

3 Compiler Construction (tgg22)

- (a) In the context of the compilation of functions, what is a *closure*? [2 marks]
- (b) The front-end of our Slang compiler eliminates let-bindings by replacing the code

```
let x e1 in e2 end
```

with the code

```
(fun x -> e2 end) e1
```

Apply this transformation to the following Slang code.

```
let f(x) =
  let x1 = e1
  in let x2 = e2
     in e3 end
end
in
e
end
```

[3 marks]

- (c) Describe the structure of the Jargon code generated from the Slang in your answer to Part (b). (Don't worry about getting the syntax exactly right.) [6 marks]
- (d) Consider the Jargon code generated in Part (c). Suppose the function f is called with the value v somewhere in the code generated from the expression e . Describe what happens at runtime when $f(v)$ is executed. In particular, describe the closures that exist in the heap and how they are used to evaluate $f(v)$. [4 marks]
- (e) Describe a better way of compiling let-bindings such as those associated with $x1$ and $x2$ in the code above. Rather than creating closures, the idea is to include these "local variables" in the stack frame for f . Explain in detail how this might be done. [5 marks]