

Interpretation and Compilation / MIEI / FCT UNL

Midterm TEST 2021 (26 NOV 2021)

STUDENT NUMBER [_____] NAME [_____]

ZERO. The abstract syntax tree for expression $2*3$ may be constructed in Java by

new ASTMul(new ASTNum(2), new ASTNum(3))

using our standard AST model. In the same way, indicate Java code for constructing abstract syntax trees for the following expression:

$-(-(4-4*2))$

ONE. Consider adding to our language a pair data type, defined by the following abstract syntax

E :=	...	% other constructs
	{E, E}	% pair
	fst E	% return pair first component
	snd E	% return pair second component

A value pair is an ordered pair $(v1, v2)$ where $v1$ and $v2$ are integer values. The expression form $(E1, E2)$ first evaluates $E1$ (to get $v1$) then evaluates $E2$ (to get $v2$) and returns a pair $(v1, v2)$. If E evaluates to a pair $(v1, v2)$, then **fst** E evaluates to $v1$ and **snd** E evaluates to $v2$. For example, the code

```
let x = 1 y = 2 in
  let p1 = {y-x, y+x} in (fst p1) + (snd p1) end end
```

evaluates to 4.

0. Explain how would you extend your JAVACC parser to support the pair expression $\{E,E\}$ (e.g., indicate the grammar rule you would need to change and how).
1. Indicate the fields of classes ASTPair, ASTFst and ASTSnd to represent AST nodes for representing the language constructs for pairs.
2. Draw a sketch of the interpreter environment when expression **(snd p1)** starts to be evaluated
3. Write Java code for a class VPair (implementing the IValue interface) to represent pair values in your interpreter.
4. Write the eval method for each of the ASTFst and ASTPair classes, needed to implement an interpreter for the language with pairs. Remember that eval has the signature:

IValue eval(Env<IValue> e) { ... }

Include any necessary dynamic type checking code in your eval methods. For example, attempting to apply **fst** on a non-pair should give a runtime type-checking exception.

TWO. Consider the following program.

```
let x = 5 y = x+2 in x + y end
```

write the JVM code generated for this program fragment.

NOTES: You may consult whatever material you want. Don't forget to write your name and number in the test sheet. Don't forget to number your answers in the following sheets.









