CMPS109, Fall 16, Section 01

ADVANCED PROGRAMMING

UC SANTA CRUZ

MIS | Phase 1 | Formal Report

Objective: This is a programming project that is designed to let you utilize all the concepts and apply all the libraries, tools, and advanced programming techniques explained in class to build a middleware for the Machine Instruction Simulator (MIS), which is in the form of a virtual machine capable of executing an instruction set.

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Design Decision

When collaborating on this assignment, we had to consider how to approach it in a modular, time efficient, and organized manner so it would present the best results. There are a lot of methods that were considered but each of their own have benefits and flaws with them. At a high level, we know that we need to use the STL containers from the library in order to maximize efficiency. Suppose we were to use arrays of a fixed size for the VARS and instructions. There would be a way to make this all work but it would be very difficult to change the code efficiently when you need to add or remove components from the code . In general, Overloading and templates to be able to pass generic objects or primitive types into our instruction methods. We were able to efficiently without having to know the object by creating operator overloads within the particular objects that would use a given function allowing us to get the primitive types from an object. We got over more of our design decision in the box to the right via our tools used and their application.

Considered Concepts

A big consideration we wanted to make but decided against it was a hash table. Having a hashtable of the instructions after reading in lines of instruction from the txt file would be helpful in the way that we would have a key that we can point to. By using a node id to refer to line numbers and iterators to obtain vector values of the string of instructions, a hash table was of great consideration. The reason why we went with maps and templates was because we both knew the concept a little better and have practiced it more often in class. A disadvantage with hash tables would be the difficulty we face when coming across many collisions which would be very critical to us resulting in very poor performance. Another thing would be that a hash table would be really efficient if we had a very large amount of data we would work with, like a Records Store. Since we know that the instructions list given won't be that large, a map will work just fine.

Lucidchart

GitHub

Trello

Tools & Application

Map - Maps were used many times in our program but was especially helpful when we were preloading the lines of instructions. The reason to preloading the instructions into a map would be so that we can refer to the map instead of the txt file when we need to JMP or refer back to certain values. The map that used an <int, vector<string>> for example, helped us load the line of string instructions into the vector<string>. This way, we can point to a particular element in that vector for what should be done. The int part of the map helps us determine which line number we are on. Having this will help us when we need to JMP in between chunks. We'll know where to restart or go back to when needed.

STD find - We used find in our Instruction class to particularly look through the instructions vector and compare it to the input string of a given input instruction. This would assure that the parameter being passed in matches the correct opcode prior to execution to avoid crash and error. It was used in a format of a range based for loop in a vector with .begin() and .end() values.

Iterators - This allows our program to be increased in it's general use and modulability. By pointing to the value of maps via key/value, we're able to access the information that we need directly. Iterators were used throughout our program due to it's overall usefulness and can be used with STL containers.

Templates - With most of the instructions being similar to each other like ADD, SUM, MUL, DIV, we needed a way to write concise code in a non redundant sense. We want to be working a lot with Generic programming, especially when working with this MIS project since we receiving input of an unknown type. The template can be used as a blueprint/model that would help create a generic class or function. Like I mentioned, this is definitely useful in our case in regards to the sixteen instructions we had to consider.

Inheritance - This was used often when we had to split up out VAR into Alphas and Numeric classes. VAR took a set of parameters that would be utilized in Numeric and Alpha but since Numeric handles numbers while Alpha handles alpha type, we split up using inheritance. It's important because there are certain methods that would only be used in either Numeric or Alpha. It's much more efficient and organized compared to piling all the VAR types into a single class that would be managing all the methods that it would correlate with.

ifstream - With ifstream, we were able to take in a txt file that would contain a list of instructions in the case that the user doesn't want to enter instruction by instruction and has a txt file which would contain it. We assumed that it would be much more efficient in the case a hypothetical client needed to run multiple lines of instruction. After loading in the file, we managed to handle the file with getLine() functions that would allows us to go through line by line to parse the instructions as needed.

Operator Overloading - This was used a lot throughout our program by allowing generic input of information to be worked with easily. In a case that we have an instruction line that requires us to modify a value, operator overloading would help adjust the type into a value that can be utilized without error.

MIS Use Case Diagram

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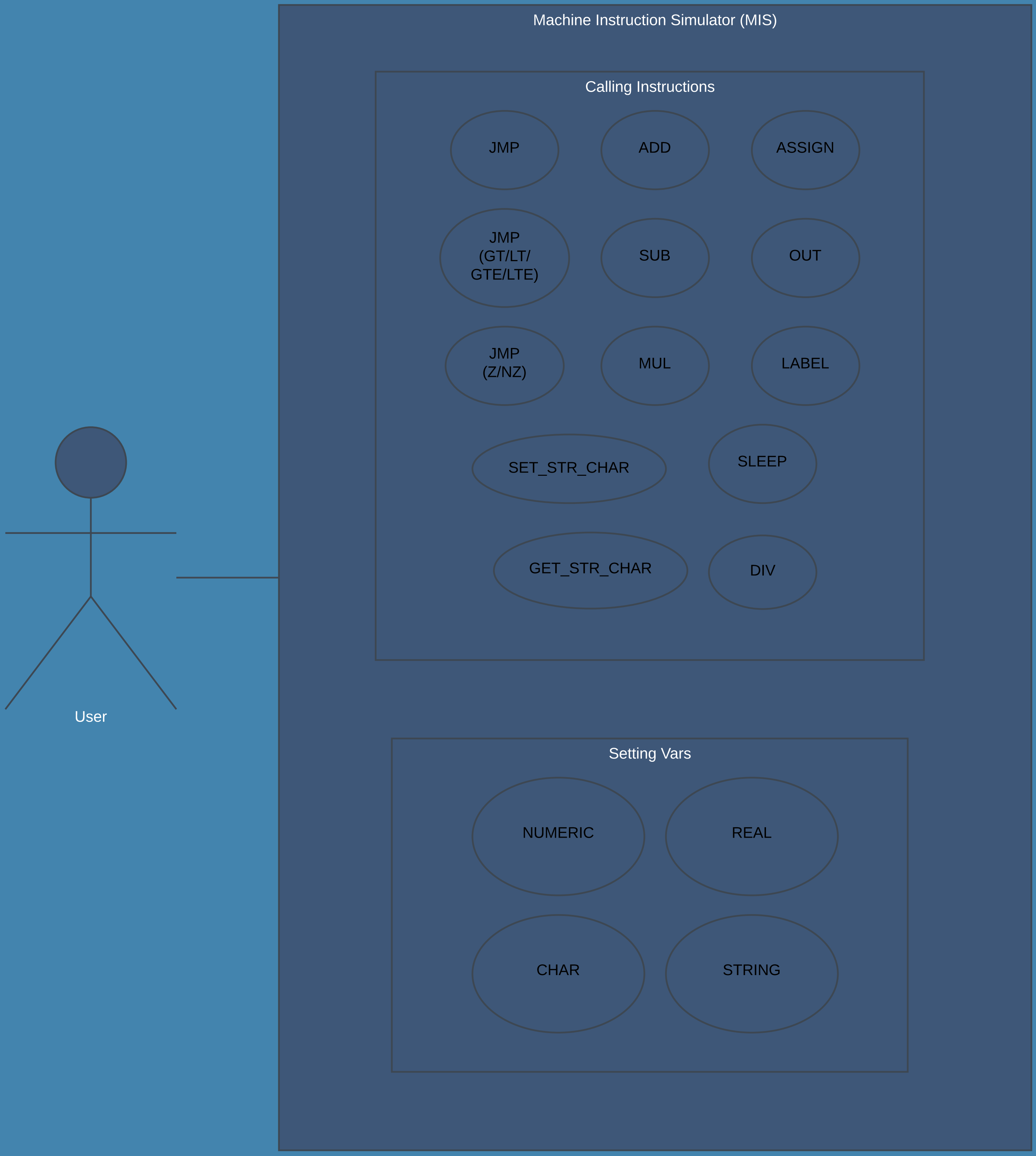

MIS Class Diagram

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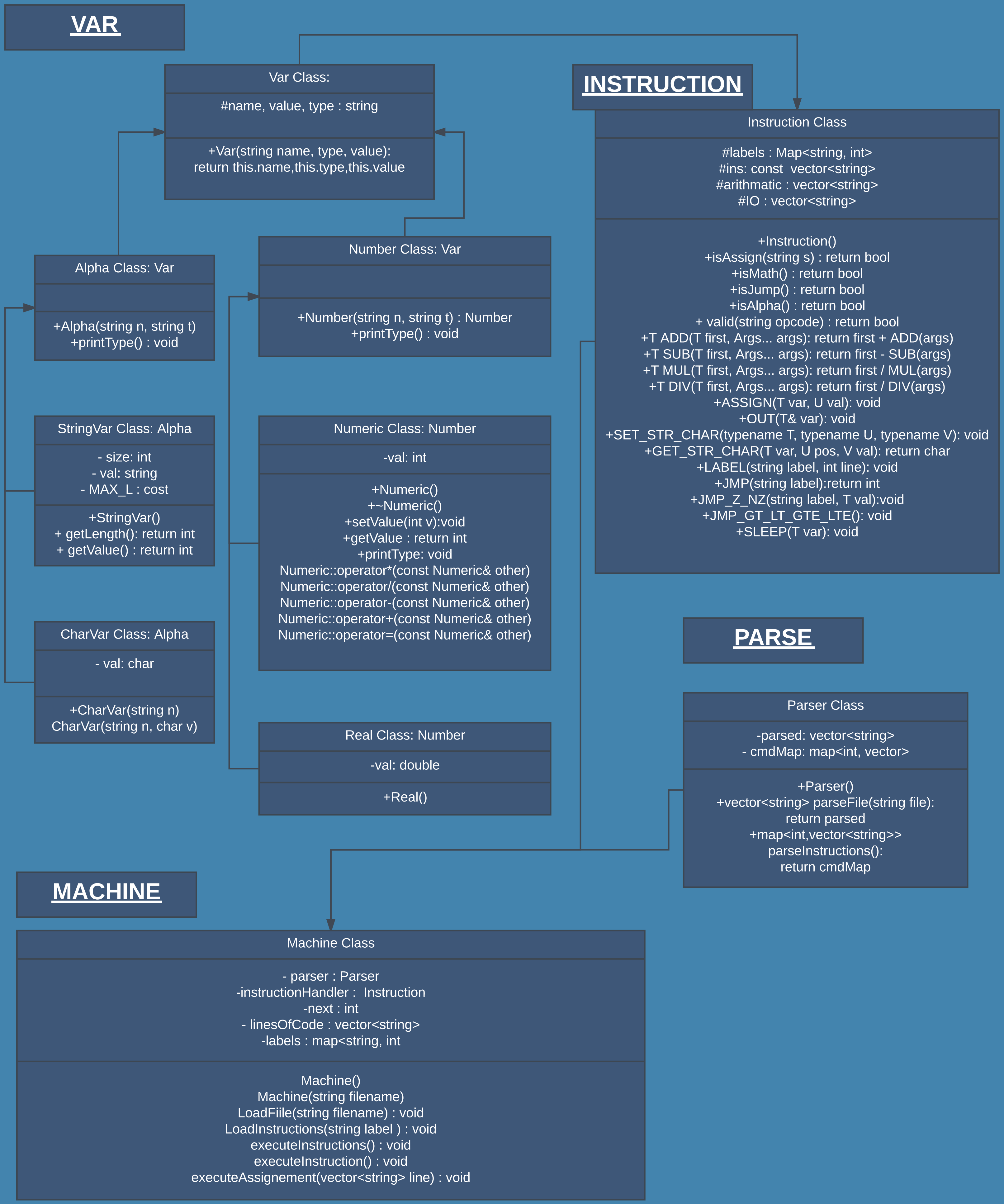
VAR
Var Class:
#name, value, type : string
+Var(string name, type, value):
return this.name,this.type,this.value
Alpha Class: Var
+Alpha(string n, string t)
+printType() : void
Number Class: Var
+Number(string n, string t) : Number
+printType() : void
StringVar Class: Alpha
- size: int
- val: string
- MAX_L : cost
+StringVar()
+ getLength(): return int
+ getValue() : return int
CharVar Class: Alpha
- val: char
+CharVar(string n)
CharVar(string n, char v)
Numeric Class: Number
-val: int
+Numeric()
+~Numeric()
+setValue(int v):void
+getValue : return int
+printType: void
Numeric::operator*(const Numeric& other)
Numeric::operator/(const Numeric& other)
Numeric::operator-(const Numeric& other)
Numeric::operator+(const Numeric& other)
Numeric::operator=(const Numeric& other)
Real Class: Number
-val: double
+Real()
INSTRUCTION
Instruction Class
#labels : Map<string, int>
#ins: const vector<string>
#arithmatic : vector<string>
#IO : vector<string>
+Instruction()
+isAssign(string s) : return bool
+isMath() : return bool
+isJump() : return bool
+isAlpha() : return bool
+ valid(string opcode) : return bool
+T ADD(T first, Args... args): return first + ADD(args)
+T SUB(T first, Args... args): return first - SUB(args)
+T MUL(T first, Args... args): return first / MUL(args)
+T DIV(T first, Args... args): return first / DIV(args)
+ASSIGN(T var, U val): void
+OUT(T& var): void
+SET_STR_CHAR(typename T, typename U, typename V): void
+GET_STR_CHAR(T var, U pos, V val): return char
+LABEL(string label, int line): void
+JMP(string label):return int
+JMP_Z_NZ(string label, T val):void
+JMP_GT_LT_GTE_LTE(): void
+SLEEP(T var): void
PARSE
Parser Class
-parsed: vector<string>
- cmdMap: map<int, vector>
+Parser()
+vector<string> parseFile(string file):
return parsed
+map<int,vector<string>>
parseInstructions():
return cmdMap
MACHINE
Machine Class
- parser : Parser
-instructionHandler : Instruction
-next : int
- linesOfCode : vector<string>
-labels : map<string, int
Machine()
Machine(string filename)
LoadFiile(string filename) : void
LoadInstructions(string label) : void
executeInstructions() : void
executeInstruction() : void
executeAssignement(vector<string> line) : void