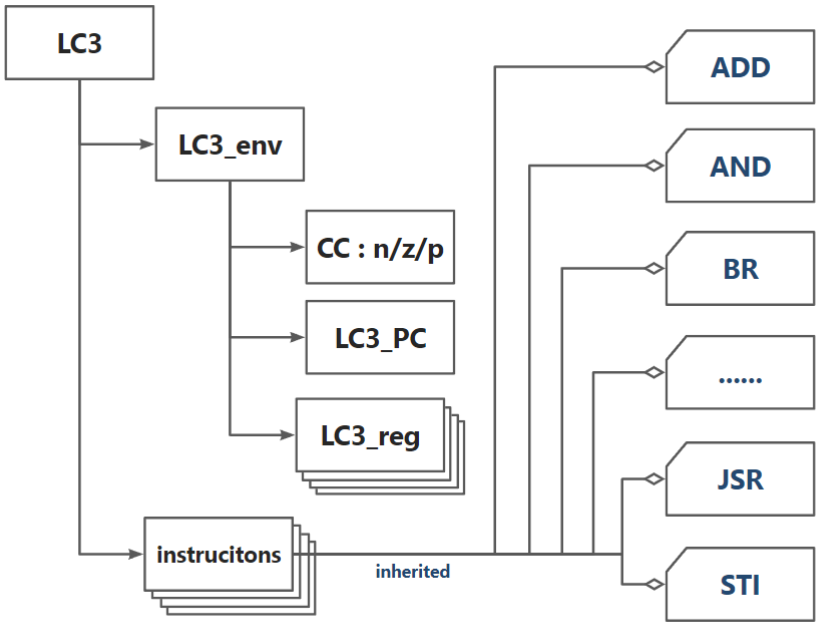
Algorithm explanation

- Just big simulation.
- I programmed this with C++ as OOP exercises.
- The classes are organized like the picture below. (arrow means contain and square means inherit)



- So after reading all the instructions in, I will first initialize a LC3 instance which has all the instructions stored as instruction class which will be routed before being executed and environment information such as registers, PC and CC.
- Then, we just need to run the LC3 instance and instructions will be executed on its own accomplish, which is just like the finite state machine figure described.

Essential parts of your code with sufficient comments

```
int main(){
    vector< string > instructionsStrings(0);
    string str;
    // Read in the input instructions.
    while(cin >> str){
        instructionsStrings.push_back(str);
    }
    // Create a little computer class here and load all the instructions and
data.
    LC3 lc(instructionsStrings);
    // Run the instructions.
    lc.run();
    // Show all the regsiters.
    lc.regMonitor();
    return 0;
}
```

```cpp
// Defination of LC3 class.
class LC3{
private:
    LC3_env env;                                // Store the env informations.
    vector< LC3_instructions * > ins;           // Store all the instrucitons and data.
public:
    LC3(){}
    // C'tor, init env and ins here.
    LC3(vector< string > vs): env( bstoi(vs[0].substr(0,16)) ){
        int locPtr = env.pc.getMPC();
        for(auto it = vs.begin()+1; it != vs.end();++it){
            auto insTmp = new LC3_instructions(*it, locPtr++);
            this->ins.push_back(insTmp);
        }
        // It can be optimized.
        ins.resize(1000000);
        envTmp = env;
    }
    ~LC3(){}
    void run(){
        env = envTmp;
        env.alive = true;
        while(env.alive){ // Keep running before halt.
            auto ins_to_load = ins[ env.pc.getVPC() ];
            // Deal instruction in dynamic ways.
            // I try to use polymorphism here but things will be complex and unsafe in that case.
            auto ins_to_exec = routing(ins_to_load->getContent(), ins_to_load->getLoc());
            // Increase pc.
            env.pc.inc();
            // Execute the instruction.
            ins_to_exec->exec(env, ins);
            delete ins_to_exec;
        }
    }
    void regMonitor(){
        for(int i = 0;i < 8;++i){
            cout << "R" << i << " = x" << setiosflags(ios::uppercase) << setw(4) << setfill('0') << hex << env.reg[i].getVal() << dec << "\n";
        }
    }
};
```

```cpp
// Choose the correct instrucion to execute.
LC3_instructions * routing(string ins, int loc){
    LC3_instructions * ret;
    string opcode = ins.substr(0,4);
    if(opcode == "0001"){
        ret = new LC3_ins_ADD(ins, loc);
    } else if(opcode == "0101"){
        ret = new LC3_ins_AND(ins, loc);
    } else {
        // ......
    } else {
        ret = new LC3_instructions(ins, loc);
```

```
    }
    return ret;
}
```

```
// The base class of all other classes.
class LC3_instructions{
protected:
    string content;
    int location;
    int val;
public:
    LC3_instructions(){}
    LC3_instructions(string, int){}
    ~LC3_instructions(){}
    int getVal(){}
    string getContent(){}
    int getLoc(){}
    virtual void exec(LC3_env &env, vector< LC3_instructions * > &insList){}
};
```

```
// e.g. JSR
class LC3_ins_JSR : public LC3_instructions{
protected:
    int offset, base;
    bool useOffset;
public:
    LC3_ins_JSR(){}
    LC3_ins_JSR(string & ins, int loc = 0): LC3_instructions(ins, loc){
        // Parse the oprands.
        useOffset = ins[4] - '0';
        if(useOffset) offset = exbstoi( ins.substr(5,11) );
        else base = bstoi( ins.substr(7,3) );
    }
    ~LC3_ins_JSR(){}
    virtual void exec(LC3_env &env, vector< LC3_instructions * > &insList){
        // Save pc to R7.
        env.reg[7].setVal( env.pc.getMPC() );
        int newPC;
        if(useOffset) newPC = (env.pc.getMPC() + offset) % overflow;
        else newPC = env.reg[base].getVal();
        // Set new pc.
        env.pc.setMPC( newPC );
    }
};
```