Quiz 10

1. What are the type rules?

- which types can be combined with certain operator
- assignment of expression to variable
- formal and actual parameters of a method call

2. Give a code example of correct and type error use of variable?

For example, in the code:

```
int x;
x := x + 1;
x.A := 1;
x[0] := 0;
```

the second line shows the correct type use of variable x: integer := integer + integer.

But the third and fourth line, it occurs the type errors use of variable x. The reasons are following.

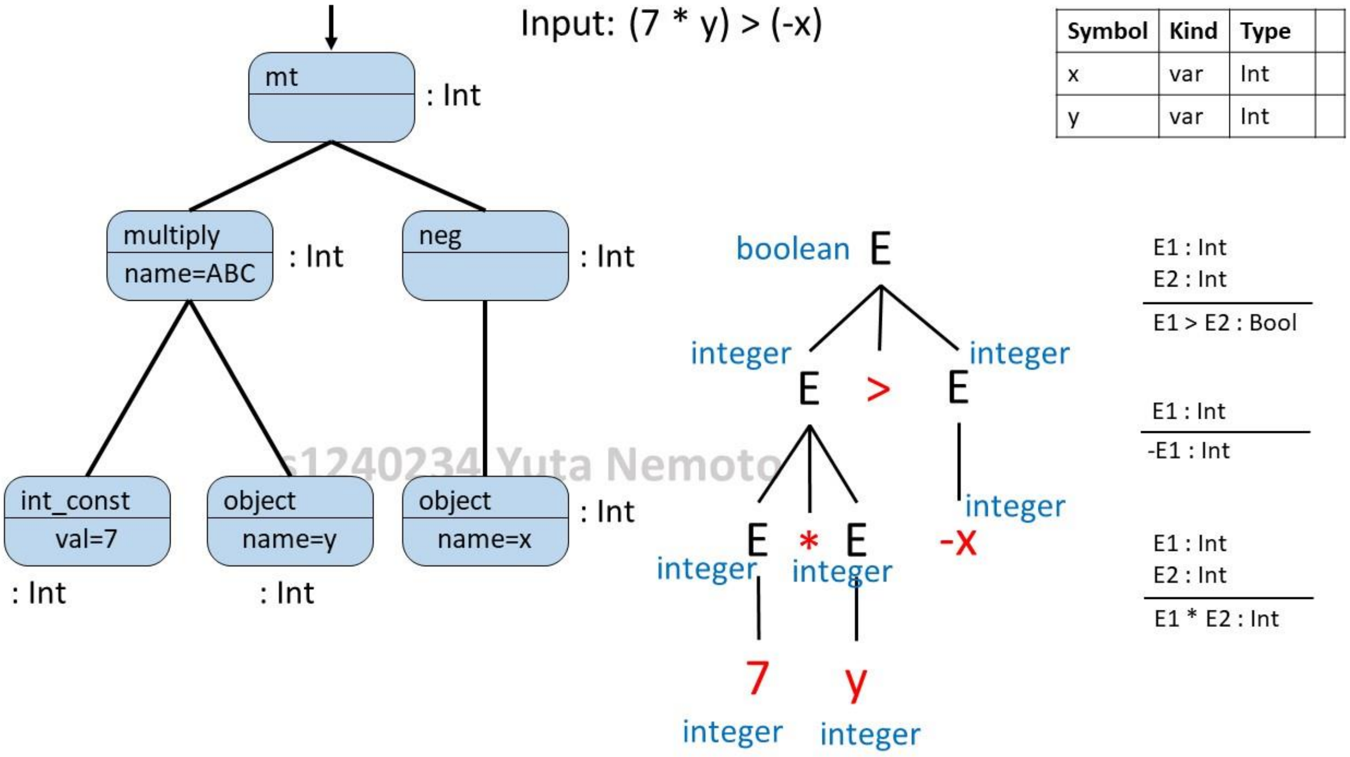
3rd line: Defines undefined element x.A, which type is not integer, as the integer value 1.

4th line: Although the variable x is declared as an integer variable, it tries to define x as an array.

3. What are the main points for type checking implementation?

- Single traversal over AST
- Types passed up the tree
- Type environment passed down the tree

4. Give the ~~parse tree~~ AST, symbol table and type checking for the expression (7*y) > (-x)?



Symbol	Kind	Type	
x	var	Int	
y	var	Int	

$$\frac{E1 : Int \quad E2 : Int}{E1 > E2 : Bool}$$

$$\frac{E1 : Int}{-E1 : Int}$$

$$\frac{E1 : Int \quad E2 : Int}{E1 * E2 : Int}$$

5. **Explain about static and dynamic types?**

Dynamic type: Class that is used in the new expression. It's checked at a runtime, and even languages that are statically typed have dynamic types.

Static type: It captures all the dynamic types that the expression could have. It's a compile-type notion.

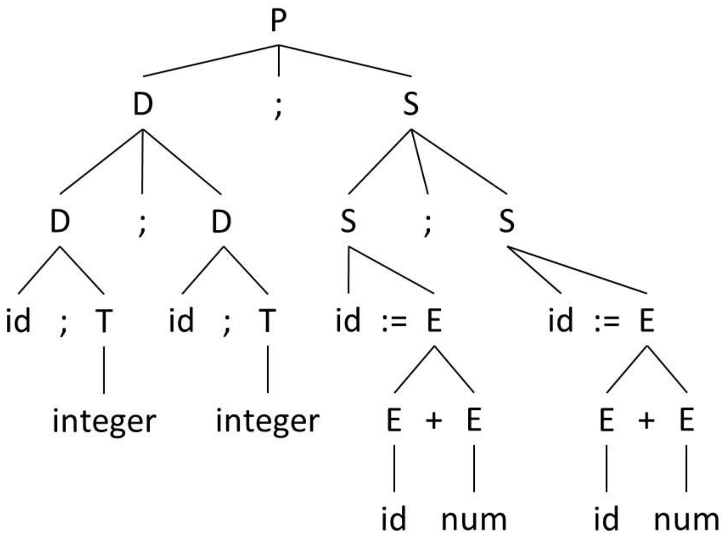
6. **Write about type system?**

- First, a type is a set of values and associated operations.
- A type system is a collection of rules for assigning type expressions to various parts of the program
  - Impose constraints that help enforce correctness.
  - Provide a high-level interface for commonly used constructs (for example, arrays, records)
  - Make it possible to tailor computations to the type, increasing efficiency (for example, integer vs. real arithmetic)

7. **Consider the language grammar given in table 1, write a valid program for this language, its parse tree with type assigned on the tree?**

Table 1: language grammar

```
P → D ; S
D → D;D | id:T
T → integer | array [ num ] of T | ^T | T → T | T×T
S → S ; S | id := E | if E then S | while E do S
E → num | id | E + E | E [ E ] | E^ | E ( E )
```

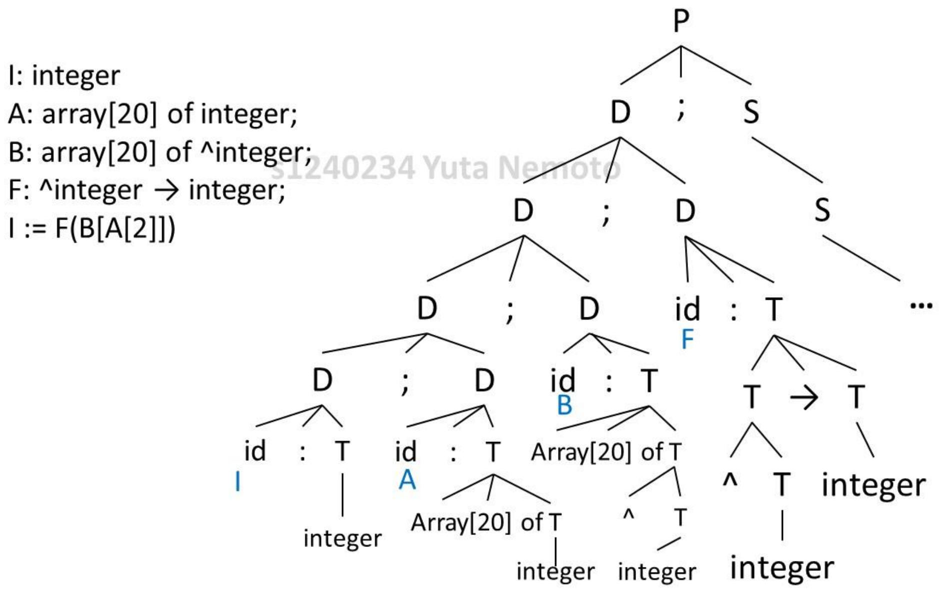


```
i: integer; j: integer
i := i + 1;
j := i + 1;
```

Accumulate information about the declared type

{insert(id.name, T.type);}	D → D ; D
{T.type = integer;}	D → id : T
{T.type = array(T_1.type,num);}	T → integer
{T.type = pointer(T_1.type);}	T → array [num] of T_1
{T.type = product(T_1.type,T_2.type);}	T → ^T_1
{T.type = function(T_1.type,T_2.type);}	T → T_1 × T_2
	T → T_1 → T_2

Parse Tree:



```
I: integer
A: array[20] of integer;
B: array[20] of ^integer;
F: ^integer → integer;
I := F(B[A[2]])
```

8. **Explain about components of type system and type equivalence?**

Components of a Type System

- Base Types: numbers, characters, Booleans.
- Compound/Constructed Types: array, string, enumerated types, record, pointer, classes (Object Oriented) and inheritance relationships, procedure/functions.
- Type Equivalence
- Inference Rules (Type checking)

  etc.

Type Equivalence

There are two types: Structural and Name

For example,

Type A = Bool

Type B = Bool

If A and B match because they are both Boolean, then it's the Structural type.

If A and B don't match because they have different name, then it's the Name type.