Hoare Logic and Model Checking
Supervision 1

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All work should be submitted in **PDF** form 36 hours before the supervision to the email `josi2@cam.ac.uk`, ideally written in LaTeX, with page numbers (e.g. 1/9). If you have any questions on the course please include these at the top of the supervision work and we can talk about them in the supervision. Since there any many proofs, it would be best for these to be done by handed and included using `\includegraphics`. Some questions are taken from the exercise sheet `http://www.cl.cam.ac.uk/teaching/1516/HLog+ModC/MJCG-HL-Exercises.pdf`

1. What is the semantics of partical and total correctness.
2. Give a reason why the triple

$$\overline{\vdash \{P\}V := E\{P[V/E]\}}$$

   is unsound, can lead to proving untrue things.

3. Prove that $C \equiv$ is sound:

   - $C_1; C_2$ (assign)
   - **if** B **then** C_1 **else** C_2 (if)

4. Define a new construct

$$\textbf{for } i \textbf{ in } 1 \textbf{ to } n \textbf{ do } C$$

   add this to the language along with another hoare triple, then prove this addition triple is sound.

5. Is this triple $[\top]C[\bot]$ decidable.
6. Derive a backwards reasining rule for $V := E$ (assign)
7. What is completeness and relative completeness?
8. Find a P and Q for $C \equiv V_1 := E_1; V_1 := E_2$ making $\vdash \{P\}C\{Q\}$ sound for all V_1, V_2, E_1, E_2.
9. Derive a VC condition for $C \equiv$

   - $V := E$ (assign)
   - **while** B **do** C

10. Question sheet questions 23, try this using forwards reasoning, giving both invariants. Prove 26 using VCs.
11. `http://www.cl.cam.ac.uk/teaching/exams/pastpapers/y2010p8q12.pdf`
12. `http://www.cl.cam.ac.uk/teaching/exams/pastpapers/y2009p7q14.pdf`