295A Complex Networks—Assignment 1
University of Vermont, Spring 2008

Dispersed: Friday, February 8, 2008.
Due: By start of lecture, 9:30 am, Thursday, February 21, 2008.
Some useful reminders:
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All parts are worth 3 points unless marked otherwise. Please show all your working clearly and list the names of others with whom you collaborated.

Branching networks:

1. Tokunaga's law is statistical but we can consider a rigid version. Take $T_1 = 2$ and $R_T = 2$ and draw an example network of order $\Omega = 4$ with these parameters.

2. Find Tokunaga's parameter T_1 in terms of Horton's R_n and R_s.

   Reminder: In class, we showed that

   $$2R_n = (2 + R_T + T_1) + [(2 + R_T + T_1)^2 - 8R_T]^{1/2} \text{ and } \quad R_s = R_T.$$

3. Show $R_s = R_\ell$. In other words show that Horton's law of stream segments matches that of main stream lengths.

4. Show $R_n = R_a$. Do this by using Tokunaga's law to find the average area of an order ω basin, $\bar{a}_\omega$, in terms of the average area of basins of order 1 to $\omega - 1$.

   Reminder: Tokunaga's law is

   $$T_{\omega,\omega'} = T_1 R_T^{\omega-\omega'-1} \quad \text{where} \quad \omega > \omega'.$$

5. For river networks, basin areas are distributed according to $P(a) \propto a^{-\tau}$.

   Determine the exponent τ in terms of the Horton ratios R_n and R_s.