown(x,y,i,j) {
    if(x[i] == y[j]) {
       if(y[j+1] != null)
    return Unknown(x,y,i+1,j+1);
       else return true;
    }
    if (x[i+1] == null) return false;
    else Unknown(x,y,i+1,j);
}
```

(return)

This algorithm determines whether y is a subsequence of x.

Ex: x = ABCAEZ, Y = AAEZ ⇒ true
Y = ADZ ⇒ false
Y = CA ⇒ true.

It is the recursive version of the iterative matching algorithm.

10

2. (10%)

(1) Initialize an m by n array c[i, j] = nil for all i, j.

(2) Set c[i, 0]=c[0,j]=0 for all i, j.

(3) x and y are arrays.

```
Unknown2(x,y,i,j){
    if (i=0 or j=0) return 0;
        if c[i,j] != nil, return c[i,j];
        else if (x[i] == y[j]),
            set c[i,j] = 1 + Unknown2(x,y,i-1,j-1);
        else set c[i, j]=
           max(Unknown2(x,y,i-1,j),Unknown2(x,y,i
           ,j-1) );
    return c[i,j];
}
```

After an invokation to Unknown2(x, y, i, j),

c[i, j] becomes the length of the longest common subsequence of x[1..i] and y[1..j].

It is the recursive version of the algorithm that was usually implemented using dynamic programming. However, this version used the 'memoization' trick (c[i,j]) to speed the process up by remembering the answers to all the subproblems solved previously.

(4a: LCS)