HISTORY OF MATHEMATICS — ASSIGNMENT TWO

(1) (2 points) What is Hilbert's "Entscheidungsproblem"?
It is the problem of finding an "effective procedure" (an algorithm) that could determine, for any given mathematical statement, whether it is true or false.

(2) (4 points) Schönfinkel introduced the fundamental concept of combinators. Could you list three combinators?
S, **K** and **I**:
- $\mathbf{S}\,x\,y\,z = (x\,z)(y\,z)$;
- $\mathbf{K}\,x\,y = x$;
- $\mathbf{I}\,x = x$.

(3) (3 points) Can you define λ-calculus' β-contraction?
β-contraction: $(\lambda x.\,M)\,N \rhd M[x/N]$.

(4) (4 points) What is the definition of a function defined by primitive recursion?
Assume g and h are partial recursive functions. Then f is defined by primitive recursion as

$$f(x_1,\ldots,x_k,0) = g(x_1,\ldots,x_k)\ ;$$
$$f(x_1,\ldots,x_k,n+1) = h(x_1,\ldots,x_k,n,f(x_1,\ldots,x_k,n))\ .$$

(5) (2 points) What is a "universal Turing machine"?
A UTM is a single, fixed Turing machine that can simulate the behaviour of any other arbitrary Turing machine.

(6) (3 points) Can you state Rice's theorem?
Any non-trivial property of the language accepted (or function computed) by a Turing machine is undecidable.

(7) (3 points) Who proved that Hilbert's tenth problem is undecidable?
Yurii Matiyasevich (1970).

(8) (1 points) Who wrote "First Draft of a Report on the EDVAC" (1945)?
John von Neumann.

(9) (2 points) Why is ENIAC significant?
It is the first general-purpose electronic digital computer.

(10) (4 points) Can you list the core components of a finite state automaton?
See slide 116.

(11) (2 points) Who proved that the Boolean Satisfiability Problem is **NP**-complete in 1971?
Stephen Cook.

(12) (2 points) What is the difference between bits and qubits?
Unlike classical bits (0 or 1), qubits can exist in multiple states simultaneously and be interconnected in complex ways.

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