MATH 634 HOMEWORK 3
DUE OCTOBER 10, 2018.

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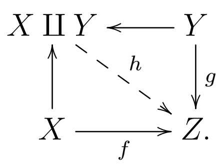
(1) Hatcher 0.6 (pp. 18–20).
(2) Hatcher Exercise 0.10 (p. 19).
(3) Hatcher Exercise 0.11 (p. 19).
(4) Hatcher Exercise 0.16 (p. 19).
(5) Hatcher Exercise 0.20 (p. 19).
(6) Recall that the *disjoint union topology* has the following property: given spaces X, Y, Z and continuous maps $f\colon X \to Z$, $g\colon Y \to Z$ there is a unique continuous map $h\colon X \amalg Y \to Z$ so that the following diagram commutes:



Here, the maps $X \to X \amalg Y$ and $Y \to X \amalg Y$ are the canonical inclusions. Moreover, this property characterizes the disjoint union topology. (If you are not familiar with this property, prove it.)

What operation has the analogous property for *based spaces* and *basepoint-preserving continuous maps*? (Hint: we saw it in class.) Formulate the property precisely and prove your answer satisfies it.

To think about but not turn in:

(1) With Exercise 6 in mind, what are analogues $X \vee Y$ for other classes of mathematical objects (e.g., sets, groups, abelian groups, rings)? Are there (well-known) classes of objects for which $\wedge$ does not exist?
(2) Read through the remaining problems in Chapter 0, and do any that seem difficult or surprising.

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