1. (20%) Explain the functions of the following system software

(a) Compiler

(b) Assembler

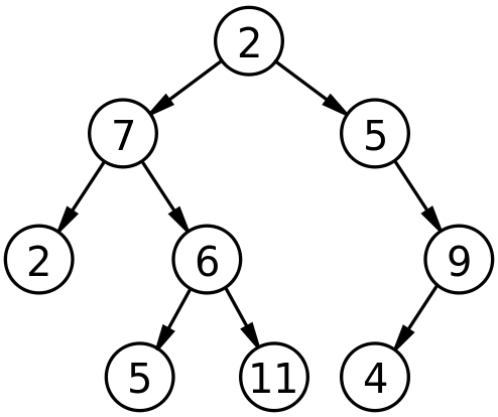
(c) Linker

(d) Loader

2. (10%) Translate the statement "*a=a+b+3*" into assembly code. Suppose integer variable *a* is in memory space 0X00F0 and integer variable *b* is in memory space 0X00F8. And there are 8 registers, r0-r7, to use. The available assembly instructions are listed in the table below.

Opcode	Operand1	Operand2	Meaning
MOV	Register1	Register2	Move data from register2 to register1
	Register1	Constant	Set the value of register1 constant
	Register1	[Addr2]	Move the data (4 bytes) in memory addressed Addr2 to register1.
	[Addr1]	Register2	Move the data (4 bytes) from register2 to the memory addressed Addr1.
ADD	Register1	Register2	Add the values in register1 to register2 and store the result in register1

3. (10%) What are the in-order and post-order sequences of the following binary tree?



4. (10%) Give an example to explain when you MUST use a pointer rather than a reference?

5. (10%) What are the three major concepts in OOP?

6. (10%) If you have three classes, *Array*, *Vector*, and *LinkedList*, to implement, how do you reuse the code using inheritance? Explain your design decision.

7. (10%) What is the usage of an abstract class in polymorphism? Explain in C++ how to declare an abstract class.

8. (10%) Explain what is the “friend” relation in C++?

9. (10%) What will the following code print?

```
class A {
    static int count;
    int id;
public:
    A():id(count++){
        cout << "A's const:" << id <<  endl;
    }
    A(const A &x) :id(count++){
        cout << "A's copy const: " << id << endl;
    }
    A& operator=(const A &x){
        cout << "A's = operator" << endl;
        return *this;
    }
    ~A(){
        cout << "A's dest: " << id << endl;
    };
};
int A::count = 0;
A func(A a2){
    A a3 = a2;
    return a3;
}
int main(){
    A a1;
    A a4 = func(a1);
    return 0;
}
```