

Answer Question 1 and two further questions.

Marks for each part of each question are indicated in square brackets

Calculators are NOT permitted

1. Parse Trees

Universal Polish Notation (UPN) supports the definition of arithmetic expressions without the need of indicating precedence with brackets. Instead operator precedence is established by giving the operator at the end of an expression, for example the UPN expression  $6\ 3 + 5 - 2 *$  is equivalent to  $((6 + 3) - 5) * 2$  in infix notation.

- a. Define a grammar for arithmetic integer UPN expressions using the Extended Backus Naur Form.

[11 marks]

For your grammar, give the parse tree for the UPN expression given in the introduction of this question.

[8 marks]

- b. Describe the difference between parse trees and abstract syntax trees.

[6 marks]

- c. Transform the above parse tree into an abstract syntax tree.

[9 marks]

[Total 34 marks]

## 2. Attribute Grammars

Consider the following grammar in Extended Backus Naur Form.

```
expr    ::= expr ? expr : expr
          | expr + expr
          | expr - expr
          | expr == expr
          | lit .
lit     ::= 'true'
          | 'false'
          | [1-9][0-9]+ .
```

- a. Which attributes would you use in an attribute grammar to be able to check type compatibility in all expressions?

[4 marks]

- b. Extend the above EBNF with semantic rules and conditions into an ordered attribute grammar that checks type compatibility of expressions.

[18 marks]

- c. Determine the attribute evaluation order for the visitor that will implement this ordered attribute grammar.

[11 marks]

[Total 33 marks]

### 3. The Eclipse Component Model

- a. In no more than 200 words explain the purpose of OSGi bundles and how they use advance the Java class loading mechanism for use in Eclipse.

[11 marks]

- b. Assume you decide to build a plug-in for Eclipse that builds on the AST primitives of `org.eclipse.jdt.core` and that uses the parser in `org.eclipse.resources.core`. Your plugin will also offer commands through user interface menus. You want your plug-in only to be loaded once when it is first used. Write a manifest file that enables the Eclipse OSGi implementation in Equinox to deploy your plug-in.

[12 marks]

- c. The Eclipse extension mechanism allows you to declare how your plugin uses the extension points provided by other Eclipse plug-ins. To do this it relies extensively on XML schemas. Describe how XML schemas are used in the implementation of the plug-in extension mechanism.

[10 marks]

[Total 33 marks]

#### 4. Build Management

- a. Modern IDEs have a build management component that ensures that an executable version of the code is available at any time. Give reasons when the internal build management is insufficient and when it will become necessary to build projects outside the IDE.

[10 marks]

- b. Explain how ant assists in build management.

[8 marks]

- c. Write an ant configuration file for handling the dependencies between FIT acceptance test cases defined in Excel and HTML reports that summarize the test results.

[9 marks]

- d. Assume you want to use ant to control the execution of performance tests with a commercial performance testing tool (such as WinRunner). The ant configuration language does not have any primitives for invoking and controlling this tool. Describe how you can extend the ant configuration language to start tasks that are performed by your performance testing tool.

[6 marks]

[Total 33 marks]

END OF PAPER