Optimising Compilers Exercise Sheet 1

This set of supervision notes is organised as one sheet per supervision, covering a range of topics lectured. I am extremely grateful to Alan Mycroft, Dominic Orchard, Tomas Petriček, Raoul Urma and Tobias Kohn for contributing questions and answers across all four sheets. In particular, answers to several old exam questions and LaTeX source for them was provided by Tobias Kohn, for which I am very appreciative.

Any questions about the lectures or these notes can be answered by supervisors or by emailing me timothy.jones@cl.cam.ac.uk, or dropping into my office SC03. Suggestions for additional questions, and especially confusion or the correction of any errors, will be greatly received.

The purpose of this exercise sheet is to practise *data flow optimisations*.

Questions

1. (a) Perform a live variable analysis (LVA) on the following function showing the *live-in* set for each statement.

```
int f(int x, int y) {
    int z = y+y;
    y = x+1;
    x = x-y;
    z = z+y;
    x = x+1;
    y = y+x;
    z = x+1;
    y = y+z;
    return y;
}
```

   (b) Based on your LVA re-write the function `f` removing any *dead code* from the function.

   (c) Simplify the function as much as you can.

2. (a) Consider the following function written in C:

```
int g(int x) {
    int z = p(x);
    int y = q(x);
    return y;
}
```

   Is there any dead code in this function, and if so where?

   (b) Given that the operation of `p` and `q` are unknown, or their analysis is undecidable, comment on the safety of performing a *dead code elimination* phase.

Suggested past exam questions

2006 Paper 8 Question 8 where part (c) is optional

2011 Paper 7 Question 13

2005 Paper 8 Question 7 Part (a)

Relevant past exam questions

This section contains links to all past exam questions relevant to the topics covered in this supervision sheet. Note that some questions appear under multiple headings and / or on multiple exercise sheets when they cover more than one topic.

Flowgraphs, basic blocks, overview

- 2019 Paper 9 Question 11
- 2018 Paper 7' Question 12
- 2006 Paper 8 Question 8
- 1997 Paper 8 Question 7
- 1994 Paper 8 Question 7

Live variable analysis, dataflow anomalies, dead code elimination

- 2020 Paper 9 Question 12
- 2017 Paper 9 Question 10
- 2016 Paper 7 Question 12
- 2013 Paper 7 Question 11
- 2012 Paper 7 Question 10
- 2011 Paper 7 Question 13
- 2009 Paper 7 Question 12
- 2005 Paper 8 Question 7
- 1995 Paper 8 Question 7
- 1994 Paper 7 Question 9
- 1993 Paper 8 Question 6

Available expression analysis, common subexpression elimination

- 2017 Paper 9 Question 10
- 2014 Paper 7 Question 11
- 2008 Paper 8 Question 8
- 2007 Paper 8 Question 8
- 2004 Paper 8 Question 7
- 1998 Paper 8 Question 7

Dataflow analysis

- 2021 Paper 9 Question 12
- 2020 Paper 9 Question 12
- 2017 Paper 9 Question 10
- 2015 Paper 7 Question 11
- 2013 Paper 9 Question 9
- 2009 Paper 9 Question 10
- 2008 Paper 8 Question 8
- 2006 Paper 8 Question 8
- 2001 Paper 7 Question 4
- 1997 Paper 8 Question 7
- 1993 Paper 9 Question 6