Outline of Fall 1995 Lectures

1. (Wed, 9/6) Administration. Definition of "halting" Scheme expressions, and statement of non-existence of Scheme procedure `halts?`.

2. (Wed, 9/8) Proof of noncomputability of `halts?` Diagonal arguments. Countability of ASCII strings and Scheme procedures.

3. (Mon, 9/11) Scheme expression halting depends on store and environment. Extension of halting problem undecidiablity to arbitrary properties of values. End with question: what is a Scheme "value"?

4. (Wed, 9/13) Relevance to other languages. Scheme interpreter for C implies C can't solve Scheme halting problem either. Paradox from self-application.

   (Fri, 9/15) Cancelled

5. (Mon, 9/18) Rewriting model for Scheme; primitive, conditional and instantiation rules. Uniqueness.

6. (Wed, 9/20) lambda application rule; renaming for static scope. Adding syntactic sugar.

7. (Fri, 9/21) state possible simulation of numbers, lists, conditional, even defines by "pure" applicative Scheme. State Hilbert's 10th to illustrate how numbers may cause problems.

   (Mon, 9/25) no classes

8. (Wed, 9/27) Equational reasoning about Church numerals.

9. (Fri, 9/29) Translation of function Scheme into pure applicative Scheme. Understanding recursion as finding fixed points.

10. (Mon, 10/2) Y operator

    (Wed, 10/4) cancelled (Yom Kippur)

11. (Fri, 10/6) Observational congruence

    (Mon, 10/9) Columbus Day

12. (Wed, 10/11) Observational congruence

13. (Fri 10/13)

14. (Mon 10/16)

15. (Wed 10/18)
    Equational proofs. The proof system $\underset{\text{func}}{=}$. Decidable iff half-decidable and co-half-decidable. Provable equations are half-decidable.

16. (Fri 10/20) car(decidable) is half-decidable.

17. (Mon 10/23) repair lacuna: car(decidable) is half-decidable requires a symbol enumerator. remark: car(half-decidable) is still half-decidable. Thm: Provable equations are half-decidable. Thm: (proof for Wed) True $\underset{\text{func}}{=}$ equations are not half-decidable. Cor: Incompleteness of sound proof systems.

18. (Wed 10/25) (*M* `= (spin))` $\in$ True$_{func}$ iff *M* $\in$ complement(Halts). set containment versus decidability. many-one reducibility.