

03-60-440: Principles of Programming Languages (2006 Winter)

Final exam (2.5 hours)

Name	Student Number	Marks

This is a close book exam. There are 21 questions, 10 pages. You can use either pen or pencil, and write on both sides of the paper if there is not enough space. Total score is 45.

For multiple choice questions, you should select only one answer.

1. (8 points) Give short answers for the following questions.
 - (a) (1 point) What is static binding? Give a short answer with one sentence.

 - (b) (1 point) Java 5 supports parametric polymorphism (generics). Write the name of another language that supports parametric polymorphism.

 - (c) (1 point) Java language support automated garbage collection. Give the name of another language that supports automated garbage collection in its typical implementation.

 - (d) (1 point) Code scattering problem can be solved by which programming method?

 - (e) (1 points) Explain strong typing in one sentence.

 - (f) (1 point) Give an example in Java that violates strong typing. You need to write a fragment of the code and explain why it is not strong typing.

(g) (1 point) Give an example in Java that will cause side effect. You need to write a fragment of the code and explain why it has side effect.

(h) (1 point) Write the steps to create a jws web service using axis.

2. (3 points) Answer True or False for the following questions:

(a) If we can prove the Hoare triple $\{P\} S \{Q\}$, we can say that program S is totally correct for the pre-condition P and pos-condition Q.

Your answer: _____

(b) Java supports higher order function.

Your answer: _____

(c) By using web services, e-commerce applications can run faster.

Your answer: _____

3. (2 point) List four different language paradigms that are mentioned in this course and give one example language for each category.

Paradigm: _____ representative language: _____

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4. (1 point) Which of the following language is a declarative language?

- (a) Algol
- (b) Java
- (c) C++
- (d) C#
- (e) Prolog

Your answer: _____

5. (1 point) For primitive data types, parameter passing mechanism in Java is

- (a) call-by-reference
- (b) call-by-value
- (c) call-by-name
- (d) call-by-copy
- (e) none of above

Your answer: _____

6. (1 point) Which one of the following is not a type of polymorphism

- (a) coercion
- (b) overloading
- (c) overriding
- (d) generics
- (e) All of them are types of polymorphism

Your answer: _____

7. (1 point) What formal system provides the semantic foundation for Prolog?

- (a) Predicate calculus;
- (b) Lambda calculus;
- (c) Hoare logic;
- (d) Propositional logic.

Your answer: _____

8. (1 points) Which of the following is the advantage of declarative languages over imperative languages?

- (a) Can use abstract data type;
- (b) Easy to verify the properties of the program;
- (c) Is more efficient;
- (d) Can be implemented by an interpreter or compiler;
- (e) Can be strong-typed.

Your answer: _____

9. (1 point) Given the expression $((\lambda x. x)\lambda x.x)a$ in lambda calculus. Derive the expression as far as possible using β -reduction. The final result will be:

- (a) $(\lambda x.x)a$ (d) a
(b) $\lambda x.x$ (e) none of the above
(c) xa

Your answer: _____

10. (1 point) Which of the following captures all the pointcuts of calling private methods that take int as its only argument?

- (a) `call(private int *())` (d) `call(* private *(*))`
(b) `call(private * *(int))` (e) None of above
(c) `call (private *(int))`

Your answer: _____

11. (1 point) Which one of the following is not a language construct in AspectJ?

- (a) Pointcut (c) Aspect
(b) Join point (d) Advice

Your answer: _____

12. (1 point) In Scheme language, which of the following is not a higher-order function?

- (a) map (c) apply
(b) member (d) compose

Your answer: _____

13. (1 point) What is the value of `(map (lambda (x) (* 2 x)) '(1 2 3))` ?

- (a) a run-time error (d) (2 4 6)
(b) () (the empty list) (e) none of above
(c) 12

Your answer: _____

14. (1 point) Web service technology is based on a set of XML standards. Which of the following standard is typically used in a **WSDL** specification?

- (a) XML Schema (c) XSLT
(b) UDDI (d) XML DOM

Your answer: _____

15. (3 points) Given the following definitions:

```
(define f (lambda (x) (lambda (y) (+ x y))))  
(define (g x) ((f x) 3))  
(define h (lambda (x) (lambda (y) (y x))))  
(define (p f) ((h 2) f))
```

a). (1 point) What is the return value of `(g 2)`? Your answer: _____

b). (2 points) What is the return value of `(p +)`? Your answer: _____

16. (2 points) Assuming that the following definitions are executed in this order:

```
(define b `(3 14 27))  
(define c (cons (car (cdr b)) (list 'a 'b 'c)))
```

What is the result of typing the following into the Scheme interpreter:

`c =>` _____

`(car (cdr (cdr c))) =>` _____

17. (4 points) Write the following two Prolog programs:

(a) `find_nth` that will find the Nth element in a list. For example,

`find_nth([11, 12, 13, 14, 15], 4, X)` returns `X=14`.

(b) `subset(A,S)`, which succeeds if the set A is a subset of the set S. For example,
`subset([2,5], [1,5,3,2])`. returns `Yes`.

18. (2 points) Given the following Java classes and aspect, fill in the missing parts so that it can print out the following:

```
Wanna learn AspectJ?  
Harry-ji, having fun?
```

Note that you will not get partial marks if your answer is not completely correct.

```
public class MessageCommunicator {  
    public static void deliver(String message) {  
        System.out.println(message);  
    }  
  
    public static void deliver(String person, String message) {  
        System.out.print(person + ", " + message);  
    }  
}  
  
public aspect HindiSalutationAspect {  
    pointcut sayToPerson(_____  
        : call(void MessageCommunicator.deliver(_____) _____);  
  
    void around(String person) : sayToPerson(person) {  
        _____ (person + " -ji");  
    }  
}  
  
public class Test {  
    public static void main(String[] args) {  
        MessageCommunicator.deliver("Wanna learn AspectJ?");  
        MessageCommunicator.deliver("Harry", "having fun?");  
    }  
}
```

19. (2 points) Given the web service description as below.

(a) List the name(s) of the operation(s) and the corresponding parameters that are provided in this service;

(b) Write the URI that provides this service.

```
<?xml version="1.0"?>
<definitions name="Procurement"
  targetNamespace="http://example.com/procurement/definitions"
  xmlns:tns="http://example.com/procurement/definitions"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
  xmlns="http://schemas.xmlsoap.org/wsdl/" >

  <message name="OrderMsg">
    <part name="productName" type="xs:string"/>
    <part name="quantity" type="xs:integer"/>
  </message>

  <portType name="procurementPortType">
    <operation name="orderGoods">
      <input message="OrderMsg"/>
    </operation>
  </portType>

  <binding name="ProcurementSoapBinding" type="tns:procurementPortType">
    <soap:binding style="document"
      transport="http://schemas.xmlsoap.org/soap/http"/>
    <operation name="orderGoods">
      <soap:operation soapAction="http://example.com/orderGoods"/>
      <input>
        <soap:body use="literal"/>
      </input>
      <output>
        <soap:body use="literal"/>
      </output>
    </operation>
  </binding>

  <service name="ProcurementService">
    <port name="ProcurementPort" binding="tns:ProcurementSoapBinding">
      <soap:address location="http://example.com/procurement"/>
    </port>
  </service>
</definitions>
```

20. (3 points) Given the following XML document as an input for XSLT programs, answer the following questions:

```
<source>
  <employee>
    <firstName>Joe</firstName>
    <surName>Smith</surName>
  </employee>
  <employee>
    <firstName>Andrew</firstName>
    <surName>Wang</surName>
    <supervisor>
      <employee>
        <firstName>Steve</firstName>
        <surName>Miller</surName>
      </employee>
    </supervisor>
  </employee>
</source>
```

(a) (1 point) Write the output of the following XSLT program. You don't need to write the exact spaces and carriage returns.

```
<xsl:stylesheet xmlns:xsl="http://www.w3.org/1999/XSL/Transform" version="1.0">
  <xsl:template match="source/employee">
    <xsl:template match="employee/supervisor/employee">
      first name is <xsl:value-of select="firstName"/>
    </xsl:template>
  </xsl:template>
</xsl:stylesheet>
```

Your answer:

(b) (2 point) Write an XSLT program to extract a list of the first names who are supervisors, separated by coma. For this sample data, you should output "Supervisors: Steve"

21. (5 points) Prove the following Hoare triple is true.

```
{true}
  f := 1; n:=10;
  while (n != 0) do ( f := n*f; n:=n-1; )
{f=10!}
```