Write your name on your answer booklets now. Thank you.

As you proceed, label each answer in your answer booklets with the appropriate ‘Qn.’ For Q4, use ‘Q4.(a)’ to label your answer to sub-question (a), etc. In general, strive to write as legibly as possible; thanks!
Q1 Prove that \( E \sim N \). (This is of course to be an informal proof, not a formal proof in Slate. By ‘informal proof’ we mean the style of proof that is expressed in a mixture of English and formal symbols.) In addition, we stipulate that \( E \) here denotes the positive even numbers; i.e., the set \( \{2, 4, 6, \ldots\} \), a definition of \( E \) that differs slightly from what is in the LAMA-BDL book.)

Q2 Suppose that you are presented with a version of the Wason Selection Task exactly the same as the one we considered in class, except the four cards in front of you have the following appearance. Which card or cards should you turn over? Prove that your answer is correct. (While you can use Slate to help you, your proof should be an informal one.)

\[ \begin{array}{cccc} G & E & 7 & 4 \end{array} \]

Q3 The following four statements are either all true, or all false. Given this, can we deduce that Lola lies? Prove that your answer is correct. (While you can use Slate to help you, your proof should be an informal one.)

1. If Lucy lies, then so does Larry.
2. If Larry lies, then so does Linda.
3. If Linda lies, then Lola does as well.
4. Lucy lies.

Q4 For each of the following formulae, first (i) write down the representation of the formula as an S-expression, then (ii) give a YES or NO answer as to whether it’s a theorem in the propositional calculus. In addition, (iii) for each of your affirmative verdicts, provide a clear, informal proof that confirms your verdict; and for each of your negative verdicts, provide a confirming counter-example (in the form of a set of assignments of TRUE or FALSE to the relevant atomic formulae (or to — in Slate’s on-screen terminology — the relevant literals).

(a) \( P \rightarrow (P \lor Q) \)
(b) \( (P \rightarrow Q) \rightarrow (\neg Q \rightarrow \neg P) \)
(c) \( ((P \rightarrow Q) \land Q) \rightarrow P \)
(d) \( P \rightarrow (Q \rightarrow P) \)
(e) \( (Z \land \neg Z) \rightarrow P \)
(f) \( (P \rightarrow (Q \rightarrow R)) \rightarrow ((P \rightarrow Q) \rightarrow (P \rightarrow R)) \)
(g) \( ((P \rightarrow Q) \land \neg P) \rightarrow \neg Q \)
(h) \( P \lor \neg P \)
(i) \( \neg(D \lor E) \rightarrow (\neg D \land \neg E) \)

Q5 In a paragraph or two, explain cogently why the Entscheidungsproblem is relevant to claims that The Singularity will soon occur.

Q6 Suppose that \( E \) is a string built by concatenating the symbols that allow well-formed formulas of the propositional calculus to be built. Such symbols include, of course, the five truth-functional connectives (\( \rightarrow, \leftrightarrow, \lor, \land, \neg \)), and atomic formulas like \( P, Q \), etc. Can you program a Raven-machine to decide whether or not \( E \) is in fact a well-formed formula of the propositional calculus? Rigorously justify your answer.