考 試 科 目	程式設計與資料結構 51524	所　別	數位內容碩士學位學程/ 資訊技術組	考 試 時 間	2 月 28 日（六）第 四 節

1. (10%) Rewrite the following program so that it computes a greatest common divisor using recursion instead of iteration.

```
unsigned greatest_common_divisor (unsigned a, unsigned b) {
    while (a != b)      {
        if (a > b)          {
            a -= b;
        } else if (b > a) {
            b -= a;
        }
    }
}
```

2. (10%) Rewrite the following program so that no "nested" conditional statement is used. Namely, you have to remove the nested if statements without affecting the semantics of the program.

```
double getPayAmount() {
    double result;
    if (_isDead) result = deadAmount();
    else {
        if (_isSeparated) result = separatedAmount();
        else {
            if (_isRetired) result = retiredAmount();
            else result = normalPayAmount();
        };
    }
    return result;
};
```

3. (5%) Match the programming paradigms (Object-oriented, Imperative, Functional, and Logical) supported by the corresponding languages. Note that one programming language may have multiple paradigms:

Scala:

Prolog:

Java (before JDK7) :

C (ANSI):

Python (version 2):

4. (15%) Arduino is a very important rapid-prototyping platform in DCT (Digital Content and Technologies) research field. For example, a PIR (Passive Infrared) sensor can be used to detect presence of a human. If the

data output of the PIR sensor is connected to pin no. 2 and there is an on-board LED occupying pin no. 13, then the following control program can direct Arduino to blink the LED when a human is detected:

```
void setup() {
  pinMode(13, OUTPUT);
  pinMode(2, INPUT);
}
void loop(){
  int val = digitalRead(2);
  if (val == HIGH) {
    digitalWrite(13, HIGH);
    delay(500);
    digitalWrite(13, LOW);
  }
}
```

Based on the example given above, please write a control program to read raw values from LM35, transform them to temperature values (in Celsius), blink LED, and then output via the serial port.
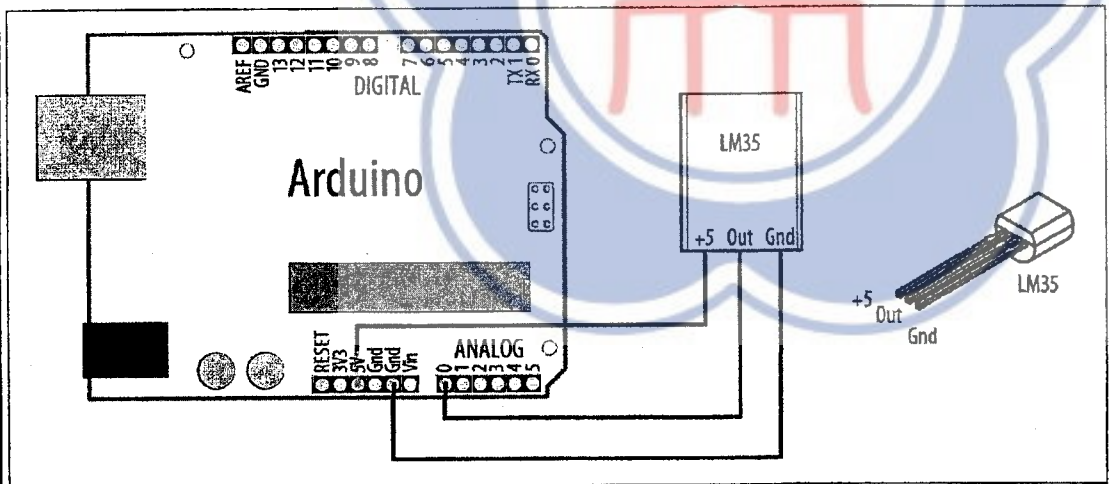

diagram source: Margolis M. Arduino Cookbook, 2/e oreilly, 2011.

Hint:

● The LM35 temperature sensor produces an analog voltage directly proportional to temperature (in Celsius) with an output of 1 millivolt per 0.1°C (10mV per degree). You can use (raw value/1024.0)*5000 to get the millivolt.

● Use Serial.print(...) for outputting data to serial port

● Since "Out" of LM 35 is attached to the analog pin, you should use analogRead(...) instead of digitalRead(...)

● Please use the following code template:

考　試　科　目	程式設計與資料結構 51 5>4	所　別	數位內容碩士學位學程/ 資訊技術組	考試時間	2月28日(六)第四節

```
void setup()
{
  Serial.begin(9600);
}

void loop()
{
  // ...(you code)
}
```

5. (5%) What is a "Callback" function? When do we need it?

6. Linked List and Array:

(1) (10%) Comparing Array and Linked List by filling in the form:

	Array	Linked List
Memory allocation	(a1)	(a2)
Data type of the elements	(b1)	(b2)
reliability	(c1)	(c2)
The speed of sequential access	(d1)	(d2)
The capability of Increasing space dynamically	(e1)	(e2)

(2) (16%)Please define data structures (in C programming language) that represents a Polynomial (ex: $3x^2+2y^3+1$) based on Array and Linked List, respectively.

(3) (4%) Based on the answer given in (2), give an exemplary Polynomial that wastes much memory space when implementing using Array.

7. B-Tree:
(1) (4%) What is the difference between B-Tree and M-way Tree?
(2) (6%) Given the following B-tree of order 4, please draw the results after inserting 888, 918, 938, and 999.

8. (5%) When shouldn't one pick the first element as pivot when using quicksort? Why?

9. (10%) What are the computational complexities for the following mechanism? (1) Worst case of Mergesort (2) Average case of Insertion Sort (3) Worst case of Heapsort (4)Deleting the whole Circularly Linked List

備　註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。