

Candidate Number

G6021

THE UNIVERSITY OF SUSSEX
BSc FINAL YEAR EXAMINATION
MComp THIRD YEAR EXAMINATION
January 2019 (A1)

Comparative Programming

Assignment Project Exam Help
Assessment Period: January 2019 (A1)

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TO BY THE LEAD INVIGILATOR

Candidates should answer TWO questions only of the three. If all three questions are attempted only the first two answers will be marked.

The time allowed is TWO hours.

Each question is worth 50 marks.

At the end of the examination the question paper and any answer books/answer sheets, used or unused, will be collected from you before you leave the examination room.

1. (a) Consider the Haskell function to compute x^y .

```
power x y = if y==0 then 1 else x*(power x (y-1))
```

- i. Define what is meant by a *tail recursive function*, and explain how this relates to Continuation Passing Style (CPS). [10 marks]
 - ii. Write a tail recursive version of the function `power` using an accumulating parameter. State the initial values of any additional parameters. [10 marks]
 - iii. Write the function `power` as the fixed point of a functional. Use the syntax of PCF (Programming Language for Computable Functions), and include types in your answer. [20 marks]
- (b) Explain and compare the following: parametric polymorphism, subtype polymorphism and ad-hoc polymorphism. Give a small example of each to help illustrate your answer. [10 marks]

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2. This question uses the λ -terms: $I = \lambda x.x$ and $W = \lambda xy.xyy$.

- (a) Draw the reduction graph starting from the term $I(II)(II)$. Underline all redexes in the graph. [10 marks]
- (b) Define *weak head normal form*. Reduce the term WI to weak head normal form using the least number of reductions. [10 marks]
- (c) Define *normal form*. Which reduction strategy guarantees termination if a normal form exists? Illustrate your answer by showing a reduction sequence of the term $WI(WI)$, and thus deduce if this term has a normal form. [10 marks]
- (d) Build a typing derivation for the term W . [12 marks]
- (e) Does WI have a type? Justify your answer using unification. [8 marks]

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3. (a) Write a function in Haskell to insert an element at a given position into a list. For example:

```
insert 20 [5,2,12,8] 4
```

should insert the number 20 at the 4th position in the list [5, 2, 12, 8] to give:

```
[5,2,12,20,8]
```

Your answer should not use any library functions. Include the type of the function in your answer. [15 marks]

- (b) Write Prolog clauses to insert an element at a given position into a list, analogous to the Haskell function in Part (a). [15 marks]

- (c) Using your clauses from Part (b), show how to write a query to:

- i. insert 20 in the list [5,2,12,8] at position 4;
- ii. remove 20 in the list [5,2,12,20,8] at position 4

Note: You do not need to complete Part (c) to get full marks for this question. [10 marks]

- (d) i. Explain how two functions can be combined using composition. Give the definition and type of the composition function.
ii. Explain how two clauses can be combined. Write a clause to illustrate this.

Add WeChat powcoder [10 marks]